华中农业大学
HUAZHONG AGRICULTURAL UNIVERSITY

“狮山硕彦计划”支撑材料

（教学特岗类）

推荐单位名称	植物科学技术学院
申报人姓名	刘立军
申报年度	2020 年度
申报岗位	教学能手 B2
填表时间	2020 年 11 月 26 日

目录

1. 学历学位证书

博士学位证书

刘立军，男，1980 年 6 月24 日生。在华中农业大学作物栽培学与耕作学学科（专业）已通过博士学位的课程考试和论文答辩，成绩合格。根据《中华人民共和国学位条例》的规定，授予 农学 博士学位。

华中农业大学

校　　长

学位评定委员会主席 邓秀新

证书编号：10504220080000191

二〇〇八 年十二月 三十一日

华中农業大學

HUAZHONG AGRICULTURAL UNIVERSITY

博士研究生毕业证书

（无华中农业大学钢印无效）

证书编号：105041200801000178

研究生 刘立军，男，生于 一九八〇年六月二十四日，

于二〇〇三年九月一日至二〇〇八年十一月三十日

在 作物栽培学与耕作学 专业学习，

修完 博士研究生 培养计划规定的全部课程，

成绩合格，通过毕业论文答辩，准予毕业。

校长：邓秀新印

华中农业大学

二〇〇八年十一月三十日

勤读力耕 立己达人

查询网址：www.chsi.com.cn

No. 00000142

2. 培训进修情况

留学回国人员证明

（2019 澳大利亚）教(文)证字 2157 号

兹证明 刘立军 （男√、女□，护照号码 G42803505 ）系我国在 澳大利亚 国 University of Western Australia 学校（单位）的高级研究学者□、访问学者√□、博士后□、博士研究生□、硕士研究生□、本科生□、大专生□、其他留学人员□

在我驻外使（领）馆报到日期 2018 年 11 月 23 日

注册入学日期 2018 年 11 月 23 日

毕（结）业日期 2019 年 11 月 23 日

拟回国日期 2019 年 11 月 23 日

毕（结）业证书名称 无 号码 _____

备注（留学经历描述）在西澳大学访学是充满收获和技能显著提升的一年。我的研究工作达到了预期的目标，除积极与外导开展合作研究之外，继续做好国内本职工作。独立完成了“Effect of drought on agronomic traits and yield of durum wheat

留学回国人员签字：刘立军

经办人签字：

负责人签字：

教育（文化）处（组）公章

2019 年 10 月 31 日

第一联：交留学回国人员　　教育部国际合作与交流司 2012 年制表

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1、本证明只为学成回国工作的留学人员开具。
2、本证明由我驻外使（领）馆教育（文化）处（组）在留学人员回国时填写，不得涂改。
3、本证明经使（领）馆教育（文化）处（组）经办人、负责人签字并在第一、第二联加盖公章方为有效。
4、第一联由留学人员保存，其他单位可查验原件，收存复印件，不得收取原件。

3. 学术兼职

聘　书

LETTER OF APPOINTMENT

兹聘请刘立军先生：

为中国作物学会第六届麻类专业委员会副秘书长。

聘期至二〇二二年十二月。

中国作物学会麻类专业委员会

二〇一八年一月

4. 教学成果奖励

荣誉证书

刘立军老师：

荣获华中农业大学2015年度教学质量优秀二等奖。

特发此证，以资鼓励。

华中农业大学

二〇一六年二月

荣誉证书

刘立军老师：

荣获华中农业大学 2018 年度

教学质量优秀三等奖。

特发此证，以资鼓励。

华中农业大学

二〇一九年三月

“十二五”普通高等教育本科国家级规划教材

作物栽培学（第2版）

Zuowu Zaipeixue

主　编　胡立勇（华中农业大学）　丁艳锋（南京农业大学）

副主编　周伟军（浙江大学）　戴其根（扬州大学）

李存东（河北农业大学）　郭华春（云南农业大学）

刘立军（华中农业大学）

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彭定祥（华中农业大学）　谢甫绨（沈阳农业大学）

靳德明（华中农业大学）

高等教育出版社·北京

内容简介

《作物栽培学》是普通高等教育“十一五”国家级规划教材、“十二五”普通高等教育本科国家级规划教材，并于2009年被评为国家级精品教材。本教材第1版发行10多年来，为近30所高等院校所选用。本版教材基于国家级精品资源共享课程建设成果，采用“纸质教材+数字课程”的新形态教材模式修订出版。

本书分为上、下两篇，共18章。上篇5章系统介绍作物栽培学的基本概念、作物生长发育特性、作物产量与品质形成、作物栽培基本技术、作物栽培新技术等共性知识。下篇13章，重点分章介绍水稻、小麦、玉米、大豆、马铃薯、甘薯、棉花、苎麻、油菜、花生、甘蔗、烟草等12种主要农作物，并在第18章介绍大麦、粟、高粱、荞麦、木薯、大麻、亚麻、红麻、向日葵、芝麻、甜菜、绿肥与饲料作物等13种小宗特色作物。本书在内容组织上尽力兼顾学术性与实用性，知识结构上力求系统性与完整性，积极追溯传承我国农耕思想文化的经典与精华，注重追踪引入现代生物科学技术的创新与应用。纸质版教材力求达到重点突出、文字精练，深入浅出，循序渐进，每章均设置了本章提要、名词解释、问答题和分析思考与讨论等导学部分。配套数字资源以增强教材的前沿性、启发性、直观性与可读性为目标，由推荐阅读、深入学习、应用实例、彩图等不同部分组成，可供教师与读者选择使用。

本书可作为农学类专业（包括农学、植保、园艺、农业资源与环境等）学生的专业课或专业基础课教材，农学类以外相关专业学生的选修课教材，以及从事农业科技、管理、教育和培训人员的农业科技用书与拓宽知识领域的参考用书。

Zuowu Zaipeixue

策划编辑　郝真真　　责任编辑　高新景　　特约编辑　郝真真　　封面设计　汪　雪　杨立新
责任绘图　黄云燕　　责任印制

出版发行　高等教育出版社
社　　址　北京市西城区德外大街4号
邮政编码　100120
印　　刷
开　　本　889mm×1194mm　1/16
印　　张　30.5
字　　数　780千字
购书热线　010-58581118
咨询电话　400-810-0598

网　　址　http://www.hep.edu.cn
　　http://www.hep.com.cn
网上订购　http://www.hepmall.com.cn
　　http://www.hepmall.com
　　http://www.hepmall.cn
版　　次　2008年11月第1版
　　2019年5月第2版
印　　次　2019年5月第1次印刷
定　　价　58.00元

物 料 号　51954-00
审 图 号　GS（2019）337号

普通高等教育农业部“十二五”规划教材
全国高等农林院校“十二五”规划教材

农学实验教程

NONGXUE SHIYAN JIAOCHENG

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中国农业出版社

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发明名称：一种苎麻山坡地抗旱栽培方法

发明人：刘立军;彭定祥;贺丽江;汪波

专利号：ZL 2015 1 0214663.8

专利申请日：2015年05月21日

专利权人：华中农业大学

授权公告日：2017年11月10日

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2017年11月10日

6. 论文检索报告

编号：2020c307

教育部科技查新工作站（N07）

检索报告

（检索日期：2020-8-13，检索责任人：余红）

委托人单位：	华中农业大学植物科技学院
委　托　人：	刘立军
检索要求：	SCIE、CSCD 数据库收录引用查证
检索时段：	2014-2020

检　索　结　果

数据库	论文收录(篇)				WOS 核心合集/CSCD 中引用情况		
	唯一通讯作者	共同通讯作者	共同第一作者	总计	被引用论文(篇)	被引次数	他引次数*
SCIE	6	3	1	10	10	117	47
CSCD	1	/	/	1	/	/	/

声明	委托人接受本证明，视为已对本证明所列论文逐篇核对，确认无误，若有不实，由委托人承担全部责任。

备注：结果见附件。

* 他引次数的统计是按照“文献被除作者及合作者以外其他人的引用”方式计算。

影响因子采用的是文献发表最新（2019）的影响因子。

高被引论文（唯一通讯作者第 2 条）来自 Essential Science Indicators 2020.7.9 日更新的数据。

教育部科技查新工作站(N07)

（公章）

二零二零年八月十三日

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检索报告附件：

SCIE 收录 10 篇

唯一通讯作者（共 6 条）

第 1 条，共 6 条

标题: Appraising growth, oxidative stress and copper phytoextraction potential of flax (Linum usitatissimum L.) grown in soil differentially spiked with copper

作者: Saleem, MH (Saleem, Muhammad Hamzah); Kamran, M (Kamran, Muhammad); Zhou, YY (Zhou, Yaoyu); Parveen, A (Parveen, Aasma); Rehman, M (Rehman, Muzammal); Ahmar, S (Ahmar, Sunny); Malik, Z (Malik, Zaffar); Mustafa, A (Mustafa, Adnan); Anjum, RMA (Anjum, Rao Muhammad Ahmad); Wang, B (Wang, Bo); **Liu, LJ (Liu, Lijun)**

来源出版物: JOURNAL OF ENVIRONMENTAL MANAGEMENT **卷:** 257 **文献号:** 109994 **DOI:** 10.1016/j.jenvman.2019.109994 **出版年:** MAR 1 2020

Web of Science 核心合集中的 "被引频次": 14

Web of Science 核心合集中的 "他引频次": 1

入藏号: WOS:000515447200007

文献类型: Article

地址: [Saleem, Muhammad Hamzah; Ahmar, Sunny; Wang, Bo; Liu, Lijun] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Core M, Wuhan 430070, Peoples R China.

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[Parveen, Aasma; Malik, Zaffar] Islamia Univ Bahawalpur, Univ Coll Agr & Environm Sci, Dept Soil Sci, Bahawalpur 63100, Pakistan.

[Mustafa, Adnan] Chinese Acad Agr Sci, Inst Agr Resources & Reg Planning, Natl Engn Lab Improving Qual Arable Land, Beijing 100081, Peoples R China.

[Anjum, Rao Muhammad Ahmad] Univ Agr Faisalabad, Inst Soil & Environm Sci, Faisalabad 38040, Pakistan.

[Rehman, Muzammal] Yunnan Univ, Sch Agr, Kunming 650504, Yunnan, Peoples R China.

通讯作者地址: Liu, LJ (corresponding author)，Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Core M, Wuhan 430070, Peoples R China.

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ISSN: 0301-4797

eISSN: 1095-8630

IF:5.647

JCR® 类别	*类别中的排序*	*JCR 分区*
ENVIRONMENTAL SCIENCES	**33/265**	**Q1**

第 2 条，共 6 条

标题: Morpho-physiological traits, gaseous exchange attributes, and phytoremediation potential of jute (Corchorus capsularis L.) grown in different concentrations of copper-contaminated soil

作者: Saleem, MH (Saleem, Muhammad Hamzah); Fahad, S (Fahad, Shah); Khan, SU (Khan, Shahid Ullah); Ahmar, S (Ahmar, Sunny); Khan, MHU (Khan, Muhammad Hafeez Ullah); Rehman, M (Rehman, Muzammal); Maqbool, Z (Maqbool, Zahid); **Liu, LJ (Liu, Lijun)**

来源出版物: ECOTOXICOLOGY AND ENVIRONMENTAL SAFETY **卷:** 189 **文献号:** 109915 **DOI:** 10.1016/j.ecoenv.2019.109915 **出版年:** FEB 2020

Web of Science 核心合集中的 "被引频次": 13

Web of Science 核心合集中的 "他引频次": 3

入藏号: WOS:000507711500087

文献类型: Article

地址: [Saleem, Muhammad Hamzah; Liu, Lijun] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Wuhan 430070, Peoples R China.
[Fahad, Shah] Univ Swabi, Dept Agr, Khyber Palchtunichwa, Pakistan.
[Khan, Shahid Ullah; Ahmar, Sunny; Khan, Muhammad Hafeez Ullah] Huazhong Agr Univ, Natl Key Lab Crop Genet Improvement, Wuhan 430070, Peoples R China.
[Rehman, Muzammal] Govt Coll Univ, Dept Environm Sci & Engn, Faisalabad, Pakistan.
[Maqbool, Zahid] Yunnan Univ, Sch Agr, Kunming 650504, Yunnan, Peoples R China.

通讯作者地址: Liu, LJ (corresponding author)，Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Wuhan 430070, Peoples R China.

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ISSN: 0147-6513

eISSN: 1090-2414

IF:4.872

JCR® 类别	*类别中的排序*	*JCR 分区*
ENVIRONMENTAL SCIENCES	**44/265**	**Q1**
TOXICOLOGY	**11/92**	**Q1**

ESI 高被引论文: Y

根据对应领域和出版年中的高引用阈值，到 三月/四月 2020 为止，本高被引论文受到引用的次数已将其归入 Environment/Ecology 学术领域同一出版年最优秀的 前 1% 之列。

来自 Essential Science Indicators 的数据

第 3 条，共 6 条

标题: Ramie, a multipurpose crop: potential applications, constraints and improvement strategies

作者: Rehman, M (Rehman, Muzammal); Gang, D (Gang, Deng); Liu, QQ (Liu, Qiqing); Chen,

YL (Chen, Yinglong); Wang, B (Wang, Bo); Peng, DX (Peng, Dingxiang); **Liu, LJ (Liu, Lijun)**
来源出版物: INDUSTRIAL CROPS AND PRODUCTS **卷:** 137 **页:** 300-307 **DOI:** 10.1016/j.indcrop.2019.05.029 **出版年:** OCT 1 2019
Web of Science 核心合集中的 "被引频次": 2
Web of Science 核心合集中的 "他引频次": 2
入藏号: WOS:000473376800037
文献类型: Article
地址: [Rehman, Muzammal; Liu, Qiqing; Wang, Bo; Peng, Dingxiang; Liu, Lijun] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Fanning Syst Middle, Wuhan 430070, Hubei, Peoples R China.
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ISSN: 0926-6690
eISSN: 1872-633X
IF:4.244

JCR® 类别	*类别中的排序*	*JCR 分区*
AGRICULTURAL ENGINEERING	**2/13**	**Q1**
AGRONOMY	**8/91**	**Q**

第 4 条，共 6 条
标题: Morpho-physiological traits, antioxidant capacity and phytoextraction of copper by ramie (Boehmeria nivea L.) grown as fodder in copper-contaminated soil
作者: Rehman, M (Rehman, Muzammal); Maqbool, Z (Maqbool, Zahid); Peng, DX (Peng, Dingxiang); **Liu, LJ (Liu, Lijun)**
来源出版物: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH **卷:** 26 **期:** 6 **页:** 5851-5861 **DOI:** 10.1007/s11356-018-4015-6 **出版年:** FEB 2019
Web of Science 核心合集中的 "被引频次": 18
Web of Science 核心合集中的 "他引频次": 6
入藏号: WOS:000460831600053
文献类型: Article
地址: [Rehman, Muzammal; Peng, Dingxiang; Liu, Lijun] Huazhong Agr Univ, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Coll Plant Sci & Technol, Wuhan 430070, Hubei, Peoples R China.
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ISSN: 0944-1344
eISSN: 1614-7499
IF:3.056

JCR® 类别	*类别中的排序*	*JCR 分区*
ENVIRONMENTAL SCIENCES	**99/265**	**Q2**

第 5 条，共 6 条
标题: Antioxidant capacity and alpha-glucosidase inhibitory activity of leaf extracts from ten ramie cultivars
作者: Wang, Q (Wang, Qin); Rehman, M (Rehman, Muzammal); Peng, DX (Peng, Dingxiang); **Liu, LJ (Liu, Lijun)**
来源出版物: INDUSTRIAL CROPS AND PRODUCTS **卷:** 122 **页:** 430-437 **DOI:** 10.1016/j.indcrop.2018.06.020 **出版年:** OCT 15 2018
Web of Science 核心合集中的 "被引频次": 5
Web of Science 核心合集中的 "他引频次": 4
入藏号: WOS:000442067300051
文献类型: Article
地址: [Wang, Qin; Rehman, Muzammal; Peng, Dingxiang; Liu, Lijun] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Wuhan 430070, Peoples R China.
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电子邮件地址: liulijun@mail.hzau.edu.cn
ISSN: 0926-6690
eISSN: 1872-633X
IF:4.244

JCR® 类别	*类别中的排序*	*JCR 分区*
AGRICULTURAL ENGINEERING	**2/13**	**Q1**
AGRONOMY	**8/91**	**Q1**

第 6 条，共 6 条
标题: A Proteomics Sample Preparation Method for Mature, Recalcitrant Leaves of Perennial Plants
作者: Deng, G (Deng Gang); Zhong, XY (Zhong Xinyue); Zhang, N (Zhang Na); Lao, CY (Lao Chengying); Wang, B (Wang Bo); Peng, DX (Peng Dingxiang); **Liu, LJ (Liu Lijun)**

来源出版物: PLOS ONE **卷:** 9 **期:** 7 **文献号:** e102175 **DOI:** 10.1371/journal.pone.0102175 **出版年:** JUL 16 2014
Web of Science 核心合集中的 "被引频次": 4
Web of Science 核心合集中的 "他引频次": 4
入藏号: WOS:000341306600041
文献类型: Article
地址: [Deng Gang; Zhong Xinyue; Lao Chengying; Wang Bo; Peng Dingxiang; Liu Lijun] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Wuhan, Hubei, Peoples R China.
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ISSN: 1932-6203
IF:2.74

JCR® 类别	*类别中的排序*	*JCR 分区*
MULTIDISCIPLINARY SCIENCES	**27/71**	**Q2**

共同通讯作者（共 3 条）
第 1 条，共 3 条
标题: Influence of phosphorus on copper phytoextraction via modulating cellular organelles in two jute (Corchorus capsularis L.) varieties grown in a copper mining soil of Hubei Province, China
作者: Saleem, MH (Saleem, Muhammad Hamzah); Ali, S (Ali, Shafaqat); Rehman, M (Rehman, Muzammal); Rana, MS (Rana, Muhammad Shoaib); Rizwan, M (Rizwan, Muhammad); Kamran, M (Kamran, Muhammad); Imran, M (Imran, Muhammad); Riaz, M (Riaz, Muhammad); Soliman, MH (Soliman, Mona H.); Elkelish, A (Elkelish, Amr); **Liu, LJ (Liu, Lijun)**
来源出版物: CHEMOSPHERE **卷:** 248 **文献号:** 126032 **DOI:** 10.1016/j.chemosphere.2020.126032 **出版年:** JUN 2020
Web of Science 核心合集中的 "被引频次": 10
Web of Science 核心合集中的 "他引频次": 2
入藏号: WOS:000527930600080
文献类型: Article
地址: [Saleem, Muhammad Hamzah; Liu, Lijun] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Wuhan 430070, Peoples R China.
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ISSN: 0045-6535
eISSN: 1879-1298
IF:5.778

JCR® 类别	*类别中的排序*	*JCR 分区*
ENVIRONMENTAL SCIENCES	**29/265**	**Q1**

第 2 条，共 3 条
标题: Influence of rice straw biochar on growth, antioxidant capacity and copper uptake in ramie (Boehmeria nivea L.) grown as forage in aged copper-contaminated soil
作者: Rehman, M (Rehman, Muzammal); **Liu, LJ (Liu, Lijun)**; Bashir, S (Bashir, Saqib); Saleem, MH (Saleem, Muhammad Hamza); Chen, C (Chen, Chen); Peng, DX (Peng, Dingxiang); Siddique, KHM (Siddique, Kadambot H. M.)
来源出版物: PLANT PHYSIOLOGY AND BIOCHEMISTRY **卷:** 138 **页:** 121-129 **DOI:** 10.1016/j.plaphy.2019.02.021 **出版年:** MAY 2019
Web of Science 核心合集中的 "被引频次": 17
Web of Science 核心合集中的 "他引频次": 0
入藏号: WOS:000463279400013
文献类型: Article
地址: [Rehman, Muzammal; Liu, Lijun; Saleem, Muhammad Hamza; Chen, Chen; Peng, Dingxiang] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Wuhan 430070, Hubei, Peoples R China.
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ISSN: 0981-9428
IF:3.72

JCR® 类别	*类别中的排序*	*JCR 分区*
PLANT SCIENCES	**33/234**	**Q1**

第 3 条，共 3 条
标题: Interactive effect of gibberellic acid and NPK fertilizer combinations on ramie yield and bast fibre quality
作者: Ullah, S (Ullah, Sana); Anwar, S (Anwar, Sumera); Rehman, M (Rehman, Muzammal); Khan, S (Khan, Shahbaz); Zafar, S (Zafar, Sara); **Liu, LJ (Liu, Lijun)**; Peng, DX (Peng, Dingxiang)
来源出版物: SCIENTIFIC REPORTS **卷:** 7 **文献号:** 10647 **DOI:** 10.1038/s41598-017-09584-5 **出版年:** SEP 6 2017
Web of Science 核心合集中的 "被引频次": 6
Web of Science 核心合集中的 "他引频次": 5
入藏号: WOS:000409439900065
文献类型: Article
地址: [Ullah, Sana; Anwar, Sumera; Rehman, Muzammal; Khan, Shahbaz; Liu, Lijun; Peng, Dingxiang] Huazhong Agr Univ, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Coll Plant Sci & Technol, Wuhan 430070, Peoples R China.
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ISSN: 2045-2322
IF:3.998

JCR® 类别	*类别中的排序*	*JCR 分区*
MULTIDISCIPLINARY SCIENCES	**17/71**	**Q1**

共同第一作者（共 1 条）
第 1 条，共 1 条
标题: Comparative proteome analysis of the response of ramie under N, P and K deficiency
作者: Deng, G (Deng, Gang); **Liu, LJ (Liu, Li Jun)**; Zhong, XY (Zhong, Xin Yue); Lao, CY (Lao, Cheng Ying); Wang, HY (Wang, Hong Yang); Wang, B (Wang, Bo); Zhu, C (Zhu, Cong); Shah, F (Shah, Fahad); Peng, DX (Peng, Ding Xiang)
来源出版物: PLANTA **卷:** 239 **期:** 6 **页:** 1175-1186 **DOI:** 10.1007/s00425-014-2040-3 **出版年:** JUN 2014
Web of Science 核心合集中的 "被引频次": 28

Web of Science 核心合集中的 "他引频次": 20

入藏号: WOS:000336404700004

文献类型: Article

地址: [Deng, Gang; Liu, Li Jun; Zhong, Xin Yue; Lao, Cheng Ying; Wang, Bo; Zhu, Cong; Peng, Ding Xiang] Huazhong Agr Univ, Coll Plant Sci & Technol, MOA Key Lab Crop Ecophysiol & Farming Syst Middle, Wuhan 430070, Hubei, Peoples R China.

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ISSN: 0032-0935

eISSN: 1432-2048

IF:3.39

JCR® 类别	*类别中的排序*	*JCR 分区*
PLANT SCIENCES	**41/234**	**Q1**

CSCD 收录 1 篇

唯一通讯作者（共 1 条）

第 1 条，共 1 条

作者: Liu Gaopeng; Liao Yishun; Liu Lijun; Qiu Lin; Guo Dawei

作者: 刘高鹏; 廖宜顺; **刘立军**; 邱霖; 郭大卫

标题: Experimental study on mechanical properties and autogenous shrinkage of cement-based materials with ramie fiber

标题: 苎麻纤维水泥基材料的力学性能与自收缩试验研究

来源出版物: 功能材料 **卷:** 50 **期:** 7 **出版年:** 2019

来源出版物: Journal of Functional Materials **卷:** 50 **期:** 7 **出版年:** 2019

文献号: 1001-9731(2019)50:7<ZMXWSN>2.0.TX;2-K

文献类型: Article

入藏号: CSCD:6550079

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在中国科学引文数据库中的被引频次: 0

ISSN: 1001-9731

Industrial Crops & Products 122 (2018) 430–437

Contents lists available at ScienceDirect

Industrial Crops & Products

journal homepage: www.elsevier.com/locate/indcrop

Antioxidant capacity and α-glucosidase inhibitory activity of leaf extracts from ten ramie cultivars

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ARTICLE INFO

Keywords:
Ramie leaves
Phenolic composition
Antioxidant
α-Glucosidase

ABSTRACT

Ramie (*Boehmeria nivea* L. Gaud) is widely cultivated as a raw material for producing natural textiles due to its fine and strong fibers. Ramie leaves are by-products and rich in bioactive compounds that contribute to the medicinal properties of its extracts. This study was conducted to identify the phenolic compounds and evaluate the antioxidant capacity and α-glucosidase inhibitory activities of ramie leaves extracts, obtained from ten cultivars widely growing in China. The phenolic compounds were identified using advanced analytical techniques such as ultra-high performance liquid chromatography coupled to electrospray ionization and quadrupole time-of-flight mass spectrometry (UPLC-ESI-QTOF-MS) and quantified by UPLC-DAD analysis. The antioxidant activity and α-glucosidase inhibitory properties were evaluated using rapid in vitro assays. The content of total phenolic compounds ranged from 0.52 to 2.41 mg/g DW, and the content of total flavonoids varied from 0.40 to 2.50 mg/g DW. UPLC-ESI-QTOF-MS analysis enabled to tentatively identify 15 compounds in ten cultivars, mainly chlorogenic acid, rutin, *p*-coumaroylmalic acid, caffeoylmalic acid, feruloylquinic acid, hyperoside and isoquercetin. The highest contents of chlorogenic acid, rutin and *p*-coumaroylmalic acid were found in cultivar Luzhuqing (LZQ) with 439.49 μg/g DW, 339.97 μg/g DW and 345.93 μg/g DW, respectively. All cultivars performed differently on the antioxidant capacity and α-glucosidase inhibitory ability. Principle component analysis revealed that Qianjiangxianma (QJX) and Luzhuqing (LZQ) were the top two cultivars. This study indicates that ramie leaves can be considered as potentially new source of antioxidants and antidiabetic agents, and it gives insights into cultivar selection in the ramie planting and production.

1. Introduction

Ramie (*Boehmeria nivea* L. Gaud) is a perennial herbaceous plant of Urticaceae family native to China, Japan and Malay Peninsula, where it has been cultivated as a fiber crop for many centuries (Hester and Yuen, 1989). In China, ramie is the second largest fiber crop with a production of 114,080 ton of fibers in 2010, participating up to 90% of the world production (Liu et al., 2013). However, being cultivated especially for its fibrous stem, ramie leaves are crop residues with great potential for reutilization and product development. Furthermore, the leaves of this plant has been used as sources of animal feeds (Kipriotis et al., 2015), herbal medicines, tea and foods (Lee et al., 2015). It has been showed that ramie leaves are rich in bioactive compounds with antioxidant (Chen et al., 2014), antibacterial (Lee et al., 2014), anti-inflammatory (Sung et al., 2013) and anti-obesity activities (Lee et al., 2016). The bioactivity was mainly attributed to phenolic compounds, such as phenolic acids and flavonoids, which exist ubiquitously in plants as secondary metabolites (Akter et al., 2018). Hence, phenolic profile has become a desirable and essential quality characteristic of ramie and a predictor for selecting ramie cultivars. Yet, few studies have evaluated chemical fractions of the leaf extracts for industrial applications among different cultivars.

Type 2 diabetes epidemic is rising rapidly worldwide and originates from the imbalance of hormones. Inhibition of α-glucosidase in mammals, which could reduce the hydrolyzation of starch into glucose, decrease glucose uptake and normalize postprandial blood glucose concentration. Phenolic bioactives of herbs and medicinal plants with higher antioxidant activity can be targeted for chronic disease management including type 2 diabetes (Saleem et al., 2017). However, there is still no report on the α-glucosidase inhibitory activity of leaf extracts of various ramie cultivars.

This study aimed to investigate the phenolic profile and the antioxidant capacity as well as α-glucosidase inhibitory activity of leaf extracts from ten ramie cultivars which are widely planted in China. Thus phenolic compounds were identified by an ultra-performance liquid chromatography/quadrupole time-of-flight mass spectrometry

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https://doi.org/10.1016/j.indcrop.2018.06.020
Received 7 April 2018; Received in revised form 4 June 2018; Accepted 6 June 2018
Available online 14 June 2018
0926-6690/

Industrial Crops & Products 137 (2019) 300–307

Contents lists available at ScienceDirect

Industrial Crops & Products

journal homepage: www.elsevier.com/locate/indcrop

Ramie, a multipurpose crop: potential applications, constraints and improvement strategies

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ARTICLE INFO

Keywords:
Bast fiber
Environmental conservation
Livestock feed
Medicinal value
Nutritional quality
Ramie

ABSTRACT

World population growth has increased the demand for food and shelter, thus threatening environmental sustainability and expanding the gap between resource availability and the ability to meet human needs. Humans are fulfilling their needs by depleting natural resources. Currently, exploring plant species that can fulfill the life requirements of both humans and animals without degrading natural resources has become a major challenge. Therefore, research on underutilized crops is of high interest among plant scientists. Ramie, an ancient plant with a long history, is being researched because of its vigorous growth, high nutritional value and multipurpose applications in Textiles, livestock feed, environmental conservation and medicine. It can be cultivated in versatile conditions including tropical, subtropical and temperate regions. The present review article provides a detailed discussion on the multipurpose utilization and nutritional importance of ramie as well as potential applications and constraints, and the outlook for the future.

1. Introduction

Globally, agriculture plays an important role in sustaining livelihood and human well-being, especially in rural communities. The cultivation of multipurpose crops such as ramie (Fig. 1) may be an optimal option to meet the rising demands of human needs. Ramie is an old Textile fiber crop that is harvested every 60 days by cutting the mature shoots without destroying the roots; thus, the root system develops continuously in the soil (Subandi, 2012). Ramie is cultivated as a major economic crop in China: 500,000 tons of fiber is produced per year, accounting for approximately 96% of global production (Kipriotis et al., 2015). Ramie farming, industries and trade provide livelihood support to approximately 5 million people (An et al., 2017). China exports a large quantity of ramie yarn and fabrics every year (Fig. 2). The major export markets for ramie products are Japan and Europe.

Besides being a source of bast fiber (Tewolde & Fernandez, 2003; Sarkar, 2005), ramie is also used as source of feed for livestock (Kipriotis et al., 2015; Rehman et al., 2019a,b) and poultry and fish farming, owing to its vigorous growth, high biomass production and high protein content. Machin (1977) has also reported ramie to be a potential forage for livestock, because it is an excellent source of crude protein, lysine, methionine, carotenoids, riboflavin and calcium, and it has a low level of crude fiber. The nutritional value of ramie has been described as similar to that of alfalfa (*Medicago sativa*). Ramie can also be utilized for environmental conservation because of its tolerance to heavy metal stress: ramie can grow and colonize diverse heavy metal contaminated lands (Yang et al. 2010; Zhou et al. 2010). In addition, ramie has potential uses in tea, foods, medicine (Lee et al., 2015) and the cosmetic industry. For example, its leaf extracts exhibit anti-HBV activity (Wei et al., 2014).

Despite the multiple benefits of ramie and its products, its cultivation has received comparatively less attention than other annual or perennial fiber crops. The reasons are manifold, but ramie based poorly grown industries are a key hindrance to ramie cultivation. Growers face large challenges to establish a crop, decorticate and degum its fiber and finally find a potential market for their produce. A lack of planting materials and cultivation of local landraces, poor crop management and lack of awareness campaigns are some other limitations to ramie production. However, if researchers and growers were to pay considerable attention to this crop, a progressive change might occur in the

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https://doi.org/10.1016/j.indcrop.2019.05.029
Received 8 October 2018; Received in revised form 2 May 2019; Accepted 10 May 2019

Journal of Environmental Management 257 (2020) 109994

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: http://www.elsevier.com/locate/jenvman

Research article

Appraising growth, oxidative stress and copper phytoextraction potential of flax (*Linum usitatissimum* L.) grown in soil differentially spiked with copper

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ARTICLE INFO

Keywords:
Antioxidative capacity
Cu-contaminated soil
Cu phytoextraction
Flax (*Linum usitatissimum*)
Gaseous exchange attributes

ABSTRACT

Flax (*Linum usitatissimum* L.) is one of the oldest predominant industrial crops grown for seed, oil and fiber. The present study was executed to evaluate the morpho-physiological traits, biochemical responses, gas exchange parameters and phytoextraction potential of flax raised in differentially copper (Cu) spiked soil viz (0, 200, 400 and 600 mg Cu kg^{-1} soil) under greenhouse pot experiment. The results revealed that flax plants were able to grow up to 400 mg kg^{-1} Cu level without showing significant growth inhabitation while, further inference of Cu (600 mg kg^{-1}) in the soil prominently inhibited flax growth and biomass accumulation. Compared to the control, contents of proline and malondialdehyde (MDA) were increased by 160.0% and 754.1% accordingly, at 600 mg Cu kg^{-1} soil level. The Cu-induced oxidative stress was minimized by the enhanced activities of superoxide dismutase (SOD) by 189.2% and guaiacol peroxidase (POD) by 300.8% in the leaves of flax at 600 mg Cu kg^{-1} soil level, compared to the untreated control. The plant Cu concentration was determined at 35, 70, 105 and 140 days after sowing (DAS) and results depicted that 16.9 times higher Cu concentration was accumulated in flax roots while little (14.9 times) was transported to the shoots at early stage of growth, i.e. 35 DAS. While at 140 DAS, Cu was highly (21.7 times) transported to the shoots while, only 12.3 times Cu was accumulated in the roots at 600 mg Cu kg^{-1} soil level, compared to control. Meanwhile, Cu uptake by flax was boosted up to 253 mg kg^{-1} from the soil and thereby extracted 43%, 39% and 41% of Cu at 200, 400 and 600 mg Cu kg^{-1} soil level, compared to initial Cu concentration. Therefore, study concluded that flax has a great potential to accumulate high concentration of Cu in its shoots and can be utilized as phytoremediation material when grown in Cu contaminated soils.

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https://doi.org/10.1016/j.jenvman.2019.109994
Received 20 September 2019; Received in revised form 27 November 2019; Accepted 11 December 2019

Chemosphere 248 (2020) 126032

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

Influence of phosphorus on copper phytoextraction via modulating cellular organelles in two jute (*Corchorus capsularis* L.) varieties grown in a copper mining soil of Hubei Province, China

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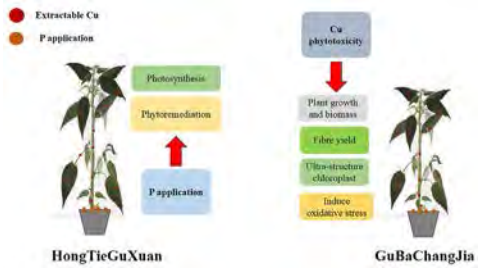
HIGHLIGHTS

- External application of P is pre-requisite for the better growth in jute under stress condition.
- The variety HongTieGuXuan was proved more tolerant as compared to GuBaChangJia.
- Application of P assisted phytoextraction of Cu in both jute varieties.
- Phytotoxicity of Cu destroy ultra-structure of chloroplast.
- Plant has strong antioxidant defence system to tolerate Cu-stress.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 14 December 2019
Received in revised form
20 January 2020
Accepted 24 January 2020
Available online 25 January 2020

Handling Editor: T Cutright

Keywords:
Fibrous crop

ABSTRACT

Soil in mining areas is typically highly contaminated with heavy metals and lack essential nutrients for plants. Phosphorus reduces oxidative stress, improves plant growth, composition, and cellular structure, as well as facilitates the phytoremediation potential of fibrous crop plant species. In this study, we investigated two jute (*Corchorus capsularis*) varieties HongTieGuXuan and GuBaChangJia cultivated in copper (Cu)-contaminated soil (2221 mg kg^{-1}), under different applications of phosphorus (0, 30, 60, and 120 kg ha^{-1}) at both anatomical and physiological levels. At the same Cu concentration, the tolerance index of HongTieGuXuan was higher than that of GuBaChangJia, indicating that HongTieGuXuan may be more tolerant to Cu stress. Although the normal concentration of P (60 kg ha^{-1}) in the soil improved plant growth, biomass, chlorophyll content, fibre yield and quality, and gaseous exchange attributes. However, high concentration of P (120 kg ha^{-1}) was toxic to both jute varieties affected morphological

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https://doi.org/10.1016/j.chemosphere.2020.126032

Ecotoxicology and Environmental Safety 189 (2020) 109915

Contents lists available at ScienceDirect

Ecotoxicology and Environmental Safety

journal homepage: www.elsevier.com/locate/ecoenv

Morpho-physiological traits, gaseous exchange attributes, and phytoremediation potential of jute (*Corchorus capsularis* L.) grown in different concentrations of copper-contaminated soil

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ARTICLE INFO

Keywords:
Fibrous crop
Metal stress
Phytoextraction
Oxidative stress
Cu uptake

ABSTRACT

Jute (*Corchorus capsularis* L.) is the most commonly used natural fiber as reinforcement in green composites and, due to its huge biomass, deep rooting system, and metal tolerance in stressed environments, it is an excellent candidate for the phytoremediation of different heavy metals. Therefore, the present study was carried out to examine the growth, antioxidant capacity, gaseous exchange attributes, and phytoremediation potential of *C. capsularis* grown at different concentrations of Cu (0, 100, 200, 300, and 400 mg kg^{-1}) in a glass house environment. The results illustrate that *C. capsularis* can tolerate Cu concentrations of up to 300 mg kg^{-1} without significant decreases in growth or biomass, but further increases in Cu concentration (i.e., 400 mg kg^{-1}) lead to significant reductions in plant growth and biomass. The photosynthetic pigments and gaseous exchange attributes in the leaves of *C. capsularis* decreased as the Cu concentration in the soil increased. Furthermore, high concentrations of Cu in the soil caused lipid peroxidation by increasing the malondialdehyde content in the leaves. This implies that elevated Cu levels cause oxidative damage in *C. capsularis*. Antioxidants, such as superoxidase dismutase and peroxidase, come into play to scavenge the reactive oxygen species which are generated as a result of oxidative stress. In the present study, the concentrations of Cu in different parts of the plant (the roots, leaves, stem core, and fibers) were also investigated at four different stages of the life cycle of *C. capsularis,* i.e., 30, 60, 90, and 120 days after sowing (DAS). The results of this investigation reveal that, in the earlier stages of the growth, Cu was highly accumulated in the belowground parts of the plant while little was transported to the aboveground parts. Contrastingly, at a fully mature stage of the growth (120 DAS), it was observed that the majority of Cu was transported to the aboveground parts of the plant and very little accumulated in the belowground parts. The results also show a progressive increase in Cu uptake in response to increasing Cu concentrations in the soil, suggesting that *C. capsularis* is a potential bio-resource for the phytoremediation of Cu in Cu-contaminated soil.

1. Introduction

In recent decades, rapid increases in urbanization and industrialization have caused the excessive release of heavy metals in farmlands with damaging effects on ecosystems (Bashir et al., 2018; Nguyen et al., 2017; Rehman et al., 2019). Heavy metal accumulation in soils is of great concern in agricultural production due to its adverse effects on food safety and marketability, crop growth due to phytotoxicity, and the environmental health of soil organisms (Chen et al., 2017; Muszyńska and Hanus-Fajerska, 2015; Nagajyoti et al., 2010; Rehman et al., 2019; Singh et al., 2010 Wang and Zhou, 2005). In China, more than 16.1% of agricultural land is being contaminated with various heavy metals and about 2.1% is contaminated by Cu (Chen et al., 2015). Soil is being polluted by high concentrations of Cu because

Abbreviations: ROS, reactive oxygen species; SOD, superoxide dismutase; POD, peroxidase

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https://doi.org/10.1016/j.ecoenv.2019.109915
Received 2 September 2019; Received in revised form 30 October 2019; Accepted 2 November 2019
Available online 10 November 2019
0147-6513/

Plant Physiology and Biochemistry 138 (2019) 121–129

Contents lists available at ScienceDirect

Plant Physiology and Biochemistry

journal homepage: www.elsevier.com/locate/plaphy

Research article

Influence of rice straw biochar on growth, antioxidant capacity and copper uptake in ramie (*Boehmeria nivea* L.) grown as forage in aged copper-contaminated soil

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ARTICLE INFO

Keywords:
Ramie
Copper
Immobilization
Biochar
Photosynthesis
Antioxidant capacity

ABSTRACT

Copper (Cu) contamination in agricultural soil poses severe threats to living organisms, and possible ecofriendly solutions need to be considered for Cu immobilization, such as using biochar. A pot study was conducted to examine the effectiveness of biochar derived from rice straw (RSB) at various application rates (0, 2.5, 5 and 10% w/w) to mitigate possible risks of Cu solubility and its uptake by ramie (*Boehmeria nivea* L.) as forage. The plant growth parameters as well as soil chemical properties (pH, electrical conductivity and cation exchange capacity) notably improved with the increasing RSB application. Moreover, prominent reduction was observed in soil bioavailable Cu concentration by 96% with RSB application of 10% relative to control. In addition, Cu content in *B. nivea* roots, leaves and stems decreased by 60, 28 and 22%, respectively, for 10% RSB application. It was noted that chlorophyll content and gas exchange parameters in leaves were significantly higher at 10% RSB application than in control. Furthermore, 10% RSB resulted in a greater reduction in oxidative stress from the Cu in soil. Thus, soil amendment with RSB demonstrated positive results for Cu stabilization in aged Cu-contaminated soil, thereby reducing its accumulation and translocation in *B. nivea* and mitigating livestock feed security risks.

1. Introduction

During recent decades, rapid increase in urbanization and industrialization has caused excessive release of heavy metals in farmlands with damaging effects on ecosystems (Lu et al., 2014). Release of heavy metals in farmlands from anthropogenic activities (e.g., wastewater irrigation, inadequate battery recycling practices and inappropriate use of pesticides and fertilizers) is a cause of global environmental pollution (Bashir et al., 2018b). Particularly, copper (Cu) is of important as a heavy metal pollutant but is also required as a micronutrient for crop production (Jiang et al., 2012a). However, high Cu concentrations in soils result in severe disorders in plant physiological and respiratory processes, which hinder plant growth (Chaffai et al., 2007; Zvezdanovic et al., 2007). The Cu toxicity level in plants is thought to be 20–30 mg kg^{-1} of dry mass (Marschner, 1995).

Ramie (*Boehmeria nivea*) is a fast growing perennial plant used in China as a source of bast fiber as well as nutritious green feed palatable to all classes of farm animals. Due to its high biomass production, high crude protein content and strong adaptability to different environments, cultivation of *B. nivea* could be an economically beneficial solution to fulfill the demand for fiber and feed in metal-contaminated areas. It is quite tolerant to Cu and can be grown as pioneer plant in mining areas to control heavy metal pollution (Min-fei et al., 2016). The stabilization of Cu in contaminated farmland will limit its buildup and translocation in aerial parts of *B. nivea* and so ensure animal food security but represents a big challenge. Several remediation techniques have been considered for Cu immobilization in farmland but *in situ* immobilization is the most important and economical approach

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https://doi.org/10.1016/j.plaphy.2019.02.021
Received 4 December 2018; Received in revised form 21 February 2019; Accepted 22 February 2019
Available online 01 March 2019

Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-018-4015-6

RESEARCH ARTICLE

Morpho-physiological traits, antioxidant capacity and phytoextraction of copper by ramie (*Boehmeria nivea* L.) grown as fodder in copper-contaminated soil

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Received: 1 August 2018 / Accepted: 17 December 2018

Abstract

Ramie (*Boehmeria nivea* L.), the oldest fiber crop in China, can also be grown as fodder crop because of its huge biomass production. Moreover, it has the potential to colonize heavy metal–contaminated soils which showed the possibilities of phytoremediation using *B. nivea*. Therefore, the present study was conducted to investigate the potential of *B. nivea* for phytoextraction of copper (Cu)-contaminated soil. Moreover, the impact of different concentrations of Cu on growth and antioxidant enzymatic activity by *B. nivea* were also studied. For this purpose, a pot experiment was conducted to examine the growth, antioxidative response, and localization (distribution) of Cu in *B. nivea* plant under different Cu concentrations (0, 50, 100, 200, 300, and 400 mg kg^{-1} soil). Results revealed that *B. nivea* tolerated up to 100 mg kg^{-1} Cu concentration without a significant decrease in biomass, but further increase in Cu concentration from 200 to 400 mg kg^{-1} exhibited a significant reduction in chlorophyll content, fresh and dry biomass, plant height, and number of leaves. It was further observed that *B. nivea* accumulated more Cu in roots (26 to 53 mg kg^{-1}), followed by the leaves (23 to 28 mg kg^{-1}) and stems (14 to 21 mg kg^{-1}), while the values for both bioaccumulation factor (BAF) and translocation factor (TF) at all treatments were less than 1. Moreover, activities of antioxidative enzymes (superoxide dismutase and peroxidase) were initially increased with the exposure of 50, 100, and 200 mg kg^{-1} Cu, but decreased by further increasing the Cu concentration to 300 and 400 mg kg^{-1} indicating the oxidative stress which is manifested by high malondialdehyde (MDA) and proline contents also. Thus, based on results, it can be concluded that *B. nivea* accumulated relatively low Cu contents in aboveground parts and could be grown as fodder crop for phytoremediation of Cu-contaminated sites.

Keywords Ramie (*Boehmeria nivea*) · Fodder crop · Cu stress · Cu uptake and accumulation · Antioxidant enzymes · Proline content

Responsible editor: Elena Maestri

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Introduction

The contamination of soil with heavy metals is a severe worldwide issue due to negative impacts of heavy metals on environmental safety (Wang et al. 2018). Anthropogenic activities such as industrial effluents, mining, and sewage sludge as well as fertilizers and pesticides application are the major sources of heavy metal accumulation in soils (Nagajyoti et al. 2010; Gallego et al. 2012). Therefore, different food and fodder crops grown on metal-contaminated soil can accumulate high concentration of metals that poses a severe threat to the human and animal health (Rattan et al. 2005; Kulhari et al. 2013). For instance, Rajaganpathy et al. (2011) revealed that agricultural land contamination with heavy metals is a very serious concern for livestock production systems.

Published online: 06 January 2019

SCIENTIFIC REPORTS

OPEN

Interactive effect of gibberellic acid and NPK fertilizer combinations on ramie yield and bast fibre quality

Received: 6 April 2017
Accepted: 26 July 2017
Published online: 06 September 2017

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Understanding the effects of different combinations of nitrogen (N), phosphorus (P) and potassium (K) fertilizers and the effects of GA_3 (gibberellic acid) foliar spray on the fiber quality and yield of ramie are important for maximizing the economic value of these plants. Three pot experiments were conducted using low NPK (140:70:140 kg/ha), normal NPK (280:140:280 kg/ha), and low NPK + GA_3 (10 mg/L) treatments. In each experiment, following fertilizers were applied: no fertilizer (control), N, P, K, NP, NK, PK, and NPK. Ramie was harvested three times from each plant; ramie grown without fertilizers had significantly lower biomass and yield than plants grown with fertilizers. At both normal and low fertilization rates, application of NPK resulted in greater growth and yield than application of N, P, K, NP, NK, or PK. Unfertilized plants produced the thinnest fibres (22-24 µm), with lowest elongation rate (3.0–3.1%) and breaking strength (22.7–23.3 cN). Fibre yield and fibre quality were improved by application of GA_3 + fertilizers. Maximum fibre yield was obtained at low NPK + GA_3 treatment, resulting in 65–81% more yield than low NPK alone. GA_3 with low NPK treatment significantly improved fibre diameter, fibre elongation, and breaking strength compared to both NPK alone and control treatment.

An important aspect of agriculture is the cultivation of plants for food, fiber, biofuel, medicine and other products used to sustain and enhance human life. Agriculture was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that nurtured the development of civilization[1–4]. In response to the current ecological and environmental problems, the textile industry has increased its demand for eco-friendly natural fibres. Additionally, the use of fully biodegradable "green" composites made from vegetable fibres and non-woody plant fibres for paper production may help to mitigate global warming[5]. Bast (phloem) fibres are a considerable source of commercial fibres and are obtained from crops such as *Linum usitatissimum* (flax), *Cannabis saliva* (hemp), *Corchorus capsularis* (jute), *Hibiscus cannabinus* (kenaf), and *Boehmeria nivea* (ramie). Ramie or China grass (*Boehmeria nivea* (L.) Gaud.) is a perennial herbaceous plant, mainly grown in China and other Asian countries. The fibres obtained from ramie plants are the longest known plant fibres in nature and attain a length of more than 550 mm[6,7]. Ramie fibre has high strength, good durability, moisture absorbance capacity, and high lustre. These characteristics have made ramie fibre suitable for use in the manufacture of a wide variety of textiles and cordage products. Ramie can be blended with other natural and synthetic fibres, including cotton, silk, wool, polyester, and flax[8,9]. However, despite the remarkable qualities of this fibre, ramie has received comparatively little attention as an important world crop. However, commercial cultivation of this crop has recently increased in countries such as China, Brazil, and the Philippines[10].

Yield and fibre quality are the most important factors to consider in ramie production. As the bast fibre from ramie is extracted from the outer part of the stem, the fibre yield is dependent on the biomass, length, diameter, and thickness of the stem. Fibre from ramie is normally harvested between three and six times each year with an average annual yield of nearly 1200–1800 kg ha^{-1} of fibre[11]. Due to the plant's robust growth and biomass production, the fibre yield of ramie is highly dependent on the availability of soil nutrients. According to Hiroce *et al.*, ramie plants cannot continue to grow without fertilizers after they reach 60 days of age[12]. The application of

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Planta (2014) 239:1175–1186
DOI 10.1007/s00425-014-2040-3

ORIGINAL ARTICLE

Comparative proteome analysis of the response of ramie under N, P and K deficiency

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Received: 18 October 2013 / Accepted: 3 February 2014 / Published online: 27 February 2014

Abstract Ramie is an important natural fiber. There has been little research on the molecular mechanisms of ramie related to the absorption, utilization and metabolism of nitrogen (N), phosphorus (P) and potassium (K). One approach to reveal the mechanisms of N, P and K (NPK) utilization and metabolism in ramie is comparative proteome analysis. The differentially expressed proteins in the leaves of ramie were analyzed by proteome analysis after 6 days of N- and K-deficient treatments and 3 days of P-deficient treatment using MALDI-TOF/TOF mass spectrometry and 32, 27 and 51 differential proteins were obtained, respectively. These proteins were involved in photosynthesis, protein destination and storage, energy metabolism, primary metabolism, disease/defense, signal transduction, cell structure, transcription, secondary metabolism and protein synthesis. Ramie responded to NPK stress by enhancing secondary metabolism and reducing photosynthesis and energy metabolism to increase endurance. Specifically, ramie adapted to NPK deficiency by increasing signal transduction pathways, enhancing the connection between glycolysis and photosynthesis, promoting the intracellular flow of carbon and N; promoting the synthesis cysteine and related hormones and upregulating actin protein to promote growth of the root system. The experimental results provide important information for further study on the high-efficiency NPK utilization mechanism of ramie.

Keywords Comparative proteome analysis · NPK stress · Ramie · Stress resistance

Abbreviations

2-DE	Two-dimensional gel electrophoresis
CHAPS	3-[(3-cholamidopropyl) dimethylammonio] propanesulfonic acid
DTT	Dithiothreitol
HSP	Heat shock protein
IAA	Iodoacetamide
IEF	Isoelectric focusing
IPG	Immobilized pH gradient
MALDI	Matrix-assisted laser dissociation ionization
MS	Mass spectrometry
PMSF	Phenylmethanesulfonyl fluoride
pI	Isoelectric point
ROS	Reactive oxygen species

G. Deng and L.J. Liu contributed equally to this work.

Electronic supplementary material The online version of this article (doi:10.1007/s00425-014-2040-3) contains supplementary material, which is available to authorized users.

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OPEN ACCESS Freely available online

PLOS ONE

A Proteomics Sample Preparation Method for Mature, Recalcitrant Leaves of Perennial Plants

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Abstract

Sample preparation is key to the success of proteomics studies. In the present study, two sample preparation methods were tested for their suitability on the mature, recalcitrant leaves of six representative perennial plants (grape, plum, pear, peach, orange, and ramie). An improved sample preparation method was obtained: Tris and Triton X-100 were added together instead of CHAPS to the lysis buffer, and a 20% TCA-water solution and 100% precooled acetone were added after the protein extraction for the further purification of protein. This method effectively eliminates nonprotein impurities and obtains a clear two-dimensional gel electrophoresis array. The method facilitates the separation of high-molecular-weight proteins and increases the resolution of low-abundance proteins. This method provides a widely applicable and economically feasible technology for the proteomic study of the mature, recalcitrant leaves of perennial plants.

Citation: Gang D, Xinyue Z, Na Z, Chengying L, Bo W, et al. (2014) A Proteomics Sample Preparation Method for Mature, Recalcitrant Leaves of Perennial Plants. PLoS ONE 9(7): e102175. doi:10.1371/journal.pone.0102175

Editor: Joshua L. Heazlewood, Lawrence Berkeley National Laboratory, United States of America

Received January 16, 2014; **Accepted** June 17, 2014; **Published** July 16, 2014

Funding: This research was supported by a grant from National science and technology support (2010BAD02B01), the National Natural Science Foundation of China (31000731) and China Agriculture Research System (CARS-19-E12). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

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Introduction

The study of proteomes is based on the qualitative and quantitative identification of proteins, their intracellular localizations and their interactions through separation and identification. The objects of study are usually total protein lysates or a subfraction thereof from cells, tissues or organs [1]. Cells maintain homeostasis through different protein functions. Alterations in environmental conditions (pathology, drought stress, salt stress, etc) result in differential accumulation of proteins. Therefore, the identification of these alterations in protein accumulation or expression can provide important information for the study of related physiological processes [2].

Two-dimensional gel electrophoresis (2-DE) is commonly used for the separation of thousands of proteins from plant tissues [3]. The success of proteomics studies on different organs and plants depends on the protein sample preparation of the materials [4]. This is especially important for differential proteomics, which focuses on the slight differences in protein abundance between treatment and control groups, the selection of an appropriate method is key for obtaining reliable experimental results [5]. The wide range of biochemical properties of proteins (such as isoelectric point, expression abundance, solubility etc) can compromise the extraction of the full proteome depending on the specific extraction method. Thus, there are few sample preparation methods that can be used simultaneously in different species and organs [2]. Plant cells contain large quantities of nonprotein substances such as polysaccharides, lipids, and organic acids [6]. While the plant cell wall is comprised of large amounts of cellulose and pectin and can have a rigid secondary cell wall due to lignification of mature cells. These substances have a significant influence on the quality of protein extracts and consequently on the results of two-dimensional gel electrophoresis [7,8,9].

Optimal protein sample preparation is required to efficiently remove nonprotein substances from the sample tissues, and methods must be adapted to different plant organs and species [4]. However, the sample preparation methods currently in common use are often not applicable to a range of plants and tissue. Sample preparation for proteomics is often applied to young and tender plant tissues [10]; the preparation of mature organs is relatively rare. Reports on the application of two-dimensional gel electrophoresis to mature tissues do exist, but the research is mainly focused on annual plants, including the mature seeds of *Lupinus albus* [11], *A. thaliana* [12], *Arachis hypogaea* [13], and *Triticum aestivum* [14,15]; the mature leaves of *Lathyrus sativus* [16] and *Oryza sativa* [17]; and the mature pollen of *A. thaliana* [18], *Oryza sativa* [10], and *Zea mays* [19]. Mature leaves are generally less sensitive to drought stress compared to juvenile leaves [20]. Furthermore, mature leaves are more developed and have the ability to better respond to plant diseases, insect pests, nutritional stress and etc. [21]. However, little research has thus far been conducted on the application of proteomics to the mature organs (especially leaves) of perennial plants. A simple, economical, and reliable method for protein sample preparation from various plants has not yet been established. The work presents a sample preparation method for two-dimensional gel electrophoresis of mature, recalcitrant leaves of perennial plants using the

文章编号:1001-9731(2019)07-07176-06

苎麻纤维水泥基材料的力学性能与自收缩试验研究*

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摘 要: 通过在水泥基材料中掺入苎麻纤维,并对比掺入钢纤维和聚丙烯纤维,研究苎麻纤维对水泥基材料抗压强度、抗折强度、自收缩及电阻率的影响。结果表明,当苎麻纤维掺量分别为 0.4%,0.9%时,水泥基材料 7 d 自收缩降低 13.4%,30.8%,28 d 抗压强度分别提高 2.2%和 8.2%,抗折强度则提高 9.6%,13.4%;钢纤维与聚丙烯纤维显著提高了水泥基材料 7 与 28 d 的抗压和抗折强度,而苎麻纤维更有利于水泥基材料早期自收缩的降低;随着苎麻纤维掺量的增加,水泥基材料的 7 d 自收缩与 3 d 电阻率显著减小,二者呈线性相关。

关键词: 水泥基材料;苎麻纤维;力学性能;自收缩;电阻率

中图分类号: TU528 **文献标识码:** A DOI:10.3969/j.issn.1001-9731.2019.07.032

0 引 言

苎麻纤维是一种纤维素含量极高的天然纤维[1],具有很高的弹性模量和拉伸强度[2],表面有细长的空洞和裂纹,具有良好的吸水导湿性[3]和较强的耐磨性[4],被称为“天然纤维之王”。从建筑材料领域来讲,植物纤维与金属纤维、合成纤维相比,拥有价格低廉、节能环保等优势。已有学者对植物纤维在水泥混凝土中的应用进行了一系列探索,如剑麻纤维、黄麻纤维的掺入能提高混凝土的力学性能[5-7]。史建丽[8]研究发现,苎麻纤维水泥基材料随着龄期的增大,抗折强度有所降低,抗压强度则会增大。潘志伟等[9]将极低含量的苎麻纤维引入环氧树脂-混凝土,增强了抗弯强度。此外,天然纤维复合材料在环境影响方面优于合成纤维复合材料[10]。

对于水泥基材料来说,水胶比是影响纤维粘结力大小的重要因素,合成纤维、金属纤维与水泥砂浆的粘结强度随着水泥基材料强度的增加而相应提高[11-12]。但有研究表明[13],在低水胶比条件下,水泥基材料水化不充分,孔隙压力大,容易出现连通的大毛细孔和微裂纹等问题,特别是毛细管压力影响水泥基材料自收缩大小而引起其体积稳定性问题,是影响工程应用的重要因素。对于纤维来说,纤维良好的吸水导湿性是纤维与基体粘结的必要前提[14],苎麻纤维的吸水导湿性可使纤维表面湿润性不足而导致界面缺陷,引起应力集中而导致破坏。然而,植物纤维在高碱性环境下具有生物降解性[15]从而影响纤维水泥基复合材料的性能,可采用火山灰材料取代水泥以降低碱性,从而改善植物纤维增强水泥性能[16]。

本文用粉煤灰、硅灰等代替部分水泥,在低水胶比的水泥基材料中掺入苎麻纤维,对比掺入钢纤维、聚丙烯纤维时的抗压强度、抗折强度、自收缩和电阻率变化规律。

1 实 验

1.1 原材料与配合比

水泥为亚东公司生产的洋房牌 P·Ⅱ52.5 级硅酸盐水泥;硅灰采用四川朗天公司的高密硅灰;粉煤灰为苏州粉煤灰厂Ⅰ级 F 类粉煤灰,28 d 强度活性指数为 80%,原材料化学成分如表 1。

表 1 原材料的化学成分(质量分数,%)

Table 1 Chemical compositions of raw materials (wt%)

原材料	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	SO_3	LOI
水泥	20.45	3.73	3.33	63.12	2.67	0.63	0.08	3.00	2.81
硅灰	93.67	0.33	0.32	0.21	0.35	0.34	0.13	0.73	3.86
粉煤灰	55.64	21.65	8.49	4.78	1.31	1.26	0.36	0.38	6.11

砂采用河砂,细度模数为 2.54;武汉三源特种建材公司生产的聚羧酸类高性能减水剂,其减水率为 40%,掺量为胶凝材料的 0.8%(质量分数);植物纤维采用湖北省苎麻纤维(RF),长 14~16 mm;四川阜阳亿富公司生产的镀铜微丝钢纤维(SF),直径 0.18~0.22 mm,长 11~13 mm,极限抗拉强度>2 800 MPa;合成纤维为湖南长沙汇祥公司生产的聚丙烯纤维(PPF),长 11 mm,极限抗拉强度>490 MPa。纤维水泥基材料

* 基金项目:国家自然科学基金资助项目(51608402);国家麻类产业技术体系资助项目(CARS-12-E16)
收到初稿日期:2019-01-17 收到修改稿日期:2019-04-24 通讯作者:刘立军,E-mail:Liulijun@mail.hzau.edu.cn
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文章编号: 1671 - 3532(2019)05 - 0199 - 06

高锰酸钾处理对苎麻嫩枝水培生根特性的影响

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摘　要: 为寻求苎麻嫩枝扦插的最佳消毒方式,试验设置 1‰高锰酸钾($KMnO_4$)浸泡插穗消毒处理(D_1: 浸泡深度 0.5 cm,时长 5 h; D_2: 浸泡深度 3 cm,时长 5 h),并以传统方法(CK: 0.1‰高锰酸钾浸泡深度 5 cm,时长 72 h)为对照,进行苎麻嫩枝水培扦插试验,分析了不同消毒处理对不定根形成时期、生根率、生根量、根长等根系性状的影响。结果表明: 高锰酸钾处理对苎麻扦插生根影响显著,D_1 处理不定根形成期提前 1 天,生根率、生根量、根长等显著高于 D_2 处理; CK 与 D_1 处理相比,生根效果较好,差异不显著,但易出现高位不定根,基部腐烂等问题。各处理显著影响苎麻插穗根干重($D_1 > CK > D_2$),但对茎、叶干重无显著影响。D_1 处理直径 0 ~ 0.5 mm 分级根根长最长,根尖数最多; 直径 0.5 ~ 1.0 mm 分级根根体积最大,根表面积最大。总体评价 D_1 处理效果最佳。

关键词: 苎麻; 水培生根; 根系性状
中图分类号: S563.1　　**文献标识码:** A

Effects of Potassium Permanganate on Root Traits of Ramie Shoots under Hydroponic Culture

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Abstract: In order to find the best disinfection method for the cuttings of ramie, a water - cultured cutting experiment was carried out by soaking the cuttings with 1‰ potassium permanganate ($KMnO_4$) (D_1: immersion depth 0.5 cm, 5 h; D_2: immersion depth 3 cm, 5 h), with traditional method (CK: 0.1‰ $KMnO_4$ immersion depth 5 cm, 72 h) as the control, and root traits were studied by integrating adventitious root formation period, rooting rate, rooting amount, root length and other indicators. The results showed that potassium permanganate treatments had significant effects on ramie cuttage rooting. Adventitious roots were formed 1 d earlier and rooting rate, rooting amount and root length were significantly higher under D_1 treatment than those treated with D_2. Compared with D_1 treatment, CK had better rooting effect, but the difference was not significant and it was prone to accompanied by higher adventitious roots position, base rot and other problems. The root dry weight of ramie cuttings was significantly different in each treatment ($D_1 > CK > D_2$), but the stem and leaf dry weight were not significantly affected. The plant had the longest root length and most root tips at φ 0 ~ 0.5 mm level and largest root volume and root

收稿日期: 2019 - 04 - 16
基金项目: 国家重点研发计划(2018YFD0201100); 国家麻类产业技术体系(CARS - 16 - E10)
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7. 其他成果

农业部文件

农科教发〔2017〕10号

农业部关于印发现代农业产业技术体系聘用人员名单(2017-2020年)的通知

各省、自治区、直辖市及计划单列市农业(农牧、农村经济)农机、畜牧、兽医、农垦、农产品加工、渔业(水利)厅(局、委、办),新疆生产建设兵团农业局,有关单位:

根据《农业部 财政部关于印发<现代农业产业技术体系建设实施方案(试行)>的通知》(农科教发〔2007〕12号)精神,在认真总结"十二五"现代农业产业技术体系(以下简称"体系")建设和运行工作基础上,根据"十三五"我国现代农业发展和农业供给侧结构性改革对科技的新需求,我部组织开展了"十三五"体系建设

工作。按照遴选条件、遴选程序，确定了50个产业技术研发中心、299个功能研究室和1252个综合试验站，聘请了50名首席科学家、1370名岗位科学家和1252名站长。

现将《现代农业产业技术体系聘用人员名单（2017-2020年）》予以印发。

中华人民共和国农业部

农　业　部

2017年6月13日

现代农业产业技术体系
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