### 中国第三届植物化感作用学术研讨会 第八届全国杂草科学大会 联合国粮农组织-中国"水稻化感作用论坛" (FAO-China Seminar on Rice Allelopathy)

## 论文摘要集

主办:

农业部种植业管理司 中国植物保护学会植物化感作用专业委员会 中国植物保护学会杂草学分会

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## 会议日程

### 会议须知

一、为保证大会秩序,请各位与会代表自觉遵守会场纪律,配合会务安排,在会议室开会期间将手机设置为无声、会议、或振动模式。

二、为保证大会报告有序进行,请所有报告人提前半天将准备好的 PPT 文件送至大会会务组,每日 12:30-13:00 和 20:00-21:00 有专人在会务组接收,将 其按报告顺序排列。

三、大会会务组在 10 楼 1013 房间, 内线电话: 1013; 外线电话: 0898 66268888 (总机)转 1013。

四、会议时间为: 2007年10月9-12日,会议结束后,请各位代表于2007年10月13日13时之前退房,结清房款。逾期者需承担占房发生的费用。

五、大会会场在2楼盛德堂报告厅。

六、作息时间 Timetable:

早餐 Breakfast: 07: 00 - 08: 00

会议 Working Hours: 08: 30-12: 00

午餐 Lunch: 12: 00 - 13: 00

会议 Working Hours: 13: 30-18: 00

晚餐 Dinner: 18: 00 - 19: 30

七、就餐地点 Dinning Room(s): 1 楼海乐缘中餐厅。

会议代表一律凭当日当餐餐券在指定餐厅就餐。

早餐 Breakfast:

午餐 Lunch:

晚餐 Dinner:

宴请 Banquet:

八、会议期间务必注意饮食、交通、财产和人身安全。

祝您身心愉快!

### 会议日程 Programme

2007 年10 月9 日 星期二 Tuesday 9 Oct. 2007

08:30-19:30 化感杂草会议注册 Registration for Allelopathy and Weed Science Conference

### 2007 年10 月9 日 星期二 Tuesday 9 Oct. 2007

联合国粮农组织-中国水稻化感研讨会 FAO-China Seminar on Rice Allelopathy

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09:00-09:20 Opening Ceremony 主持人 Chairman: Prof. Chuihua KONG

09:20-10:00 Allelopathy as a Tool for Weed Management Dr. R. Labrada, Plant Protection Service, FAO

10:00-10:40 Prospect and Progress of Researches on Rice Allelopathy Professor K.U. Kim, Kyungpook National University, Korea

10:40-11:00 Coffee Break 主持人 Chairman: Prof. K.U. KIM

11:00-11:40 Potent Allelopathic Substance Momilactone B in Rice Root Exudates

Professor Kato Noguchi, Kagawa University, Japan

11:40-12:20 Rice Allelopathy in Aquatic System in India

Professor R.M. Kathiresan, Annamalai University, India

12:20-13:30 Lunch

主持人 Chairman: Prof. R. KATHIRESAN

13:30-14:20 Varietal Improvement in Rice Allelopathy

Professor F. Hu, South China Agricultural University, China

14:20-15:00 Molecular Approaches in Improving Rice Allelopathy

Professor L.Q. Yu, China Rice Research Institute, China

15:00-15:20 Coffee Break 主持人 Chairman: Dr. R. LABRADA

15:20-16:00 Progress of Weed Management in Rice in Vietnam

Dr. D.V. Chin, Cuulong Delta Rice Research Institute, Vietnam

16:00-16:40 The Role of Allelochemicals in Rhizospehere Interaction with Rice and

Soil Microbe

Mr. P. Wang, Chinese Academy of Sciences, China

主持人 Chairmen: Drs. Labrada. Kim and Kong

16:40-17:40 General Discussion

### 2007 年10 月10 日星期三 Afternoon, Wednesday 10 Oct. 2007

联合国粮农组织-中国水稻化感研讨会 FAO-China Seminar on Rice Allelopathy

### **Laboratory Exercise**

地点 Location:	二楼环宇厅报告厅 Conference Hall at Conference Centre
14:30-15:30	Bioassay Methods for Rice Allelopathy: (1) Relay Seeding in Agar and
	Water (filter paper), (2) Haustorium Induction Method
	Professor K.U. Kim, Kyungpook National University, Korea
15:30-16:30	Bioassay and Extraction for the Research in Rice Allelopathy
	Professor Kato Noguchi, Kagawa University, Japan
16:30-16:40	Coffee Break
16:40-17:30	General Discussion (Question and Answer)
18:00	Dinner

### 2007 年10 月10 日 星期三 上午 Morning, Wednesday 10 Oct. 2007

### 中国第三届植物化感作用学术研讨会

第八届全国杂草科学大会

08:30-10:00 开幕式 Opening Ceremony

地点(Location): 二楼盛德堂报告厅 Conference Hall at Conference Centre

主持人(Chairman): 孔垂华 Prof. Chuihua KONG

介绍领导、来宾 Introduction

张朝贤 致开幕词 Opening Speech By Dr Chaoxian ZHANG

陈秋波 致欢迎词 Welcome Speech By Prof. Qiubo CHEN

领导讲话、来宾致词 Speeches By VIPs

09:40-09:50 代表合影留念 Conference photograph

10:00-18:00 特邀报告 Invited speeches

地点(Location): 二楼盛德堂报告厅 Conference Hall at Conference Centre

主持人(Chairmen): 张朝贤 Drs. Chaoxian Zhang and Per Kusdk

10:00-10:40 The Future of Allelopathy for Weed Management

Dr. Stephen O. Duke (USDA-ARS, USA Past President of International Weed Science Society, President-Elect of the International Allelopathy

Society)

10:40-11:20 The role of cover crops and their allelopathic exudates in IWM systems

Robert E. Blackshaw (Agriculture and Agri-Food Canada, President of

Canadian Weed Science Society, Chief Editor of Weed Science)

11:20-12:00 Invasive Alien Plants and Allelopathy

Y. Fujii (National Institute for Agro-Environmental Sciences, Japan,

President of International Allelopathy Society)

12:00 午餐 Lunch

### 2007 年10 月10 日 星期三 下午 Afternoon, Wednesday 10 Oct. 2007

主持人(Chairmen): 陈秋波 Prof. Qiubo Chen and Dr. Duke S O

13:30-14:10 Modified benzoxazinoids based on allelochemicals from Gramineae as

potential rice protection tool against Echinochloa crus-galli.

Professor Francisco A. Macías, (Universidad de Cádiz., Spain Past

*President of International Allelopathy Society*)

14.10-14:50 Optimising herbicide use – lessons learned in Denmark over the last 20 years

Per N. Kudsk (University of Aarhus, Denmark, Vice-President of the

European Weed Research Society and President-Elect (2008 & 2009) of

the European Weed Research Society)

14:50-15:30 Trichomes and root Hairs Function as Natural Pesticide Factories

FRANCK E DAYAN (USDA-ARS, USA)

15:30-16:10 Evaluation of *Trigonella foenum- graecum* L. allelopathic potential

R. HAOUALA, (UNIVERSITY OF MONASTIR, TUNISIA)

主持人(Chairmen): 陈友权 郑永权 Drs. Youquan CHEN and Yongquan ZHENG

16:25-17:05 Chemical interactions between crops and weeds

孔垂华(中国科学院)

17:05-17:45 我国杂草科学的机遇与挑战

张朝贤(中国农业科学院植物保护研究所)

18.00-19.30 欢迎晚宴 Welcome Reception

地点(Location): 二楼潮泰城餐厅 Dinning Hall

主持人(Chairman): 朱朝华 Prof. Chaohua Zhu

2007 年10 月11 日 星期四 上午 Thursday 11 Oct. 2007

08:00-18:00 大会报告

地点(Location): 二楼盛德堂报告厅 Conference Hall at Conference Centre

主持人(Chairman): 惠肇祥 倪汉祥

08:00-08:30 稻田除稗剂的优化选择

王焕民(农业部农药检定所)

08:30-08:50 海南几种热带植物化感作用的研究

朱朝华(海南大学(原华南热带农业大学)环境与植物保护学院

王险峰 (黑龙江省农垦植保协会)

09:10-09:30 梭梭-肉苁蓉一体苗在生产中的应用

马永清(中国科学院水利部水土保持研究所)

09:30-09:50 具有开发潜力的稗草生防菌弯孢 B6

倪汉文(中国农业大学)

主持人(Chairman): 王敬国 褚建君

10:00-10:20 除草剂减量施用的技术与实践

李香菊 (中国农业科学院植物保护研究所)

10:20-10:40 水稻化感作用基因的研究与展望

余柳青(中国水稻研究所)

10:40-11:00 龙葵果实汁液的除草活性初探

赵长山(东北农业大学)

11:00-11:20 前茬作物残体对后茬杂草的化感作用研究

董立尧(南京农业大学植物保护学院)

11:20-11:35 中国菟丝子对不同大豆品种的危害差异及相互影响

胡飞(华南农业大学)

11:35-11:50 江苏省泰州杂草稻的起源及其遗传多样性研究

张娟(中国水稻研究所)

11:50-12:05 草甘膦对田旋花、打碗花体内莽草酸含量的影响

刘延(中国农科院植保所)

12:00- 午餐 Lunch

### 2007 年10 月11 日 星期四 下午 Thursday 11 Oct. 2007

地点(Location): 二楼盛德堂报告厅 Conference Hall at Conference Centre

主持人(Chairman): 徐效华 余柳青

13:30-14:00 凤眼莲 (水葫芦)的可控及规模化利用技术集成

褚建君(上海交通大学)

14.00-14:20 脂肪酸对植物病原菌的抑制作用

阮维斌 (南开大学)

14:20-14:40 杂草化感物质作用的靶标系统研究

马瑞君 (韩山师范学院)

14:40-15:00 耐草甘膦菜豆 DNA 导入大豆及其分子检测

陶波 (东北农业大学)

15:00-15:20 赤霉素在光合细菌增殖培养中的化感作用

李兰生(中国海洋大学)

15:20-15:40 6种除草剂防除恶性杂草猪殃殃效果评价

李美(山东省农业科学院)

主持人(Chairman): 胡飞 梁帝允

15:50-16:10 外来入侵植物预警、控制体系的建立—以江苏防治加拿大一枝黄花为

例

强胜(南京农业大学)

16:10-16:30 一种自然控草方法-植物相克作用研究的展望

沈健英(上海交通大学)

16:30-16:50 河北省玉米田杂草发生与环境因子的关系

魏守辉 (中国农业科学院植物保护研究所)

16:50-17:10 利用琼脂混粉法测定植物组织的化感活性

罗小勇(青岛农业大学)

17:10-17:30 青海草地毒草狼毒的发生与防治对策

魏有海(青海农科院)

17:30-17:50 芒果叶挥发物化学成分分析与鉴定

赵冬香(中国热带农业科学院环境与植物保护研究所)

17:50-18:10 稗草生防菌蟋蟀草平脐蠕孢菌 99-01 的形态学和分子鉴定

张建萍(中国水稻研究所)

18:10-18:25 不同溶剂提取芦竹化感物质抑制铜绿微囊藻的效果比较研究

洪喻 (清华大学)

18.30- 晚餐 Dinner

2007 年10 月12 日 星期五 上午 Friday 12 Oct. 2007

08:30-10:20 大会报告

地点(Location): 二楼盛德堂报告厅 Conference Hall at Conference Centre

主持人(Chairman): 张鸿秀 朱朝华

08:00-08:30 共生条件下金鱼藻对铜绿微囊藻的化感作用机制

鲜啟鸣(南京大学)

08:30-08:50 海南外来入侵杂草概况

范志伟(中国热带农业科学院)

08:50-09:10 外来入侵杂草假高粱 (Sorghum halepense (L.)Pers.) 的化感作用初评

黄红娟(中国农科院植保所)

09:10-09:30 水稻免耕直播品种适应性及其杂草防除研究

陆永良(中国水稻研究所)

09:30-09:50 Bioassay methods comparison on evaluation allelopathic potential of rice

(Oryza) germplasm

郭怡卿(云南省农科院)

09:50-10:10 土壤中异噁草酮降解菌的分离鉴定、适应性及生物修复效果的研究

刘亚光 (东北农业大学)

10:10-10:20 茶歇 Coffee/Tea Break

主持人(Chairman): 赵杨景 李香菊

10:20-10:40 不同 N 水平条件下水稻化感效应对稻田杂草种群变化的影响

李永丰(江苏省农业科学院)

10:40-11:00 鸭舌草抗氧化活性物质的分离与鉴定

周勇军(中国水稻研究所)

11:00-11:15 双氧水( $H_2O_2$ )和赤霉素( $GA_3$ )对播娘蒿种子萌发的影响

崔海兰(中国农科院植保所)

11:15-11:30 KM0612 防治稗草的生物活性测定

耿锐梅(中国水稻研究所)

11:30-11:45 酚酸对水葫芦的生长抑制作用

王江岭(华南农业大学)

11:45-12:00 黄顶菊对 6种草坪草种子萌发和幼苗生长的化感作用

张米茹(中国农科院植保所)

12:05 午餐 Lunch

2007 年10 月12 日 星期五 下午 Friday 12 Oct. 2007

13:30-16:45 学科研讨

化感组

地点(Location): 二楼盛德堂报告厅 Conference Hall at Conference Centre

主持人(Chairman): 鲜啟鸣 马瑞君

1. 植物化感作用研究中的问题

2.2008年赴美国出席第五届世界植物化感作用大会的准备

杂草组

地点(Location): 二楼天上人间报告厅 Conference Hall at Conference Centre

主持人(Chairman): 郭平毅 郭青云

1. 应对农田杂草草相变化的措施

2. 如何预防和治理除草剂药害

3.2008年赴加拿大出席第五届国际杂草科学大会的准备

注: 1. 请主持人严格控制时间

2. 请各位代表充分准备,言简意明地表明观点。

16:45-18:00 闭幕式 Closing Ceremony

地点(Location): 二楼盛德堂报告厅 Conference Hall at Conference Centre

主持人(Chairman): 倪汉文

16:45-17:00 化感组汇报

17:00-17:15 杂草组汇报

17:15- 马永清会议总结、闭幕词

安排相关事宜

18.00-19:30 晚餐

## 论文摘要

## **ABSTRACTS**

## THE FUTURE OF ALLELOPATHY FOR WEED MANAGEMENT

### Stephen O. DUKE\*, Scott R. BAERSON, Franck E. DAYAN, Agnes M. RIMANDO, and Zhiqiang PAN

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For the past century, the study of plant-plant allelopathic interactions has been of interest to those interested in improving weed management technologies. There are thousands of papers, treatises, and monographs during this time period that attempt to advance our knowledge of allelopathy for such uses. During the same period, weed management in most crops, in most of the world, has become dependent on synthetic herbicides and, in several major crops, transgenes for herbicide resistance paired with herbicides. In fact, the objective of a significant fraction of allelopathy research during the last few decades has been to discover natural phytotoxins that might be good lead compounds for synthetic herbicide development. Minor crops and niche markets, such as organic crops, are not as dependent on herbicide-based technologies, but weed management is much more expensive for most of these crops. Furthermore, in parts of the developing world, the expense of modern weed management technology is economically prohibitive. In these situations, manual labor must be used. In the developed world, weed management without herbicides is very expensive, and in much of the under-developed world the necessity for manual weeding deprives children of educational opportunities and women of more fulfilling uses of their time. For organic farmers, farmers of minor crops, and many farmers in the under-developed part of the world, crops that control weeds without herbicide application or high levels of labor input are highly desirable. Efforts to breed allelopathic crop varieties have met with some technical success, but have had little or no commercial impact. As mentioned above, transgenic technology has been used for weed management, but only to allow for the use greater use of some synthetic herbicides. Transgene technology is being used to reduce use of synthetic insecticides and fungicides. Can it be used to eliminate or reduce herbicide use? The biotechnology industry is engineering crops to have traits such as drought resistance that might make the crop more competitive with weeds. This is not their objective, but this potential secondary benefit of such crops will be interesting to evaluate. Our laboratory has a project with the objective of producing sorghum varieties with enhanced allelopathic capabilities by means of transgene alteration of the crop. We chose sorghum because it has two advantages over some other crops. First, it produces the highly potent phytotoxin sorgoleone that appears to have more than one mode of action. Second, this compound is apparently produced only in root hairs, thus maximizing movement to competing species in soil and minimizing the metabolic cost of production. We have determined the metabolic pathway of sorgoleone and discovered putative genes for its production. We are now in the process of evaluation of sorghum lines transformed with vectors derived from our knowledge of the genes of the biosynthetic pathway. We hope that this will be a model system to demonstrate that transgene technology can be used to produce crops that are less reliant on synthetic herbicides.

## TRICHOMES AND ROOT HAIRS FUNCTION AS NATURAL PESTICIDE FACTORIES

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In their continual struggle to overcome pests and competitors, plants have evolved biosynthetic pathways to produce a variety of natural pesticides. The synthesis of these bioactive secondary metabolites is often compartmentalized in specialized epidermal cells called trichomes. These anatomical structures are at the interface of the plant with its biotic environment and serve as first line of defense against biotic attacks. Trichomes can be small single-celled or large multicellular structures and their morphology is extremely diverse. Glandular trichomes are normally physiologically active and secrete secondary metabolites into the subcuticular space at their tips. Root hairs are classified as trichomes present on roots, and their development is under the same genetic controls as aerial trichomes. Root hairs are protrusions of single epidermal cells and are structurally less diverse than other aerial trichomes. While the primary functions of root hairs are typically associated with increasing the root surface area and enhancing water and nutrient uptake, some plants have developed specialized root hairs that produce and release bioactive secondary products to the environment. The pesticide industry has, in some instances, capitalized on the biological activity of these phytochemicals in their efforts to discover new pesticides, usually exploiting their structural backbones to develop commercial pest control agents. Examples of the chemical diversity of bioactive natural products produced by these specialized cell types to be discussed will include the production of the gossypol in cotton, leptospermone in Leptospermum scoparium and artermisinin in Artemisia annua trichomes, and the biosynthesis of the allelochemical sorgoleone from the root hairs of sorghum.

## OPTIMISING HERBICIDE USE – LESSONS LEARNED IN DENMARK OVER THE LAST 20 YEARS

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Danish agriculture is characterised by a relatively low pesticide use compared our neighbouring countries. Although differences in cropping systems and climatic conditions, and the introduction of pesticide taxes partly explain the lower pesticide use several technical features have contributed to the low use of chemical inputs. Another important factor in Denmark is the close collaboration between research and the advisory service ensuring a swift communication of new knowledge to farmers as well as a high degree of willingness among farmers to adopt new knowledge.

Herbicides vary considerably in the weed spectrum they control and a detailed knowledge of the activity profile is a pre-requisite for optimising herbicide use. Similarly growth stage of weeds and environmental conditions around the time of application may affect herbicide performance. Field research and research under controlled conditions have provided very detailed knowledge on the importance of these parameters. For example in the official efficacy testing of herbicides in cereal crops results are required for three doses (1/1N, 1/2N and 1/4N) providing very important information on the strong and weak points of the herbicides. The information generated over the years has provided advisors with the opportunity to develop more field-specific herbicide recommendations and as a result of this applying the full dose is more the exception than the rule. An additional reduction in herbicide inputs can be obtained using herbicide mixtures "designed" to control a specific weed flora.

Another aspect to consider is the competiveness of the crop. The risk of failure from using reduced doses is significantly lower in competitive than in less competitive crops. But even between varieties pronounced differences in competitiveness can be found. Early vigour and crop height are important parameters determining competitiveness of cereal varieties.

In Denmark the abovementioned information is available to farmers and advisors through the internet-based decision support system "Crop Protection Online". The system demands input on weed species, weed growth stage, climatic conditions and crop cultivar competitiveness and then provides an assessment of the need for a herbicide treatment and ranks the potential herbicide solutions.

"Crop Protection Online" is widely used by advisors however the number of farmers using the decision support system is limited despite the potential of "Crop Protection Online" to reduce herbicide use in cereals has recently been estimated to be around 45% of the current use. One reason for this discrepancy is the risk-adverse behaviour of many farmers. Despite the fact that the use of high doses have been shown to be less profitable in the long term they are prepared to pay the costs of taking the insurance of a high herbicide dose. This attitude is common on larger farms to overcome labour bottlenecks and with the steadily increasing farm size observed over the last 20 years this will have an increasing impact on herbicide use.

Besides the risk-adverse attitude of farmers other changes are challenging the currently low herbicide use in Denmark. In a recent weed survey assessing the frequencies of 68 common weed species including perennial species it was found that weed frequencies had generally increased. The increase in weed frequencies reflects the changes in crop rotation towards more winter crops but also indicate that many farmers have not responded in time to the changed in weed flora that are the result of any herbicide strategy but often are more pronounced using reduced doses. Many farmers will most likely increase herbicide use in the coming years. The changes in weed flora reflect the importance of management using reduced doses but also highlight the importance of other measures besides the direct control methods, such as crop rotation, to assure a continued low use of herbicides. A more widespread adoption of non-inversion tillage will contribute further to an increased herbicide use.

Another important aspect to consider is the risk of herbicide resistance. In this context it is important to distinguish between the situation where herbicide doses are reduced without a corresponding reduction in herbicide activity due to proper selection of herbicides and the situation where herbicide doses and activity are reduced because a high level of efficacy is not cost-effective to the farmers. The former pose no threat compared to the application of recommended doses but the latter may increase the risk of selecting metabolic resistant biotypes but on the other hand reduce the risk of target-site resistance. Herbicide resistance is not widespread in Denmark and currently not a decisive parameter when farmers decide on weed control options.

# MODIFIED BENZOXAZINOIDS BASED ON ALLELOCHEMICALS FROM GRAMINEAE AS POTENTIAL RICE PROTECTION TOOL AGAINST ECHINOCHLOA CRUS-GALLI.

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Rice is one of the most exciting and interesting crops in the world both from the social and economic point of view. The salinity, quality and other characteristics of the soils in those areas where is predominant allow a reduced number of other crop choices.<sup>1</sup> Thus, monoculture becomes a much extended practice. The monoculture practices along with the heavy use of herbicides are characteristic of modern agriculture and are inducing the appearance of tolerant and/or resistant herbicides weed biotypes.<sup>2</sup> This is the case the weed *Echinochloa crus-gallis* world's main weed of rice.<sup>3</sup> It has been described a number of resistant biotypes in the United Stated, Brazil, Spain, Canada, France, Italy, China and other countries affecting different herbicide groups as synthetic auxines, thiocarbamates or dinitroanilins as well as different modes of action as photosystem II or ACCase inhibitors.<sup>4</sup>

2-Deoxy derivatives of benzoxazinones DIBOA and DIMBOA has been proposed as useful candidates for natural herbicides models development.<sup>5</sup> In this context, a second generation of chemicals, which include structural modifications to enhanced their phytotoxicity and selectivity have been synthesized and tested on rice and *Echinochloa crus-galli*. These modifications include the introduction of side-chains of different length to regulated their lipophillicity, and the introduction of halogenated substituents that modified electronic properties of the aromatic ring. Those compounds that present an halogen atom at position 8 have shown high selectivities. These products showed strong inhibition effects on *Echinochloa crus-galli* at concentration lower than 1μM, whereas rice seeds growth with low effect at that concentration. These results allow us to propose these compounds as potential rice protection tool against *Echinochloa crus-galli*.

$$R^{5}$$
  $R^{1} = H$ , Alkyl  $R^{2} = OH$ , Alkanoyloxy  $R^{3}$ ,  $R^{4}$ ,  $R^{5}$ ,  $R^{6} = H$ , F, CI, CF<sub>3</sub>, COOMe, ...

### INVASIVE ALIEN PLANTS AND ALLELOPATHY

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Recently, the movement of people and substances is becoming more active as human activity and living organisms are being introduced into new regions in a manner that exceeds the living organisms' natural ability to move. Such introduction of organisms to new regions may drastically alter biodiversity in the region when they feed on or drive out native living organisms that do not have defensive capabilities. The phenomenon is reported worldwide and cases have been observed in which this has led to harm to human beings or to agriculture, forestry, or fisheries. June 2005, the Japanese Government has enacted the "Invasive Alien Species Act" with the purpose of preventing adverse effects to Japanese ecosystems, human safety, or agriculture, forestry and fisheries caused by alien species. In order to contribute to this Act, a new National Project "Risk assessment of alien plants and their control" has started in Japan. The aim of this project is to survey the distribution and hazard by alien invasive plants, and make scientific background for the selection of harmful alien species, and develop practical methods for the mitigation of alien invasive plants.

As for the mechanism of biological invasion, allelopathy is supposed to be one of the important factors. Weapon of mass destruction hypothesis, suggest that invaders succeed because of their allelochemicals to alter the environment to their own needs at the expense of native species. We are evaluating the allelopathic activity by specific bioassays, and will show the allelopathic invasive plants. As a result of our database of allelopathic activity of 4,000 plant species, we would like to demonstrate an "Allelopathy Hypothesis" that endangered, old, slow growing and weak plants tend to have allelopathic activity and play an important role in the evolution of biodiversity.

To develop mitigation method and control or eliminate hazardous alien plants is also acute problem. Use of cover plants with allelopathic activity to prevent invasive weeds will be demonstrated. Major results will be reported and a proposal for cooperative research on these topics in Monsoon Asian region will be presented.

Key words: invasive alien plants, allelopathy, natural toxin, mitigation, biodiversity

## METHODOLOGY OF RICE ALLELOPATHY AND ALLELOPATHIC COMPOUNDS ISOLATED FROM RICE HULL AS POTENTIAL HERBICIDAL AGENTS

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Rice (*Oryza sativa* L.) is a principle food for many people in the world. Our research, conducting during 2000-2007 has been focused on searching allelopathic potential of rice by either screening or isolating chemical substances from hulls of rice. Several screening methods on bioassay, greenhouse and field trials were developed, of which relay seeding, rationing, straw meal mixture and hydroponic show a simple, rapid, inexpensive, reliable technique that can be conducted year round. Allelopathic activity of rice reveals a variety and origin-dependent. Japonica rice exhibits higher allelopathic property than Indica and Japonica-Indica hybrids, also the correlation between genetic and morphological characteristics of rice cultivars and allelopathic potential were confirmed. Forty-three chemical substances including new and known compounds, were isolated, identified and tested for their biological activities. Most of them are belonging to terpenoids, steroids, aliphatic, anthracene derivatives, flavonoids, and other classes. Of these, several compounds show strong herbicidal activity against some noxious weeds, could serve as a source of natural herbicides. It suggests that rice hulls which are most abundant in rice-producer countries that have many phytoalexin substances can be used as a source to alleviate the heavy dependence on synthetic herbicides.

**Keywords**: Allelopathy, allelochemical, rice cultivar, phytoalexin, herbicidal agent

## EVALUATION OF TRIGONELLA FOENUM- GRAECUM L. ALLELOPATHIC POTENTIAL

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Trigonella foenum-graecum is known to contain substances that have medicinal virtues. Aqueous extracts from various plant parts (aerial parts: LS, roots: R, ground seeds: GS and not ground seeds: NGS) and powdered aerial parts were assayed to determine their allelopathic effects on seed germination and early seedling growth of several test crops, for evaluating fenugreek allelopathic potential. The aqueous extracts applied to filter paper showed an inhibitory effect which depended on target species and varied among plant parts. Phaseolus vulgaris was the most resistant species and Foeniculum vulgare, Hordeum vulgare and Zea mays were the most sensitive ones. Incorporation aerial part residue in peat was a good fertilizer for target species especially for P. vulagaris, whose root and shoot growth was multiplied by 4 and 8 times respectively. These results suggested that extracts or residues from T. foenum-graecum plants had potent allelopathic activity and that the activity differed depending on target species and plant parts. The degree of toxicity of different plant parts can be ranked in the following order of inhibition: leaves and stems > not ground seeds > ground seeds > roots. Fenugreek biomass was a stimulative effect on test crops germination and growth.

**Key words:** Allelopathic potential, bioassay, germination, inhibition, plant extracts, pot culture, seedling growth, *T. foenum-graecum*.

### ALLELOPATHY AS A TOOL FOR WEED MANAGEMENT

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Several studies have demonstrated that many plants have a strong allelopathic effect enabling them to reduce growth of other plants growing simultaneously or subsequently in the fields. Exuded or secreted substances derived from their normal metabolism called allelochemicals inhibit certain plants while others are not affected at all. This differential effect is due to the fact that the same paradigm governing herbicide selectivity is also implicit in the selectivity of the allelochemicals. Crops with strong allelopathic effect may become an additional important tool for weed management. Practically allelopathy is used widely in those areas where cover crops are planted in rotation with other crops and effectively smoother or suppress several weeds. Today it is also known that various cultivars have an allelopathic potential making possible the control of some major weeds during the crop cycle. One of these crops is rice. Evaluation of the allelopathic potential of rice germplasm indicates that there are some lines quite aggressive against such troublesome weeds as Echinochloa crus-galli and Cyperus difformis. In this context, breeders should be able to combine the characteristics of these allelopathic lines with those high yielding varieties. In China it has been found that here is not correlation between allelopathic traits and main agronomic characters of productive varieties, and this makes possible to effectively breed allelopathic lines with high-yielding varieties. Allelopathic rice varieties should be suitable for direct-seeding as well as for transplanting. Another possibility to explore in the near future is to improve crop varieties with less allelopathic potential by incorporating desired genes encoding the synthesis of allelochemicals. Therefore allelopathy may also be another component of desired improved weed management. It will not solve all weed problems in any field, but may help considerably to reduce the stand of some prevailing weeds in the fields.

## POTENT ALLELOPATHIC SUBSTANCE MOMILACTONE B IN RICE ROOT EXUDATES

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The negative impacts of commercial herbicide use on the environment make it desirable to diversify weed management options. Many investigations have been attempted to exploit allelopathy of plants for weed control purposes in a variety of agricultural settings, since allelopathy is regarded as the direct influence of an organic chemical released from one living plant on the growth and development of other plants.

Rice has been extensively studied with respect to its allelopathy as part of a strategy for sustainable weed management, such as breeding allelopathic rice strains. A large number of rice varieties were found to inhibit the growth of several plant species when these rice varieties were grown together with these plants under the field or/and laboratory conditions. These findings suggest that rice may produce and release alleochemical(s) into the neighboring environment, thus encouraging the exploration of allelochemicals in rice.

Allelopathic potential of early developmental stages of rice seedlings of eight cultivars was determined in Petri dishes under controlled laboratory conditions. Three plants; alfalfa (Medicago sativa L.), cress (Lepidium sativum L.) and lettuce (Lactuca sativa L.) were chosen for the bioassay as test plants because of their known germination behaviors. MES buffer (pH 6.0) was chosen as the test solution, which did not affect the germination and growth in cress, lettuce and alfalfa as well as rice, and did not cause any significant pH changes during the bioassay. Furthermore, no effect of osmotic potential of the test solutions in all dishes was detected on the germination and growth of these plant species.

As a result of the trial, all rice cultivars tested inhibited the growth of roots, shoots, fresh weight of these test plants. However, effectiveness of cv. Koshihikari on growth inhibition was the greatest in these rice cultivars and more than 60 % inhibition was recorded by cv. Koshihikari in all bioassays. Test plants may germinate and grow with the rice seedlings without competition for nutrients and water, because no nutrients were added in the bioassay and water was supplied regularly. Light is also unnecessary in the developmental stages of these seedlings, since seedlings mostly withdraw nutrients from the reserve of their seeds during early developmental stages. Thus, during early development, rice seedlings inhibited the growth of the test plants. The inhibitory effect may not be due to competitive interference, suggesting that young rice seedlings may release growth inhibitory substances into the neighboring environment.

About 5,000 rice seedlings, cv. Koshihikari, were hydroponically grown for 14 days in order to find out an allelochemical in rice root exudates. Keeping track of the biological activity, their culture solution was purified by several chromatographic fractionations and finally 2.1 mg of putative compound causing the inhibitory effect of the rice seedlings was isolated. The chemical structure of the inhibitor was determined from its high-resolution MS, and  $^{1}$ H- and  $^{13}$ C-NMR spectral data as 3,20-epoxy-3 $\alpha$ -hydroxy-9 $\beta$ -pimara-7,15-dien-19,6 $\beta$ -olide (momilactone B). Momilactone B was originally isolated from rice husks as a growth inhibitor involved in seed dormancy and later found in rice leaves and straw. This was, however, the first report of the finding that momilactone B is in rice root exudates.

Momilactone B inhibited the root and hypocotyl growth of cress seedlings at concentrations greater than 3  $\mu$ M. The inhibition was increased with increasing concentrations of momilactone B. The concentrations required for 30 % inhibition in the assay were 12 and 16  $\mu$ M on cress roots and hypocotyls, respectively, and for 50 % inhibition on cress roots and

hypocotyls were 36 and 41  $\mu$ M, respectively, as interpolated from the concentration-response curves.

Three-day-old rice seedlings, cv. Koshihikari, were transferred to hydroponic culture where only rice roots were immersed in the culture solution, and the release level of momilactone B into the culture solution from the seedlings was determined. At 15 day after transfer to hydroponic culture, the level of momilactone B in the culture solution was 1.8 nmol per rice seedling and its endogenous level in rice was 0. 63 and 0.32 nmol per shoot and root, respectively. These results indicate that the rice seedlings probably release momilactone B into the culture solution and this release may be active because of its high level in the culture solution compared with the level in the seedlings.

At day 15 after transfer to hydroponic culture, the level of momilactone B in culture solution was 1.8 nmol per rice seedling, which indicates that one rice seedling may release 1.8 nmol of momilactone B to the culture solution over this period. If ten rice seedlings were incubated with 10 cress seeds in one Petri dish containing 1 mL of assay medium, the medium was found to contain 18 nmol of momilactone B. Compared with the biological activity of momilactone B, this amount of momilactone B is able to induce more than 30 % growth inhibition in the roots and hypocotyls of cress seedlings, suggesting that the release level of momilactone B may be sufficient to cause growth inhibition of neighboring plants.

Rice plants were also hydroponically grown for 130 days and release level of momilactone B from their plants into the medium were determined. Rice plants released momilactone B throughout its life cycle and release rate of momilactone B increased with plant growing until flowering initiation. The release rate of momilactone B at the day of flowering started was 2.1 µg plant day. On average, a single rice plant released about 100 µg of momilactone B into the medium over its life cycle. At a conventional plant density (100 rice plants m<sup>-2</sup>), momilactone B would be released approximately 10 mg m<sup>-2</sup>. Thus, accumulation of momilactone B may occur in the field conditions sufficiently to inhibit germination and growth of neighboring plants.

Rice has been extensively studied with respect to its allelopathic potential and its production of allelochemicals. In one of the recent trials searching for allelochemicals, momilactone B was found in rice root exudates and revealed to be released from their roots into the environment. Together, the release level of momilactone B from rice seedlings and the effectiveness of momilactone B on the growth inhibition suggest that momilactone B may act as an allelochemical by inhibiting growth of neighboring plants. Thus, momilactone B may play an important role in rice allelopathy. This was the first finding that the potent growth inhibitor momilactone B may be released from living rice roots to the environment in sufficient quantities to inhibit the growth of neighboring plants.

## BIOASSAY AND EXTRACTION FOR THE RESEARCH IN RICE ALLELOPATHY

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Plant-to-plant interference is a complex combination of competitive interference for resources such as light, nutrients and water, and allelopathic interactions (Qasem and Hill, 1989; Einhellig, 1996). Considering allelopathic potential of plants, it is essential to distinguish between the effects of competitive interference and allelopathy (Fuerst and Putnam, 1983; Leather and Einhellig, 1986; Inderjit and Olofsdotter, 1998). Thus, bioassays in allelopathy research should be design to eliminate the effects of the competitive interference from their experimental systems.

Many scientists have also paid attention to test solution characteristics for bioassays in allelopathy research because growth of roots and shoots of several plants as well as germination are inhibited by extreme pH and osmotic potential in the test solutions (Wardle et al., 1992; Haugland and Brandsaeter, 1996; Hu and Jones, 1997).

Screening for allelopathic rice under field conditions

The first observation of allelopathy in rice was made in field examinations in Arkansas, U.S.A. in which about 191 of 5,000 rice accessions inhibited the growth of *Heteranthera limosa* (Dilday et al. 1989). This finding led to a large field screening program. More than 16,000 rice accessions from 99 countries in the germplasm collection of USDA-ARS have been screened. Of these, 412 rice accessions inhibited the growth of *Heteranthera limosa* and 145 rice accessions inhibited the growth of *Ammannia coccinea* (Dilday et al. 1994, 1998). In Egypt, 1,000 rice varieties were screened for suppressive ability against *Echinochlola crus-galli* and *Cyperus difformis*, and inhibitory activity was found in more than 40 varieties of these (Hassan et al. 1998). Similar attempts have been conducted in some other countries, and many rice varieties were found to inhibit the growth of several plant species (Kim and Shin 1998, Olofsdotter et al. 1999, Pheng et al. 1999). It is obscure, however, whether these inhibitions were caused by only allelopathic effects because the competitive interference and allelopathy cannot be separated under field conditions (Fuerst and Putnam 1983, Leather and Einhellig 1998).

### Screening for allelopathic rice under laboratory conditions

Well-designed bioassays under controlled environments can evaluate allelopathic potential of plants (Leather and Einhellig 1986, Inderjit and Olofsdotter 1998). A laboratory whole-plant bioassay for allelopathic rice screening, called "relay-seedling assay", was developed at International Rice Research Institute in Philippines (Navarez and Olofsdotter et al. 1996). This bioassay may eliminate the effects of competitive interference for resources between rice and test plants from the experimental system, and may evaluate allelopathic potential of rice. By using this bioassay, several rice varieties were found to possess strong growth inhibitory activity. In addition, the 111 rice varieties were tested on their growth inhibitory activity under laboratory and field conditions, but the results were significantly inconsistent (Olofsdotter et al. 1999).

Screenings for allelopathic rice have also been undertaken in several other laboratories. These studies show that there is a marked difference among rice varieties in growth inhibitory activity and that about 3-4 % of tested rice varieties have strong allelopathic potential (Fujii 1992, Hassan et al. 1998, Kim et al. 1999, Olofsdotter et al. 1999, Azmi et al. 2000), suggesting that some living rice may release alleochemical(s) into their neighboring environment. However, rice allelochemicals have not yet been identified. Dekker and Meggitt (1983)

hypothesized that most allelochemicals are released during the early developmental stage of plants when the plants are most stressed and competitive with neighboring plants for resources such as light, nutrients and water.

### Allelopathic potential of crude extracts of rice plants

Aqueous extracts of rice plants were found to inhibit the germination and growth of several plant species. Aqueous methanol extracts of rice plants were also found to inhibit the germination and growth of lettuce and *Echinochloa crus-galli*. A number of secondary metabolites, phenolic acids, phenylalkanoic acids, hydroxamic acids, fatty acids, terpenes, and indoles, were identified in extracts of rice plants (Rimando and Duke, 2003).

### Allelopathic substances in decomposing rice residues

It is well known that the crop residues left in soil are sometimes harmful to plant growth. The plant residues in soil could release phytotoxic substances during decomposition period. Chou and Lin (1976) observed decrease in plant productivity of the second rice crop in a paddy field containing residues from the first rice crop. They found that aqueous extracts of decomposing rice residues in soil inhibited the growth of mungbean and lettuce as well as rice. Aqueous extracts of rice residues were also found to suppress the growth of *Phalaris minor*, *Echinochloa crus-galli* and lettuce (Khan et al., 2001; Jung et al., 2004).

### Allelpathic substances in rice root exudates

Several phenolic acids and fatty acids were found in water obtained from soils in which allelopathic or non-allelopathic rice plants were incubated for 48 h (Mattice et al., 1998). Kim and Kim (2000) were identified several compounds in acidic fraction isolated from root exudates of allelopathic rice cv. Kouketsmochi. Fifteen compounds were identified and quantified in the root exudates of alleloapthic and non-allelopathic rice cultivars (Seal et al., 2004). Momilactone B was isolated from rice root exudates (Kato-Noguchi et al., 2002). Momilactone B is quite active at submillimolare concentrations (Takahashi et al., 1976; Kato et al., 1977; Lee et al., 1999b), indicating that it may account for allelopathic effects of some rice cultivars.

## PROGRESS AND PROSPECT OF RICE ALLOLOPATHY RESEARCH

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An improvement in allelopathic potential in rice will have a great impact on both low-input and high-input management systems. Alleopathy alone is not likely to replace other weed control practices, but it surely functions as a component of integrated weed management technology. Marginally reduced use of herbicide over time will provide significant economical benefits to farmers and will also reduce adverse effects on the environment.

An important research area is establishment of screening method to evaluate allelopathic potential. There are several methods available at moment, but development of universal bioassay method (easy to carry out, but most reliable and economic one) applicable to all the conditions is needed. For instance, hostorium induction of parasitic plants can be a new bioassay method through determining reactive oxygen species. It is also meaningful to search for morphological characters related to rice allelopathy; early crop biomass (early seedling emergence, seedling vigor, fast growth rates etc.) and color of awn or plant and any others.

Another important research areas are identification of allelochemicals and genes responsible for allelopathic effects and these traits can be easily incorporated into improved cultivars by either classical breeding or biotechnology. There is a great possibility of breeding new allelopathic rice by regulating their capacity to produce allelopathic substances. Allelopathic potential in rice was greatly improved by the classical breeding method of crossing between a non-allelopathic commercial cultivar and an allelopathic cultivar. Use of allelopathic cultivar, K21, a progeny of Dongjinbyeo (non allelopathic cultivated variety) and Kouketsumochi (wild type: having allelopathic potential) can reduce herbicide rate more than 20% in green house experiment.

Allelopathic activities of rice seem to be derived from the joint action of momilactones with phenolic compounds. Phenolics, however, are unlikely to be the primary allelochemicals since they never reach a phytotoxic level in soil. However, it is believed that phenolics like other multiple compounds present at concentrations below the activity threshold could have pronounced allelopathic effects through their joint action. Momilactone B seems to be the responsible allelochemical which are released throughout its life cycle because its activities were 30-fold to 300-fold greater than phenolic acids. Of course, it is believed that there might be unknown compounds among rice germplasm which may exhibit unexpected allelopathic effects.

Insertion of two specific genes such as CA4H for p-coumaric acid and OsDTS2 for momilactone into one commercial rice cultivar by biotechnology will lead to the development of allelopathic rice cultivar. This work is under way.

Further studies on characterization of morphological character, genetic control of rice allelopathy, the complete array of the responsible chemicals in rice root exudates and their mode of action will shed more light on developing an allelopathic rice crop.

## HAUSTORIUM INDUCTION OF PARASITIC PLANTS AS A NEW BIOASSAY METHOD

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### 1-1. Seed sterilization and germination

T. versicolor seeds were surface sterilized in 70% ethanol for 15 min, 2% NaClO added 1 drop of Tween 20 for 25 min and then rinsed in four to six volumes of sterile water. Approximately 200 seeds were placed in round Petri dishes (90 mm × 25 mm) containing 0.1% Noble agar. The plates were sealed with parafilm, placed at 4°C for 2 days to stimulate germination, and then transferred to a 16°C growth incubator under a light condition. Germination occurred 10-14 days after sowing.

### **1-2.** Transfer seedlings of *T. versicolor* to square Petri-dish:

Prepare nursery plate containing 0.25x Hoaglands, with micronutrients and 0.5% (w/v) sucrose, and 1.0 % (w/v) agar-C (Bio basic Inc) in a square petri dish. Gently remove the *Triphysaria* seedling from the germination Petri-dish to the square Petri-dish. Plants should be evenly spaced in a parallel arrangement, across the surface of the media. It is important that roots grow in the surface of the agar and orienting seedlings are top up, roots down. Plates were sealed with parafilm and placed vertically in growth chamber at a temperature of 16-20°C under light condition.

### 2-1. Extracts of various rice varieties (rice germplasm)

Three rice cultivars, Kouketsumochi, Dongjinbyeo and K21, were grown aseptically for two weeks. Shoot and root of 20-day-old rice-seedling were harvested, respectively, and then cut into approximately 0.3-0.5 cm lengths and extracted in water at the concentrations of 100 mg ml<sup>-1</sup>.

### **3-1. Haustorium induction in root tip of** *T. versicolor*

On a Laminar flow cabinet, the root tips of *T. versicolor's* seedlings with 2.0-2.5 cm long root were treated by filter-sterilized tissue extracts of rice. The plates were placed in the growth chamber. The root tips were checked at the given time under a dissecting microscope at 0.6-3.2 x magnification.

### 4-1. Phytotoxic activity

Extracts from rice tissues were applied to the roots of *T. versicolor* seedlings as described for the haustorium bioassays. Phytotoxic activity of the extracts was determined by measuring the root growth of *T. versicolor* after 60 h after treatment.

### 4-2. Measurement of ROS

ROS (reactive oxygen species) was assayed by staining root tip of parasitic plants with probe CM-H<sub>2</sub>DCFDA [5-(and 6)-chloromethyl- 2', 7'-dichlorodihydro-fluorescein diacetate, acetyl ester], and monitoring the change of fluorescence. When the dye was oxidized by ROS to dichlorofluorescein (DCF), the fluorescence increased.

### RICE ALLELOPATHY IN AQUATIC SYSTEMS

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Lake Veeranum and it's distributaries form the major irrigation source of Tamilnadu state in South India, with a command area of 18,000 ha of double cropped rice. The distributaries in recent years have been infested with water hyacinth (Eichhornia crassipes. Mart. Solms). However, the invasive alien weed has not entered any of the cultivated rice fields in this tract. Based on this observation, residues of sixty different rice cultivars have been screened for their allelopathic inhibition on water hyacinth through laboratory bio-assays as well as micropond confirmatory tests. In the laboratory bio-assays, aqueous extract of the residues at varying concentrations viz. 2, 5 and 10 per cent in polystyrene cups, each hosting a water hyacinth plant, were compared with an untreated control for reduction in weed bio-mass and chlorophyll content. Cultivars that exhibited a weed bio-mass and chlorophyll reduction above 40 per cent on three days after treatment were grouped as highly allelopathic and those that exhibited a bio-mass and chlorophyll reduction ranging from 20 to 40 per cent were grouped as moderately allelopathic. These highly allelopathic cultivars and moderately allelopathic cultivars were later tested in cement concrete circular microponds of diameter 1.3 m and height 60 cm with water up to 50 cm and floating water hyacinth plants, of uniform density in each. The residues of selected rice cultivars were soaked in water of the micropond to make concentrations of 2, 5 and 10 per cent respectively and compared with floating weeds of a micropond with normal untreated water. Reduction in weed bio-mass and chlorophyll content at 24 hr interval were recorded. It was observed that cultivar BPT was highly allelopathic on water hyacinth that was imparting a weed biomass reduction of 47.68 per cent in the laboratory screening and 45.61 per cent in the micropond confirmative study. Rice cultivar ADT-36 was moderately allelopathic that resulted in a weed bio-mass reduction of 33.40 per cent in laboratory screening and 32.20 per cent in micropond confirmative study. Based on the results a recoverable straw unit has been developed with the rice residues bundled in a perforated polyurethane bag tied to an anchor rope sealed by bamboo pole at required intervals, in the water bodies during the monsoon season. During summer, when the channels dries off, the straw units could removed, to get rid off the decomposing residues from the channel. This demonstration has been commenced in this year with the onset of monsoon, during July and is currently observed for it's efficacy in controlling waterhyacinth in selected water bodies of Veeranum command area.

#### PROGRESS OF WEED MANAGEMENT IN RICE IN VIETNAM

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One of the major pests in rice in Vietnam is weeds. About 400 weed species have been reported to occur in rice fields of which the Poaceae and Cyperaceae are major families with 176 species. The next important families are: Asteraceae, Scrophulariaceae, Fabaceae, Lythraceae and Laminaceae. Echinochloa crus-galli is the most important weed in rice in Vietnam. Beside that, the other emerging weeds have been observed. They are Leptochloa chinensis and weedy rice ( Oryza sativa). Yield loss due to weeds ranges from 10 to 46% in weedy check. Regarding the weed management in rice, research and development continue to emphasize on using certified seeds, proper land preparation, good water management, sowing in line by drum seeder, rotational use of herbicides, crop rotation ... Some new studies on mycoherbicides, herbicide resistant rice varieties and allelopathy have been carried out. Research results revealed that the fungi Exserohilum monoceras effectively controls Echinochloa crus-galli and Setosphaeria rostrata controls Leptochloa chinensis very well. The mutant gene PWC in CL161 tropical japonica rice variety developed by scientists at the Louisiana University has been transferred successfully to the Vietnamese indica rice. The results of this backcrossing are some new varieties namely OMCF 6, OMCF9, OMCF 39, OMCF 48 carrying the gene which is resistant to imidazolinone herbicides. The adoption of these varieties and application of imidazolinone herbicides resulted in a good control of weedy rice ( Oryza sativa) and other common weeds in rice fields. The research on allelopathy also has been conducted recently in Vietnam .An extract from cucumber (Cucumis sativus) is effective in checking the germination and growing of Echinochloa crus- galli. In another research, organic matter from 30 plant species were tested for allelopathical effects on indicator plants such as lettuce, radish, vegetables and some common rice weeds namely Echinochloa crus-galli and Monochoria vaginalis. Results have shown that there are 7 species with stimulative effect ,5 species 0.9 to 20 %, 7 species from 20 with inhibitory effects from % to 50 %, 5 species from 50 to 80%. Six species having very high allelopathical inhibitory effect (80-100%) are Nerium oleander, Passiflora incarnate, Sophora japonica, Helianthus tuberosus, Azadirachta indica and Leucaena glauca.

**Key words**: Rice weeds, mycoherbicide, imidazolinone, herbicide resistant rice, allelopathy.

### THE APPLICATION OF TRIFLURALIN USED IN DRY SOWN RICE

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The field trials for investigating phytotoxic effect of trifluralin in dry sown rice were conducted. Two treatments were arranged by applying herbicide into paddy fields during paddling or after paddling. After the herbicide applied for 20 days, rice seeds were dry-sown in the field trial plots. The minimal application rates of trifluralin resulting significant phytotoxic reduction in rice stand and grain yield were used as criteria for distinguishing phytotoxicity. The results clearly indicated that the application rate of trifluralin at 375 g a,i,/ha did not cause reduction in number of rice stands and grain yield in both treatments; at the rate of 750 g a.i./ha, there was significant in reduction of rice stands and grain yields in the treatment by applying herbicide during paddling, At high rate of 3000 g a.i./ha, the reduction in number of rice stands and grain yield was very significant in the treatment that the application of trifluralin was applied after the fields had been paddled. The normal application rate of trifluralin at 375-750 g a.i./ha by spraying its water dilution into flooded fields after paddling could be used in dry sown rice for grass weed control.

**Key words:** Dry sown rice; phytotoxicity; trifluralin

### ALLELOPATHIC RESEARCH AMONG SEVERAL PASTURE SPECIES DURING GERMINATION STAGE

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Allelopathy is the chemical inhibition of one organism by another. Allelopathic effects are often observed between plant species at germination. Pasture plants contain biologically active substances that are allelopathic to intra- and interspecific. This study was conducted to investigate varietals differences in allelopathic potential in pastures species. Five common varieties of pasture plants seeds of *Sorghum sudanense* (Piper) Stapf)( Gramineae), *Cichorium intybus* Linn.)( Compositae), *Medicago sativa* L. (Leguminosae), *Lolium perenne* Linn. (Gramineae) and *Trrifolium repens* L.(Leguminosae), were grown by mix culture of each other species and bioassayed of exudates from germinated seeds against other species. Results demonstrated that the allelopathic effect in every plant species was existent whether in seeds mix-cultured or in the exudates from seeds germinated. The degree of inhibition or promotion of seeds germination and growth of seedling varied with the variety of pasture species. The results suggested that some pasture species cultivation conditions should be based on the varieties of allelopathic characteristics of difference pastures species as their various allelopathic potentials.

**Keywords:** Allelopathic effects, seed exudates, seeds germination, pasture species, bioassay.

#### 1. Introduction

Inhibition of growth of plants by other plants in their vicinity has been known for a long time. Chemical substances released from plant organs into the neighboring environment as biological information stimulate or suppress the development and/or growth of other plants; this chemical interaction has been termed "allelopathy" as "any direct or indirect beneficial or detrimental effect by one plant on another through production of chemical compounds that are released into the environment" (Molisch 1937; Rice 1974)<sup>[1,2]</sup> and has been extensively studied<sup>[3,4]</sup> (Rice, 1984; Einhellig, 1995). According to Rice (1977)<sup>[5]</sup>, a report by Banzan Kumazawa, which documents that rain or dew washing the leaves of red pine (Pinus densiflora) was harmful to crops growing under the pine (Lee & Monsi 1963)<sup>[6]</sup>, is historically considered to be the first report on allelopathy. Since then, various allelopathic substances were isolated and identified from different adult plant organs and the volatiles, exudates and leaches released from them. Allelopathic effects are usually considered to occur between mature plants but there is considerable evidence for the production of allelochemicals by plants at germination (Stowe, 1979)<sup>[7]</sup>. However, information on allelopathy during seed germination, which occurs in the very early stages of development, is limited(Keiko, Kosumi & Hideyuki, 2004)<sup>[8]</sup>. Studies showed that allelopathy of plant seeds indicated on inhibition when they were germinating. These allelopathic effects is not only reflected in the growth of the root, but also sometimes manifested in the growth of hypocotyl, and seeds germination(Keiko et al. 2004; Tran Dang Xuan et al. 2002)<sup>[8,9]</sup>. These allelopathic effects also showed the inhibition on the root growth and promoting on hypocotyl growth, or inverse. In recent years, some research reported that the exudate (lepidimoide) was released from germinating seeds which could promote the growth of root or hypocotyls on the other plant seedlings (Kosumi et al . 1997; Goto et al . 1995;

Hasegawa *et al* . 1992; Hasegawa *et al* . 1992; Yamada *et al* . 1995; Miyamoto *et al* . 1997.)<sup>[10,11,12,13,14,15]</sup>. It was therefore suggested that lepidimoide acts as a phytohormone-like substance as well as an allelopathic substance. In contrast, inhibitory allelopathic substances released from germinated seeds were also isolated from watermelon and sunflower, and identified as vanillic acid and sundiversifolide, respectively (Kushima *et al* . 1998; Ohno *et al* . 2001) <sup>[16,17]</sup>. Therefore, germinating seeds might exudate beneficial and/or detrimental compounds into their culture environment to regulate plant communities. The final aim of the present study was to explore the possibility of growth regulation among pasture plants using chemical communication between plant–plant interactions and/or bioactive substance(s). The importance of allelopathy in agriculture is becoming increasingly recognized, in particular in the biological control of weeds (Rice 1984). On the other side, how to eliminate the allelopathic effect among pastures species in agriculture was a new study.

In the present study, we designed the experiments to evaluate varietal differences in allelopathic potential and investigated the chemical interaction among several pasture species during seed germination at the laboratory level.

#### 2. Materials and Methods

Seeds of five varieties of pastures species, namely Sudan grass (*Sorghum sudanense*), Escarole (*Cichorium intybus Linn*.), Alfalfa(*Medicago sativa L*.), Ryegrass(*Lolium perenne Linn*.) and White Clover(*Trrifolium repens L*.) seeds were used in the present study. All seeds were provided by the HeFei Seed Company (Hefei City, China) as commercial type.

Each seed of all pasture species was sterilized with 0.5% potassium permanganate for 10 min and rinsed with distilled water.

#### 2.1 Experiment 1. Mix culture of seven species of plant seeds

The dry weight of 15 seeds of each species is about 381, 20, 35, 63 and 10 mg, respectively. Fifteen seeds of each species were placed together alternately with 15 seeds of another species at even intervals on filter paper moistened with 10 mL of distilled water in a 11 :cm Petri dish. Three filter papers were put into every dish and all dishes were put into constant-temperature biochemical incubator to retain humidity and incubated at 24 °C in the dark. After 4 days, the shoots and roots of each seedling and the seeds germination rate were measured. Fifteen seeds of each species alone were also incubated as a control. The experiments were repeated three times.

#### 2.2 Experiment 2. Bioassay of exudates from germinated seeds

Fifteen seeds of each species alone were placed on filter paper moistened with 10 mL distilled water in a 11 :cm Petri dish and incubated at 24 °C in the dark. Three filter papers were put into every dish. After 2 days, the incubated seeds were removed from the dish. Fifteen fresh seeds of each species were placed on the dish, in which 2 mL of fresh distilled water was added to maintain a similar water level, and incubated for another 4 days at 24 °C in the dark. After incubation, the lengths of the shoots and roots and the seeds germination rate were measured. Fifteen seeds of each species alone were also incubated as a control. The experiments were repeated three times.

#### 2.3 Statistical analysis

All treatments were carried out using a completely randomized design with three replications. Data were analysed using the analysis of One-way Variance (ANOVA) procedures of Excel and SPSS, version 13.0.

#### 3. Results and Discussion

#### 3.1 Experiment 1. Mix culture of seven species of plant seeds

Plant seeds of five species of pastures were selected, such as *Sorghum sudanense* (Piper) Stapf) and *Lolium perenne* Linn. in Gramineae, *Cichorium intybus* Linn. in Compositae, *Medicago sativa* L. and *Trrifolium repens* L. in Leguminosae. Two kinds of plant seeds were mixed planted in individual Petri dishes.

Table 1. The shoot length of seedling between plant-plant interaction (:cm)

	None	Sudan grass	Escarole	Alfalfa	Ryegrass	White Clover
Sudan grass	3.86±0.36(100)	3.77±0.42(98)	2.95±0.54*(76)	3.54±0.36(92)	2.89±1.04*(74)	4.07±0.80(105)
Escarole	0.50±0.20(100)	$0.45\pm0.08(90)$	0.46±0.03(92)	0.75±0.05**(150)	0.52±0.12(104)	0.54±0.05(108)
Alfalfa	2.20±0.18(100)	2.21±0.26(100)	3.03±0.23**(137)	2.11±0.20(96)	2.15±0.34(98)	2.69±0.50*(122)
Ryegrass	3.76±0.32(100)	3.70±0.34(98)	2.96±0.26*(78)	2.41±0.47**(64)	3.91±0.32(104)	3.81±0.71(101)
White Clover	1.18±0.26(100)	0.98±0.46(83)	1.13±0.18(96)	0.96±0.49*(81)	0.53±0.37**(45)	1.24±0.31(105)

Each value shows the growth of the shoots of the acceptor plant (15 seeds) cultured together with the donor plant (15 seeds). Data represent mean ± SE of three independents. Values in parentheses indicate the percentage of the control (acceptor plant). \* Significant at the 0.05 probability level. \*\* Significant at the 0.01 probability level.

Table 2. The root length of seedling between plant-plant interaction (:cm)

	None	Sudan grass	Escarole	Alfalfa	Ryegrass	White Clover
Sudan grass	6.26±0.54(100)	6.18±0.8(99)	5.15±0.48*(82)	5.09±2.0 (81)	5.15±1.74(82)	5.77±0.49(92)
Escarole	1.31±0.21(100)	0.95±0.30*(73)	1.28±0.30(98)	0.61±0.14**(47)	0.95±0.27*(73)	1.03±0.28*(79)
Alfalfa	2.65±0.42(100)	2.95±0.34(111)	2.71±0.85(102)	2.50±0.20(94)	2.63±0.51(99)	2.95±0.27(111)
Ryegrass	5.33±0.28(100)	4.78±0.48(90)	5.22±0.32(98)	4.67±0.66(88)	5.66±0.35(106)	5.11±0.57(96)
White Clover	0.54±0.20(100)	0.62±0.03*(114)	1.10±0.10**(203)	$0.48\pm0.22(88)$	0.45±0.16(83)	0.59±0.08(109)

Each value shows the growth of the roots of the acceptor plant (15 seeds) cultured together with the donor plant (15 seeds). Data represent mean  $\pm$  SE of three independents. Values in parentheses indicate the percentage of the control (acceptor plant).\* Significant at the 0.05 probability level. \*\* Significant at the 0.01 probability level.

Table 3. The germination rate of seedling between plant-plant interaction (%)

	None	Sudan grass	Escarole	Alfalfa	Ryegrass	White Clover
Sudan grass	0.5444(100)	0.5444(100)	0.4889(90)	0.6889(126)	0.5111(94)	0.4444(82)
Escarole	0.5778(100)	0.4444(77)	0.6000(104)	0.4000(69)	0.8000(138)	0.8222(142)
Alfalfa	0.6667(100)	0.7333(110)	0.6222(93)	0.6444(97)	0.5778(87)	0.8889(133)
Ryegrass	0.8444(100)	0.8444(100)	0.8889(105)	0.8444(100)	0.8778(104)	0.9333(110)
White Clover	0.2222(100)	0.1778(80)	0.1778(80)	0.1111(50)	0.2667(120)	0.1889(85)

Each value indicate the rate of seeds germination percentage. Values in parentheses indicate the percentage of the control (acceptor plant)

Table 1 and Table 2 show the measurements of seedling growth of each plant. As the density of the seeds is expected to have some effect on their growth, the control was a single culture of 15 seeds per Petri dish of each species. The observation of characteristic interactions between plants, depending on the combination of plants, is as follows (Table 1, Table 2 and Table 3). In the case of Sudan grass, its shoot lengths were inhibited by Escarole and Ryegrass (76, 74, respectively), shoot length was increased by White Clover only in 105. Its root was inhibited by Escarole, Ryegrass and Alfalfa (82, 81 and 82, respectively). Its germination rate was inhibited by other seeds except Alfalfa (126). There was no markedly influence on Escarole shoot by other species, except promotion by Alfalfa (150), while its root was inhibited markedly by Sudan grass, Alfalfa, Ryegrass and White Clover (73, 47, 73, 79, respectively). Its germination was promoted by Escarole, Ryegrass and White Clover (104, 138, 142, respectively), but was inhibited by Sudan grass and Alfalfa. The growths of Alfalfa were promoted significantly by Escarole and White Clover, and its root was gained little promotion

by other plants. The markedly promotion of germination rate of Alfalfa comes from White Clover (133). For Ryegrass shoot, inhibition comes from Escarole and Alfalfa (78 and 64), but its root and germination rate was not affected by other plants evidently. White Clover was inhibited by Alfalfa and Ryegrass in shoot (81, 45) and its root was promoted significantly by Escarole and Sudan grass (203, 114, respectively) and germination rate was significantly inhibited in Alfalfa (50).

#### 3.2 Experiment 2. Bioassay of exudates from germinated seeds

Table 4. The shoot length of seedling against exudates from germinated seeds (:cm)

	None	Sudan grass	Escarole	Alfalfa	Ryegrass	White Clover
Sudan grass	3.56±0.26(100)	3.43±0.44(96)	3.95±0.81(110)	2.85±0.35*(80)	2.49±0.41*(70)	2.41±0.33**(68)
Escarole	0.44±0.30(100)	0.38±0.15(86)	0.41±0.10(93)	0.32±0.05**(73)	0.28±0.05**(64)	0.25±0.04**(57)
Alfalfa	2.20±0.21(100)	1.62±0.15**(74)	2.11±0.31(96)	2.01±0.24(91)	2.14±0.16(97)	1.53±0.22**(70)
Ryegrass	3.46±0.42(100)	3.10±0.47(90)	3.33±0.61(96)	2.74±0.44*(79)	3.38±0.46(98)	2.83±0.52*(82)
White Clover	1.20±0.25(100)	1.23±0.16(103)	1.34±0.26(111)	1.42±0.15*(118)	0.88±0.45*(73)	0.98±0.55(82)

Each value shows the growth of the shoots of the acceptor plant (15 seeds) cultured against the donor plant exudates (15 seeds). Data represent mean  $\pm$  SE of three independents. Values in parentheses indicate the percentage of the control (acceptor plant). \* Significant at the 0.05 probability level. \*\* Significant at the 0.01 probability level.

Table 5. The root length of seedling against exudates from germinated seeds (:cm)

	None	Sudan grass	Escarole	Alfalfa	Ryegrass	White Clover
Sudan grass	5.48±0.80(100)	5.50±0.59(100)	5.68±1.18(104)	4.36±1.04(80)	4.17±0.49*(76)	4.13±0.55*(75)
Escarole	1.22±0.20(100)	0.97±0.19*(79)	1.32±0.21(108)	0.95±0.26*(78)	0.85±0.13*(70)	0.66±0.10**(54)
Alfalfa	2.45±0.46(100)	1.88±0.27*(77)	2.87±0.29*(117)	2.62±0.24(107)	3.12±0.26*(127)	3.28±0.53*(134)
Ryegrass	5.43±0.58(100)	4.87±0.94(90)	4.35±1.02(80)	4.04±0.58*(74)	5.28±0.83(97)	5.06±0.72(93)
White Clover	0.74±0.22(100)	0.59±0.22(80)	0.76±0.26(102)	0.72±0.09(97)	0.56±0.23*(76)	0.78±0.19(105)

Each value shows the growth of the roots of the acceptor plant (15 seeds) cultured against the donor plant exudates (15 seeds). Data represent mean  $\pm$  SE of three independents. Values in parentheses indicate the percentage of the control (acceptor plant). \* Significant at the 0.05 probability level. \*\* Significant at the 0.01 probability level.

Table 6. The germination rate of seedling against exudates from germinated seeds (%)

	None	Sudan grass	Escarole	Alfalfa	Ryegrass	White Clover
Sudan grass	0.5444(100)	0.4444(82)	0.4444(82)	0.42222(78)	0.3778(70)	0.4444(82)
Escarole	0.5444(100)	0.4889(90)	0.5333(98)	0.5778(106)	0.7556(139)	0.3556(65)
Alfalfa	0.7111(100)	0.5333 (75)	0.9111(128)	0.7778(109)	0.8889(125)	0.8222(115)
Ryegrass	0.8889(100)	0.9111(102)	0.9556(107)	0.8667(98)	0.9111(102)	0.9111(102)
White Clover	0.3333(100)	0.3556(107)	0.4000(120)	0.4000(120)	0.2000(60)	0.1333(40)

Each value indicate the rate of seeds germination percentage. Values in parentheses indicate the percentage of the control (acceptor plant).

Table 4, Table 5 and Table 6 are verified the allelopathic effects against seeds of pasture species by exudates from germinated seeds. The shoot and root length of Sudan grass was inhibited by Alfalfa, Ryegrass and White Clover (80, 70, 68, and 80, 76, 75, respectively), but promoted by Escarole (110, 104). Its germination rate was represented inhibition in all. The growth of Escarole was inhibited significantly by others except itself in root (shoot: 73, 64, 57, root: 79, 78, 70, 54, respectively). Germination rate was promoted in Alfalfa and Ryegrass, but inhibited in others. For Alfalfa, shoot was inhibited in all (74, 96, 91, 97, 70, respectively), but root was promoted in all except in Sudan grass (117, 107, 127, 134) and similarly in its germination rate. The shoot growth of Ryegrass was also inhibited by about 79 and 82, root growth was inhibited by about 80 and 74, and germination rate was promoted in little. In contrast, there was difference on growth of White Clover. Its shoot was promoted by about 103,

111 and 118, respectively, but was inhibited by Ryegrass and White Clover (73, 82). Its root was inhibited by about 80 and 76, and germination rate was inhibited by about 60 and 40, and was promoted by about 107, 120 and 120.

#### 3.1 Discussion

These results reveal that interactions among plants of five species of three families used in the present study differ depending on the combination. However, there was no characteristic difference between dicotyledoneae and monocotyledoneae. In addition, no characteristic difference was observed among families, as well as species within the same family.

The second purpose of the present study was to clarify whether these plant–plant interactions are controlled by chemical substance(s) released by the germinated seeds of each plant species, by competition in water absorption between plants or by contact among the shoots or roots. Seeds of each plant were single-cultured, and then various plant seeds were added to the culture medium from which the germinated seeds had been removed, to investigate the effects on growth (Table 4, 5, 6). Comparison of Table (4, 5, 6) with Table (1, 2, 3) clarifies that the activity of the exudates from the seeds used in the experiment had a similar tendency to that obtained from the mixed planted seeds of two species. This strongly suggests that plant–plant interactions caused by mixed planting results from species-specific chemical substance(s) released from the germinated seeds of each species. As mentioned previously by Tang & Zhan (1986)<sup>[18]</sup>, the concept of the allelochemical sphere is one of the important factors to exhibit allelopathy.

Under the limited culture condition, seed size may provide some influence against acceptor plants. Among the seeds used here, the largest seed is Sudan grass, followed by Ryegrass and Alfalfa, whereas smaller ones are Escarole and White Clover. However, in the present study, a group of larger seeds does not always affect the growth of smaller ones, and vice versa. In addition, the results on shoot and root growth obtained in both the mix-culture and seed exudates were similar, suggesting that seed size has a poor correlation with activity. The mode of exudation of allelochemicals described here in relation to seed germination is not clear. Therefore, it is of great interest to clarify the source of these chemical substances and the mode of exudation into the environment.

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# THE COMPARISON OF POSTEMERGENCE HERBICIDES SIGMABROAD 3.6%WG, SIGMABROAD OD12G/L AND SIGMA OF 30G/L ON CONTROL EFFICACY OF GRAMINEAE AND THE BROAD-LEAF WEED AND WINTER WHEAT SAFETY

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The test indicated that, SigmaBroad 3.6% WG、SigmaBroad OD12g/l and Sigma OF30g/l are inner extravagant berbicide. The efficacy increases progressively on 10days, 20 day, 45 day after spraying. The fresh weight efficacy is superior to the number efficacy on 45 day after spraying. SigmaBroad 3.6% WG、SigmaBroad OD12g/l and Sigma OF30g/l can kill the weeds excellently such as Common Aeschynomene, Compositae, Cruciferae, chickweed and so on, extremely supuier to Common Polypogon and Kanmainiang, poor to Siebold Buttercup, Laxflower Speedwell and Tend Catchweed Bedstraw.

**Key words:** SigmaBroad 3.6% WG, SigmaBroad OD12g/l, Sigma OF30g/l, weeds of Winter wheat field, berbicide, safety, control efficacy

### THE EFFECT OF H<sub>2</sub>O<sub>2</sub> AND GA<sub>3</sub> ON GERMINATION OF FLIXWEED SEED

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The experiments were conducted in 2007 to determine the effect of H<sub>2</sub>O<sub>2</sub> and GA<sub>3</sub> on the seed germination of flixweed. The seeds collected from Hebei and Shanxi provinces were selected, treatments, (1) soaked in 30% H<sub>2</sub>O<sub>2</sub> (for 40, 50, and 60 min), (2) soaked in GA<sub>3</sub> (0.05%, 0.1% for 24 hrs), and (3) 30% H<sub>2</sub>O<sub>2</sub> combined with GA<sub>3</sub> (soaked in 30% H<sub>2</sub>O<sub>2</sub> for 40, 50, and 60 min, then soaked in 0.05% GA<sub>3</sub> or 0.1% GA<sub>3</sub> for 24 hrs) were conducted. Seeds were then rinsed with distilled water 5 times at the end of each soaking. Every 50 pretreated seeds were placed in a petri dish (16 cm in diameter) laid with 4 layers of cheese cloth, then 5 ml distilled water was added to each petri dish, the Petri dishes were placed in a growth chamber and incubated under  $20^{\circ}$ C (day) with 12 hr supplemented light and  $15^{\circ}$ C (night). 1, 2, 4, 6, 8, 10, 12, 14, 16 and 18 days after incubation, the seed germination rates were measured and calculated. Seed soaked in distilled water was taken as control, and all treatments were replicated for four times. It was shown that the H<sub>2</sub>O<sub>2</sub>, GA<sub>3</sub>, and their combination significantly increased the germination rate and germination capacity of flixweed seeds when compared with the control (0.0% and 6.3% for Hebei and Shanxi biotypes). The germination rates reached 53.3% and 43.8% with H<sub>2</sub>O<sub>2</sub> treatment, 87.3% and 85.6% with GA<sub>3</sub> treatment, the germination rate were sharply increased to 40-50% 4 days after incubation with H<sub>2</sub>O<sub>2</sub> and GA<sub>3</sub> combination, while with GA<sub>3</sub> alone the germination rate was only 3-5% 4 days after incubation.

**Key words:** H<sub>2</sub>O<sub>2</sub>, GA<sub>3</sub>, flixweed (*Descurainia sophia* (L.) Webb.), seed germination

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## THE SAFETY OF MESOTRIONE AND NICOSULFURON TO THE DIFFERENT VARIETIES OF MAIZE

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The trials were carried out during 2005-2006 in the field of Beijing to evaluate the safety of mesotrione and nicosulfuron to the summer maize. There were two factors. The treatment with herbicide was the first factor, and the treatments were 300 g a.i./ha mesotrione, 120 g a.i./ha nicosulfuron, and no treatment. The second factor was the different varieties of the maize, and there were 46 varieties which were popular cultivated in Beijing, Hebei, Shandong and Henan province. The herbicides were applied at the 4-5 leaf stage for maize, and spray volume was 450 L/ha. The treatments were repeated 4 times. The visual injury was observed after treatment, and the plant height were measured after treatment 5 days, 10 days, and 15 days. The maize were harvested, and the data were measured, for instance, shoot dry weight, leaf numbers, the dry weight of ears, the length of ears, the seed weight. The visual injuries were different for the herbicide with different mechanisms. The beaching on the leaf was observed after treatment mesotrione 4 days, and the young leaf turned yellow after treatment nicosulfuron 5 days. The plant heights were significant inhibited after treatment 5 days, and they could not refresh after treatment 15 days. With the data analysis of the harvest maize, especially shoot dry weight for the crossing crop, mesotrione was safe to the maize, and nicosulfuron was not. The yields or growths were reduced by 20-50% for some varieties. Some other varieties were killed. The designed dose of the herbicide was two times larger than the highest limit of the registration was. With this high dose, the mesotrione was safe to the maize, and nicosulfuron was not to the sweet maize, even to some common maize. It was very necessary to apply nicosulfuron at accurate dose on appropriate stage of the maize; otherwise, there would be some injury cases.

**Keywords:** mesotrione; nicosulfuron; maize; safety

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## A REVIEW OF STUDY ON NATURAL ANTIOXIDANT AND THE PROSPECT OF DEVELOPMENT $^{\ast}$

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Free radicals are among the main products of lipid peroxidation and have been implicated in playing a role in over 100 diseases such as cancer, atherosclerosis and arthritis. The scavenging capacity on free-radical of anti-oxidants has aroused great interests. The synthetic antioxidants which were harmful to human beings in some ways were used commonly, such as BHT, BHA, PG. But natural antioxidants extracted from plants were harmless.

The research on natural antioxidant were generalized. The methodologies used extensively to estimate the antioxidant activity, such as DPPH, TBAS, FRAP, were mainly provided. In the same conditions estimating one antioxidant with different methodologies as comparisons is essential in choosing the appropriate method. Over recent years many trials had been made to boost the antioxidant levels by individual antioxidants, antioxidant combinations extracted from antioxidant-rich foods, such as fruits, vegetables, and weeds in paddy field. The antioxidants in garlic, *Allium*, tea have been investigated generally but the low-cost weed resources haven't been paid more attentions. So the research and development of low-cost antioxidative resources from weed resources have brilliant prospect.

**Key words:** Natural antioxidant; TBAS; FRAP; DPPH

### ALLELOPATHY OF LILY ROOT EXUDATES ON SOME RECEIVER ORNAMENTAL PLANTS

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The allelopathy effects of supplier plant lily (*Lilium brownii*) root exudates of two varieties Pollyanna and White Fox on four receiver plants lettuce (*Lactuca sativa*), snapdragon (*Antirrhinum majus*), gomphrena (*Gomphrena globosa*) and starriness (*Gypsophila elegans*) were studied by the method using filter paper to collect root exudates. The result showed that the root length and the number of lateral root of lettuce and starriness were significantly inhibited by the root exudates of lily cv. Pollyanna, and the other indexes were not significantly inhibited, which suggested that the two crops were the tolerant letter crops of Pollyanna. Generally, the allelopathy effects of root exudates of White Fox on the four receiver crops were inhibitory, which suggested that they were not suitable as the latter crops of White Fox.

**Key words:** lily; root exudates; allelopathy

#### INVASIVE ALIEN WEEDS IN HAINAN ISLAND OF CHINA

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There are invasive alien weeds of 35 families, 103 genera and 140 species in Hainan Island, South China for the moment after investigation. Thereinto, the families with more species belong to Leguminosae (31 species), Compositae (19 species), Gramineae (17 species), Amaranthaceae (11 species), Euphorbiaceae (10 species) and Solanaceae (7 species); 61.2% of them are native to America and the most of them are native to Tropical America.

The 10 worst invasive alien weeds in Hainan Island are Eupatorium odoratum, Eupatorium catarium, Alternanthera philoxeroides, Eichhornia crassipes, Echinochloa crusgalli, Eleusine indica, Panicum repens, Sorghum halepense, Rhynchelytrum repens and Cyperus rotundus. The main invasive alien weeds in Hainan Island are Parthenium hysterophorus, Ageratum conyzoides, Conyza canadensis, Synedrella nodiflora, Bidens pilosa, Crassocephalum crepidioides, Wedelia trilobata, Tithonia diversifolia, Borreria latifolia, Mimosa invisa var. invisa, Amaranthus spinosus, Amaranthus viridis, Celosia argentea, Gomphrena celosioides, Chenopodium ambrosioides, Euphorbia hirta, Stachytarpheta jamaicensis, Lantana camara, Cassia tora, Cassia occidentalis, etc. Quarantine and surveillance must be attached importance to those worst invasive alien weeds, such as Eupatorium adenophorum, Solidago canadensis, Ambrosia artemisiifolia, Galium aparine, Spartina alterniflora, Lolium temulentum and Scirpus planiculmis, etc., which have not invaded into Hainan Island. However, these weeds have caused great harm and economic losses in China and the world.

Keywords Invasive alien weed, Species and origin, distribution and harm, Hainan Island

## BIOASSAY OF A STRAIN KM0612 FOR THE CONTROL OF *ECHINOCHLOA CRUS-GALLI* (L.) BEAUV.

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Echinochloa crus-galli (L.) Beauv was one of the most troublesome weeds in the world, which has coursed the resistance to some chemical herbicides. However, biological control had more advantage in avoiding the negative influence of chemicals. A new fungal pathogen KM0612 was isolated from diseased barnyardgrass collected in Kunming, China. The potential of the fungus as a mycoherbicide for barnyardgrass control was further investigated. Root growth inhibition bioassay showed that the culture filtrate with five days old had a very good inhibition activity to the root and bud growth of barnyardgrass. Culture filtrate had higher activity than 10×dilution, and root growth inhibition was much more susceptible than bud. Inoculum concentration above 15% (mycelial wet weight) were all equally effective in controlling barnyardgrass. Under laboratory condition, detached leaf bioassay suggested that the initial symptoms of the disease, brownish irregular spots with chlorotic halo around them, started developing after second day post treatment. There was marked damage around the fourth day. More than 90% disease incidence of the detached leaves occurred on the fifth day. Under greenhouse conditions, whole plant bioassay suggested that disease symptoms were apparent at the third day. The fall of leaves and wilting of shoots occurred at seventh day. What's more, a good efficacy in baryardgrass has been also proved in fields. Thus, the present study illuminates that the fungus pathogen KM0612 existed the potential for developing a sort of mycoherbicide of Echinochloa crus-galli (L.) Beauv.

**Key words:** a fungal pathogen; KM0612; *Echinochloa crus-galli* (L.) Beauv.; biological control.

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## ALLELOPATHIC POTENTIAL OF BARNYARD GRASS ON RICE AND SOIL MICROBES IN PADDY

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Allelopathic potentials of barnyard grass (*Echinochloa crus-galli*) on rice (*Oryza sativa*) and soil microbes in paddy were investigated. As a result, rice growth was inhibited in the barnyard grass infested soil in which the growth of non-allelopathic rice variety Liaojing-9 was considerably reduced compared to that of allelopathic rice variety PI312777. Further experiments showed the germination and growth of rice were suppressed by barnyard grass germination exudates and their one component *p*-hydroxymandelic acid. The inhibitory effect varied significantly with concentrations, which the highest inhibition occurred at the concentrations 2000 seeds/dish (barnyard grass germination exudates) and 500 µg/g soil (*p*-hydroxymandelic acid). Similarly, soil microbial populations in paddy were varied with concentrations of barnyard grass germination exudates and *p*-hydroxymandelic acid. Actinomycetes and fungi appeared to be less sensitive than bacteria to the exogenous application of barnyard grass germination exudates, but fungi were more sensitive to *p*-hydroxymandelic acid. The results suggested that allelopathic interference could occur in barnyard grass against rice growth and soil microbial population in paddy ecosystem.

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## BIOASSAY METHODS COMPARISON ON EVALUATION ALLELOPATHIC POTENTIAL OF RICE (ORYZA) GERMPLASM

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Rice production has been becoming highly depending on herbicides. Allelopathy in rice may be one of the potential biological ways to weed management. Screening or evaluating the allelopathic potential rice variety is the first step.

In this study, three bioassay methods such as relay seeding in filter paper (RSF, Navarez and Olofsdotter 1996), relay seeding in agar (RSA, Wu et al. 2001) and rice root exudates (RE), and HPLC (high pressure liquid chromathography) hierarchical cluster analysis (Mattice et al. 2001) were employed to compare their allelopathic potentials of nine rice cultivars. The results indicated that three bioassay methods had a same tendency in evaluating the allelopathic potential of rice; there existed a significant difference among different bioassay methods, and an interaction between bioassay methods and rice lines. Among three bioassay methods, RE method showed the best result with the highest value and a correlation efficiency of 0.98, compared to RSF and RSA methods, since this method uses 0.3% agar medium, it keeps adequate moisture condition and couples with eliminating competition for nutrients and microbial breakdown of compounds, also supports development of good root system. So that RE was considered as ideal bioassay method for evaluation of allelopathic potential in laboratory.

Alleopathic potential determined in bioassay methods was further confirmed by HPLC hierarchical cluster analysis to classify nine rice lines into three groups. Lemont known as non-allelopathic line belonged to entirely different group compared with other 8 rice lines. Thus, HPLC hierarchical cluster analysis can be used as a supplementary method to further confirm the results obtained from other bioassay methods.

**Key words:** Rice allelopathy, bioassay methods, comparison

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# AUTOTOXIC COMPOUNDS FROM FIBROUS ROOTS OF PANAX QUINQUEFOLIUM L. EXTRACTS: ISOLATION, IDENTIFICATION AND BIOLOGICAL ACTIVITY

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The phenomenon of autotoxicity of *Panax quinquefolium* (American ginseng) has been reported by many investigators, but the autotoxic compounds was not known. In this paper, 9 phenolics and 5 aliphatic acids that could inhibit the radicle growth of American ginseng were reported for the first time, which were the potential autotoxic compounds to American ginseng. In the active part (the ether fraction of aqueous extracts) of fibrous roots of American ginseng, which could inhibit the radicle growth of American ginseng seedling, five compounds were isolated by column chromatography and determined to be 2 phenolics (vanillic acid, (P)-coumaric acid) and 3 aliphatic acids (azelaic acid, palmitic acid and (9Z,12Z)-linoleic acid) by NMR spectroscopy and mass spectrometry, 44 compounds including 9 phenolics ((P)-hydroxybenzoic acid, (P)-coumaric acid, ferulic acid, vanillin, trans-cinnamic acid, vanillic acid, salicylic acid, benzoic acid and syringic acid) and 5 aliphatic acids ( azelaic acid, palmitic acid, (9Z,12Z)-linoleic acid, oleic acid and stearic acid) were identified by GC/MS technique, and these 9 phenolics were also identified by HPLC through comparing UV spectra and retention times with authentic standards. The contents of these 9 phenolics were determined by HPLC in the plow layer soil of four-year-old American ginseng. Studies on bioassay indicated that these 9 phenolics and 5 aliphatic acids could inhibit the radicle growth of American ginseng seedling. These results suggested that these 14 compounds were involved in autotoxicity of American ginseng.

**Key Words** *Panax quinquefolium* L., autotoxicity, phenolic acid, aliphatic acid, soil, bioassay, replant problem.

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### PRELIMINARY STUDY ON HERBICIDAL ACTIVITY OF FRUIT JUICE OF SOLANUM NIGRUM L.

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The herbicidal activity of fruit juice of *Solanum nigrum* L. was determinde by the seeds germination of *Solanum nigrum* L. and *Amaranthus retroflexus* L.. The test showed that the herbicidal activity materials content are very high in fruit juice of *Solanum nigrum* L., the materials kept herbicidal activity after heated 0.5h under 150°C, and the effect on *Solanum nigrum* L. was better than on *Amaranthus retroflexus* L.. The result of 14<sup>th</sup> day indicated that the fruit juice content of 1% only delayed the seed germination and didn't influence on the final germination rate of *Solanum nigrum* L., the seed germination rate of *Solanum nigrum* L. was 21.5% when the fruit juice content was 5%, and the fruit juice content of 10% entirely inhibited the seed germination of *Solanum nigrum* L. The fruit juice content under 5% didn't influence on seeds germination of *Amaranthus retroflexus* L., the seed germination rates of *Amaranthus retroflexus* L. were 60.00%, 43.75% and 22.50% respectively when the fruit juice content was 10%, 15% and 20%.

Key word: the fruit juice of Solanum nigrum L herbicidal activity bioassay

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# COMPARATIVE STUDIES ABOUT INHIBITORY EFFECTS OF ALLELOCHEMICALS OF ARUNDO DONAX LINN EXTRACTED BY DIFFERENT SOLVENTS ON MICROCYSTIS AERUGINOSA

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The inhibitory effects of allelochemicals of Arundo donax Linn. extracted by the solvents with different polarities including methanol, ethyl acetate and hexane on the growth of Microcystis aeruginosa were studied comparatively. The results show the allelochemicals extracted with all the three solvents had inhibition on M. aeruginosa. The occurrence of inhibition of the allelochemicals are decreased as extract with methanol< extract with ethyl acetate < extract with hexane. But as treatment time extended, the algal regrowth occurred significantly in the low-dose allelochemicals extracted with methanol, and its inhibition effect at high dose was lower than with ethyl acetate and hexane. After 2d and 4d of incubation, inhibition ratio of the allelochemicals extracted with ethyl acetate and hexane reached almost 100%, respectively. The 50% effective concentration of the extract with methanol, ethyl acetate and hexane was 0.17g•L<sup>-1</sup>, 0.05g•L<sup>-1</sup> and 0.08g•L<sup>-1</sup>, respectively. Besides allelochemical effects on the algal biomass, their effects on the cell morphology and volume were studies. The results show that the allelochemicals extracted with methanol caused cell in cavity, the ones with ethyl acetate caused cell in cavity, to break up into pieces, and conglomerated in part, and the ones with hexane caused cell in goffer initially and then conglomerated later. The cell volume of M. aeruginosa treated with the allelochemicals extracted with hexane, ethyl acetate and methanol were all reduced versus the controls', and the effect of the ones extracted with ethyl acetate was strongest.

**Key words:** Allelochemical; *Arundo donax* Linn.; *Microcystis aeruginosa*; Extraction

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## ASSESSMENT OF ALLELOPATHIC EFFECT OF INVASIVE EXOTIC GRASS SORGHUM HALEPENSE (L.) PERS.

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The allelopathic effect of invasive grass, *Sorghum halepense* (Johnsongrass), to four crops, wheat, maize, lettuce and cotton was investigated by seed germination and seedling growth. Laboratory study revealed that Johnsongrass inhibited seed germination and seedling growth of the crops. The allelopathy of *S. halepense* increased with the concentrations but decreased with the time. The allelopathic effect on germination of lettuce was decreased from 81.3% to 18.9% between 3rd and 20th day. This experiment demonstrated that *S. halepense* depressed the seedling growth of the four crops between 3rd and 10th day, but the inhibition effect disappeared on 20th day. The results implied that the allelopathy of *S. halepense* plaid an important role in its replacement of native plants.

**Key words** *Sorghum halepense*, allelopathy, Invasive alien species

#### STUDIES ON THE ALLELOPATHIC EFFECTS OF PIPER **NIGRUM**

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The fresh leaf crude extracts and the soil of the root system of pepper were used to determine the allelopathetic effect on the germination and growth of Raphanus satvus. Aster tataricusly Tylosanthes guianensis Digitaria sanguinalis Bidens pilosa. The result showed that the extracted things form the fresh leaf crude extracts of pepper produced a certain Allelopathy on the germination and growth. In general, the higher consistency the inhibitory to the same seeds germination and growth more stronger; But Stylosanthes guianensis and Bidens pilosa has obvious promoter effect on the germination again lower consistency. The inhibitory to the different seeds again different consistency is not equality. Result from the soil of the root system of pepper showed that it has obvious promoter effect on the germination and growth of Raphanus satvus and Bidens pilosa.

**Key words:** pepper; allelopathy; donator plant; receptor plant

Authour to correspond

# DEVELOPMENT DIRECTION OF THE DAI NATIONALITY'S RICE PRODUCTION VIEWED FROM THE WEED CONTROL TECHNIQUES IN PADDY FIELDS OF XISHUANGBANNA

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The author studies the species of major weed, occurrence characteristics and changes in control techniques from hand weeding to chemical control by herbicides oxyfluorfen, bensulfuron-methyl+metsulfuron-methyl, bensulfuron-methyl, butachlor and ethachlor in transplanted paddy fields in Xishuangbanna, Yunnan Province. The results show that standard cultivation of non-polluted rice is very important to help Dai nationality to develop modern rice production technology and necessary to promote agricultural quality and benefit in this area.

**Key words** Xishuangbanna, rice production, weed control

### STUDY ON WEED COMMUNITY OF CORN FIELD IN LIAONING PROVINCE

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Weed damage is the major factor that affecting the growth and yield of corn in Liaoning Province. There is immediate significance to make clear the present situation of weed damage and community composition for preventing weeds in corn field. So the first particularly and concretely study during the last 20 years of the different regions in Liaoning Province was carried out. It was according to the method of fixed-point arithmetic and five rating damage level of weed by visualization and SPSS and EXCEL data stat system, to make sure the main weed community of different regions. The result showed that there are 35 weed species belonged to 19 families. The main harmful weeds in corn field are Chenopodium album L., Commelina Echinochloa crusgalli L. Beauv., Abutilon theophrasti Medic., Amaranthus retroflexus L., Polygonum orientale L., Digitaria sanguinalis L. Scep., Acalypha australis L., Portulaca pleracea L. The relative abundances of these weeds are 38.75%, 34.07%, 29.72%, 29.38% \ 21.86% \ 20.98% \ 19.38% \ 17.05% \ 11.46%. On the basis of investigation data, the level of dominant weeds is analyzed. The dominant weeds categories in each corn growing region are affirmed. In Fushun region, there are 6 dominant weed species, in Liaoyang, Anshan and Xiongyue region, there are 6 dominant weed species, in Jinzhou and Yixian region, are 7 dominant weed species, in Tieling region, there are 9 dominant weed species, in Shenyang region, there are 8 dominant weed species. All these dominant weeds with corn compose the corn-weed community in different corn growing regions. As far as the damage level is concerned, the harm of weed in corn field has been controlled ultimately and the growth of corn hasn't been affected seriously. Although the harmful weed has been controlled on A<sub>1</sub>-A<sub>2</sub> level, even in some field there are nearly no weed, it is rampant in the local region. For example, in Jinzhou, Tieling, Fushun region, the harm of Commelina communis L. is more serious; but in Liaoyang and Shenyang region, Chenopodium album is more harmful. In each region, the quantity of weed community in Jinzhou, Fushun, Tieling, Liaoyang is from high to low in order. At present, Commelina communis L. in monocotyledon weed is the most harmful weed, and Chenopodium album in broadleaf weed is more harmful relatively. Especially, broadleaf weeds have more categories, in particular, the asteraceae weed which occupies 25.71% in broadleaf weed. Although at present the broadleaf weed isn't the dominant or subdominant community, it is difficult to control if it expands vicious weed. So adequate attention should be paid. As far as the damage period of weed is concerned, the damage grade of weed expands due to the field management in later phase of corn growth is neglectful which make the relative height and density of weed enhance. According to the investigation of weed community in corn field in Liaoning Province, a comprehensive system of weed control that taking different measures based on different weed community was suggested.

Keyword: corn; weed; community; control

#### PRIMARY INVESTIGATION RESEARCH ON RELATIONSHIP BETWEEN PLANT DIVERSITY AND GROUND BEETLES (CARABIDAE) AMOUNTS IN PEACH ORCHARD

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Investigation has conducted on relationship between plant diversity and ground beetles in peach orchards with two different weed managements in 2004-2005 in Beijing region. Weed management ways include maintaining vegetation with 3 mowing in the season of weed growth rapid, or weeding by hand as a control in peach orchard. Weed species and vegetation cover have been investigated, and ground beetles numbers were surveyed by pit-fall traps semimonthly in two different weed managements. The results indicated that (1) there are 65 species plants, belonging to 27 families, 50 genera, and 80%-100% vegetation cover on ground in maintaining vegetation orchard,; or 44 species plants, belonging to 19 families, 35 genera, and 20%-30% vegetation cover on ground in weeding orchard; (2) there are 132 ground beetles each 5 samples in maintaining vegetation orchard, or 19 ground beetles each 5 samples in weeding orchard. It is 5.95 times in the former more than in the later; (3) there are some relationships between plant diversity and ground beetles amounts.

**Key word**: Plant diversity, Ground beetles (*Carabidae*), Peach orchard

# STUDY ON INDUCTION AND INHIBITION OF *OROBANCHE*MINOR. GERMINATION BY EXTRACTS OF TRADITIONAL CHINESE MEDICINAL HERBS

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Orobanche minor parasitize many kinds of crops and cause serious damage to host, but it's difficult to control. So it's important on how to utilize the germination characters of small broomrape to reduce its soil bank, especially to induct or inhibit germination using nonhost root secretion. We screened the extracts of 240 traditional Chinese medicinal herbs to test their ability to induce or inhibit the germination of Orobanche minor seeds. The results indicate that herb water extracts that induced Orobanche minor germination rate greater than 70% were Juncus effuses L.var.decipiens Buchen, Quisqualis indica L., and Nelumbo nucifera Gaertn. Herb methanolic extracts that induced Orobanche minor germination rate greater than 70% were Stemona japonica (BL.) Miq., Morus alba L., Oryza sativa L., and Dioscorea hypoglauca Palib. Herb water extracts that inhibit rate greater than 50% were Chrysanthemum morifolium Ramat., Trachycarpus wagnerianus Becc., Prunus armeniaca L., and Phellodendron amurense Rupr., Herb methanolic extracts that inhibit rate greater than 70% were Dipsacus asper Wall., Rehmannia glutinosa (Gaertn.), Myristica fragrans Houtt., Kochia scoparia (L.) Schrad., Coptis chinensis Franch., Equisetum hiemale L., and Picrorrhiza hurrooa Royle ex Benth. The result from this study indicate that some traditional medicinal herbs and may have the potential to be used as trap-crops to reduce the *Orobanche minor* soil bank, and its metabolites may be used as bioheribicides.

Key words: Traditional Chinese Medicinal Herbs, Orobanche minor, induct, inhibit

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# ALLELOPATHY AND MANAGEMENT OF THREE INVASIVE WEEDS (AMBROSIA TRIFIDA, LANTANA CAMARA AND AGERATUM CONYZOIDES) IN CHINA

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Ambrosia trifida, Lantana camara and Ageratum conyzoides are American in origin and invade natural and managed ecosystems to reduce biodiversity and crop productivity in China. Both A conyzoides and L. camara occur mainly in South China, but A. trifida in North China. Three plants species become economically destructive weeds and could produce and release allelochemicals to interfere with other species in agricultural ecosystems. Clarification of chemical interactions between three invasive weeds and other organisms can potentially be used to improve their management. A. trifida residues could release  $1\alpha$ -angeloyloxycarotol and  $1\alpha$ -(2methylbutyloyloxy)-carotol into the soil to act as allelochemicals inhibiting the growth of wheat and thus clean A. trifida residues in cultivated field to overcome allelopathic effect on crops. Lantadene A and lantadene B released from L. camara leaves reduced the biomass of the aquatic weed Eichhornia crassipes and thus L. camara allelopathy could be utilized against E. crassipes. Major weeds and soil pathogenic fungi in citrus orchards were significantly inhibited by flavones and ageratochromene released into the soil by intercropped A. conyzoides. Besides, intercropping A. conyzoides in citrus orchards could make the orchard ecosystem more favorable for the predatory mite Amblyseius newsami that is an effective natural enemy of Panonychus citri, which the volatile allelochemicals released from A. conyzoides regulated the population of A. newsami to keep the population of P. citri at non-injurious levels. These studies would be helpful to further understanding of plant invasive species and develop new strategy to improve management of the worst weeds.

## ACTIVITY AND ALLELOPATHY OF SOIL OF FLAVONE O-GLYCOSIDES FROM RICE

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Two flavone O-glycosides were isolated from allelopathic rice seedlings and have been identified as 5,4'-dihydroxy-3',5'-dimethoxy-7-O-β-glucopyranosylflavone and 7,4'-dihydroxy-3',5'-dimethoxy-5-O- $\beta$ -glucopyranosylflavone. Considerable levels of these glycosides could be found in allelopathic rice tissues. They could not be detected in the soils growing allelopathic rice seedlings. Only their aglycone 5,7,4'-trihydroxy-3',5'-dimethoxyflavone could be found in the soil. Further experiments showed that two flavone O-glycosides were exuded from allelopathic rice roots to the rihzosphere and then transformed into their aglycone form, i.e. 5,7,4'-trihydroxy- 3',5'-dimethoxyflavone with a great diversity of biological activities on associated weeds and microbes by soil interactions once released. The glycosides degraded rapidly  $(t_{1/2}<2 \text{ h})$ , while their aglycone was more resistant toward degradation in paddy soils, in which the half life  $(t_{1/2})$  at low  $(25 \mu g/g)$  and high  $(200 \mu g/g)$  doses reached  $19.86\pm3.64$   $(r^2=0.97)$ and  $28.78\pm3.72$  ( $r^2=0.98$ ) h, respectively. Furthermore, mobility of both glycosides and their aglycone in paddy soil was evaluated by soil TLC with bioassay. Mobility of the glycosides  $(Rf=0.418\pm0.069, n=18)$  is higher than that of aglycone  $(Rf=0.361\pm0.048, n=18)$ . The results suggested that two flavone O-glycosides are form in rice biosynthesis and storage of the allelochemicals and their aglycone 5,7,4'-trihydroxy-3',5'-dimethoxyflavone is the agent of alleloapthic rice which interferes with weeds or microbes in paddy soil. (This paper was released online in Journal of Agricultural and Food Chemistry on June 30, 2007)

# RESEARCH OF HERBICIDES SCREENING, THRESHOLD ON BROMUS JAPONICUS THUNB. AND AEGILOPS TAUSCHII COSS. AND SAFETY TO WINTER WHEAT

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The experiments researched fenoxaprop-ethyl, isoproturon, mesosulfuron and flucarbazone-sodium on the serious weeds, Bromus japonicus Thunb. and Aegilops tauschii Coss. in different leave stage at the green house. The results showed that mesosulfuron and flucarbazone-sodium can control *Bromus* at the dosage 13.5g ai/ha and 31.5g ai/ha respectively at 1.5 leave stage. Mesosulfuron also can control Aegilops tauschii Coss. before three leave stage at 13.5g ai/ha. The weeds showed severe growth inhibition and weed biomass control effect is about 80%. There is significant negative correlation between the control effect and the leave stage of Aegilops tauschii Coss.. So we consider that the weeds should be controlled before three leaves and the advisable control stage is autumn. The experiments also showed that the herbicides used in the experiment are safety to winter wheat at 2.5 leaves.

**Key Words:** winter wheat, herbicide, *Bromus japonicus Thunb.*, *Aegilops tauschii Coss.*, control threshold

# OCCURRENCE AND MANAGEMENT OF MALIGNANT WEEDS IN DIRECTLY SOWING RICE FIELD IN JIANG-HUAI REGION

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As the rapid expansion of directly sowing rice in Jiang-Huai region, malignant weeds such as barnyardgrass [Echinochloa crusgalli (L.) Beauv], chinese sprangletop [Leptochloa chinensis (L.) Nees] and common crabgrass [Digitaria sanguinalis (Linn.) Scop.] occur widely in directly sowing rice field and do serious harm to rice. Now, chemical herbicide application is an important measure to control the weeds. But there are faster occurrence and larger quantity of weeds, more diversified weed community, and a fewer economical herbicide varieties that have high efficiency to weeds and good safety to rice simultaneously, which could result in greater difficulties in the weed management. Further, whether to control weeds effectively or not would be one of restrictive factors to directly sowing rice development. Therefore, we should develop new herbicide quickly, reform the existing herbicides creatively, meanwhile, and strengthen the research on weed ecology. It is necessary to establish perfect weed administrative strategy based on ecosystem of directly sowing rice field, combining cultivated techniques, agricultural measures, scientific application methods of chemical herbicides and suitable herbicide safety agent to rice.

Key words: Directly sowing rice; Weed; Management

## CURVULARIA SPP. - A POTENTIAL MYCOHERBICIDE FOR BARNYARDGRASS CONTROL IN RICE

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Sixty five strains of fungi were isolated and purified from naturally infected barnyardgrass in different ecological regions of China. Experimental results showed that the strain B6, belonging to *Curvularia*, was most virulent among these strains and had the potential of being developed as a mycoherbicide for barnyardgrass control. In segment experiments, all leaves turned yellow or wilt 7 days after inoculation with strain B6. In pot experiments, mortality rate could reach 80% 14 days after inoculation at the 3-leaf stage of barnyardgrass. Under the conditions of 24-hour dew period, this strain could provide 95% control when applied at  $1.0 \times 10^6$  conidia/ml at the 3-leaf stage of this weed. Host range test was done with 32 representative plant species. It was safe for rice and most crops, but could infect wheat, barley, and corn under the condition of 48-hour dew period.

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### EFFICACY OF 6 HERBICIDES AGAINST *GALIUM APARINA* L. IN WHEAT FIELD

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To evaluate the efficacy of 6 herbicides against *Galium aparina* L., two experiments were conducted in winter and spring based on different temperature conditions in wheat field, respectively. The result showed that bensulfuron and dicamba had higher control effect against *Galium aparina* L. than others, both of them had no remarkable difference on different temperature conditions. The plant effect were 89.8%~91.7% and the weight effect were 90.8%~96.6% of bensulfuron 10% WP at the dosage of 600, 750 g/hm² and dicamba 48% AS at the dosage of 225, 300 g/hm² when sprayed in winter, and 63.4%~81.2% and 93.4%~97.4% sprayed in spring. Bentazone and MCPA also had no remarkable difference on different temperature conditions, but their control effects were lower than others, the weight effect were 55.6%~75.4%. Fluroxypyr and tribenuron had remarkable difference on different temperature conditions, especially Fluroxypyr, they had lower control effect against *Galium aparina* L. when sprayed in winter, while they had higher control effect when sprayed in spring. The weight effect were 47.0%~59.1% of Fluroxypyr 20% EC at the dosage of 750, 900 g/hm² and tribenuron 75% DF at the dosage of 22.5, 27 g/hm² when sprayed in winter, while they were 78.0%~90.3% sprayed in spring.

Key words: herbicides; Galium aparina L.; control effect

# THE SELECTIVE SPECIAL ALLELOPATHIC EFFECTS OF A-NAPHTHYLACETIC ACID ON THE GROWTH OF PHOTOSYNTHETIC BACTERIA

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We studied the effects of  $\alpha$ -naphthylacetic acid, a plant growth regulator, on the growth of photosynthetic bacteria (PSB). Our experimental results showed that  $\alpha$ -naphthylacetic acid OD<sub>660</sub> promoted 9%, 16. 1% and 23. 6% of the growth of PSB with the optimal  $\alpha$ -naphthylacetic acid concentration at 0.1, 0. 5, 1. 0 mg/L afeter inoculation 6 days. At the optimal concentration 1.0 mg/L, the growth rate reached maximum. The growth rates of the three treated samples were0. 367, 0. 406 and 0. 434 , especial at the optimal concentration 1.0 mg/L ,the growth rate was 0. 434 , the growth rate of the control culture was 0. 344. the OD<sub>660</sub> result of promoted the growth of PSB with statistical analysis by SPSS, obviously treated samples were higher than control ,the diference was markedness (P < 0.05),But when the treated samples concentration of  $\alpha$ - naphthylacetic acid was 1.5 mg/L,the experimental results showed that the growth of PSB was smother. The concentration 1.0 mg/L reached maximum allelopathic effects in this test was named the Selective special allelopathic effects .

**Key words**: α-naphthylacetic acid; plant growth hormone; growth promotion; photosynthetic Bacterium (PSB); allelopathic effect.

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## THE WEED OCCURANCE AND CONTROL TECHNIQUE FOR UPLAND RICE-FIELD IN SHANGHAI

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Weed is one of the barrier factors for upland rice extension in large area. The citywide survey of upland rice-field weeds in shanghai in 2005 and 2006 showed that there were 26 species belonging to 12 families and 21 genera, the accurance of weeds showed excessive, long period, drought and wet weed colony's characteristic. Weed control efficiency evaluation experiments were carried out with eight pre-emergence herbicides. The results showed that 33% pendimethalin EC,90% benthiocarb EC, 23.5% oxyfluorfen EC, 36% butachlor + oxadiazon EC all had weed control effect in different degree. Among them, pendimethalin (495g a.i./hm²) combining with pyrazosulfuron-ethyl(15,22.5g a.i./hm²) respectively could get satisfying effects and long effective period, once spraying could control all the tested weeds which in the whole growing period of upland rice. All the above mentioned dosages of herbicides had no adverse effect on plant height, tiller number, panicle length, and grain number per panicle.

Key words: Upland rice; Weed; Chemical control technique; safety

## A REVIEW OF THE PRACTICES ON MINIMUM USE OF HERBICIDES

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The over application of herbicides has been causing a lot of problems such as soil and water pollution, crop damages, resistant weeds and low profit in agriculture products. Consequently, it is becoming increasingly important to protect the environment and increase crop yield and benefits by reducing the application of herbicides.

In this paper, an overview is given of the past and current research toward the practices on minimum use of herbicides (e.g., crop rotations, site-specific herbicide applications, adjuvants, etc.) as well as toward the relationship between cultural weed control, mechanical weed control, biological weed control and chemical weed control.

**Keywords:** herbicide, minimum use

# EFFECTS OF DIFFERENT N FERTILITY CONDITIONS ON WEED SPECIES VARIATION IN TRANSPLANTING ALLELOPATHIC RICE

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The dry weight of the various weed species were respectively determined in transplanting allelopathic rice 777 and non- allelopathic yangdao 6 widely cultivated in Yangzi River at full heading stage under different N fertilizer with field culture. Weed-inhibiting effects of test rice varieties and weed Parameters of weed community structure at full heading stage in paddy were also analyzed between two varieties. The results showed that the allelopathic potential and competition ability with broadleaf and cyperaceae weeds of 777 was stronger at high levels of N fertilizer and Total species richness, total individual No, evenness and community diversity at full heading stage had significant variation at four levels. Its allelopathic potential and competition ability were decreased at low levels of N fertilizer. However the degree of the growth of barnyardgrass in yangdao 6 became greater as the increase of N levels, but its competition ability with broadleaf and cyperaceae weeds were increased. Parameters of weed community structure at full heading stage in paddy were greater in allelopathic rice 777 than that non-allelopathic yangdao 6.

**Key words:** Rice; N Fertility; weed species; allelopathy

## ALLELOCHEMICALS AND MECHANISM OF WEED-SUPPRESSING ACTIVITY FROM ALLELOPATHIC RICE\*

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Allelochemicals can be produced from the roots of allelopathic rice. Phenolic acids were used to being identified as the primary allelochemicals. In this paper Assay-guided fractionation of the EtOH crude extract of *allelopathic Rice PI312777* was isolated and 35 secondary metabolites were identified by means of 1D, 2DNMR,MS,IR,X-ray.The preliminary screening data indicated that hydroxamic acid;

3-isopropyl–5-acetoxycyclohexene2-one–1and5,7,4–trihydroxyl-3'5'-dimethoxyflavone at their released concentration could inhibit the growth of weeds *Echinochoa crus-galli* and *Cyperus difformis* associated rice. These results showed that non-phenolic acids were the principle allelochemicals of rice.

**Keywords:** *Oryza sativa*; allelopathy; non-phenolic allelochemicals; weed-suppressing activity

Fig.1 allelochemicals of allelopathic rice PI312777

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## CHEMICAL CONSTITUENTS AND ALLELOPATHIC EFFECTS OF PISTIA STRATIOTES L.

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The chemical components and allelopathic effects of *Pistia stratiotes* L., an exotic invasive plant in Dian Chi of Kunming, Yunnan were carried out. From *Pistia stratiotes* L. using column chromatography on silica, Sephadex LH-20, Toyopearl HW-40F and RP-18 gel. eleven compounds were isolated and identified by spectral analysis as (24R) - ergosta -7,22 -diene- 3 $\beta$ , 5 $\alpha$ , 6 $\beta$ -triol (1), 7 $\beta$ -hydroxysitosterol (2), sitoindoside I (3), soyacerebroside I (4), luteolin (5), chrysoeriol 4'-O- $\beta$ -D-gluco pyranoiside (6), stigmasta-5,22-diene-3, 7-diol (7), inosine (8), annuionone E (9),  $\beta$ -sitosterol (10), daucoterol (11). Compounds 1-9 were first obtained from this plant.

Allelopathic effects of the *Pistia stratiotes* L. toward the seeds of *Lactuca sativa* and *Brassica campestris* were carried out. The results showed that the ethyl acetate phase had obvious inhibition on the seed germination and the growth of root length and seedling height. The inhibiting rate of *Lactuca sativa* on the seed germination was -14.29%, 52.38%, 100%, 100% at 0.00 01 g·ml<sup>-1</sup>, 0.001 g·ml<sup>-1</sup>, 0.01 g·ml<sup>-1</sup>, 0.02 g·ml<sup>-1</sup>, and the inhibition rates of root length and seedling height were 4.01 %, 60.65 %, 100 %, 100 % and 14.41 %, 51.63 %, 100 %, 100 %; While the *Brassica campestris* were -13.64 %, 18.18 %, 68.18 %, 72.73 %; -0.26 %, 13.95 %, 29.40 %, 61.86 % and -8.68 %, 26.68 %, 30.70 %, 43.01 %.

**Key words** *Pistia stratiotes* L. Chemical constituents Allelopathic effects

### THE REVIEW OF THE PESTICIDE REGISTRATION IN CHINA

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The main laws for pesticide registration of China and some other developed countries were reviewed. Considering the status of China, the suggestions for innovation on pesticide registration were pointed out. The law for registration could not adapt the development, and should be revised. The revised new law should describe the requirements for the pesticide production, registration, export, application, supervision and so on. The disorder and broken the law way should be punished according to the law. Some new guidelines should be established to improve the quality of the reports, for example, the guideline for pesticide resistance, for ecological risk evaluation, long term persistence and damage to succeeding crops, GAP, and so on. The authorized organizations should be supervised and trained and the good reports could be submitted to the government for registration. The data for registration could be accepted in the future. The disposals for pesticide should be callback and treated with some allowance. The old pesticide should be reviewed and revaluated with the new developing technologies. The pesticide registration should be managed in scientific, determined, procedure way, and it could be good to control the pest and facilitate the sustainable development of agriculture.

Keywords: Pesticide, registration, review

## STUDY ON ISOLATION AND IDENTIFICATION, ADAPTABILITY AND BIOREMEDIATION EFFECT OF MICROORGANISMS OF DEGRADING CLOMAZONE IN SOIL

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Three bacteria strains capable of degrading herbicide clomazone in 2 basal liquid meadia were isolated from soil, polluted by the pesticide, using batch culture with clomazone as a sole carbon. The biomass of three degrading clomazone bacteria strains that named as X, Y1, and W2, were studied under different temperature and moisture of soil, different clomazone concentration, different fertilizer and different type soils. The experiment evaluated the effects of Clomazone degrading bacteria named X, Y1 and W2 under different soil moistures, different fertilizers application and different inoculation methods by corn's morphological and physiological indices. The result showed that: W2 was identified as Brevibacterium, Y1 and X were identified as Bacillus sp., based on the morphological appearances and physiological characters. The optimal temperature of W2, Y1 and X was at  $30^{\circ}$ C,  $35^{\circ}$ C, and  $30^{\circ}$ C respectively. The optimal range of pH of W2 was  $6.0^{\sim}$ 9.0, and that of Y1 and X was  $6.0 \sim 8.0$ ; the optimal initial concentration of clomazone of W2 was 200 mg a.i.·L<sup>-1</sup>, and that of Y1 and X was 100 mg a.i.·L<sup>-1</sup>. The optimal growth temperature range of the three strains was  $25\,^\circ\!\!\!\mathrm{C} \sim 35\,^\circ\!\!\!\mathrm{C}$ , three bacteria strains reached the most biomass under 50% soil humidity, the sequence of the adaptation ability of three strains was as W2>Y1>X, the biomass of degrading bacteria can be obviously increased by adding fertilizer, the biomass of the three degrading bacteria were different in four different type soils. The degradation effect of three bacteria under 50% of water field capacity (WFC) in soil was better than under 30% and 70% of WFC. The effects of soil bioremediation were evidently better than that of the bank control within 90 days. Fertilizer could enhance the bioremediation ability of degrading bacteria evidently, and that the degradation effect of applying inorganic fertilizer was better than that of applying organic fertilizer.

**Key words:** clomazone; degrading microorganisms; isolation and identification; adaptability; bioremediation.

## SHIKIMATE ACCUMULATION IN FIELD BINDWEED AND JAPANESE FALSE BINDWEED AFTER GLYPHOSATE APPLICATION

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Field bindweed(Convolvulus arvensis L.) and Japanese false bindweed (Calystegia hederacea wall.) have become the main noxious weeds of wheat, maize, and soybean field in North of China, also enlarged to all glebe area. In a general way, farms seed corn or soybean after wheat harvested for saving cost. And they spay broad-spectrum herbicide such as glyphosate and paraquat to control weeds. If plant do not exhibit extensive glyphosate injury symptoms, injuried can not be judged in time. Glyphosate 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS, EC 2.5.1.19) in the shikimate pathway. Glyphosate inhibits EPSPS resulting in the accumulation of shikimate. Shikimate accumulation has been used to assess the exposure of plants to glyphosate. Glyphosate was applied with a sprayer at 1000ae/ha, 1500 ae/ha to field bindweed and Japanese false bindweed 60 days stage for experiment. Each sample 0.5g was generated from an individual weed separated above part from under soil respectively each day after application(DAA), frozen in liquid nitrogen and were homogenized, added 1.0ml 0.25M HCl, the homogenate was centrifuged at 23,000g for 15 min at  $4^{\circ}$ C and extraction stored at  $4^{\circ}$ C. The standard curve for shikimate ranged from 0 to  $100\mu g/\mu L$ of 0.25M HCl extraction solution. Transferred 200µL extraction to the test tube 2.0ml of 1% periodic acid, tubes were incubated at room temperature (25°C) for 3h. 2.0ml of 1M sodium hydroxide was added to each tube, blended with 1.2ml of 0.1M glycin. The optical density at 380 nm was measured with a microtiter plate spectrophotometer. The standard curve equation y =0.0415+0.0667x. Shikimate accumulated in leaf tissue in two species after 1000ae/ha, 1500 ae/ha glyphosate treatment 24h compared to control weed 8.0~10μg/μL content. Shikimate was increasing in 9 DAA, rapidly reached maximum levels in 7 DAA. Shikimate accumulated in ground part of weed tissue after 1000ae/ha, 1500 ae/ha glyphosate treatment 3 days compared to control weed 5.0µg/µL content. In our experiment, shikimate of Japanese false bindweed leaf tissue began decline and the under ground part of a rapid rise in 8 DAA, by contraries, shikimate of field bindweed leaf tissue began rapid rise and the under ground part declined. Samples of two species which were planted right along mostly would be died, but after a few days base stem lateral buds could come out both applications. In the test, 80% of *Convolvulus arvensis* and 50% Calystegia hederacea can regrow.

Plant treated by low dose glyphosate can pull though, shikimate accumulated would gradual reduced by metabolizing themselves, injury serious and shikimate accumulated enhanced as the dose increased. Our studies suggest that the important mechanism of glyphosate-resistant *Convolvulus arvensis* and *Calystegia hederacea* is shikimate accumulated in different tissues, maybe because of glyphosate different tissue distribution. Glyphosate-resistant weeds in the occurrence and spread is a major potential agricultural threat. We can supervise glyphosate-resistant weeds by level of shikimate accumulated in China.

Keywords: Glyphosate; Convolvulus arvensis L.; Calystegia hederacea wall.; Shikimate

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## EVALUATION ON ECOLOGICAL ADAPTABILITY AND WEED CONTROL OF SEVEN COVER PLANTS IN CHESTNUT (CASTANEA MOLLISSIA) ORCHARD OF BEIJING

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Ecological adaptability of 6 cover crops and their effectiveniss of controlling weeds was evaluated in Chestnut (*Castanea Mollissia*) orchard of Beijing in order to replace herbicide, avoid bare soil, reduce soil erosion by water and increase plant diversity. *Trifolium repens, Dactylis glomerata, Festuca arundinacea, Lolium perenne, Poa pratensis* and *Bromus inermis* established well at soil organic matter (SOM)12.1g/Kg in Huairou County, their coverage is 90%. With artificial weeding about 40 days after sowing in first growing year, upon-ground weed fresh weight was reduced 94.6% ~99.5%. *F. arundinacea, L. perenne* and *D. glomerata* could live through the winter well when there were irrigation in autumn and spring, while they could not do this when the soil dried seriously in autumn and spring in Huairou County. But they did not establish well and did not control weeds almost at SOM 4.6g/Kg in Miyun County, and their maximum coverage is 60%. *Medicago sativa* did not grow well under the shadow of Chestnut trees at two sites.

## RICE VARIETY ADAPTATION AND WEED CONTROL IN NO-TILLAGE AND DIRECT SEEDING RICE $^{\ast}$

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In order to understand rice variety adaptation to no-tillage and direct seeding rice and weed control, experiments was conducted at Haining, Zhejiang Province and Wuhan, Hubei respectively. The results indicat that weed control to no-tillage and direct seeding rice field, the herbicide of 41% roundup in water aqua was used at 7 to 10 days before seeding, the herbicide of 38% bensufuron-methyl in water soluble powder was used as second time treatment at rice two-leaf and one heart to three-leaf stage, and last time treatment the herbicide of 10% cyhalofop butyl in emulsion was used at rice four leaf stage. Excellent weeds control were given after treatment of these herbicides in combination application. The results also indicated that all of the test varieties of rice had good adaptability for no-tillage and direct seeding under the local environment condition. Higher grain yield of rice was obtained.

## ASSESSMENT OF THE ALLELOPATHIC ACTIVITIES OF PLANT TISSUES WITH METHOD OF PPA

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Laboratory studies were conducted to determine the allelopathic activities of leaf powder of 38 plant species with method of grinded powder of plant mixed with agar (PPA) we developed. Growth of radicles and hypocotyls of lettuce as a test plant were inhibited due to the allelopathic effect. The inhibition effect was higher for radicles than for hypocotyls. Among these plants, the inhibition rates of leaves of *Nandina domestica*, *Pittosporum tobira*, *Hypericum chinensis*, *Hedera nepalensis*, *Koelreuteria bipinnata*, *Punica granatum*, *Petunia hybrida*, *Pinus armandii*, *Acer palmatum*, *Prunus persica*, *Albizia julibrissin* and *Hemerocallis fulva* for radicle elongation reached above 90%. These results provide important evidence for further study allelopathy and developing bionic herbicides.

Key words: Method of PPA, Allelopathy, Bioassay, Lettuce, Garden plants

# STUDY OF COMPONENTS IN CUCUMBER ROOT EXUDATES WITH THE DIFFERENT RESISTANCE OF FUSARIUM WILT ON THE INOCULATED BY *FUSARIUM OXYSPORUM*. F. SP. *CUCUMERINUM* OWEN

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Root exudates have an important effect on the resistance to plants, soil microorganisms, soil-borne disease and nutrients. The cucumber (*Cucumis sativus* L.) is an economically important vegetable, and fusarium wilt (*Fusarium oxysporum*. f. sp. *cucumerinum* owen) infection in cucumber production can be severe. Rigorous investigation of root exudates requires the study of the components of the root exudates; therefore, an experiment was designed.

The seedlings of the resistant cucumber cultivars and the susceptible cucumber cultivars were treated with different concentration fungus liquid (0 and  $1\times10^7$  /ml), and then, the root exudates were collected. Amino acids from these root exudates were detected using an Automatic Amino Acid Analyzer, and the other compounds were detected by GC-MS.

The results showed that the kinds of amino acids and the percentage of methionine, glycine and phenylalanine were higher in the root exudates from the inoculated seedlings than that of the un-inoculated seedlings' root exudates. Except the dissolvable amino acids, eighty-five kinds other compounds were detected in the root exudates, the nine of them were existed in all treatments. Under the un-inoculated seedlings' root exudates, the kinds and the concentration of the all compounds in the root exudates of the susceptible cucumber cultivars were higher than that of the resistant cultivars. And the compound kinds and the concentration were higher in the root exudates from the inoculated seedlings than that of the un-inoculated seedlings' root exudates. A further found that the organic acids (acetic acid and Benzoic acid) had an evidence correlation with the resistant of cucumber cultivars, and these organic acids could increase the resistant of cucumbers to *Fusarium oxysporum*. F. sp. *Cucumerinum* owen.

**Key words:** cucumber cultivars; root exudates; amino acid; GC-MS; *Fusarium oxysporum*. F. sp. *Cucumerinum* owen.

# ESTABLISHMENT OF PRECAUTION AND CONTROL PROGRAM FOR INVASIVE ALIEN PLANTS — A CASE STUDY OF CONTROL OF GOLDERNROD (SOLIDAGO CANADENSIS) IN JIANGSU PROVINCE

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A quantitative survey of goldernrod (Solidago canadensis), an invasive alien weed, was made in Jiangsu Province. Morphological characteristics and ecological distribution of 40 populations collected from eastern China were comparatively studied. The character of its reproductive biology was observed through LM and ESM. The distribution pattern of this weed was quantitatively described in this province. Through AFLP and ITS marker techniques, genetic diversity was studied and moreover a kind of cutflower "Hungyinhua" widely grown in China was identified as Solidago canadensis complex. An inhibitor for flower bud differentiation was developed and applied at a large scale so that it completely halted seed set through inhibition of microspore and megaspore development. As a result, speed of the weed spread slowed down. We screened five different combinations of herbicides such as glyphosate, 2,4-D and Sulfometuron-methyl to extend to whole province, established eradication programs and cultured administrators, farmers and extension agents at local plant protection units. A total of 10,000 ha areas of invaded goldernrod were eradicated, out of which the first tenth land was reclaimed. Five natural enemies, found on goldernrod, were evaluated as potential biological control agents. A technique was developed using straw of goldernrod as media to culture more than ten kinds of edible mushrooms. The information system of invasive alien plants on web was built with most species in China, providing information about biology, monitor and prevention of the worst invasive weeds such as goldernrod (http://weed.njau.edu.cn). It has become a hot website that has been visited 0.75 million times so far. The knowledge of alien plants has been propagandized through the internet, TV, newspaper, broadcast and short training courses in order to enhance public consciousness. In conclusion, we have established integrated management system with combination of precaution and emergent eradication including biological control for long-term management, utilization through ecological way for prevention, chemical control for rapid response, building information system and enhancement of public consciousness for prevention.

**Key word:** Invasive alien plant; *Solidago canadensis*; Integrated management; Precaution

### STUDY ON THE ALLELOPATHY OF OXALIS CORYBOSA DC

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Oxalis corybosa DC is a noxious invasive alien species, and it has become widespread in many areas in China, and caused seriously economic losses and ecological threat. This exotic species was mainly reproducted in an asexual reproductive way by its underground bulbs, this plant is a typical vicious weed on the upland with strong adaptability, quick growth, reproductive efficiency, intrusive power and highly resistant to coldness, drought, flood and shade. To investigate the main cause of the successful invasion of the weed, we studied on the allelopathy and allelochemicals of *O. corybosa*. The results showed: (1) The aqueous and methanolic extracts of leaves at 0.1 g·ml<sup>-1</sup>concentration have significant inhibitory effects on wheat, lettuce, rape, purslane, Sophia (especially equeous extracts); the aqueous and methanolic extracts of stems at 0.1 g·ml<sup>-1</sup>concentration have week inhibitory effects; the aqueous extract of soil around of the root shows no effects; (2) The aqueous and methanolic extracts of leaves at 0.1,0.01,0.001 g·ml<sup>-1</sup> concentration have different allelopathy on tested seeds; (3) the content of organic acids in leaves is higher, β-sitosterol, oxalic acid, malic acid, tartaric acid and citric acid in the aqueous extract of leaves are the main allelochemicals.

**Key words:** Oxalis Corybosa DC; Invasive alien species; Allelopathy; Allelochemicals; Organic acids

A PRELIMINARY STUDY ON ALLELOPATHY OF CARICA

PAPAYA L.

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The paper used *Carica papaya* as donors and *Cucumbe,Radish,Sesamum indicum* as acceptors. The paper mensurated the allelopathy of *Carica papaya* through the seed germination and the mensuration of rhizome growth. The result showed that the aqueous extract from *papaya* leave inhibited the germination and growth of seed. In addition, effect of the inhibition enhanced with the increased of the concentration. Under the treatment of extract from papaya seed, it promoted the germination of *Radish* seed, however it inhibited the germination of *Cucumbe* and *Sesamum* indicum seed. It inhibited the growth of the three kinds of acceptors, moreover, the more the concentration, the stronger the inhibition. Preliminary studies have confirmed that *Carica papaya* L. have allelopathy, which would provide specific basis for the rotation, row intercropping,

Key words: Carica papaya L.; Allelopathy; Seed germination; Seedling growth

relay intercropping and weed biocontrol.

## FUTURE TRENDS AND PROSPECTS ON ALLELOPATHY---A NATURAL ALTERNATIVE FOR WEED CONTROL

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According to the definition given by the International Allelophathy Society (IAS), allelophathy "studies any process involving secondary metabolites produced by plants, algae, bacteria and fungi that influence the growth and development of agricultural and biological systems". This definition depicts the allelopathic phenomenon as a general defence mechanism present in plants that fulfils the economy, safety, and efficiency of weed control. The first classification split them into 14 classes according to their biosynthetic origin and included most of the more commonly cited allelochemicals are phenolic compounds, quinines, and terpenoids. Base on extraction and mode-of-action of simple phenolic acids, flavonoids, mono- and sesquiterpenes and diterpenes, among others, the authors envision allelopathy's primary future trends in some specific topics and subjects: the identification and knowledge of the molecules responsible for allelopathy is the keystone and the chemistry should be closely connected with the appropriate ecological field studies and bioassays, supporting the allelopathic role of the compounds; it is extremely important to know the reactions involved in the allelochemical action and the architecture of the putative binding sites in protein, enzymes and DNA; much work remains to be done in developing appropriate procedures in proteomics and metabonomics, and three of them are thought to constitute a field where much effort should be spent in the next decades; however, the key point will be the development of real applications of allelopathy in agriculture and forest management, and obtaining GMO's to enhance allopathic traits in crops.

## STUDY ON GRASS WEED CONTROL EFFICACY OF 108G/L HALOXYFOP-R-METHYL EC IN POTATO FIELD

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Adopting small plot experiment in potato field, the efficacy of grass weed after applied by 108g/L Haloxyfop-R-methyl EC were studied. The result showed that 108g/L Haloxyfop-R-methyl EC was very effective to control grass weed in potato field and it was safe for potato. At the dosage of 56.7g/hm² was proposed spraying in potato and its weed control efficacy was above 90%.

Key words: Haloxyfop-R-methyl; potato; grass weed; weed control efficacy

# INTRODUCTION OF TOTAL DNA FROM GLYPHOSATE TOLERANCE IN BEAN INTO SOYBEAN AND MOLECULAR DETECTION

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This paper reports the results of exogenous DNA of bean tolerant to glyphosate directly introduced into the soybean through formed passage of the pollen tube. The SSR and RAPD molecular verification indicated that it was possible to created soybean resistant to glyphosate. Using the pollen tube passage to introduce foreign DNA into soybean.

**Key word:** glyphosate; Exogenous DNA introduction; SSR; RAPD

#### **INHIBITORY EFFECT OF SEVEN SPECIES LARGE** SEAWEEDS EXTRACTS ON GYMNODINIUM BREVE

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Using antialgal allelopathy of the large seaweeds to inhibit red tide has been an area of much research recently. In order to identify which species of large seaweed has a strong allelopathic inhibitory effect on Gymnodinium breve, 7 species of large seaweeds were studied. Extracts of the large seaweeds were put into the cultures of G. breve which were precultivated to the exponential growth phase, and then the inhibitory effect was measured. The results showed that both Entermorpha Prolifera and Ulva Pertusa had inhibitory effects. The highest inhibition rate of E. Prolifera on G. breve was 98% at concentration of 2.5 g·L<sup>-1</sup>. However, the inhibition rate decreased with the growth of G. breve; the highest inhibition rate of U. Pertusa was 94% at concentration of 2.5 g·L<sup>-1</sup>, its inhibition rate always remained above 80% during the whole experiment period. When extracts of both seaweeds were added into the culture together, the inhibition rate was over 50% before 5<sup>th</sup> d, but decreased quickly from 6<sup>th</sup> d. Compared with 5 other species of large seaweeds, the EC<sub>50</sub> of *U. pertusa* and *E. prolifera* on *G. breve* were the lowest, 1.45 and 2.95 g<sup>-</sup>L<sup>-1</sup> respectively. Both E. prolifera and U. pertusa showed strong inhibitory effect on G. breve. The GC-MS result showed that there were 18 different compounds in the extract of *U. pertusa*, and 1, 2-benzenedicarboxylic acid,bis (2-methylpropyl) ester was 49.94%. The inhibitory effect on *G. breve* of all kind of compounds needed further research.

**Key words:** allelopathy; red tide; large seaweed; *Gymnodinium breve*; GC-MS

Author to correspond

## Allelopathy of Garlic Straw Aqueous Extracts on tomato and Primary Identification of the Allelochemicals

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Through germination test and hydroponic culture of seedling, the allelopathy of garlic straw aqueous extracts on tomato was studied. The results indicated that at the concentration of 0.005 g·ml<sup>-1</sup> garlic extracts showed promotion effects on seed germination rate, germination index and seedling growth of tomato. Starting from the concentration 0.02 g·ml<sup>-1</sup> garlic extracts showed inhibitory effects. The activity of protective enzymes showed the change trend of decreasing increasing -rapid decreasing as the increase of garlic extracts concentration. MDA content, PAL and PPO activities were lowest and the root vigor was highest at the concentration of 0.005 g·ml-1garlic extracts. By means of GC-MS analysis, the major inhibitory ingredients in garlic straw aqueous extracts were preliminarily determined to be the ester like compounds such as dimethyl 2-methoxyhexane-1,6-dioate and dibutyl phthalate, the organic acid like compounds such as 4-hydroxy-3-methoxy benzoic acid and 4-hydroxy- benzoic acid, and the phenol like compounds such as mequinol.

**Key words:** Garlic straw, Tomato, Allelopathy, Allelochemicals

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<sup>\*</sup> Author to correspond

# STUDY ON SPATIAL AND TEMPORAL HETEROGENEITY PROPERTY OF ALLELOPATHIC EXPRESSION IN RHIZOSPHERE SOIL FROM DIFFERENT DRYLAND WINTER WHEAT CULTIVARS ON THE LOESS PLATEAU OF CHINA

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Through pot trials the characteristics of spatial and temporal heterogeneity of allelopathic potential from living roots amended in soil of four common winter wheat accessions on the Loess Plateau of China was conducted in four continuous growth periods based on bioassay of aqueous extracts from top soil (0 - 20 cm) as well as typical statistic theory. There was a significant difference on allelopathic expression in rhizosphere soil from different wheat varieties (p<0.01). With growth and development process, allelopathic variation of rhizosphere soil closely depended on specific wheat cultivars. Interestingly, 15 cm as soil depth will determine allelopathic feature for increasing or declining key loci. Based on normal distribution trait of allelopathic index variation functions of four wheat materials showed that allelopathic expression in rhizosphere soils would be independent, stochastic and heterogeneous. From mathematical modeling it concluded that four wheat materials displayed four various functions like No 1 Bima for line model, No 3 Fengchan for spherical model, No 1 Ningdong for exponential model and No 22 Xiaoyan for Guass model. Especially, allelopathic background and spatial distribution would enhance concerned with No 22 Xiaoyan during development process, which exhibited obvious spatial heterogeneity in surface soil (0-20 cm). Among spatial and temporal heterogeneity in four wheat accessions, allelopathic dynamic of rhizosphere soil in No 1 Ningdong exhibited significant topological trait adhering to scale level. Allelopathic expression indicated that No 1 Ningdong displayed enriched scattering fine roots, with efficient radii for cross radius as 5 cm and longitudinal radius as 14 cm. In the present study it was deduced and hypothesized that the spatial and temporal heterogeneity feature in allelopathic expression from wheat rhizosphere soils possibly related to roots growth conformation, turnover movement and surrounding soil environment. In fact allelopathic explosion would lead to entropy enrichment. The study will provide theory reference for monitoring allelochemicals fate and utilizing allelopathic potential in rhizosphere soil. Meanwhile, it also supported popular viewpoints for shifting and transforming on roots exudates including allelochemicals in view of allelopathic evidence.

**Key words:** *Triticum aestivum* L., allelopathic expression, rhizosphere soil, spatial and temporal herterogeneity, ecological management

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### SEVERAL HERBICIDES ON MAIZE SAFETY AND GROWTH

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The tests were conducted in Experimental Station of Institute of Cereal and Oil Crops, Hebei Academy of Agricultural and Forestry Sciences during 2003 to 2005, which were concerned with five kinds of herbicides on maize safety such as Nicosulfuron, Sulcotrione, carfentrazone-ethyl, thifensulfuron-methyl, Bromoxynil Octanoate. There are two treatments: conventional dose and twice of conventional doses respectively on maize Zhengdan 958 ---the large variety in 6-7 leaf stage. When phytotoxicity became evident, measurement of plant height and fresh weight were carried out, as well as observation of growth and appearance. When harvested, measurement of yield was made with products from the middle two lines of per district, as well as analysis of the quality indicators. Test results showed that different types of herbicides affected the safety of maize to different degrees. Five days after treatment with Nicosulfuron on maize, the leaves near the base turned into yellow, but the growth was not affected basically. One day after treatment with--ethyl medication, the leaves emerged brown contact-spot and some were seriously injured and broke, but new leaves and plant growth was not influenced. Two days after treatment with Bromoxynil Octanoate, maize leaves emerged contact-spot, and some leaves gradually withered and plant growth was inhibited. With treatment of methyl thiophene, maize growth had been seriously inhibited: the plant was short, the leaf packaged together, the new leaves grew difficultly. Moreover, some leaves turned yellow, narrow, short, and even the base of plants sprouted branches. Three days after treatment with Sulcotrione, maize leaves missed Green to varying degrees, and leaves edge started drying up from serious influence so that the growth was affected.

Based on the measurement of products, the results showed that methyl thiophene and Sulcotrione can reduce yield, but Nicosulfuron, - ethyl, Bromoxynil Octanoate have less effect on yield of maize. The results of quality analysis showed that other herbicides can increase starch content of maize except the inter-methyl thiophene. Instead, with the exception of methyl thiophene, other herbicides treatments will reduce the protein content of maize. According to the tests, all of five kinds of herbicides will affect the fat content to a certain degree, among which Bromoxynil Octanoate will improve fat content of maize.

Keywords: herbicides, maize, safety, growth

## ALLANTOIN INVOLVED IN SPECIES INTERACTIONS WITH RICE AND OTHER ORGANISMS IN PADDY SOIL

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Allantoin (5-ureidohydantoin) plays an essential role in the assimilation, metabolism, transport, and storage of nitrogen in numerous higher plants, but its ecological implications are largely unknown. In this study, allantoin was found in tissues of 11 rice (Oryza sativa) varieties tested and its structure was characterized by X-ray diffraction analysis to confirm the fact that allantoin was actually obtained from rice plants. Furthermore, the endogenous allantoin was exuded from rice roots to the rihzosphere soils with a great diversity of biological activities on associated weed and microbe by soil interactions once released. However, allantoin levels in tissues or soils could not be distinguished between the allelopathic and non-allelopathic rice varieties. Field experiments showed that levels of allantoin released from rice varieties were varied with their growth stages and reached the maximal levels at the stem elongation or panicle initiation to booting stages and then decreased dramatically. Allantoin could significantly stimulate the germination and growth of Echinochloa crus-galli and populations of soil bacteria and actinomycetes at selected test concentrations (30-500 µg/g), but had no effect on soil fungi. The half life  $(t_{1/2})$  of allantoin in autoclaved soil  $(20.2\pm2.5 \text{ h}, r^2=0.95)$  was almost 3-fold longer than with non-autoclaved soil (7.3 $\pm$ 1.9 h,  $r^2$ =0.92), indicating that rapid biodegradation or transformation of allantoin occurs in paddy soil. The results suggest that allantoin may play roles not only in the transport and storage of nitrogen in rice tissues, and may participate in species interactions between rice and other organisms in paddy soil. (This paper was released online in Plant and Soil on June 20, 2007)

## THE ROLE OF ALLELOCHEMICALS IN RHIZOSPEHERE INTERACTION WITH RICE AND SOIL MICROBE

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Rice (Oryza sativa) has been widely studied in recent years by many investigators interested in selecting or breeding for enhanced ability to suppress weeds. Consequently, a number of compounds of several chemical classes involved in rice allelopathy have been determined from rice extracts and exudates, and further putative allelochemicals continue to be identified. These allelochemicals of different classes include fatty acids, phenolic acids, flavonoids and terpenoids, especially momilactone Β, 3-isopropyl-5-acetoxycyclohene-2-one-1, 5,7,4 -trihydroxy-3 ,5 -dimethoxyflavone may be considered as the most promising candidate allelochemicals. Our previous work had confirmed that allelopathic rice at their early growth stages released momilactone B, 3-isopropyl-5-acetoxycyclohexene-2-one-1, 5,7,4 ´-trihydroxy-3 ´,5 ´-dimethoxyflavone into soil phytotoxic levels, non-allelopathic rice did not.

For flavone's identified 5. 4 ´-dihydroxy-3 ´ glycoside, as 4 '-dihydroxy-3 ' 5 ' -dimethoxy-7-O- $\beta$ -glucopyranosylflavone 7. and 5 '-dimethoxy-5-O- $\beta$ -glucopyranosylflavone, which are formed in rice biosynthesis and that storage of the allelochemicals and their aglycone is the agent of alleloapthic rice which interferes with weeds or microbes in paddy soil. Through the culture-dependent method, soil bacteria and ammonifying bacteria populations were obviously influenced by the glycosides, but actinomycetes and fungi appeared to be less sensitive than bacteria to the exogenous application of glycosides in either high or low concentrations tested. Furthermore, effect of flavone O-glycosides, rice variety and root exudates on soil microbial community structure had been investigated by the culture-independent method. The results of principal components analysis showed that PLFAs profiles clearly separated the allelopathic and non-allelopathic variety on the basis of variation of the data. Comparison of PLFAs pattern of the soils adding root exudates and flavone O-glycoside showed that differences in PLFAs profiles among sample incubation time were significant. For the profiles of treatment with flavone O-glycoside, the samples of day 3 or day 5 were distinguished from that of the other days. Besides, changes of PLFAs profiles in treatment with root exudates of the allelopathic and flavone O-glycoside exhibited generally similar tendency through canonical correlation analysis. Also, a cluster analysis confirmed similar result between treatment with flavone O-glycoside and root exudates of allelopathic variety.

Allantoin was unexpectedly isolated and identified from allelopathic rice seedling, and then allantoin levels in tissues of 11 rice varieties or soils could not be distinguished by the allelopathic and non-allelopathic varieties. Allantoin could significantly stimulate the germination and growth of *Echinochloa crus-galli* and populations of soil bacteria and actinomycetes, but no effect on soil fungi. The results suggest allantoin act as a potent allelochemical participating in species interactions between rice and soil microorganisms in paddy soil.

# A STUDY ON THE STRUCTURE-EFFECT OF THE ALLELOPATHY MEMBER FROM NERIUM INDICUM TO ON COMELANIA HUPENSIS\*

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Schistosoma japonicum Katsurade is a major threat to the heath of Chinese people and prevent social economies from development. Oncomelania hupensis Gredler is a unique host of S. japonicum, eliminating snails is the most important thing approach to control the spread of S. japonicum. Because chemical drugs causes serious harm to human and environment while killing snails, more effective drugs must be searched for overcoming these defects. To explore and utilize snail-killing resource from plant is becoming an important research field of snail-killing task. In our primary study on snail-killing drugs extracted from plant, we have found firstly that effective component from Nerium indicum Mill. showing significant effect against O. hupensis. To evaluate the snail-killing effect of N. indicum and offer theoretic support to exploit new molluscicide and build artificial plant community to control schistosomiasis, modern biotechnologies were employed to study the snail-killing effect of triterpenoid saponins from N. indicum and the relationship between structure and effect, investigate the allelopathy mechanism.

Triterpenoid saponins were isolated from the leaf, stem coat and root coat of N. indicum using systematic extraction, according to their polarity, its separate proportion is 6.16% in average. The concentration-effect and time-effect were determined by linear regression analysis, and the concentration and time of  $LC_{50}$  and  $LC_{90}$  were calculated. Our research showed that all of triterpenoid saponins had molluscicidal activity to some degree. Especially, saponins which isolated from leaves collecting in summer achieved  $LC_{50}$  and  $LC_{90}$  as low as 10.62mg/L and 81.02 mg/L, which reached the standard of effective molluscicides of WHO $_{\circ}$  Meanwhile, snails have obviously repellent action from it.

Column chromatogram separating and purification methods were used to purify an effective saponins from leaf which collecting in summer; Spectroscopy technique and chemical hydrolyze was employed to identify the chemical structures as monoglycoside oleanolic acid—type saponins. According to the experiment on killing *O. hupensis*, this saponins showing active effect while its sapogenin has inactive absolutely. It can be find the firmly relationship between the monoglycoside and the effective activity.

According to spectrum datas, the main difference is that the  $C_3$  position of this triterpene sapogenins is linked with a sugar chain, while the  $C_3$  position of sapogenins is linked with

<sup>\*</sup> Fondation item: National Natural Science Foundation of China (30471506, 39670654) and Hubei Provincial Key Laboratory of Biotechnology of Traditonal Chinese Medicine, Hubei University, Wuhan, 430062, China.)

hydroxyl group. So as for this triterpene sapogenins, we can deduce that the existence of sugar chain is crucial to the effect of killing *Oncomelania* in saturation.

The sugar chain of triterpene sapogenins accounts for its bioactivity. Furthermore, the sugar chain of triterpene sapogenins has great influence on its absorption and metabolism. This two facts show that the sugar chain must involve in the action of sapogenin and special cell or receptor. But at present, the mechanism of sugar chain on sapogenins's bioactivity lack systematic investigations and instructive conclusions. Maybe it can change the compound's physical properties, or it can affect the identity and binding between sapogenin molecular and receptor. Obviously, clarifying this problem has great significance on understanding the mechanism of sapogenins's metabolism and function in vivo and the mechanism of changing the structure of sugar chain to design new sapogenin medicine with low poison and high effect.

Interrupting the spreading of *O. hupensis* is the key measure in precaution of schistosomiasis. Our experiment validate that triterpene sapogenins in *N. indicum* has strong effect on killing *O. hupensis* in saturation and avoiding schistosomiasis. Base on these two points, it is practical to interrupt *Oncomelania*'s spreading by using of triterpene sapogenin in *N. indicum*. This method is especially significant in control of amphibious *Oncomelania*. Its application prospect can be considered into the following two aspects: Since triterpene sapogenin in *N. indicum* is dissolvable in water, with high content and easy to extract and separate, we can extract and separate triterpene sapogenin from *N. indicum* directly and made it into medicine; Or we can synthesis bionic medicine on the basis of knowing more about its Structure-Activity Relationships.

The breed land of *O. hupensis* has nice humid climate. Yangtze valley and south of the area in our country has relatively longer precipitation in spring and autumn, which is easy to cause ground ponding. Besides, this continental area also has 3-5 months long flood period every year. This area has the higheast density of *O. hupensis* and the biggest risk of schistosomiasis infection. Using forestry ecological engineering method, we can plant *N. indicum* as the main trees to construct artificial forest against *O. hupensis*. Through the ways of fallen leaf, eluviation, rhizosphere secretion and so on, the trees can slowly release plant allelochemicals to peripheral water body and beach in long term. In this way, the *O. hupensis* not only is soaked to death but also is expelled out of production and life region, reducing the chance of human and animal being infected.

At present, the plant ecology research of extinguishing *O. hupensis* is a hotspot in the international research of extinguishing *O. hupensis*. Our present work just focus on this aspect. But only the laboratory work is by far insufficient, we need carry out more investigations in the open air and more researches of increasing and decreasing rule of *O. hupensis* and its mechanisms in artificial phytocenosis against *O. hupensis*. Only from carefully binding these two ways can we truly implement them and benefit the humanity.

**Keywords:** Nerium indicum Mill.; triterpene sapogenin; O. hupensis; structure-effect

## EFFICIENCY OF SOME DIFFERENT HERBCIDES MIXTURE ON CONTROLLING WEEDS IN CORN FIELDS

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Weed survey in maize was conducted using an inverted W pattern with 9 sampling points in corn producing area of northeast. There appeared 50 species, belonging to 20 families, among which Echinochloa crusgalli (1.) Beauv, Ixeris chinensis (Thunb.) Nakai, Ixeris chinensis (Thunb.) Nakai, Abutilon theophrasti Medic, Amaranthus retroflexus L, Sonchus brachyotus D, Cephalanoplos segetum (Bunge.) Kitam are dominated in the field. Control effect of herbicides 42% 2,4-Dbutylate·propisochlor·atrazineSC, 64% showed that 2,4-D EC. 40% sulcotrione·atrazine SC. 25% butylate · prometryne · propisochlo 4-D butylate sulcotrione EC controlled most of the weeds present without injuring corn. 42% 2,4-D butylate propisochlor atrazine SC. Applied preemergence at 6000ml/hm<sup>2</sup> provided 99.1% control of weed numbers. 64% 2,4-D butylate-prometryne -propisochlor EC at 6000ml/hm<sup>2</sup> applied preemergence provided 94.5% control of weed numbers. 40% sulcotrione atrazine SC at 3750ml/hm<sup>2</sup> applied to 4-leaf maize and 1 to 3-leaf weeds provided greater than 93.7% control of weed numbers. 25% 2,4-D butylate sulcotrione EC applied to 4-leaf maize and 1 to 3-leaf weeds provided greater than 90 % control of weed numbers. Compared with routine herbicides in the aspectof performance and price, 42% 2,4-D butylate-propisochlor-atrazine SC.64%2,4-D butylate-prometryne-propisochlor EC sulcotrione-atrazine 40% SC 25% butylate sulcotrione EC controlled most of the weeds present without injuring corn. 42% 2,4-D butylate propisochlor atrazine SC have the practical value. Related with the element of weather, a idea about the combination of herbicides using once and twice were raised.

Key words: maize; weed; herbicide; control effect; compare of performance and price.

# COMPETITION AND INHIBIT RULE OF ALLELOPATHIC RICE HUAKANG 78 TO ECHINOCHLOA CRUSGALLI (L.) BEAUV.

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Compare inhibit rank of various growth index by Different leaf-age allelopathic rice huakang 78 and non- allelopathic rice Lemont to different leaf-age *Echinochloa Crusgalli* (L.) Beauv. The results showed that effect of growth control by huakang 78 to *Echinochloa Crusgalli* (L.) Beauv were evidently better than Lemont to *Echinochloa Crusgalli* (L.) Beauv Competitive capability of huakang 78 were decrease with the leaf-age of *Echinochloa Crusgalli* (L.) Beauv increase, but the decrease were slowly than Lemont. Control effect of 6 leaf-age huakang 78 to *Echinochloa Crusgalli* (L.) Beauv were better than 3 leaf-age. Control effect of huakang 78 to abovegrand parts of *Echinochloa Crusgalli* (L.) Beauv were better than which to roots.

Key words: rice; allelopathy; Competition; inhibit

## DETECTION AND PCR-RFLP ANALYSIS OF 16S RIBOSOMAL DNA OF PHYTOPLASMA ASSOCIATED WITH WITCHES' BROOM OF *PRAXELIS CLEMATIDEA*

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Praxelis (*Praxelis clematidea*) plants showing witches'-broom symptoms typical of phytoplasmas were observed from Danzhou, Hainan in China. Phytoplasmas were detected from symptomatic samples by PCR amplification of their 16SrDNA. An expected 1189bp DNA fragment was amplified from diseased plants but not from known healthy or symptomless plants. The products of nested-PCR were then analyzed by restricted fragment length polymorphism (RFLP) with *Hinf* I, *Kpn* I, *Rsa* I, *Taq* I, *Msp* I and *Hha* I, and by 1.8% agarose gel electrophoresis. The result showed that the diseased samples of praxelis collected from different habitats were infected by the same kind phytoplasma. PCR products were purified and directly sequenced. The sequence showed a high similarity with members of the 16SrII group of phytoplasmas, and had the highest similarity (98.5%) with the phytoplasmas from Peanut witches'-broom and Sweet potato witches' broom, members of the 16SrII-A, as well as Chinese pigeon pea witches' broom. To our knowledge, this is the first report of a phytoplasma from the peanut witches' broom group infecting praxelis.

Key words: Praxelis clematidea; witches' broom; 16S ribosomal DNA; phytoplasma; RFLP

# ALLELOPATHIC INHIBITION OF FIVE MACROALGAL EXTRACTS ON RED TIDE MICROALGAE SKELTONEMA COSTATUM

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Harmful red tide is a severe oceanic disaster, having inducing huge economic loss and adversely impacts to environmental and human health all over the world. Allelopathic inhibition of marine macroalgae on red tide microalgae has been reported, but the exact responsible chemicals are largely unknown. The objective of this work was to identify effective and safe antialgal allelochemicals against red tide microalgae from marine macroalgae, with a practical goal of developing new algaecides to control red tide. The crude seawater extracts of macroalgal dry tissue were added into the culture medium of Skeltonema costatum to evaluate the inhibitory effects of 5 marine macroalgae - Ulva pertusa, Entermorpha clathrata, Porphyra tenera Laminaria japonica and Undaria pinnatifida on Skeltonema costatum by comparing the inhibitory rate (IR%) and the half-effective concentrations at 120 hours (EC<sub>50, 120h</sub>). The EC<sub>(50, 120h</sub>) <sub>120h)</sub> of the seawater extracts were 0.6, 0.9, 1.0, 1.0 and 4.7g/L for Porphyra tenera, Laminaria japonica, Entermorpha clathrata, Ulva pertusa and Undaria pinnatifida, respectively. The results indicated that three macroalgae Ulva pertusa, Entermorpha clathrata, Laminaria japonica possess strong and similar allelopathic activity on S. costatum, The cloudy culture media with the extract of Porphyra tenera may attribute the higher impact of crude extract of which on growth of S. costatum, while Undaria pinnatifida was the weakest. The GC-MS analysis on crude ethanol extracts of E. clathrata detected 21 compounds belonging to 6 chemical groups. There have been some reports found that unsaturated fatty acid are a very important part of allelochemicals isolate from macroalgae. Acrylic acid (C<sub>3</sub>H<sub>4</sub>O<sub>2</sub>) and linolenic acid (C<sub>18</sub>H<sub>30</sub>O<sub>2</sub>), as unsaturated fatty acid are most likely the allelochemicals in Entermorpha clathrata. Ulva pertusa, Entermorpha clathrata, Laminaria japonica were found possess strong and similar allelopathic activity on S. costatum in this study, the latter two have never been reported the allelopathy of macroalgae on microalgae in marine system. Furthermore, the GC-MS indicated the most likely allelochemicals are the two unsaturated fatty acid linolenic acid (C<sub>18</sub>H<sub>30</sub>O<sub>2</sub>) and Acrylic acid (C<sub>3</sub>H<sub>4</sub>O<sub>2</sub>). The important results can provide us more basic data to development the new method that using allelochemicals from macroalgae to control red tides without inducing hazard to marine ecosystem. However the antialgal activities of the two fatty acids still need to prove whether they possess allelopathic activity. The next work we need to chose appropriate method to isolate and purify the chemicals. Then we can directly test their allelopathic activity and develop a new and safe algaecide for practical use.

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## EFFECT OF ENVIRONMENTAL FACTORS ON THE OCCURRENCE OF WEEDS IN CORN FIELDS IN HEBEI

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A survey on the occurrence of corn weeds in Hebei province was conducted from 2004 to 2005 by inverted W-pattern. The species composition and dominancy of weed community were determined. Relationship between weed occurrence and environmental factors were analyzed by partial correlation analysis (PCA) and path analysis (PA). PCA Results showed that soil temperature was the principal factor affecting the occurrence of corn weeds, but the altitude, longitude and latitude, rainfall and sunshine had no significant effects. PA results indicated that soil temperature and latitude affect weed occurrence in an indirect way, while rainfall and sunshine gave a direct impact on the weed occurrence. The interaction between soil temperature and rainfall was higher compared with other interactions among environmental factors.

**Keywords**: corn weeds; occurrence; environmental factor; partial correlation analysis; path analysis

## INHIBITION OF ALLELOPATHIC RICE COMBINED WITH HERBICIDE AND DEEP WATER ON WEEDS IN PADDY FIELD

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Field experiments were conducted to examine the effects of herbicide on the interference of allelopathic rice in weeds under different water depth on soil surface. The results showed that allelopathic rice could inhibit the germination and growth of barnyardgrass [Echinochloa crusgalli(L.) Beauv] effectively, and bensulfuron methyl [30g(a.i)/ha] applied 6 days later after rice transplantation could significantly reduce the plant numbers and biomass accumulation of difformed galingale (Cyperus difformis L.) and procumbent falsepimperne [Lindernia procumbens (Krock.) Philcox]. Combined with allelochemicals, competition between rice and weed, 10cm-depth water and herbicide, 50days after rice transplantation, the control efficiency of HuangKangcao 78 and Yangdao 6 on barnyardgrass dry weightwere 89.1% and 81.8%, respectively, and that on difformed galingale dry weight, 83.6% and 84.9%, respectively, on procumbent falsepimperne dry weight, 95.2% and 82.7%, respectively As a whole, the total efficiency of HuangKangcao 78 and Yangdao 6 on dry weight of the above weeds were 87.7% and 82.7%, respectively. Moreover, under the condition of 10cm-depth water and herbicide application, the yield of HuangKangcao 78 and Yangdao 6 were 5752.5kg/hm<sup>2</sup> and 6234.0 kg/hm<sup>2</sup>, respectively, which increased the yield by 67.0% and 28.2% as compared to those under the treatment of 5cm-depth water and no herbicide. All the above indicated that the integrative control not only resulted in better effect on the weeds and higher yield of rice, but also resulted in less herbicide application. These will provide the scientific foundation of the large-scale use of allelopathic rice, and new ways of weed management in agriculture.

**Key words:** Rice (*Oryza sativ.* L), allelopathy, herbicide, deep water, weed

## THE BIOLOGICAL CHARACTERISTICS, HARM, PREVENTION AND CURE OF LEYMUS SECALINUS

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In order to control Leymus secalinus efficiently in rhubarb fields and decrease consumption of soil water and nutrient, we have invested and analyzed the biological characteristics, harm, prevention and cure of Leymus secalinus. As a result, it was indicated that the Leymus secalinus was 45~120 cm in height, exhibited single or cluster, and expanded their roots transworsely in the layer 30~50 cm of soil. In 50 cm plough layer per m<sup>2</sup> area, the total rootstalk weight of Leymus secalinus was 1129.3 g, the total length of rootstalk was 2793.3 m, and the fresh bud of rootstalk was 589.7, all which caused soil water-absent and fertility-deficient. When the soil water was about 13.4%, seedlings came out normally but their growth was affected greatly. When air temperature was -6~6°C, rootstalks came out from soil, which was up to top stage in the first ten days of April. The average seed number of individual plant was 468.4. When the number of Leymus secalinus was 120-160 per m<sup>2</sup> area, the loss of rhubarb yield was 15.8~17.8%. In the field of Leymus secalinus, manual work or mechanism deep to pick out the downground rootstalks was employed in order to alleviate the next year's harm. In the peduncle of Leymus secalinus, 10% Glyphosate 22.5 kg/hm<sup>2</sup> was adopted, and antiimpact rate was 98% during the 1~3 leaf stage with switching off the spread from peduncle to field effectively. However, the environment of agricultural field was not polluted and the persistent and steady development of Chinese Tibetan Drugs would be favorable.

Key words: Leymus secalinus; biological characteristics; harm and loss; prevention and cure

## STUDIES ON THE OPTIMUM PROPORTION OF MIXING ATRAZINE WITH PROPISOCHLOR

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Mixing atrazine with propisochlor is one of efficacious methods that can reduce phytotoxicity of triazine herbicides on corn field succeeding crops. Use corn field main weeds bamyardgrass and crabgrass as the treatment weeds, the experiment was conducted in greenhouse to research the optimum proportion on the mixture of atrazine and propisochlor. The results showed that with soil treatment combining these two herbicides produced synergic action on controlling gramineous weeds. As the results, when the effect of the mixture causing 90% reduction in fresh weight of bamyardgrass, the mixed ratio was choosed at 1.7-3: 1 using the least dosage of the mixture, on the while, when the effect of the mixture causing 90% reduction in fresh weight of crabgrass, the mixed ratio was choosed at 1-1.8:1, by using the least dosage of the mixture.

**Key words:** Atrazine, Propisochlor, Optimum Proportion

## STUDIES ON THE ALLELOPATHY AMONG SEVERAL TROPICAL PLANTS IN HAINAN

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The cultivated land in Hainan utilizes the state to be researched, the multiple crop index of the crops is relatively low, 189% only. Because much cultivated land have not been adopted rationally complex cultivated and inter space plant or crop rotation and so on. The cropping system is relatively backward. Industrial crops such as pepper, mango, *Phellodendron chinense* Schneid, of the large area, etc. are planted in Hainan at present, far relatively interval, if we can plant some short cycle crops among, so there can be more considerable. Agriculture compounds systematic setting-up needs to analyze various inter action among plants such as industrial crops, crops and herb, etc. correctly, make out reasonable crop rotation system, culture and choose and plant the configuration plan. Among them, take research of Allelopathy to compound agriculture systematic foundation and optimization have important meanings.

The Allelopathy of several tropical plants in Hainan Island was studied in the present paper. Litchi, pepper, mango, *Phellodendron chinense* Schneid, cassava, *Areca catechu*, rubber, guava were used as donors and maize, soya bean, pumpkin, *Echinochioa crusgalli, Digitaria sanguinalis* (L.) *Scop.*, radish and *Styiosanthes guianensis*, as receptor. Effects of leaf extracts of the donors and the soil around the donors' root system on the seed germination and growth of the receptors were bioassayed. From extraction by ethyl acetate and *n*-butanol two solvents, separate it into three parts and carry on the processing to the receptor. The experiment concentrate *n*-butanol part and column layer separate and detect by MODEL U-1800 UV-Vis Spectrophotometer.

The results of experimental indicates that plants leaf withdraw liquids from majority support bodies influence sprouting and growth of receptor certainly. *Phellodendronchinense Schneid* leaf withdraw liquid suppress sprouting and growth of the maize, soya bean and pumpkin and all has stronger inhibitory activity on the *Echlnochloa crusqalli(L.)Beauv* and *Digitaria sanguinalis* (L.) *Scop.* growth among them; Mango and pepper leaf withdraw liquids suppress sprouting of pumpkin and suppress growth of *Echlnochloa crusqalli(L.)Beauv* and *Digitaria sanguinalis* (L.). Cassava leaf withdraw liquid suppress sprout and grow of soya bean and pumpkin. Major support body plant leaf withdraw liquids influence sprouting of the bodies, which show as low seed germination percentage, the growth of radicle and the embryo are suppressed; withdraw liquid influence plant growing situation, blade shape, etc. mainly to influence that seedling growth. The ones that dealt with are worse than to contrast and grow the slow, growing situation, the plant is short and small, turn yellow, there are rotten seedlings, death seedling. Most have high density suppress, low density promote. Litchi leaf withdraw liquid promote sprout and growth of maize and soya bean under low density. Mango leaf withdraw liquid have promoted in sprouting and growing of soya bean and peanut under low density.

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<sup>\*</sup> Authour to correspond

*Areca catechu* leaf withdraw liquid have promoted in sprouting and growing of maize, soya bean and pumpkin under low density.

The experimental results of the soil around support body roots to determine sprouting rate of the seed and growing speed of receptor indicate that the soil around cassava roots suppress sprout peanut, on the contrary, promote the sprouting of the maize and the growth of maize and soya bean. The soil around mango roots suppress sprout and grow of peanut, on the contrary, promote the sprouting and growing of the maize. The soil around *Areca catechu*, rubber and cassava roots promote the sprouting and growing of the maize. The soil around litchi roots promote the sprouting and growing of the maize, soya bean and pumpkin. The soil around guava roots promote the sprouting and growing of the maize, soya bean and peanut.

From extraction by ethyl acetate and n-butanol two solvents, separate it into three parts and carry on the processing to the seed. The experimental results indicate that the parts of strong polarity have better Allelopathy. The results also showed that water parts and n-butanol parts have stronger Allelopathy than ethyl acetate parts of both *Piper nigrum* and *Mangifera indica* withdraw liquid. They both suppress *Raphanus sativus*, *Styiosanthes guianensis* seed germination and growth reach 90%. The water part of *Phellodendronchinense Schneid* leaf withdraw liquid suppress radish and *Styiosanthes guianensis* sprouting and growth. The experiment also thick to withdraw n-butanol part of mango and liquid, concentrate, extract, crystallization and column layer analyses, separate and detect. Using MODEL U-1800 UV-Vis Spectrophotometer to scan the wavelength, the result is in  $\lambda = 262$ nm has stronger absorption. The documents and materials are recorded mango glucoside has stronger absorption in  $\lambda = 262$ nm. So allelopathic of mango leaf withdraw liquid must be mango glucoside.

The results of experiments detected on Allelopathy of eight support bodies indicate that pepper, mango, cassava, litchi so on all have certain potentiality. For lightening the negative influence, soya bean and peanut may not be planted in the rubber plantation. Peanut may not be plant in the in the litchi plantation too. On the contrary, maize and soya bean will be suggested to plant in the litchi garden. maize, soya bean and peanut will be suggested to plant in the guava garden; Peanut will be suggested to plant in the cassava garden. In addition, pepper and mango leaf withdraw liquid suppress the growth of *Echlnochloa crusqalli*(L.)*Beauv* and *Digitaria sanguinalis* (L.). The potential allelopathic of these plants need further research, especially use source materials of these plants to prevent and kill off the farmland weeds in the future.

**Keywords:** Allelopathy extraction tropical plant;

## STUDY ON ALLELOPATHIC POTENTIAL OF ASTRAGALUS ADSURGENS PALL IN DIFFERENTL GROWTH STAGES

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Allelopathic potential of Astragalus adsurgens Pall in nutritional growth stage, blossom and seed stage, mature stage was studied by using radish seeds as receptor. The result showed that A. adsurgens in different growth stage has different allelopathic effect on radish seedling growth. It included: (i).Extract partitioned with ethyl acetate (1:60, g/mL, the same below) from leaves of A. adsurgens in three different growth stages intensively inhibited elongation of radish seedling. The intension of inhibitory effect on elongation of radish radicles and coleoptiles is uniform, that is nutritional growth stage<br/>
slossom and seed stage<mature stage. (ii).Extract isolated with ethyl acetate from stems of A. adsurgens in nutritional growth stage obviously stimulated elongation of radish radicles, however, its stimulatory effect on elongation of radish coleoptiles is weak. Extract from stems of A. adsurgens in blossom and seed stage, mature stage has intensive inhibitory effect on elongation of radish radicles and coleoptiles. (iii).Extract partitioned with ethyl acetate from aerial parts of A. adsurgens in nutritional growth stage stimulated elongation of radish radicles and inhibited elongation of radish coleoptiles, but the both effects are not intensive. Extract from aerial parts of A. adsurgens in blossom and seed stage, mature stage has inhibited elongation of radish radicles and coleoptiles, whereas, the inhibitory effect on elongation of radish coleoptiles is not remarkable. (iv). The effect of extract isolated with ethyl acetate from underground parts of A. adsurgens in nutritional growth stage on elongation of radish radicles and coleoptiles is stimulation, but the stimulatory effect on elongation of radish coleoptiles is not conspicuous. The effect of extract from underground parts of A. adsurgens in blossom and seed stage, mature stage on elongation of radish radicles and coleoptiles is inhibition, but the inhibitory effect in blossom and seed stage is not prominent. ( v ). Extract partitioned with ethyl acetate from whole plants of A. adsurgens in nutritional growth stage stimulated elongation of radish radicles and inhibited elongation of radish coleoptiles, meanwhile, the both effects are not obvious. Extract from whole plants of A. adsurgens in blossom and seed stage, mature stage intensively inhibited elongation of radish radicles and coleoptiles. It suggested that A. adsurgens in mature stage, blossom and seed stage has more intensive allelopathic potential than that in nutritional growth stage. This study can provide some references for application of A. adsurgens in agricultural production.

**Key words:** Allelopathic potential; *Astragalus adsurgens* Pall; Growth stage

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## PRELIMARY STUDY ON ALLELOPATHY OF THE DIFFERENT TISSUES OF *EUCALYPTUS SMITHII*

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Introduction of *Eucalyptus* species has effectively promoted wood industry in China. However, large scale planting of *Eucalyptus* trees has seriously influenced healthy development of regional ecological environment. Hence, conducting researches of allelopathy in Eucalyptus species is significant to regional ecological safety and biodiversity protection. In this study, Eucalyptus smithii was selected as experimental subject. Extract with allelopathic activity was isolated from materials of different tissues (leaves, branches, bark, lither) of E. smithii with distilled water. The effect of different extracts on seedlings growth of two receptor species (lettuce, radish) was measured using seedlings culture experiment in Petri dishes. The results showed: (1) Extracts partitioned from different tissue of E. smithii with distilled water has definite allelopathic effect on growth of lettuce seedlings and radish seedlings. The character and intensity of this impact was related with concentration of the extracts presenting trend of high concentration inhibiting growth and low concentration stimulating growth. (2) Extracts from different tissue of E. smithii showed different allelopathic activity to seedlings growth of receptors, in which, high concentration extract from leaves and lither had the most intensive inhibitory effect on seedlings growth of receptors. This study would accumulate some basic references for chemical ecology researches of E. smithii.

Key words: Eucalyptus smithii; Allelopathy

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## STUDIES AND PROSPECTS OF ALLELOPATHIC GENE OF $RICE^*$

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The heredity rule for controlling the allelopathic effects of rice is quantitative traits. Jensen *et al.* analysed quantitative trait loci (QTL) on controlling allelopathic effects against barnyardgrass by using a population of 142 recombinant inbred lines derived from a cross between cultivar IAC 165 and cultivar CO 39, and four main-effect QTLs were mapped on three chromosomes. Ebana *et al.* assessed the allelopathic effects by the growth inhibition of water-soluble extracts from the rice seedlings on lettuce seedlings and analysed QTL using the  $F_2$  population from the cross between an *Indica* type line PI312777 (most inhibitory) and a *Japonica* cultivar Rexmont (least inhibitory). Seven QTLs associated with the allelopathic effects of rice were identified using RFLP markers on chromosomes 1, 3, 5, 6, 7, 11 and 12 and one of the QTLs on chromosome 6 had the maximum effect on the expression of allelopathic effect of rice and explained 16.1% phenotypic variation.

Zeng *et al.* in China National Rice Research Institute assessed the allelopathic effect by testing the effect of water-soluble extracts from the rice seedlings on the growth of lettuce seedlings. They also analysed QTL using 123 DH populations from the cross between Zhaiyeqing 8 and Jingxi 17. Four QTLs associated with the allelopathic effect of rice were mapped on 3, 9, 10 and 12 chromosomes.

QTL mapping was done by Zhou *et al.* in China National Rice Research Institute using population of 147 recombinant inbred lines from a cross between most allelopathic cultivar Zhong-156 and least allelopathic cultivar Gumei-2. The map contained 168 DNA markers, covering all 12 chromosomes with 1447.9cM spans. The AI (Allelopathic Index) determined by the special secondary metabolite marking method was used to evaluate the allelopathic effects of rice lines. Three main-effect QTLs, mapped on chromosomes 5, 5 and 11, explained 13.6% phenotypic variation. One QTLs on chromosome 11 had the largest effect on the expression of allelopathic rice and explained 10.6% phenotypic variation. A multiple QTL model estimated that three QTLs with LOD scores > 2.0 were 10.02, 11.23 and 16.51, respectively. Five pairs of digenic epistatic loci were also found, which collectively explained 41.5% of the phenotypic variation. Two of those main-effect QTLs participated in digenic epistatic loci. The main QTLs and epistatic loci totally explained 55.1% of the phenotypic variation of allelopathic activity.

**Key Words:** Rice (*Oryza sativa* L.); allelopathy; gene mapping

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# ALLELOPATHIC RESPONSE OF CUCURBITA MOSCHATA M. CULTURED ROOTS TO NUTRIENT ELEMENTS REGULATION \*

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Based on the combination of plant culture technique and allelopathic bioassay, allelopathic response and dynamic modes of Cucurbita moschata M. cultured roots was conducted through regulating kinds and contents of selective mass element and micro-elements in B<sub>5</sub> culture base, under four concentration series (1/2 B<sub>5</sub>, B<sub>5</sub>, 3/2 B<sub>5</sub>, and 2 B<sub>5</sub>) for five necessary elements (P, Mg, Fe, Cu, and B), as well as discussing the effect of pumpkin roots exudates on the growth of two acceptors seedlings (Var. Jingou and Var. Heizi) . Different elements showed various adjustment effects on allelopathic potential of pumpkin cultured roots, which depended significantly on their corresponding contents (P= 0.05). The response of allelopathic roots displayed two typical styles named as "S" and "A" shapes coinciding with tested acceptors, to elements regulation. Pumpkin cultured roots exhibited marked inhibition under deficit (1/2 B<sub>5</sub>) and normal (B<sub>5</sub>) nutrient circumstance. And under nutrient abundance (3/2 B<sub>5</sub> and 2 B<sub>5</sub>), it generally showed significant stimulation, closely combining with elements kinds and related receptors. However Fe and B redundancy would lead to certain inhibition. Especially, under the most redundant environment (2 B<sub>5</sub>), B element would cause strong auto-toxic effects of Var. Jingou. Meanwhile, Fe would induce inhibitory effect of Var. Jingou cultured roots on seedlings growth of Var. Heizi. In addition, the nutrients element would regulate indirectly the effects of pumpkin cultures roots exudates on acceptors seedlings, which related closely to their concentration (p=0.05). With the content increasing of P, Mg, Fe, Cu, and B, all treatments would show uniform formula like first declining of inhibitory effects on two acceptors seedlings, and then gradual increasing of stimulatory effects, among which 3/2 B<sub>5</sub> became the critical point determining allelopathic property. As concerned with Var. Heizi receptor, lower Fe content would show stimulatory effects of radicle length, seedling height and thin roots number. But higher Fe content would display significant inhibition. At the same time, excessive B content would cause obvious auto-toxic effects of Var. Jingou self. Therefore, according to the theory of nutrient elements controlling efficiently stronger allelopathic inhibition and autotoxic effect in pumpkin cultured roots, phytotoxic effects would be reduced and even eliminated by modulating fertilizer kinds and their quantitative utilization. In the present study, it was concluded that P and Mg fertilizer would reduce harmful continuous cropping of pumpkin. However, Fe, Cu, and B should be properly utilized based on counterpart pumpkin accessions.

**Key words:** Cucurbita moschata M. var. Jingou; cultured root; allelopathic effects; nutrient regulation; response mechanism

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# THE RESEARCH OF WEED COMMUNITY DYNAMICS IN SPRING AND SUMMER IN GUANGZHOU

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Weed community in spring and summer was surveyed at Zhongshan University, South China Agricultural University, Yuntai Park and Liu-huahu Park by employing the investigation p procedure with 5 sampling locations in Guangzhou in 2007. The result showed that a total 62species, which belonged to 24 families and 52 genera, were found and the number of weed category increased at first and then reduced from January to June. The largest number of species appeared in April, which was 57. The gravest 10 species were *Kyllinga brevifolia* Rottb. Var. Leiolepis (Franch.et Sav.) Hara, *Hydrocotyle sibthorpoioides* Lam., *Hedyotis corymbosa* (Linn.) Lam., *Lindernia crustaca* (Linn.)F.Muell., *Hydvocotyle sibthorpioides* Lam.Var.Batvachium (Hand.-Mazz.) et shan, *Digitaria sanguinalis* (L.)Scop., *Oxalis corniculata* Linn., *Ophioglossum vulgatum* Linn., *Centella asiatica*(Linn.)Urb., *Desmodium triflorum* (Linn.)DC.. The dominance of *Oxalis corniculata* Linn., *Ophioglossum vulgatum* Linn.gradually reduced .However, *Kyllinga brevifolia* Rottb.Var.Leiolepis (Franch.et Sav.)Hara, *Lindernia crustaca* (Linn.)F.Muell. were reverse. The rest kept relatively stable. At the same time, it was found that management level has great effect on weed community.

**key words:** spring and summer weed Community Dynamics

# OPPORTUNITIES AND CHALLENGES IN WEED SCIENCE IN CHINA

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Currently, approximately 70 million ha of crop fields are receiving herbicide treatments annually throughout the country, herbicide production and market shares have increased rapidly with the development of chemical weed control in China. As estimated, about 8.5 million farmers will move into towns annually in the next 10 years, and 0.3 billion people will be citizenised in the next 20 years with the fast development of rural economy. Minimum and non-tillage agriculture, and the development of modern agriculture will demand new techniques for sustainable weed management. China has put a lot of efforts on developing herbicide tolerant GM crops, soon or later, those crops will be launched. All those developments will certainly require more powerful new tactics to meet accelerated requirements of agriculture, which provided many opportunities for weed scientists in China. At the same time, we are also facing several challenges: (1) In the past 2 decades, farming system have changed, agricultural management has been simplified, and changes in the weed flora has accelerated with some previously unimportant annual and perennial weeds becoming increasing problems to Chinese crop growers. (2) China is one of the countries seriously threatened by alien invasive species. Eupatorium adenophorum, Mikania micrantha, Alternanthera philoxeroides, Ambrosia artemisiifolia, Lolium temulentum, Spartina alterniflora, Eupatorium odoratum, Eichhornia crassipes and Sorghum halepense are the 9 worst species. They grew and spread rapidly, presented more or less in almost 34 provinces, municipalities and autonomous regions in China, and posed great threats to biodiversity, agriculture, and ecosystems. (3) Herbicides with long persistence have been widely used in China. About 17 million ha (32%) of crop fields have received chlorsulfuron, metsulfuron, imazethapyr and atrazine treatments in recent years. As a consequence, herbicide injury on various following crops became very serious. In the north-east, crop rotation has been affected. In the Yangzi river region, rice, oil seed rape, maize, cotton and vegetables are suffering badly. Farmers' income has been reduced by 20-30%. (4) Herbicide resistant weed is not only a problem for developed countries. Herbicide resistance is also becoming serious in recent years, with increased and more intensive herbicide use in China. Sinece paraquat resistant Conyza sumatrensis, occurred in Taiwan Province in 1980s was first reported in China, various weeds, including A. japonicus, B. syzigachne, Echinochloa crus-galli, Monochoria korsakowii, Sagittaria pygmaea, Scirpus planiculmis, Alopecurus myosuroides, B. syzigachne, Galium aparine, Descurainia sophia, Lithospermum arvense, P. annua, Digitaria sanguinalis, Mazus pumilus, Solanum phoreinocarpum, Calystegia hederacea, Conyza canadensis and Eleusine indica have been recorded showing resistance to different herbicides used in the country. Therefore, increasing herbicide and crop diversities, crop rotation, multiple cropping systems, use of herbicide mixtures, and herbicide rotation with different modes of action should be encouraged to reduce the usage of long persistent herbicides, should be important approaches for future weed management and for safeguarding Chinese agriculture.

# WEED RISK ASSESSMENT AND POST-ENTRY WEED RISK MANAGEMENT IN CHINA

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China is one of the largest countries in the world, with variant ecosystems, and environments that maybe well suited as habitation for most invasive alien species, and seriously threatened by alien invasive species. It was estimation that there are over 600 naturalized exotic plant species in China, among them 108 species were exotic weeds, belonging to 23 families and 76 genera, and 90 species determined as invasive plants. Those species grew and spread rapidly, directly lead to decline of plant communities and biodiversity, and serious economic damage.

China has recognized the importance of pest risk analysis, efforts are under way to improve the PRA process and standards, following the relevant standards of the IPPC, China has standardized the procedures for pest risk assessment, and drafted "Guideline for pest risk analysis of import and export plant and plant product". Four risk grades are classified based on potential risk assessment of seven categories with 14 sub-categories. Recommendations for risk management, eradication, containment, and other control measures are provided to relevant governing bodies after consulting with various management sectors. Under the governmental supervisions and related regulations, appropriate actions are employed to ensure that such activities give an assurance of freedom from quarantine and regulated weeds, including alien weed species for importing countries.

# THE SUMMARY OF THE HERBICIDE PRECISE APPLICATION TECHNOLOGY

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The summary of the herbicide precise application technology being conducted from 2003 to 2007 in the field of the soybean, maize and wheat in Hei longjiang province, He bei province, Shan dong province and Beijing city. The bentazone, atrazine, mesotrione, isoproturon, broxynil and some others were applied as tanked mixture with adjuvant to control the young weed according to the GEWIS, GAP and Manuals. The efficacy and injury were evaluated by PPM after treatment 2-3 days, and the second treatment or some measures may be taken. After training, the local technicians learned how to master the equipments, for examples weather station, GEWIS, boom sprayer, lance sprayer, and PPM. It was easy to spray herbicides according to the GAP with the constant values and good span nozzles. The dose could be measured, calculated and calibrated.

The technology was applied in 35 sites, and the local technicians accepted the good ideas. It was good to apply foliar herbicide to control weed according to the situation in the field and climates to replace the soil applied herbicides which was contaminate to the environment. The precise dose could be determined also by the leaf stage of the weed and crop, weed species, herbicides, formulations, adjuvant, expert suggestion system, sprayer and spray man. It was easy to control the weed at very early stage with low dose, and two times at low lethal dose was better than one time at high dose. It was good to apply second time after treatment 2-3 days by PPM measurements. The precise technology was good to the environment.

According to the results during 2003 to 2007, the dose could be decreased about 30% by this technology comparing to the traditional dose. It was good way to avoid the crop injury, decrease the contamination with the precision agriculture.

**Keywords:** Herbicide, precise application, review

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<sup>\*</sup> Author to correspond

# MORPHOLOGICAL AND MOLECULAR CHARACTERISTICS OF A BARNYARDGRASS POTENTIAL BIOCONTROL FUNGUS BIPOLARIS ELEUSINES 99-01\*

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It was studied on bioassay methods of herbicidal activity of 99-01 which had a potential for barnyardgrass. Two weeks after inoculation with the pathogens, all barnyardgrass developed 100% disease incidence, and disease severity ranged from 80% to 100%. When the barnyardgrass was treated with  $4.2 \times 10^7$  spores/m<sup>2</sup>, 99-01 showed stronger herbicidal activity against barnyardgrass. The mortality rate against barnyardgrasses was up to 73.9% which is 4.7 times higher than that of 8×10<sup>5</sup> spores/m<sup>2</sup>. It indicated 99-01 had potential biocontrol barnyardgrass sprayed with top dose spores. Host range testing showed 99-01 was high pathogenicity to barnyardgrass and safe to rice. Upon comparison with all ITS sequences and 5.8S rDNA sequences available in databases, it was found the nucleotide sequence of 99-01 was completely identical to the type species of the genus, the graminicolous plant-pathogenic species Cochliobolus eleusines and Bipolaris eleusines which were respectively teleomorph and anamorph taxonomy nomenclature. Following alignment, maximum parsimony (MP) and distance methods were performed using PAUP\* 4.0 Version 4.0b4a. The result indicated that 99-01 grouped together with Cochliobolus eleusines and Bipolaris eleusines. Because telemorph of 99-01 was not found naturally, it was identified as the same biological species with *Bipolaris* eleusines following ITS sequence analysis. It was basically accordant to the result of morphological identification.

**Key words:** barnyardgrass biocontrol fungus, *Bipolaris eleusines*, molecular identification.

# GENETIC DIVERSITY AND ORIGIN OF WEEDY RICE IN JIANGSU PROVINCE\*

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Recently, weedy rice was occurred seriously in Jiangsu Province, which diminished farmers income extremely. 22 SSR primer pairs were used for analyzing of genetic diversity among 54 weedy rices (31 from Jiangsu Province, 6 from other regions in China, 6 from American, 4 from Bhutan, 1 from Korea, 1 from Australia, 1 from Bangladesh, 1 from Cambodia), 2 wild rice, 4 hybrid rice parents and 5 cultivars. A total 107 fragments were amplified, averaged 4.9 alleles on per SSR with a range from 3 to 8. It was significantly higher genetic diversity on chromosome 1,6,7,8 and considerably the highest polymorphic level with 8 loci on chromosome 7. PIC (polymorphic index content) values ranged from 0.3077 to 0.7951, and 0.5870 in average. The genetic distance ranged from 0.0909 to 0.9545, and 0.6372 in average. The dendrogram of those sample indicated that there was high diversity in weedy rice from Taizhou, Jiangsu Province. Furthermore, investigations on morphological characterization were conducted in the same sampling location. Based on these datum, it is indicated that the weedy rice from Taizhou, Jiangsu Province had the closest relationship with hybrid rice parents and generally originated from natural hybridization and introgression between hybrid rice or its discrete type of descendant.

**Key words**: weedy rice; genetic diversity; origin.

# ALLELOPATHIC EFFECTS OF *FLAVERIINAE BIDENTIS* ON SEED GERMINATION AND SEEDLING GROWTH IN SIX HERBACEOUS SPECIES

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As another alien invasive weed in China,  $Flaveriinae\ bidentis$  was found in Hengshui in Hebei Province and Tianjin Nankai University in 2003. The habitats of F . bidentis were diversified, including the place nearby lawns. Once invading successfully, it would cause a great impact on the ecosystems. Allelopathy was one of the mechanisms, the answer to the invasiveness of exotic plant. Nowadays reports were not available on allelopathic effects of F . bidentis on lawns. Experiments were conducted in Petri dishes under laboratory conditions to investigate the effect of aqueous extracts of F . bidentis on seed germination and seedling growth in six herbaceous species. For all the 6 selected receiver plants, germination was inhibited and seedling growth was reduced to varying degree. In aqueous extracts of F . bidentis,  $Zoysia\ japonica$  is the most sensitive, with its emergence rate 21.43%; on the contrary, the emergence rate of  $Poa\ pratensis$  came to 100%. Embryo and radical length reduction was observed lowest in  $Agrostis\ tenuis$ , respectively 28.24% and 64.36%. Under the same concentrations of the extracts, root growth was inhibited more strongly than sprout growth. Seedling growth of  $Lolium\ perenne$  and tall fescue ( $Festuca\ arundinacea\ Schreb$ .) were inhibited more by extracts from young plants than from mature plants of F . bidentis.

# ALLELOPATHIC POTENTIAL OF REPRODUCTIVE ORGANS OF EXOTIC WEED LANTANA CAMARA

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The potential allelopathic effects of aqueous extracts of the reproductive organs (flower and fruit) of *Lantana camara* on seed germination, seedling growth and dry matter production was investigated on radish, Chinese cabbage and lettuce, which were also compared with the effect of aqueous extract of its vegetative organ. The reproductive organs of *L. camara* displayed to be allelopathic and the effects were significantly concentration-dependent. Among which, fruit extracts showed the most significant stimulatory effects while flower extracts had the similar stimulatory/inhibitory effects as that of leaves with different intensity in some cases. It can be concluded that the allelopathic effects of reproductive organs of *L. camara* are stronger, at least the same as, that of vegetative organs. *L. camara* can flower and seed all year round, thus the large output of flowers and fruits greatly improve the producing of allelochemicals. Allelopathic effects of the reproductive organs of *L. camara* make it more competitive and contribute to its invasion.

**Key words**: Allelopathy, biological invasion, alien plants, germination, seedling growth.

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# CHEMICAL COMPONENTS OF MANGIFERA INDICA LEAVES VOLATILE

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Plant Allelopathy was now the research hotspot in agriculture ecology and chemical ecology. Allelopathy refers to the effects of one plant on an other plant and/or microorganisms due to chemicals released by them, or due to the breakdown of their metabolites. Literatures showed that the aqueous extracts of mango could affect the gemination and growth of *Zea mays*, *Echinochlo crusgalli and Digitaria sanguinalis*, indicating that *Mangifera .indica* had allelopathic effect on these crop. However, there was little research reports about the chemical constitutes and the function on *M. indica* leaves volatiles.

Adopting the steam distillation, followed by concentration using high pure  $N_2$ , the volatile oils were analyzed by GC/MS, and their relative contents were determined by inner standard. Meanwhile, the difference between the volatiles constitutes of mango tender leaves and function leaves was compared.

The result showed that mango tender leaves and function leaves had the common constitutes included [+]-2-carene, 1,3,6-octatriene,3,7-dimethyl,(Z)-, 3-carene, Beta-pinene, Beta-myrce-ne, Alpha-phellandrene, 3-hexen-1-ol acetate (Z)-, 3-hexen-1-ol (Z)-. Among them, the terpene was the main components that occuping the 75% of all compounds. And the [+]-2-carene was the hightest in relative amount both in tender leaves and function leaves. Besides the common components, the mango tender leaves volatiles also included following components: 1,3,7-octatriene,3,7-dimethyl-, D-limonene, 1,6-octadine,3,7-dimethyl-, 3-penten-2-ol, hexanoic acid 3-hexenyl ester and so on and the function leaves volatiles components also included: Alpha-pinene, Limonene, Beta-phellandrene, 1,3,6-octatriene,3,7-dimethyl-, Alpha-farnesene, benzeneacetaldehyde, 1-hexanol, Camphene and so on.

In conclusion, the main components of mango leaves were terpenes, ocupying 62.5% and 80% of the compounds of mango tender leave and function leaves volatiles respectively. Knowing that terpene compound such as Limonene et al. had allelopathic potential, so the volatile components of mango leaves may also had allelopathic potential. The data of analysis and identification on the volatile of mango leaves could offer the foundation for research further the mango tree's allelopathy. Meanwhile, it might help us to understand better about the relationship between the mango and insect pests.

Key words: Mangifera indica; Volatiles; Allelopathy; Chemical component

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### BIOLOGICAL INDUCTION OF DIMBOA IN WHEAT

#### SEEDLINGS BY WEEDS

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For the first time, it was studied on the biological effects of 6 weed species on DIMBOA concentration in root exudates and aerial parts of wheat seedlings. The results of hydroponic experiments showed that DIMBOA content in both root exudates and shoot of wheat seedlings were significantly induced by 3 weed species, i.e. *Digitaria sanguinalis, Avena fatua* L, and *Amaranthus retroflexus*, and the induction effects happened to be in the 3 different resistant wheat cultivars (Zhongfu9507, Zhongbeizhong39, Jing411), while other 3 weed species *Poa annua* L., *Lolium multiflorum* Lam. and *Capsella bursa-pastoris* showed weak effects on DIMBOA in wheat root exudates and aerial parts. Grown in pot, the biological induction by the former three weeds gave the consistent results as those grown in hydroponic solution, but DIMBOA content of aerial parts was higher when wheat grown in the pot than that grown in the hydroponic solution. When wheat cultivars were intercropped with different density of *D igitaria sanguinalis*, the general trend was found that DIMBOA content in aerial parts was positive correlated with the density of *Digitaria sanguinalis*, This result implies that changing the density of inducing plants may be a useful way to artificially improving crops resistance.

**Key words:** biological induction; wheat seedlings; DIMBOA; digitaria sanguinalis

# ISOLATION AND IDENTIFIED OF ANTIOXIDATIVE COMPOUND OF MONOCHORIA VAGINALIS\*

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Antioxidants are important inhibitors of lipid peroxidation used not only in food preservation but also as a defence mechanism of living cells against oxidative damage. At present, such chemical antioxidants as BHT, BHA, PG etc. are commonly used, but they are harmful to human liver and lung, while natural antioxiditive substances extracted from natural plants do no harm to human beings. Monochoria vaginalis, the experimental material, was screened from twelve weeds in rice field by a ferric thiocyanate method (FTC) for its higher antioxidative activity. Four different extractions were separated with different solvents from 75% alcohol extraction of Monochoria vaginalis. Their antioxidative activities were measured by means of iodine method. The results showed that the n-butanol fraction exhibited the highest antioxidative activity, not only significantly higher than that of CK but also significantly higher than that of tea polyphenols (natural antioxidant) and butylated hydroxyl toluene (BHT) (synthetic antioxidant). Four compounds were isolated from the n-butanol fraction by using column chromatography and two of them were identified as stigmasterol 3-O-β-D-glucopyranoside andβ-Daucosterol by means of MS and NMR analysis, respectively. The antioxidative activity of them were estimated by ferric thiocyanate method (FTC). The result showed that the four compounds all exihibited higher antioxidative activitiy than BHT did.

**Key words:** *Monochoria vaginalis*; antioxidative activity; isolation; identification

# COMPARISON OF PHOTOSYTHETIC CHARACTERISTICS BETWEEN INVASIVE PLANT *LANTANA CAMARA* AND ITS COMPANION PLANTS

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The alien plant have a strong adaptation and tolerance in acclimation to environment, which was one of the important factors that they can successfully inbreak. The characteristics of photosynthetic physiological of Lantana camara and its companion plants Bidens, Urena lobata, and Achyranthes aspera under different light intensity and different CO<sub>2</sub> concentration were investigated .Results were as follows: (1) Lantana camara and its companion plants all have higher Lihgt saturation point that were more than 1200µmol·m<sup>-2</sup>·s<sup>-</sup>; their show a strongest photosynthetic capability in strong light condition. Light compensation point (LCP) of Lantana camara was 13.58μmol·m<sup>-2</sup>·s<sup>-1</sup>, which was lower than that of other three species; Quantum use efficency (QUE) was 0.0503µmol·m<sup>-2</sup>·s<sup>-1</sup>, and also had the capacity in acclimation to shade environment. (2) With the increase of control CO<sub>2</sub> concentration ,the net photosynthetic rate of Lantana camara and its companion plants were raising. The maximum net photosynthetic rate of Lantana camara was33.0755µmol·mol<sup>-1</sup>, which was higher than that of other three species; CO<sub>2</sub> saturation point was 1350µmol·mol<sup>-1</sup>, which was only lower than that of Achyranthes aspera Linn; CO<sub>2</sub> compensation point and carboxylation rate were 61.78µmol·mol <sup>-1</sup>and 0.0324µmol·mol <sup>-1</sup>respectively, which show that *Lantana camara* had a strong capacity for the increase of CO<sub>2</sub> concentration . (3) The increase of control photosynthetic active radiation and CO<sub>2</sub> concentration had little effect on cond and Trmmol of Lantana camara, but promote the WUE. (4) The above information would be helpful for understanding about Lantana camara in aspects of fast growing ,great productivity and competition ability.

**Key words:**Invasive plant, *Lantana camara*, Companion Plants, Photo-synthetic active radiation, CO<sub>2</sub> concentration, Photosynthetic physiological characteristics

# PRELIMINARY STUDY OF ENVIRONMENTAL FITNESS OF MAIN WEEDS FROM THE IMPORTED GRAINS\*

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The influence of temperature, soil moisture and thickness of the soil to seed germination of ragweed (Ambrosia artemisiifolia ), false sorghum (Sorghum halepense), gill chrysanthemum Nim(Sida spinosa) and split Pharbitidis(Ipomoea nil) was conducted in this study. Germination of ragweed, gill chrysanthemum Nim and false sorghum was more suitable when the soils moisture was in a range of 85% -100% of soil capacity (the soil capacity was 13.7% in this experiment). There was no germination for ragweed and gill chrysanthemum Nim when soil moisture was below 40% of soil capacity, germination of split Pharbitidis was increased with of increase of soil moisture in a range of 45% -100% of soil capacity. Germination of ragweed was more appropriate at temperature range of 20°C-25°C, the germination rate of false sorghum and gill chrysanthemum Nim was increased with the increase of temperature within 15°C-30°C, germination of split Pharbitidis was more appropriate at temperature range of 20°C-30°C. Germination rate of ragweed was relatively high when the soil thickness was in a range of 2-5 cm, germination of false Sorghum was more appropriate in soil thickness of 1 cm to 3 cm, germination of gill chrysanthemum Nim was more appropriate in a range of soil thickness of 1-3 cm. The germination rate of split pharbitidis was relatively high when soil thickness was in a range of 1-7cm, over 7 cm the germination rate was lower and there was no germination when soil thickness was more than 13cm. Competetion of soybean and ragweed was conducted in local field under natural condition, seeds of the two species were put into sand in the same time for germination, the seedlings of two species were transplanted into the field in the same time, when the plants were in growth stage of two leaves. The density of soybean was always 4plants/m<sup>2</sup> in all the treatments, and the density of ragweed was 5plants/m<sup>2</sup> \, 12plants/m<sup>2</sup> and 21plants/ m<sup>2</sup>, respectively, which was signed as A,B,C treatment, respectively. The results showed that, in 10,20 and 30d after transplanted, the average height of soybean in different treatment, was 2.61, 2.29, 1.94 times of that of ragweed. But the total leaf number of ragweeds increased quikly, the average leaf number of ragweed in different treatment, was 1.35, 1.42 and 1.49times of that of soybean, in 10,20 and 30d after transplanted. There is no Lateral stem apical at 10d after transplanted for ragweed, but the average number of lateral stem apical was 3.68 and 9.03 at 20d and 30d after transplanted, which was 2.10 and 4.21 times of that of soybean, respectively. In conclusion, the results of this experiment showed that the fitness of ragweed, false sorghum, gill chrysanthemum Nim, and split Pharbitidis in the environment is high, the seeds of the fours species can germinate in most parts of China. In early period of co-grow of soybean and ragweed, there is advantage in height for soybean, but ragweed has more leaves and lateral stem apical.

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## 稻田除稗剂的优化选择

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**摘要:** 本文对稻田常用的丁草胺等 10 余种除稗剂的优缺点进行了分析对比,并对这些产品的优化选择提出了建议。

关键词:丁草胺;二氯喹啉酸;乙草胺;丙草胺;恶草酮;优化选择

# THE OPTIMUM CELECTION OF BARNYARD-GRASS HERBICIDES IN PADDY RICE FIELD

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Abstract: Strongths and weaknesses of 10 barnyard-grass herbicides used in paddy rice field are compared mutually. An optimum celection of these products are proposed

#### 1. 序言

稗草一直是水稻生产的头号恶性杂草。研究表明,若每亩稗草密度达到 7500 株时,可使水稻减产 57%,为此,稻田若人工除草,每亩需用工 7 个以上。此外,在南方水稻主要生产省,抛秧田的面积目前多已达 70%左右,直播田面积也在不断扩大。种植方式的改变,稻田已基本不可能靠人工防除杂草,水稻生产对除草剂(尤其是除稗剂)的依赖性达到了前所未有的程度。

早期稻田使用的敌稗和除草醚,主要对稗草有效,需要与阔叶除草剂配伍,因而,"稻田除稗剂"这一名词便为业界沿用下来。上世纪80—90年代,我国的稻田各类除草剂品种有了长足发展。本文所要讨论的"稻田除稗剂"包括:丁草胺、 丙草胺、 乙草胺、 苯噻草胺、二氯喹啉酸、 莎稗磷、 恶草酮、 禾草丹、 禾草特和敌稗等。它们是目前稻田除稗的最常见品种。在生产应用中,60%以上的除稗剂是与磺酰脲类阔叶除草剂组成混剂,以便使杀草谱变得更宽一些。由于二者品种较多,因而它们在市场上的混剂产品更显纷杂。

经过近 20 几年的生产应用检验,这些除稗剂显尽了自身生物学特性的优劣。本文拟从多个层面,对上述除稗剂的优缺点进行梳理,分析和评价,提请读者和生产、管理及应用部门的各位同仁关注这一问题,以便加快稻田除稗剂优化选择的进程。

#### 2. 除稗剂的使用现状及问题

调查表明,2006年,全国水稻种植面积为4.4亿亩,水稻化除面积已达4.5亿亩,市场金额约为16.4亿元,占当年农用除草剂总金额的22%。我国北部广大单季稻区,由于生长期较长,需要两次处理才能控制杂草危害,是处理面积超过种植面积的主要原因。现将上述除稗剂在去年的使用面积及所占比例列于表1。

上世纪末期, 酰胺类除草剂在国际市场的销量开始逐年下滑,2002年达到低谷, 次年虽小有回升,但其销售颓势已难以挽回。1998-2003的6年中,丁草胺销售金额以年均12.9%的比例递减;但在我国,四种酰胺类除稗剂占处理总面积近46%。而且,丁草胺、乙草胺

和二氯喹啉酸作为稻田除稗剂的当家品种的位置相当稳定,三者 2006 年使用面积占水稻田总处理面积的 54.7%。这种局面已经持续近 10 年。其中,丁草胺连续作为稻田头号当家产品,则长达 20 年头。这种状况在其他水稻生产国是不多见的。

表 1.2006 年水稻田除稗剂使用情况

除稗剂及剂型含量	有效成分	用量(吨)	处理面积(万	比例(%)
			亩)	
50%丁草胺 EC	butachlor	12140.0	12000.0	26.7
50% 乙草胺 EC	acetochlor	1080.0	5850.0	13.0
30%丙草胺 EC	pretilachlor	380.0	634.0	1.4
50%苯噻草胺 EC	menfenacet	543.0	2127.0	4.7
50%二氯喹磷酸 WP	quinclorac	1590.0	6750.0	15.0
30%莎稗磷 EC	anilofos	960.0	1598.0	3.6
12.5%恶草酮 EC	oxadiazon	690.0	347.0	0.8
90%禾草特 EC	molinate	264.0	163.0	0.4
50%禾草丹 EC	thiobencarb	270.0	110.0	0.2
其他			15421.0	34.2
总 计			45000.0	100.0

註①用量(吨)栏的数据,是该产品单用与混剂的数量之和。

## 3. 稻田除稗剂的生物学特性分析对比

化学结构决定化合物的生物学特性。上述产品的结构炯然不同,即使同类除草剂在结构上的细微差异,都使得产品具备了明显不同的特点。现从杀稗活性、对水稻的安全性、对水生生物的毒性、对水层管理的要求、杂草群落演变与抗药性问题,以及药费成本等几个方面,对上述产品进行综合分析评价。

#### 3.1 用药成本

长期以来,除草剂价格一直是影响多数农户购药的首要因素。在多地对除草剂用户最终价格和使用剂量调查时,得到的数据多有差异。下表的除草剂单价、剂量和亩成本为22个调查点的平均值。

表 2. 除稗剂的平均亩用药成本

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除稗剂	50%丁草 胺 EC	30%丙草 胺 EC	50%乙草 胺 EC	50%苯噻 草胺 EC	SU% <sub>一</sub> 录 喹磷酸 WP	30%莎稗 磷 EC	12.5% 恶 草酮 EC	90%禾草 特 EC	50%禾草 丹 EC
单 价 (元/升)	24.0	46.0	20.0	25.0	135.0	57.0	42.0	65.0	35.0
剂 量 (升/亩)	0.11	0.08	0.01	0.13	0.05	0.07	0.14	0.20	0.20
成 本 (原/亩)	2.64	3.68	0.20	3.25	6.75	3. 99	5.88	13.00	7.00

国产丁草胺和乙草胺,分别在 1984 年和 1997 开始应用于水稻田,多年来,二者低廉的价格优势是其市场占有率举高不下的主要原因。乙草胺由旱田进入水田之后,杀稗活性

② 其他栏包括: 20% 敌稗 EC(propanil)、50% 哌草丹 EC (dimepiperrate)、41% 草甘膦 SL (glyphosate)、20% 百草枯 SL (paraquat),以及 10%千金 EC(cyhalofop-butyl)、10%农美利 SC(bispyribac\_sodium)、2.5%稻杰 OF (penoxsulam)等。后三个产品是除草剂中值得注意的 新秀,但由于上市较晚,成为主流产品尚需时日,本文暂不讨论。

几乎提高 10 倍,因而亩成本最低。但由于对水稻的安全性差,只能作为一个配伍者,无 法撼动丁草胺的领先位置。长期以来,二者的低价优势,越来越成为其他性能更好但价格 稍微偏高的产品进入市场的障碍。

#### 3.2 杀稗活性

在推荐剂量下,控制稗草的能力当属二氯喹磷酸为最强,它对 5-7 叶的大龄稗草,甚至分蘖到抽穗早期,都会有很好的防治效果;其次是,禾草特能防治 4-5 叶期稗草,在二氯喹磷酸尚未问市之前,禾草特(即禾大壮)以其对大龄稗有效性,一度受到用户青睐,在 80 年代中后期,曾连续多年成为紧俏商品,当时该产品的广告流传颇广;其三是,恶草酮、莎稗磷和苯噻草胺,3 叶期以前的稗草均对三个产品敏感;其四是,丁草胺、丙草胺、乙草胺和禾草丹,四者只能有效防治 1.5 叶期以下的稗草。对 2 叶期的稗草,即使按推荐剂量的高限进行处理,它们的除稗效果也不尽理想。

#### 3.3 对水稻的安全性

水稻种子萌发期对除草剂最为敏感,随着叶龄增多,耐药性逐步增强。上述产品中,安全性最高者首推哌草丹,它是唯一的能在催芽稻播种的同时直接使用的品种,因而能及时防治与水稻同步发生的早期稗草,这对直播稻种植无疑是很有价值的特性。但由于合成工艺存在问题,该产品的市场份额始终很小;其次是禾草特,但它需要提前 2-3 天使药,或者使药混土后,才可以播下催芽的稻种;其三是敌稗,可对立针期的稻苗进行处理,而不至于出现药害。丁草胺也可在立针期或播种前提前 2-3 天进行处理,但需要覆盖一定厚度的土层,使用技术要求严格,且安全性不够稳定;其四是丙草胺、苯噻草胺和禾草丹,处理 2 叶期以上的秧苗才较为安全。二氯喹磷酸处理 2 叶一心期以下的秧苗,2-3 周之后,时常会有部分"筒状苗"受害株出现;其五是乙草胺和莎稗磷,4 叶期以下的秧苗对两剂仍然敏感,因而它们只适于在 4 叶期以上的大龄秧移栽田使用。

这里要特别强调的是丁草胺对水稻的安全性问题。很多技术人员都有这样的经验,即在推荐剂量下,经丁草胺处理的稻株,与丙草胺、苯噻草胺、草酮等处理相比,不仅分蘖数少,而且根部发育相对要差,新根偏少,贪青晚熟,增产幅度不明显。而且,该产品除草不增产,甚至减产的情况屡有报道。弱苗秧或水层淹过心叶时,丁草胺的药害较其它药剂更为明显。目前抛秧田面积快速增加,所用的 2.5-3.0 期秧苗的根部对药剂更敏感,而且抛后要裸露田表一段时间,才能扎根入土。此时用丁草胺处理不利于稻株新根的生长。几种酰胺类除稗剂对水稻的安全性顺序是:

丙草胺>苯噻草胺>丁草胺>乙草胺

#### 3.4 杂草群落演变与抗药性问题

这是连续长期使用单一种农药后必然会遇到的问题,除稗剂也不例外,其中又以丁草 胺和二氯喹磷酸在这方面暴露出的问题最多。

室内实验表明,2003年浙江杭州部分稻田区的稗草生物型对二氯喹磷酸的 EC50值为13.47mg/L,相对抗性比(R/S)为42.2,表明该稗草生物型对二氯喹磷酸已经处于高水平抗性阶段。绍兴和温州部分稻区的被测的稗草生物型,相对抗性比分别达到718.5和695.8,

抗药性属极高水平。2000 和 2001 年,在湖南安乡采集的稗草生物型,对二氯喹磷酸的相对抗性比已经达到了 50.4 和 93.2。在常德、汉寿、黄梅等地也有类似情况。二氯喹磷酸的抗性问题由此可见一斑;此外,由于杀草谱的局限性,长期使用二氯喹磷酸的稻区,造成千金子和双穗雀稗等耐药杂草再猖獗,这在长江流域和华东的部分稻区,已经是常见的现象了。

至于丁草胺,早在 1993 年,我国学者实验证明,在一些连续 8-12 年使用年丁草胺的稻区,一些稗草生物型的相对抗性比在 1.3-5.4 之间,有些监测点则高达 11.0。连续使用禾草丹的地区,稗草对禾草丹的相对抗性比大于 2.8。表明部分重点使用稻区的稗草,在 10 多年前,已经对丁草胺和禾草丹表现出一定的抗药性了。而且,研究结果还显示,丁草胺和禾草丹可能存在交互抗性。

我国稻区有长期重复使用某种除草剂的习惯,具备产生抗药性的潜在条件,应该引起 足够重视。

#### 3.5 施药后对水层管理的要求

华北、东北,尤其是西北稻区,5-6 月水稻播种或移栽的关键季节,缺水问题一直十分突出,是发展水稻生产的制约因素。在诸多的除稗剂中,以禾草特对保持水层的要求最为严格,使药后,如果3厘米水层无法保持5-7天,则会因为产品挥发,使药效大为降低,甚至完全无效;而恶草酮为水旱两用除草剂,使后只要田面能保持湿润,不发生干裂,一般就会取得良好除草效果,这在缺水稻区是很可贵的。触杀型除稗剂敌稗,喷雾前需要放干田水,药后1-2天内不灌水,这种水层要求则另当别论,缺水稻区一般难以接受放干田水的要求;至于四个酰胺类除稗剂,莎稗磷和禾草丹,则都需要在使下后保持水层3-5厘米5-7天。田块漏水,或雨水过深,将会造成药害,其中以丁草胺最为常见,水层是否适中和能否保持足够的天数,是发挥药性的关键因素之一。

#### 3.6 对水生生物的毒性

这是一个被忽视多年,但是一个越来越突出的问题。现将上述产品对鱼类的致死中量(LC<sub>50</sub>值)列于表 3。

#### 表 3. 除稗剂对鱼类的致死中量(有效成分)

产品 丙草胺 苯噻草胺 乙草胺 二氯喹磷酸 恶草酮 丁草胺 莎稗磷 禾草特 禾草丹 虹鳟鱼 鲤鱼 鲤鱼 鲤鱼 鲤鱼 鲤鱼 虹鳟鱼 鲤鱼 鲤鱼  $LC_{50}$ 96 小时 96 小时 48 小时 (mg/L)0.32 0.45 > 1001.76 2.80 12.00 1.80 8.0 很显然,在上述除稗剂中,以丁草胺对鱼类和两栖类水生动物的毒性为最高,比丙草胺 和恶草酮高 5.5 倍。乙草胺的致死中量固然也高,但在水田,它的有效用量仅是丁草胺的 1/10, 因而使其对鱼类毒性大为降低。笔者推算, 一亩水层 5 厘米的稻田, 地表水大约为 3000 升, 假定 110 毫升/亩的 50%丁草胺乳油的有效成分(55 克/亩)有 1/2 被土壤吸附, 稻田地表水中的游离丁草胺浓度仍高达 9.2mg/L,是其致死中量的 29 倍,丁草胺是稻田及 周围水域中有益水生动物的强劲杀手,其原因就在这里。使用丁草胺的田块及其周围的水 渠,第二天肯定会有小鱼、青蛙、蝌蚪大量死亡,凡是用过丁草胺的人都熟知这种情况。 我国每年丁草胺含盖的水面近 2 亿亩,这种现象已持续近 20 年之久,已经成为农业环境

生态问题的隐隐伤痛。

二氯喹磷酸虽然对水生动物很安全,但受药田的排水能对周围农田的阔叶(尤其是伞形科)作物会造成药害。这一问题是推迟它进入其他一些水稻生产国除草剂市场的重要原因。笔者曾试验,二氯喹磷酸的 10<sup>-12</sup> 摩尔稀释液,对西红柿幼苗不定根的形成,仍然有强烈的抑制作用,相这样如此低浓度仍然能对其他作物根部造成伤害的产品是不多见的。我国稻田现有 6700 多万亩用二氯喹磷酸进行处理,它们对周围阔叶作物所造成的隐形药害损失,一直未引起人们的注意。

#### 3.7 除稗剂性能的综合对比

上述 6 点基本上代表了水稻生产和环境保护最关心的重要方面。现按六个方面(指标)的优劣程度,进行打分排序,以便对这些除稗剂的综合特性(效益)作进一步对比(表 4)。

	农量 脉冲加纵 自拉 压化												
	用药 成本	杀稗 活性	安全性	抗药性	水层 要求	鱼类及其他作物毒性	总计	名次					
丁草胺	5.0	3.0	3.5	3.5	4.0	2.0	21.0	6					
乙草胺	4.0	3.0	2.0	4.0	4.0	3.0	20.0	7					
丙草胺	4.5	3.0	4.3	4.0	4.0	4.7	24.5	3					
苯噻草胺	4.5	3.4	4.0	4.0	4.0	4.8	24.7	2					
二氯喹磷酸	3.0	5.0	4.0	3.0	4.0	4.5	23.5	4					
莎稗磷	4.0	3.5	3.0	5.0	4.0	5.0	24.5	3					
恶草酮	3.3	3.5	4.0	5.0	5.0	4.7	25.5	1					
禾草特	2.0	4.2	5.0	5.0	2.0	4.5	22.7	5					
禾草丹	3.0	3.0	4.0	3.7	4.0	5.0	22.7	5					

表 4 除稗剂综合特性比较

註: 六项指标均在 2—5 分之间打分。例如,用药成本栏中,2 分表示用药成本最高 ,5 分为用药成本最低 ,居间数值表示成本中等,中等偏上,或偏下。其他 5 项打分方法类同。

比较表 1 和表 4 可以看出,目前,在我国稻田除稗剂的使用中,处理面积最大(占 54.7%)的三个产品(丁草胺、乙草胺和二氯喹磷酸),它们的综合性能(效益)名次仅仅是居中,或者是比较差的;而综合性能(效益)好的前三名的产品(恶草酮、苯噻草胺和丙草胺),目前的使用面积则不足 7%。

## 3. 结论与建议

很显然,广大稻农在除稗剂的使用中,远并未达到优化程度。长期以来,过分集中使用的三个产品,缺点突出,埋没了其他性能更好的产品的增产潜力。这对化工和农业两个方面来说,是双重的隐性的浪费。用户选用丁草胺,同性能好的前三名产品相比,药费固然会少花 1-3 元/亩,但丁草胺因安全性差造成的稻谷增产量的减少,因对鱼类的毒力太强所造成的对环境生态的损害,因抗药性的存在所要加大的用药量等等,绝非节省的 1-3 元/亩钱所能弥补的。经过 20 多年的发展,除稗剂优化选择的空间已经大大增加。如果稻农仍然走不出"唯低价选择"的怪圈,则目前似的的不合理使药的混沌状态仍然会继续下去,这对农户和农村来说,无疑是典型的因小失大;对厂家而言,长期坚持过量投放低价位低利率除稗剂的营销路线,是缺乏远见之举,最终势必会使开发新产品的能力受到损害。

由于专利保护和价格方面的原因,文中提到的除稗剂新秀的市场占有率短期内难以快速提高。禾草特、禾草丹等产品,或因为中间体供应的变化,或因为使用剂量过高,成本

过高等问题,将会逐步淡出除稗剂市场。其余的8个产品,在相当长的时间里,仍将会活跃在稻田除稗剂市场。为了合理发挥它们的作用,笔者认为做到以下几点是至关重要的:

- (1) 在丁草胺和乙草胺使用时间长,或水源丰富地区的稻田,提倡改用恶草酮、丙草胺、苯噻草胺或莎稗磷等产品。以缓解对水体鱼虾和两栖类动物的危害,和推迟杂草抗性问题的进一步发展。
- (2) 鉴于二氯喹磷酸对小令秧苗和稻田周围阔叶作物的危害和抗性问题的发展,该产品的使用不可过多过滥,官在贻误农时稗草过大时,作为"救荒产品"使用。
- (3) 加大宣传力度,提高稻农全面识别杀稗剂性能优劣的利害关系的能力,改变长期重复使用某一除稗剂的习惯。

当然,在当今市场竞争的大潮之中,要做到上述几点决非易事。但五种高毒杀虫剂禁止生产和使用所取得的重大进展,使人们从中看到了解决重大不合理使用农药问题的希望,因而对除稗剂做到优化选择也充满了期待,希望生产、应用和管理部门重视和解决这一问题,以免在这方面所付出的代价太久,太沉重。

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Sodium(82), butachlor(100),cyhalofop-butyl(195), molinate(560), oxadiazon(600), quinclorac(712), thiobencarb(747).

## 从西双版纳稻田除草技术的变迁看傣族稻作的发展方向

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本文简述了西双版纳稻田主要杂草种类和发生特点,稻田除草方式从单纯依靠人力向主要使用乙氧氟草醚(oxyfluorfen)、苄嘧磺隆+甲磺隆(bensulfuron-methyl+

metsulfuron-methyl)、苄嘧磺隆(bensulfuron-methyl)、丁草胺(butachlor)、克草胺(ethachlor)等除草剂变迁,并提出实施标准化种植,发展无公害水稻生产是傣族稻作走向现代化的重要途径,也是提高西双版纳农业质量和效益的必然选择。

关键词:西双版纳,水稻生产,杂草防除

云南省的傣族多数居住在海拔较低的河谷地带,气候炎热,土地肥沃,灌溉便利,为水稻生产提供了优越的自然条件,同时也十分有利于稻田杂草的滋生蔓延。在傣族古歌谣中曾经有这样的唱段:"九月是薅秧的季节,田里的水要保持一拃深。有水苗棵旺,杂草也不会生。稗子是秧苗的敌人,专吸土中肥,比秧苗还长得旺。阿妹啊,薅秧时要提防,别把秧当稗子薅。"直到上个世纪五十至六十年代,西双版纳的傣族仍然按照这种古老的传统种植水稻,不仅每年要耗费大量人力薅除稻田杂草,而且稻谷产量也难以提高。

为了解决稻田草害问题,自上个世纪六十年代末期开始,我省农业科研和技术推广部门集中力量,协同攻关,研究开发了稻田化学除草新技术,并在全省各地大面积推广。八十年代末至九十年初笔者在西双版纳傣族自治州主持并参与了稻田草害调查和新除草剂乙氧氟草醚(oxyfluorfen)、苄嘧磺隆+甲磺隆(bensulfuron-methyl+metsulfuron-methyl)等的应用技术研究和稻田化学除草试验、示范,推动了当地稻田除草技术的进步,现将主要成果和今后展望分述如下。

#### 1 西双版纳傣族自治州稻田杂草种类和发生特点

调查结果表明(表1),西双版纳稻田杂草的发生具有以下几个特点:(1)杂草种类多,生长速度快,群落密度大,周年均有发生,既有禾本科和莎草科杂草,又有阔叶杂草;不仅有一年生杂草,还有多年生杂草。(2)稻田中既有稗草、异型莎草、鸭舌草、萤蔺等在温带、亚热带和热带地区广布的种类,也有异芒菊、尖瓣花、冠果草等在南亚热带、热带地区特有的杂草。(3)优势草种的分布具有地带性特征,景洪县澜沧江、流沙河流域的早稻田内,鸭舌草、陌上菜、三蕊沟繁缕等阔叶杂草发生较多;在勐海县一带的稻田内禾本科的稗草则为优势草种。(4)水稻育秧田和移栽本田的杂草种类也有一定差异,牛毛毡、圆叶节节菜、蘋等湿生杂草常见于育秧田;地势低凹、排水不便的移栽本田多发生水筛、虻眼、水龙、冠果草等沉水和浮叶杂草。

表 1	<b>西双版纳王要稻田杂草</b>
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杂草类别	中 名	学名				
一年生禾本科杂	稗草	Echinochlora crus-galli (Linn.) Beauv.				
草	千金子	Leptochloa chinensis (Linn.) Nees.				
	光穗筒轴茅	Rottboellia leavispica Keng				
一年生莎草科杂	异型莎草	Cyperus difformis Linn.				
草	日照飘拂草	Fimbristylis miliacea (Linn.) Vahl.				

	萤蔺	Scirpus juncoides Roxb.					
一年生阔叶杂草	鸭舌草	Monochoria vaginalis (Burm.f) Presl. et					
		Kunth					
	水苋菜	Ammannia baccifera Linn.					
	多花水苋菜	Ammannia multiflora Roxb.					
	水筛	Blyxa japonica (Miq.) Maxim.					
	陌上菜	Lindernia procumbens (Krock) Tang.					
	母草	Lindernia crustacea (Linn.) F. Muell.					
	虻眼	Dopatrium junceum (Roxb.) Buch.					
	冠果草	Lophotocarpus guyanensis (H. B. K.) Smith					
	异芒菊	Blainvilea acmella (Linn.) Philipson					
	丁香蓼	Ludwigia prostrata Roxb.					
	尖瓣花	Sphenoclea zeylanica Gaertn.					
	三蕊沟繁缕	Elatine triandra Schkuhr.					
多年生禾本科杂	双穗雀稗	Paspalum distichum Linn.					
草	田间鸭嘴草	Ischaemum rugosum Salisb.					
4 L 1 + + + 1 +	11414-						
多年生莎草科杂	水莎草	Juncellus serotinus (Rottb.) C. B. Clarke					
草	扁杆藨草	Scirpus planiculmis Fr. Schmidt					
	牛毛毡	Eleocharis aricularis (Linn.) Roem et					
		Schult					
多年生阔叶杂草	野慈菇	Sagittaria sagittifolia Linn.					
	矮慈菇	Sagittaria pygmaea Miq.					
	水龙	Jussiaea repens Linn.					
	圆叶节节菜	Rotala rotundifolia (BuchHam.) Koehne					
	蘋	Marsilea quadrifolia Linn.					
漂浮杂草	大薸	Pistia stratiotes Linn.					
	紫萍	Spirodela polyrriza (Linn.) Schleid.					
	槐叶蘋	Salvinia natans (Linn.) All.					

可湿性粉剂(新得力)进行杀草谱、用药量、施药时期、田水管理等方面的试验,并将该剂试验样品分送允景洪镇曼景兰、嘎洒乡曼洒和嘎栋乡曼沙等村寨的224户稻农,示范推广面积共910.14亩。试验示范结果表明,10%苄嘧磺隆+甲磺隆可湿性粉剂每亩用药3-10克,于水稻移栽后8天左右施药,对鸭舌草、陌上菜、三蕊沟繁缕、萤蔺、异型莎草等多种阔叶杂草和莎草有良好防效,除草效果达80-90%。此外,还对10%苄嘧磺隆+甲磺隆可湿性粉剂与50%乙草胺乳油混用的效果做了初步试验,证明开发前景广阔。为了进一步研究以磺酰脲类、氯代乙酰胺类、二苯醚类和均三氮苯类化合物为母剂的稻田除草混配剂,1992年笔者在西双版纳嘎洒乡曼洒、曼倒和嘎栋乡曼广龙等村寨对含有苄醚磺隆(bensulfuron-methyl)、苄嘧磺隆+甲磺隆、异丙甲草胺(metolachlor)、乙草胺(acetochlor)、丁草胺(butachlor)、克草胺(ethachlor)、扑草净(prometryn)、乙氧氟草醚(oxyfluorfen)等活性成分的除草剂进行了单用和混用试验(表2),结果表明,苄嘧磺隆与甲磺隆的复配制剂(新得力),以及苄嘧磺隆单剂(农得时)分别与乙草胺、异丙甲草胺(都尔)等混配使用能扩大杀草范围、提高除草效果,降低用药成本。其中,苄嘧磺隆+甲磺隆+乙草胺(bensulfuron-methyl+metsulfuron-methyl+ acetochlor)的混配制剂 10.6%愈得力可湿性粉

剂,能有效防除稗草、千金子、鸭舌草、狼把草、鲤肠、泽泻、水苋菜、异型莎草、碎米莎草、陌上菜、母草、三蕊沟繁缕、节节菜、小茨藻、蘋、日照飘拂草、萤蔺、牛毛毡等多种稻田杂草。自上个世纪九十年代以来,根据类似配比制成的三元复配除草剂已成为我国稻田除草剂的当家品种,每年使用面积超过1亿亩。

进入二十一世纪,稻田化学除草技术在西双版纳已全面普及,无论早稻、中稻,还是晚稻,都采用丁草胺、苄嘧磺隆+甲磺隆、苄嘧磺隆、乙氧氟草醚等除草剂防除杂草,不仅有利于减轻繁重的薅秧劳动,节省稻田除草用工,降低生产成本,而且,还有利于种植业结构调整和农村劳动力就地转移。近年在景洪、勐海和勐腊等地,橡胶、蔬菜、水果和热带、亚热带经济作物得以迅猛发展,稻田化学除草技术的推广可谓功不可没。

#### 2 发展无公害水稻生产,进一步提高西双版纳农业的质量和效益

笔者及其同事在西双版纳试验、示范和推广的稻田除草剂几乎都是对人畜安全,对环境友善的高效、低毒、低残留农药。进一步规范这些除草剂的应用技术,制定安全使用技术规范,可以为无公害水稻的认证打下良好基础。

此外,为了进一步提高傣族地区稻作的质量安全水平,还应做好以下几项工作:(1)制定本地区无公害水稻生产技术规程。西双版纳土壤肥沃、气候适宜、环境优良,发展无公害水稻生产有得天独厚的条件。建议州人民政府农业主管部门组织相关专家,参照农业部部颁标准(无公害食品 水稻生产技术规程 NY 5117— 2002),结合西双版纳的具体情况,制定本地区的无公害水稻生产技术规程,严格种子、化肥、农药(含除草剂)等农业投入品的使用,避免稻谷中有毒、有害物质残留超标。(2)划定水稻生产适宜区域。根据《农产品质量安全法》和农业部部颁标准(无公害食品 水稻产地环境条件 NY 5116—2002)的相关要求,对景洪、勐海和勐腊等水稻产区的大气、土壤和水体质量进行监测和评价,提出水稻适宜生产区域和禁止生产区域,报本级人民政府批准后公布,并实施动态管理。(3)建立水稻标准化生产示范基地。在生态环境条件良好,农田基础设施完善,产地环境和产品质量分别通过认定和认证,产品商标经过注册,稻农科学种田意识较强,能够按照技术规程生产的稻区建立示范基地,以带动全州无公害水稻的标准化生产。为确保产品质量符合无公害食品的相关要求,基地应建立农业投入品、农田生产过程、稻谷收获加工、市场营销等档案,并在销售大米的外包装上加贴无公害农产品标志,以满足优质稻米质量安全的可追溯要求。

以上各项工作如能付诸实施,西双版纳傣族自治州的水稻生产将会迈上一个新的台阶,不仅能为当地傣族群众提供优质、安全的主食,而且还能增强外销大米的市场竞争力。 从长远来看,还有利于建设社会主义新农村,发展高产、优质、高效、生态、安全农业,加快推进西双版纳农业现代化的进程。

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# 湖北省油菜田杂草发生规律及化学防除技术\*

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摘要:本文总结了湖北省油菜田杂草发生的规律及危害,分析了油菜田杂草种类和群落发生不断变化的原因,明确了湖北油菜田的杂草发生高峰主要在冬前,一般于 10 月初至 11 月 20 日之间,冬前杂草占油菜整个生育期杂草总量的 70%~80%,对油菜的生长和产量影响极大,是杂草防除的关键。同时,按使用时间对 90 %圣农施乳油、72 %异丙草胺、50%的高渗异丙隆 WP、36%恶草酮·乙草胺乳油、52%油草清(丁草胺·扑草净)SC、5 %精喹禾灵乳油、10.8%高效盖草能乳油、15 %精稳杀得乳油、10.8%高效氟吡甲禾灵、24%烯草酮、15%顶尖、6.9%威霸、50%草除灵悬浮剂、75%龙拳、41%二氯·草·胺 WP、14.5%精氟·胺苯·草除灵 WP、12%烯草酮·草除灵 EC、20%百草枯水剂和 15%的克利多水剂等近20种除草剂防除油菜田各类杂草的效果进行逐一说明。最后简单讨论了油菜田杂草化学防除存在的主要问题和可采取的适当对策。

#### 关键词:油菜田 杂草 发生规律 化学防除

油菜居我国五大油料作物之首,是重要的食用油和蛋白饲料来源。湖北省是我国油菜主要栽培区之一。近年随着"双低"油菜的推广和农业产业结构的调整,油菜种植面积进一步扩大。然而油菜田杂草种类多,危害重。一般年份可以造成油菜减产 10%~20%,草害严重时甚至减产五成以上。同时,杂草可充当多种油菜害虫和病菌的宿主。由于宿主密度的增大可使病虫害感染的几率增加,从而加重油菜病虫害的发生。因此,杂草是制约油菜生产的一大因素。必须准确掌握油菜田杂草群落特征、种群动态,分析杂草的发生、生长、分布,及其对作物产量的损失,并在此基础上,对现行的杂草防除措施进行改进,以求最终建立既能满足经济利益,又兼顾生态效益的杂草综合治理体系。笔者多年从事油菜田杂草研究和化学防除工作,现将部分研究总结如下。

#### 1 油菜田杂草发生规律及危害

湖北省属冬油菜区,油菜田的主要杂草有看麦娘、野燕麦、稗草、棒头草、罔草、早熟禾、雀舌草等禾本科杂草和繁缕、牛繁缕、碎米荠、通泉草、水苦荬、稻槎菜、猪殃殃、婆婆纳、大巢菜、毛茛、波斯婆婆纳、野老鹳草、泥胡菜、一年蓬、小飞蓬、荠菜等阔叶杂草。由于生态条件、耕作栽培制度的不同,杂草种类和群落组成差别很大。根据笔者等对武汉地区油菜田杂草群落特点及分布规律的研究表明: A 组,旱一旱连作的油菜田,土壤类型为经旱耕后熟化的黄刚土,土质粘重,土壤湿度较低。群落以旱生杂草占主导地位,主要优势种为大巢菜、野燕麦,亚优势种为婆婆纳、猪殃殃。一年蓬、小飞蓬也具有一定的优势度; B 组,稻一油连作的油菜田,土壤为水稻土,湿度较大。禾本科杂草优势种为看麦娘、罔草(棒头草),阔叶杂草优势种有的为牛繁缕,有的为稻搓菜。另外,旱生杂

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草猪殃殃、大巢菜也占有一定比重。

农田杂草群落与自然植物群落有一些不同之处,前者处在人工干扰的独特生境之中, 其群落特征除了受气候条件、土壤性质、自然环境因素的影响外, 还受到人为因素的干扰, 包括作物类型、耕作措施、轮作类型和除草剂的应用等。油菜田杂草群落作为一类农田杂 草群落,既有农田杂草群落的一般共性,又表现出自身独特的群落特征:(1)旱-油连作与 稻-油连作形成了两种差别极大的土壤环境,前者旱生杂草猪殃殃、大巢菜、野燕麦构成 优势群,后者喜湿性杂草看麦娘、牛繁缕、罔草等构成优势群。由于轮作制度不同,形成 了两种差别明显的杂草群落。(2)除草剂的大量使用,增加了杂草对环境的选择压力,使一 些耐药性或抗药性杂草从次要种群上升为优势种群。(3)由于耕作制度的改变、气候的变化, 油菜田杂草种类和群落也不断发生变化。根据 1992~2002 年全国农作物病虫草预测预报网 络站的长期观察资料,在湖北省的油菜区,禾本科杂草偏多发生年份,出草最高峰在油菜 移栽后的 20 d(11 月中下旬),占油菜全生育期禾本科杂草发生量的 39.8%,阔叶杂草偏多 发生年份,出草最高峰也出现在油菜移栽后的 20 d,占油菜全生育期阔叶类杂草发生量的 41.4%。分析以上调查结果可知,冬油菜田的杂草发生高峰主要在冬前,一般于10月初至 11月20日之间。油菜在苗期遭受杂草危害,常导致成苗株数少和形成瘦苗、弱苗、高脚 苗、抽薹后分枝结角少、对油菜生长和产量影响较大。春季虽还有一个小的出草高峰、但 数量较少,并由于此时油菜生长迅速,田间阴闭,这些杂草往往因光照不足而逐渐死亡, 通常构不成危害。

#### 2 油菜田杂草的化学防除

冬前杂草占油菜整个生育期杂草总量的 70%~80%,对油菜的生长和产量影响极大, 是杂草防除的关键。此时,可根据各块油菜田的杂草种群和特点,选用相应的除草剂,在 恰当的时间进行防除,力争对整个冬前杂草防效达到 90%以上。

采用化学除草,必须严格按照各类除草剂的使用剂量不能随意扩大或缩小。除草剂按 施药时间可分为播前、播后苗前和苗后处理三种。

- 2.1 播后苗前或移栽前土壤处理(直播田在油菜播种盖土后发芽前喷施,翻耕移栽田在移栽前 3 d 喷施)
- 2.1.1 圣农施乳油。用 90 %圣农施乳油 750~1200  $ml/hm^2$ ,兑水 500  $kg/hm^2$ ,80 d 对油菜田牛繁缕、罔草和水苦荬的密度防效分别为 93.14~97.19%、85.11~93.18%、100%,防效显著高于对照药剂 50%的乙草胺乳油 1500  $ml/hm^2$ ,且在安全性方面也好于对照。
- 2.1.2 异丙草胺(旱乐宝)。对油菜田许多杂草均有理想的封杀作用,且对油菜无药害,是一种安全、高效的油菜田除草剂。使用方法:用 72 %异丙草胺  $1500\sim3000$  ml/hm², 兑水 600kg/ hm², 70 d 对油菜田看麦娘、牛繁缕、罔草和水苦荬的密度防效分别为  $91.43\sim100\%$ 、  $91.51\sim96.26\%$ 、  $88.74\sim93.08\%$ 、 100%。
- 2.1.3 高渗异丙隆 WP。50%的高渗异丙隆 WP 1500 $\sim$ 1875 ml/hm²,兑水 750 kg/hm²,30d 对油菜田牛繁缕和粹米荠的密度防效分别为 99.37 $\sim$ 99.72%、99.32 $\sim$ 100%。
- 2.1.4 防除禾本科杂草和阔叶杂草复配剂。36%恶草酮·乙草胺乳油,使用剂量为 1875~3000  $ml/hm^2$ ,兑水 750  $kg/hm^2$ ,100 d 对油菜田牛繁缕、罔草和水苦荬的密度防效分别为 92.34~96.98%、97.17~100%、100%;52%油草清(丁草胺·扑草净)SC,使用剂量为 3000~6000  $ml/hm^2$ ,兑水 750  $kg/hm^2$ ,60 d 对油菜田早熟禾、牛繁缕、罔草和水苦荬的密度防效分别为 81.51~92.25%、93.33~96.28%、94.49~96.09%、100%。

#### 2.2 苗后茎叶处理

- 2.2.1 防除禾本科杂草。药剂主要有精喹禾灵、高效盖草能、精稳杀得、高效氟吡甲禾灵、烯草酮、顶尖、威霸等。一般在杂草  $1\sim4$  叶期施药,用 5 %精喹禾灵乳油  $750\sim900$  ml/hm²或 10.8 %高效盖草能乳油 450 ml/hm²或 15 %精稳杀得乳油  $450\sim750$  ml/hm²或 10.8 %高效氟吡甲禾灵  $300\sim450$  ml/hm²或 24%烯草酮  $150\sim300$  ml/hm²或 15%顶尖  $300\sim400$  ml/hm²或 6.9%威霸  $600\sim750$  ml/hm²,对水  $450\sim600$  kg/ hm²,均匀喷雾,对油菜田禾本科杂草如看麦娘和罔草等的防效都可达 90%以上。而 15%顶尖和 6.9%威霸对野燕麦效果更好。
- 2.2.2 防除阔叶杂草。目前应用较多的是草除灵(高特克、阔草克),龙拳等。用 50 %草除灵悬浮剂 450~750  $ml/m^2$ ,对水 600  $kg/m^2$  喷雾, 60 d 对牛繁缕、繁缕、雀舌草、碎米荠等防效分别为 95.39~100%、93.51~100%、91.67~99.08%、100%。。75%龙拳水溶液是一种防治油菜田稻搓菜等菊科杂草的高效药剂,同时对大巢菜等阔叶杂草也有较好的防效,使用剂量为 100~200  $ml/m^2$ ,兑水 600  $kg/m^2$  喷雾,90 d 对稻搓菜、大巢菜的防效分别为 95.59~100%、91.61~95.87%。
- 2.2.3 防除禾本科杂草和阔叶杂草复配剂。目前,应用较多的复配剂是精喹禾灵与草除灵,品种非常多, 如草除·精喹禾灵、快刀、双锄、丰山阔禾净等。由于各厂家的配方不同,所以单位面积用量的差异也很大,使用时应以标签说明为准,它们对油菜田禾本科杂草和阔叶杂草的综合防效达到 90%以上。另外,还有许多复配剂如:; 41%二氯·草·胺 WP,使用剂量为 450~1500 ml/ hm²; 14.5%精氟·胺苯·草除灵 WP,使用剂量为 750~900 ml/ hm²; 12%烯草酮·草除灵 EC,使用剂量为 2250~3750 ml/ hm²; 这三个为茎叶处理剂,施药时看麦娘 1.5~3.5 叶,牛繁缕 2.5 叶~分蘖期,60 d 它们对油菜田禾本科杂草和阔叶杂草的综合防效分别为 93.02~99.70%、86.53~92.24%、94.49~99.49%。

#### 2.3 免耕油菜田除草剂

- 2.3.1 百草枯。对油菜田看麦娘、罔草、石龙芮、飞蓬、粹米荠和牛繁缕等杂草均有理想的封杀作用,是一种高效、广谱的灭生性除草剂,且对油菜安全。适宜在免耕油菜田使用。使用方法: 20%百草枯水剂 2250~3000 ml/hm², 兑水 750 kg/ hm², 80 d 对油菜田禾本科杂草和阔叶杂草的综合密度防效达到 93.85~98.93%,但对通泉草的防效较差。
- 2.3.2 克利多。15%的克利多水剂防除油菜田的禾本科杂草和飞蓬、牛繁缕等杂草效果很好,且对油菜无药害,是一种用于免耕油菜田的高效除草剂。推荐剂量为 2000~5000 ml/hm², 兑水 600 kg/hm², 90 d 对油菜田禾本科杂草和阔叶杂草的综合密度防效达到 95.53~98.49%。

#### 2.4 "一杀一封"除草法

该方法可有效防除主要单、双子叶杂草。使用方法: 前茬收获后油菜移栽前,用 20% 克芜踪水剂 2250 ml/ hm² 或 41% 农达水剂 1 200~1 500ml/ hm² 或 10% 草甘膦水剂 6 000~7 500 ml/ hm², 对水 450~600 kg/ hm² 喷雾,杀灭已出土的杂草或残茬。油菜栽前,喷施前面列出的播后苗前或移栽前土壤处理剂进行土壤封闭,以防除未出土杂草; 也可以将"杀封"同时进行,即在油菜移栽前,选用上述除草剂,按规定剂量直接桶混,现配现用。"一杀一封"或"杀封"后 3~5 d,移栽油菜。

#### 3 油菜田杂草化学防除存在的主要问题

3.1 恶性杂草呈上升趋势

多年来,由于选用除草剂品种单一,如茎叶处理剂选用高效盖草能、精喹禾灵、草除灵等,土壤处理剂选用乙草胺等,致使恶性杂草上升明显,稻槎菜、早熟禾等成为优势杂草。但是,油菜田阔叶杂草除草剂品种少,不能满足生产需要,因此,必须加大油菜田阔叶杂草除草剂的研发力度,尽快改变当前药剂品种单一的局面。

#### 3.2 部分杂草对常用除草剂的敏感性下降

看麦娘对精喹禾灵、高效盖草能的耐药性明显增强,若要达到理想的防除效果,则使用剂量要比推荐剂量提高 30%~50%;部分阔叶杂草对乙草胺的敏感性也呈下降的趋势。这些都应引起高度重视。

#### 3.3 药害现象时有发生

导致药害的主要原因:①由于一些主要杂草对常用除草剂的敏感性下降,常规推荐剂量已很难奏效,所以农户常自行加大剂量和重复施药,从而引起油菜药害;②农户乱用药,如小苗田、弱苗田按照正常油菜田用药,白菜型油菜施用草除灵等,常造成药害;③除草剂本身质量问题:④除草剂引起的积累性药害有加重趋势。

#### 4 对策

#### 4.1 建立草情监测制度

受除草剂应用日益广泛、种植业结构调整及油菜种植方式变革的影响,油菜田杂草群落受人为因素的干扰越来越大,杂草群落结构的演替也以前所未有的速度发生着。为及时掌握草情变化,实现油菜田草害的可持续治理,必须建立草情系统监测制度。

#### 4.2 加强杂草抗药性的监测和治理工作

油菜田中一些常见除草剂的防除效果已明显下降, 所以应尽快组织有关单位开展主要杂草的抗药性监测和治理工作。

#### 4.3 加快引进新型除草剂

针对呈上升趋势的恶性杂草和新形成的优势种杂草,在广泛试验示范的基础上,引进新型除草剂以迅速抑制这种趋势

#### 4.4 大力推广免耕化除技术

免耕化除是一项新兴的耕作技术,具有省工、省力、节本、高效等优点。目前,草甘 膦、百草枯灭茬免耕技术已较成熟。该技术配合使用适当的油菜田除草剂,实行全免耕栽 培,能明显降低生产成本,提高生产效率。

#### 4.5 将化除与农业防治相结合,进行综合治理。

采用轮作灭草、合理密植,培育壮苗、深耕或种植转基因抗除草剂油菜,并结合化学 防除,对油菜田杂草进行综合治理。

总之,对油菜田杂草的发生和发展规律的认识,是一项复杂和繁重的任务。我们只有对各种油菜品种的特性及油菜田杂草种类、群落特征和群落动态变化认识得越充分,才能建立更具优越性的杂草综合治理体系。

## 阔世玛防除麦田禾本科恶性杂草节节麦推广应用

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本文记述了临汾市植保部门秋末和初春应用新型除草剂 3.6% 阔世玛防治麦田节节麦、雀麦等禾本科恶性杂草的防效情况,以及不同用量、不同时间的药效情况,并提出了宜秋末冬前推广使用的建议。

#### 关键词: 节节麦杂草 防治新技术 推广应用

近几年来,节节麦、雀麦等禾本科恶性杂草在我市高水肥麦田普遍发生危害,一般轻发生田每平方米达 1~50 茎,中发生田每平方米达 51~100 茎,重发生田达 101~320 茎,2007 年发生危害面积达 162 万亩,给小麦生产安全造成严重威胁。由于缺乏有效的化学防治措施,农民只好蹲在地里用手拔,费工费时,且难取得良好的防效,成为影响我市小麦生产的一大难题。针对这种情况,2005 年以来,我市植保部门引进世玛、阔世玛等禾本科杂草除草剂在我市尧都区、洪洞、襄汾三区、县小麦田节节麦重发区分别不同时期、不同剂量、不同品种进行了药效对比试验和大面积推广应用。2006 年秋至 2007 年春阔世玛应用面积达 6.7 万亩,秋末冬前应用 3.6%阔世玛防治节节麦、雀麦等禾本科杂草,株防效达99.1%。春季应用平均单株干重防效达 80.4%~88.1%。每亩挽回小麦损失平均在 60 公斤以上,为我市农民群众化学防治节节麦、雀麦等禾本科恶性杂草解决了一大技术难题。2007年 3 月山西省农业厅在我市尧都区召开了"全省麦田病虫草害综合防治现场会"。

#### 1 材料和方法

1.1 农药名称及来源: 3%世玛油悬剂和 3.6%阔世玛水分散粒剂为德国拜耳作物科学有限公司生产; 禾清由杜邦公司生产。

#### 1.2 使用方法和时间

药剂统一使用 WP-16 型卫士牌背负式喷雾器喷雾。秋末示范田用药时间为 2006 年 11 月 2 日,面积 50 亩。2007 年 3 月 13 日用阔世玛、世玛、禾清 3 种药剂分别作了效果对比试验。2007 年 3 月 28 日和 4 月 6 日用阔世玛作了不同时间用药对比试验,以观察对后茬作物的影响。3.6% 阔世玛用量分别为 20g/亩和 25g/亩两个处理。禾清每亩 100g。分别留清水作对照。

#### 1.3 示范田概况

示范田选择在近几年来禾本科杂草发生较重、农民科技意识较强、村政管理较好的尧都区吴村镇洪堡村。小麦品种为临丰 615、临汾 8050、临优 145。播种时间 2006 年 10 月5 日。麦田杂草主要以禾本科节节麦、雀麦和阔叶草播娘蒿、荠菜为主。2006 年 11 月 2 日用药时,小麦和节节麦均刚出齐苗,3~5 片叶;2007 年 3 月 13 日用药时,小麦已返青,节节麦分蘖平均 7 个,株高 7~10 cm;4 月 6 日用药时,小麦已开始拔节。

#### 1.4 调查内容和方法

小麦抽穗后每个处理按 5 点随机取样,每样方 1 平方米,调查节节麦成穗茎数、穗粒数、株高、干重防效及对其它杂草的抑制情况,分别计算株防效、干重防效。

对照区节节麦株数/m²--处理区节节麦株数/m²

株防效=----×100%

对照区节节麦株数/m²

对照区平均单株重量(g)—处理区平均单株重量(g)

干重防效=----×100%

对照区单株重量 (g)

- 2 防治结果与分析
- 2.1 秋末施药效果分析

秋末施药调查分别为 11 月 17 日,翌年 3 月 12 日和 5 月 18 日,防治效果主要表现为: 2.1.1 节节麦、雀麦等禾本科杂草株防效达 99.1%。施药 15 天后调查节节麦植株生长明显受到抑制,株高较对照明显偏低,叶色发暗,植株萎靡。春季 3 月 12 日调查,对照区平均每平方米节节麦 15 株,施药后每平方米平均 5 株,株防效达 66.7%。5 月 18 日调查,对照区每平方米节节麦平均茎数为 127.4,施药区每平方米节节麦平均茎数只有 1.2,株防效达 99.1%。

2.1.2 节节麦、雀麦等禾本科杂草生长量明显减少。3月12日调查,节节麦次生根对照平均为10个,处理区为7个,次生根减少30%;节节麦分蘖数对照区平均为7个,处理区为3.5个,分蘖减少50%;节节麦茎高对照区8cm,处理区5cm,茎高减少37.5%。2007年5月18日采样调查,对照区节节麦单株平均干重为9.55g,处理区为0.98g,干重防效为89.7%。对照区节节麦每株分孽数平均为11.6,处理区为2,分孽数减少率达82.8%。

#### 2.2 春季施药效果分析

春季施药调查时间为 2007 年 5 月 18 日,防治效果主要表现为对节节麦生长的抑制、成穗率的降低。正常使用剂量下基本不会造成节节麦、雀麦等禾本科杂草的死亡。只有在地垅可以看见重复喷药(重度施药)情况下造成节节麦、雀麦发黄停止生长的现象。同样也会看见个别小麦受药害的症状。小麦受药害后,植株矮化,叶片发黄,茎秆、叶片、穗变型。通过对春季不同时间用药、不同用量用药田调查,同对照相比有以下几个显著的特点:

#### 2.2.1 植株明显降低

对照田节节麦、雀麦直立高出麦田,株高一般在90~110 cm,而处理区90%以上的节节麦株高为57.3~61.1 cm,株高降低32.7~48.9 cm,降低率为36.3~44.5%,给农民一个防治效果良好的印象。

#### 2.2.2 成穗率明显减少

对照田节节麦每株平均成穗为 4.2, 3 月 13 日施药田每株平均成穗为 2.3, 成穗减少率 为 45.2%。节节麦穗节数也明显减少, 对照区节节麦每穗平均节数为 9.5, 合 19 粒种子,

施药区每穗平均节数为 5.7,合 11.4 粒种子,节节麦种子减少率为 40%。则节节麦种子实际存量为(1-45.2%)×(1-40%)=32.9%。节节麦种子实际减少率为 1-32.9%=67.1%。

#### 2.2.3 单株干重明显减少

3月13日用药 (每亩20g 阔世玛),对照干重9.55g/单株,处理干重1.14g/单株,单株干重减少88.1%。3月28日用药,处理1.78g/单株,单株干重减少81.4%。4月6日用药,处理2.14g/单株,单株干重减少77.6%。3月28日,每亩25g 阔世玛处理干重1.00g,单株干重减少89.5%。

#### 3 结论与建议

#### 3.1 防治效果评价

从示范田和推广田调查数据看,秋末应用阔世玛防治节节麦、雀麦等禾本科杂草,能起到杀死杂草幼苗的作用,株防效达 99.1%,防治效果显著。春季(3 月底前)施用阔世玛每亩 20g 防治节节麦、雀麦,主要作用表现在对生长的抑制和干物质的减少上,节节麦干物质减少率为 81.4%~88.1%,节节麦种子减少率为 67.1%。禾清对节节麦、雀麦防治无效。阔世玛对荠菜、播娘蒿也有较好防控作用。春季不同用量不同时间之间对节节麦、雀麦防治效果有显著性差异。通过对后茬玉米出苗情况及生长情况观察,各不同处理均未发现异常。

#### 3.2 推广使用建议

- 3.2.1 秋末施用阔世玛对麦田节节麦、雀麦等禾本科杂草防除效果显著,并有兼治阔叶杂草的作用,建议大面积推广应用。每亩用量为 20g。
- 3.2.2 春季施用阔世玛或世玛防除麦田节节麦、雀麦等禾本科杂草效果较好,可基本控制 靶标作物危害。但由于对节节麦种子减少率仅为 67.2%,仍有一定数量种子残留于田间,对翌年杂草繁殖仍造成一定隐患。如失去秋末防治机会,可在春季作为补救措施。应用阔世玛每亩 20g 为宜,世玛每亩 30g 为宜。
- 3.2.3 要严格按照阔世玛和世玛药剂说明书施药。秋末施药最低温度低于 0℃施药后表现 无效。春季地表解冻后用药愈早效果愈好,一般最迟应掌握在 3 月底以前,以防产生药害。

# 广州地区菜心田杂草发生特点与防除现状\*

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摘要:本文对广州市郊规模化菜场菜心田杂草进行了调查,调查结果表明:杂草有 38 种,隶属于 18 科、27 属,其中恶性杂草为马齿苋,重要杂草有碎米莎草、马唐、凹头苋,常见杂草 7 种,一般杂草 27 种。对不同菜场菜心田杂草群落组成进行了调查,对广州地区菜心田杂草防治的现状以及恶性杂草为马齿苋成灾的现象进行了分析。

#### 1、广东蔬菜产业的结构特点

广东毗邻港澳和东南亚,水陆交通方便,加上特殊的气候优势,已成为我国蔬菜生产和出口的大省。广东蔬菜生产结构布局是主要市区的近郊以种植叶菜类为主,远郊以种植较耐运输的瓜、果、根、茎菜类为主。由于菜心是具有广东地方特色的蔬菜,因而成为出口和供港澳的重要叶菜品种,在广东主要城市近郊基本实现规模化、标准化和产业化生产。据统计,仅广州市近郊的番禺、花都和从化等地常年蔬菜生产基地叶菜种植生产面积在100亩(6.67hm²)以上的就有123个,其中1000亩(66.67hm²)以上的大型基地有14个,近年来一些新菜场叶菜种植面积还在不断扩大。

#### 2、广州市菜心田杂草发生种类及危害情况

菜心系十字花科芸苔属草本植物,品质脆嫩,风味独特,是华南地区特产蔬菜之一,品种繁多,四季栽培,常年生产供应。由于菜心田土壤肥沃,肥水充足,因此,田间杂草危害十分严重,特别是老菜场,由于叶菜生长期短,周年内的复种指数高,长期频繁地使用单一品种的除草剂,使得恶性杂草发生重、防除难,严重地影响了菜心的产量,草害已成为叶菜生产持续发展的重要限制因素之一。为此,笔者在菜心田杂草发生的高峰期6月至9月,对广州市的天河区、花都区、番禺区以及从化市区的7个规模化新老菜场菜心田进行系统调查,累计调查共63块菜心田,以样方(1m²)为单位,利用五点法取样,根据每种杂草的相对盖度、多度和高度的综合指标,计算杂草的相应优势度值,评价杂草的发生危害状况,明确菜心田杂草的群落组成,为生产上杂草的防除提供依据。

#### 2.1 杂草种类

调查结果表明,菜心田杂草有38种,隶属于18科、27属。其中单子叶杂草有3科8属13种;双子叶杂草有15科19属25种(见表)。其中莎草科、禾本科、苋科杂草种类最多,分别为6种、5种、5种,共占杂草种类总数的42.1%。

#### 2.2 杂草危害性分类

各菜场菜心田虽采取过各种防除杂草的措施,但在6至9月由于广东夏季高温、高湿、多雨的气候条件,仍有85%左右的田块受到不同程度的杂草危害,根据调查各菜场每种杂草总的优势度和频度值,将广州地区菜心田杂草划分为4种类型,即恶性杂草、重要杂草、常见杂草和一般杂草。

马齿苋(Portulaca olerace 优势度为 56.74%)为广州菜心田恶性杂草,在各菜场普遍发生,发生优势度和频度最高,对菜心生的生长发育和产量均产生显著影响,防除特别困难;其次是碎米莎草(Cyperus iria 优势度为 8.70%)、马唐(Digitaria sanguinalis 优势度为 6.38%)、凹头苋(Amaranthus lividus 优势度为 5.83%)为重要杂草,在各菜场发生优势度和频度较高,对菜心生的生长发育和产量有一定的影响,对其防除也较困难;日照飘拂草(Fimbristylis miliacea 优势度为 3.97%)、无芒稗(Echinochloa crusgali 优势度为 3.0%)、牛筋

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草(Eleusine indica 优势度为 2.18%)、皱果苋(Amaranthus viridis 优势度为 1.90%)、碎米芥(Cardamine hirsuta 优势度为 1.42%)、丁香蓼(Ludwigia prostrata 优势度为 1.23%)和千金子(Leptochloa chinensis 优势度为 1.00%)为常见杂草,在调查的各菜场虽都有发生,但优势度不大,对菜心产量影响较小;云南莎草(Cyperus duclouxii)、异型莎草(Cyperus difformis)、扁穗莎草(Cyperus compressus)、球柱莎草(Bulbostylis barbata)、香附子(Cyperus rotundus)、蚬子草(Leptochloa panica)、空心莲子草(Alternanthera philoxeroides)、莲子草(Alternanthera sessilis)、无瓣蔊菜(Rorippa dubia)、芥菜(Brassica juncea)、母草(Lindernia antipoda)、陌上菜(Lindernia procumbens)、石胡荽(Centipeda minima)、通泉草(Mazus japonicus)、泥花草(Lindernia antipoda)、鳢肠(Eclipta prostrata)、酸模叶蓼(Polygonum lapathifolium)、水蓼(Polygonum hydropiper)、铁苋菜(Acalypha australis)、鸭跖草(Commelina communis)、夏至草(Lagopsis supina)、伞房花耳草(Hedyotis corymbosa)、圆叶牵牛(Pharbitis purpurea)、小叶冷水花(Pilea microphylla)、圆叶节节菜(Rotala rotundifolia)、粟米草(Mollugo stricta)、肖梵天花(Urena lobata)等 27 种为一般杂草,在个别菜场局部发生,对菜心的生长影响极微。

## 2.3 杂草发生特点和群落组成

不同菜场由于建场年限、防除杂草的技术水平、耕作栽培的方式以及施肥与用药的不同,导致不同的蔬菜生产基地优势种杂草的群落结构组成的差异。广州番禺区东升菜场杂草群落为:马齿苋+无芒稗+马唐;花都区广州市蔬菜所基地为:马齿苋+碎米莎草+马唐;花都区晓利菜场为:马齿苋+碎米莎草+皱果苋;花都区会达菜场为:马齿苋+碎米莎草+日照飘拂草;花都区源丰菜场为:马齿苋+皱果苋+碎米莎草;广州天河区龙洞菜田为:马齿苋+凹头苋+碎米莎草;从化市从玉菜场为:马齿苋+日照飘拂草+马唐。

菜场年限越长,如花都区的会达菜场 10年,番禺区的东升菜场 8年,且菜心连作的田块,马齿苋危害越重。调查危害最重的田块平均每平方米样方马齿苋鲜重 580g,菜心鲜重 320g,马齿苋盖度达到 80%,造成菜心减产近 90%,有些田块几乎无收。

#### 3、防治现状及存在的问题分析

菜心田可供选择的除草剂品种较少,杂草防除难度大,菜心属小粒种子直播为主,对药剂较敏感,稍有不慎会影响菜心出苗。目前,生产上使用的除草剂以芽前土壤处理的品种为主,菜农普遍使用的除草剂是丁草胺、二甲戊乐灵,苗后茎叶处理的品种以防除禾本科杂草的品种为主,主要有盖尖、拿捕净、威霸、盖草能等。现使用的土壤处理剂对马齿苋的防效均不理想,适合菜田使用的防除马齿苋、莎草科杂草的苗后茎叶处理剂较少,因此各菜场投入菜心田的人工除草的劳力仍相当多,广州由于人力成本高,对于草害(主要是马齿苋)严重的田块,有些菜场选择放弃,无人清理,而6至9月正至马齿苋生长旺盛和开花结实的高峰期,大量的种子落入田块,结果导致菜场马齿苋危害越来越重。

广东菜心的栽培是各菜场一年四季均在不同时间段播种,以保证市场连续不断地供应菜心。4~9月菜心生长期为30~40天,因此,菜场的有些田块连续重复种植菜心,一年种9~10造,其操作顺序是: 先用克芜踪喷雾田块,清除杂草及废弃物,然后翻土、做垄、播种、喷药,而克芜踪并不能完全杀死马齿苋全株,翻土时较多的残体又被留在原田块,这也是导致菜场马齿苋危害越来越重的一个原因。

近两年,个别老菜场,如广州花都区的会达菜场、从化市的从玉菜场改变了耕作制度,在马齿苋危害重、防治难的时间段,即 4~9 月改种水稻或甜玉米,结果表明,水旱轮作的田块比旱-旱连作的田块,草害大大减轻,这或许与水稻种植时灌水淹渍土壤中旱生杂草包括马齿苋的繁殖体,导致其腐烂死亡,大大降低了杂草的种群数量有关,因此,利用水旱轮作方式,改变某些杂草延续的生存环境,不失为蔬菜生产基地控制恶性杂草的一种有效的农业措施。但研制开发适用于菜心田防除恶性杂草的除草剂,研究拓宽现有除草剂使用范围,探索其在菜心田的安全使用技术,对于提高菜场的经济效益仍是非常必要的。

## 百合根系分泌物对几种观赏植物的化感作用

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摘 要:用滤纸收集根系分泌物的方法,研究了波利安娜和白狐 2 个百合品种(供体)根系分泌物对莴苣、金鱼草、千日红、满天星等园艺植物(受体)的化感作用。结果表明:波利安娜百合根系分泌物对莴苣和满天星的根长和侧根数抑制作用达到显著水平,但对这两种受体植物的其他指标的抑制作用不显著;对金鱼草的化感抑制作用除发芽率和根鲜重未达显著水平外,其他指标均达显著水平;对千日红的化感抑制作用(根鲜重除外)达显著水平。因此莴苣和满天星可作为波利安娜百合的后茬作物;白狐根系分泌物对 4 种园艺植物的化感作用总体上表现为抑制作用,因此白狐百合后茬不宜种植这 4 种园艺植物。

关键词:百合;根系分泌物;化感作用

目前, 化感作用的研究主要集中在作物与杂草、森林演化及大田作物上, 对观赏植物的研究比较少, 实际上观赏植物的化感作用也是非常普遍的, 并且影响生产。近几年的一些研究表明, 一些重要观赏植物确实存在着化感作用, 如万寿菊<sup>[1]</sup>, 向日葵<sup>[2]</sup>等。

百合对"重茬"的敏感性远远高于其他花卉作物。一般情况下,种植了一茬百合的地块,至少要间隔一年才可再种百合<sup>[3]</sup>。董沁方等研究表明,百合地上部水浸液对几种蔬菜受体植物表现出不同程度的抑制作用<sup>[4]</sup>,但关于百合根系分泌物的化感效应的研究还未见报道。本试验通过对百合根系分泌物化感效应的研究,探讨百合根系分泌物对供试受体植物是否有化感作用,为百合的产业化生产选择后茬作物提供一定的科学依据。

#### 1 材料与方法

#### 1.1 试验材料

供体材料百合(*Lilium brownii*)有2个品种,分别为波利安娜(Pollyanna)和白狐(White fox)。受体植物有金鱼草(*Antirrhinum majus*)、千日红(*Gomphrena globosa*)、满天星(*Gypsophila elegans*)和莴苣(*Lactuca sativa*)。百合种球购于甘肃临洮美兰有限公司,千日红购于农友种苗(中国)有限公司,金鱼草、满天星、莴苣购于芳萱苑种子公司。

#### 1.2 试验方法

- **1.2.1** 供试材料的培养 试验于2007年在西北农林科技大学园艺学院农业部西北园艺植物种质资源重点实验室进行。3月20日播种种球,每盆2株,盆栽基质为珍珠岩,培养期间,每3d浇一次自来水。待百合开始现蕾时,为所需植株。
- 1.2.2 获得根系分泌物 5 月 14 日将开始现蕾并产生了大量新根的百合植株从基质中取出,用自来水清洗附着在根系上的基质,待用。将百合根系均匀的摆放在铺有 3 层滤纸的直径为 10 cm 的塑料盒中(每个塑料盒放一株百合),再用一层滤纸将根盖住,浇 20 mL 自来水。在塑料盒的上方,用硬纸片将百合植株固定。以后每 3 d 浇 10 mL 自来水,确保不让滤纸变干。15 d 后将百合取出,此时 4 层滤纸上已含有百合根系分泌物,将其铺在培养皿中,生物测试时用。
- **1.2.3** 生物测定 在铺有 4 张直径 9 cm 定性滤纸的培养皿中,每皿加 10 mL 自来水,在滤纸上播种受试植物种子,种子选择均匀饱满的,播种前用 10%H<sub>2</sub>O<sub>2</sub> 消毒处理 5 min。莴苣、金鱼草每皿播 50 粒种子,千日红、满天星每皿播 30 粒种子。各处理 3 个重复,在温度 24~

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26℃,光照 4000 lx 条件下培养,每 3 d 每皿补充自来水 5 mL。以铺有新的,干净的 4 层滤纸为对照,铺上面含有百合根系分泌物的 4 层滤纸为处理。

**1.2.4** 测定项目及数据统计分析 自培养之日起,常规方法记录受体种子的发芽数,当大部分受体种子的两片子叶完全展开时,常规方法测定幼苗的苗高、根长、每株侧根数、地上部和地下部的鲜重。.

参照 Williamson<sup>[9]</sup>等的方法,采用化感效应指数(RI)进行化感作用分析。化感效应指数计算式为: RI=1-C/T(当 T≥C), RI=T/C-1(当 T<C 时)。其中,C 为对照值,T 为处理值,RI 为化感作用效应,RI>0 为促进作用,RI<0 为抑制作用。绝对值大小与作用强度一致。采用 DPS 软件进行数据的统计和方差分析。

#### 2 结果与分析

#### 2.1 百合根系分泌物对受试作物种子发芽的影响

由表 1 可以看出,百合根系分泌物对不同受试作物种子的发芽率和发芽指数有不同的影响。波利安娜百合对 4 种受试作物的发芽率和发芽指数均有一定的抑制作用,与对照相比,对莴苣、满天星发芽率和发芽指数的抑制作用未达显著差异;对金鱼草发芽率的抑制未达显著水平,但对发芽指数的抑制达显著水平;对千日红发芽率和发芽指数均有极显著抑制作用;而白狐百合对莴苣的发芽率表现为既不促进也不抑制,发芽指数表现抑制作用,但未达显著水平;对满天星、千日红、金鱼草的发芽率和发芽指数均有极显著抑制作用。

表 1 百合根系分泌物对受试作物种子发芽的影响

Table 1 Effect of lily root exudates on seed germination of the receiver crops

处理		发芽率 (%)	Germination rate			发芽指数	Germination in	dex
Treatment	莴苣	满天星	千日红	金鱼草	莴苣	满天星	千日红	金鱼草
	Lettuce	Starriness	Gomphrena	Snapdragon	Lettuce	Starriness	Gomphrena	Snapdragon
CK	97.3aA	92.2aA	53.3aA	65.3aA	59.10aA	31.97aA	10.60aA	31.22aA
P	94.3aA	90.0aA	32.2bB	56.7aAB	57.78aA	30.74aA	4.53bB	21.00bB
W	97.3aA	65.6bB	31.0bB	41.3bB	58.09aA	24.52bB	5.53bAB	12.78cC

CK: 对照 control; P: 波利安娜 Pollyanna; W: 白狐 White Fox

注:同列数据后标相同小写字母表示在 P=0.05 水平上无显著差异,大写字母表示在 P=0.01 水平上无显著差异,下表同。 Note: Data followed by lowercases are not significantly different at P=0.05,data followed by capital letters are not significantly different at P=0.01. The following table is same.

#### 2.2 百合根系分泌物对受试作物幼苗生长的影响

由表 2 可以看出,百合根系分泌物对受试作物幼苗生长均表现出化感抑制作用。波利安娜根系分泌物对受试作物幼苗生长的影响,与对照相比,对金鱼草、千日红的苗高生长有显著的抑制作用,对莴苣和满天星也表现出抑制作用,但差异不显著;对 4 种受试作物根长生长,都表现出极显著的抑制作用。白狐百合根系分泌物对受试作物苗高生长的影响,与对照相比,对莴苣、满天星、金鱼草有极显著的抑制作用,对千日红则表现为既不促进也不抑制;对四种受试作物根长生长的影响都表现出极显著的抑制作用。

表 2 百合根系分泌物对受试作物幼苗生长的影响

Table 2 Effect of lily root exudates on seedling growth of the receiver crops

处理 _	苗高(cm) Shoot height					根长(cm) Root length			
Treatment	莴苣	满天星	千日红	金鱼草		莴苣	满天星	千日红	金鱼草
	Lettuce	Starriness	Gomphrena	Snapdragon		Lettuce	Starriness	Gomphrena	Snapdragon
CK	1.89aA	1.49aA	1.32aA	1.98aA		2.22aA	1.84aA	2.11aA	2.62aA
P	1.75aA	1.54aA	1.10bA	0.78bB		1.33bB	1.09bB	1.26bB	1.02bB
W	1.29bB	0.54bB	1.32aA	0.96bB		1.49bB	0.64cC	0.88cC	0.90bB

#### 2.3 百合根系分泌物对受试作物幼苗鲜重的影响

由表 3 可以看出,百合根系分泌物对受试作物幼苗鲜重的影响不尽相同。波利安娜根系分泌物对莴苣、满天星的地上部鲜重起促进作用,根鲜重起抑制作用,对千日红、金鱼

草的地上部鲜重有显著的抑制作用,但对根鲜重的抑制作用,未达显著水平。白狐根系分泌物对莴苣的地上部鲜重的抑制作用,未达显著水平,但对莴苣的根鲜重有显著的抑制作用;对满天星的地上部、根鲜重均有显著的抑制作用;对千日红的地上部、根鲜重均无显著差异;对金鱼草的地上部鲜重有显著差异,但对根鲜重的差异未达显著水平。

#### 表 3 百合根系分泌物对受试作物幼苗鲜重的影响

Table 3 Effect of lily root exudates on seedling fresh mass of the receiver crops

处理	地上部鲜重 Top fresh mass(mg/5plant)					根鲜重 Root fresh mass(mg/5plant)				
Treatment	莴苣	满天星	千日红	千日红 金鱼草		莴苣	满天星	千日红	金鱼草	
	Lettuce	Starriness	Gomphrena	Snapdragon		Lettuce	Starriness	Gomphrena	Snapdragon	
CK	0.109abA	0.056aA	0.057aA	0.031aA		0.028aA	0.009aA	0.005aA	0.004abA	
P	0.118aA	0.061aA	0.049bA	0.015cC		0.021abA	0.007abA	0.003aA	0.005aA	
W	0.097bA	0.047bB	0.053abA	0.020bB		0.015bA	0.005bA	0.003aA	0.002bA	

#### 2.4 百合根系分泌物对受试作物侧根数的影响

由表 4 可以看出,百合根系分泌物对受试作物侧根数的影响表现不一致。波利安娜对受试作物侧根数均表现化感抑制作用。白狐对莴苣和金鱼草表现出化感促进作用,而且与对照差异显著,对千日红和满天星有显著的抑制作用。

表 4 百合根系分泌物对受试植物侧根数的影响

Table 4 Effect of lily root exudates on lateral root number of the receiver crops

处理 Treatment	莴苣 Lettuce	满天星 Starriness	千日红 Gomphrena	金鱼草 Snapdragon
СК	2.4 bB	1.9 aA	3.0 aA	2.0 bB
P	0.5 cC	0.8 bAB	1.4 bB	1.2 cC
W	3.4 aA	0.0 cB	0.8 bB	2.2 aA

#### 2.5 百合根系分泌物对受试作物的化感效应

由表 5 可以看出,亚洲百合根系分泌物对莴苣、满天星、千日红、金鱼草的发芽及幼苗生长均有不同程度的化感效应,总体上抑制作用要大于促进作用。从 4 种作物来看,波利安娜根系分泌物对莴苣的地上部鲜重,满天星的苗高、地上部鲜重的化感效应指数为正值,即 RI>0,化感效应表现为促进作用。而对莴苣和满天星的其他指标以及千日红和金鱼草的所有指标的化感效应指数为负值,即 RI<0,化感效应表现为抑制作用。表明波利安娜根系分泌物可以提高莴苣和满天星地上部有机物质的积累。

表 5 波利安娜百合根系分泌物对受试作物的化感效应指数

Table 5 The allelopathic index of lily cv. Pollyanna root exudates on receiver crops

受试作物 Receiver crops	发芽率	发芽指数	苗高	根长	地上部鲜重	根鲜重	侧根数
	Germination	Germination	Shoot height	Root	Top fresh mass	Root fresh mass	Number
	rate(%)	index	(cm)	length(cm)	(mg/5plant)	(my/5plant)	of lateral root
莴苣 Lettuce	-0.031	-0.022	-0.074	-0.401	0.076	-0.250	-0.857
满天星 Starriness	-0.024	-0.038	0.032	-0.408	0.082	-0.222	-0.572
千日红 Gomphrena	-0.396	-0.573	-0.167	-0.403	-0.140	-0.400	-0.533
金鱼草 Snapdragon	-0.132	-0.327	-0.606	-0.611	-0.516	0.200	-0.400

由表 6 可以看出,白狐根系分泌物对四种受试作物的发芽和幼苗生长也有不同程度的化感效应,总体表现为抑制作用大于促进作用。白狐根系分泌物对莴苣的发芽率和千日红的苗高的化感作用表现出既不抑制也不促进;莴苣和金鱼草的根条数的化感效应指数为正值,即 RI>0,化感效应表现为促进作用,而对其他指标以及满天星的所有指标的化感效应指数为负值,即 RI<0,化感效应表现为抑制作用。

#### 表 6 白狐百合根系分泌物对受试作物的化感效应指数

#### Table 6 The allelopathic index of lily cv. White Fox root exudates on the receiver crops

受试作物	发芽率(%)	发芽指数	苗高(cm)	根长(cm)	地上部鲜重	根鲜重	侧根数
	Germination	Germination	Shoot	Root	(mg/5plant)	(mg/5plant)	Number of
Receiver crops	rate	index	height	length	Top fresh mass	Root fresh mass	lateral root
莴苣 Lettuce	0.000	-0.017	-0.3174	-0.329	-0.110	-0.464	0.588
满天星 Starriness	-0.289	-0.233	-0.638	-0.652	-0.161	-0.444	-1.000
千日红 Gomphrena	-0.418	-0.478	0.000	-0.583	-0.070	-0.400	-0.733
金鱼草 Snapdragon	-0.368	-0.591	-0.516	-0.656	-0.355	-0.500	0.091

#### 3 讨论

目前,根系分泌物的收集主要采用溶剂浸提、水培、基质培等方法<sup>[10]</sup>。化感物质是经自然途径进入环境的化学物质,因此在研究方法上应该高度注意溶剂和浓度。在自然状态下,除了水以外,不可能有其他溶剂将植物中的化学物质淋溶出来;在自然状态下,化感物质作用的最高浓度只能是其在水中的饱和溶解度。考虑到以上两个因素,本试验采用滤纸收集根系分泌物的方法,具有直接性。

本试验中两个百合品种的根系分泌物表现出的抑制作用要大于促进作用。百合根系分泌物对不同受体植物以及同种受体植物不同器官表现出了不同的化感效应,这可能是因为同一作物的化感物质对不同植物的化感效应不同,同种植物不同器官的敏感性不同。波利安娜根系分泌物对莴苣和满天星的根长和侧根数的抑制作用达到显著水平,但对这两种受体植物的其他指标的抑制作用均未达显著水平,对金鱼草的化感抑制作用除发芽率和根鲜重未达显著外,其他指标均达显著水平,对千日红的化感抑制作用(根鲜重除外)均达显著水平,因此莴苣和满天星可作为波利安娜百合的后茬作物。白狐百合根系分泌物对4种受体植物在很大的程度上都表现出了显著的抑制作用,虽然白狐百合根系分泌物促进了莴苣和金鱼草侧根的发生,但在幼苗生长中并没有表现出促进作用,甚至表现为抑制作用,且差异显著。所以这4种受体作物都不适宜做白狐百合的后茬作物。

波利安娜和白狐百合的根系分泌物对各受体作物的根长都有显著的抑制作用,这可能是因为根系直接接触到了百合分泌的化感物质,这些化感物质对根系的生长有抑制作用。

采用滤纸收集根系分泌物的方法,具有直接性,但在试验中发现,供体植物很可能因为缺乏营养而无法正常生长,从而影响试验进行。本试验的供体植物是百合,百合的鳞茎储存了大量的营养物质,因此在只有水供给的情况下,可以正常生长约 20 d,但对于非球根花卉来说,可能该方法就有一定的局限性。

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## 大蒜秸秆对番茄的化感作用及化感物质初步鉴定<sup>\*</sup>

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摘 要:通过发芽试验和水培试验,研究了大蒜秸秆水浸液对番茄发芽和幼苗生长的化感作用。结果表明,在 0.005 g·ml<sup>-1</sup>浓度下,大蒜对番茄发芽率、发芽指数和苗高、鲜重、根长、根鲜重表现化感促进作用;从浓度 0.02 g·ml<sup>-1</sup>开始表现化感抑制作用。水培试验中番茄幼苗 CAT、SOD、POD 活性随着大蒜浓度的增加呈现先降低后升高再急剧降低的趋势;大蒜浓度在 0.005 g·ml<sup>-1</sup>时 MDA 含量最低及PAL 和 PPO 活性呈现最低,根系活力最高。GC-MS 鉴定初步确定化感物质有 2-甲氧基-1,6-己二酸甲酯、邻苯二甲酸二丁酯等有机酯类,3-甲氧基-4-羟基-苯甲酸、对羟基苯甲酸等有机酸,以及对甲氧基苯酚等酚类化合物。

关键词: 大蒜秸秆,番茄,化感作用,化感物质

化感作用又称他感作用,是由德国科学家 Molish 1973 年首次提出,用以表达不同种属 间的植物在化学方面的相互作用,这种相互作用包括相互促进和抑制两方面。Rice(1974 年)在他的专著《Allelopathy》中对化感作用的定义为:一种植物(包括微生物)通过向环境释放化学物质而对另一种植物(包括微生物)产生直接或间接的有益或有害的作用。化感物质释放的途径有四种,挥发、淋溶、根的分泌和植株残体的腐解<sup>[1]</sup>。

近年来对植株残体腐解的化感作用研究较多。Borner 发现大麦、黑麦和小麦秸秆的水提物中对羟基苯甲酸、阿魏酸、香豆酸等化感物质在水培低浓度时,能抑制小麦根的生长;番茄植株水浸液对黄瓜、萝卜、生菜、白菜、包心菜的幼苗均有显著的抑制作用<sup>[2]</sup>;银胶菊残体腐解产生的反式肉桂酸抑制番茄幼苗的生长。同时,残体腐解也是多种作物连作障碍主因之一。

大蒜为百合科葱属植物,具有很好的药用价值。秸秆是大蒜生产的副产品,在大蒜产区来源丰富。 大蒜秸秆在田间可能受雨水或灌溉水浸淋而向土壤中释放其有效成分,并通过化感作用方式而影响土 壤微生物和田间生长的植物。因此,研究大蒜秸秆水浸液的化感作用,鉴定化感物质,将有助于揭示 大蒜种植茬口为什么是其他作物种植的良好前茬(土传病害轻,作物生长好)。

番茄是重要的蔬菜作物,由于自毒作用<sup>[2]</sup>致使其连作障碍问题突出。生产经验表明,与大蒜轮作可以有效克服番茄连作障碍,但对其机理尚缺乏研究。采用大蒜秸秆水浸提法模拟植株残体腐解,研究大蒜对番茄的化感作用,分离鉴定化感物质,有助于揭示大蒜对番茄的前茬效应机理,并为生产中合理轮作和间套作提供理论依据。

## 1 材料和方法

#### 1.1 材料

以大蒜 (Allium sativum L, 苍山大蒜)为供试作物,番茄(Lycopersicon esculentum M., 农城 906) 为受试作物。

#### 1.2 生物测定

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#### 1.2.1 供试材料的培养

供试大蒜秸秆来自于西北农林科技大学园艺场种植的大蒜,在大蒜收获时取其秸秆用清水洗净, 105℃杀青 0.5 h 后 65℃烘干,粉碎保存备用。

#### 1.2.2 大蒜秸秆水浸液的制备

分别称取大蒜秸秆干粉样 40~g 放入三角瓶中,加清水 1000ml 封口,置摇床上 25~℃,160~ r·min<sup>-1</sup> 浸提 48~h,真空抽虑即得浓度为 0.04~g·ml<sup>-1</sup> 的水浸原液。将原液分别配成 0.005,0.01,0.02,0.03,0.04~g·ml<sup>-1</sup> 的系列浓度,进行种子发芽和幼苗生长处理试验。

#### 1.2.3 种子萌发试验

番茄种子用 0.3%高锰酸钾溶液浸泡 10 min 消毒,蒸馏水冲洗  $2\sim3$  次。在铺有 2 张滤纸的培养皿中播放番茄种子 60 粒,每皿加 8 ml 各浓度大蒜溶液(以清水为对照),以后每 2 d 添加 2 ml 相应浓度的大蒜液,重复 4 次,在 25 ℃,4000 Lx 光照下培养,每天调查种子的发芽数,14 d 计算发芽率、发芽指数,测量地上部长、根长和鲜重。

种子发芽标准为芽长达种子长度的一半;发芽指数=∑(Gt/Dt),Gt 为第 t 天的发芽数,Dt 为相应的发芽天数。

化感效应分析参照 Yu JQ<sup>[3]</sup>和 Komada H<sup>[4]</sup>的化感效应指数(RI)进行。当 T $\geq$ C 时,RI=1-C/T;当 T $\leq$ C 时,RI=T/C-1,其中 C 为对照值,T 为处理值,RI 为化感效应指数。RI>0 为促进作用,RI<0 为抑制作用,绝对值大小与作用强度一致。

#### 1.2.4 水培试验

将 0.10 g·ml<sup>-1</sup> 的大蒜秸秆水浸原液用 1/2 剂量的 Hogland and Snyder 营养液配制成 0.005 g·ml<sup>-1</sup>, 0.01 g·ml<sup>-1</sup>, 0.02 g·ml<sup>-1</sup>, 0.03 g·ml<sup>-1</sup>, 0.04 g·ml<sup>-1</sup> 的系列处理浓度备用。

挑选大小一致的番茄种子消毒催芽后 25 °C恒温内基质中培养至幼苗 3 叶期,移栽于 1/2 剂量的 Hoglandand Snyder 营养液中培养 7 d,分别更换为含 0,0.005,0.01,0.02,0.03,0.04 g·ml<sup>-1</sup> 大蒜水浸液的营养液,2 d 后测定生理生化指标。用高俊凤 <sup>[5]</sup>的 TTC 还原法测定根系活力和丙二醛(MDA)含量;用 NBT 还原法测定超氧化物歧化酶(SOD)活性;用愈创木酚法以单位时间内  $OD_{470}$  值变化 0.01 为一个酶活单位测定过氧化物酶(POD)活性,以  $OD_{240}$  值变化 0.01 为一个酶活单位测定过氧化氢酶(CAT)活性  $OD_{398}$  值变化 0.01 为 1 个酶活单位测定多酚氧化酶(PPO)活性。樊自红等  $OD_{399}$  变化 0.01 为 1 个酶活单位测定多酚氧化酶(PPO)活性。樊自红等  $OD_{399}$  变化 0.01 为 1 个酶活单位测定苯丙氨酸解氨酶(PAL)活性。

#### 1.3 化感物质的分离鉴定

#### 1.3.1 有机提取物的提取

取  $0.10 \text{ g·ml}^{-1}$  大蒜水浸原液 125 ml 加入 250 ml 分液漏斗中,按有机溶剂极性依次用等体积的石油 醚、三氯甲烷、乙酸乙酯萃取,每次萃取 5 h,3 种萃取液的有机相在旋转蒸发仪上(30 C)真空减压浓缩至 5 ml,4 C 冰箱保存备用。

#### 1.3.2 水浸液提取组分的 GC-MS 分析

采用 GC-MS(GC 为 Agilent 6890, MS 为 HP5973)鉴定化感物质的成分<sup>[9]</sup>。GC-MS 分析条件如下:

**色谱条件**: 毛细管柱: HP-5 (Crosslinked 5% pH ME Siloxanle, 30 m×0.25 mm×0.25 μm); 进样口温度 250℃; 程序升温: 柱温 50℃ (2 min), 以 6 ℃·min<sup>-1</sup>程序升温至 250℃(保持 15 min); 载气: He; 流速: 1.0 ml·min<sup>-1</sup>。

**质谱条件**: EI 源(电子轰击源); 轰击电压 70 eV; 扫描范围 m/z: 30~600amu.; 扫描速度 0.2 s 扫全程; 离子源温度: 230℃; 四极杆温度: 150℃。进样量: 1 μl。不分流进样。应用 NIST98 质谱数据

库,分析质谱图,确定各组分物质名称。

## 2 结果分析

#### 2.1 大蒜秸秆水浸液对番茄种子萌发的化感效应

由表 1 可知,大蒜秸秆水浸液浓度在  $0.005~g\cdot ml^{-1}$ 时对番茄发芽率和发芽指数促进作用最强,化感效应指数分别为 0.0528 和 0.0491; 浓度达  $0.02~g\cdot ml^{-1}$ 时开始表现抑制作用,并随着浓度的增大,抑制作用增强,浓度达  $0.04~g\cdot ml^{-1}$ 时化感效应指数分别为-0.1661 和-0.5761。

对番茄的地上部长和鲜重表现高浓度抑制低浓度促进的双重效应,以 0.01 g·ml<sup>-1</sup> 为转折点,在 0.01g·ml<sup>-1</sup>时地上部长虽然比对照大,但其鲜重低于对照,且达到极显著差异水平; 0.04 g·ml<sup>-1</sup>时对地上 部长和鲜重的化感效应指数分别为-0.5622 和-0.6169,抑制作用最强。大蒜秸秆水浸液对番茄根长及其鲜重的化感效应与对地上部长和鲜重的趋势一致。

#### 2.2 大蒜秸秆水浸液对番茄幼苗的化感效应

#### 2.2.1 对保护酶体系的影响

由图 1 可以看出,番茄幼苗中保护酶 CAT、SOD 和 POD 的活性随大蒜秸秆水浸液浓度升高呈现 先降低升高后再急剧降低的趋势。这可能是由于在 0.005 g·ml<sup>-1</sup> 浓度下,化感物质促进番茄的生长,SOD 活性较低,随着化感物质浓度的增加,植株受到胁迫,启动保护酶系统对植株的保护作用。当浓度达到 0.03 g·ml<sup>-1</sup> 时,化感胁迫作用已经超出了保护酶体系的保护范围,因此 SOD 的活性急剧降低。

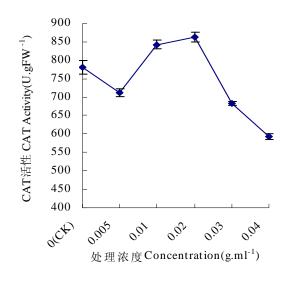
#### 表 1 大蒜秸秆水浸液对番茄种子萌发的化感作用

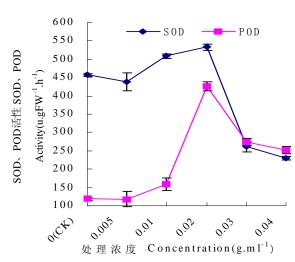
Table 1 Allelopathy of garlic plant water immersion on tomato seed germination

处理浓度	发芽率	发芽指数	地上部长	根长	地上部鲜重	根鲜重
Concentration	Germination	Germination	Top length	Root length	Top fresh	Root fresh
$(g \cdot ml^{-1})$	rate(%)	index	(cm)	(cm)	weight(g)	weight(g)
0	82.5 a AB	29.82 a A	1.85 b BC	10.01 b AB	0.201 a A	0.117 ab AB
0.005	87.1 a A	31.36 a A	2.54 a A	11.44 a A	0.249 a A	0.136 a A
0.01	83.3 a AB	30.12 a A	2.31 a AB	8.19 c BC	0.160 b B	0.115 b AB
0.02	80.0 a AB	21.36 b B	1.67 b CD	7.35 c C	0.152 b BC	0.106 b B
0.03	79.2 ab AB	16.73 c C	1.25 c DE	3.94 d D	0.129 c C	0.068 c C
0.04	68.8 b B	12.64 d C	0.81 d E	1.37 e E	0.077 d D	0.044 d C

注:表中数字后小写和大写英文字母分别表示 LSR 测验 5%和 1%水平的差异显著性。

Note: The little and capital English letters indicate the difference in 5% and 1% level, respectively, by LSR test.





#### 2.2.2 对丙二醛含量和根系活力的影响

由图 2 可以看出,番茄 MDA 含量在大蒜水浸液浓度 0.01 g·ml<sup>-1</sup> 时最低,0.04 g·ml<sup>-1</sup> 时达到最高。这是由于当大蒜处理液浓度小于 0.02 g·ml<sup>-1</sup> 时,大蒜化感效应表现为促进,并且在保护酶系的保护范围内,MDA 的含量比对照低;当大蒜处理液浓度大于 0.02 g·ml<sup>-1</sup> 时,化感抑制效应使得膜脂过氧化程度增强,同时保护酶系的综合保护能力降低,MDA 含量逐渐增加,标志着细胞受伤害的程度加剧。

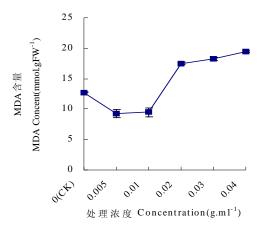


图 2 大蒜秸秆水浸液对番茄 MDA 含量的影响 Fig. 2 Effect of garlic extracts on MDA in tomato

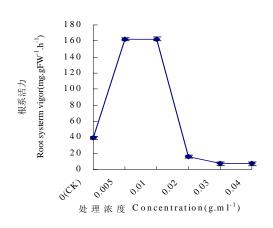


图 3 大蒜秸秆水浸液对番茄根系活力的影响 Fig.3 Effect of garlic extracts on root vigor in tomato

由图 3 可以看出,从 0.01 g·ml<sup>-1</sup> 开始,随着大蒜处理液浓度的升高,番茄根系活力逐渐降低,这可能是由于化感胁迫效应已经超出植株的自我防御能力,植株不能维持正常的生长。

#### 2.2.3 对番茄 PAL 和 PPO 的影响

PAL 在植物次生生化代谢中具有极重要的地位。由图 4 可以看出,随着化感物质浓度的升高,番茄 PAL 都呈现先降低后升高的趋势。这可能是因为化感物质在低浓度时化感效应呈现促进作用,植株次生代谢状况趋于平衡,PAL 的活性较对照低;然而随着化感物质浓度的升高,植株受到胁迫,体内次生代谢紊乱,引发了PAL 的活性升高以加速次生代谢物的代谢,以保证植株正常生长。

PPO 能使一元酚和二元酚氧化生成醌,而醌类物质可抑制植物不定根的产生,使植物渐趋死亡,即过高的多酚氧化酶活性对植物生长不利。由图 5 可以看出,大蒜秸秆水浸液浓度在 0.005 g·ml<sup>-1</sup> 时,PPO 活性较对照低,随着大蒜浓度的增加,PPO 活性升高并高于对照,在 0.04 g·ml<sup>-1</sup> 时达到最高点。

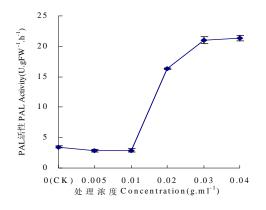


图 4 大蒜秸秆水浸液对番茄 PAL 的影响 Fig.4 Effect of garlic extracts on PAL in tomato

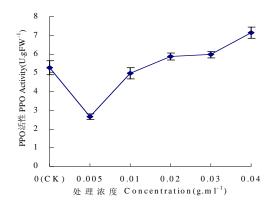


图 5 大蒜秸秆水浸液对番茄 PPO 的影响 Fig.5 Effect of garlic extracts on PAL in tomato

#### 2.3 大蒜秸秆水浸液中化感物质的初步鉴定

将大蒜秸秆水浸液石油醚、三氯甲烷、乙酸乙酯 3 种萃取组分, 经 GC-MS 分析鉴定, 应用 NIST98 质谱数据库分析质谱图, 结合人工解析核对, 初步确认其中的化合物。

由表 2 和图 6 可以看出,大蒜秸秆水浸液石油醚组分的可能抑菌化感物质按出峰顺序有: 2-丙烯酸环氧乙烷甲酯、3-甲基-4-庚酮、2-甲氧基-1,6-己二酸甲酯、甾酮、2,5-二甲基-2-正己醇、2-羟基-苯甲酸甲酯、邻苯二甲酸丁酯-2-炔-1-丁酯等。按其含量在 1%以上且由高到低的顺序,主要有甾酮、2,5-二甲基-2-正己醇、2-甲氧基-1,6-己二酸甲酯等。

表 2 石油醚组分 GC-MS 鉴定结果分析

Table 2 The petroleum ehter component GC-MS determination result analyzes

鉴定物质 Appraisal material		分子式	百分含量	保留时间
		Molecular	%	Retain
		formula	Percentage	time(min)
2-丙烯酸环氧乙烷甲酯	2-Propenoic acid, oxiranylmethyl ester	$C_6H_8O_3$	0.24	8.32
3-甲基-4-庚酮	4-Heptanone, 3-methyl-	$C_8H_{16}O$	0.36	8.72
2-甲氧基-1,6-己二酸甲酯	Dimethyl 2-methoxyhexane-1,6-dioate	$C_8H_{18}O_2$	1.95	9.34
甾酮	Testosterone	$C_{19}H_{28}O_2$	8.03	9.66
甲苯	Toluene	$C_7H_8$	0.04	10.56
烯丙基二硫化物	Diallyl disulphide	$C_6H_{10}S_2$	0.04	11.15
2,5-二甲基-2-正己醇	2-Hexanol, 2,5-dimethyl-, (S)-	$C_8H_{18}O$	4.89	11.88
2-羟基-苯甲酸甲酯	Benzoic acid, 2-hydroxy-, methyl ester	$C_8H_8O_3$	0.01	13.47
邻苯二甲酸丁酯-2-炔-1-丁酯	Phthalic acid, isobutyl tridec-2-yn-1-yl ester	$C_{25}H_{36}O_4$	0.05	26.67

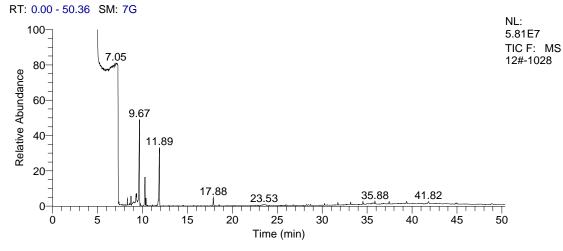


图 6 石油醚组分 GC-MS 分析图谱

Fig. 6 Petroleum aether component GC-MS analysis atlas

由表 3 和图 7 可以看出,大蒜秸秆水浸液三氯甲烷组分的可能化感物质按出峰顺序有:烯丙基二硫化物、对甲氧基苯酚、2-羟基二丁酸二甲酯、3-乙烯基 1,2-硫环戊 4-烯、苯甲酸 2-己烯酯、2-甲氧基 -5-(1-丙烯)基苯酚、香草醛、二十七烷等。按其含量在 1%以上且由高到低的顺序,主要有二十七烷、烯丙基二硫化物、3-乙烯基 1,2-硫环戊 4-烯、2-羟基二丁酸二甲酯等。

#### 表 3 三氯甲烷组分 GC-MS 鉴定结果分析

Table 3 The chloroform component GC-MS determination result analyzes

		分子式	含量	保留时间
鉴定物质	Appraisal material	Molecular	Percenta	Retain
		formula	ge(%)	time(min)
烯丙基二硫化物	Diallyl disulphide	$C_6H_{10}S_2$	2.99	8.76
对甲氧基苯酚	Mequinol	$C_7H_8O_2$	0.25	9.12
2-羟基二丁酸二甲酯	Butanedioic acid, hydroxy-dimethyl ester	$C_6H_{10}O_5$	2.33	9.30
3-乙烯基-1,2-硫环戊-4-烯	3-Vinyl-1,2-dithiacyclohex-4-ene	$C_6H_8S$	2.88	11.34
苯甲酸 2-己烯酯	Phenol, 2-methoxy-3-(2-propenyl)-	$C_{13}H_{16}O_2$	0.08	12.38
2-甲氧基-5-(1-丙烯)基苯酚	Phenol, 2-methoxy-5-(1-propenyl)-, (E)-	$C_{10}H_{12}O_2$	0.19	15.14
香草醛	Vanillin	$C_8H_8O_3$	0.30	16.35
1,5,5 三甲基-6-丙基酮环己烯	Cyclohexene1,5,5-methyl-6-acetylmethyl	$C_{12}H_{20}O$	0.05	17.67
红没药烯-环氧化物	cis-Z-à-Bisabolene epoxide	$C_{15}H_{24}O$	3.18	21.56
利福霉素	Rifamycin	$C_{37}H_{47}NO_{12}$	1.57	24.03
1-甲氧基-六氢-2-萘酮	2-Naphthalenone-hexahydro-1-methoxy	$C_{11}H_{16}O_2$	1.61	26.48
2,6,10-三甲基十四烷	Tetradecane, 2,6,10-trimethyl	$C_{17}H_{36}$	2.27	28.30
8-己基十五烷	Pentadecane, 8-hexyl-	$C_{21}H_{44}$	2.69	29.79
9-辛基十七烷	Heptadecane, 9-octyl-	$C_{25}H_{52}$	2.82	31.22
二十九烷	Nonacosane	$C_{29}H_{60}$	3.06	32.60
二十七烷	Heptacosane	$C_{27}H_{56}$	3.70	33.96
三十七醇	1-Heptatriacotanol	$C_{37}H_{76}O$	0.73	36.94
1,54-二溴五十四烷	Tetrapentacontane, 1,54-dibromo-	$C_{54}H_{108}Br_2$	3.57	37.55
1-氯二十七烷	Heptacosane, 1-chloro-	$C_{27}H_{55}Cl$	3.98	40.07
三十五烯	17-Pentatriacontene	$C_{35}H_{70}$	4.07	43.29

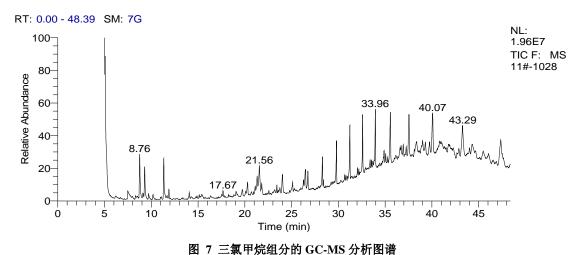


Fig.7 Chloroform component GC-MS analysis atlas

由表 4 和图 8 可以看出, 大蒜秸秆水浸液乙酸乙酯组分的可能化感物质按出峰顺序有: 二甲苯、苯 甲酸己烯酯、2一羟基十四酸、苯酚、烯丙基二硫化物、3一十二炔、3,4-二甲基噻吩、对异丙基苯酚、2, 6-二叔丁基对苯醌、2,6-二叔丁基-对甲苯酚、4,4'-叔丁基二苯酚、3-甲氧基-4-羟基-苯甲酸、对羟基苯 甲酸、对甲氧基苯酚、连二环戊2一烯-4一酮、邻苯二甲酸二丁酯、二十七烷、紫菌红素乙等。按其含量 在 1%以上且由高到低的顺序,主要有邻苯二甲酸二丁酯、3-甲氧基-4-羟基-苯甲酸、2,6-二叔丁基-对甲苯 酚、对羟基苯甲酸、对甲氧基苯酚、连二环戊2-烯-4-酮、二十七烷等。

#### 表 4 乙酸乙酯组分 GC-MS 鉴定结果分析

Table 4 The ethyl acetate component GC-MS determination result analyzes

در جازا	Politica .	分子式	百分含量	保留时间
签为	足物质 Appraisal material	Molecular	% D	Retain
→ m #r	Y7.1	formula	Percentage	time(min)
二甲苯	p-Xylene	$C_8H_{10}$	0.22	5.96
苯甲酸己烯酯	E-2-Hexenyl benzoate	$C_{13}H_{16}O_2$	0.08	7.61
2一羟基十四酸	Tetradecanoic acid, 2-hydroxy-	$C_{14}H_{28}O_3$	0.15	8.30
苯酚	Phenol	$C_6H_6O$	0.36	9.67
烯丙基二硫化物	Diallyl disulphide	$C_6H_{10}S_2$	0.74	10.43
3一十二炔	3-Dodecyne	$C_{12}H_{22}$	0.87	12.65
3,4-二甲基噻吩	3,4-Dimethylthiophene	$C_6H_8S$	0.88	13.17
对异丙基苯酚	Benzenemethanol, 4-(1-methylethyl)-	$C_{10}H_{14}O$	0.76	16.37
2,6-二叔丁基对苯醌	Cyclohexadiene-1,4-dione,2,6-bisdimethylethyl	$C_{14}H_{20}O_2$	0.13	19.32
2,6-二叔丁基-对甲苯酚	Butylated Hydroxytoluene	$C_{15}H_{24}O$	2.41	20.24
4,4'-叔丁基二苯酚	4,4-(1-methylethylidene)bis-phenol	$C_{18}H_{22}O_2$	0.27	21.49
3-甲氧基-4-羟基-苯甲酸	Benzoic acid, 4-hydroxy-3-methoxy	$C_8H_8O_4$	2.74	22.52
对羟基苯甲酸	Benzoic acid, 4-hydroxy-	$C_7H_6O_3$	2.23	23.10
对甲氧基苯酚	Mequinol	$C_7H8O2$	2.20	23.27
2,7-二甲基-4-硫代苯基	Octa-2,6-diene, 2,7-dimethyl-4-phenylthio-	$C_{16}H_{22}S$	0.26	24.44
2,6-二辛烯				
连二环戊2一烯一4一酮	1,1'-Bis(cyclooct-2-en-4-one)	$C_{16}H_{22}O_2$	1.71	25.97
邻苯二甲酸二丁酯	Dibutyl phthalate	$C_{16}H_{22}O_4$	5.12	28.33
紫菌红素乙	Rhodopin	$C_{40}H_{58}O$	2.30	42.76

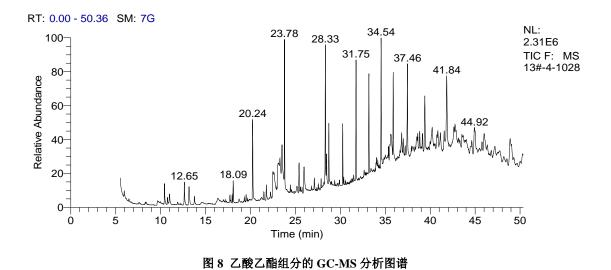


Fig.8 Ethyl acetate component GC-MS analysis atlas

比较 3 种溶剂组分的质谱图可以看出,大蒜秸秆水浸液的乙酸乙酯组分中物质最丰富,明显多于三氯甲烷组分和石油醚组分。大蒜秸秆水浸液的主要化感物质可能有 2-甲氧基-1,6-己二酸甲酯、邻苯二甲酸二丁酯等有机酯类,3-甲氧基-4-羟基-苯甲酸、对羟基苯甲酸等有机酸,以及对甲氧基苯酚等酚类化合物。

## 3 结论与讨论

本研究结果表明大蒜秸秆水浸液在一定浓度下对番茄种子萌发及幼苗生长有显著的化感抑制作用。石油醚、三氯甲烷、乙酸乙酯萃取水浸液 GC-MS 初步鉴定结果显示,大蒜秸秆水浸液中包含很多化感物质,主要有 2-甲氧基-1,6-己二酸甲酯、邻苯二甲酸二丁酯等有机酯类,3-甲氧基-4-羟基-苯甲酸、对羟基苯甲酸等有机酸,以及对甲氧基苯酚等酚类化合物。这些结果与韩丽梅<sup>[10]</sup>等在大豆地上部水浸液的化感作用及化感物质的研究结果基本相似。水浸液对番茄种子萌发、胚根生长、幼苗生长所表现的化感抑制作用,是多种化感物质协同作用的结果。酚类物质是研究最多也是被证实是化感活性较强的一类物质。Tang 等人 1995 年发现,万寿菊(Tageteserecta)在水分胁迫条件下,其酚类物质的含量显著升高<sup>[11]</sup>,由此初步确定酚类物质是大蒜秸秆水浸液中化感活性较强的物质。有关大蒜秸秆水浸液中化感物质还有待进一步鉴定,并通过化合物的生物活性试验加以验证。

化感物质对植物生长的抑制作用。肉桂酸、苯甲酸、对羟基苯甲酸等都能够对叶绿素造成伤害,降低杉木幼苗叶绿素 a、叶绿素 b 的含量。随着酚类物质浓度的升高,叶绿素的含量更低 。这说明酚类化感物质能够抑制植物体内叶绿素的合成。而叶绿素 a 具有收集和转化光能的作用,叶绿素 b 具有收集光能的作用,叶绿素在植物的光合作用过程中起着十分重要的作用。酚类物质抑制了叶绿素的合成,将会降低对光能的收集和转化能力及杉木光合作用速率,从而影响干物质的合成,降低杉木的生产力。

酚类物质的化感作用影响了植物对根际养分的吸收,致使植株养分吸收不平衡,抑制植物的生长,降低了植物的生产力。同时这些酚类化合物还影响林地土壤养分含量和酶的活性,降低土壤中的某些有效养分,如有效磷、有效钾,从而造成土壤养分的亏缺,影响植物的生长。另外,对羟基苯甲酸等酚类物质能够影响杉木幼苗的多种生理活动,如净光合速率、蒸腾速率、气孔导度、根系活力等。生理活动的变化必然导致杉木幼苗体内的酶系统紊乱、内平衡失调,从而影响杉木幼苗的生长。化感物质对植物生长的抑制作用与浓度有关。鞠会艳等研究表明,高浓度的邻苯二甲酸和丙二酸其对半裸廉孢菌的生长有化感抑制作用,尤其是邻苯二甲酸的化感抑制作用达到极显著水平[12]。

大蒜在其生长发育过程中,通过根系分泌、残体腐解及植株地上部物质淋洗等途径产生化感物质, 这些化感物质在土壤生态系统中大多要经过微生物的转化和修饰后才发挥作用。为了揭示大蒜对其他 作物的化感作用,有必要进一步研究土壤中稳定的化感物质种类和数量,并探明大蒜土壤中化感物质及 其协同作用与其他作物生理代谢失调、产量降低、品种下降、病虫害严重发生的关系。

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## 灭草净、草甘膦等防除棉田杂草效果比较试验

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本文针对我市棉花生长中前期处于梅雨季节,杂草发生量大,生长特别旺盛。2005年—2006 年分别在我市八台和武功棉田进行了灭草净、草甘膦等除草剂防除棉花中前期田间杂草试 验。通过试验结果表明: ①除草效果。灭草净用药后第二天杂草即开始枯萎。药后 16 天 (八台) 株数及鲜重防效,对单子叶杂草分别为 67.91%~88.71%及 81.53%~97.38%;对双 子叶杂草分别为 28.18%~58.71%及 64.57%~76.86%。药后 35 天,对单子叶杂草,株数防 效为 59.30%~78.63%, 比药后 16 天有所下降, 而鲜重防效为 36.23%~78.93%。对双子叶 杂草的株数及鲜重防效分别为 85.02%~97.88%和 82.55%~96.18%,均比药后 16 天提高。 药后 55 天(武功) 株数及鲜重防效,对单子叶杂草分别为 90.1%~94.7%和 96.0%~98.0%, 对双子叶杂草分别为 90.4%~95.9%和 61.0%~100%。从用药量看,对单双子叶杂草的防效 随着用药量的增加而提高,灭草净 350ml/亩处理防效最佳。从杀草谱看,对单子叶杂草防 效好于对双子叶杂草防效。草甘膦用药后4天杂草开始发黄。药后16天株数及鲜重防效, 对单子叶杂草分别为 86.76%和 95.35%, 对双子叶杂草防效略差, 分别为 15.07%~49.07% 和 64.13%~80.91%.药后 35 天株防效都有不同程度的下降,鲜重防效都有不同程度的提高, 分别为 96.23%~83.44%以上。药后 55 天(武功) 株数及鲜重防效,对单子叶杂草为 77.8%~91.3%以上,对双子叶杂草为 93.4%~83.9%以上。"草甘膦+乙草胺"处理,对单子叶 杂草防除效果好,控制时间长。275g/亩处理株防效,对单子叶杂草药后 16 天为 93.16%, 药后 35 天为 92.65%。对双子叶杂草防效较差,药后 16 天为 45.6%,药后 35 天为 0。药 后 35 天对单双子叶杂草鲜重防效分别为 98.67%及 91.06%以上。药后 55 天(武功)对单 双子叶杂草株数及鲜重防效都在94.%以上。农达+助剂处理药后第二天双子叶杂草即开始 枯萎,药后55天(武功)对单、双子叶杂草株防效分别为98.%和85.%以上。武功用药时 间比八台迟, 前期杂草不严重, 用药期距棉花封行期比八台短, 及时封行后控制了杂草的 生长, 所以, 在药后 55 天, 各处理都有较高的防效。②棉花的安全性。药后 3 天目测, 除 11% 灭草净 350ml/亩对接触药液的棉花叶片有轻度灼伤斑点外, 其他各处理无明显药害 症状。各处理对棉花果枝数、果节数、成铃数和产量的影响均无明显差异。八台试验,单 株果枝数为 12.93~13.97、果节数 33.97~39.63 个、成铃数 12.32~15.03 个。武功试验,单 株果枝数 13.92~15.90 个,果节数 48.53~56.77 个,成铃数 15.12~16.97 个,亩产皮棉 81.2~84.2kg。各药剂处理区与人工除草及不喷药不除草对照区比,除单株果枝数无明显差 异外,其他都有不同程度的提高,其皮棉分别提高 9.2~12.2kg 和 16.62~19.62kg。

## 火柴头的非恶性杂草的生态机制初步研究

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火柴头(Commelina benghalensis L.)为一年生草本植物,属鸭跖草科,是我国农田中的一种常见植物。目前关于火柴头的研究多是集中于它的"农田杂草"特性方面,在非洲、美洲等部分地区,火柴头已经发展成为一种恶性杂草,与农作物竞争水分、矿物质、等生长要素。而在我国,火柴头虽常见于玉米和棉花种植地等,但是并未有其泛滥成灾的报道。本文从火柴头浸提液对玉米幼苗生长的影响和火柴头实生植株与玉米幼苗混种后两者之间的相互影响两个方面进行研究,探讨火柴头与玉米之间的相互作用。结果表明,火柴头根浸提液在实验浓度范围内对玉米幼苗的根长、苗高的生长均具有促进作用,而火柴头叶浸提液对玉米幼苗根长和苗高的生长表现为低浓度促进,高浓度抑制的作用。在火柴头行间和株间混种玉米两种方式下,火柴头实生植株均促进了玉米幼苗生物量的增加,尤其是地上大种火柴头实生植株的生长极显著地促进了玉米幼苗的生长,而玉米仅促进了地下大种火柴头植株的资源向根分配。据此推测,火柴头在我国为一种非恶性杂草,它与玉米等农作物之间可能存在着互利的关系。

## 华南外来入侵植物薇甘菊水提物对土壤N的影响\*

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许多研究表明,外来植物入侵会影响生态系统的结构功能及 N 循环过程。薇甘菊 (Mikania micrantha) 是华南主要的外来入侵植物之一,它具有很强的化感作用,其化感 物质会影响周围其它植物的生长,还会改变土壤微生物群落。本研究采用薇甘菊水提物处 理土壤,通过测定土壤  $C \times N \times NO_3^- \times NH_4^+$ 及土壤的矿化速率和硝化速率,来研究薇甘 菊水提化感物质对土壤 N 素的影响。在薇甘菊入侵较为严重的珠海,采集薇甘菊的新鲜 茎叶,烘干粉碎后用水浸泡后制作出 3 个浓度(T<sub>1</sub>: 0.005 g ml<sup>-1</sup>; T<sub>2</sub>: 0.025 g ml<sup>-1</sup>; T<sub>3</sub>: 0.100 g ml<sup>-1</sup>)的薇甘菊水提物,分别用它们来喷洒处理土壤,用水作为对照。于 60 天后再进行同 样的喷洒处理,再过20天,测定土壤全N及矿化N的含量。结果表明,与对照水处理相 比, 薇甘菊水提物明显改变了土壤的 N 素, 并且这种影响作用与水提物浓度有关。研究 发现, 薇甘菊水提物明显降低了土壤的 pH, 用水提物 T<sub>1</sub> 处理后, 土壤 pH 的降低幅度最 大。薇甘菊水提物提高了土壤的  $C \setminus N$  含量,其中  $T_1$  处理对土壤  $C \setminus N$  的提高最大。另 外,薇甘菊水提物提高了土壤的  $NO_3^-$  and  $NH_4^+$ 含量,不过 3 个水提物浓度之间差异不显 著。与对照水处理相比,水提物处理降低了土壤的净矿化速率,甚至在 T2和 T3处理下出 现了 N 的固持。然而,水提物提高了土壤净硝化速率,并且净硝化速率比净矿化速率高。 本研究表明, 薇甘菊水提化感物质能够提高土壤可利用 N, 这种土壤 N 可利用性的提高 可能有助于薇甘菊的进一步入侵。

关键词: 薇甘菊,入侵,土壤 N, 化感,水提物

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# 阔世玛 3.6%WG/OD12g/l 和世玛 OF30g/l 等苗后防除冬小麦田禾本 科杂草和阔叶草的药效及安全性比较

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试验结果表明,阔世玛 3.6% WG/OD12g/l 和世玛 OF30g/l 等药剂均为内吸传导型除草剂; 药后 10 天、20 天、45 天阔世玛 3.6% WG/OD12g/l 和世玛 OF30g/l 等药剂药效随时间增长 递增,药后 45 天所有药剂鲜重防效优于株防效;SigmaBroad 3.6% WG(阔世玛 3.6% WG)/OD12g/l(阔世玛 OD12g/l)和世玛 OF30g/l(Sigma OF30g/l)各剂量对大巢菜、菊科杂草、十字花科杂草、繁缕等防效优良,对禾本科杂草棒头草、看麦娘的防效良好,对扬子毛茛、疏花婆婆纳、猪殃殃防效次之。

**关键词:** 阔世玛 3.6%WG 阔世玛 OD12g/l 世玛 OF30g/l 冬小麦田杂草 除草剂 安全性 防治效果

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## 化感水稻新品种的选育

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利用化感指数辅助育种与田间播稗草检筛相结合的方法,对课题组历年选育积累的230个常规稻品系、100个杂交稻组合以及利用美国化感稻品种 PI312777 作化感基因供体杂交转育的117个水稻高代新品系进行了抗草化感特性的筛选,并经产量比较及综合农艺性状评价,已选育出 化感稻 1 号、化感稻 3 号和培杂软香 3 个具有明显化感特性的水稻品种参加了广东省区试,并于2007年6月3日通过了广东省农业厅组织的专家现场鉴定。鉴定结果,三个水稻品种对稗草具有明显的化感特性,平均抑草率分别达 44.9%、42.2%和44.8%,与对照种美国化感稻 PI312777(平均抑草率 42.1%)相当。目前,培杂软香和化感稻 1 号已完成或即将完成广东省品种试验程序,可望在2007年底或2008年初经审定通过后推向生产应用。

化感稻 1 号属非 PI312777 化感源常规中迟熟籼稻,2006 年晚造参加广东省区试,平均亩产 421.35 公斤,与对照粳籼 89 产量相当,中抗稻瘟病和白叶枯病,2007 年晚造参加广东省区试复试及生产试验。经 3 年 12 次直播试验,化感稻 1 号对稗草的平均抑草率为44.9%;对照 PI312777 为 42.1%。经 9 次 6 叶期化感指数 AI 值测定,化感稻 1 号平均 AI 值为 0.54;对照 PI312777 平均 AI 值为 0.58。

化感稻 3 号属 PI312777 化感源常规中迟熟籼稻,2007 年晚造参加广东省区试。经 3 年 12 次直播试验,化感稻 3 号对稗草的平均抑草率为 42.2%;对照 PI312777 为 42.1%。经 9 次 6 叶期化感指数 AI 值测定,化感稻 3 号平均 AI 值为 0.50;对照 PI312777 平均 AI 值为 0.58。

培杂软香属非 PI312777 化感源感温迟熟两系杂交籼稻组合,2005 年晚造参加广东省区试,亩产 399.5 公斤,比对照丰优 128 增产 3.78%,增产不显著;2006 年晚造参加广东省区试复试,亩产 419.1 公斤,比对照丰优 128 减产 3.62%,减产不显著;2006 年晚造参加广东省杂交稻新组合生产试验,平均亩产 450.7 公斤,最高产的潮安点亩产 671.0 公斤。抗稻瘟病、感白叶枯病。米质除直链淀粉含量外,其余指标均达国优三级米以上,米饭芋香味,属香型杂交稻。经 3 年 12 次直播试验,培杂软香对稗草的平均抑草率为44.8%;对照 PI312777 为42.1%。经 9 次 6 叶期化感指数 AI 值测定,培杂软香平均 AI 值为0.45;对照 PI312777 平均 AI 值为0.58。

## 水稻抗稗草化感特性的遗传及田间表达效应研究

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通过对美国化感稻品种 PI312777 与非化感稻品种或其它来源化感稻品种的杂交后代  $F_1$ - $F_3$  及正反交  $F_1$ 代抑草率的调查分析,证明了化感特性受多基因控制,并且胞质效应对化感特性也有一定的影响。因此,可以通过杂交、回交等方法累加聚合化感基因,从而选育出抗草力强的化感稻新品种。

用美国化感稻品种 PI312777 与多个不同品种(系)或不育系配组,通过对  $F_1$  及双亲抑草率的调查分析表明, $F_1$  同样表现具有化感特性,并且部分  $F_1$  在化感强度上有明显的杂种优势。因此,可以通过利用化感不育系与化感恢复系配组,培育聚合了双亲化感基因同时利用化感杂种优势的强化感杂交稻。

对美国化感稻品种 PI312777 的田间抗稗草力在广州进行了 3 年 5 造的种植试验评价,主要结果有: PI312777 在田间的抗稗草效果主要表现为抑制稗草萌发,对已萌发生长稗草的苗高、根长及干物重没有明显影响; PI312777 的田间抑草率一般在 20%-60%之间,随着环境、秧苗的生长发育阶段、种植方式、播草方式的不同而有较大差异,主要表现在不同年份、不同造别、同一造别不同播植期之间抑草率均有较大差异; 在生长发育上,水稻 3 叶期前一般表现抑草率低,其后至 6 叶期抑草率明显增高,表现出明显的时段效应; 此外,水稻与稗草种植数量的比例、相距远近其抑草率也有明显差异,表现出明显的剂量和梯度效应。说明抑草率非常容易受生长条件的影响。

调查了用 8 个不同品种与 PI312777 按 2:2 混种的混系稻及其各自单独种植时的抗草效果,结果混系稻的抑草率在秧苗 2.5 叶龄前一般表现比抑草率高值品种单独时下降,而在 5-6 叶龄时则一般表现比抑草率高值品种单独时提高。

通过对三个化感强度水平相近,产量水平、遗传背景及化感源不同的化感品种 PI312777(产量低)、茉莉新占(产量高)、华丰占 1 号(产量中)进行了播稗草与不播稗草处理水稻产量的比较试验,以明确抗草化感特性表达是否对水稻产量有影响。结果表明:不同品种间,产量水平低的品种一般播稗草处理的水稻产量会比不播稗草的对照减产,随着品种产量水平提高,播稗草处理的水稻产量与对照间的产量差异缩小,直至差异不显著或播稗草处理的水稻产量反而高于不播稗草的对照;同一品种也表现出同样的趋势,则随着种植产量水平的提高,播稗草处理与不播稗草的产量差异缩小,直至差异不显著或播稗草处理的产量反而高于不播稗草的对照。上述结果说明,抗草特性与高产品种及高产栽培技术结合应用于生产非常有利,初步展现了抗草化感特性在生产利用上的广阔前景。

## 凤眼莲(水葫芦)的可控与规模化利用技术集成

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从 2002 年开始,上海市陆续设立 3 个科技攻关重大专项,来对水葫芦问题进行综合研究。2006 年,有关水葫芦生物防治的内容,又被列入国家 863 计划的子课题。通过努力,5 年来,我们取得了一系列进展。其核心技术概括如下:

- 1、首次提出在不使水葫芦腐烂死亡的前提下,控制其无性繁殖的概念,并生产出专利产品"水葫芦无性繁殖抑制剂"KWH02。该产品对水葫芦群体或生物量的控制率达 70%,同时可以避免大量除草剂使用造成水葫芦死亡腐烂而影响水质的情况。该产品采用植物源助剂等天然成分,毒性低,对环境安全。该产品还为水葫芦的可控状态下的养植、利用,提供了可能。
- 2、研制出了"防治水葫芦的微生物除草剂",并获得相关国家发明专利。从上海市及 其周边地区,分离得到能够较好控制水葫芦生长的本地致病菌,并将其制成生物除草剂。 通过安全性检测等,表明是一种对本地作物和环境安全、低成本而有效、可以定向使用的 生物制剂。
- 3、研究出规模化处理水葫芦,并将之制作成有机肥的专利技术。提出了水葫芦含量高达95%的有机肥发酵配方,并实现对水葫芦的规模化、无害化处理;解决了因水葫芦含水量高而难以发酵的技术难题;不需采用烘干等耗能的过程,从而有效降低了生产成本;同时,又实现生产过程污水零排放,对环境安全;该技术可以应用到农作物秸秆、畜禽粪便、农产品加工废料等其他生物质的无害化、资源化处理。

系统测定和评估了水葫芦有机肥中重金属的含量、其使用对作物产量和品质的影响, 为该有机肥的推广应用提供了保障。该技术的成熟应用和推广,为发挥水葫芦的净水功能 等而加以人工养植、利用,解决了后顾之忧。

- 4、首次提出了将水葫芦的根粉,用于制作"畜禽养殖复合型植物除臭剂"的专利技术。本发明的复合型植物除臭剂,作为饲料添加剂使用,可从源头上控制畜禽养殖中臭气的产生,对氨气和硫化氢等物质的去除率达 85%以上,从而改善环境质量和畜禽生产性能。
- 5、首次提出了将水葫芦用于制作"复合型霉菌毒素吸附剂"的专利技术。该吸附剂使用后,可有效降低饲料中的多种霉菌毒素,特别是对黄曲霉毒素 B1、赭曲霉毒素 A、玉米赤霉烯酮、玉米赤霉烯醇、呕吐毒素等中国常见霉菌毒素有良好的吸附性能。

在我们的工作中,既没有将水葫芦当作单一的"害草"来处理,也没有将之当作单一的"资源"来处理,而是寻求一种平衡的技术体系。因此,有效的控制技术和规模化处理技术的提出,为水葫芦危害的防治和水葫芦的利用,提供了积极的保障。相关技术的尝试和应用,为循环经济背景下的杂草综合管理,提供了有益的参考。

关键词:水葫芦,控制,利用

## 武汉市夏季外来杂草调查研究

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生物入侵对生物多样性、农林牧渔业生产以及人类健康造成严重经济损失或生态灾 难。其中,外来杂草在外来生物中占有相当大的比重。目前,外来杂草已经对我国的生态 系统、农业生产及人体健康造成了重大危害。因此,对外来杂草的分布范围、传播途径、 风险评估、有效治理等进行研究十分必要。基于此,对武汉市的夏季外来杂草进行了调查, 主要调查不同生境下外来杂草的种类、数量和分布情况。在 42 个样点中共发现杂草 149 种,其中外来杂草 16 科 42 种。在 42 个样点中,均有外来杂草出现。从分类地位来看, 菊科外来杂草种类最多,共计14种,占33.33%;禾本科、苋科和豆科均为4种,占9.52 %;十字花科3种,占7.14%;伞形科和旋花科各2种,占4.76%;其余为每科1种。在 这些外来杂草中,绝大多数为双子叶杂草,共有37种,占88.10%,而单子叶杂草仅5种, 占 11.90%。从原产地看,大多数来自美洲,共有 29 种,占 69.05%;来源于欧洲的有 8 种,占 19.05%;其余 5 种分别来自非洲和亚洲。从发生的频度来看,在各个样方中出现 频率最高的外来杂草为一年蓬(Erigeron annuus), 频度达到 42.59%, 其次为小飞蓬(Convza canadensis)、空心莲子草(Alternanthera philoxcroides)和野塘蒿(Conyza bonariensis), 频度分别为 37.96%、36.11%、27.59%, 其他频度在 10%以上的外来杂草有豚草(Ambrosia artemisiifolia)、苦苣菜(Ambrosia artemisiifolia)、野老鹳草(Geranium caroliniamum)、波 斯婆婆纳(Veronica persica)、野胡萝卜(Daucus carota)和野燕麦(Avena fatua),以上 9 种杂草可视为武汉市分布最为广泛的9种外来杂草,而这些杂草大多发生的密度和盖度也 较高,说明其不光分布广泛,危害也相当严重。其他 33 种外来杂草出现的频度均在 10% 以下,但其中不乏一些恶性或有毒杂草,如水葫芦、加拿大一枝黄花、假高梁等。本次调 查研究的时间范围较窄,难免错过某些外来杂草的生育期,而导致未调查到某些在本地实 际有发生分布的外来杂草。因此可以推定,在武汉市发生分布的外来杂草种类应多于本次 调查的42种,此项调查研究将在今后予以完善。

关键词 外来杂草 调查 频度 夏季

## 双氧水(H<sub>2</sub>O<sub>2</sub>)和赤霉素(GA<sub>3</sub>)对播娘蒿种子萌发的影响

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2007 年在室内采用平皿法比较了双氧水和赤霉素对播娘蒿种子萌发的影响。试验设 30% 双氧水浸泡种子 40、50、60 分钟, 0.05%和 0.1%的 GA3 浸泡种子 24 小时, 30%双氧水分 别浸泡种子 40、50、60 分钟后, 再用 0.05%和 0.1%的 GA3 浸泡 24 小时, 先将采自陕西 和河北的两种生物型播娘蒿种子进行必要的筛选,再按以上设计进行种子处理,然后用蒸 馏水漂洗 5 次: 将经处理的 50 粒种子均匀排放在底部放有 4 层纱布的直径为 16 厘米的培 养皿中,加入 5 毫升蒸馏水,置于光照培养箱,在 20 ( $\{ \}$ ) / 15 ( $\{ \}$ 0) ℃,光照 12 小时的 条件下培养。以蒸馏水为对照,各处理重复四次。培养1、2、4、6、8、10、12、14、16 和 18 天调查发芽率。试验结果表明,蒸馏水浸泡种子发芽率很低,培养 18 天后调查结果 陕西和河北的发芽率分别是0%和6.3%;双氧水单独处理的种子发芽率,随处理时间延长 而发芽率不断增加,最高达到 53.3%和 43.8%; GA3 单独处理,效果较好,两个生物型发 芽率都在80%以上,0.1%浓度处理发芽率分别是87.3%和85.6%,略高于0.05%浓度处理, 但与 0.05%浓度处理差异不显著; 双氧水与 GA3 结合处理, 效果非常明显, 发芽率均达到 80%以上,各处理间差异不显著,但发芽势明显优于 GA3 单独处理。结合处理第 4 天,发 芽率就达到 40%-50%, 而 GA3 单独处理第 4 天的发芽率仅为 3%-5%, 处理后第 6 天的发 芽率才达 40%。结果显示,用 30% 双氧水浸泡 40 分钟,再用 0.05% GA3 浸泡 24 小时,对 提高播娘蒿种子发芽率,促进播娘蒿种子发芽势都有较好的效果。

关键词:双氧水,赤霉素,播娘蒿,种子萌发

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## 硝磺草酮和烟嘧磺隆对玉米不同品种的安全性评价

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本试验于 2005-2006 年在北京郊区试验地,开展了硝磺草酮和烟嘧磺隆对夏玉米安全性 方面的评价。试验为二因素试验,因素1为药剂处理,包括300克/公顷的硝磺草酮,120 克/公顷的烟嘧磺隆和空白对照;因素2为北京、山东、河北、河南的46个主栽夏玉米品 种。试验于玉米 4-5 叶期施药,喷液量为 450 升/公顷,4 次重复。在施药后目测药害症 状,施药后5天、10天和15天测量玉米株高;在玉米收获时测量玉米叶片数、地上部分 干重、果穗干重、果穗长度、百粒重。两种药剂因作用机理不同施药后的药害症状也明显 不同,硝磺草酮在施药后4天,玉米的叶片出现白化现象,而烟嘧磺隆在施药后5天,玉 米的新叶出现不同程度地褪绿、黄化。施药后7天,一些玉米品种陆续表现出不同程度地 生长抑制,株高显著低于空白对照。随着时间的推移,施药后 15 天,玉米的药害症状和 株高抑制仍没能恢复。根据对玉米收获期的生理指标的统计(考虑到玉米杂交特性,本试 验重点统计了玉米地上部分干重),硝磺草酮对玉米品种影响不大,与空白差异不显著; 烟嘧磺隆对玉米品种生长发育影响较大,与空白差异显著,除了对鲁单 999、郑单 518、 中原 312、农大 108、农大 368、金海 45、菜农 15 和浚单 18 有 20% - 50%的减产或抑制 外,其他玉米品种或者被杀死,或者被严重抑制不能正常结实。本试验的剂量为相应药剂 登记剂量上限的两倍,在如此高剂量的压力下,硝磺草酮对不同玉米品种安全性较好,而 烟嘧磺隆除了对甜玉米、糯玉米、爆裂玉米不安全之外,对一些普通马齿型玉米也不安全。 因此在田间实际施药过程中,对于烟嘧磺隆要严格控制施药剂量和施药时期,否则容易出 现药害。

关键词: 硝磺草酮; 烟嘧磺隆; 玉米; 安全性

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## 水稻中化感物质 5,7,4'-三羟基-3',5'-二甲氧基黄酮及其甙的合成

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化合物 A、B、C 是从水稻化感品种 PI312777 的茎叶萃取物中分离得到的三个黄酮类物质,生物活性测定显示,化合物 A 在其释放浓度范围内对稻田常见杂草稗草和异型莎草有抑制作用。为对此类物质的除草活性进行深入研究,本文从间苯三酚出发,经 Hoesch¹ 反应得到 α-氯代苯乙酮,再与芳香醛在稀碱的醇溶液中室温反应后用稀酸酸化,然后脱保护制得化合物 A,接着经选择性保护、糖苷化等步骤合成了化合物 B 和 C,合成路线如图(scheme 1)所示:

reagents and conditions(a) NaOH,95%EtOH,rt (b) 稀HCl,rt (c)10%Pd-C,EtOAc:EtOH=1:1,  $H_2$ ,rt (d)  $K_2$ CO $_3$ ,TBAB,CHCl $_3$ - $H_2$ O,40 $^{\circ}$ C (e) NaOEt,EtOH,CH $_2$ Cl $_2$ ,rt (f) DIPEA,DMF

#### Scheme 1

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## 新型水旱两用除草剂双甲胺草磷的研发

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双甲胺草磷(H9201)是一种选择性土壤处理除草剂。双甲胺草磷的产业化开发,被列入 国家"十五"科技攻关计划及"十一五"科技支撑计划。双甲胺草磷的工艺路线,以 2,4-二 甲基苯酚、三氯硫磷、氯氧化钠、异丙胺等为原料,经硝化、酰氯化、缩合三步反应,合 成其原药,熔点 95~96℃,含量指标为>95.0%,干燥减量<0.5%,酸度<0.1%。原药经 UV、 IR、<sup>1</sup>H-NMR、MS、GC 及 GC-MS 定性分析得到证实。50t/a 中试技术已通过省级成果鉴 定。双甲胺草磷原药毒性试验,雌雄大鼠经口 LD50 均大于 2150mg/kg,经皮 LD50 均大于 2000mg/kg, 属低毒; 对家兔眼及皮肤均无刺激性, 属弱致敏物; 小鼠骨髓嗜多染红细胞 微核、睾丸染色体畸变以及 Ames 试验均为阴性;对大鼠的经口亚慢毒性的阀剂量为 25mg/kg。20%EC 雌雄大鼠经口 LD50 均大于 5000mg/kg, 经皮 LD50 均大于 2000mg/kg, 属低毒; 对家兔眼有轻度刺激、皮肤则无刺激性, 属弱致敏物; 对蜜蜂低毒, LC50100μg/μL, LD<sub>50</sub>大于 200μg/蜂; 对鹌鹑低毒, LD<sub>50</sub>大于 2000mg/kg; 对鱼的毒性中等, LC<sub>50</sub> (96h) 5.67mg/L, 95%可信限 4.46~7.21mg/L; 对桑蚕 LC<sub>50</sub>5000mg/L。除草活性测定, 盆栽法播 后苗前土壤处理,双甲胺草磷的除草活性与除草通相当,高于胺草磷、甲基胺草磷、丁草 胺、苯噻草胺、绿麦隆等,对禾本科草的活性高于阔叶草。药剂在杂草体内抑制分生组织 的生长,受害的杂草芽鞘和根变粗、分蘖节肿大、内部心叶变为深绿色,大多数叶片不能 突破芽鞘而死,有的叶片虽伸出芽鞘但叶片短而厚、叶色深绿、畸形、慢慢干枯死亡。小 杯法比较,对稗草幼叶和幼根的抑制作用大于甲基胺草磷,而且在小杯法中幼根对药剂更 敏感,对幼根长抑制的LC501.42×10<sup>-4</sup>mg/L。吸收部位比较,对0~4mm长的幼芽和幼根对 药剂最敏感,芽与根比较幼芽是吸收药剂的重要部位,与除草通、甲基胺草磷特点基本一 致。对作物安全性试验, 伞形花科蔬菜(胡萝卜、茴香、芜荽)、大豆、水稻、小麦对该 药有很好的耐药性,对胡萝卜、芹菜的安全性高于除草通。应用技术研究,混土、淋水、 有水层可提高双甲胺草磷除草效果,随着苗龄的增大杂草耐药性增强,以芽前用药防效最 好,在土壤中的半衰期 45d。667m<sup>2</sup> 用药量旱田 50~100g,移栽稻及蔬菜 30~60g,与磺酰 脲类混配可使用药量降为 10~30g。经苏、鲁、豫、津胡萝卜田及苏、赣、湘、鄂移栽水稻 二年田间试验,双甲胺草磷对一年生杂草特别是禾本科草防效显著,对作物安全且有增产 作用,已取得农药登记。

## 前茬作物残体对后茬杂草的化感作用研究

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随着农业的发展,化学除草剂在杂草防除方面发挥了巨大作用,但也产生了环境污染和杂草抗性等严重问题。为此,我们进行了利用前茬作物收获后废弃的根茎叶对后茬杂草的化感作用防除杂草的技术研究。

以收获后小麦残茎根为材料、室内水培和土培法进行生物测定、研究了小麦茎根水提取液对直播稻田千金子的化感作用。结果表明:扬麦 158 和扬麦 10 号不同生育期的 1:20 水提取液对千金子种子萌发均有抑制作用,但对幼苗生长无抑制作用。其中,扬麦 158 收获后残茎根水提取液对千金子种子萌发的抑制率达 95.77%;小麦茎根水提取液对水稻种子萌发及幼苗生长均无抑制作用;利用乙醚萃取法分离有机物成分,发现有机酸是抑制千金子种子萌发的化感物质,对千金子种子萌发的抑制率达 94.90%; 经 GC-MS 联用仪分析鉴定,有机酸的主要成份为棕榈酸、油酸、亚油酸、硬脂酸及肉豆蔻酸。

以收获后油菜残茎根为材料、室内水培和土培法进行生物测定、研究了油菜茎根水提取液对直播稻田千金子的化感作用。结果表明:汇油 50、油研 9 号和秦油 7 号不同生育期的 1:20 水提取液对千金子种子萌发均有抑制作用,对幼苗生长也均无抑制作用。其中,汇油 50 和油研 9 号收获后残茎根水提取液对千金子种子萌发的抑制率达 100%,而秦油 7 号仅有 27.33%;油菜茎根水提取液对水稻种子萌发及幼苗生长均无抑制作用;利用乙醚萃取法分离有机物成分,也发现有机酸是抑制千金子种子萌发的化感物质,对千金子种子萌发的抑制率达 100%。

以收获后向日葵叶子为材料,研究了向日葵叶子水提取液对有关杂草的化感作用。结果表明:食葵山区一道眉、KD206、油葵康地-115三种向日葵叶子的水提取液对反枝苋、丁香蓼、狗尾草、大巢菜、千金子、稗、日照飘拂草、鳢肠种子萌发均有抑制作用。食葵KD206、油葵康地-115、食葵山区一道眉叶子 1:20 水提取液对反枝苋、大巢菜、猪殃殃萌发抑制率达 100%;对反枝苋的鲜重抑制率分别为 86.5%、84.6%和 85.1%。

可见,利用前茬作物残根茎叶的化感作用进行后茬杂草的生物生态防除,既能有效利用前茬作物的废弃残体,又能减少化学农药使用、保护环境、实现农业可持续发展,这是一项既具有重要理论意义又具有实践意义的技术研究。

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<sup>\* &</sup>quot;十一五"国家支撑计划 通讯作者,

## 天然抗氧化活性物质的研究进展与开发前景\*

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诸多疾病,如癌症、动脉粥样硬化和关节炎等都与油脂过氧化作用所产生的自由基有关,而抗氧化活性物质以其具有的清除自由基的能力而越来越引起各界重视。目前常用的抗氧化剂以化学合成抗氧化剂为多,如二丁基羟基甲苯(BHT)、丁基羟基茴香醚(BHA)、没食子酸内酯(PG)等,但这些化学物质对人体有不良影响。而从天然植物中提取的抗氧化剂对人类健康无不良影响。

本文综述了近年来国内外在研究天然抗氧化活性物质方面所取得的进展。重点介绍了目前常用的抗氧化作用评价方法二苯代苦味酰基自由基(DPPH)法、三价铁还原抗氧化力(FRAP)法和硫代巴比妥酸反应物(TBAS)法等方法在评价和筛选天然抗氧化物质中的作用。指出有必要加强在同一条件下用不同的测定方法对同一来源的天然抗氧化物质进行抗氧化活性比较的研究,这对于选择抗氧化活性测定的方法具有指导意义;国内外一些学者通过试验在富含抗氧化物质的天然植物中如水果,蔬菜以及田间杂草中得到了单一或复合的抗氧化物质以提高抗氧化水平,其中生姜,葱属植物,茶叶中的抗氧化活性物质的开发比较全面,但廉价的杂草资源并没有得到广泛的重视。因此,从成本廉价的杂草资源中研究和开发利用具有高抗氧化活性的抗氧化资源具有广阔的前景。

**关键词** 天然抗氧化活性物质 硫代巴比妥酸反应物法 三价铁还原抗氧化力法 二苯 代苦味酰基自由基法

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# 70. 5%哈利 (HARRIER) 干悬浮剂防治夏玉米田香附子试验及示范研究

## 段美生

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香附子是我市夏玉米田危害较重且难以防治的杂草,我们进行了 70.5%哈利(唑草酮+二甲四氯)防治夏玉米田香附子的试验,结果表明,在香附子 9—11 叶期,使用 70.5%哈利茎叶喷雾,用量 45—60 克/667 m²,用药后 45 天株防效 81.4%--89.0%,鲜重防效 86.2-93.5%,有较好的防除效果,显著高于目前常用的 56%二甲四氯可溶性粉剂、13%二甲四氯钠盐水剂、75.5%附子清等;收获时测产表明使用 70.5%哈利有增产效果,田间观察 70.5%哈利对玉米安全,无药害;大面积示范也取得了良好的效果。

关键词: 哈利: 防治: 夏玉米: 香附子

## 海南外来入侵杂草概况\*

## 范志伟\*\*\* 沈奕德 陆英

中国热带农业科学院环境与植物保护研究所,海南省热带农业有害生物检测与监控重点实验室 海南儋州 571737

海南目前有外来入侵杂草 35 科、103 属、140 种(亚种/变种),其中豆科种类最多,有 19 属 31 种,其次是菊科,有 16 属 19 种,其它种类较多的科依次为禾本科 12 属 17 种,苋科 4 属 11 种,大戟科 5 属 10 种,茄科 5 属 7 种,唇形科 2 属 4 种。从原产地分析,大部分来自美洲,占 61.2%,而其中的绝大多数来自热带美洲。

海南重要(恶性)的10种外来入侵杂草是飞机草、假臭草、喜旱莲子草、凤眼蓝、稗、牛筋草、铺地黍、假高梁、红毛草和香附子;主要的外来入侵杂草有银胶菊、藿香蓟、小蓬草、金腰箭、鬼针草、野茼蒿、三裂蟛蜞菊、肿柄菊、阔叶丰花草、巴西含羞草、刺苋、皱果苋、青葙、银花苋、飞扬草、土荆芥、假马鞭、马缨丹、决明、望江南等。薇甘菊也于2003年在海南发现,现已定居和建立局部的种群,并有扩散蔓延趋势,如果不及时扑灭和控制,必将给海南的生态安全和农林生产带来巨大威胁。海南还必须加强对未入侵恶性杂草(如紫茎泽兰、加拿大一枝黄花、豚草、猪殃殃、互花米草、毒麦、扁秆藨草等)的检疫和监视,这些杂草在国内外已造成过重大危害和经济损失,若一旦入侵海南,后果将不堪设想。

关键词:海南 外来入侵杂草 种类与原产地 分布与危害

<sup>\*</sup>中国热带农业科学院环境与植物保护研究所中央级公益性科研院所基本科研业务专项资助项目

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## 河北省棉田杂草发生特点及除草剂筛选

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本试验于 2005-2007 年对河北省不同种植模式棉田杂草发生情况进行了调查,并对除 草剂进行了筛选,结果表明:河北省常见杂草有12科近30种。棉花苗期,露地棉田以阔 叶杂草为主,占杂草发生总量的70-80%;危害比较严重的杂草有:反枝苋、藜、铁苋菜、 马齿苋、打碗花。特别是反枝苋因其植株高大、生长迅速而对棉花危害最为严重,棉花播 种后 45 天反枝苋的数量达到 8 株/m²以上即对棉花生长和产量产生不同程度的影响,而其 数量达 35 株/m²以上时可致使棉花绝收。地膜覆盖棉田以禾本科杂草为主,占 60-80%, 在4月下旬至6月上旬,温度越高,禾本科杂草所占的比率越大,危害比较严重的杂草有 马唐、牛筋草、狗尾草和稗草。棉花现蕾后,6月中下旬至7月下旬杂草出现第二个发生 高峰,禾本科杂草和阔叶杂草发生比例随年份和不同地块而有一定差异。针对河北省棉田 杂草发生特点,对15种除草剂进行了筛选。露地棉田,播后苗前选用40%扑草净.乙草胺 乳油 1200-1500g/hm<sup>2</sup>或 45%扑草净·乙草胺悬乳剂 1350-1518.8g/hm<sup>2</sup>,对棉花安全,对 禾本科和阔叶杂草防效均比较理想;苗后防除禾本科杂草可选用10.8%高效氟吡甲禾灵乳 油 40.5-48.6g/hm², 5%精喹禾灵乳油 48.8-64.8g/hm², 15%精吡氟禾草灵乳油 112.5-146.3g/hm<sup>2</sup>;棉花苗后亦可用 20%百草枯水剂 450-600g/hm<sup>2</sup>进行定向喷雾处理。地膜棉 田,效果比较理想的土壤处理剂为 20%二甲戊灵·乙氧氟草醚乳油,用量为 270-360g/hm², 此外,40%扑草净·乙草胺乳油和45%扑草净·乙草胺悬乳剂的使用量比露地棉田减少1/3 左右亦有好的效果; 苗后除草同露地棉田。

## KM0612 防治稗草的生物活性测定\*

耿锐梅1张建萍1张文明2余柳青1\*\*

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稗草是世界上危害最严重的恶性杂草之一,且对部分化学除草剂已经产生了严重的抗药性,而生物防治具有可避免化学除草剂副面影响的优势。本研究对分离自云南昆明感病稗草植株上的病原真菌 KM0612 开展了防治稗草潜力的评价。结果显示,各潜力菌培养 5d 的发酵液对稗草根长和芽长均有很高的抑制活性,发酵原液的活性高于 10 倍稀释液,对根长的抑制活性高于芽长。菌丝体对离体叶片致病性的室内试验表明,15%的湿菌丝体对稗草叶片致病性高,处理 2d 后,叶片出现棕褐色不规则圆形褪绿晕圈病斑,4d 后症状加重,5d 后统计病情指数表明各处理病情指数均大于90%。菌丝体对稗草植株的防治活性温室盆栽试验结果显示,处理 3d 后植株出现明显的感病症状,7d 后植株下部叶片出现萎蔫症状和脱落。同时,田间试验也证明了该菌对稗草的控制作用。因此, KM0612 菌株具有进一步研究和开发成稗草生物防治制剂的潜力。

关键词 病原真菌 KM0612 稗草 生物防治

<sup>\*</sup>国家 863 课题(2006AA10A214); 浙江省自然科学基金项目 (Y306180); 中央级公益性科研院所专项资金项目(100012)

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## 加拿大一枝黄花化感潜力的室内生物测试与田间验证

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我国加入WTO后,与各国的动植物及其产品贸易量迅速增加,外来有害生物传入的机率增大,外来入侵物种已对我国生物多样性和生态环境造成了严重的危害,并造成了巨大的经济损失。据统计,我国由外来入侵生物每年造成超过500亿元人民币的直接经济损失。目前我国已发现入侵植物性生物有400多种,仅杂草有320种,占了60%。尤其是近几年,一些园林、牧草和花卉等植物的大量引进,使杂草疫情日趋复杂,这些植物逃逸后有可能成为我省新的有害生物,将给农林牧业生产和人畜安全带来了很大的威胁。加拿大一枝黄花(Solidago canadensis L.)也是一种外来引进后逃逸造成危害的入侵杂草,原产北美,具有极强的繁殖和快速占有空间的能力,在被闲置的空地上,第一年长出几株或几簇,第二、三年即连成片,压抑其它植物的生长,能迅速形成单生优势,破坏入侵地的植被生态平衡,成为世界上危害最大的100种外来入侵物种之一。

现在普遍认为加拿大一枝黄花的大举入侵与其根系分泌物质对周围植物产生的化感作用有关。据此,本试验以土著植物一枝黄花为对照,采用室内生物测试与田间验证相结合的方法对加拿大一枝黄花的化感作用进行了初步的研究。结果表明,加拿大一枝黄花和一枝黄花水浸提液对七种作物幼苗和幼根生长的影响有明显的差异。主要表现在加拿大一枝黄花对本地植物物种绿豆、花菜、萝卜、莴苣、小麦、甘蓝和白菜幼苗及幼根的生长具有强烈的化感作用。在相同水浸提液浓度下,加拿大一枝黄花对本地植物的化感抑制作用均强于一枝黄花,且随着水浸提液浓度的升高,加拿大一枝黄花对受体植物的抑制作用明显增强;田间的生物测试也验证了加拿大一枝黄花对受试植物有显著的抑制作用,并且随着加拿大一枝黄花种植密度的增大,受试植物的产量损失随之增大,其中以小麦受到加拿大一枝黄花抑制的影响最为显著。显然,加拿大一枝黄花对本地植物的强烈化感抑制效应,有利于其自身的生长及对资源的占领。而一枝黄花对本地植物物种的化感作用相对较弱,反而在一定程度上促进其生长。与一枝黄花相比,加拿大一枝黄花的强化感抑制作用可能是其作为外来杂草能够成功入侵并泛滥成灾的主要原因之一。

## 20%噻吩磺隆•乙草胺可湿性粉剂防除冬小麦田杂草田间试验

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田间试验表明,20%噻吩磺隆•乙草胺可湿性粉剂在冬小麦播后苗前土壤处理,能够有效防除冬小麦田的主要禾本科杂草硬草、罔草、碱茅和阔叶杂草播娘蒿、荠菜;适宜用量为525~600g/公顷(有效成分),该剂量下,用药后30天株防效为87.5-89.5%,用药后130和160天仍有较好的株防效和鲜重防效;用药后观察,20%噻吩磺隆•乙草胺可湿性粉剂各处理区小麦无药害症状,对小麦安全。

关键词: 噻吩磺隆•乙草胺; 冬小麦; 杂草; 防除

## 西洋参自毒物质的分离、鉴定及生物活性研究<sup>\*</sup>

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西洋参的自毒现象已经有许多报道,但自毒成分一直不清楚。本文在前人研究的基础 上对西洋参的自毒化学成分进行了研究,利用水提取、乙醚萃取及各种柱色谱分离,并辅 以生物活性跟踪测定加以指导等方法,从须根的活性部位中分离得到2个酚酸和3个脂肪 酸,通过质谱和核磁共振技术鉴定其结构分别为:香草酸、香豆酸、壬二酸、棕榈酸和亚 油酸。在此基础上对活性部位进行了GC-MS测定,鉴定出44个化学成分,其中包括一些常 见的化感成分,如:对羟基苯甲酸、香豆酸、阿魏酸、香草酸、香草醛、肉桂酸、水杨酸、 苯甲酸和丁香酸等酚酸类成分,以及壬二酸、棕榈酸、硬脂酸、油酸和亚油酸等脂肪酸。 由于这9种酚酸和5种脂肪酸纯品易得且含量也相对较高,所以本文以这14种成分作为继续 研究对象。通过HPLC技术鉴定出了9种酚酸成分也存在与自毒作用的活性部位,同时测定 了不同地块的四年生西洋参耕作层土壤中9种酚酸的含量,得出这9种酚酸成分不同程度地 存在于西洋参耕作层土壤中,其中以香豆酸含量最高(0.46~0.98 g/kg)其它酚酸含量从0.01 g/kg到0.13 g/kg不等。采用平皿滤纸法测定了这14种化学成分对西洋参幼苗胚根生长的影 响,设置3个浓度(0.1,1,10 mM),3个重复,结果表明这14种成分对西洋参胚根生长均 有不同程度的抑制作用,其中以水杨酸和苯甲酸抑制活性最强,酚酸的抑制活性呈现明显 的浓度依赖关系,而脂肪酸的抑制活性则与浓度关系不明显。上述结果表明这14种化学成 分为西洋参的自毒成分。

**关键词:** 西洋参, 自毒作用, 酚酸, 脂肪酸, 土壤, 生物测定, 连作障碍

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## 龙葵果实汁液的除草活性初探

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以龙葵(Solanum nigrum L.)、反枝苋(Amaranthus retroflexus L.)种子为试材,用种子萌发法检测了龙葵果实汁液的除草活性。试验证明,龙葵果实汁液中除草活性物质的含量较高;活性物质稳定,在 150℃下加热 0.5 小时依然保持除草活性;对龙葵的除草活性比对反枝苋高。培养 14 天的结果表明,龙葵果实汁液含量为 1%时,仅延迟龙葵种子萌发,对最终的发芽率没有影响;含量为 5%时,龙葵种子的发芽率仅为 21.5%;含量为 10%时能够完全抑制龙葵种子的萌发。龙葵果实汁液含量低于 5%时,对反枝苋种子萌发没有影响;含量为 10%、15%、20%时,反枝苋的发芽率分别为 60.00%、43.75%、22.50%。

关键词: 龙葵果实汁液 除草活性 生物测定

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## 不同溶剂提取芦竹化感物质抑制铜绿微囊藻的效果比较研究\*

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对比研究了甲醇、乙酸乙酯、正己烷三种极性不同的有机溶剂提取芦竹(Arundo donax Linn.) 中化感物质抑制铜绿微囊藻的效果。研究发现三种溶剂提取物对铜绿微囊藻均有抑制作用,其抑藻效果出现早晚次序:甲醇提取物<乙酸乙酯提取物<正己烷提取物。但随着作用时间的延长,投加低浓度甲醇提取物中藻细胞生长恢复较明显,高浓度抑藻效果较乙酸乙酯提取物及正己烷提取物弱,高浓度乙酸乙酯提取物及正己烷提取物在培养 2d 及 4d 后,抑藻效果接近 100%。各溶剂提取化感物质的半效应质量浓度(EC<sub>50,6d</sub>)分别为,甲醇提取物 0.17g•L<sup>-1</sup>,乙酸乙酯提取物 0.05g•L<sup>-1</sup>,正己烷提取物 0.08 g•L<sup>-1</sup>. 在考察各溶剂提取物对藻生物量影响的同时,对藻细胞形态及大小也进行了研究。研究发现,投加甲醇提取物的藻细胞出现空洞,投加乙酸乙酯提取物的藻细胞出现空洞、破碎以及少量抱团现象,投加正己烷提取物的藻细胞在培养初期出现褶皱后细胞聚集抱团。各溶剂提取物均引起铜绿微囊藻细胞体积的减小,且乙酸乙酯提取物的效果最强。

关键词 化感物质 芦竹 铜绿微囊藻 物质提取

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## 不同化感抗源水稻抗稗草率与稳定性的研究

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通过田间分期播和室内液相色谱分析,对选育的9个具有化感潜力的水稻品系的抗稗草稳 定性及其影响因素进行了分析。结果表明: 封行前所选水稻品系之间和播期之间的抗草率 均表现显著差异,品系与播期存在极显著的互作效应,不同化感抗源水稻之间的平均抗草 率表现出一定的差异。封行前的前5播期的所选水稻平均抗草率低于后4播期的平均抗草 率,且差异显著。与R1 封行前抗草率相比,PI312777 抗源R2、R3、R4 和R5 以及自筛 抗源常规品系 R6 和 R7 较低,而自筛抗源杂交稻 R8、R9 和 R10 的较高。从稳定性来看, PI312777 抗源 R1、R2、R3、R4 和 R5 以及自筛抗源 R6 和 R7 抗草率稳定性较差,自筛抗 源杂交稻 R8、R9 和 R10 抗草率稳定性较好。气温、日照时数和降水是影响封行前水稻抗 草效应的主要原因。收获期所选水稻品系之间和播期之间的抗草率均表现极显著差异,品 系与播期之间亦存在显著的互作效应,不同化感抗源水稻之间的平均抗草率亦表现一定的 差异。播期间抗草率差异比封行前小,抗草率稳定性高。收获期的前5播期的所选水稻平 均抗草率略高于后4播期的平均抗草率,但差异不显著。封行后日照是影响水稻与稗草之 间竞争的主要因素, 而气温和降水对收获期抗草率的影响不明显。 品系之间与播期之间的 平均 AI(Allelopathic Index)表现出一定的差异。同 PI312777 抗源 R2、R3 和 R4 的 AI 与 R1 差异不显著,表明转入与合成化感物质有关的 R1 基因后其化感潜力与 R1 相当。不 同抗源水稻之间的 AI 亦存在显著差异。AI 与封行前抗草率相关性不显著,表明水稻化感 物质的释放、以及环境条件等都会对具相近 AI 的水稻的抑草率产生影响。AI 分别与叶绿 素 a 和叶绿素总量呈显著相关, 与叶绿素 b 和类胡萝卜素无明显相关。气温和日照能影响 水稻化感物质的合成而使 AI 表现一定的不稳定性,降水对 AI 的影响不明显。AI 的高峰 期出现在5或6叶期,表现出了极强的稳定性。五个特征次生物质的相对含量和种类在品 系间和播期间变化显著。特征次生物质3和4的相对含量最多,且在不同播期下都能够合 成,特征次生物质7、8和9相对含量较少,且合成受环境的影响明显。前5播期特征次 生物质的相对含量和种类均少于后 4 播期的,这与封行前的 AI 以及抗草率的变化趋势一 致。

关键词: 水稻 稗草 化感抗源 抑草率稳定性 气象因素

## 中国菟丝子对不同大豆品种的危害差异及相互影响

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室内和田间试验相结合的方法,研究中国菟丝子对不同大豆品种的寄生差异及两者寄生关 系生理生态机制。所得结果如下:采用盖度和频度指标将 14 个大豆品种寄生危害程度划 分为三个危害等级, 即轻度(东 44、东 40、福豆 234、东 1168、合丰 25、绥农 14)、中 等(东42、东46、L202、东32384)和严重(赣豆4、粤春03-3、东31990、南春1号)。 根据中国菟丝子寄生前后不同大豆品种生理生化指标的变化数据进行抗(耐)寄生聚类分 析,其结果与田间划分结果大致相同。中国菟丝子寄生对大豆植株高度和结荚习性具有明 显抑制作用,降低产量。大豆产量降低幅度的顺序为:严重寄生品种>中等寄生品种>轻 度寄生品种,不同大豆品种上寄生的中国菟丝子生物量大小顺序与其受危害程度顺序一 致。被寄生大豆品种光合色素、可溶性糖、总黄酮、植株全氮含量越高,中国菟丝子生长 状况就越好。对上述指标进行主成分分析的结果表明:在寄生关系建立前,寄主总黄酮含 量是中国菟丝子寄生差异的主要指标,寄生关系建立后,寄主光合色素和全氮含量是影响 中国菟丝子寄生差异的主要指标。中国菟丝子寄生降低不同大豆光合色素含量、净光合速 率、水势、总黄酮和植株全氮含量,以上所有指标下降幅度顺序为:寄生严重的品种>寄 生中等的品种>寄生轻度的品种。中国菟丝子寄生后,不同大豆品种可溶性糖和丙二醛含 量升高,不同等级大豆品种可溶性糖升高幅度顺序为:危害重度的品种>危害中等的品种 >危害轻度的品种, 丙二醛升高也有同样的趋势。危害严重大豆品种根系分泌物对中国菜 丝子萌发率、生长伸长量和鲜重有促进作用,危害轻度有抑制作用,抑制作用强弱顺序为: 东 44>东 46>南春 1 号。在黑暗条件下,中国菟丝子的生长向寄主方向偏移,危害严重 品种的中国菟丝子偏移数量多。光照条件下,光源是影响中国菟丝子生长方向的主要因素, 不同光谱有不同差异,在 8—14h,幼苗对趋光的反应速度为:绿光>CK>蓝光,到 48h 后全部向光源方向偏移。

# 鸭跖草(COMMELINA COMMUNIS L.) 与大豆(GLYCINE MAX (LINN.) MERR.)竞争关系研究

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采用田间小区人工接种鸭跖草的试验方法,研究了鸭跖草密度与大豆的竞争关系。结果表 明,在大豆田中,鸭跖草密度不仅影响大豆的生长发育,而且影响鸭跖草自身的生长发育, 形成种间和种内两种竞争关系。鸭跖草低密度下竞争力较小,随着密度的增加,鸭跖草种 内竞争力及其与大豆的种间竞争力逐渐增强。不同密度下鸭跖草的生长发育受到不同程度 的影响。随着鸭跖草密度的增加,种内的竞争增强,使植株长势减弱,其结果是鸭跖草的 单株鲜重及干重随之降低。鸭跖草密度从 5 株/m²增加到 60 株/m²时,鸭跖草的株高从 81.9cm 增加到 89.0cm (增长 8.67%), 鸭跖草的单株鲜重 49.7g/株下降到 10.6g/株 (降低 78.67%), 单株干重从 12.4g/株下降到 2.9g/株(降低 76.61%)。鸭跖草密度为 5 株/m²时的 单株鲜重和干重分别是 60 株/m² 时的 4.69 倍和 4.28 倍。生长前期鸭跖草与大豆的竞争不 明显,鸭跖草不同密度试验区大豆和鸭跖草株高差异不大。在生长后期,由于对生存空间 及养分的需求增加,鸭跖草与大豆的竞争增强,鸭跖草株高超过大豆株高,高密度试验区 鸭跖草和大豆植株均明显增高。鸭跖草密度从 5 株/m²增加到 60 株/m²时,成株期鸭跖草 的株高从 81.9cm 增加到 89.0cm (增长 8.67%)。鸭跖草密度从 0 株/m²增加到 60 株/m²时, 大豆的株高从73.9cm增加到76.0cm(增长2.76%)。鸭跖草密度越高,对大豆生育和产量 的影响越大。随着鸭跖草密度的增高,大豆的主茎变细,单株荚数和粒数减少,产量逐渐 降低,而百粒重却出现逐渐增高的趋势。鸭跖草密度从 0 株/m²增加到 60 株/m²时,大豆 主茎的茎粗分别从 0.564cm 下降到 0.457cm (降低 18.97%); 单株荚数从 22.1 个/株减少到 10.2 个/株 (降低 53.85%); 单株粒数从 52.9 个/株减少到 33.8 个/株 (降低 36.19%); 百粒 重从 21.1 g 增加到 22.4g (增长 6.16%); 产量从 2643.0kg/hm<sup>2</sup>下降到 1481.3kg/hm<sup>2</sup> (降低 43.95%)。鸭跖草不同密度均可使大豆减产,大豆产量损失率随鸭跖草密度的增加而提高。 对小区试验所得的鸭跖草密度与大豆产量损失率相关数据,分别采用直线、对数、指数和 幂 4 种函数进行回归分析。结果表明,鸭跖草密度与大豆产量损失率之间呈正相关,相关 系数均达极显著水平(α=0.01)。比较直线、对数、指数和幂 4 种函数的相关系数认为, 以幂函数回归拟合最好,回归方程为: Y=1.5446x<sup>0.6089</sup>,相关系数 r=0.8721\*\*,相关系数最 高;直线回归拟合次之,对数和指数函数回归拟合较差,相关系数也较低。

关键词 鸭跖草 大豆 竞争

# 外来入侵杂草假高粱(Sorghum halepense (L.) Pers.)的化感作用初评<sup>\*</sup>

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利用种子萌发和幼苗生长的生测方法,研究了假高粱(Sorghum halepense (L.) Pers.)对 4 种农作物小麦、玉米、莴苣和棉花的化感作用。结果表明,假高粱能够抑制作物种子萌发和幼苗生长,其化感作用强度随浓度升高而增强,随时间而降低。其中对莴苣种子萌发率在 3 天时 0.1 g/mL 浓度下抑制强度达 81.3%,20 天时相同浓度下抑制率仅为 18.9%,下降了 62.4%。3 天和 10 天时对作物幼苗生长有抑制作用,20 天时对 4 种作物幼苗生长均无影响。

关键词 假高粱: 化感作用: 外来入侵种

<sup>\*</sup>国家"十一五"科技支撑重大项目(2006BAD08A09)资助

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# 两种一枝黄花属植物对土壤微生物的影响比较

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目前,加拿大一枝黄花(Solidago canadensis L.)已成为一种外来引进后逃逸造成危害的新入侵杂草,主要分布在中国境内的东部地区,包括浙江、上海、江苏、安徽、江西、湖北以及台湾等地。近些年在河南、新疆、辽宁、四川、重庆、湖南、广东和云南等地也发现了它的踪迹,并且扩张速度十分惊人。福建省北部的武夷山市、南部的漳州市芗城区及西部的长汀县均有加拿大一枝黄花的分布。随着研究的不断深入,人们发现加拿大一枝黄花具有较强的化感作用并认为加拿大一枝黄花的化感作用有可能是其入侵的主要机制之一。随着目前入侵生态学的兴起,外来植物的化感作用对本地生物多样性和生态系统功能的影响,特别是对地下部的生物多样性及生态系统的影响日益成为人们关注的焦点之一。因此,不少学者开始重视探究外来杂草对土壤微生物多样性的影响。

本研究以外来入侵杂草加拿大一枝黄花和土著种一枝黄花为试验材料,采用 Yoshiharu Fujii 等人提出了"土壤抖落法"的取样技术以及土壤微生物培养方法,检测了这两种一枝黄花植物的根部土壤中微生物区系和微生物生理类群的变化。结果表明,具化感作用潜力的加拿大一枝黄花明显影响了土壤中根部微生物群落多样性。加拿大一枝黄花的分泌物改变了根部土壤的 pH 值,土壤微生物的生物量显著增加,有机质含量亦有所提高,并抑制了真菌的生长,而对细菌和放线菌有促进作用。具体表现在加拿大一枝黄花的根系分泌物对土壤中亚硝酸细菌、好气性自生固氮菌和氨化细菌的数量具有促进作用,而对反硝化细菌的生长有抑制效应,可使入侵地土壤中的氨化作用、固氮作用和硝化作用得以加强,反硝化作用变弱,因而提高了土壤氮素的代谢水平及利用效率,减少了氮素的损失。此外,加拿大一枝黄花的根系分泌物还促进了好气性纤维素分解菌和硫化细菌的生长,抑制了反硫化细菌和嫌气性纤维素分解菌的数量增长,从而有得于土壤中碳和硫等营养元素的循环和能量流动。

而土著植物一枝黄花对土壤 pH 值无明显的影响,其根表、根际和根圈土壤的微生物数量均受到不同程度的抑制。综上所述,在未受外界干扰的情况下,外来入侵杂草加拿大一枝黄花和土著种一枝黄花在根部土壤微生物的结构和功能上存在明显的差异。这主要是因为加拿大一枝黄花具有较强的化感作用潜力,通过根部组织向土壤中分泌其所含的化感物质,改变了根部土壤的理化性质,从而影响了土壤微生物的结构和功能。

# 胡椒化感作用的研究\*

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本实验通过用胡椒新鲜叶的提取液及根系土壤,分别对白菜、萝卜、柱花草、马唐草和三叶鬼针草几种受体植物种子处理,测定种子的萌发率及受体植物幼苗的生长速率;结果表明,胡椒新鲜叶的提取液及根系土壤对受体有一定的化感作用。一般浓度越高对种子的萌发和生长的抑制作用越强,同一浓度对不同种子的萌发和生长的抑制作用不同;在低浓度对柱花草和三叶鬼针草种子的萌发则有促进作用;胡椒根系土壤对萝卜和三叶鬼针草的萌发和根茎生长都有促进作用。

关键词: 胡椒; 化感作用; 供体; 受体

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### 加拿大一枝黄花化感活性成分的提取与分离

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化感作用是外来植物成功入侵的重要机制之一,许多外来种为了在新的环境内更好地生存 下来,会向环境释放化感物质影响周围其他植物的生长,使自身在资源竞争中取得优势, 例如三裂叶豚草 Ambrosia trifida L.、豚草 Ambrosia artemisiifolia L.和 Centaurea diffusa L. 等。近年来,随着植物化感作用及生物入侵机制研究的不断深入和实验仪器设备等方面的 完善和进步,外来植物的化感作用越来越引起学界的重视,特别是在化感物质的提取、分 离和鉴定已成为外来入侵杂草化感作用研究的热点之一。加拿大一枝黄花同样具有较强的 化感作用潜力,但其具体的化感活性物质以及化感作用机制目前未见报道。本研究采用常 规化学方法,提取加拿大一枝黄花的化学组分,并用生物检测和 GC-MS 进行化感活性物 质追踪与鉴定,以期为今后进一步深入研究加拿大一枝黄花的生物入侵机制提供理论根 据。试验结果表明,加拿大一枝黄花的粗提物—酒精浸膏以及从此中分离出来的石油醚、 氯仿、乙酸乙酯和甲醇等浸膏在浓度为 0.0001%时, 五种浸膏对莴苣根长的影响都比较小, 酒精浸膏和乙酸乙酯浸膏对莴苣的生长有轻微的促进作用,氯仿浸膏,石油醚浸膏和甲醇 浸膏则对莴苣的根长略有抑制效应。但随着浓度的提高,五种浸膏的抑制效应呈现出不断 加强的趋势。当浓度为 1%,氯仿浸膏对莴苣根长的抑制作用更是达到了 77.02%。进一步 对加拿大一枝黄花氯仿浸膏(化感部位)分离,经氯仿/甲醇梯度洗脱,TLC 检测合并相 同组分, 共获得 25 个组分, 其中 6 个组分(分别是第 3、4、8、10、13、20 个组分) 具 有强化感作用活性(抑制率超过50%)。对6个组分混合物的GC-MS检测分析表明其化感 活性物质主要包括烷烃、醇类、酯类、烯类、吲哚等9大类物质。本研究对加拿大一枝黄 花化学成分进行初步分离鉴定发现的相关化感活性物质,为探讨加拿大一枝黄花的化学入 侵机制提供了科学依据,但对这些化感活性物质是如何影响加拿大一枝黄花邻近的土著植 物? 其具体的作用机制目前尚不明了,有待今后综合运用生物信息学,蛋白组学,代谢组 学等现代系统生物学进行进一步的深入研究。

### 辽宁省玉米田杂草群落研究

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玉米是辽宁省的主要农作物之一,草害是影响玉米生长和产量的重要因素,准确掌握辽宁 省玉米田杂草的危害现状及群落组成,对玉米田杂草防除具有重要的现实意义,为此 20 年来首次对辽宁省不同地区玉米田杂草危害状况与群落组成进行了系统研究。这次调查改 变以往只强调杂草种类的普查模式,而从生态学角度对杂草种群数量和群落组成与演替进 行了研究。采用定点计数法和草害五级目测法,利用 SPSS 和 EXCEL 数据统计系统,综 合分析了辽宁省杂草群落组成并对省内不同地区杂草群落各参量进行了比较,明确了辽宁 省玉米各主产区的田间杂草种类、优势杂草种类与群落组成。辽宁省内各地区玉米田常见 杂草有35种,分属19科。其中主要危害杂草有藜(Chenopodium album)、鸭跖草(Commelina communis L.)、稗草(Echinochloa crusgalli L. Beauv.)、苘麻(Abutilon theophrasti Medic.)、 反枝苋 (Amaranthus retroflexus L.)、红蓼 (Polygonum orientale L.)、马唐 (Digitaria sanguinalis)、铁苋菜(Acalypha australis L.)、马齿苋(Portulaca pleracea L.),其相对多 度分别为 38.75%、34.07%、29.72%、29.38%、21.86%、20.98%、19.38%、17.05%、11.46%。 综合全省的调查数据,就杂草群落组成与群落形成因子而言,根据杂草的危害程度和优势 度,明确了各地区玉米田杂草的优势种群,这些优势杂草与玉米组成了各地的玉米——杂 草群落。抚顺地区,构成玉米——杂草群落的杂草有6种,分别为鸭跖草、牛筋草、马唐、 铁苋菜、苦荬菜和苘麻;辽阳、鞍山、熊岳地区、构成玉米——杂草群落的杂草有6种, 分别为藜、铁苋菜、反枝苋、马齿苋、稗草和苘麻;锦州地区,构成玉米——杂草群落的 杂草有7种,分别为鸭跖草、反枝苋、藜、马齿苋、铁苋菜、问荆和苦荬菜;铁岭地区, 构成玉米—杂草群落的杂草有9种,分别为鸭跖草、藜、稗草、苘麻、苍耳、稗草、香薷、 马唐和问荆;沈阳地区,构成玉米——杂草群落的杂草有8种,分别为稗草、萝摩、刺菜、 鸭跖草、藜、苘麻、蓼、马唐。就危害水平而言,玉米田杂草危害已基本得到控制,对玉 米生长已不构成严重影响。虽然将玉米苗期至生长后期的杂草草害控制在 A<sub>1</sub>-A<sub>2</sub>级,而且 在一些田块几乎找不到杂草。但是,局部地区草害仍有猖獗之势。例如在锦州、铁岭、抚 顺地区,鸭跖草危害程度较严重,在辽阳和沈阳地区,藜的危害程度较严重。就杂草的种 群数量而言,各地区杂草的种群数量由高到低依次为辽宁西部的锦州、东部的抚顺、北部 的铁岭、南部的辽阳。就杂草种类而言,目前,单子叶植物类的鸭跖草仍为危害最严重的 杂草,阔叶类杂草中的藜危害也相对较严重。尤其阔叶杂草种类较多,特别是菊科杂草, 其占阔叶杂草总数的 25.71%, 虽然目前还没有上升为优势种和亚优势种群, 但一旦发展 为恶性杂草将很难防治, 所以应给予足够的重视。就杂草的危害时期而言, 由于玉米生长 中后期的疏于农田管理,造成杂草相对高度和相对盖度的增加,从而使杂草为害等级有所 上升。

关键词: 玉米田 杂草 群落 防治

### 桃园中植物多样性与步甲(Carabidae)数量关系初探

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2004~2005 年在北京桃园中进行了两种不同杂草管理模式下,植物多样性与步甲数量的关系的调查。桃园两种杂草管理方式分别为保留植被,只在杂草迅速生长期刈剪 3 次,或人工清除桃园杂草。分别调查了两种管理方式下杂草种类、植被覆盖度以及步甲数量,步甲数量调查采用陷阱法。调查结果表明:(1)在保留植被的桃园中,树下草本植物有 65 种,分属 27 科,50 属,地面长期保持 80%~100%的覆盖度; 而清耕桃园有 44 种植物,分属 19 科,35 属,地面覆盖度只有 20%~30%;(2)陷阱法调查 5 点,在保留植被的桃园平均有步甲 132 只,而清耕桃园只有 19 只,前者数量是后者的 5.95 倍;(3)数据分析表明,植物多样性与步甲数量之间具有相关性。

关键词: 植物多样性, 步甲(Carabidae), 桃园

### 传统中草药刺激或抑制小列当种子发芽的研究

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小列当可寄生在很多农作物上,对作物生长造成危害,但其防除较困难,所以如何利用小列当的发芽特点来减少其土壤种子库显得尤为重要,特别是怎样利用非寄主作物的根系分泌物来刺激或抑制小列当种子的发芽是一个亟待解决的问题。本试验针对我国 240 种常用中草药对小列当的刺激或抑制作用进行了研究,结果表明:水提取物能够刺激小列当种子的发芽率超过 70%的中药有灯心草、降香和莲须。甲醇提取物能够刺激小列当种子的发芽率超过 70%的中药有百部、桑椹、谷芽和萆薢。水提取物对小列当的抑制率超过 50%的中药有菊花、棕榈、苦杏仁和黄柏。甲醇提取物对小列当的抑制率超过 70%的有续断、地黄、肉豆蔻、地肤子、黄连、木贼和胡黄连。从试验结果可以看出一些中草药具有作为诱捕作物来减少列当土壤种子库的潜力,另外其中的某些化合物具有开发生物除草剂的可能。

关键词 中草药;小列当;刺激;抑制

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### 水稻化感品种的抑草机制及稻田杂草控制

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近年,水稻化感作用得到广泛的研究,揭示并充分利用水稻化感品种的抑草机制不仅能拓宽认识水稻和伴生杂草间相互作用关系的视野,而且能开拓稻田杂草控制的新途径。

水稻化感品种与杂草间的化感作用是通过特定的次生物质而实现的,这样化感物质一直是水稻化感作用研究的中心问题。但长期以来在对水稻化感物质的研究中,主要关注水稻合成和释放化学物质对杂草的直接抑制作用,这样不仅使研究结果零散和不关联,也使得水稻合成和释放活性的次生物质的功能被局限在狭小的范围。本研究在系统阐明水稻化感品种化学物质的基础上,确定黄酮甙及萜氧内酯等化感物质,修正了长期认为水稻根分泌的酚酸是主要化感物质的结论,研究还证实水稻化感物质在体内大多以糖甙形式存在,但释放到土壤中很快变成甙元而显示化感效应。如水稻化感品种体内的各种糖甙黄酮释放到土壤中均很快(半衰期<2小时)转变成同一黄酮甙元(5,7,4′-三羟基-3′,5′-二甲氧基黄酮)。这一黄酮甙元在土壤中能持续较长的时间(半衰期>5天),而对土壤中稗草种子的萌发和生长产生抑制作用,同时,黄酮甙元也对土壤微生物产生明显的影响。

进一步研究发现水稻化感品种与伴生杂草共存及紫外光、除草剂和重金属等环境因子胁迫时能启动相应的化学响应机制。如稗草种子萌发液或根分泌液中的糖醛酸能诱导水稻化感物质的释放,而且稗草释放的糖醛酸只有在土壤载体中才能诱导水稻合成释放化感抑制物质,显示稗草释放的信息物质是以土壤为媒介并与土壤发生作用才能发挥效应。这表明水稻化感品种是通过稗草种子萌发液和根分泌液中的糖醛酸分子识别稗草并及时启动抑草机制,水稻化感品种与稗草种间存在着化学识别及信息传递关系。这样,水稻化感品种的抑草机制至少涉及两个密不可分的过程,即:水稻首先是通过与伴生杂草间的化学识别及信息传递,然后才是合成释放相应的化感物质抑制杂草。

利用建立的特征次生物质标记评价筛选水稻品种和单植株化感潜力的方法,选育的水稻化感新品系已通过省级区试实验。区试实验显示,在合适的栽插密度和保水时间等栽培条件下,水稻化感新品系能有效地控制稗草和异型莎草,种植水稻化感新品系的稻田只需对少数阔叶类杂草使用除草剂,除草剂用量可减少50%以上。

本研究全面揭示了水稻化感品种和伴生杂草间的化学相互作用关系并阐明相应的化学物质基础,尤其是发现水稻化感品种和伴生杂草间的化学识别及信息传递关系,这些结果为进一步建立以水稻化感品种和活性外源功能物质为中心,辅以必要栽培管理和生态调控措施的稻田杂草控制新技术奠定基础。

### 雀麦、节节麦的除草剂筛选、应用时期和安全性研究\*

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本试验系统地对精噁唑禾草灵、异丙隆、甲基二磺隆、氟唑磺隆进行了除草效果筛选,并对冬小麦冬前用药的安全性进行了研究。安全性试验表明甲基二磺隆、氟唑磺隆、精噁唑禾草灵、异丙隆在冬小麦 2.5 叶期用药是比较安全的。除草效果试验结果表明,甲基二磺隆和氟唑磺隆对雀麦均有效,剂量分别为 13.5g ai/ha 和 31.5g ai/ha 时于雀麦 1.5 叶期用药 30d 鲜重防效 80%左右。甲基二磺隆在节节麦 3 叶期前用药,剂量为 13.5g ai/ha 时 30d 鲜重防效 80%左右。节节麦叶龄对甲基二磺隆的防效呈明显负相关,甲基二磺隆对分蘖后节节麦的防效仅为 35~40%,因此冬小麦田禾本科杂草防治时期应该为秋季防治。

关键词: 冬小麦,除草剂,雀麦,节节麦,防治时期

<sup>\*</sup>国家粮食丰产工程项目资助内容(2004BA520A07-05-04)

### 江淮稻区直播稻田恶性杂草的发生及其治理

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随着直播水稻在江淮稻区的快速发展,以稗草、千金子、马唐等为代表的恶性杂草发生普遍、危害严重,目前化学除草剂是直播稻田杂草治理的重要手段,但生产上安全、高效、经济防治恶性杂草的除草剂品种较少,加上杂草发生速度快、杂草发生量大、群落组成多样等原因造成杂草防治难度加大,杂草的有效防除成为直播水稻发展的制约因素之一。加强杂草生态理论研究的同时需加快新除草剂品种的开发,创新改造现有除草剂品种,建立完善的除草剂使用技术及其评价体系,建立基于直播稻田生态系统之上的栽培技术—农艺措施—除草剂品种及安全剂—施药技术相结合的防治策略。

关键词: 直播水稻: 恶性杂草: 防治

### 除草剂对假臭草化感作用的影响研究\*

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植物化感物质的产生、释放及其效应强弱除了与植物的内在特性有关外,在很大程度上取决于植物生存的环境。本研究运用野外实验和室内生物测定方法,以触杀型除草剂百草枯、传导型除草剂草甘膦和选择型除草剂稳杀得的不同浓度(1/2 倍推荐浓度、推荐浓度、2倍推荐浓度)的药液处理假臭草,对处于胁迫下的假臭草进行动态取样,以小白菜为受体检测假臭草在不同类型除草剂胁迫下的化感作用及变化规律。研究结果表明:(1)在整个取样时间段,施药样品的高浓度(0.5g/m1)提取液完全抑制了小白菜的萌发,对照(未施药样品提取液)仍有较高的发芽率;(2)在施药后的40天时间内,施药样品化感作用变化幅度大过对照样品;且施药浓度越高,化感作用变化幅度也越大:(3)不同类型除草剂作用下假臭草化感作用最强的时间不同,施百草枯和稳杀得的假臭草最大化感作用时间在第10天,草甘膦的最大作用时间在第30天;(4)假臭草的化感作用经最大作用时间后逐渐开始恢复,但恢复的结果不尽相同,经百草枯胁迫后的种群化感作用仍强于对照,而经草甘膦和稳杀得胁迫后的种群化感作用弱于对照。

关键词:除草剂;假臭草;化感作用

<sup>\*</sup>基金项日:海南省自然科学墓金(30612),科技部科研院所社会公益研究专项资助项目(2004DIA4J012)。第一作者简介:李光义,男(1983.6),硕士研究生,从事农业生态学研究。Tel: 0898-23306827,13648660239通讯作者:李勤奋,女,副研究员,硕士研究生导师,主要从事农业环境保护研究。Tell: 0898-23306827,E-mail:qinfenli@sina.com

### 具有开发潜力的稗草生防菌弯孢 B6

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从不同生态区域天然发病的稗草病斑上分离到 65 个真菌菌株并进行单孢分离。通过离体叶段法及整株接种法经柯赫氏法则检测这些真菌对稗草的致病性和致病力。用这些真菌的孢子悬浮液接种稗草,结果发现一株编号为 B6 弯孢属(Curvularia)真菌对稗草有较高的致病力。该菌接种离体叶段 7 天叶片全部变黄、枯死;接种 3 叶期稗草植株 14 天后,稗草植株死亡率一般可达 80%以上。在保湿 24 小时,孢子悬浮液浓度为 1.0×10<sup>6</sup> 个孢子/毫升的条件下,B6 对 3 叶期稗草的防效能达到 95%以上。保湿 48 小时的条件下,接种 32 种有代表性的植物以检测 B6 的寄主范围。用 B6 孢子悬浮液接种 9 个水稻品种,结果表明B6 对这 9 个水稻品种均不能侵染。但是,在保湿 48 小时的条件下 B6 能够侵染小麦、大麦及玉米,导致叶片失水变黄,部分叶片枯死。B6 对测试的其他植物均表现为不致病。B6 具有开发成水稻田除稗剂的潜力。

# 6 种除草剂防除恶性杂草猪殃殃效果评价\*

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本文选择小麦田防除阔叶杂草的 6 种药剂,在田间冬季和春季两种不同温度情况下施药,对比分析了 6 种药剂防除猪殃殃的效果。结果表明,不同药剂对猪殃殃防效差异较大。小麦返青期调查,6 种药剂中 10% 苄嘧磺隆 WP600、750g/hm² 和 48%麦草畏 AS 225、300g/hm² 在不同温度情况下施药对猪殃殃均表现出很好的防除效果,冬季施药的处理,株防效为89.8%~91.7%,鲜重防效为90.8%~96.6%;春季施药的处理,株防效为63.4%~81.2%,鲜重防效为93.4%~97.4%。25%灭草松 AS 和 56%2 甲 4 氯钠 SP 受温度影响也较小,但二者对猪殃殃的控制作用稍差,56%2 甲 4 氯 WP 1200、1500g/hm²;25%灭草松 AS4500、5250g/hm² 两次施药鲜重防效为55.6%~75.4%。20%氯氟吡氧乙酸 EC 和 75%苯磺隆 DF,尤其是20%氯氟吡氧乙酸 EC,表现出受环境温度及猪殃殃的生长状态影响较大,在冬季低温、猪殃殃处于休眠状态下施药,除草效果较差,相反,在春季气温回升、猪殃殃开始生长时施药,除草效果显著提高,对猪殃殃有很好的控制作用。20%氯氟吡氧乙酸 EC750、900 g/hm² 和 75%苯磺 DF 22.5、27g/hm² 冬季施药鲜重防效为 47.0%~59.1%,春季施药鲜重防效为 78.0%~90.3%。

关键词 除草剂;猪殃殃;防效

<sup>\*</sup>项目资助: 国家"十一五"科技支撑重大项目(2006BAD08A09)

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# 旱稻田杂草发生及其化学防除技术研究

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杂草是旱稻大面积推广的障碍因子之一,2005~2006 年调查结果表明,上海市旱稻田现有杂草 26 种,隶属 12 科 21 属,杂草发生呈现种类多、周期长、旱湿田种类混生等显著特点。8 种不同除草剂评价试验结果表明,33%施田补 EC、90%高杀草丹 EC、23.5%果尔 EC 和 36%丁·恶 EC 都能不同程度地控制旱稻田杂草的危害,尤以 33%施田补 EC495g a.i./hm²和 10%克草绅 WP15~22.5g a.i./hm²混配使用持效期最长,一次用药可基本解决旱稻田整个生育期杂草的危害,且对旱稻生长安全。

关键词: 旱稻; 杂草; 化学防除技术; 安全性

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### 除草剂减量施用的技术与实践

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除草剂的发现是近代农业科学的重大成就之一。化学除草改变了依赖人工、畜力和机械除草的状况,以其省工、快速、高效在杂草防除中起到了巨大作用,农民对除草剂的依赖性也越来越大。据统计:美国等发达国家如果离开了除草剂,主要粮食作物的损失占每年粮食总产的1/3以上。然而,除草剂的大量投入已经带来了诸如:土壤环境及水资源污染、当茬及后茬作物药害、抗性杂草的出现、经济效益降低等一系列问题,有的已成为农业持续发展的限制因素。因此,减少除草剂的施用量已经成为世界杂草科技工作者关注的热点研究问题之一。

除草剂减量施用即综合利用一切可以利用的控草手段,降低化学除草剂在环境的投入量,使杂草发生水平控制在生态经济除草阈值之下,达到持久增产增收和保护环境的目的。

本文分析了物理措施、农作措施、生物措施、化学措施等与除草剂减量施用的关系,并就目前国内外在除草剂减量施用技术方面的应用实践进行了阐述。

<sup>\*</sup>基金项目:国家"十一五"科技支撑重大项目(2006BAD08A09) 作者简介:李香菊,女,1963年生,研究员,研究方向为杂草生态与防除,email:xjli@ippcaas.cn

### 金鱼藻与铜绿微囊藻共生情况下化感作用的研究\*\*

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近年来湖泊水华频频暴发,利用水生植物治理水体富营养化以及控制水华备受世界各国关 注。尤其是抑藻机理的研究,引起广大学者的兴趣。通过金鱼藻和铜绿微囊藻共生实验, 研究了二者之间的相互胁迫作用。通过测定铜绿微囊藻的藻细胞密度、叶绿素a浓度、藻 胆蛋白含量(包括藻蓝蛋白、别藻蓝蛋白和藻红蛋白)、SOD活性以及MDA含量在共生 培养过程中的变化趋势,研究金鱼藻对铜绿微囊藻的作用机制。同时,还对铜绿微囊藻对 金鱼藻的胁迫作用进行了研究。结果表明,金鱼藻对铜绿微囊藻有明显的抑制作用,实验 第3天藻细胞数量急剧下降,4天后藻细胞完全死亡。本研究排除了营养和光照的竞争,确 定金鱼藻的化感作用是导致铜绿微囊藻死亡的主要原因。24小时后,铜绿微囊藻叶绿素a 的浓度呈下降趋势,到第48小时,实验组和空白组叶绿素含量已经有了显著性差异 (P=0.043), 而此时藻细胞数目还没有发生显著差异。说明在化感物质导致藻死亡之前, 已经对藻的叶绿素a造成了破坏,导致光合作用无法正常进行,直到藻体死亡。藻蓝蛋白 (PC)、别藻蓝蛋白(AP)和藻红蛋白(PE)都有不同程度的损伤,实验72小时后,藻 蓝蛋白的损伤程度最大,仅为对照组的19%,与叶绿素a损伤程度相似(为对照组的23%)。 SOD活性在实验初期升高,12小时达到最大值,然后呈下降趋势,第3天时仅为对照组的 52%。与之类似, MDA浓度也呈先升高的趋势, 24小时达到最大值, 然后降低直到藻体死 亡。由此推测,金鱼藻释放的化感物质导致铜绿微囊藻体内活性氧增加,并且细胞膜严重 受损,趋于死亡。铜绿微囊藻对金鱼藻也有一定胁迫作用,经过3周的培养,单独培养的 金鱼藻湿重增加了15.8%, 而和铜绿微囊藻共同培养的金鱼藻湿重几乎没有增加, 并且叶 绿素a和类胡萝卜素的含量分别降低了38.6%和22.8%。这可能是由于铜绿微囊藻对营养的 竞争以及分泌藻毒素的毒害引起的。

关键词 金鱼藻 铜绿微囊藻 化感作用

<sup>\*</sup>国家重点基础研究发展规划资助项目(2002CB412307)

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### 不同 N 水平条件下水稻化感效应对稻田杂草种群变化的影响

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选用具有化感特性的 PI312777 和长江流域地区主栽的扬稻 6 号,通过田间试验明确在不同 N 水平条件下,水稻品种的抑草效应与田间杂草的种群变化,结果表明:在较高施 N 水平条件下,PI312777 的化感潜力及与莎草科杂草和阔叶类杂草的竞争能力较强,水稻齐穗期稻田物种丰富度、均匀度和群落多样性指数较高,降低施 N 水平,PI312777 的化感潜力及与非敏感性杂草的竞争能力下降。与 PI312777 相比,扬稻 6 号种植区,提高施用 N 水平,可提高对莎草科杂草、阔叶类杂草的竞争能力,但能够促进稗草的生长,提高水稻齐穗期稗草的干重,水稻齐穗期稻田杂草群落特征值较低。

关键词: 水稻 N肥 化感 杂草种群

# 麦田恶性杂草发生趋重 小麦生产受到严重威胁\*

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近年来,河北、河南、山西等省小麦产区恶性杂草发生逐年加重。以节节麦、日本看 麦娘、雀麦和野燕麦等为主的禾本科恶性杂草在局部地区麦田发生十分严重,一些田块因 节节麦等恶性杂草危害造成小麦毁种、绝收,对小麦安全生产造成了严重威胁。

当前,冀、晋、豫麦田恶性禾本科杂草其发生、危害呈现以下特点:一是**发生范围广**。据不完全统计,三省麦田节节麦、日本看麦娘、雀麦和野燕麦等恶性禾本科杂草发生面积为 1500 万亩,其中河南省野燕麦发生面积达 501.2 万亩,以南阳、漯河、驻马店、洛阳、焦作等市最为严重;看麦娘发生面积 172.7 万,焦作、平顶山、商丘、郑州等地发生严重。河北省节节麦、雀麦、日本看麦娘发生面积达 329.8 万亩,主要分布在邯郸、邢台、石家庄、保定、衡水等冬小麦主产区。山西省临汾市的平川七县麦田节节麦、雀麦、野燕麦、早熟禾等麦田恶性杂草发生面积达 43.02 万亩,占该市小麦种植总面积的 25.42%。二是危害程度重。一般危害田块恶性禾本科杂草的平均穗数为 10-60 穗/m²,严重田块在 100-500 穗/m²,个别田块高达 800-1200 穗/m²以上,杂草的密度已超过小麦。部分麦田因恶性杂草发生太重,不得不毁麦改种其它作物。三是蔓延速度快。河北省 2001 年在盐山县首次发现节节麦,2002 年在定州首次发现雀麦,当时的发生面积均不足 1 亩,到 2006年,全省禾本科恶性杂草发生面积已达到了 300 多万亩。以节节麦、日本看麦娘和雀麦等为主的恶性禾本科杂草近年在陕西、山东、新疆、江苏、四川、重庆等地也均有发生。

据调查分析,造成节节麦等恶性禾本科杂草近年来发生为害加重的原因主要有:①耕作方式改变。目前,小麦播种前多以浅旋耕代替了传统的深耕方式,致使落地的杂草种子集中在浅土层,有利于杂草的萌发危害。近年免耕栽培技术的推广应用,也为适宜浅层萌发的禾本科恶性杂草提供了适宜的出苗条件。②杂草优势种群变化。在一些麦田,由于长期使用 2,4-D 丁酯和苯磺隆等除草剂,使得以播娘蒿、荠菜等阔叶杂草得到了有效的控制,但也导致了难以防除的节节麦等禾本科杂草上升为麦田的主要恶性杂草。③小麦种子混杂。1998 年以前,节节麦在河北邯郸等地麦田极为少见,后因从外地引种、调种,未经严格检疫,加上农民互相频繁换种,造成夹带在麦种中的节节麦在大范围迅速传播蔓延。④跨区作业收割机械携带杂草传播。随着大型联合收割机跨区作业的快速发展,近几年以节节麦、雀麦为代表的恶性禾本科杂草也随收割机械作业迅速传播蔓延,发生面积不断扩大。如在河北省节节麦已由几年前仅在邯郸市零星发生迅速扩展到邯郸、邢台、石家庄、衡水、保定地区,并已在部分地区出现了难以控制的势头。⑤防除难度大。节节麦、雀麦等恶性杂草与小麦的形态特征、生活习性极其相近,苗期很难识别,而且目前可用于防治这些恶性禾本科杂草的除草剂品种仅有1-2个,亩防治成本高达20多元。

以目前节节麦等麦田恶性禾本科杂草的传播蔓延速度,如不给予高度重视、采取紧急防范措施,不用几年节节麦等麦田恶性禾本科杂草必将在所有适生区泛滥成灾,将对我国小麦安全生产乃至粮食安全造成严重影响。

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### 大漂的化学成分及化感活性初探

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研究了云南昆明滇池附近的大漂(*Pistia stratiotes* L.)化学成分及初步化感活性。采用硅胶、葡聚糖凝胶 LH-20、RP-8、RP-18、 Toyopearl HW-40F 等柱层析方法,从大漂中分离得到了 16 个化合物,借助质谱、氢谱、碳谱、二维核磁共振技术等光谱分析技术鉴定了其中的 11 个: (24R)-麦角甾-7, 22-二烯-3β,  $5\alpha$ , 6-三醇(1)、 $7\beta$ -羟基谷甾醇(2)、sitoindoside I (3)、大豆脑苷 I (4)、木犀草素(5)、柯伊利素-4′-O-β-D-吡喃葡萄糖吡喃苷(6)、Stigmasta-5,22-diene-3, 7-diol(7)、肌苷(8)、annuionone E (9)、β-谷甾醇 (10)及胡萝卜苷(11),化合物 1-9 首次从该植物中得到。

对大漂乙醇提取物及其石油醚、乙酸乙酯和正丁醇萃取部分进行了植物种子化感活性初探,结果表明乙酸乙酯萃取部分对莴苣种子的萌发、根长和苗高有显著的抑制作用,浓度为 0.00 01 g·ml<sup>-1</sup>, 0.001 g·ml<sup>-1</sup>, 0.01 g·ml<sup>-1</sup>, 0.02 g·ml<sup>-1</sup> 时抑制率分别为-14.29%, 52.38%, 100%, 100%; 4.01%, 60.65%, 100%, 100% 和 14.41%, 51.63%, 100%, 100%。 对油菜种子的萌发、根长和苗高也有一定的抑制作用,但效果不如莴苣。石油醚部分对供试植物的种子萌发、根长和苗高没有明显的抑制作用。正丁醇部分则对供试种子的苗高在一定范围内具有一定的促进作用。

关键词 大漂 化学成分 化感活性

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### 脂肪酸对植物病原菌的抑制作用\*

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脂肪酸(fatty acids)是长链的饱和或不饱和有机物,除了能提供人类的使用食物成分之外,它还有抑菌作用。前期盆栽试验中,我们观察到在取自发生连作障碍的保护地土壤中加入 1‰的棕榈酸和油酸后,黄瓜和番茄植株的地上和地下部分干重都显著增加,说明这两种天然脂肪酸类物质可能具有一定的抗病化感潜力。为了验证天然脂肪酸类物质是否存在一定的抗病化感潜力,我们开展了几种脂肪酸对几种常见的植物病原菌进行离体抑菌试验。

试验选取了九种脂肪酸(丁酸,己酸,辛酸,癸酸,月桂酸,肉豆蔻酸,棕榈酸,油 酸,亚油酸)分别对四种植物病原真菌(番茄早疫病菌 Alternaria solani,黄瓜枯萎 Fusarium oxysporium f.sp.cucumerinum 番茄枯萎 Fusarium oxysporum f.sp.lycopersici, 黄瓜炭疽 Colletotrichum lagenarium)进行离体抑制试验,每种酸分别设 0 μM、100 μM、1000 μM 和 2000 μM 四个浓度。结果表明,丁酸在浓度为 100 μM 时只对番茄早疫病原真菌有明显的 抑制作用, 当其浓度达到  $1000 \, \mu M$  和  $2000 \, \mu M$  时, 对四种病原菌都有明显的抑制作用。己 酸在浓度为 1000 μM 时只对黄瓜枯萎有明显的抑制作用;而在 2000 μM 时对黄瓜炭疽,黄 瓜枯萎和番茄枯萎均有明显的抑制作用。辛酸和癸酸在浓度为 2000 µM 时对黄瓜炭疽都有 极强的抑制作用,可以完全抑制菌丝体的生长,其中癸酸在浓度为 1000µM 时就已经能够 完全抑制黄瓜炭疽菌丝体的生长了,而 100 μM 时能则显著抑制黄瓜炭疽的菌丝体生长。 除此之外,辛酸在浓度为 2000 µM 时还能抑制番茄早疫,黄瓜枯萎和番茄枯萎等病原真菌 的菌丝体生长, 1000 μM 时能抑制黄瓜枯萎和番茄枯萎的菌丝体生长。癸酸在浓度为 100  $\mu$ M,  $1000 \mu$ M,  $2000 \mu$ M 时能抑制番茄早疫的菌丝体生长, 在浓度为  $2000 \mu$ M 还能抑制黄 瓜枯萎的菌丝体生长。月桂酸浓度为 100 µM, 1000 µM, 2000 µM 时只对番茄枯萎有抑制 作用。肉豆蔻酸在浓度为 1000 μM 和 2000 μM 时对番茄早疫和番茄枯萎的致病菌都有抑制 作用, 当其浓度为 100 µM 时就已经对番茄早疫有明显的抑制效果。棕榈酸只在 1g/L 时对 四种菌有抑制作用,而其它浓度下没有观察到对四种病原真菌的抑制效应。油酸在所选用 的几种浓度下对四种菌均没有抑制作用,亚油酸在浓度为 2000 μM 时对番茄早疫、黄瓜枯 萎、番茄枯萎都有抑制作用,在浓度为 1000 μM 时只对番茄枯萎有抑制作用。通过离体试 验,发现某些脂肪酸对特定的病原真菌有抑制作用,但是脂肪酸抑菌的机理还不清楚,今 后还需要进一步研究,而且还需将此项结果应用于活体试验研究。

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# 应用除草剂防除三裂叶豚草研究

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豚草是影响人类健康和为害农业生产的危险性杂草, 自 30 年代传入我国后, 经过一个较 长的适宜过程,现已迅速蔓延。目前辽宁省除阜新市尚未发现外,其余 13 个市、地均已 发生为害。每年7~9月造成许多人患病态反应症,并对农田已形成包围态势和侵入态势。 从长远看,如不加以根治,顺其蔓延,具有极大的潜在威胁。控制豚草为害,虽然可以采 用人工拔除、生物防除、辅之以替代控制措施。但是,由于分布广、发生面积大,天敌控 制尚不稳定,采用化学防除措施,仍是十分必要的。2003~2004年在沈阳地区采用多种除 草剂防除三裂叶豚草试验,结果表明25%辛酰溴苯腈乳油有良好的防除效果,3叶期左右 每亩适宜剂量 75~100 毫升, 4~8 叶期每亩适宜剂量 100~125 毫升, 8~12 叶即开花期 每亩适宜剂量 125~150 毫升。同时可以有效的防除反枝苋、凹头苋、藜、小藜、苍耳、 红蓼等阔叶杂草。5月下旬至6月中旬,三裂叶豚草4~6叶期,株高50厘米以下,是采 取茎叶处理法的最佳时期。气温是影响防效的关键因子,温度高时施药可提高防效。辛酰 溴苯腈乳油与 2,4D 丁酯混用有增效作用,最佳配比是每亩 25%辛酰溴苯腈乳油 75~100 毫升混用 72%2, 4D 丁酯 25 毫升。研制的 39% 阔草除乳油可用于防除玉米、小麦田三裂 叶豚草可兼治多种阔叶草,每亩适宜剂量为75~100毫升。25%氟磺胺草醚水剂、5%咪草 烟水剂在大豆田使用,对三裂叶豚草有较好的防除效果,每亩 12%收乐通乳油 35 毫升与 25%氟磺胺草醚水剂 70 毫升混用对禾本科杂和阔叶杂草均有良好的防除效果。在三裂叶 豚草分布不均匀的地块, 可采用挑治法, 即降低成本, 又提高工效, 还有利于保护生态。

### 我国农药登记现状概述

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本文概述了我国和部分世界发达国家的农药的登记管理的基本情况,结合我国的现状提出 些建议,在法规建设方面应加快推进我国《农药管理条例》的修订,以更好的明确和促进 我国农药和特殊用途转基因生物的生产、登记、使用、出口、监督执法、违法处罚等方面 的职能建设;在标准建设方面应加强农药抗性风险评价、新农药生态危害风险评价、长残 毒药剂后茬安全性、农药田间良好使用规范(GAP)等,进一步规范我国农药登记各类试 验技术报告,为将来农药登记试验技术报告的国际互认奠定标准基础;在登记试验体系建 设方面,加强各试验单位的监督与管理,在为政府把关和企业服务过程中,不断提高试验 效率,为国际试验报告互认奠定试验体系基础;在环境保护方面应建立农药废品的处理和 回收体系及奖惩制度,老产品再登记制度,建立农药行业的诚信制度,加强农民、农技人 员的技术培训等,依靠不断革新的科学技术更好地为保护环境服务。农药登记与管理的科 学化、规范化和制度化,对于我国农业的有害生物防治和农业的可持续发展具有重要意义。 关键词:农药,登记,概述

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### 土壤中异噁草酮降解菌的分离鉴定、适应性及生物修复效果的研究

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利用长期施用长残留性除草剂异噁草酮的土壤,采用高压富集的方法,从两种培养液中共 分离出3株细菌,根据菌株的形态特性和生理生化特征,对这3个菌株进行了初步鉴定。 并以这3株异噁草酮降解细菌 X, Y1, W2 为试验材料, 研究土壤温度、湿度、异噁草酮 浓度、施用肥料以及土壤类型等环境条件对其生长量的影响。以玉米为指示植物,在设置 不同的土壤湿度、添加不同的肥料和采用不同的接菌方式等条件下,通过作物的形态和生 理指标系统地评价了(X、Y1、W2)3种微生物降解土壤中异噁草酮的效果。结果表明, W2 为短杆菌属(Brevibacterium); Y1 和 X 同为芽胞杆菌属(Bacillus); W2、Y1 和 X 的最 适生长温度分别是 30℃、35℃和 30℃; W2 培养基的适合 pH 值为 6.0~9.0, Y1 和 X 的 最适 pH 值为  $6.0\sim8.0$ ; W2 生长最适异噁草酮的初始浓度是 200mg  $a..i.·L^{-1}$ , Y1 和 X 生长 最适异噁草酮的初始浓度是 100mg a..i.·L $^{-1}$ 。当土壤温度为 25℃ $\sim35$ ℃时,均适合 3 株降 解菌的生长;土壤湿度为田间持水量 50%时,3 株菌株均达到最大生长量;3 株细菌在高 浓度异噁草酮中的适应能力由强到弱的顺序为 W2>Y1>X;添加肥料能够显著提高降解菌 的生长量; 3 株降解菌在 4 种不同类型的土壤中生长量均有一定的差异。当土壤湿度为田 间持水量 50%时, 三个菌株对异噁草酮的降解效果均最好; 在处理 90 天内, 随着降解时 间的延长,加入降解菌的处理对土壤的修复效果明显好于对照;添加肥料能够显著提高降 解菌对土壤的修复,其中添加无机肥的降解效果明显好于有机肥。

关键词 异噁草酮 降解菌 分离鉴定 适应性 生物修复

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# 草甘膦对田旋花、打碗花体内莽草酸含量的影响\*

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田旋花(Convolvulus arvensis),打碗花(Calystegia hederacea)在我国华北已成为小 麦、玉米、大豆等旱田中的主要危害杂草,并在全国大面积蔓延。多数农民为了节省成本 一般不翻地,在麦茬里直接播种下茬玉米、大豆等作物,喷施广谱灭生性除草剂草甘膦、 百草枯进行除草。由于草甘膦处理后植物中毒症状表现缓慢,植物是否已经受害往往不能 得到及时的判断,它的作用机理主要是竞争性抑制莽草酸途径中的5-烯醇丙酮莽草酸-3-磷酸合成酶(5-enolpyruvylshikimate-3-phosphate synthase, EPSP 合成酶,EC 2.5.1.19), 结果导致植物体内莽草酸积累过量而死亡。所以通过检测被测植物莽草酸含量的积累可以 作为及时判断植物是否受草甘膦影响的有效方法。我们通过试验来探索田旋花、打碗花对 草甘膦的反应和莽草酸含量变化反应具有怎样的关系。草甘膦按1000ae/ha,1500 ae/ha用量 茎叶喷雾处理生长50天后的田旋花,打碗花,喷药后每天剪取打碗花、田旋花的地上叶茎 和地下部分洗净晾干各0.5g左右,剪碎于研钵中液氮研磨,加入1.0ml0.25mol/L的HCl,于 4℃, 12000rpm离心15min, 收集上清液, 4℃保存待测。将莽草酸标准样品10mg溶于 0.25mol/LHC11.0ml中,分别取0,1,5,10,50,100μL加0.25mol/LHCl至1.0ml。制作标 准曲线。取200μL上清液,加入2.0ml 1%的过碘酸溶液,3h后加入2.0ml 1.0mol/L的NaOH 并混匀,然后加入1.2ml的0.1mol/L甘氨酸混匀静置,于380nm比色测定吸光度OA值。标准 曲线关系式为y=0.0415+0.0667x。试验发现田旋花、打碗花的地上部分莽草酸含量一般 为8.0~10μg/μL,草甘膦施用后24h就比对照的莽草酸含量高,九天内一直上升,在第七天 迅速上升。田旋花、打碗花的地下部分莽草酸含量一般为5.0µg/µL左右,草甘膦施用后第 四天开始比对照的莽草酸含量高,第七天迅速上升。打碗花从第八天开始地上部分莽草酸 的量下降而地下部分迅速上升; 田旋花正好相反, 第八天地上部分莽草酸含量迅速上升而 地下部分降低。同时从取样后继续培养的样品看到的田旋花、打碗花地上部分大部分都会 枯死,但又会重新长出新的侧芽。只是打碗花的生长势头比田旋花低,田旋花的再生率能 达到80%而打碗花为50%。植株受草甘膦作用后,低剂量下的伤害能自行恢复,莽草酸的含 量会因其自身代谢而逐渐减少。而在高剂量下植株的伤害逐渐加重,其体内莽草酸的含量也 逐渐增加。因此可以通过检测植株体内的莽草酸的含量随时间的变化而预测受伤的植株能 否恢复。从试验中可以得到这样的推测:草甘膦处理后的植株的莽草酸积累位置的不同是 田旋花、打碗花产生草甘膦耐药性的一个重要机制。这也许是由于草甘膦在感抗性植物组 织中分布不同造成的。抗草甘膦杂草的发生和蔓延是农业生产中的一大潜在威胁。我们也 可以通过对比不同植物草甘膦处理后的莽草酸积累的水平来监测草甘膦抗性情况。

关键词:草甘膦;田旋花;打碗花;莽草酸

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# 6种覆盖植物在北京北部栗园生态适应性及杂草控制研究

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采用覆盖植物控制山地栗园杂草,替代除草剂防除杂草,既可以避免地表裸露,减少水土流失,增加生物多样性,又可以减少农药对环境的污染。为此,我们在北京栗园树间进行7种覆盖植物生态适应性试验以及杂草控制研究。结果表明,在土壤有机质含量为12.1g/Kg的北京怀柔栗园白三叶、鸭茅、高羊茅、黑麦草和早熟禾能够成坪,覆盖度可以达到90%。在种植的当年,覆盖植物生长初期(约40d左右)辅助人工除草1次。成坪后的覆盖植物对杂草有良好的控制效果,其杂草地上部鲜重抑制率为94.6%~99.5%。秋春季灌溉的高羊茅、黑麦草、鸭茅、无芒雀麦均可安全越冬。但在秋春季无灌溉的旱冬年份,高羊茅、黑麦草、鸭茅不能安全越冬。在土壤有机质含量为4.6g/Kg的北京密云栗园上述覆盖植物均不能成坪,最大覆盖度仅为60%,对杂草几乎没有控制作用。在两地栗园树荫下,紫花苜蓿均不能良好生长。

关键词: 栗园; 覆盖植物; 生态适应性; 杂草控制

# 水稻免耕直播品种适应性及其杂草防除研究\*

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为了明确免耕直播水稻品种的适应性和经济高效的杂草防除模式,在浙江海宁和湖北武昌二地进行了试验。试验结果表明,水稻免耕直播田除草,在播前7-10天第一次用41%农达水剂、在播后水稻3叶期第二次用38%苄.二氯可湿性粉剂、在水稻4叶期第三次用10%千金乳油,对当地免耕水稻田主要杂草均有优良防效。各水稻品种对除草剂的反应无显著差异,安全性良好。从田间观察的情况看,供试各水稻品种作为单季稻播种,在当地均有良好适应性,从测产情况看,产量均较理想。

关键词 水稻 免耕直播 品种 杂草防治

<sup>\*</sup> 农业部结构调整项目(05-01-01A); 国家科技支撑计划(2006BAD08A09)

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# 利用琼脂混粉法测定植物组织的化感活性

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近年来,有关植物化感作用的研究十分活跃,通过这一研究不仅可以很好的指导生产 实践,增加农业生态系统的良性循环,建立合理的栽培技术和耕作制度,而且可以以植物 化感作用为理论依托,从植物组织中寻找具有抑制杂草生长的天然除草活性物质,进而进 行仿生除草剂的研究与开发,以减少有害化学制剂的投入,有效合理利用资源,保护生态 环境,提高农业生产力。在植物化感作用研究中,生物测定是必不可少的环节,常规的方 法是先提取后测定,即利用极性溶剂或非极性溶剂对植物组织中的化合物进行提取,经浓 缩后进行生物测定,即费时又费力。为此,日本学者藤井于 1994 年研究开发出了可以直 接利用植物叶片进行测定的"三明治法",该方法模仿三明治的制作,将采集的植物叶片固 定于两层琼脂之间,以测定从叶片中渗透出来的化合物对播种于上层琼脂表面上的生菜种 子发芽及生长的影响。但该方法存在所渗透出来的化合物在琼脂中的分布不均匀、渗透量 小以及种子发芽不齐等不足。为了寻找更为便利有效的测定方法,我们在三明治法的基础 上进行了探索研究,形成了"琼脂混粉法",即将植物的组织粉末混入最终浓度为0.5%的琼 脂溶液后,来测定植物化感作用的方法。利用该方法对 38 种园林植物叶片的粉末进行了 化感作用的测定。在  $10 \text{ g·L}^{-1}$ 的粉末添加浓度下,各供试植物均对结球生菜幼苗的生长产 生了不同程度的影响,且普遍对胚根生长的抑制大于对胚轴的抑制。其中,南天竹、海桐、 金丝桃、常春藤、复羽叶栾树、石榴、矮天牛、华山松、鸡爪槭、观赏桃、合欢和萱草等 植物对胚根生长的抑制率以及南天竹对胚轴生长的抑制率均达90%以上。这些研究结果为 我们今后进一步研究植物化感作用和开发植物源仿生除草剂提供了依据。

关键词 琼脂混粉法: 化感作用: 生物测定: 结球生菜: 园林植物

### 梭梭-肉苁蓉一体苗在生产中的应用

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肉苁蓉属列当科肉苁蓉属多年寄生草本植物,别名大芸,是一种名贵中草药,有"沙漠人参"之称。 专性寄生与沙漠植物梭梭的根部。梭梭和肉苁蓉又是荒漠地区的宝贵资源,也是荒漠植被的基本成份, 它对维持荒漠地区脆弱的生态平衡起着重要的作用,也是该地区发展畜牧业和经济建设的首要保障, 合理开发应用这一珍稀资源,一直是社会各界所关注的内容。

肉苁蓉具补肾、壮阳、润肠通便的独特药效。最近医学研究发现,它所含的苯乙醇苷、苷类化合物在治疗老年性痴呆症、调节免疫力、抗衰老方面有显著疗效,加之相关保健产品的开发,造成对原药量的需求猛增,导致药材价格在近 10 年来上升 400%-500%,每公斤干品抬升至 200 元左右。

目前的人工培育肉苁蓉技术,一般都是将处理过的野生肉苁蓉种子播种梭梭植物的根系周围,或者是人工直接接种于梭梭根系,人为切开小口的根毛区来诱导肉苁蓉种子萌发,完成其生长发育过程。接种肉苁蓉及采收培育成肉苁蓉须经过两次挖掘工作,无疑对梭梭根系及周围土层造成更大破坏,而且也是劳动强度较大的工作,投入与产出比不符合投资经营规律的最低要求。我们采用人工诱导肉苁蓉种子发芽、火箭盆培育梭梭幼苗、人工接种肉苁蓉种子到梭梭根部等方法,已经在小面积范围内获得成功。目前正在陕西、甘肃、宁夏等地开展小面积试验示范。





# 生物碱 noranabasamine、pyridylnicotine 合成

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联吡啶新型生物碱 noranabasamine、pyridylnicotine 是从毒蛙皮肤中分离得到的烟碱样胆碱 受体激动剂化学防御物质,深入研究化学生态功能具有重要学术与应用价值。本文拟设计 合成以上两个化合物。

图 目标化合物合成路线

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### 根系接菌对枯萎病不同抗性黄瓜根系分泌物组分影响的研究

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本研究以对枯萎病(Fusarium oxysporum. f. sp. cucumerinum owen)抗性不同华北生态型密刺类黄瓜品种为试验材料,设置接菌与非接菌两种处理条件,采用基质培的方式通过浸根法获得根系主动溢泌、可溶的根系分泌物提取液;采用氨基酸自动分析仪和气质联用仪对不同处理根系分泌物组分进行测定,并对检测结果进行分析比较,以期明确不同抗性黄瓜品种根系分泌物组成及其与抗病性之间的关系;探讨在化感层面不同抗性黄瓜品种抗枯萎病的机制。

研究结果表明:各处理检测出的氨基酸种类不同;感病黄瓜品种根系分泌物中的氨基酸种类较多;苯丙氨酸、缬氨酸、甲硫氨酸、甘氨酸和半胱氨酸在所有的处理中出现;未接菌条件下,感病品种根系分泌物中这些氨基酸的占有比率高于抗病品种的;接菌处理的根系分泌物中这五种氨基酸的占总氨基酸的百分率比未接菌的低。

在黄瓜根系分泌物中用GC-MS共检测到可能存在的化合物85种;感病品种根系分泌物中化合物的种类和总浓度都明显高于抗病品种的;未接菌处理的根系分泌物中可测得的化合物的种类和化合物总浓度均比接菌处理的多。有机酸类物质与黄瓜抗病性关系最密切,主要表现在:在未接菌条件下,抗病品种根系分泌物中含有机酸组分的化合物种类数比感病品种的多(乙酸、苯甲酸、磷酸、苹果酸);在接菌处理后,抗性品种的根系分泌物中的含有机酸组分的化合物种类数增多(乙酸、苯甲酸、顺丁烯二酸);感病品种接菌处理后的根系分泌物中的含有机酸组分的化合物种类数也同样表现为增加(乙酸、苯甲酸、丁酸、磷酸)。

**关键词:** 黄瓜品种; 根系分泌物; 氨基酸; GC-MS分析; 黄瓜枯萎病菌。

### 红花酢浆草化感作用的研究

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红花酢浆草(Oxalis corybosa DC.) 是一外来入侵种,在我国广泛分布且危害严重。主要以地下鳞茎进行无性繁殖,其适应性强,生长速度快,再生性能强,繁殖率高,侵占性强,抗逆性特强如耐寒、耐旱、耐涝、耐阴蔽等,为了探索其入侵后发展成为单种优势群落的重要原因,本文对其化感作用及其化感物质进行了研究。主要研究结果如下:(1) 0.1 g·ml¹的酢浆草干叶的水提液和甲醇提液对供试小麦、莴笋、油菜、马齿苋、播娘蒿种子萌发和生长表现出强烈的抑制作用(尤其是水提液),0.1 g·ml¹的根状茎水提液和甲醇提液作用较弱,0.1 g·ml¹的根际土水提液则没有表现出化感作用;(2) 0.1,0.01,0.001 g·ml-1的叶的水提液和甲醇提液分别对供试种子表现出不同程度的化感作用;(3) 叶中有机酸的含量较高,其水提液中草酸、酒石酸、苹果酸、柠檬酸及β-谷甾醇是主要化感物质。

关键词 红花酢浆草 外来入侵种 化感作用 化感物质 有机酸

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### 不同类型草坪香附子防除技术

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香附子是草坪的主要恶性杂草之一,繁殖能力强且发生周期长,其防治应采取"土壤封闭和茎叶处理相结合并多次用药"的策略。马蹄金草坪中 20%绿茵 SL-2 号 WP525 g/ha 和675g/ha,药后 20d 对香附子的防治效果分别为 87.2%和 94.7%,对马蹄金草坪安全。48%苯达松 AS2250g/ha,防效为 80.3%,对马蹄金草坪的新生叶生长有一定的抑制作用。暖季型禾本科结缕草和狗牙根等草坪中 10%绿茵 L-7 号 WP1500 g/ha 和 25%啶嘧磺隆 WG225 g/ha,药后 20d 的防效分别为 96.4%和 97.8%,两种药剂均对草坪草安全。冷季型禾本科高羊茅、黑麦草和早熟禾等草坪中,10%绿茵 L-7 号 WP1500 g/ha 和 48%苯达松AS2250g/ha,药后 20d 的防效分别为 97.1%和 78.6%,对草坪草安全。应用 20%绿茵 SL-2号 WP、10%绿茵 L-7号 WP和 25%啶嘧磺隆 WG 后,防除香附子效果彻底,地下块茎再生率低。

关键词:草坪:香附子:除草剂

# 外来入侵植物预警、控制体系的建立—以江苏防治加拿大一枝黄花 为例

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在对全省外来入侵杂草加拿大一枝黄花的野外数量调查及对采集的 40 多个种群的入侵生 物、生态学研究的基础上,结合对加拿大一枝黄花生殖生物学及其近缘种的形态特征比较, 明确了加拿大一枝黄花在江苏的发生分布规律、形态和遗传多样性和生殖生物学特点,确 定了生殖敏感期的形态特征。进一步,运用AFLP和ITS区序列分析的分子手段鉴定出鲜切 花"黄莺花"属于加拿大一枝黄花复合种。研制的加拿大一枝黄花花芽分化抑制剂大面积应 用可以有效抑制加拿大一枝黄花的大、小孢子发育从而控制结实并遏制其迅速入侵扩张的 势头。研制筛选出以草甘膦、2,4-D和甲嘧磺隆等为主要成分的高效、除根的除草剂配方 5个以及配套的应用技术,并得到大范围的推广应用,对控制加拿大一枝黄花蔓延扩散起 到了关键作用。系统开展了加拿大一枝黄花的生物防除的研究,发现了具有应用开发潜力 的自然天敌 5 个: 开创了利用加拿大一枝黄花茎杆培养多种食用菌的技术: 此外, 还进行 了替代种植的研究工作;以此作为长效治理的技术储备。建立了国内收集种类信息最多的 中国外来入侵植物信息系统http://weed.njau.edu.cn , 为加拿大一枝黄花等严重入侵性杂草 的监测、控制提供信息,点击访问75万人次。通过网络、媒体和培训班等多种宣传渠道, 增强社会对外来杂草的关注和认识。构建了以生物防除长效控制,生态途径的利用控制、 化学药剂的迅速控制、建立预警信息系统和提高公众意识的快速遏制和长效管理相结合的 外来入侵植物立体化综合防控体系,推广应用到全省,累计达1万余公顷。

### 番木瓜化感作用的初步研究\*

#### 邱庆军 朱朝华\*\* 骆焱平 徐震宇 王兰英

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以番木瓜为供体,黄瓜、萝卜、芝麻为受体,通过种子萌发法和生长速率法测定番木瓜的 化感作用。结果表明,黄瓜、萝卜、芝麻的萌发和生长都受到了供体番木瓜叶水浸提液的影响,供体水浸提液在高浓度下抑制而在低浓度下则促进受体的萌发和幼苗生长,表现为水浸提液浓度越高,抑制作用越强;番木瓜种子水浸提液的处理,对萝卜种子的萌发表现为促进、对黄瓜和芝麻表现为低促进高抑制的现象,对3种受体的生长均表现为抑制,且浓度越高,抑制作用越强。试验初步证实了番木瓜具有化感潜力,可对番木瓜的轮作、间作、套种及杂草生物防除具有一定的指导意义。

关键词: 番木瓜; 化感作用; 种子萌发; 幼苗生长

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### 加拿大一枝黄花无性繁殖特性研究\*

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# STUDIES ON PROPERTY OF ASEXUAL REPRODUCTION OF SOLIDAGO CANADENSIS RHIZOMA

SHEN Guo-hui, QIAN Zhen-guan, GUAN Li-qing, LI Tao, CAI Xiao-lin

无性繁殖是加拿大一枝黄花扩散蔓延的重要途径。研究结果表明,加拿大一枝黄花地下根状茎一般自当年 10 月起大量萌生新植株,幼苗在上海地区能安全越冬,越冬幼苗占无性繁殖苗总量的 85.7%。2 月移植的加拿大一枝黄花植株,至当年秋季平均每株能繁殖 33.3 株开花的植株,这些植株又可萌生出 201.7 株越冬苗,其占地面积可达 1.08m²,地下根状茎生物量达 3.97kg,连接长度为 178.65m;第 2 年年末猛增到 259.6 株成株,可形成越冬苗 503.6 株,占地面积高达 3.24 m²,地下根茎鲜重高达 5.088kg,长度达 266.8m。加拿大一枝黄花根茎在 20℃-30℃的温度条件下出苗最好;根茎在表土的出苗率较低,而在 5-10cm 土层内的出苗率最高;在 50%的土壤水分条件下根茎不能出苗,示范结果证明,种植水稻可有效控制加拿大一枝黄花的发生。

关键词: 加拿大一枝黄花; 无性繁殖; 生态调控

<sup>\*</sup>基金项目:上海市科委重大攻关项目"重要外来杂草监测预警和防除对策研究"(项目编号 03dz19313)资助作者简介:沈国辉,男,1965年生,研究员,长期从事杂草生物学及其综合防除与利用技术研究。电话:13501620619, E-mail: zb5@saas.sh.cn

### 一种自然控草方法-----植物相克作用研究的展望

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根据国际化感协会(IAS)的定义,植物相克是指研究包括植物、藻、细菌及真菌的次生代谢物对农业与生物系统的生产和发展影响的任何过程和机制。按此定义,化感作用现象可作物一种经济、安全、有效地抑制杂草生长的新的化学物质来源和控制途径。 目前化感物质按生物合成可以分成 14 大类,其中主要分为酚类化合物、苯醌类和萜类化合物。在阐述单酚,类黄硐、单烯、倍半烯、双烯等化合物的萃取和作用机理的基础上,从蛋白质组学,基因组学及应用学角度提出对植化相克研究的展望。 一是在现有大量研究的基础上继续开展化感化合物的鉴定和分子结构研究,并应结合田间生态和生物效应发展化感化合物作用的研究。二是在化感化合物作用方式研究的基础上,探索其在蛋白质、酶及DNA上的作用体系和推定的作用位点。 三是构建基因组学,蛋白质学及代谢组学体系,开展化感转基因作物(GMO<sub>S</sub>)的研究。四是开展化感化合物在农业及林业上的应用推广研究。 化感作用的深入研究,对于了解物种间相互作用的机理及其物质基础,对于应用化感物质控制杂草危害,发展农林业具有重要意义,也是一种新的控草方式的里程碑。

# 108g/L 高效氟吡甲禾灵 EC 防除马铃薯田禾本科杂草试验研究

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采用田间小区试验的方法,研究了 108g/L 高效氟吡甲禾灵 EC 在马铃薯田防除禾本科杂草的效果。研究结果表明,该药在马铃薯田苗后茎叶喷雾处理,能够有效防除马铃薯田的禾本科杂草,在 56.7g/公顷剂量处理下对禾本科杂草的鲜重防效在 90%以上,防效理想。该药对马铃薯安全。

关键词: 高效氟吡甲禾灵; 马铃薯; 禾本科杂草; 除草效果

# 耐草甘膦菜豆 DNA 导入大豆及其分子检测

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本文利用筛选出天然耐草甘膦菜豆 89-05-3-8 为供体材料,采用花粉管导入法将供体菜豆 DNA 导入感性大豆受体东农 42 中,在田间条件下,在草甘膦(有效量 1kg/hm²)对耐草 DNA 导入感性大豆植株进行筛选,获得耐性大豆新品系 DS-15,DS-17 和 DS-19,经 SSR 和 RAPD 扩增均能出现与供体相同,而与受体不同的 DNA 片段,证明耐性后代确有供体的 DNA 导入。同时对耐性大豆新品系进行选育,获得稳定耐性大豆新品系,并且明确耐性大豆安全稳定性。

关键词: 草甘膦: 外源 DNA 导入: SSR: RAPD

# 大型海藻对短裸甲藻的化感抑制作用

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为筛选对典型赤潮藻短裸甲藻(Gymnodinium breve)具有强化感抑制作用的大型海藻,研究了 7 种大型海藻对短裸甲藻的抑制作用。将大型海藻的水提液加入预培养至指数增长初期的短裸甲藻培养液中,考察其对短裸甲藻的抑制作用。结果表明,在试验条件下,受试大型海藻中条浒苔和孔石莼对短裸甲藻的抑制作用最强,条浒苔浸提液浓度为 2.5 gL<sup>-1</sup>时对短裸甲藻的最高抑制率显著下降至不足20%;而孔石莼浸提液浓度为 2.5 gL<sup>-1</sup>时对短裸甲藻的最高抑制率为 94%,但是其抑制率始终保持在 80%以上。将二者的浸提液同时加入预培养至指数增长初期的短裸甲藻培养液中,试验结果表明抑制率在前 5 d 在 50%以上,之后迅速下降,并没有表现出较强的抑藻能力。孔石莼和条浒苔对短裸甲藻的半效应浓度(EC<sub>50</sub>)分别为 1.45 gL<sup>-1</sup>和 2.95 gL<sup>-1</sup>。GC-MS结果表明,孔石莼浸提液中含 18 种物质,其中邻苯二甲酸二异丁酯(1,2-benzenedicarboxylic acid,bis (2-methylpropyl) ester)含量为 49.94%。各种物质的抑藻活性仍需进一步研究。

关键词: 化感作用; 赤潮; 大型海藻; 短裸甲藻

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# 黄土高原旱作小麦化感表达在根际土中的时空异质性研究

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采用盆栽实验基于统计学方法对 4 种不同品种普通小麦材料在 4 个连续生长期根系表层土壤(0~20 cm)化感潜势时空异质性进行了研究。结果表明:不同品系小麦根系土壤之间化感潜势差异极显著(p<0.01),随着生育期的变化,化感潜力的变异与品系有关,一般 15 cm 为普通小麦耕层土壤化感潜力的转折位点。变异函数分析显示,4 种普通小麦根系土壤化感潜势变化是独立的、随机的,是异质性的。其中碧玛 1 号、丰产 3 号、宁冬 1 号、小偃 22 号变异函数理论模型分别为线形模型、球型模型、指数模型以及高斯模型。其中小偃 22 号,随着生育期的生长和发育,使得化感背景值和化感潜力空间结构比增大,导致 0-20 cm 表层土壤化感表达具有高度的空间异质性。4 种普通小麦的化感表达均存在时空异质性,其中宁冬 1 号的表层土壤化感表达具有很好的分形特征,其空间分布格局的变异存在尺度依赖,化感潜势在表层土壤的空间分布趋于离散根系,化感潜力的有效纵向半径和有效延深半径为别为 5 cm 和 14 cm。这种时空变异格局可能与根系的发育特征,根系翻转运动以及土壤环境有关,化感实施过程可能为熵增过程。根系表层土壤化感潜势时空异质性的研究将为监测化感作用实施,定位有效化感物质和合理利用土壤化感潜势提供理论依据,从化感现象上理论得出根系分泌的化感物质可能存在迁移转化的机制。

关键词 普通小麦; 化感表达; 根际土; 时空异质; 生态管理

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# 几种茎叶处理除草剂对玉米安全性的影响

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本试验于 2003-2005 年在河北省农林科学院粮油作物研究所堤上试验站进行,研究了烟嘧 磺隆、磺草酮、唑酮草酯、噻吩磺隆、辛酰溴苯腈 5 种茎叶处理除草剂对玉米安全性的影 响。各药剂分别设常规剂量和常规剂量的倍量两个处理,玉米为种植面积大的品种郑单 958, 在玉米 6-7 叶期施药。药害明显时测玉米株高, 地上部鲜重, 目测长势、长相。收 获时每小区取中间两行测产,并对玉米的品质指标进行分析。试验结果表明,不同类型的 除草剂对玉米的安全性影响有一定的差异。烟嘧磺隆用药后5天,玉米新叶近基部褪绿、 黄化,对玉米生长基本无影响;唑酮草酯用药后1天,玉米叶片即出现褐色接触性药斑, 受害严重的叶片折断,对新出叶片无影响,对玉米生长基本无影响;辛酰溴苯腈用药后用 药后2天,玉米叶面出现接触性药斑,受害严重叶片逐渐干枯,植株生长受到一定的抑制; 噻吩磺隆用药后玉米生长受到严重抑制,株高低,叶片包在一起,新叶长出困难,叶片失 绿、窄、短,植株基部长出分枝:磺草酮用药后3天,玉米叶片出现不同程度的失绿、白 化,受害严重的叶片从边缘开始干枯,对玉米的生长有一定程度的影响。测产结果表明, 噻吩磺隆、磺草酮、降低玉米产量,烟嘧磺隆、唑酮草酯、辛酰溴苯腈对玉米产量影响较 小。品质分析结果表明,除噻吩磺降外,其它各药剂处理均提高玉米淀粉含量。相反,除 噻吩磺隆, 其它各用药处理均降低玉米蛋白质含量。各除草剂对玉米脂肪含量有不同程度 的影响,其中以辛酰溴苯腈对玉米脂肪含量提高较多。

关键词:除草剂,玉米,安全性 生长

### 利用化感物质防治杂草研究现状及应用前景

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对国内外植物化感作用的研究概况、植物化感作用在抑制杂草方面应用的优越性以及国外植物化感抑草的研究现状和草地毒杂草化感物质的利用现状进行了综述,指出对草地畜牧业生产造成很大危害的草地恶性毒杂草可以从开发利用的方面来思考草地恶性毒杂的应用价值,既能保护生态环境,又能合理利用自然资源,使草地恶性毒杂可以"变害为宝"。研究利用其地上部分中存在的化感物质,研发出除草剂应用发展前景广阔。

### 酚酸对水葫芦的生长抑制作用

### 王江岭 张茂新 凌冰 易振 董易之

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水葫芦 Eichhornia crassipes (Martius) Solms-Laubach 是一种世界性的有害杂草,目前已入侵了 40°N~45°S 之间的非洲、亚洲、北美洲、大洋州、甚至欧洲等国家和地区,带来了一系列的生态、经济、社会问题。本文研究了马缨丹叶提取物及其酚类化合物对水葫芦生长及其生理生化指标的影响。

试验进行了 4 种化学渗透剂对水杨酸(SA)的增效作用试验,结果表明单独施用水杨酸对水葫芦并没有明显的效果;筛选出 KUDOS SL-101C(S2)(KD)对水杨酸的增效作用显著。通过混配剂 KD+SA 的药效试验,发现在水葫芦不同生长期喷施不同浓度混配剂可以达到经济有效防治水葫芦的目的:在水葫芦开花期喷施 1000mg/L SA 加 4%KD 和2000mg/L SA 加 4%KD 可使水葫芦的枯叶率达到 93.33%和 86.67%;在水葫芦越冬期喷施2000mg/L SA 加 4%KD 可使水葫芦的枯叶率达到 70.21%。KD 与水杨酸的混配剂对水葫芦的叶绿素含量也有一定影响,并随浓度增加和时间的延长,效果也增强。从机理上进一步说明水杨酸处理使水葫芦的叶绿素含量降低,是导致水葫芦枯萎死亡的原因之一。

# 地黄连作后土壤微生物变化分析<sup>\*</sup>

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地黄(Rehmannia glutinosa Libosch.)为玄参科多年生草本植物,以干燥块根入药,怀地黄因为梓醇及其他有效成分含量高一直被视为地黄药材的上品,且有很高的经济价值,怀地黄每茬收获后继续种植会出现严重的减产,病虫害严重。为满足市场需求及受经济利益驱动,药农不得不在焦作以外其它地区种植。但由于土壤,田间小气候等环境条件与道地产区不同,它们虽然还被称为怀地黄,但其主要有效成分的含量会发生改变。如:作为主要有效成分之一的梓醇会因地黄种植地域不同,其含量有较大差异,严重影响了怀地黄的生产和质量保证。

本文以怀地黄为研究对象,运用传统平板培养和现代分子生物学技术,对地黄根际非根际微生物种群随种植养次的动态变化进行了研究。

地黄种植导致土壤中微生物种群发生巨大变化,土壤生物学性状变差。地黄种植后导致土壤中可培养微生物数量减少。其中细菌数量降幅明显,对连作表现出很高的敏感性,放线菌也变化明显。地黄种植后致使少数真菌种群富集,同时有几种真菌类群数量减少,Trichoderma sp., Asp Flavus 种植地黄过程中数量明显增加。地黄连作使得土壤微生态畸形发展。

地黄连作导致的土壤微生物多样性减少,种群失衡主要由根分泌物中化学物质引起的。DGGE分析表明地黄种植引起根际细菌种群的巨大变化,大多数细菌种群数量减少。地黄连作对土壤放线菌起到一定的增殖作用,头茬和二茬地黄生长过程放线菌数量增加。对真核微生物的影响也很大,种群变化明显。地黄连作导致的根部微生物种群生态失衡,多样性水平降低应该是根系分泌物在土壤中累积所引发。

总之,地黄根系分泌的化学物质造成土壤微生态以及地黄植株本身的变化,使得二茬 地黄植株发育不良,块根不膨大。

<sup>\*</sup>基金资助:国家自然科学基金项目"阿魏酸影响地黄块根膨大机理的研究" (30671201)

### 根系分泌物的化感作用及其对土壤微生物的化感效应

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本文总结了根分泌化感物质的种类及其化感效应,分析了生物和非生物因素与根系分泌化感物质之间的关系。此外,根系分泌化感物质的研究手段对于所取得的研究结果至关重要,其中根分泌物收集系统是收集根分泌化感物质的常用而可行的方法之一。对于根分泌化感物质的分离鉴定技术有多种,可根据需要选择适宜的分离方法。还列举了一些作物根分泌的化感物质对根际微生物产生的影响,阐明了根分泌的化感物质所起的重要化感作用。根分泌物化感作用的研究已成为土壤生态学领域的热点与前沿课题,自然条件下原位收集鉴定植物根系分泌物中的化感物质等诸多问题是该领域今后的研究重点。

关键词:根系分泌物:化感作用:根际微生物:生态效应

# 夹竹桃化感物质三萜皂甙对钉螺作用的构效关系研究\*

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日本血吸虫病是严重危害我国人民身体健康,阻碍社会经济发展的重大传染性疾病,湖北钉螺是日本血吸虫唯一的中间宿主,因此灭螺是阻断和控制血吸虫病传播的重要手段之一。由于化学合成药物对人畜有毒,环境污染严重,所以灭螺植物资源的开发与利用,是目前灭螺药物研究的一个热点。在我们的前期的筛选研究中首次发现,夹竹桃提取物对湖北钉螺有明显的杀灭作用。为了进一步评价夹竹桃的灭螺作用,为开发新的灭螺药物和兴建人工抑螺林进行生态工程阻断传播提供理论支持,本文利用现代生物技术手段研究了夹竹桃三萜皂甙的灭螺效果与构效关系,揭示其灭螺作用的化感作用机理。

应用系统分离法得到采自不同季节的夹竹桃的根皮、茎皮、叶的三萜总皂甙,平均得率6.16%。通过浸杀钉螺实验,直线回归分析灭螺剂量-效应方程和时间-效应方程,并通过方程预测提取物达 $LC_{50}$ 和 $LC_{90}$ 的浓度和时间。研究表明,12份三萜总皂甙均有一定的灭螺活性,其中夏叶三萜总皂甙活性最高,其 $LD_{50}$ 和 $LD_{90}$ 为10.62mg/L和81.02mg/L,达到了WHO规定的有效灭螺剂标准,同时,驱避实验也显示了较好效果。

利用柱层析技术从夏叶三萜总皂甙中分离纯化了一种三萜皂甙,经波谱方法和化学分析相结合,确定其为一种单糖链齐墩果酸型三萜皂甙。浸杀实验表明具有较好灭螺效果,而水解该皂甙获得的皂甙元却完全没有杀灭作用,可以推定单糖链的存在与灭螺效果密切相关。根据波谱数据,两者的主要的区别是该三萜皂甙的 $C_3$ 位上连有一条糖链,而皂甙元的 $C_3$ 位连接的是羟基。由此不难推断,对该三萜皂甙来说,糖链的存在对浸杀效果具有决定性的作用。

皂甙分子中的糖链对于它们的生物活性有着显著的作用,同时还对皂甙的吸收和代谢有重要的影响,表明皂甙分子与特定细胞或受体的作用一定涉及到糖链的参与。但是,目前对于糖链是通过怎样的机制影响皂甙的生物活性的,如通过改变化合物的物理性质、或影响分子与受体的识别和结合等,还没有系统的研究和得出有指导性的结论。显然这一问题的阐明不仅对于了解皂甙分子在体内的代谢和作用的机制,而且对于通过改变糖链结构设计新型的、低毒、高效的皂甙类药物,都具有重要的意义。

阻断钉螺传播是防治血吸虫病的关键举措。我们的实验证实夹竹桃三萜皂甙对钉螺具有高效浸杀作用和驱避作用,基于这两点,夹竹桃三萜皂甙阻断传播是可行的,尤其对于抑制水陆两栖的湖北钉螺更具有重要意义,其应用前景可从两方面去考虑。夹竹桃三萜皂甙易溶于水,含量高,提取分离方便,可以直接从夹竹桃中提取分离三萜皂甙作为灭螺药物,或者在进一步了解其构效关系的基础上人工合成仿生药物。

钉螺孳生地气候湿润,我国长江流域及以南地区在春季和秋季均有较长时间的降水,容易造成地面积水,此外,洲滩地区每年还有3—5个月的洪水泛滥期,这些地方也是钉螺密度最高、血吸虫病感染风险最大的地方。利用林业生态工程的方法,把夹竹桃作为主要树种来构建人工抑螺林。通过落叶、淋溶、根际分泌等方式,向周围水体和滩地长期缓慢释放化感物质,既可以浸杀钉螺,也可以将其驱逐出生产、生活地域,减少人畜感染机会。

植物生态灭螺研究是目前国际上灭螺研究的热点,我们目前所做的工作也是偏重于这一方面。但仅有实验室的工作是远远不够的,还需要更多地开展野外调查及人工灭螺植物群落中钉螺消长规律及其机理的研究,只有两者有机结合才能真正实施并造福于人类。

关键词:夹竹桃;三萜皂甙;钉螺;构效关系

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# 东北地区除草剂药害问题与解决方法

王险峰 1 谢丽华 2 刘洪亮 2 关成宏 3

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东北地区由于多年使用除草剂,杂草群落发生急剧变化,杂草种类减少,难治杂草增 多,突出问题是除草剂药害发生频繁、严重影响农业生产的效益和种植结构的调整,当务 之急必须解决除草剂药害问题。东北地区苗前除草剂使用期温度低,作物生长缓慢,对除 草剂代谢解毒能力差,内造成内吸除草剂药害;苗后除草剂使用常遇高温干旱作物易受触 杀性除草剂药害。东北地区除草剂应用突出问题是药害发生频繁,损失严重,使用安全性 好的除草剂与安全性差的比水稻产量差 100~200 kg/亩,减产 20~40%; 大豆产量差 50kg/ 亩以上,减产25~30%,大豆常常是200~250kg/亩的投入,125~150kg/亩的产量。小麥 田單用 2, 4-滴丁酯可使小麥減產 7~26%。除草剂药害投诉和要求鉴定案件有逐年加重的 趋势,黑龙江省在省高院鉴定案件中已上升到第二位。作物受除草剂药害一般抑制生长, 叶深绿、扭曲,或枯焦、或发黄、不发根,烂根,生育期拖后 10~20 天,重者生长点死 亡、根腐烂、成片死亡。长残留除草剂药害突出、玉米、小麦、大麦、水稻、高粱、谷子、 向日葵、马铃薯、亚麻、南瓜、元葱、瓜类、甜瓜、蔬菜等比较普遍。已严重影响了农业 种植结构的调整和可持续发展。易造成药害的除草剂大豆田有咪唑乙烟酸、氯嘧磺隆、甲 氧咪草烟、氟磺胺草醚、三氟羧草醚、乙草胺、2,4-滴、嗪草酮、氟乐灵、乙羧氟草醚、 异噁草松等、混剂乙草胺 +2,4—D+嗪草酮、乙草胺+氯嘧磺隆、乙草胺+咪唑乙烟酸+氯嘧 磺隆乙草胺+氯嘧磺隆+2,4-滴丁酯、乙草胺+扑草净+2,4-滴丁酯、乙草胺+恶草灵、咪唑乙 烟酸+氯嘧磺隆、咪唑乙烟酸+乙羧氟草醚;咪唑乙烟酸+氯嘧磺隆+乙羧氟草醚;咪唑乙烟 酸+氟磺胺草醚+乙羧氟草醚、咪唑乙烟酸+氟磺胺草醚+乙羧氟草醚+精喹禾灵。玉米田除 草剂 2,4-滴、2 甲 4 氯、嗪草酮等。水稻田有丁草胺、2 甲 4 氯、二氯喹啉酸、丙炔恶草 酮、丁·扑、丁·西、丁·苄等。马铃薯有恶.乙(恶草酮+乙草胺)。油菜田有胺苯磺隆。芸豆、 红小豆田有乙草胺、嗪草酮、异丙草胺、氯嘧磺隆、2,4-滴等。长残留除草剂在土壤中 残留时间长,一般可达 2~3 年,长的可达 4 年以上,在轮作农田中使用极易造成后茬作 物药害、减产、甚至绝产。这类除草剂有有咪唑乙烟酸、氯嘧磺隆、胺苯磺隆、甲磺隆、 绿磺隆、甲氧咪草烟、氟磺胺草醚、莠去津、嗪草酮、异噁草松、唑嘧磺草胺、西玛津等。 解决方法: 1、调整除草剂结构,(1) 我国除草剂生产供过于求,调整除草剂结构时机已 成熟,应对有替代品种的长残留除草剂及安全性差的除草剂取消登记或限制使用,取消登 记除草剂如甲磺隆、氯磺隆、氯嘧磺隆、咪唑乙烟酸、胺苯磺隆等及其混剂。限制使用除 草剂如莠去津、烟嘧磺隆、异噁草松、唑嘧磺草胺、甲氧咪草烟、氟磺胺草醚、二氯喹啉 酸、西玛津等。限制在长江以南使用品种有苯噻酰·苄·甲草、苄·异丙草、苄·甲磺·乙、苄·乙、 苄·异等。嗪草酮在大豆、玉米田限制在有机质 2%以上的土壤使用。(2) 有些安全性差的 除草剂应淘汰 如玉米 2,4-滴玉米苗后,玉米苗前嗪.异、嗪·乙、滴丁.嗪.乙等;水稻 2 甲 4 氯、扑草净、2, 4-滴、2 甲钠•灭松; 大豆 50%乙草胺、氟乐灵、乙羧氟草醚及混剂乙·嗪、 乙.二、滴丁.扑.乙、二. 滴丁.嗪.乙、噁草.乙、乙氧.乙、精喹.三羧、利.乙、扑.乙、精喹.乙 羧等。麦田 2,4-滴丁酯。(3)一些药效差的除草剂应淘汰 如烯·氟烯草、氟羧草·咪、噻 磺·乙、精喹·乙、丁·乙、丁.异等。特别建议评价除草剂安全性对照药剂一定选用安全性好 的除草剂。2、加强农药管理、严格除草剂注册登记田间药效试验。3、加强喷雾器械的管 理,规范推广喷雾器械使用技术。4、除草剂产品开发要把安全性放到首位。5、加强化学 除草使用技术的普及与提高。6、利用内源植物生长调节剂缓解药害。

关键词: 东北 除草剂 药害 问题 解决

# 几种不同除草剂混剂防除玉米田杂草试验

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用倒置"W"9点取样法,对东北不同地区玉米田杂草调查表明,东北地区玉米田主要杂草有50种,属20科,其中危害严重的主要有稗草、苣荬菜、小蓟、山苦菜、鸭趾草、苘麻和反枝苋等。药效试验结果表明,42%2,4-D丁酯·异丙草胺·莠去津 SC、64%2,4-滴丁酯·扑草净·异丙草胺 EC、40%磺草酮·莠去津水悬剂、25%2,4-D丁酯·磺草酮 EC可有效防除玉米田绝大多数杂草,且对玉米安全。播后苗前施用.42%2,4-D丁酯·异丙草胺·莠去津 SC6000ml/hm²,对玉米田杂草的总株防效 99.1%。64%2,4-滴丁酯·扑草净·异丙草胺 EC6000ml/hm²,对玉米田杂草的总株防效 94.5%。在玉米4叶期,杂草1~3叶期茎叶喷雾,用40%磺草酮·莠去津水悬剂3750ml/hm²,对玉米田杂草的总株防效93.7%。25%2,4-D丁酯·磺草酮 EC总株防效均在以上90%。经过与常规用药在性能与价格方面的比较,42%2,4-D丁酯·磺草酮 EC总株防效均在以上90%。经过与常规用药在性能与价格方面的比较,42%2,4-D丁酯·磺草酮 EC总株防效均在以上90%。经过与常规用药在性能与价格方面的比较,42%2,4-D丁酯·磺草酮 EC,具有实际应用的意义。并结合气候因素,提出了一次性施药与二次施药相结合的观点。

关键词: 玉米田,杂草,除草剂,药效、性价比

# 水稻化感品种华抗草 78 号对稗草的竞争抑制规律

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不同叶龄化感品种华抗草 78 号和非化感品种 Lemont 对不同叶龄稗草各生长指标抑制程度的对比,结果表明,水稻化感品种华抗草 78 号对稗草干扰控制作用主要有以下规律: 1、化感品种华抗草 78 号对稗草的控制作用显著高于非化感品种 Lemont。2、华抗草 78 号对稗草的竞争能力随稗草草龄的增大逐步衰减,但衰减程度明显比非化感品种缓慢。3、6叶龄华抗草 78 号对稗草的控制作用显著优于 3 叶龄。4、华抗草 78 号对稗草地下部的抑制作用比地上部强。

关键词:水稻: 化感: 竞争: 抑制

# 假臭草丛枝病植原体16SrDNA的检测与PCR-RFLP分析

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假臭草原产地为南美,近20年来在中国华南地区、澳洲和东南亚地区广泛蔓延,它的入侵 对于受干扰和未受干扰的生态系统都形成巨大威胁。生物防治被认为是最有前途的控制杂 草的方法,而用于生物防治的天敌和病原菌需要从原产地引进或者在其入侵地寻找。在海 南儋州,我们观察到假臭草植株具有典型的由植原体引起的丛枝病症状,对表现丛枝的假 臭草植株总DNA进行直接PCR及巢式PCR扩增,得到1189bp的植原体DNA片段。选用限制 性内切酶Hinf I、Kpn I、 Rsa I、Taq I、Msp I和Hha I对采自不同生境的3株假臭草感病样 品巢式PCR产物进行酶切,酶切产物经1.8%琼脂糖凝胶电泳进行限制性片断长度多态性 (RFLP)分析,结果显示6种限制性内切酶中同一种酶对3个样品的酶切带型基本一致,可以 断定引起来自3个不同生境假臭草感病单株发生丛枝的植原体病原属于同一类型植原体, 并将RFLP图谱与Lee等对34种植物以R16F2n/R16R2为引物进行nested-PCR扩增的植原体 16SrDNA的RFLP分析图谱进行比对,6种限制性内切酶对假臭草植原体16SrDNA的酶切带 型与植原体16Sr II 组代表株系酶切带型一致。感病植株DNA模板直接PCR产物纯化后直接 测序,序列显示出与16srII组植原体有较高的同源性,假臭草丛枝病与植原体16SrII组中的 花生丛枝病、西红柿丛枝病和中国木豆丛枝病同源率最高,达到98.5%。因而可以确认, 假臭草丛枝病植原体属植原体16Sr II 组即花生丛枝病组(Peanut witches'broom group), 就我 们所知,这是国内外首次报道该组植原体引起假臭草丛枝病。假臭草目前在海南乃至整个 华南地区发生严重,并且尚无有效的生防措施控制其传播和蔓延,而假臭草丛枝病植原体 在一些地区可以严重影响其生长发育,其田间发生总体情况及传播媒介的研究尚未见报 道,可以考虑利用其作为假臭草生物防治剂,经媒介昆虫传播丛枝病病原,将其应用于假 臭草的生物防治, 来达到控制假臭草传播和蔓延的目的。

**关键词** 假臭草 丛枝病 16SrDNA 植原体 限制性片段长度多态性

# 河北省玉米田杂草发生与环境因子的关系

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2004-2005 年采用"倒置 W"取样法对河北省玉米田杂草群落进行了调查,明确了各地区杂草群落的物种组成和优势度。采用偏相关分析和通径分析,研究了杂草发生与环境因子间的关系。偏相关分析结果表明,地表温度为杂草出苗的主导因子,海拔高度、经纬度、降水及日照时数等因子与杂草发生的相关性不显著。通径分析结果表明,地表温度和地理纬度对杂草的发生以间接影响为主,而降水、日照时数对杂草的发生以直接影响为主。地表温度与降水间的互作对杂草出苗产生的效应较大,其它因子之间的互作效应较小。

关键词: 玉米田杂草; 发生; 环境因子; 偏相关分析; 通径分析

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# 水稻化感品种结合除草剂及深水层对稻田杂草的抑制作用

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选用具有化感特性的水稻品系华抗草 78 和长江流域地区主栽的扬稻 6 号,通过田间试验,明确了水稻化感作用结合深水层可有效抑制稗草的萌发和生长。同时,水稻移栽后 6 天使用苄嘧磺隆(30 a.i g/hm²)单剂处理,明显地抑制了异型莎草和陌上菜的萌发数量和生物量积累。综合水稻化感品种分泌对稗草等具有抑制作用的化学物质、水稻自身的竞争作用、10cm 深水层及化学除草剂单剂这四者效应,水稻移栽后 50 天考测结果表明,华抗草 78 和扬稻 6 号对稗草的干重防效分别为 89.1%和 81.8%、对异型莎草的干重防效分别为 83.6%和 84.9%、对陌上菜 干重防效分别为 95.2%和 82.7%,对这三种杂草的总干重防效分别为 87.7%和 82.7%。10cm 深水层及施用化学除草剂单剂条件下两个水稻品种(系)的产量分别为 5752.5kg/hm²和 6234.0 kg/hm²,这分别比 5cm 水层、不施化学除草剂的处理增产 67.0%和 28.2%。四种因子的综合效应不仅具有良好的控草效果,增产显著,而且明显降低了除草剂的使用量,这为水稻化感品种在生产上应用提供了科学依据,同时开拓了农田杂草治理的新途径。

关键词: 水稻 化感 深水层 除草剂 杂草

# 赖草的生物学特性、危害与防治

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为有效控制大黄田赖草,减少对土壤水分、养分的消耗,对赖草的生物学特性、危害损失及其控制进行调查研究。结果表明: 赖草株高 45-120cm,单生或丛生,具下伸土壤 30-50cm 耕层间有横走根群,每平方米内,深 50cm 耕层内赖草根茎总重量为 1129.3g,根茎总长度为 2783.3m,根茎上的新芽 589.7 个,使土壤严重缺水,肥力下降;土壤水分在 13.4%左右时,对出苗影响不大,对生长发育有很大的影响;气温在-6-6℃,根茎萌发出土,高峰期为 4 月上旬,平均单株种量为 468.4 粒;每平方米内有赖草 120-160 株时,大黄产量损失达 15.8%-17.8%;对于田间赖草采用人工或机械深耕捡出地下根茎,减轻翌年危害来源,对于田埂赖草采用 10%草甘膦 22.5kg/hm²,于 1-3 叶期茎叶均匀喷施,防效达 98%,有效切断田埂赖草根茎传播于田间,且不污染农田土壤环境,有利旱作农业的持续、稳定的发展。关键词:赖草 ,生物学特性,危害损失,防治

# 莠去津与异丙草胺最佳混配比例筛选研究\*

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三氮苯类与酰胺类除草剂混配是减少前者对玉米田后茬作物药害的有效方法之一。本试验在温室栽培条件下,以玉米田主要杂草稗、马唐作为供试杂草,采用等效线法研究了莠去津与异丙草胺混配的最佳配比。研究结果表明,采用播后苗前土壤处理喷雾法施药,两者复配对禾本科杂草稗和马唐的防治具有增效作用。莠去津与异丙草胺两者复配对稗草鲜重防治效果达90%时,在(1.7-3):1的范围内选择配比药剂使用剂量最少;两者复配对马唐鲜重防治效果达90%时,在(1-1.8):1的范围内选择配比药剂使用剂量最少。

关键词: 莠去津, 异丙草胺, 最佳配比

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# 海南几种热带植物化感作用的研究\*

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从海南耕地利用状况看,农作物复种指数较低,仅 189%。由于不少耕地没有合理地采用间种、套种或轮种等,耕作制度比较落后。海南目前有大面积的胡椒、芒果、黄皮等经济作物种植,行间距都较大,如果能间种一些周期短的农作物,则效益很可观。农业复合系统的建立需要正确地分析经济作物、农作物及牧草等植物间的各种相互关系,制订出合理的轮作制度、栽培选择及种植构型计划。其中,植物间化感作用(Allelopathy)的研究对农业复合系统的建立和优化有着重要的意义。

本实验对海南几种热带植物的化感作用的进行了研究。采用荔枝、胡椒、芒果、黄皮、木薯、槟榔、橡胶、番石榴作供体植物,采用玉米、黄豆、南瓜、稗草、马唐、萝卜和柱花草作为受体植物。主要研究了供体植物叶片水浸提液、供体根系周围的土壤对受体种子的萌发和露白种子生长的影响,以及胡椒、芒果、黄皮叶片浸提液通过乙酸乙酯、正丁醇萃取各相对受体种子的萌发和露白种子生长的影响,还对芒果叶片浸提液的正丁醇萃取相通过柱层析分离,紫外-可见分光光度计进行波长扫描。

实验结果表明多数供体植物叶片浸提液对受体植物的萌发和生长都产生一定的影响。其中黄皮叶片浸提液对玉米、黄豆和南瓜的萌发和生长以及对稗草和马唐的生长都具有较强的抑制作用;芒果、胡椒叶片浸提液对南瓜的萌发、稗草和马唐的生长有抑制作用;木薯叶片浸提液对黄豆、南瓜萌发和生长有抑制作用。多数供体植物叶片浸提液对受体植物的萌发影响表现为种子发芽率低、胚根、胚芽生长受到抑制;浸提液对幼苗的生长主要是影响植株长势、叶片形态等,处理的受体植物比对照生长慢、长势差,植株矮小,变黄,有烂苗、死苗等现象。多数具有高浓度抑制、低浓度促进的现象。荔枝叶片浸提液在较低的浓度下对玉米、黄豆萌发和生长有促进作用;芒果叶片浸提液在较低的浓度下对黄豆、花生萌发和生长有促进作用;槟榔叶片浸提液在较低的浓度下对玉米、黄豆、南瓜萌发和生长有促进作用。

供体植物根系周围土壤对受体种子萌发和生长的影响试验表明: 胡椒根系周围土壤对花生种子的萌发有抑制作用,而对玉米的萌发,以及玉米和黄豆的生长有较强的促进作用; 芒果根系周围土壤对花生的萌发和生长有抑制作用,而对玉米的萌发和生长有促进作用; 槟榔、橡胶、木薯根系周围土壤对玉米的萌发和生长都有一定的促进作用; 荔枝根系周围土壤对玉米、黄豆和南瓜的萌发和生长都有促进作用; 番石榴根系周围土壤对玉米、黄豆和花生的萌发和生长都有促进作用。

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经萃取胡椒、芒果、黄皮叶片浸提液的乙酸乙酯相、正丁醇相和水相三种不同极性部分对受体萌发和生长的影响实验结果表明: 芒果叶片浸提液的正丁醇相、水相和胡椒浸提液极性较大的部分即正丁醇相和水相对受体植物的抑制作用较强,萌发和生长的抑制率都达到 90%以上。黄皮叶片浸提液的水相对柱花草和萝卜的萌发和生长也都有很好的抑制作用。实验中对芒果叶片浸提液的正丁醇相进行了浓缩、萃取、柱层析分离纯化,再用紫外一可见分光光度计扫描波长,结果表明该组分在 λ=262nm 处有较强的吸收。文献资料记载,芒果苷在波长 262nm 处有强烈吸收。所以芒果叶片浸提液中具有化感作用的物质可能为芒果苷或芒果苷类似物。

实验对荔枝、胡椒、芒果、黄皮、木薯、槟榔、橡胶、番石榴八种供体植物进行化感作用的测定和分析结果表明,胡椒、芒果、木薯、荔枝、番石榴、橡胶都具有一定的化感潜力。因此,为减轻其负面的影响,建议橡胶园里不要间种黄豆和花生;荔枝园里也不适合间种花生。建议荔枝园间种玉米和黄豆,番石榴园里可以间种玉米、黄豆和花生,木薯可以间种花生。此外,胡椒和芒果叶片浸提液对稗草和马唐有较强的抑制作用,今后可以深入研究如何利用这些植物源物质来防除农田杂草的潜力。

关键词: 化感作用 萃取 热带植物;

# 化感物质 Grosheimin 和 8-Epigrosheimin 全合成研究

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愈创木内酯是一类重要一类化感物质倍半萜内酯,开展愈创木内酯的全合成以及结构改造,构效关系的研究对于发现潜在新作用模式除草剂先导具有重要的理论意义和应用前景。Grosheimin(1)是 8-Epigrosheimin(2)从多种菊科植物中分离得到的愈创木内酯倍半萜。本文以此为模式化合物,利用香芹酮为手性原料合成五元环手性中间体(3)<sup>i</sup>,经过缩合、氧化成内酯、还原、ENE反应等合成了天然产物(1)和(2),从而建立了合成8-羟基愈创木内酯的新方法。合成路线如图(Scheme 1)所示:

$$\begin{array}{c} \xrightarrow{c} \text{ THPO} & \xrightarrow{d} & \xrightarrow{d} & \text{HO} & \xrightarrow{e} & \text{HO} & \xrightarrow{f} & \xrightarrow{e} & \text{HO} & \xrightarrow{f} & \xrightarrow{f}$$

$$O = \begin{pmatrix} H \\ 0 \\ 0 \end{pmatrix} \qquad OH \qquad \begin{pmatrix} H \\ 0 \\ 0 \end{pmatrix} \qquad OH \qquad \begin{pmatrix} R_2 \\ R_1 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_2 \\ R_1 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_2 \\ R_1 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_2 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_2 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_2 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_2 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_2 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_2 \\ R_1 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_2 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_2 \\ R_1 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_2 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \begin{pmatrix} R_1 \\ R_1 \\ 0 \\ 0 \\$$

Reagents and conditions:(a)Lewis acid, DCM, -78  $^{\circ}$ C; (b) (1) LiOH, THF, H<sub>2</sub>O, rt; (2) HCl, rt; (3)CH<sub>2</sub>N<sub>2</sub>, Et<sub>2</sub>O, rt; (c)PCC, rt; (d) (1) Ba(OH)<sub>2</sub>.8H<sub>2</sub>O, MeOH; (2)HCl; (e) (1)cyanuric chloride, DME; (2)NaBH<sub>4</sub>, H<sub>2</sub>O; (f) swern oxidation; (g) Lewis acid; (h) (CH<sub>2</sub>OH)<sub>2</sub>, TsOH, PhH, reflux; (i) (1)Eschenmoser's salt, THF, -78  $^{\circ}$ C; (2) TsOH, acetone, H<sub>2</sub>O, rt.

### TOTAL SYNTHESIS OF GROSHEIMIN AND 8-EPIGROSHEIMIN H.S YANG, F.Y LI, X.X QIAO, X.H $XU^{\dagger}$ , L.G. XIE

National laboratory of Elemento-Organic Chemistry ,NanKai University,TianJin 300071,China Two mode allelochemicals ,naturally occurring Guaianolide sesquiterpene lactones ,Grosheimin (1) 8-Epigrosheimin (2) were synthesized starting from s-carvone by 9 –steps procedures.

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# 不同生长时期沙打旺的化感潜势研究\*

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以萝卜种子为受体,研究了营养期、花果期、成熟期沙打旺(三年生)的化感潜势。结 果显示:不同生长时期沙打旺对受体幼苗生长显示不同的化感活性,即时期差异性。具 体包括: ①不同生长时期沙打旺叶的乙酸乙酯提取物(1:60,g/mL,下同)显著抑制受 体幼苗的伸长生长,且对其胚根、胚芽伸长的抑制作用一致,即成熟期>花果期>营养期 。②营养期沙打旺茎的乙酸乙酯提取物显著刺激受体胚根的伸长,但对其胚芽伸长的刺 激作用不显著; 花果期和成熟期的茎提取物对受体的胚根和胚芽伸长均具有显著的化感 抑制作用。③营养期沙打旺地上部的乙酸乙酯提取物对受体胚根的伸长具有较弱的刺激 作用,而对其胚芽伸长显示较弱的抑制作用:花果期和成熟期的地上部提取物对受体胚 根伸长的影响均为显著的抑制作用,但对其胚芽伸长的抑制作用不显著。④营养期沙打 旺地下部的乙酸乙酯提取物显著刺激受体胚根的伸长,但对其胚芽伸长的刺激作用不显 著: 花果期和成熟期的地下部提取物对受体的胚根和胚芽伸长均显示化感抑制作用,但 花果期的抑制作用未达到统计显著水平。⑤营养期沙打旺整株的乙酸乙酯提取物对受体 胚根的伸长具有较弱的刺激作用,而对其胚芽伸长显示较弱的抑制作用:花果期和成熟 期的整株提取物对受体胚根和胚芽伸长的影响均为显著的抑制作用。表明在花果期和成 熟期沙打旺通常具有较强的化感潜势。本研究可为生产实际中沙打旺的应用提供一定的 理论指导。

关键词: 化感潜势: 沙打旺: 生长时期

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# 史密斯桉不同组织的化感作用初步研究\*

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桉树引种有力地推动了我国木材经济的发展,然而,桉树的大面积种植也严重影响到区域生态环境的健康发展。加强对桉树化感作用的研究,对于维持区域生态安全和生物多样性保护意义重大。本研究以史密斯桉(Eucalyptus smithii)为实验对象,用蒸馏水从其不同组织的材料(叶片、枝条,树皮,枯落物)中提取活性化感物质(粗提物),并采用培养皿幼苗培养实验测定了史密斯桉不同组织的提取物对两种受体植物(生菜、萝卜)幼苗生长的影响。实验结果显示:①史密斯桉不同组织的水提液对生菜幼苗和萝卜幼苗的生长都具有一定的化感作用。化感作用的性质及强弱与水提液的浓度显著相关,基本呈现出高浓度抑制生长、低浓度促进生长的趋势。②史密斯桉不同组织的水提液对受体幼苗的生长显示不同的化感活性,其中,叶片和枯落物的提取物在高浓度时对受体幼苗生长显示最强的化感抑制作用。本研究将为史密斯桉的化学生态学研究积累一定的基础。

关键词: 史密斯桉; 化感作用

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# 水稻化感基因研究和展望\*

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水稻化感作用表现为数量性状遗传。对水稻化感作用的数量性状基因定位研究已取得令人鼓舞的进展。 Jensen 利用水稻品种 IAC165 和 CO39 构建的重组自交系、及已构建的研究抗稻瘟病和根形态结构特征的连锁图谱对水稻化感抗杂草的数量性状位点(QTLs)进行了定位, 确定了 4 个与化感作用相关的主效应 QTL 位点,并定位于第 2,3,8 条染色体上。 Ebana 等利用 PI312777/Rexmont 的 F2 群体,将 7 个与水稻化感作用相关的 QTL 定位在第 1,3,5,6,7,11 和 12 染色体上,其中位于第 6 染色体上的 QTL 对水稻化感作用的表达影响最大,决定了 16.1%的表现型变化。

中国水稻研究所的曾大力和钱前等以典型的窄叶青 8 号/京系 17 DH 群体为材料,系统考察了 123 个 DH 株系幼苗叶片的水溶性提取物对莴苣根系生长的抑制作用,并以此进行了水稻化感作用的 QTLs 分析,结果共检测到 4 个与水稻化感作用相关的 QTL,它们分别位于第 3,9,10 和 12 染色体上,其 LOD 值分别为 3.40, 2.68, 2.75 和 3.08; 其中,第 3 和第 10 染色体上的 QTL 加性效应分别为 1.65 和 1.43,第 9 和第 12 染色体上的 QTL 加性效应分别为-1.44 和-1.58。

中国水稻研究所周勇军等以中 156/谷梅 2 号构建的重组自交系群体为材料,利用特征次生物质标记法在 HPLC 上对其 147 个株系的三叶期水稻叶片进行了次生物质含量的检测,并计算出它们的化感指数,并以此为表型,然后结合利用该重组自交系群体所构建的包括 168 个 DNA 标记的遗传连锁图谱进行了水稻化感作用的数量性状位点(QTLs)分析。共检测到 3 个与化感作用相关的主效应 QTL,分别位于第 5、5 和 11 染色体上,其 LOD值分别为 10.02、11.23、16.51,其加性效应分别为一0.005、一0.006、0.017,其对表型的贡献率分别为 1.1%、1.3%和 10.6%;同时检测到了 5 对上位效应 QTL,其中两个主效应 QTL同时又参与基因的互作效应。检测到的主效应 QTL 和上位效应 QTL 共解释了 55.1%的表型变化。

**关键词** 水稻 化感作用 基因定位

<sup>\*</sup>国家自然科学基金项目(30571231)

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# 基于营养元素调控的南瓜组培根化感效应的响应研究\*

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采用植物组培技术,结合生物测试方法,通过调节B5培养基中大量元素和微量元素含量, 研究了南瓜(金钩南瓜)组培根在五种生长营养元素(P、Mg、Fe、Cu、B)四个浓度梯 度(1/2  $B_5$ 、 $B_5$ 、3/2  $B_5$ 、2  $B_5$ )培养下化感潜力的响应模式以及对黑籽南瓜和金钩南瓜两 种受体幼苗生长的影响。结果表明:不同营养元素对南瓜组培根化感潜力直接调节效应不 一致,与元素含量显著相关(P=0.05);总体表现为两种模式,分别为"S"型和"Λ"型,主 要依赖于受体选择。五种营养元素在亏缺(1/2 B<sub>5</sub>)和正常条件(B<sub>5</sub>)下南瓜组培根均表 现为抑制效应; 而营养冗余(3/2  $B_5$  和 2  $B_5$ )下,南瓜组培根的化感潜力与元素种类和受 体密切相关,一般为促进作用,但Fe和B却存在一定的抑制作用。最大试验冗余(2B5) 含量下,B元素导致金钩南瓜的自毒效应,而Fe能引发金钩南瓜组培根对黑籽南瓜幼苗的 抑制效应。而营养元素诱导南瓜组培根对受体幼苗的生长影响的间接调控作用,也与浓度 显著有关(P=0.05)。随着P、Mg、Fe、Cu、B浓度的增加,各处理对两种南瓜胚根长、 胚芽长和侧根数的抑制作用显著减弱,促进作用逐渐增强,一般在3/2 B5浓度下显示为化 感性质的临界点。只是对于受体黑籽南瓜幼苗来说, Fe 含量较低时对其胚根长、胚芽长 和侧根数呈现促进作用,但当Fe 含量较高时则呈现抑制作用: 同理,对受体金钩南瓜来 说,过量B易导致金钩南瓜明显的自毒效应。因此,针对南瓜组培根具有明显的化感抑制 作用和自毒作用营养控制理论,在生产上可以通过调节肥料的施用类别和具体定量上加以 控制不利效应,减缓甚至消除毒性效应。根据本研究在理论上初步得出南瓜栽培中施用P 和Mg肥可以减轻南瓜的连作障碍,而对微肥Fe、Cu、B应该结合南瓜的品系适量施肥。 关键词 南瓜: 组培根: 化感潜力: 营养调控: 响应机制

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# 广州市春夏季草坪杂草群落动态变化研究

### 岳茂峰 冯莉 参彩虹

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利用 5 点法取样于 2007 年春夏季对广州市中山大学、华南农业大学、云台花园、流花湖公园等 4 个地点草坪进行杂草群落调查。调查结果表明: 1~6 月份 4 个样地共调查出 24 科 52 属 62 种杂草,杂草种类数目呈先增加后减少的趋势; 4 月份杂草种类最多,为 57 种。其中危害最严重的 10 种杂草分别为光鳞水蜈蚣、天胡荽、伞房花耳草、母草、破铜钱、马唐、酢浆草、瓶儿小草、崩大碗、三点金。从 10 种杂草 1~6 月份的优势度来看,酢浆草、瓶尔小草的优势度逐降低; 光鳞水蜈蚣和母草的优势度逐渐升高; 其他杂草的优势度相对稳定。同时发现,不同样点的管理水平对杂草群落有较大影响。

关键词 春夏季;杂草;群落动态

<sup>\*</sup>基金项目:广东省科技项目"城市绿地杂草群落动态及防除技术研究"(2006B20301056).

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# 除草剂精准施药新技术概述

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本文概述了自 2003 年-2007 年在我国黑龙江、河北、山东和北京开展的在大豆、玉米和小麦田的除草剂精准施药技术应用和推广情况。本技术是以灭草松、莠去津、硝磺草酮、异丙隆、溴苯腈为主,采用添加助剂的桶混技术,在专家决策系统和精准施药技术手册的指导下,结合田间和气候实际情况,在杂草 2-3 叶期施药; 施药采用 GAP 操作规程,施药后 2-3 天,利用植物光合作用测定仪,判断防效和药害,以决定是否需要二次施药或补救。经过试验和培训,参加试验的技术人员充分掌握了仪器设备包括气象站、专家决策系统、牵引式喷雾器、背负式喷雾器、植物光合测定仪的技术原理和操作规程; 利用项目的仪器设备,逐步尝试采用良好农业技术操作(Good Agricultural Practice, GAP)规程开展田间和示范试验研究; 逐步以扇形带限压阀喷雾器,测算施药剂量、喷液量和行走速度等推动我国精准施药技术,取得较好结果。

该精准施药技术已经在上述地区的 35 个示范点推广,技术人员已经普遍接受以下理念,并在实践中逐步运用,如以茎叶处理药剂逐步替代某些存在高污染风险的土壤处理药剂;添加合理助剂,根据天气和草相选用适合药剂和剂型,见草施药,因草定量,减少药剂飘失靶标,提高药剂中耙率;在杂草低叶龄阶段就尽早施药,提高药效,以少量多次替代一次超量,施药后迅速用植物光合作用测定仪评价药效,否则及时 2 次施药,降低药剂对杂草无效和药剂对作物有害的风险;将安全使用农药的培训纳入到整个农药管理的常规工作中,以确保安全、合理地使用农药,重视施药人员的健康防护,最大限度地减少农药对环境、人类身体健康的危害;有意识地向农药低用量方向发展,利用各种专家决策系统、气象预测模型,通过明确气象条件而预测杂草发生和发育状况(一些专家决策系统也可以预测病害或虫害的发生),而选择合适的药剂,提前使用,以最低致死剂量防治靶标生物,更好的指导农民施药,减少农药污染,降低抗性发生风险等。

根据目前已经取得的试验结果,在保证药效的情况下,与传统施药剂量比较,通过应用精准施药技术可以将降低30%的剂量,较好的降低了药害发生的几率,减轻了环境污染。精准施药技术以精量播种、施肥、灌溉及田间管理为前提,以精准施药理念和硬件设备为基础,是当今世界农业可持续发展的主流。

关键词: 除草剂,精准,概述

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# 稗草生防菌蟋蟀草平脐蠕孢菌99-01的形态学和分子鉴定<sup>\*</sup>

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采用生物测定方法评价一株稗草生防菌99-01的除草活性,孢子接种两周后,发现稗草100%发病,病情严重度达80-100%。4.2×10<sup>7</sup> 孢子/m²接种后稗草致死率达73.9%,为8×10<sup>5</sup> 孢子/m²接种后稗草致死率的4.74倍,表明高浓度的孢子接种后对稗草有较高的除草活性。作物安全性试验发现99-01对稗草高度敏感,对水稻安全。与GenBank数据库中ITS 和5.8S rDNA序列比对后发现99-01与植物病原菌蟋蟀草旋孢腔菌和蟋蟀草平脐蠕孢菌(同一种菌的有性态和无性态命名)序列完全一致。采用PAUP软件的最大简约法和距离法分析序列发现它与蟋蟀草旋孢腔菌和蟋蟀草平脐蠕孢菌聚在一个类群中。因为99-01在自然界未发现有性态,所以被鉴定为与蟋蟀草平脐蠕孢菌同种,这和形态学鉴定结果基本一致。

关键词: 稗草 平脐蠕孢菌 分子鉴定

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# 江苏省泰州杂草稻的起源及其遗传多样性研究\*

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近些年,杂草稻在江苏大面积发生,给农民造成了严重的经济损失。 通过对54份杂草稻(江苏的31份、中国其它地方的6份、美国的6份、不丹的4份、韩国的1份、澳大利亚的1份、孟加拉国的1份、柬埔寨的1份),2份野生稻,4份杂交稻亲本和5份栽培稻材料的SSR分子标记和聚类分析,共检测到107个等位变异(Ae),Ae范围为3-8,平均每对引物检测到4.9条带,染色体1、6、7、8上的SSR引物多态性较高,第7染色体上最高扩增出8个多态性位点。多态性信息含量(PIC)变幅为0.3077~0.7951,平均为0.5870。遗传距离范围0.0909~0.9545,平均为0.6372。聚类分析结果表明江苏杂草稻具有较高的遗传多样性。同时也对江苏各采样地点的杂草稻进行了农艺性状的调查。结合这两方面认为:江苏省泰州杂草稻与杂交稻亲本的亲缘最近,确定江苏省泰州杂草稻主要来源于杂交稻及其分离后代。

关键词 杂草稻 遗传多样性 起源

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# 黄顶菊对6种草坪草种子萌发和幼苗生长的化感作用

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黄顶菊是2003年在河北省衡水和天津南开大学相继发现的一种我国植物志无记载的植物。 黄顶菊生境范围广泛,在草坪周边也发现了黄顶菊生长。一旦它入侵成功,将对城市生态 环境产生重要影响。化感作用是外来杂草入侵的机制之一,黄顶菊是否对草坪有化感作 用?目前尚未发现有此方面的报道。采用培养皿滤纸法,就入侵性杂草黄顶菊水提液对6 种草坪草(黑麦草、高羊茅、白三叶、巴林、结缕草、帕特)种子萌发及幼苗生长进行了 研究。结果表明黄顶菊对6种供试受体植物种子萌发和幼苗生长具有不同程度的抑制作用。 其中,结缕草对黄顶菊水提液母液最敏感,发芽率为21.43%; 巴林敏感程度最差,发芽 率为100%。帕特胚芽长和胚根长的受抑制程度最低,分别为28.24%和64.36%。相同浓度 处理时,黄顶菊水提液对6种供试受体植物根的生长抑制作用高于对芽的抑制作用。不同时 期采集的黄顶菊植株提取液对草坪草种子抑制程度有差异,表现为:幼苗期植株(3-10对 叶)>当年成熟期植株茎 > 现蕾前植株(13-14对叶) >成熟后笠年采集植株。

# 外来植物对入侵地土传病原真菌的化感效应\*

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# THE ALLELOPATHIC EFFECTS OF EXOTIC PLANT ON SOIL-BORNE PLANT PATHOGENS

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近年来对外来植物入侵机制的研究多从入侵过程的影响因素出发,研究热点集中在外来植物本身的特性、外来种与土著种的相互作用、初始入侵种群参数、新栖息地环境的可入侵力等方面,形成的关于入侵植物可以成功入侵的机制一般有以下几种:群落物种丰富度(community species richness)假说、空缺生态位(vacant niches)假说、天敌逃避(enemy release)假说、迁移前后干扰(disturbance before or upon immigration)假说等。其中天敌逃避(enemy release)假说里认为,外来植物在入侵地由于摆脱了原生境天敌(虫、病等)的控制,因而种群迅速发展,成为入侵种(Keane and Crawley,2002;),然而,目前大多数研究表明,入侵植物可能通过影响入侵地的微生物,抑制入侵地土传病原真菌的生长,从而在非本土地区比在本土区要生长得旺盛。本文从研究入侵植物对入侵地土壤病原微生物的影响着手,研究外来入侵种与入侵地土传微生物之间的相互作用,揭示其入侵的可能机理;分析抑制土传病原真菌的化感物质,试图利用入侵植物的化感物质防治土传病害。

本研究设计了两个实验: (1) 加拿大一枝黄花砂培 3-4 个月后去除地上部分植株,余下石英沙和根系(含根状茎)混合物,进行两组实验,一组用于提取和分离化感活性物;另一组于盆钵直接接种供试病原菌,培养 1-2 周,取样测定病原菌种群,并播种西红柿,2 周后测定其萌发率。实验处理为: i)入侵植物(加拿大一枝黄花)+P.; ii)入侵植物+R.; iii)入侵植物+空白; iv)对照+P.; v)对照+R.; vi)对照+空白; (2) 用加拿大一枝黄花的根状茎的粗提取物对广泛分布、对植物产生严重危害的土传病菌 Pythium ultimum 和 Rhizoctonia solani 进行生物测试。

实验结果表明:(1)入侵植物生长 4 个月后的土壤基质,西红柿的发病率明显低于无入侵植物生长过的土壤。加拿大一枝黄花的根系分泌物在没接菌 P.或 R.和对选定病原真菌 P.和 R.的情况下,对西红柿种子的萌发分别起抑制和促进的作用;(2)加拿大一枝黄花的根状茎的粗提物对选定的土传病菌具有明显的抑制作用,且随着浓度的提高,抑制作用增强。抑制率最高可以分别达到 74%(Pythium ultimum)、91%(Rhizoctonia solani),而且加拿大一枝黄花根状茎提取液在相同浓度下,对菌 R.的抑制作用比对菌 P.大。

上述结果意味着外来植物(以加拿大一枝黄花为例)成功入侵的可能新机理,即入侵植物通过化感作用对入侵地的病原微生物有抑制作用(抑制天敌假说)。

关键词: 外来植物 土传病菌 入侵机制 化感

<sup>\*\*</sup> 浙江省自然科学基金人才项目,国家杰出青年科学基金海外合作项目(30228005)

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# 农田除草存在问题及对策措施

#### 张绍明

江苏省植物保护站 江苏南京,

农田杂草防除技术的普及对控制农田草害发挥了巨大的作用。但目前农田除草工作还存在一些问题,必须采取有效措施加以解决。

由于种植结构不断调整、耕作方式快速变革以及技术普及难度加大等原因,给农田除草工作带来一些新情况、新问题。**药害严重**。"十五"期间,由于除草剂本身质量问题、使用技术不当以及绿黄隆、甲黄隆等长残留除草剂的违规使用等原因,导致全省农作物当茬及后茬药害严重,年平均药害面积达五十万亩左右。**草相变化。**耕作方式的变化以及除草剂的连续使用等原因,导致草相发生很大变化。如麦田、油菜田早熟禾,水稻田千金子以及棉花田阔叶杂草等迅速上升。此外,野老鹳草、泽漆等田埂、沟边杂草也逐步蔓延到田间危害。**药械落后**。江苏省 06 年背负式机动药械社会保有量 50 万台,手动施药药械社会保有量 700 万台,其中大部分手动施药器械以及部分机动施药器械都存在"跑、冒、滴、漏"现象,导致农药有效利用率仅达 30%左右。抗性明显。由于长期单一使用某类除草剂,导致一些杂草对部分除草剂产生抗性,除草效果不断下降。据调查,日本看麦娘对绿麦隆、绿黄隆,网草对绿黄隆,播娘蒿对苯磺隆等防除效果不断下降,均表现出一定的抗药性。标准过时。恰合实际的"防治标准"不仅可以为及时防治提供依据,而且还能避免不必要的浪费。但本省 80 年代初期制定的农田杂草防治指标以及"三层三级"法草害调查方法都已无法适应目前种植业结构调整的格局。

针对农田杂草防除工作中存在的问题,必须采取有效措施,控制其发生与危害。**优化 防除技术。**根据草相变化特点,及时调整化除配方,推广综合治理措施,完善防除配套技术,提高农田除草效果。**强化技术培训。**开展除草剂使用技术培训,普及安全用药知识,推广专业化防治,预防和控制除草剂药害的产生。**更新施药机械。**加强植保机械的更新换代,大力推广优质、高效施药器械和除草剂专用喷头,提高除草剂的利用率。**完善防治指标。**针对现代农业特点,加强协作研究,修订防治指标和草害调查标准,为科学防治提供依据。加强抗性研究。加强杂草抗药性监测,坚持除草剂的混配与交替使用,延缓杂草抗药性产生。

# 紫茎泽兰化感作用初探

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紫茎泽兰是一种入侵性极强的外来杂草,目前已在我国西南的云南、四川、广西、贵州、重庆等地广泛分布且危害严重。本文模拟化感物质释放的淋溶途径,采用室内生物测定的方法,对紫茎泽兰水浸提液对几种受体植物的化感作用进行了研究,结果表明:紫茎泽兰水浸提液对 6 种植物: 黄瓜、三叶草、苜蓿、莴苣、黑麦草、稗草化感作用的生物测定结果表明,受体植物的种子萌发和幼苗生长均受到明显的抑制,且浸提液对受体植物幼苗的抑制作用要强于对种子萌发的作用,对种子的影响主要有抑制萌发和延迟萌发两种作用形式,根长和芽长生长受到抑制,使幼苗在形态上明显发生畸形;相同浓度下紫茎泽兰地上部分水浸提液的化感作用明显强于其地下部分水浸液的化感作用;浸提液对受体植物种子萌发中根的抑制作用明显强于对芽的影响。紫茎泽兰对受体植物化感作用受浸提液浓度的影响,且表现对不同种受体植物不同的化感效应,中低浓度(0.005 gDW/ml、0.0005 gDW/ml)浸提液对同属莴苣有促进作用,在高浓度(0.05 gDW/ml)下才表现出显著抑制作用,对豆科苜蓿也在高浓度(0.05 gDW/ml)下才表现显著抑制作用,对豆科苜蓿也在高浓度(0.05 gDW/ml)下才表现显著抑制作用,浸提液中低浓度(0.005 gDW/ml、0.0005 gDW/ml)对葫芦科黄瓜,豆科三叶草及禾本科黑麦草和稗草即表现出显著或极显著化感抑制作用,且化感作用大小随组分浓度增加而增加。分析显示,发芽速度指数较发芽率对种子萌发敏感,更适合于评价化感作用潜势。

# 芒果叶挥发物化学成分分析与鉴定\*

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植物化感作用是目前农业生态和化学生态学研究的热点,植物的化感作用主要指通过茎叶挥发,茎叶淋溶,根系分泌和残体腐解等过程向周围环境中释放化感物质,从而抑制周围一种或多种植物生长发育的现象。已有文献研究表明,芒果水浸提液对玉米、稗草和马唐等的萌发和根生长都有影响,表明芒果对这些作物具有化感作用。然而,没有关于芒果叶挥发物成分及作用的研究报道。

采用水蒸气蒸馏萃取法(SDE)进行芒果叶挥发物的提取,提取物经高纯  $N_2$ 浓缩后,用 GC-MS 分析成分,采用内标法确定各组分的相对含量,并比较芒果嫩叶和功能叶挥发物成分的差异。

研究结果表明,芒果嫩叶和功能叶有 8 个共有组分,分别是[+]-2-蒈烯、顺-3,7-二甲基-1,3,6-辛三烯、3-蒈烯、β-蒎烯、β-香叶烯、α-水芹烯、顺-3-己烯-1-醇乙酸盐、顺-3-己烯-1-醇,其中萜烯类占总数的 75%。而且两种类型叶中相对含量最高的成分均为[+]-2-蒈烯。此外,除共有成分外,芒果嫩叶挥发物组分还有:3,7-二甲基-1,3,7-辛三烯、D-柠檬烯、3,7-二甲基-1,6-辛二烯、3-戊烯-2-醇、己酸-3-己烯酯等等;芒果功能叶挥发物组分还有:α-蒎烯、柠檬烯、β-水芹烯、3,7-二甲基-1,3,6-辛三烯、α-法呢烯、苯乙醛、1-己烯醇、莰烯等等。

可见,芒果叶挥发物的主要成分为萜烯类,分别占嫩叶和功能叶化合物检出总量的62.5%和80%。已经知道如柠檬烯等萜烯类化合物是具有化感潜力的物质,因此推测芒果叶挥发物也具有化感作用潜力。明确芒果叶挥发物组分以及不同类型叶挥发物组分的差异,可为进一步深入研究芒果树化感作用奠定基础。同时也为更好地理解芒果树与害虫危害之间的相互关系提供理论基础。

关键词: 芒果: 挥发物: 化感作用: 化学成分

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### 攀援与匍匐生长五爪金龙地上部分水浸液的化感效应对比研究

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通过测定攀援和匍匐生长五爪金龙地上部分水浸液对莴苣种子萌发率和根长的影响,对其化感效应进行了对比分析,结果表明:攀援生长五爪金龙地上不同部分高浓度水浸提液的化感抑制效应均高于匍匐生长五爪金龙,低浓度水浸提液的化感促进效应均小于匍匐生长五爪金龙;攀援和匍匐生长五爪金龙的地上部分水浸提液化感效应存在差异,不同处理浓度的"高抑低促"现象明显;在0.0025~0.02g/ml浓度范围内,五爪金龙地上部分水浸提液浓度和化感综合效应指数均为负相关;攀援生长五爪金龙茎尖、成熟叶、茎拟合直线斜率大于匍匐生长五爪金龙,其综合化感效应受水浸液浓度变化影响较大;攀援和匍匐生长五爪金龙落叶回归系数相差较小,且斜率均较小,表明落叶化感效应受水浸液浓度变化的影响较小。对攀援和匍匐生长五爪金龙化感潜力的浓度效应研究对探讨其化感作用规律及入侵机理具有重要意义。

关键词: 五爪金龙: 攀援: 匍匐: 化感作用: 生物测定

# 芒萁溶剂浸提液的化感作用研究

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通过研究芒萁(Dicranopteris pedata)各器官(叶、地上茎、地下茎和枯落物)的系统溶剂 (水、乙醇(95%)、丙酮和石油醚)浸提液对莴苣、白菜、黄瓜和萝卜种子的萌发和幼苗生长的影响,系统评价芒萁的化感作用。结果表明:芒萁各部位不同溶剂浸提液在 0.04gDW·ml<sup>-1</sup>时,对 4 种受试植物的发芽率、根长和苗高都有不同程度的抑制作用。相同部位不同溶剂浸提液的化感效应存在差异,其中以乙醇的最强,其次是水、丙酮,石油醚最弱;不同部位相同溶剂的浸提液中,以叶的化感效应最强,其次是地上茎、地下茎和枯落物。4 种受试植物中,对芒萁的化感作用表现最为敏感的是莴苣。

芒萁在自然生态环境中常易成为"纯植丛",形成这一现象的原因与芒萁的化感作用密切相关。通过本实验初步验证了,芒萁是通过地上部挥发和淋溶向环境中释放化感物质,对周围植物产生较强的抑制作用,尤其是对受体植物根的生长表现出较强的抑制作用,其次是对植株苗高生长的抑制作用。

关键词: 芒萁; 化感物质; 化感作用; 系统溶剂

# 鸭舌草抗氧化活性物质的分离与鉴定\*

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抗氧化剂是重要的脂质过氧化抑制剂,不仅能用于食品保鲜,而且具有抵抗活体细胞被氧化伤害的机制。目前常用的抗氧化剂以化学合成的抗氧化剂为多,如二丁基羟基甲苯(BHT)、丁基羟基茴香醚(BHA)、没食子酸内酯(PG)等。但这些化学物质对人体肝、肺等器官均有不良影响。而从天然植物中提取的抗氧化剂对人类健康无不良影响。鸭舌草(Monochoria vaginalis(Burm.f.) Preslex Kunth)是从 12 种杂草中筛选出的具有高抗氧化活性的材料。本试验用溶剂萃取法把鸭舌草的 75% 乙醇提取物浸膏分成四个不同组分,并用典量法测定它们的抗氧化活性。试验结果表明,其高极性组分正丁醇相具有更强的抗氧化活性,与天然抗氧化剂茶多酚和化学合成抗氧化剂 BHT 的抗氧化活性相当,显著高于对照。因此,我们利用柱层析技术对具有高抗氧化活性组分正丁醇相进行了进一步的分离纯化,得到 A、B、C、D 等 4 个晶体化合物,并对 A、B 化合物进行了 EI-MS,  $^1$ H NMR,  $^1$ 3 C NMR 谱的测定,鉴定了它们的结构分别为豆甾醇葡萄糖甙、β 一胡萝卜甙,另外 2 个化合物正在鉴定中。以 BHT 为对照,用硫氰酸铁(FTC)法对该 4 个化合物进行了评定。结果显示这 4 个化合物均具有比 BHT 更高的抗氧化活性,具有很好的天然抗氧化剂开发前景。

关键词 鸭舌草 抗氧化活性 分离 鉴定

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# 入侵植物马缨丹及其伴生种光合特性比较

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外来植物能够成功入侵新的生境的一个重要因素就是具有对环境因子较强的适应性和耐受性。本实验对入侵植物马缨丹及其常见主要伴生种鬼针草、肖梵天花、土牛膝在不同光强和不同  $CO_2$  含量下的光合生理特性进行比较,结果表明:(1) 马缨丹及其伴生种的光饱和点(LSP)较高,均在  $1200\mu mol \cdot m^2 \cdot s^{-1}$  以上,对强光的忍受能力都比较强。马缨丹的光补偿点为  $13.58\mu mol \cdot m^2 \cdot s^{-1}$ ,低于其 3 种伴生种;光子利用率达到  $0.0503\mu mol \cdot m^2 \cdot s^{-1}$ ,能适应阴生环境。(2) 随  $CO_2$  含量的增加,4 种植物的净光合速率增加,马缨丹最大净光合速率达到  $33.0755\mu mol \cdot mol^{-1}$ ,高于其 3 种伴生种; $CO_2$  饱和点为  $1350\mu mol \cdot mol^{-1}$ ,仅次于土牛膝;补偿点为  $61.78\mu mol \cdot mol^{-1}$ ,表观羧化效率  $0.0324\mu mol \cdot mol^{-1}$ ,马缨丹对  $CO_2$  含量的升高具有较高的适应能力。(3) 有效光合辐射的增强和  $CO_2$  含量的增加,对马缨丹气孔导度、蒸腾速率影响不大,但能在一定的程度上促进其水分利用。该研究结果有助于解释马缨丹生长迅速、生长力高、竞争性强的生物学特点,并为探索针对入侵植物马缨丹的防控对策提供有价值的参考。

关键词: 入侵植物, 马缨丹, 伴生植物, 有效光合辐射, CO2含量, 光合生理特性

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# 进境粮谷中主要危险性杂草的环境适生性初步研究

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本文探讨了温度、土壤水分和盖土厚度对豚草、假高粱、刺黄花稔及裂叶牵牛等四种 杂草种子萌发的影响及大豆与豚草的竞争关系。温度是影响豚草、假高粱、刺黄花稔及裂 叶牵牛四种杂草种子萌发的重要因素, 培养皿滤纸法试验结果表明, 在光照条件下, 四种 杂草在 15  $\mathbb{C}$ -30  $\mathbb{C}$  的范围内都能萌发,其中豚草在 20  $\mathbb{C}$ -25  $\mathbb{C}$  的范围内较适宜萌发,假高 粱和刺黄花稔在 15℃-30 ℃的范围内随着温度的升高萌发率提高, 裂叶牵牛在 20℃-30 ℃ 的范围内较适宜萌发。室内种子萌发试验结果表明、土壤含水量对豚草、假高粱、刺黄花 稔及裂叶牵牛种子萌发的影响很大。四种杂草在土壤含水量为田间持水量的 55%-100% (试验土壤的田间持水量为13.7%)范围内均能萌发,其中假高粱与裂叶牵牛在土壤水分 为田间持水量的 40%时仍能萌发。豚草、刺黄花稔和假高粱在土壤水分为田间持水量的 85%-100%的时候较适宜萌发,裂叶牵牛在40%-100%的范围内随着土壤含水量的增加而 提高。盖土厚度试验在光照条件下进行, 豚草与假高粱的土壤含水量为田间持水量的85%, 刺黄花稔与裂叶牵牛的土壤含水量为田间持水量的 100%。结果表明,四种杂草在 0-7cm 盖土厚度下都能萌发,其中豚草在2-5cm 盖土厚度下萌发率较高,假高粱在1-3cm 的盖土厚度下较适宜萌发,刺黄花稔在1cm-3cm 的盖土厚度下较适宜萌发,随着盖土 厚度的增加或者减少三种杂草萌发率降低。裂叶牵牛在 1-5cm 盖土厚度下萌发率都较高, 无显著差异,7-11cm 范围内随盖土厚度的增加萌发率下降,超过 13cm 后不能萌发。豚草 与大豆竞争试验,在自然条件下大豆与豚草同时播种后于1对真叶期移栽于露地,不同处 理大豆种植密度均为 4 株/ $m^2$ , CK 处理仅种植大豆,A、B、C 三个处理的豚草密度分别为  $5 \, \text{株/m}^2 \, \text{、} 12 \, \text{株/m}^2 \, \text{与} \, 21 \, \text{株/m}^2 \, \text{、} 试验期间人工除去其它杂草。大豆与豚草移栽后不同时$ 间调查结果表明,生长前期大豆在株高方面有优势,移栽后 10、20 与 30d,各处理大豆的 平均株高分别是豚草的 2.61、2.29、1.94 倍。但豚草的叶片数与分枝数增加速度超过了大 豆,移栽后 10、20 与 30d,各处理豚草的平均叶片数分别是大豆的 1.35 、1.42 、1.49 倍。 移栽后 10d 豚草主茎上尚无分枝,但 20d、30d 豚草的平均分枝数已达 3.68、9.03 个,分 别是大豆的 2.10、4.21 倍。移栽后 30d 内,不同处理大豆间以及豚草间的上述生物学参数 没有显著性差异。豚草、假高粱、刺黄花稔和裂叶牵牛的种子在进境粮谷中被截获的频率 很高,温度、土壤水分和盖土厚度等三因素对刺黄花稔与裂叶牵牛种子萌发的影响国内外 未见文献报道。本试验结果表明, 豚草、假高粱、刺黄花稔和裂叶牵牛等 4 种杂草种子都 能在我国大部分地区萌发生长,应加强防控。大豆与豚草共生前期,大豆在株高方面有优势, 但豚草的叶片数与分枝数增加速度超过了大豆。

关键词: 豚草,假高粱,刺黄花稔,裂叶牵牛,大豆,温度,水分,盖土厚度,萌发,竞争

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