ISA

Sanrui
三瑞农科

2018 International Symposium on Confection Sunflower Technology and Production
2018年世界向日葵产业发展论坛

Symposium Abstracts
论坛文集

Wuyuan, China
August 8–10, 2018

中国·五原
2018年8月8–10日

主办单位
Sponsors

国际向日葵协会

The International Sunflower Association, Paris, France

中国食品工业协会坚果炒货专业委员会（中国葵花联盟）

The Specialized Committee for Nuts and Roasted Seeds of China National Food Industry Association (The Chinese Sunflower Network), China

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The People's Government of Bayannoer Municipality, Inner Mongolia, China

内蒙古自治区旅游发展委员会

Tourist Development Council of Inner Mongolia Autonomous Region, China

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Inner Mongolia, China

三瑞农业科技股份有限公司

Sunrise Agritec Co.,Ltd., Wuyuan, Inner Mongolia, China

中国食葵种业创新领导企业——三瑞农科

企业简介

三瑞农业科技股份有限公司成立于2010年，专注于食葵种子的选育、生产、推广、销售和技术服务等工作，是中国食葵种子行业“育繁推”一体化的现代种业公司。公司下设北京三瑞农科、甘肃三瑞农科两个全资子公司，内蒙古三瑞食品一个参股子公司。

多年来，三瑞农科以科技创新作为第一发展战略，引领了中国向日葵产业品种杂交化和品质化两次技术革命。公司成立了中国首家向日葵专业性技术研究机构——三瑞农科向日葵技术研究院；建有甘肃育种基地和海南测试基地，在新疆建有3万亩制种基地，拥有专业化的育种制种团队；广泛收集3000多份国内外优质向日葵种质资源，建成了国内规模最大的现代化向日葵种质资源库；聘请了国内外优秀育种科学家到研究院任职；成立了抗列当、抗菌核病、分子育种三大科技攻关研发团队；在分子辅助育种、品种抗性研究、病虫草害防治等领域，已取得重大突破。

公司成功研发、拥有自主知识产权的SH363、SH361、三瑞3号等优质食葵品种，科技含量高，市场效益好，全国市场占有率近三年达37%以上。近三年，农民种植该系列品种的平均亩收益，比国内外其他主流品种，亩均增收300—800元，部分地区亩均增收可高达500—1500元，为全国百万葵农年均增收15亿元，为中国乃至世界向日葵产业带来了颠覆性变革。

公司及个人近三年年均纳税3000万元以上，每年出资参加各种社会公益和帮扶救助活动。2016年，三瑞农科在全国中小企业股份转让系统（简称“新三板”）挂牌，股票名称：三瑞农科；股票代码：836645；连续两年入选新三板创新层。2017年，三瑞农科与隆平高科达成战略合作，隆平高科成为三瑞农科的控股股东。战略合作将助推杂交食葵、籽用西葫芦、高粱、水稻及其他北方高附加值经济作物的市场拓展，让科技发展的红利惠及、造福全产业链的参与者。

目前，公司在科研水平、品种优势、市场份额、社会贡献、企业效益及品牌价值等方面居行业领先，已成为中国食葵种子行业的创新型领导企业。

》企业文化

企业宗旨： 服务农民　成就自我

发展理念： 诚信 创新　共赢

企业使命： 振兴民族种业　引领产业发展

奋斗目标： 创建百年企业 打造世界向日葵产业中心

企业精神： 追求卓越 敢为人先 创新超越 引领未来

企业道德： 诚信守信 公平竞争 质量上乘　环保安全

》发展战略

未来，三瑞农科将以三大发展战略为统领，努力将公司建设成为“百年企业”，将中国打造成为世界向日葵产业中心。

一是继续把科技创新作为第一发展战略，在新品种研发上取得重大突破。瞄准当前制约向日葵产业发展的突出问题，加大科研投入和研发力度，研发培育抗列当、抗菌核病、抗水锈等食葵新品种，为广大种植户提供高产、高抗、优质的食葵种子。争取用两年左右时间，在抗菌核病、抗水锈等新品种研发方面取得新突破，争取在3-4年内，研发出食葵健康营养品种，让消费者在享受食葵香甜酥脆口感的同时，还能补充人体所必须的氨基酸、维生素等有益成分，引领向日葵产业第三次技术革命——品种健康化的发展。

二是要全面实施精准服务战略，提高种植户种植管理水平，提升向日葵的商品品质。每年培训农民不少于3万人，将种植、田间管理和插盘晾晒收获等技术传授给种植户。同时，建立完善的省、县、乡、村四级技术信息服务网络，配备专职技术人员深入田间地头，开展全过程专业化技术服务，不断提高种植管理水平，种出优质、高端的食葵商品，依靠品质提高种植收益。

三是实施品牌提升战略。2017年，三瑞农科战略性引入世界种业巨头隆平高科。通过强强联手，打造三瑞全新品牌。同时，公司将积极开展品牌的宣传工作，创建河套食葵绿色品牌，以品牌建设提升向日葵产业上档升级，形成品牌效应，实现向品牌要效益。

我们的目标就是要以河套地区为中心，辐射带动全国向日葵产业绿色健康发展，把中国打造成为世界向日葵产业中心，实现农民增收、企业壮大、产业增效、经济发展、多方共赢！

洽洽 ChaCha 华葵 HUA KUI

洽洽食品股份有限公司简介

公司成立于2001年8月9日，位于中国合肥市国家级经济技术开发区，主要生产坚果炒货类、焙烤类等休闲食品。洽洽系列产品口味独特，品类丰富，有洽洽香瓜子、蓝袋、小而香、咯吱脆、怪U味、好南仁、喜悦、每日坚果等众多家喻户晓的全国知名产品，公司营销网络健全，产品不仅畅销全国各省市，更出口远销东南亚、欧美等30多个国家和地区，深受全世界各地消费者喜爱。

经过多年的发展，“洽洽”已成长为中国坚果炒货行业的领军品牌。洽洽食品通过技术创新和营销创新，将民族传统食品发展成集规模化、产业化、机械化和信息化为一体的现代化食品工业，引领了中国坚果炒货行业的整体发展，为行业的发展做出了巨大的贡献。

2011年3月2日，洽洽食品在深圳交易所挂牌上市，企业发展迎来了更广阔的空间。2013年8月，洽洽收购江苏恰康股份有限公司60%的股权，正式进军调味品行业。

2014年8月1日，洽洽食品成立味乐园电商公司，自营和分销及020渠道网络逐步完善，洽洽已经真正成为“互联网+”食品企业！

展望未来，洽洽将秉承“有华人的地方就有洽洽”的品牌理念，发扬“客户价值、绩效为要、奋斗卓越”的价值观，为实现“创世界知名品牌，建世界一流企业”的宏伟目标而奋斗不止。



五原农商银行
WUYUAN RURAL COMMERCIAL BANK

内蒙古五原农村商业银行股份有限公司简介

五原农商银行是经中国银行业监督管理委员会批准，在原五原县农村信用合作联社的基础上改制成立的股份制商业银行，于2013年11月8日正式挂牌开业，注册资本20773万元人民币。

五原农商银行经过60余载不断自励自新、砥砺奋进，如今已发展成为拥有29个营业网点和390余名在岗员工的县域内规模最大的金融机构。

作为联系广大群众的“金融纽带”和扶持县域经济发展的主力军，五原农商银行将不断践行“信立五原、助力农商”的社会承诺，争创新业绩，实现新跨越，为县域经济的发展做出新的更大的贡献。

五原农商银行是咱老百姓的贴心银行

巴彦淖尔市三胖蛋食品有限公司简介

巴彦淖尔市三胖蛋食品有限公司始建于2010年，独立法人，经营项目有农副产品收购、加工销售为一体的多元化的民营企业。

公司位于巴彦淖尔经济技术开发区中小企业创业园，占地面积13830平方米，办公面积2000平米，车间厂房7200余平米，公司成立以来，已打造一支懂经营、会管理、高素质的管理团队，投资流水线全自动化生产设备240多万元，为打造巴彦淖尔是炒货食品的龙头企业奠定了良好的基础。

公司主经营产品中端原味瓜子和高端原味瓜子，颗粒饱满、色泽光亮、皮薄仁香。从原料的选购、化验、筛选、炒制、二次手选、包装等要经过十四道流程，层层把关。三胖蛋原味瓜子保持传统炒货手法，通过最新工艺调配，使得普通的原味瓜子，具有了入味、香酥、不脏手、不上火、不发胖等诸多的特点。做瓜子我们更专业，河套地区昼夜温差大，使得本地葵花籽具有独特的香味；不放任何添加剂，保持瓜子特有的香味，公司贯彻踏踏实实做事，清清白白做人的价值观，做良心企业，品舌尖美味。有阳光的地方就有三胖蛋原味瓜子，是每一个人一生中必吃的原味瓜子。

公司以专业价值、铸一流品质，作为企业发展的经营理念，以弘扬河套瓜子文化为使命，以质量求生存、以效益求发展，全面打造有特色的知名品牌。努力将公司打造成为管理科学、运作有序、诚实守信、开拓进取、务实创新、效益优良的民营企业。为广大消费者提供绿色食品。

Golden Lily Seed

酒泉希望种业有限公司

酒泉希望种业有限公司是一家专业研发籽用西葫芦品种和销售国外进口洋葱种子的科技型种业企业。

自1998年开始研究南瓜西葫芦作物的育种，先后育成了“瑞丰九号、瑞丰八号、希望九号、希望3000、希望骄子、中国梦”等十余个品种，这些品种都成为了种植户和收购加工出口商追捧的对象，改变了国内打籽葫芦种植区的种植结构，成为打籽葫芦行业的划时代品种，也成了同行业争逐模仿的对象，但“一直被模仿、从未被超越”，在几年的推广销售中得到广大农民朋友的高度认可和好评，销售区域遍布东北、内蒙古、甘肃、新疆等省市，给广大农民朋友带来显著的经济效益。　由于公司的良好业绩，公司的产品被中国中轻产品保障中心评为“中国著名品牌”。

酒泉希望种业有限公司还是一个专业销售国外进口洋葱种子的公司，从事引进美国的洋葱品种，在中国进行实验示范，推广和销售等方面的工作，从而为专业洋葱进出口企业，规模种植客商以及广大农民提供优质的各类洋葱品种。我们已经做到品种与世界同步，还有一个由洋葱专家组成的知识团队，对洋葱的种植，病虫害预防，商品鲜销市场预测进行共同探讨。

公司的经营宗旨是“因为专业、所以放心”，与经销商的合作始终坚持“长期、高效、稳定、多赢”的原则，我们坚持探索市场，了解市场，跟进市场，科学定位产品，公司发展本着以市场为导向，以服务为根本，以质量为生命的理念，全力推出符合农民朋友需求和渴望的新一代系列优质产品，在不断推出新品种的同时，我们也将和大家积极探索栽培创新模式以及更广阔的产品功能开发，为籽用西葫芦产业的发展做出自己的贡献，也竭诚欢迎志同道合的朋友们加入到我们的团队，共同创造籽用葫芦新时代，同时讨论未来洋葱产业的发展。

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Foreword to the "International Confection Sunflower Symposium"

On August 8, 2018, the countryside of China is enjoying crisp fall weather and the sunflower is in full bloom. Fittingly, the International Symposium on Confection Sunflower Technology and Production is being held at Wuyuan County, Inner Mongolia, China. Domestic and international sunflower organizations, expert research scientists of the international sunflower community, and representatives of the roasting industry and international marketing and mechanical manufacturing from 16 countries have been invited to join with prominent local political and business figures to discuss future development of the sunflower industry together.

Wuyuan County is known as the "hometown of sunflower," and is the center of the Chinese sunflower industry. Appropriately, "Wuyuan Sunflower" has received trademark certification of China geographical indications. In recent years the Chinese sunflower seed industry, represented by Sunrise Agritec Co., Ltd. in Wuyuan County, has been constantly innovating and completed two technological revolutions of hybrid variety and improved quality of Chinese sunflower. The Chinese confection sunflower is at the forefront in terms of scientific research, variety advantages, planting area, export quantity, and the number of employees. These desirable accomplishments have contributed wisdom and strength to the great revolution of the international sunflower industry.

The Sunrise Agritec Co., Ltd. has systematically and comprehensively edited, translated, and organized this abstract booklet covering the latest scientific and technological accomplishments in the fields of sunflower broomrape, *Sclerotinia*, breeding, production and processing, and marketing and export.

This Symposium booklet represents the accumulated achievements of leading experts and scholars of the international sunflower industry. It

shares the experiences of researchers and processors, and the wisdom of the international sunflower industry. It will provide valuable experience and new ideas to colleagues aspiring to further development of the sunflower industry in the world, and will significantly contribute to the promotion of new directions for the international sunflower industry.

International Sunflower Association

Sunrise Agritec Co. Ltd.

August 8, 2018

《世界向日葵论坛文集》序言

2018 年 8 月 8 日，中国大地秋高气爽、葵花盛开。世界向日葵产业发展论坛在中国五原盛大召开。国内外行业协会、世界向日葵产业界的尖端科研专家、种业企业及炒货剥仁、外贸出口和机械制造企业等来自全球 16 个国家和地区的嘉宾，和政商名流齐聚一堂，共话世界向日葵产业发展大计。

五原县素有“葵花之乡”的美誉，是中国向日葵产业基地，“五原向日葵”通过了中国地理标志证明商标认证。近年来，以三瑞农科为代表的中国向日葵种业公司，以五原县为中心，不断创新引领，完成了中国向日葵产业品种杂交化和品质化两次技术革命，在科研水平、品种优势、种植面积、出口数量、从业人数等方面位居领先水平，为世界向日葵产业的大变革贡献了智慧与力量。

三瑞农业科技股份有限公司对本次论坛中发布的向日葵列当、菌核病、科研育种、生产加工、商贸出口等最新科技前沿成果进行了全面系统的整理、归纳，编辑形成了本册文集。

本册文集是世界向日葵产业顶尖专家学者的心血积累，是产业实践者的经验共享，更是世界向日葵产业发展的智慧结晶，它也将对全世界无数热心向日葵产业发展的业界同仁提供宝贵的经验与思路，为推动世界向日葵产业实现新发展作出巨大贡献。

国际向日葵协会

三瑞农业科技股份有限公司

2018 年 8 月 8 日

2018 International Symposium on Confection Sunflower Technology and Production

Date: August 8-10, 2018
Location: Wuyuan, Inner Mongolia, China
About the Symposium: The "International Symposium on Confection Sunflower Technology and Production" will host over 100 leading experts for a 2-day discussion focusing on sunflower science, technology, marketing and production in Wuyuan, Inner Mongolia. It is the first and largest international symposium primarily for confection sunflower.

Program Overview

Registration

Registration is open from June 20, 2018 through August 10, 2018
(contact: Jiuhuan Feng, jiuhuan.feng@sunriseseed.com)
Registration is free for all participants
All scientific sessions and field trips are open to all attendees
All meals including lunch and dinner during the meeting are provided

Poster and Abstracts

All participants are invited to submit posters, which can be printed in Wuyuan if you send us your posters before **July 25**. The available space for each poster is 1 m x 1.2 m. Please provide both PDF and PowerPoint documents.
Abstracts of posters and oral presentations must be submitted via email to Jiuhuan Feng (jiuhuan.feng@sunriseseed.com) by **July 25**, and will be reviewed by the scientific committee. Abstract should be prepared following the instructions below:

Abstract Features

Title	Font Times New Roman, bold, size 12, UPPERCASE centered;

Author	Font Times New Roman, size 12; mark the corresponding author with an asterisk, name (s) and surname (s) of the authors set below the title;
Abstract Text	Font Times New Roman, size 12; limited to 500 words maximum;
Key Words	Font Times New Roman, size 12, limited to 5 words.

Tuesday, August 7, 2018

Registration (Zidong Hotel, Wuyuan**)** 08:00-20:00

Wednesday Morning, August 8, 2018 Opening Ceremony (Sunflower Square)

08:00-08:30	Opening Speech
08:30-10:00	Visiting Sunflower Expo Garden
10:30-11:30	Visiting Hetao Agricultural Museum
11:30-12:30	Lunch Buffet **(**Zidong Hotel, Wuyuan**)**

Wednesday Afternoon, August 8, 2018 City and Field Tours (Wuyuan)

14:30-15:10	Visiting Wuyuan Sunflower Expo Museum of China
15:10-15:40	Visiting Dafeng Grain and Oil Company
15:40-16:40	Visiting Hetao E-commerce Industrial Park，Agricultural Museum
16:40-17:30	Visiting Sunflower Technology Institute, Sunrise Agritec Co., Ltd.
17:30-18:30	Visiting Lianxing New Village
19:00-	Banquet (Zidong Hotel, Wuyuan)

Thursday Morning, August 9, 2018

Session 1: Sunflower Production and Processing (Zidong Hotel, Wuyuan)

Session Chair：Dr. Brady Vick (Former Research Leader of Sunflower Research Unit, USDA-ARS, Fargo, USA)

08:00-08:15 Opening Speech-Wuyuan County Governor
08:15-08:30 Opening Speech- Bayannoer City Governor
08:30-08:45 Opening Speech-Dr. Etienne Pilorge (ISA Secretary-Treasurer): ISA the world Community of Sunflower R&D
08:45-09:00 Opening Speech- The Chinese Sunflower Network
09:00-09:15 Opening Speech-Longping High-Tech
09:15-09:45 Dr. John Swanson: National Sunflower Association (NSA) and Intellectual Property Right (National Sunflower Association, Bismarck, USA)
09:45-10:00 Mr. Zhang Yongping: Sunflower Development and Production in China (Sunrise Agritec Co., Ltd.; The Chinese Sunflower Network)
10:00-10:15 Confection Sunflower Production, Process, and Marketing (Qiaqia Food Co. Ltd)

10:15-10:45 **Coffee Break & Media Interview**

10:45-11:00 Jie Zhao: The Analysis Report on Sunflower Market in China (Wuyuan County Dafeng Oil Food Co. Ltd)
11:00-11:30 International Market and Trend Forecast on Sunflower Seed (Adak Tejaratazhand Dastpak Mohammad, Iran)
12:00-13:00 Lunch Buffet (Zidong Hotel, Wuyuan)

Thursday Afternoon, August 9, 2018

Session 2: Weed, Insect and Disease Resistance (Zidong Hotel, Wuyuan)

Session Chair：Dr. Chao-Chien Jan (Director, Institute of Sunflower Technology, Sanrui Agritec, China)

14:30-15:00 Dr. Leonardo Velasco: Sunflower Broomrape: Problems and Solutions for a global threat (CSIC Institute for Sustainable Agriculture, Cordoba, Spain)

15:00-15:20 Dr. Emmanuel Byamukama: Major sunflower diseases and their management in USA: A review (South Dakota State University, Brookings, USA)

15:20-15:40 Dr. Etienne Pilorge (ISA Secretary Treasurer): Worldwide sunflower

15:40-16:00 Dr. Quanjiang Bai: Problems and Management of Sunflower Broomrape in China (Inner Mongolia Academy of Agricultural & Animal Husbandry Science, China)

16:00-16:30 Dr. Larry Charlet: Integrated Pest Management Progress of Cultivated Sunflower (Former Research Entomologist, Sunflower Research Unit, USDA-ARS, Fargo, USA)

16:30-17:00 **Coffee Break & Media Interview**

17:30-18:00 Dr. Jun Zhao: Seed Transmission of Sunflower *Verticillium* Wilt (Inner Mongolia Agricultural University, China)

18:00-18:30 Dr. Stevan Masirevic: Latest Sunflower Diseases Research Progress and Control (European Center for Peace Development, Novi Sad, Serbia)

18:30-18:50 Dr. Bilig Bater: Application of IMI Herbicides on Controlling sunflower *Orobanche* (Wulaateqianqi New Century Seeds LLC)

18:50-19:00 Shengli Kong: Insect Pests Control using Keyun Products (Baiyun Company in Jiyuan, Henan)

19:00-20:30 Banquet (Zidong Hotel, Wuyuan)

Friday Morning, August 10, 2018

Session 3: Molecular Breeding and Marker-assisted Selection
(Zidong Hotel, Wuyuan)

Session Chair：Dr. Leonardo Velasco (Director, CSIC Institute for Sustainable Agriculture, Spain)

08:00-08:30 Dr. Dragan Skoric: Problems in Breeding Confect Sunflower (Serbian Academy of Sciences and Arts, Belgrade, Serbia)

08:30-09:00 Dr. Branislav Dozet: Sunflower Breeding Achievements and Challenges (Global Chief Breeder, Syngenta Seeds, Hungary)

09:00-09:30 Mr. Lianshe Li: Progress and Research Direction of Sunflower Breeding in China (Chief Agronomist, Sunrise Agritec Co., Ltd., Wuwei, China)

09:30-10:00 Dr. Maurice Ku: Integration of Genetic Modification andMolecular Breeding in Crop Improvement (National Chiayi University, Taiwan China; Washington State University, USA)

10:00-10:30 **Coffee Break & Media Interview**

10:30-11:00 Dr. Michail Christov: Intergeneric Hybridization of *Helianthus annuus* L. and *Carduus acanthoides* L. (Mihsan, Sofia, Bulgaria)

11:00-11:30 Dr. Jinhua Xiao: Application of Molecular Breeding Technologies in Commercial Crop Breeding (Huazhi Rice Bio-Tech Co. Ltd)

11:30-12:00 Symposium Proposal & Declaration

12:00-13:00 Lunch Buffet

Friday Afternoon, August 10, 2018

15:30-17:30 **Social Hour and Communication**

18:00-20:00 Banquet (Zidong Hotel, Wuyuan)

Sponsors

The International Sunflower Association, Paris, France

The People's Government of Bayannoer Municipality, Inner Mongolia, China

Tourist Development Council of Inner Mongolia Autonomous Region, China
The Specialized Committee for Nuts and Roasted Seeds of China National Food Industry Association (The Chinese Sunflower Network), China

Organizers

The People's Government of Wuyuan, Inner Mongolia, China
Tourist Development Council of Bayannoer, Inner Mongolia, China
Agriculture and Animal Husbandry Department of Bayannoer, Inner Mongolia, China
Sunrise Agritec Co.,Ltd., Wuyuan, Inner Mongolia, China

世界向日葵产业发展论坛活动安排

为了进一步提高世界向日葵产业发展水平，促进向日葵产业健康持续发展，增进国际间向日葵科研育种、栽培管理、病害防治、生产加工、出口贸易等领域的交流合作，决定举办 2018 年世界向日葵产业发展论坛。

一、主办单位

国际向日葵协会

中国食品工业协会坚果炒货专业委员会（中国葵花联盟）

巴彦淖尔市人民政府

内蒙古自治区旅游发展委员会

二、承办单位

五原县人民政府

巴彦淖尔市旅游发展委员会

巴彦淖尔市农牧业局

三瑞农业科技股份有限公司

三、论坛主题

天赋河套 世界共享

四、论坛时间

2018 年 8 月 8 日-8 月 10 日

五、论坛地点

中国 内蒙古 五原县

六、活动安排

（一）报到

1、时间：2018 年 8 月 7 日全天

2、地点：五原县宾馆、金百富大酒店、开元大酒店

3、住宿：五原县宾馆、金百富大酒店、开元大酒店

4、午餐：住宿酒店

5、晚餐：五原县宾馆、金百富大酒店、开元大酒店

6、参加人员：全体参会嘉宾

（二）具体活动

1、2018 年 8 月 8 日上午，参加 2018 年世界向日葵产业发展论坛暨国际向日葵花季旅游文化节开幕式，参观考察（五原）。早餐后统一乘车参加活动。

地点：五原县葵花广场

参加人员：全体参会嘉宾

08:00-08:30 开幕式

08:30-10:00 葵海盛世

10:00-11:30 河套农耕文化博览苑

11:30-12:30 自助午餐 （各自住宿宾馆）

2018 年 8 月 8 日下午 参观考察 （五原）

14:30-15:10 中国五原葵花博物馆

15:10-15:40 大丰粮油

15:40-16:40 河套电子商务产业园、农展馆

16:40-17:30 三瑞农科向日葵技术研究院

17:30-18:30 联星光伏新村

19:00- 五原县人民政府接待晚宴（五原县宾馆）

2、2018 年 8 月 9 日上午

专题 1：世界向日葵产业发展论坛开幕及论坛报告（五原县宾馆）

地 点：五原县宾馆会议厅

参加人员：全体参会嘉宾

主持人：Brady Vick 博士 (原美国农业部北方作物研究中心向日葵研究室主任)

08:00-08:15 五原县领导致辞；

08:15-08:30 市政府领导致辞；

08:30-08:45 国际向日葵协会秘书长皮洛基(Dr.Etienne Pilorge)博士致辞；

08:45-09:00 中国食品工业协会坚果炒货业委员会（中国葵花联盟）领导致辞；09:00-09:15 隆平高科领导致辞

09:15-09:45 美国向日葵协会及向日葵产业概括（前美国向日葵种子协会史旺森博士 Dr. John Swanson）

09:45-10:00 中国向日葵产业发展报告（三瑞农科董事长、中国葵花联盟执行会长 张永平）

10:00-10:15 向日葵生产加工技术报告及消费市场模式及消费市场趋势预测（洽洽公司总裁助理 王斌）

10:15-10:45 **休息及媒体采访**

10:45-11:00 中国出口商品技术报告（大丰粮油总经理 赵杰）

11:00-11:30 国际商品市场发展预测（Adak Tejaratazhand Dastpak Mohammad）

12:00-13:00 自助午餐及午休(各自住宿宾馆)

2018 年 8 月 9 日下午

专题 2：向日葵列当草害及病虫害（五原紫东宾馆）

地　点：五原县宾馆会议厅

参加人员：全体参会嘉宾

主持人：冉超健博士 (三瑞农科向日葵技术研究院院长)

14:30-15:00 向日葵列当抗性育种最新进展：维拉斯科博士（Dr.Leonardo Velasco 西班牙 CSIC 可持续农业研究院院长)

15:00-15:20 美国向日葵主要病害研究概况：伯姆库默博士(Dr.Emmanuel Byamukama 美国南达科他州立大学助理教授)

15:20-15:40 世界向日葵概括：皮洛基博士（Dr. Etienne Pilorge，ISA Secretary-Treasurer)

15:40-16:00 中国向日葵列当发生危害及防控技术研究进展：白全江博士（内蒙古农科院研究员）

16:00-16:30 栽培向日葵主要虫害防控进展：夏洛特博士

(Dr. Larry Charlet 原美国农业部北方作物研究中心病虫害学家)

16:30-17:00 **休息及媒体采访**

17:30-18:00 向日葵种子带菌以及防控技术研究：
赵君博士（内蒙古农业大学教授）

18:00-18:30 向日葵病害最新研究进展及防控：
马斯内维齐博士 (Dr. Stevan Masirevic 塞尔维亚诺维萨德大学教授)

18:30-18:50 咪唑啉酮类除草剂在防治向日葵列当中的应用：
毕力格博士（乌拉特前旗新世纪种业有限责任公司）

18:50-19:00 科云产品防治向日葵虫害：
（河南省济源白云实业有限公司孔胜利）

19:00-20:30 晚宴（三瑞农科）

3、2018 年 8 月 10 日上午

专题 3：向日葵育种及分子标记辅助选择

地　点：五原县宾馆

参加人员：全体参会嘉宾

主持人： 维拉斯特博士(**Dr.Leonardo Velasco** 西班牙 CSIC 可持续农业研究院院长）

08:00-08:30 食用向日葵育种研究：斯克瑞齐博士（Dr.Dragan Skoric 塞尔维亚国家科学与艺术研究院院士)

08:30-09:00 向日葵育种成就及面临的挑战：都日特博士 (Dr.Branislav Dozet 先正达种子公司全球总育种师)

09:00-09:30 中国向日葵育种研究的进展及发展方向：李联社 (三瑞农科总农艺师)

09:30-10:00 遗传修饰与分子育种整合进行作物改良：古森本博士 (Dr.Sun-Ben Ku 中国台湾国立嘉义大学教授)

10:00-10:30 **休息和媒体采访**

10:30-11:00 种间及种内杂交在向日葵育种中的应用：赫里斯托夫

博士(Dr.Michail Christov 前保加利亚 Dobroudja 农业研究院研究员)

11:00-11:30 分子育种技术在商业育种中的应用：肖金华博士（华智水稻生物技术有限公司）

11:30-12:00 论坛宣言

12:00-13:00 自助午餐（各自回宾馆）

2018 年 8 月 10 日下午 酒会及自由交流

15:30-17:30 自由交流

18:00-20:00 巴彦淖尔市政府接待晚宴（五原县宾馆）

4、2018 年 8 月 11 日，嘉宾返程。

CONTENTS

Report of the Development of the Sunflower Industry in China

Sunrise Agritec Co. Ltd., Wuyuan, Bayannur, China
Yongping Zhang

I. Summary of development of the sunflower confectionery industry

After going through a rapid seventeen-years development period, the sunflower industry in China is presently ranked at the top in the world in five areas. **First**, annual average planted area of the domestic confectionery sunflower has been maintained between1.32 and 1.65 million acres, the largest confection sunflower production in the world. **Second**, the seed business of the confectionery sunflower in China has an annual value of 1 billion Yuan, while the farmers' seed production is valued at 10 billion Yuan, and the consumed roasted sunflower seed has a value of 40 billion Yuan, making China the largest consumer in the world in this section. **Third**, the export volume of confectionery sunflower in 2016 amounted to 0.30 million tons, and 0.41 million tons in 2017, showing an upward yearly trend, making China the largest confectionery sunflower exporting nation in the world. **Fourth**, the representative Chinese confectionery sunflower hybrids, SH361 and SH363, possess the top-ranking technological standards and economic value in the world. **Fifth**, population working on confection sunflower production and related business has reached one million, making China the country with the largest employee of people working in the sunflower business. In conclusion, the confectionery sunflower of China ranks No.1 in five areas, including planted area, consumption, exporting, scientific research standards, and number of employees. China has rapidly become the center of worldwide attention for its confection sunflower industry.

II. Confectionery sunflower planting and general production in China in 2016 and 2017

1. Planted area: planted area of confectionery sunflower was about 1.89 and 1.25 million acres in 2016 and 2017, respectively.

2. Production: total production of confectionery sunflower were 2.0 and 1.5 million tons in 2016 and 2017, respectively.

3. Export trade: sunflower seed exports in China were 0.30 and 0.40 million tons in 2016 and 2017, respectively.

III. Cultivation and production of Chinese confectionery sunflower in 2018

1. Planted area and variety utilization

In 2018, the confectionery sunflower planted area is projected to be about 1.17 million acres, mainly distributed in Inner Mongolia, Xinjiang, Gansu as well as provinces in northeast China. Inner Mongolia is still the largest confectionery sunflower production area of China with 0.89 million acres, 75.5% of China's total sunflower production.

In 2018, varieties for confectionery sunflower planted were still primarily SH363, SH361 and 601 series, with 33% of SH363, 41% of SH361, 10% of SH601, and ~16% of others.

Hetao region of Inner Mongolia occupies about 0.60 million acres with main sunflower varieties SH361 and SH601. Chifeng City and its peripheral regions plants about 0.15 million acres with the majority of varieties SH363 (90%). Ulanqab and the surrounding regions occupies a total of 0.12 million acres mainly with varieties SH363, T339 and 3167 planted. Xinjiang has a planted area of about 0.20 million acres. The Changji area plants varieties SH363, SH361, and Xianrui No.7, while in the Altay area varieties SH361and SH363 are planted.

The planted acres of Gansu are about 0.02 million acres, mainly in Wuwei with varieties SH363.

The planted acres of Shanxi are about 0.03 million acres with the majority of varieties SH363 and 601.

The planted areas of northeast China are 0.04 million acres, mainly planting varieties SH363 and Fengkui.

2. Commodity production and quality

Due to dry weather at the early growth stage of sunflowers, in 2018, pathogen infection, pest incursion, and weed invasion occurred earlier than those in the year of 2017. A number of disease and pests such as leaf spot and moths occurred in particular areas. Broomrape were discovered as early as the time when plants were 30cm height. However, climate condition at the medium development stage was favorable, making promising prospect for yield and seed quality at the later development stage. Facilitated by the promotion of new varieties and optimized cultivation techniques, average yield will remain stable to a certain extent, while higher quality of commodity is expected. The common seed price of variety SH363 is estimated at about 7-8 Yuan/kilo, and high-end seed at about 11-13 Yuan/kilo. For variety SH361, the price of common seed is estimated at about 6-7 Yuan/kilo, and high-end seed at about 8 yuan/kilo, while the variety 601 remains at 7-8 yuan/kilo. The high-end quality seed is mainly from areas like Chifeng of Inner Mongolia and Altay of Xinjiang.

3. Export trade

In 2018, the production of confectionery sunflower is expected to be up to 1.35 million tons, with about 30%, or about 0.41 million tons exported to the Middle East and Europe.

IV. Issues and suggestions for the sunflower seed industry

Firstly, With the lack of rotation, sunflower production and quality shows the trend of deterioration, affecting growers' incomes seriously.

Secondly, over recent years, Broomrape tends to spread quickly, which has caused loss of capability to growing sunflowers for nearly 0.08 million acres, and resulted in production loss of 0.03 million tons. Further, *Sclerotinia* affected the land of nearly 0.06 million acres with the loss of capability to growing sunflowers and resulted in production loss of ~6800 tons. A new disease named grain watermark strongly affects

seed quality which is expected to be a main restrict for sustainable development of sunflower business.

China is facing the same issues in sunflower business as those in the rest of the world. We, the community of sunflower industry, should closely collaborate, actively integrate the innovation resources, continuously develop new varieties with the traits of high yield, high disease resistance and superior quality; meanwhile, we should further improve cultivation technologies to increase the growers' profit, and eventually promote the sustainable and healthy development of the sunflower industry.

2018 年中国食葵产业发展报告

三瑞农业科技股份有限公司
中国内蒙古巴彦淖尔五原县

张永平

一、中国食葵产业发展概况

中国向日葵产业经过 17 年的高速发展，目前在五个方面居世界领先水平。一是中国食葵年均种植面积保持在 800-1000 万亩左右，已成为世界最大的食葵种植国；二是中国食葵种子年均营业额达 10 亿元左右，农民种植的食葵商品每年的营业额达 110 亿元，炒货加工完成后食葵消费年营业额达 400 亿元，已成为世界最大的食葵消费国；三是中国食葵商品出口呈逐年上升趋势，中国已成为世界最大的食葵出口国；四是以 SH363、SH361 为代表的杂交食葵种子，科技含量和经济价值居领先水平；五是全国从事食葵种植及相关服务的人员达百万，产业从业人数居世界第一。中国食葵产业在种植面积、消费能力、出口贸易、科研水平和从业人数等五个方面居世界领先水平，中国向日葵产业对世界向日葵产业影响力与日俱增。

二、2016 年、2017 年食葵种植生产概况

1.种植面积：2016 年中国食葵种植面积达 1150 万亩，2017 年为 760 万亩。

2.总产量：2016 年中国食葵总产量约 200 万吨，2017 年约 152 万吨。

3、出口贸易：2016 年我国食葵商品出口量达 30 万吨，2017 年达 40.96 万吨。

三、2018 年中国食葵种植生产基本情况

1.种植面积及品种使用情况：经调查统计，2018 年中国食葵种植面积约 711.9 万亩，主要分布在内蒙古、新疆、东北、山西、甘肃等地区。内蒙古依然是中国最大的食葵种植区，种植面积约 537.5 万亩，占全国种植面积的 75.5%。

2018 年中国食葵种植品种主要以 363 系列、361 系列和 601 系列为主。经统计，363 系列占种植面积的 33%，361 系列占 41%，601 系列占 10%，其他品种占 16%。

内蒙古河套地区种植面积约 367 万亩，种植品种以 361、601 为主。赤峰及周边地区种植面积约 95 万亩，363 品种占有率达 90%以上。乌兰察布及周边地区种植面积约 75.5 万亩，种植品种以 363、T339、3167 等品种为主。新疆种植面积约 125 万亩。昌吉地区种植品种以 363、361、三瑞 7 号为主；阿勒泰地区种植品种以 363、361 为主。

甘肃地区种植面积约 11 万亩。主要集中在武威地区，种植品种以 363 为主。

山西地区种植面积约 15.4 万亩，种植品种以 363、601 为主。

东北地区种植面积约 23 万亩，种植品种以 363 和丰葵杂等品种为主。

2.产量、品质等情况：

2018 年由于向日葵生长前期气候干旱，病虫草害发生时间较早，叶斑病、葵螟、草地螟、粘虫、棉铃虫等病虫草害在局部地区均有发生。列当在向日葵植株 30cm 时已发生，较 2017 年相比发生较早。向日葵生长中期气候适宜，对向日葵后期的产量和品质较为有利。在新品种推广和成熟栽培技术的带动下，预计亩均产量将保持相对稳定，商品品质预计好于往年，SH363 系列商品普货价格预计平均为 7-8 元/公斤，高端原料价格预计平均为 11-13 元/公斤；SH361 系列商品普货价格预计为 6-7 元/公斤，高端原料价格预计平均为 8 元/

公斤左右；601 系列商品价格保持在 7-8 元/公斤左右。高端原料产区主要集中在内蒙古赤峰市和新疆阿勒泰等地区。

3.出口贸易：2018 年中国葵花籽产量预计达到 135 万吨，预计出口量 41 万吨左右，占全年产量的 30%左右，主要销往中东、欧洲等地区。

四、产业发展存在的问题及建议

一是由于连年重茬种植，导致向日葵产量、品质下降，影响了种植户的收益。

二是向日葵列当近年来呈大面积蔓延趋势，造成近 50 万亩土地无法种植向日葵，每年造成的商品损失近 3 万吨。菌核病的发生造成近 100 万亩土地无法种植向日葵，每年造成商品损失近 6800 吨。水锈病的频繁发生影响了葵花籽商品品质，制约了向日葵产业的持续健康发展。

中国向日葵产业面临的问题也是世界向日葵产业所面对的共同难题，产业界应当继续深化交流合作，积极整合科技创新资源，不断培育高产、高抗、商品优势突出的新品种，推广先进的田间栽培管理技术，增加种植户的经济效益，推动产业持续健康发展。

Sunflower Broomrape: problems and Solutions for a Global Threat

Leonardo Velasco, José M. Fernández-Martínez, Begoña Pérez-Vich
Institute for Sustainable Agriculture (CSIC), Córdoba, Spain
Email: lvelasco@ias.csic.es

Abstract

Sunflower broomrape (*Orobanche cumana* Wallr.) has become a major global threat for sunflower production in the Old World. The capacity of the parasite to evolve to more virulent forms through mutation and recombination, together with the use of resistant sunflower hybrids mainly based on single dominant *Or* genes, has led to an extremely complex racial situation. A detailed characterization of broomrape populations coupled with alternative breeding strategies is required to increase the durability of genetic resistance to broomrape. In this sense, it is important to develop new genetic sources of genetic resistance, to characterize them in detail at the genetic and physiological level, and to characterize avirulence genes in the parasite. The final goal is to develop diagnostic molecular markers for identification of resistance genes in sunflower to support pyramiding strategies as well as for identification of avirulence genes in the parasite. This can be seen nowadays as a kind of science-fiction approach, but the isolation of individual resistance genes in sunflower is becoming already a reality, and will also become a reality soon for avirulence genes, although a lot of research is still required. With such tools available, our capacity to develop sunflower germplasm with a durable resistance to broomrape will go undoubtedly beyond our current expectations.

Key words: broomrape, molecular marker, avirulence genes

向日葵列当：这一全球性的威胁存在的问题及解决方案

Leonardo Velasco, José M. Fernández-Martínez, Begoña Pérez-Vich
Institute for Sustainable Agriculture (CSIC), Córdoba, Spain
Email: lvelasco@ias.csic.es

摘要

过去向日葵列当 (*Orobanche cumana* Wallr.) 一直是困扰向日葵生产的一个全球性的威胁。由于突变及重组使病原菌毒力不断增强，而向日葵抗性杂交种主要仍依赖单一的显性基因 *Or* genes ，这就出现了极度复杂的生理小种情况。所以就迫切需要对列当群体特性进行研究并找到替代的育种策略以增加对列当的持久抗性。鉴于此，开发新的遗传抗性资源，阐明遗传及生理特性，已经病原菌的无毒基因尤为重要。我们的最终目的是找到特征性的抗性分子标记以配合聚合育种的需要以及鉴定病原菌的无毒基因。目前这看起来有点科幻小说的办法，但分离向日葵单个的抗性基因以及成为现实，而且对于鉴定无毒基因不久也将成为现实，当然大量的工作还需要去做。有了这些工具，鉴定持久性的抗列当的遗传资源就毫无疑问在我们的预期之中。

关键词：列当、分子标记、无毒基因

Major sunflower diseases and their management in USA: A review

Emmanuel Byamukama
South Dakota State University, Brookings, USA
Email: emmanuel.byamukama@sdstate.edu

Abstract

Sunflower, *Helianthus annuus*, is one of the major oilseed crops grown in USA. Two types of sunflowers are grown: oil- and non-oilseed, with the oilseed sunflower accounting for 90% of the sunflower production. Several sunflower diseases develop and cause significant yield losses annually. The major diseases include sunflower rust (*Puccinia helianthi*), Phomopsis stem canker (*Phomopsis spp.*), downy mildew (*Plasmopara halstedii*), Alternaria leaf spot (*Alternaria spp*.), and white mold (*Sclerotinia spp.*). The main risk factors for these diseases to develop include inoculum abundance (alternative hosts), cultural practices (mainly minimum or no-tillage), and conducive weather. Planting resistant hybrids, crop rotation, and use of foliar and seed treatment fungicides are some of the management practices used in the USA. The extent of the occurrence and challenges to manage sunflower diseases will be discussed.

Key words*:* *Helianthus*, diseases, disease management

美国主要的向日葵病害及其防治：综述

Emmanuel Byamukama
South Dakota State University, Brookings, USA
Email: emmanuel.byamukama@sdstate.edu

摘要

向日葵是美国种植的最重要的油料作物之一。两种类型的向日葵包括油用型和非油用型，其中油用型向日葵占向日葵生产的 90%。一些向日葵病害的发生每年都会造成产量显著降低。最主要的病害包括：向日葵锈病（*Pucciniaheliathi*）、茎溃病（*Phomopsis spp.*）、霜霉病（*Plasmoparahalstedii*）、黑斑病（*Alternaria spp*.）和菌核病（*Sclerotinia spp.*）。这些病害发生的可能因素包括：种菌充足（可选择的寄主）、栽培方式（主要是少耕或免耕）以及有利的天气条件。在美国主要的防治措施有种植抗性杂交种、轮作以及用杀菌剂进行叶片或种子处理。向日葵病害发生程度和防治面临的挑战将会进一步讨论。

关键词：向日葵，病害，病害防治

Pest Management of Insect Pests in Cultivated Sunflower

Larry D. Charlet*[1] (Retired), Jarrad R. Prasifka[1], Janet J. Knodel[2]
[1]Northern Crop Science Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Fargo, USA
[2]Department of Plant Pathology, North Dakota State University, Fargo, USA
Email: larry.charlet@q.com

Abstract

Sunflower, *Helianthus annuus* L., is attacked by a diversity of insect species worldwide. Because sunflower is native to North America, a large pest complex has evolved on wild sunflower and has moved from wild ancestors to commercial cultivars of both oilseed and confection sunflower. In other countries and to a lesser extent in North America, some insects have adapted to utilize sunflower as an alternative host. Insect pest status often varies from year to year, but a number of species may cause economic damage annually. These include species attacking the sunflower stem, leaves, roots, head and seeds. The successful management of insect pests depends on correctly identifying the pest, understanding the pest's biology, field sampling of pest densities, and selection of the most appropriate control methods. The use of integrated pest management assures that control decisions will be based on economics and achieved with minimal disruption to the environment, including nontarget organisms and pollinators. This strategy assures that the most effective control approaches based on past and current research investigations utilize techniques that combine resistant cultivars, cultural control, biological control, and the application of insecticides only when pest populations have reached economic injury levels.

Key words: *Helianthus*, insects, pest management, resistance, biology

栽培向日葵虫害的防治

Larry D. Charlet* (Retired) and Jarrad R. Prasifka, Northern Crop Science Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Fargo, USA
Janet J. Knodel, Department of Plant Pathology, North Dakota State University, Fargo, USA
Email: larry.charlet@q.com

摘要

向日葵在世界范围内受多种昆虫的危害。因为向日葵起源于北美，大多害虫已在野生向日葵上演化，并从野生向日葵转移到油用和食用向日葵的商业栽培种中。在其它国家和较小程度上北美的国家，一些昆虫已经适应于把向日葵作为替代寄主。害虫的状况通常每年都有所不同，但是有一些种类每年都会造成经济损失。包括危害向日葵茎秆、叶片、根系、花盘和种子的种类。害虫的成功防治取决于正确的识别害虫，了解其生物学特性，害虫在田间分布的密度并且能够选择最合适的控制方法。使用综合的害虫防治方法取决于经济状况以及对环境的影响，包括非目标的物种和传粉物种。这一策略确保基于过去和目前的研究调查制定的最有效的控制方法并结合抗性品种、栽培防治、生物防治和当害虫群体达到经济损失时才应用杀虫剂。

关键词：向日葵、昆虫、害虫管理、抗性、生物学

PCR Combined with GFP-Tagged *Verticillium dahliae* Confirmed the Seeds' Transmission of Sunflower Verticillium Wilt

Yuanyuan Zhang, Gui Zhang, Jian Zhang, Jun Zhao
College of Agronomy, Inner Mongolia Agricultural University, Hohhot, 00018, China. Email: zhaojun02@hotmail.com

Abstract

Verticillium Wilt of sunflower (*Helianthus annuus* L.) is a widespread and destructive disease caused by the soil-borne fungal pathogen *Verticillium dahliae* (*V. dahliae*). The quick spreading of Sunflower Verticillium Wilt in the sunflower planting region of China caused us to consider the possibility of seeds' transmission of the pathogen. Therefore, knowledge about the contamination of the seeds by *V. dahliae* is critical for understanding the infection cycle and also to develop ways to control the spreading of this disease. In this study, sunflower seedlings were inoculated with conidial suspensions of a GFP-tagged isolate. Colonization was studied with a confocal microscope. After 12 to 96 hours of post-inoculation (hpi), conidia germinated and formed hyphal colonies on the root tips and in the root elongation zones. Hyphae colonized cortical tissues and vascular elements 2 weeks after inoculation (2wpi). 10 wpi later, the xylem of the upper stem, sunflower disc， and sunflower seed parts, including the pericarp and seed coat, had been colonized by the pathogen. Moreover, pathogen DNA could be detected by RT-PCR in the pericarp and seed coat. Additional experiments that detected the transmission rate of seeds from different sunflower cultivars were conducted with PCR. Our results indicated that the transmission rate of sunflower seeds ranged from 10 to 25% among all tested cultivars. In conclusion, seed transmission is the main way for the long distance transmission of sunflower *V. dahliae*, and seed pretreatment should be done to control the infection of sunflower seedlings in the future.

Keywords: sunflower (*Helianthus annuus* L.); *Verticillium dahliae*; seed transmission

向日葵黄萎病的种子带菌研究

张园园 张贵 张键 赵君*
内蒙古农业大学农学院，中国内蒙古呼和浩特
Email: zhaojun02@hotmail.com

摘要

向日葵黄萎病是一种由大丽轮枝菌引成的极具破坏性的真菌性病害。该病原体通过种子带菌进行长距离传播，并能够引起向日葵黄萎病的快速蔓延。因此，了解向日葵种子是否携带黄萎菌是确定向日葵黄萎病侵染周期、制定控制这种病害方法的关键。在本研究中，应用 GFP 标记大丽轮枝菌的分生孢子悬浮液接种向日葵幼苗。利用共焦显微镜观察该病原菌的定殖过程。接种 12~96 小时后，分生孢子开始萌发形成菌丝并附着在根尖和根伸长区。接种 2 周后，菌丝定殖在根的皮层组织以及维管束里。接种 10 周后，地上部分的向日葵茎秆、向日葵花盘以及向日葵种子的各部分结构（包括果皮、种皮），均有病原菌的定殖。此外，通过 RT-PCR 在种子的果皮和种皮结构中检测到该病原体的 DNA。同时，我们利用 PCR 技术检测不同品种的向日葵种子的带菌率，结果表明，所有供试向日葵种子的带菌率为 10~25%。总之，种子带播是向日葵黄萎病进行长距离传播的主要途径，进行种子预处理是减少向日葵幼苗被侵染的关键。

关键词：向日葵；大丽轮枝菌；种子带菌

Latest Sunflower Diseases Research Progress and Management

Stevan Maširević
Univestity of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia
Email: stevanmasirevic5@gmail.com

Abstract

Sunflower diseases have been and remain a major limiting factor in successful sunflower production in the world. From a historical point of view, in last several years new disease agents did not occur, however, new races have emerged. "Virulent pathotypes", usually called pathogenic races occurred in some important diseases. Many disease agents have been present in the whole sunflower production regions, and despite the extensive marketing of resistant hybrids throughout the world, they have persisted in some regions. The exception is the *Phomopsis*/*Diaporthe* complex in which several new species in the genus *Phomopsis* appeared. Broomrape should also be added to this list, but as it will be discussed elsewhere. We shall restrict our discussion only to diseases. Many disease agents are present throughout sunflower producing regions and some of them, despite high turnover and migration of seeds in the world remained present in some areas. Their spread is evident just due to seed exchange. Considering all sunflower pathogens, it should be noted that 13 of them are significant to a greater extent for sunflower production, in terms of yield and oil quality reduction, although historically in this significant oil crop, much higher number of them have been described. Diseases are by far the most important factor in yield, oil, and protein reduction, although there are different intensities each year and growing region. Significant progress has been made in better identification and comparison of certain parasite races in the world, and in some regions due to new research techniques at the molecular level. Good international cooperation using a series of isogenic lines in determination of the intensity and the appearance of certain disease inducing races of downy mildew, rust, Verticillum wilting and others has

contributed to this. As new parasite races emerge, pesticides have remained one of the more significant tools in control of disease agents, in addition to the other control measures such as genetic resistance. This requires a joint effort of researches in plant protection, breeding, and others struggling with the reduction of losses caused by disease agents. It is, therefore, important to organize periodic surveys that would uncover their exact distribution and harmfulness in certain regions of sunflower production. Taking into account the tendency of soil tillage, i.e. no tillage or minimum tillage, it leads to the fact that many parasites remain on the surface as dry-desiccated or in infected plant residues. They are truly brown bridges for many sunflower parasites. This primarily refers to Argentina, USA, part of France, Australia and many other countries. Increased problems in sunflower arise in such situations. Deep tillage and incorporation of plant residues into deeper layers, and not leaving them on the soil surface eliminates infection pressure of many parasites. In this process, it is most important for the Diaporthe complex, *Scletotinia*, *Phoma*, *Plasmopara, Puccinia* and others. Crop rotation as a system to combat diseases does not have such significance if no tillage technology, i.e. crop cultivation is performed. The same situation is with weeds that should be controlled since they are reservoirs as alternate hosts for many disease agents including viruses; therefore they need to be eliminated from the sunflower crop. Wild sunflower plants should be added to this, since wild sunflower plants are in fact weedy plants in all cultivated crops, and should be eliminated and destroyed as they often serve to parasites for crossing over and as one kind of a green bridge. Use of tractors and sprayers with high clearance for other agricultural cultures enables their application for treatment of sunflower crops against diseases. This is a way to obtain particularly high yields, especially in confectionary sunflower type that has a higher price and can serve as a place for the multiplication of certain parasites because it is generally less resistant to many parasites.

Key words: Sunflower diseases, pathogen identification, host resistance.

向日葵新病害研究最新进展及防治

Stevan Maširević1
Univestity of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia
Email: stevanmasirevic5@gmail.com

摘要

向日葵病害已经成为世界上限制向日葵生产的重要因素。从历史角度看，过去几年没有新的病原菌发生，但是近来有新的小种出现。在一些重要的病害中，出现了“有毒力的致病型”，又常称为致病生理小种。许多病原菌在世界向日葵产区中广泛出现；尽管抗病杂种已经广泛推广，在一些地区仍存在病害。一个极个别的事例是，近年来发现了拟茎点霉属的新种。列当也应被列入重要的病害，但是我们将在其它地方讨论。许多病原菌在向日葵整个产区或部分区域存在；尽管抗病种子广泛推广，病原菌仍然在一些地区继续出现。病原菌的传播很明显是由于种子的交换引起的。在所有的向日葵病原菌中，13 种病原菌对向日葵产量和品质具有重要影响。尽管病害发生程度在年份和种植区间有所不同，但总体上是导致产量、含油量及蛋白质含量降低的重要因素。由于新的分子水平的研究技术的应用，针对世界上或特定地区特定的寄生性小种的研究已经取得了重要进展。我们在国际合作中也取得了成功，如通过国际合作，成功地使用一系列近等基因系来确定特定病害生理小种的发生强度，尤其是是针对霜霉病、锈病、黄萎病及其它病害的强度确定。随着新的寄生性小种的出现，杀虫剂仍然是除培育抗性品种外控制病原菌的重要手段之一。然而，我们需要在植物保护、育种以及其它方面的共同努力来减少病害造成的损失。因此，组织针对向日葵特定产区病原菌的分布和危害的定期调查显得尤为重要。免耕或少耕导致许多寄生菌仍然留在土壤表面或被侵染的病残体，它们成为了许多向日葵寄生菌的桥梁。这主要发生在阿根廷、美国、法国的部分地区，以及澳大利亚以及许多其它国家。这种情况会使向日葵产业面临的问题更加严重。建议通过深耕或将植物残体埋入土壤深层，

不让其留在土壤表面，来减少寄生菌的侵染。该方法对茎溃病、菌核病、黑茎病、霜霉病、锈病和一些其它病害的防治尤为有效。如果不采取特定的耕作技术，轮作对病害的防治并不是很重要。同样，应当清除向日葵中的杂草，因为杂草是许多病原菌、包括病毒的储存库。野生向日葵对栽培向日葵而言也是杂草，也应当被清除和消灭，因为寄生菌经常在野生向日葵上过渡。对其它农业上的植物使用高清除率的拖拉机和喷雾器可以防治向日葵病害。这是获得高产的一种方法。尤其是价格较高的食用向日葵是某些寄生菌的繁殖场所，因为它们一般很少抗多种寄生菌。

关键词：向日葵病害、病原菌识别，寄主抗性

Effects of IMI Herbicides in Controlling *Orobanche* In Sunflower fields

Bilig Bater
Wulaateqianqi New Century Seeds LLC

Abstract

IMI herbicides are widely utilized in controlling *Orobanche* in sunflower fields, especially in Mediterranean countries. They are marketed by the German Company BASF as "Clearfield Technology". They have a broad spectrum control of broad-leaf weeds. They are widely utilized in controlling weeds in soybean fields in China. They inhibit acetolactate synthase inhibiting plant growth. IMI resistant sunflower is non-GMO, developed by traditional hybrid breeding methods, like endogenous gene mutation/crossing/field selection technologies. IMI herbicides can kill *Orobanche*, but not IMI resistant sunflower. First of all, sunflower absorbs the sprayed IMI herbicides. After imbibing the IMI herbicides from the roots of the sunflower, *Orobanche* will die. IMI herbicides have relatively short residual effect in the soil, especially Imazamox; it has a residual effect of less than 12 months. IMI herbicides have passed patent protection time; they are generic now. Application methods of IMI herbicides are: IMI herbicides are sprayed on sunflower at 4-8 leaf stage. Using Imazamox as an example, it is a 4% concentration, used at 1.5 liter/ha, active ingredient of 60 g/ha. BASF's recommendation is 50 g/ha. IMI herbicides need to be uniformly sprayed on sunflower. There are two ways to controlling sunflower *Orobanche***.** One way is by utilizing IMI herbicides, for example, NC#1 hybrid. Another way is by introducing *Orobanche* resistant genes in sunflower, for example, NC#2 hybrid. NC#1 hybrid was developed by Wulaateqianqi New Century Seeds LLC. The breeding started in 2014 by a cross between USDA sunflower germplasm "IMISUN" with domestic parental lines. It is currently commercially available. The NC#1 hybrid was experimentally tested at two regions of Inner Mongolia, Wulaateqianqi and Siziwangqi. At Wulaateqianqi, the maturity was 93 days, the yield was 3,795 kg/ha, 292

seeds/50g, and the *Orobanche* infected rate was 5%, while at Siziwangqi, the maturity was 97 days, the yield was 3,660 kg/ha, 285 seeds/50g, and the *Orobanche* infected rate was 7%. In conclusions, IMI herbicides are very effective in controlling *Orobanche* in sunflower fields. The NC#1 sunflower hybrid is an IMI resistant and *Orobanche* resistant satisfactory confection sunflower hybrid commercially available for sale in the Chinese market.

Key words: IMI herbicides, Clearfield technology, *Orobanche* resistance

咪唑啉酮类除草剂在防治向日葵列当中的应用

乌拉特前旗新世纪种业有限责任公司
毕力革

摘要

咪唑啉酮类除草剂已广泛被应用于向日葵列当防治，特别是在地中海国家。咪唑啉酮类除草剂最早由德国巴斯夫公司研发并被命名为“净田技术”，属广谱性除草剂，能够杀死阔叶草。在中国已广泛被应用于控制大豆田杂草。此除草剂是通过抑制植物的乙酰乳酸合成酶来抑制植物的生长。

耐咪唑啉酮类除草剂的向日葵不是靠转基因技术，而是通过传统杂交育种比如内源基因诱变，杂交，田间筛选等培育成功的。咪唑啉酮类除草剂可以杀死列当，但杀不死特定选育出来的耐咪唑啉酮类除草剂向日葵。首先，向日葵吸收被喷洒的咪唑啉酮类除草剂，当列当从根部吸收向日葵营养时也因吸收咪唑啉酮类除草剂而死亡。咪唑啉酮类除草剂在土壤中的残留时间相对比较短，特别是甲氧咪草烟，在土壤里的残留时间低于 12 个月。咪唑啉酮类除草剂已过专利保护期，可以通用。

咪唑啉酮类除草剂的使用方法为，首先，要在向日葵 4-8 叶子时喷洒咪唑啉酮类除草剂。以甲氧咪草烟为例，4%的浓度，1.5 升/公顷，有效成分为 60 克/公顷。巴斯夫推荐量为 50 克/公顷。咪唑啉酮类除草剂要均匀地喷洒到向日葵上。

防治列当的方法有俩种，一种为利用咪唑啉酮类除草剂，例如：新世 1 号杂交种。另一种是利用抗列当基因，例如：新世 2 号杂交种。

新世 1 号杂交种是由乌拉特前旗新世种业有限责任公司培育成功的。新世 1 号杂交种的育种起始于 2014 年，是通过美国农业部向日葵研究所的“ImiSun” 和国内向日葵亲本杂交培育而成。新世 1 号向日葵耐咪唑啉酮类除草剂，所以抗列当。新世 1 号向日葵杂交种已通过了中国农业部的认证，现已在市场上销售。在 2017 年分别在

内蒙古两个旗，乌拉特前旗 和四子王旗，试种，并获得如下试验结果：在乌拉特前旗新世 1 号的成熟期为 93 天，产量为 3795 公斤/公顷，292 粒/50 克，列当感染率为 5%。在四子王旗新世 1 号的成熟期为 97 天，产量为 3660 公斤/公顷，285 粒/50 克，列当感染比例为 7%。

综上所述，咪唑啉酮类除草剂在防治向日葵列当方面是很有效的。新世 1 号作为耐咪唑啉酮类除草剂抗列当的良好食葵杂交种子现已在中国市场上销售。

关键词：IMI 除草剂、Clearfield 技术、列当抗性

Beneficial Bacteria from the Olive Rhizosphere Promote Growth of Sunflower Plants and Reduce Infection by *Orobanche cumana*

C. Gomez-Lama Cabanás, J. Mercado-Blanco, A.B. García-Carneros, L. Molinero-Ruiz* (Institute for Sustainable Agriculture (IAS-CSIC), Córdoba, Spain) Email:leire.molinero@csic.es

Abstract

Contrarily to oilseed sunflower, in which genetic resistance provides effective control of *Orobanche cumana* Wallr. (broomrape), confectionary sunflower is highly susceptible to the holoparasite. Until breeding programs succeed in incorporating resistance into commercial hybrids of confectionary sunflower, other alternatives must be considered for the control of *O. cumana*. Biological control agents (BCA), alone or in combination with other measures, constitute an eco-friendly alternative in the management of crop diseases. Some *Pseudomonas* spp. strains do not only display *in vitro* growth inhibition of different crop pathogens, but they are also able to suppress their deleterious effects in plants. Selected strains of *P. fluorescens* and *P. putida* have been demonstrated as effective BCA against *Verticillium dahliae* affecting olive trees. Moreover, the ability of strain *P. fluorescens* PICF7 to colonize the roots of sunflower has been previously reported by our research group. Other BCA effective in disease suppression are *Bacillales* members such as *Paenibacillus* spp. or *Bacillus* spp. The objectives of this work were: a) to assess whether bacterial BCA had any (beneficial or detrimental) effect on the growth of sunflower; and b) to analyse the potential of some *Pseudomonas* spp. and *Bacillales* strains as BCA against broomrape of sunflower. Two experiments were conducted in the greenhouse at 22–28°C and 14-h light photoperiod for 5 weeks. In the first experiment seeds of the confectionary sunflower B117 were germinated and bacterized with suspensions of six *Pseudomonas* spp. strains and three *Bacillales* strains. Water and $MgSO_4$ treatments were included as controls. Eight seedlings (replications) were planted into 250-g pots. The

same number of replications was used in the second experiment, in which bacterized B117 seedlings were individually transferred into 250-g pots containing a sand:silt:peat moss mixture uniformly infested with 10 mg of parasite seeds (Oc01-15 population of *O. cumana*). Results showed that among *Bacillales* representatives, *Paenibacillus polymyxa* PIC73 significantly decreased the height of sunflower. On the contrary, the beneficial effect of *P. fluorescens* PICF6 was evidenced by significantly higher weights of above-ground plant biomass upon bacterization. Remarkably, presence of *Pseudomonas indica* PIC25 resulted in a significant reduction of the number of broomrape nodules in sunflower. These results are currently being confirmed in experiments in the greenhouse, as well as the effect of novel bacterial BCA on both sunflower growth and *O. cumana* infection in the plants.

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Key Words: Biological control, *Helianthus annuus* L., *Paenibacillus* spp., Plant growth promotion, *Pseudomonas* spp.

橄榄根际有益细菌促进向日葵植株的生长减少列当的侵染

C. Gomez-Lama Cabanás, J. Mercado-Blanco, A.B. García-Carneros, L. Molinero-Ruiz* (Institute for Sustainable Agriculture (IAS-CSIC), Córdoba, Spain) Email:leire.molinero@csic.es

摘要

油用向日葵的遗传背景能够有效地抗列当，相反，食用向日葵对列当表现为高感。在能够成功将列当抗性基因转入食用向日葵商品杂交种之前，必需有替的方法来控制列当。单独使用生物控制剂（BCA）或与其它措施结合使用是防治病害中有利于生态的选择。一些假单胞菌属菌株不仅在体外对不同作物致病菌的生长表现出抑制作用，而且能够抑制它们对植株的有害影响。已经证明所选菌株 *P. fluorescens* 和 *P. putida* 是橄榄树黄萎病菌的有效生物控制剂。此外，我们以前的研究也表明 *P. fluorescens* PICF7 菌株能够在向日葵的根系生长。其它的对病害起有效抑制作用的生物控制剂是芽孢杆菌目，如类芽孢杆菌和芽孢杆菌。本研究的目标有：a）评价细菌的生物控制剂对向日葵的生长作用（有益的和有害的）；b）分析一些假单胞菌属和芽孢杆菌目菌株作为向日葵列当生物控制剂的潜在可能性。两个实验均在温室中 22–28°C 和 14h 光周期下持续 5 周。第一个实验中，食用向日葵 B117 的种子发芽并在 6 个假单胞菌属菌株和 3 个芽孢杆菌目菌株的悬浮液中生长。水和 $MgSO_4$ 处理作为对照。8 株幼苗（重复）种植在 250g 的花盆中。第二个实验的重复数同第一个实验，将菌液中的 B117 幼苗单独转移到沙子：泥沙：泥炭均匀混合基质并含有 10mg 列当种子的 250g 花盆中。结果表明，在芽孢杆菌目中，多粘类芽孢杆菌（*Paenibacillus polymyxa*）PIC73 导致向日葵的植株显著降低。相反， *P. fluorescens* PICF6 由于菌液的作用使得植物地上部的生物量显著提高。尤其明显的是，假单胞菌属 *indica* PIC25 的存在显著降低了向日葵列当的结瘤数。上述结果及新的细菌生物控制剂对向日葵生长和列当侵染的作用正在进行温室实验的验证。

关键词：生物防治，向日葵，类芽孢杆菌，假单胞菌，植物生长，列当

Obtaining Sunflower Genotypes, Resistant to Imidazolinone or Sulfonylurea Herbicides with Improved Genetic Resistance to *Plasmopara halstedii* Pathogen and *Orobanche cumana* Parasite

Maria Joita-Pacureanu[1], Luxita Rîșnoveanu[2], Gabriel Florin Anton[1]
Alexandru Bran[3], Elisabeta Sava[3]
[1]National Agricultural Research and Development Institute Fundulea, Romania
[2]University "Dunarea de Jos", Galati-Braila, Romania
[3]Institute for Variety Testing and Registration, Bucharest, Romania
Email:pacurean@ricic.ro; mariapacureanu2@yahoo.com

Abstract

New sources of genes for improving different characteristics in sunflower breeding are needed. Genetic resources in sunflower, which could to be used as a base to create new inbred lines or as donor sources for genes controlling different characteristics are made up of old or new varieties, hybrids and inbred lines, induced mutations, synthetic populations, as well as wild sunflower species. Herbicide resistant crops are becoming increasingly common in agricultural production. A wild population of annual *Helianthus annuus* was the source for developing cultivated sunflower genotypes resistant to imidazolinone and sulfonylurea herbicides. There have been inbred lines created that serve as sources for transferring genes into elite lines. The sunflower genotypes resistant to herbicides can be used in the CLEARFIELD or Express-Sun systems. The virulence of *Plasmopara halstedii*, which produces downy mildew in sunflower, has increased in recent times with new virulent races of this fungus appearing. The parasitic plant *Orobanche cumana* (broomrape) is the most important biotic constraint to the production of sunflower in all countries where sunflower is grown, except North and South America. There is a diversity of *O. cumana* races identified worldwide. The

appearance of new races of this parasite has considerably reduced the available sources of resistance in cultivated sunflower. A high level of resistance for both the *P. halstedii* pathogen and *O. cumana* parasite have been found in the wild *Helianthus* spp. Resistance to the most virulent races of the pathogen and parasite has been transferred from wild *Helianthus (H. debilis and H. argophyllus)* into cultivated sunflower by interspecific hybridization. The inbred lines created by interspecific hybridization have been used for the improvement of resistance to the pathogen and parasite and lines resistant to imidazolinone and sulfonylurea herbicides using backcross or recurrent selection methods.

Key words: sunflower, herbicides, resistance, downy mildew, broomrape

同时具有抗向日葵除草剂咪唑啉酮、抗霜霉病和抗列当性状的向日葵基因型材料的获得

Maria Joita-Pacureanu[1], Luxita Rîşnoveanu[2], Gabriel Florin Anton[1]
Alexandru Bran[3],
Elisabeta Sava[3]
[1]National Agricultural Research and Development Institute Fundulea, Romania
[2]University "Dunarea de Jos", Galati-Braila, Romania
[3]Institute for Variety Testing and Registration, Bucharest, Romania
Email:pacurean@ricic.ro; mariapacureanu2@yahoo.com

摘要

如果要通过育种来改善向日葵中特定的性状，我们就需要特定的基因供体资源。在向日葵自交系选育中，由已有品种或新的品种、杂交种/自交系、诱变体、杂交群体以及野生种组成的向日葵遗传资源可以用作创建新的向日葵自交系的基础，或者可以作为改良不同性状的遗传资源。农业生产中，使用具有除草剂抗性的作物越来越普遍。在本研究中，我们利用一个野生的一年生向日葵群体，将其作为培育抗咪唑啉酮和脲磺隆除草剂的向日葵栽培品种的基因供体。我们已经创建了可转移至优良自交系的基因源。除草剂抗性品种可以用于 CLEARFIELD 和 Express-Sun 系统。

由单轴霉属引起的向日葵霜霉病发病率在过去的一段时间有所增加，并且出现了该真菌的新的生理小种。此外，寄生性列当是除美洲以外的所有国家向日葵生产的最大的生物胁迫。世界上已经鉴定出多种列当生理小种。新的列当生理小种的出现极大的减少了栽培向日葵可利用的抗性资源。我们发现，野生向日葵种质对霜霉病和列当均具有很高的抗性。我们进一步通过种间杂交，从野生向日葵材料中，将抗霜霉病和和针对致病力最强的列当生理小种抗性的基因转移至栽培向日葵。总之，我们通过种间杂交创建自交系，并通过回交和轮回选择，提高了向日葵对霜霉病、列当、以及咪唑啉酮和脲磺隆除草剂的抗性。

关键词：向日葵，除草剂，抗性，霜霉病，列当

Breeding Strategies for Incorporation of Resistance to Major Diseases on Sunflower (*Helianthus annuus* L.) in India

Sujatha Mulpuri*, Hari Prakash Meena, Mangesh Y. Dudhe and A. Vishnuvardhan Reddy
ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad 500 030, India
Email: mulpurisujata@yahoo.com

Abstract

Sunflower had become one of the most important oilseed crops in the Indian economy following its introduction in the country during the late seventies. The area under cultivation had increased steeply from 0.2 m. ha in 1981-82 to 2.6 m ha in 1993-94, followed by a drastic decline since 2010 reaching 0.5 m. ha in 2014-15. While one of the prime reasons for the decline is competition from other remunerative crops like cotton, maize, soybean, and pulses, the other reason is the vulnerability of the crop to a wide range of diseases. The disease situation in India is rather dynamic and there has always been a constant threat of new diseases limiting sunflower production and productivity. In the initial years and till 1990, the major disease was leaf spot caused by *Alternariaster helianthi.* From 1997, the crop suffered from sunflower necrosis disease (SND) caused by tobacco streak virus (TSV), and from 2006 onwards, powdery mildew incited by *Golovinomyces orontii* has assumed importance. Downy mildew, which is a major disease in the tropics, is localized to a single pocket in Central India. Thus, it has been a constant challenge for the breeders to identify durable sources of resistance in cultivated and wild *Helianthus* species. Sources of resistance to *A. helianthi* were identified in diploid perennial *Helianthus* species with limited crossability success (Sujatha et al. 1997). Hence, 16 stable interspecific derivatives involving perennial species such as *H. hirsutus, H. tuberosus,* and *H. strumosus* were obtained from USDA for assessing their reaction to the pathogen and utilization in the breeding programmes.

Owing to the lack of reliable sources of resistance to TSV, transgenic events harbouring the coat protein gene of TSV were developed for conferring resistance to SND (Vasavi et al. 2018). Sources of resistance to powdery mildew were identified in diploid annual species like *H. argophyllus* and *H. praecox*, and prebreeding programmes for transfer of resistance to the cultivar background is under way (Reddy et al., 2013). The donors for powdery mildew resistance, including *H. praecox* (PRA 1823), were subjected to proteome and transcriptome profiling for identification of candidate gene(s) and key regulatory pathways governing resistance to the pathogen (Reddy et al., 2018).

Key words: biotechnological tools, biotic stresses, interspecific hybridization, wild sunflowers

印度针对主要病害的向日葵抗性育种策略

Sujatha Mulpuri*, Hari Prakash Meena, Mangesh Y. Dudhe and A. Vishnuvardhan Reddy
ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad 500 030, India
Email:: mulpurisujata@yahoo.com

摘要

自从 17 世纪晚期向日葵被引入印度起，向日葵就已成为印度经济中最重要的油料作物之一。1982-1982 年，印度向日葵栽培面积仅 20 万公顷；到 1993-1994 年，栽培面积已急升至 260 万公顷。自 2010 年起，向日葵在印度的栽培面积开始下降；至 2015 年，栽培面积已降至 50 万公顷。其原因，一方面是由于来自棉花、玉米、大豆等经济作物的竞争，另一方面，是由于向日葵对一系列病菌的高感。印度的向日葵病害非常严重，一直以来，它是限制向日葵产量和丰产性的重要影响因素。直至 1990 年，主要为由 *Alternariaster helianthi* 导致的叶斑病。从 1997 年起，向日葵受由烟草条纹病毒引起的坏死病变得非常严重。从 2006 年起，由 *Golovinomyces orontii* 导致的白粉病变得非常严重。霜霉病是热带地区的主要病害，它在印度中部的部分地区较为常见。因此，如何从向日葵属栽培种及野生种中鉴定长久可用的抗性资源，是育种家长久以来面临的持续的挑战。我们从多年生的向日葵属二倍体材料中鉴定得到了抗 *A. helianthi* 的资源， 但可杂交性比较低(Sujatha et al. 1997)。我们从美国农业部引进了 16 份稳定的来源于野生种 *H. hirsutus, H. tuberosus,* 和 *H. strumosus* 的种间杂种材料用来评价它们对病原的反应，并试图将它们应用于育种实践中。鉴于缺少可靠的抗烟草条纹病毒的遗传资源，我们创建了含烟草条纹病毒外壳蛋白的转基因向日葵材料，从而使其具有抗坏死病的抗性(Vasavi et al. 2018)。从一年生二倍体材料（如 *H. argophyllus* 和 *H. praecox*）中，我们鉴定得到了抗白粉病的材料，目前我们正开展将抗性引入栽培材料中(Reddy et al.,

2013)。此外，我们对抗白粉病的供体材料，如 *H. praecox* (PRA 1823)，开展了蛋白质组和转录组分析，以期鉴定控制该病害的候选基因和关键调控通路(Reddy et al., 2018)。

关键词：生物技术工具，生物胁迫，种间杂交，野生向日葵

Confectionery Sunflower Hybrid Breeding Studies in Turkey: Current and Future Strategies

Yalcin Kaya and Necmi Beser
Trakya University, Engineering Faculty, Genetic and Bioengineering Department, Edirne, Turkey. Email: yalcinkaya22@gmail.com

Abstract

Sunflower (*Helianthus annuus* L.) is mainly grown as an oilseed in the world, but it is also one of most preferable for confectionery seeds. Confectionery production is generally produced on irrigated lands to obtain bigger kernel sizes, but it also produced on dryland with lower plant densities. As a summer crop, sunflower is affected by higher summer temperatures, especially during the grain filling period leading to more empty seeds. On the other hand, some biotic stress such as broomrape parasite (*Orobanche*), rust, *Verticillium*, downy mildew and weeds are the main yield reducing factors of confectionery sunflower. Although open-pollinated (OP) seed still exists in the world production, a big portion in some countries, confectionery hybrids provide higher seed yields and quality, homogenous and bigger size seeds, and are the main sunflower grown in almost all parts of the world. Therefore, most of confectionery sunflower breeding programs in the world focus on the develop of new hybrids having tolerance genes to biotic and abiotic stresses in addition to higher seed yield, bigger kernel sizes and greater adaptation capability. In Turkey, most confectionery seed is local OP seed (Inegol type). Turkish people mostly like consuming white colored seed with grey stripes, so all the production in Turkey is from these OP seeds. Although there are some registered confectionery hybrids in recent years, they are not yet a considerable part of the market share in Turkey. On the other hand, Clearfield system hybrids resistant to Imidazolinone (IMI) herbicide which controls both broomrape and also key weeds are starting to dominate markets in oil types, as well as the confectionery seed sector. The development of resistance genes to new races of broomrape and other diseases are not easy in confectionery

sunflower breeding, so IMI types solve both broomrape problem and especially broad-leaf weeds which are two devastating problems in sunflower production. On the other hand, higher oleic acid and tocopherols (vitamin E) content in the seeds increase both shelf life, and also nutritional quality of confectionery sunflower seed. Besides, some molecular methods especially MAS selection are useful tools both for developing new hybrids and inbred lines with greater accuracy and precision in selection accelerating breeding program in sunflower. Therefore, new confectionery sunflower inbred lines and hybrids should have resistant to both broomrape and some important diseases mentioned above and also be Clearfield type, as well as high oleic type and larger kernel size and yield capacity in the sunflower breeding program in Turkey. Furthermore, more heat tolerant hybrids, developing new plant phenotypes to increase leaf area with shorter petioles to increase plant numbers per unit area, new hybrids with increased heterosis for seed yield and quality will be main targets in sunflower breeding programs in the near future both in Turkey and other countries in the world.

Key words: confectionery sunflower, sustainable production, disease resistance, clearfield, hybrid breeding,

土耳其食葵杂交育种的研究：当前的情形和未来的发展趋势

Yalcin KAYA and Necmi BESER
Trakya University, Engineering Faculty, Genetic and Bioengineering Department, Edirne, Turkey. Email: yalcinkaya22@gmail.com

摘要

世界上向日葵多数是油葵，但是也有一些选育出的表现优良的供消费的食葵种子。食葵生产中，为了获得较大的籽仁，一般将食葵种植在灌溉区，但是也有以相对较小的密度种植在干旱地区。作为夏季作物，向日葵易受夏季高温的影响，特别是在籽粒灌浆期高温会导致更多的空壳。另一方面，一些生物胁迫，如寄生性列当、锈病、黄萎病、霜霉病和杂草也是降低食葵产量的主要因素。尽管一些国家大部分产区仍然存在开放授粉的种子，但是食葵杂交种表现出较高的产量、质量、均匀性和以及相对较大的籽粒，这使得向日葵杂交种的种植在世界向日葵产区几乎很普遍。因此，世界上多数食葵育种项目集中在培育新的除了籽粒产量高、籽仁大和适应性强外含有耐生物和非生物胁迫基因的杂交种。在土耳其，多数食葵属于开放授粉的农家种（Inegol type）。土耳其人多数喜欢消费白底灰条纹的葵花籽，所以土耳其的所有种植区种植的都是上述开放授粉的种子。尽管近几年在土耳其有一些登记的食葵杂交种，但是它们在土耳其并没有占很大的市场份额。另一方面，能够控制列当和主要杂草的抗咪唑啉酮类（IMI）除草剂的 Clearfield System 杂交种开始占领油葵和食葵市场。因为在食葵育种上培育含有抗列当新的生理小种和其它病害基因（的品种）并不容易，所以 IMI 型在向日葵生产中可以解决列当和阔叶杂草两大难题。另一方面，食葵种子中油酸和维生素 E 含量高，它们可以延长保质期并且提高营养质量。此外，一些分子方法，如分子标记辅助选择（MAS）是很有用的工具，在向日葵新品种和自交系选育中可以为育种家提供准确的信息，

同时也能够加快育种进度。因此，土耳其向日葵的育种目标是使新的食葵自交系和杂交种具有抗列当、抗上述提到的重要的病害、抗 IMI 除草剂等特性，同时要像油葵一样籽仁大且高产。此外，培育更多的耐热杂交种，培育新的有较大叶面积且短柄的植株而增加单位面积株数，并培育新的在籽粒产量和质量上有更好的杂种优势的杂交种，将在今后在土耳其和世界上其它国家成为主要的针对向日葵育种的目标。

关键词：食葵，可持续生产，抗病性，Clearfield

Sunflower Breeding Achievement and Challenges

Branislav Dozet
Syngenta Ltd., Aliz u 2, H-1117 Budapest, Hungary
Email:branislav.dozet@syngenta.com

Abstract

A highly segmented market, such as that of sunflower, can rapidly change the demands placed on breeders and their programs. Environmental variations also change the attitude of breeders themselves, by shifting the process from distinct programs based on the efforts of an individual to team-based programs. Effective delivery will require: increases in breeding efficiency, discovery and development of new native traits through interspecific hybridization and induced mutations, introduction of new methods and techniques, expedition of the selection process using methods such as Marker Assistant Selection (MAS) and MARS, efficient intra-/extra organizational material transfer (including the drafting and validation of material transfer agreements where necessary), strict breeder rights enforcement wherever possible, and the creation of joint programs in collaboration with public and non-profit institutions. One of the greatest challenges breeders face is improving the analysis and understanding of gene expression/regulation and the subsequent impact on individual phenotypes, the phenome, and the metabolome given the context of environment. Genome-based selection as a methodology is of a more recent date and has great prospects for the future. Information relating to the phenotype and genotype of a reference population enables the prediction of model parameters. One of the greatest challenges found in breeding today is the selection of genotypes which bear higher yields in ever more volatile and complex climate conditions. The adaptability of a genotype depends largely on introducing new traits into hybrids which provide better productivity and stability. Crop physiology should support the discovery of complex traits by taking advantage of data and knowledge integration under a Genotype by Environment approach. Characterization and elucidation of mechanisms for gene regulation in sunflower will have high impacts for our scientific, agricultural, and commercial aspirations in near future.

Key words: sunflower breeding, challenge, genome-based selection

向日葵育种取得的成就与挑战

Branislav Dozet
Syngenta Ltd., Aliz u 2, H-1117 Budapest, Hungary
Email:branislav.dozet@syngenta.com

摘要

像向日葵这样高度细分的市场，可以迅速改变育种家及其研究项目的需求。环境的变化育种家们的态度也会发生变化，从独立研究转向团度合作项目。有效的沟通和传达要求：提高育种效率、通过种间杂交和诱变创造全新的性状、引进新方法新技术、使用 MAS 和 MARS 的方法加速选育进程、有效的机构之间材料交换（必要时包括签署材料转移协议）、可能条件下严格的育种家权利约束、以及创造与公共组织与非营利机构携手合作。育种家面临的最大挑战之一是提高对基因表达/调控的理解以及后续对个体表型、表型组和特定环境中代谢调控的影响。基于基因组的选择是最新的很有前景的方法。与参照群体的表型和基因型有关的信息能够进行模型参数的预测。当前，育种上巨大的挑战之一是选择在不稳定和复杂气候条件下高产的基因型。一种基因型的适应性很大程度上取决于将新性状转移到杂交种中以提供高产和稳产的特性。作物生理学应当整合基因型与环境互作的数据和知识来开展复杂性状的发现和研究。阐明和揭示向日葵的基因调控机制将会对我们未来的科技、农业、商业产生巨大影响。

关键字：向日葵育种、挑战、基因选择

Progress and Research Direction of Sunflower Breeding in China

Lianshe Li, Deshou Wang, Yongping Zhang, Wanhu Hu
Sanrui Agritec Co. Ltd., Wuwei, Gansu China
Email: lilianshe941223408@sunriseseed.com

Abstract

In this paper, the development process and progress of Sunflower Breeding in China are summarized, the future development direction of Sunflower Breeding is prospected, and the problem of solving the theory of sunflower genetic breeding is solved; ideal plant type research, resistant breeding, quality breeding and mechanized harvesting are the direction of breeding, and a large number of germplasm resources have been introduced. the application of biotechnology and the technology of distant hybridization, multidisciplinary combined with various techniques and means, in order to help improve the breeding level of sunflower in China, and make our sunflower industry get more development.

Key words: confectionery sunflower, resistant breeding, technology

我国向日葵育种研究的进展及研究方向

李联社　王德寿　张永平　　胡万虎
三瑞农业科技股份有限公司
Email: lilianshe941223408@sunriseseed.com

摘要

本文概述了我国向日葵遗传育种的发展过程和取得的进展，对向日葵育种的未来发展方向做了展望；解决向日葵遗传育种理论上的问题；理想株型研究，抗性育种，品质育种和适用于机械化收割的品种选育是方向；引进大量的种质资源，应用生物技术和远缘杂交技术，多学科联合多种技术并用是手段；以期帮助提高我国向日葵育种水平，使我国向日葵产业取得更大发展。

关键字：食用向日葵，抗性育种，技术

Integration of Genetic Modification and Molecular Breeding in Crop Improvement

Maurice S. B. Ku
National Chiayi University (Taiwan China), Washington State University (USA)
Email: mku@mail.ncyu.edu.tw

Abstract

Crop improvement through conventional breeding relies on natural genetic variation. However, natural genetic variation in many crop species is limited. In these cases, artificial mutation has been induced by chemical mutagens, such as EMS and sodium azide, or T-DNA insertion through transformation. Mutants thus generated represent useful material for functional genomics study, and with desirable traits the mutants could be directly developed into cultivars or used as breeding stocks. Double haploid technology represents another important technology for production of truly homozygous plants with novel traits.
Modern marker-assisted molecular breeding largely improves the efficiency of breeding, facilitated by QTL, RAPD, or SNP. Transgenic approaches are also increasingly adopted for crop improvement with transgenes from different sources, breaking the genetic barrier. *Agrobacterium*-mediated plant transformation has been established in many crop species, but it requires a proper facility and lengthy tissue culture. Alternatively, pollen-mediated transformation via electroporation provides a simple and fast method to generate transgenic plants without the need for tissue culture. The modern CRISPR-Cas9 gene editing technology is gaining popularity in crop improvement, and the newest version bypasses the requirement of integrating foreign DNA into the host genome. These technologies will significantly impact agricultural production in the future.

Key words: Molecular breeding, chemical mutagenesis, double haploid technology, genetic transformation.

遗传修饰及分子育种的整合在作物改良中应用

Maurice S. B. Ku
National Chiayi University (Taiwan China), Washington State University (USA)
Email: mku@mail.ncyu.edu.tw

摘要

通过常规育种进行作物改良需要依靠自然遗传变异。然而，许多作物中自然遗传变异是非常有限的。在这样的情况下，就出现了人工诱变的方法比如 EMS、叠氮化钠、或通过转化的 T-DNA 插入的化学诱变。产生的突变体代表着功能基因组学研究的有用材料，有目标性状的突变体可以直接培育成栽培种或被用作育种材料。双单倍体技术代表了另一重要技术用于创造具体全新性状的纯合植株。

现代分子标记辅助育种技术借助 QTL, RAPD 和 SNP 等极大地提高了育种效率。转基因方法也越来越多地被用于不同来源的转基因作物改良，打破遗传障碍。农杆菌介导的植物转化已在许多作物种中建立，但需要适当的设施和耗时的组织培养。或者，通过电穿孔的花粉介导的转化提供了一种简单而快速产生转基因植物而不需要组织培养的方法。现代 CRISPR-CAS9 基因编辑技术在作物改良中越来越普遍，并且最新的方式不需要将外源 DNA 整合到宿主基因组中。这些技术将显著影响未来的农业生产。

关键词：分子育种、化学诱变、二倍体技术、遗传转化

Contribution of Interspecific and Intergeneric Hybridization in Sunflower Breeding

Michail Christov
Mihsan, 1750 Sofia, Bulgaria
Email: misho_h5@abv.bg

Abstract

The experiment covered a 30-year period. Its aim was to improve sunflower *Helianthus annuus* L. by conducting wide hybridization. Thirty-six species of *Helianthus* and 28 species of other genera of the *Compositae* family were included in the study. From cultivated sunflower, 16 varieties and 18 lines were used with their sterile analogs. Intraspecific, interspecific, and intergeneric hybridization and a targeted consecutive selection were conducted. New sunflower materials with bio-morphological, biochemical, and phytopathological characteristics were developed.

More than 65,000 F_1 hybrid plants were obtained from the interspecific hybridization, and more than 1,900 F_1 hybrid plants from intergeneric crosses. The following generations were derived; F_2, F_3, BCF_1, etc. until obtaining stable hybrid forms for creating new lines. Many of the new lines have resistance to downy mildew, phomopsis, phoma, alternaria, tolerance to sclerotinia, and full resistance to the new races of the parasite sunflower broomrape. The lines have a new plant architecture, different vegetation periods, and varying seed size and color. Developed A, B and R lines are characterized by high combining ability, high oil content, varying fatty acid composition of the oil, and an amino acid composition of the protein in the seed. These lines have been used to create and register six hybrid sunflower varieties; five oil types and one confectionery type.

Eighteen cytoplasmic male sterility (CMS) sources have been obtained from interspecific hybridization. Two hundred-seventy sources of fertility restorer genes (*Rf* genes) were established and transferred into cultivated sunflower. The new sources of CMS and *Rf* genes have greatly

diversified the genetic of the CMS-fertility restorers system that have been successfully used in heterosis breeding. As a result of this long study, new genetic material was transferred to the cultivated sunflower and contributed interspecies and intergeneric hybrids for use in breeding sunflowers.

Key words: *Compositae*, *Helianthus*, interspecific hybridization, CMS lines

种间和属间杂交对向日葵育种的贡献

Michail Christov
Mihsan, 1750 Sofia, Bulgaria
Email: misho_h5@abv.bg

摘要

本试验前后历时 30 年，目的是通过远缘杂交来对一年生向日葵材料进行改良。本研究所使用的材料包括向日葵属的 36 个种和 28 个位于菊科其它属的种，而栽培向日葵的 16 个品种和 18 个自交系作为受体材料。本研究进行了种内、种间和属间杂交，并对目标性状进行连续选择。在此过程汇总，我们对产生的向日葵新材料进行生物形态、生物化学和植物病理学特性等研究。

通过种间杂交和属间杂交，我们分别获得了超过 65,000 株和 1,900 株的 F_1 代杂交种。在此基础上，我们获得了 F_2，F_3，BCF_1 等衍生后代，直到获得稳定的自交系材料。新获得的自交系多数具有抗霜霉病、茎溃病、黑茎病、黑斑病、耐菌核病等抗性，并且全部具有针对寄生性列当新的生理小种的抗性。这些自交系具有新型株型，并表现出不同的营养生长期、籽粒大小和颜色。育成的保持系/不育系和恢复系具有高配合力和高籽粒含油量等特点，并且具有不同的脂肪酸组成和氨基酸组成。在育成的材料中共登记注册了 6 个向日葵杂交种（包括 5 个油用型和 1 个食用型）。

通过种间杂交获得了 18 个细胞质雄性不育系（CMS），并发现和转育了 270 个恢复基因（Rf genes）到栽培向日葵中。新的 CMS 和 Rf 基因资源使遗传体系（CMS 和 Rf）的多样性大大增加，并且这些资源在杂交育种中得以成功运用。

作为我们长期研究的成果，新的遗传基因转移到了向日葵栽培种，并使种间杂交和属间杂交等手段在向日葵育种中得以成功运用。

关键词：菊科，向日葵，种间杂交，自交系

Intergeneric Hybridization of *Helianthus annuus* L.and *Carduus acanthoides* L.

Miroslava Hristova-Cherbadzhi
Mihsan, 1750 Sofia, Bulgaria
Email: mihsan2013@abv.bg

Abstract

Carduus acanthoides L. (spiny plumeless thistle) is a perennial wild species with 2n=22 chromosomes. Using this plant and *Helianthus annuus* L., an intergeneric hybrid was made. After crossing, it was established that *C. acanthoides* pollen germinated on the stigmas of sunflower lines HA 89A at 48 hours. The crossability rate was low, but seed was set and hybrid plants obtained. The F_1 plants strongly resembled the cultivated sunflower in the most important bio-morphological characters even though they had an intermediate type of heritability. The hybrid nature was confirmed through cytological and RAPD methods. The polymorphism between *H. annuus* and *Carduus acanthoides* and theirs F_1-hybrids was studied using RAPD. The result showed introgression of *C. acanthoides* in the hybrid progeny. It was established that the spiny plumeless thistle carried R_f genes for CMS PET-1. As a result, self-pollination and sib-pollination of the F_1 plants and back-crossing with cultivated sunflower, F_2, BC_1 and hybrid progenies were obtained. Some of the new lines were included in a breeding program for developing heterotic sunflower hybrids for the market.

Key words: *Carduus acanthoides*, sunflower, cytology, intergeneric hybridization, RAPD

一年生向日葵与 Carduus acanthoides L.的杂交

Miroslava Hristova-Cherbadzhi
Mihsan, 1750 Sofia, Bulgaria
Email: mihsan2013@abv.bg

摘要

Carduus acanthoides L. (spiny plumeless thistle)为多年生野生种（2n = 22）。将该材料与一年生向日葵杂交。杂交 48 小时后，将落在 HA89 品系柱头上的 *C. acanthoides* 花粉进行固定。二者杂交亲和力很低但可获得种子和杂交植株。尽管具有中等遗传力，但 F_1 代植株最重要的生物形态特征非常类似于栽培向日葵。它们的杂种性质通过细胞学和 RAPD 方法得到了验证。利用 RAPD 方法研究了一年生向日葵、*Carduus acanthoides* L 与其 F_1 代杂交种之间的多态性并在杂交后代中检测到 *C. acanthoides* 的基因渗入。*C. acanthoides* 野生种具有恢复 CMS Pet-1 的 Rf 基因。F_1 代通过自花授粉，姊妹交以及与栽培向日葵回交，可以获得 F_2，BC_1 和后代杂种。一些新的品系已被用于育种体系中用来培育市场上需要的向日葵杂交种。

关键词：*Carduus acanthoides L.* 、向日葵、细胞学、种间杂交、RAPD

Breeding of Confectionery Sunflower Varieties in VNIIMK

Iakov Demurin
VNIIMK, All-Russia Research Institute of Oil Crops, ul. Filatova 17,
KRASNODAR 350 038, RUSSIA
E-mail: yakdemurin@yandex.ru

Abstract

During the last five years, the production of confectionery sunflower in Russia was about one million hectares annually. This is about 12% of the total area of sunflower production. Large-seeded open pollinated confectionery varieties are mainly grown in commercial fields in Russia. From a botanical point of view, the achenes of these OP varieties are of an intermediate type between confectionery and oilseed hybrids. The weight of thousand achenes of these varieties is 100-120 grams; the oil content is 45-47%, and the hull content 28-30% at a plant density of 40 thousand plants per hectare. VNIIMK (Krasnodar) breeding varieties belong to the maturity group with 110 to 120 day vegetation period. New directions of breeding of confectionery varieties are associated with the development of high-oleic, imidazolinone and tribenuron-methyl resistant genotypes.

Key words: confection sunflower, achenes, oil, hull, variety

VNIIMK 食葵品种的选育

Iakov Demurin
VNIIMK, All-Russia Research Institute of Oil Crops,
KRASNODAR 350 038, Russia
E-mail: yakdemurin@yandex.ru

摘要

近 5 年来，俄罗斯食葵的种植面积每年约为 100 万公顷，占向日葵种植面积的 12%。大籽粒开放式授粉食葵品种目前在俄罗斯主要是商业种植。从植物学的角度来看，这些开放授粉品种的瘦果为介于食葵和油葵之间的中间类型。在种植密度为每公顷 4 万株情况下，品种的千粒重为 100-120 克，含油量在 45-47%之间，果壳比例为 28-30%。VNIIMK 培育的品种属于不同的成熟区，营养生长从 110 天-120 天。食葵选育的新方向是培育高油酸、含有抗咪唑啉酮类与抗苯磺隆类的品系。

关键词：瘦果；向日葵；油；果壳；品种

A Germplasm Collection of Confectionery Sunflower Landraces from Spain

Leonardo Velasco, José M. Fernández-Martínez, Begoña Pérez-Vich
Institute for Sustainable Agriculture (IAS-CSIC), Córdoba, Spain.
Email: bperez@ias.csic.es

Abstract

Confectionery sunflower has been traditionally cultivated in Spain in small vegetable gardens since its introduction from the New World in the 16th century. This created great genetic diversity in the form of local landraces, which have been collected for conservation and characterization. The germplasm collection consists of 195 accessions, which are maintained at the National Plant Genetic Resource Center (CRF; http://wwwx.inia.es/inventarionacional/Introduccioneng.asp). Evaluation of the collection, conducted in Córdoba (Spain) in 2011, 2012, and 2013, revealed large variation for morphological, phenological, and biochemical traits. Great variability was particularly observed for hundred-seed weight (4.2 to 19.7 g), plant height (65.0 to 361.7 cm), head diameter (9.0 to 31.0 cm), seed length (0,9 to 1,8 cm), days to flowering (64.3 to 163.0), oil content (16.0 to 29.8%), fatty acid profile (e.g. oleic acid from 22.9 to 63.9%), kernel tocopherol content (114.0 to 423.2 mg kg^{-1}), kernel squalene content (12.0 to 128.1 mg kg^{-1}), kernel phytosterol content (1344.0 to 2942.5 mg kg^{-1}), and phytosterol profile (e.g. β-sitosterol from 32.3 to 66.1%; Δ^7-stigmastenol from 7.1 to 35.2%). The analysis of the genetic structure of the germplasm collection with a set of 52 SSR markers revealed the existence of two genetic groups, one of them widely distributed geographically and another one linked to a reduced area in the north of Córdoba Province. Genetic diversity of this germplasm collection can be of great utility for widening the genetic base of cultivated sunflower in breeding programs.

Key words: Fatty acids, genetic structure, germplasm evaluation, oil content, seed quality traits

西班牙食用向日葵地方品种种质资源的收集

Leonardo Velasco, José M. Fernández-Martínez, Begoña Pérez-Vich
Institute for Sustainable Agriculture (IAS-CSIC), Córdoba, Spain.
Email: bperez@ias.csic.es

摘要

食用向日葵自十六世纪引入西班牙以来，主要用传统的栽培方法种植在小蔬菜园中。这种形式使地方品种具有遗传多样性，并被收集和保存下来。入库编号的种质资源有 195 个，主要保存在国家植物遗传资源中心（CRF；http://www*.iia.sEs/StutoRea-Nosial/PixCioNo.asp）。2011、2012 和 2013 年在科尔多瓦（西班牙）对收集的种质进行评价，并得出从形态学、物候学和生化特性方面表现出很大的变异性。变异性最大的是籽仁百粒重（4.2～19.7 克）、株高（65～361.7 厘米）、花盘直径（9～31 cm）、种子长度（0.9～1.8 cm）、开花期（64.3～163）、含油量（16～29.8%）、饱和脂肪酸组成（如油酸含量在 **22.9 到 63.9%之间**）、籽仁生育酚含量（在 114-423.2 mg kg-1 之间）、籽仁植物甾醇含量（12-128.1 mg kg-1）、核仁甾醇含量（1344-2942.5 mg kg-1）、植物甾醇谱（如 β-谷甾醇在 32.3-66.1%之间；δ7-雌甾醇在 7.1-35.2%之间）。利用 52 个 SSR 标记对收集的种质资源的遗传结构进行分析，发现两个遗传类群，一个在地理上分布广泛，另一个与科尔多瓦省北部不断减少的种植面积紧密相关。种质资源的遗传多样性对栽培向日葵育种中拓宽向日葵的遗传基础具有重要意义。

关键词：脂肪酸、遗传结构、种质评价、含油量、种子品质性状

Sunflower Seed Production and Processing in Romania

Maria Joita-Pacureanu
National Agricultural Research and Development Institute, Fundulea, 1 Nicolae Titulescu, Fundulea, Calarasi County, Romania
Email:pacurean@ricic.ro; mariapacureanu2@yahoo.com

Abstract

The sunflower crop has an important place in world agriculture due to many advantages; the capacity for high seed yield and good oil content. Sunflower kernels are used in industry for obtaining healthy oil for human consumption, as well as the secondary use in animal feed. Since the first sunflower hybrids were developed with high oil content, cultivated sunflower production has increased all over the world, including Romania. There have been sunflower hybrids developed with low oil content and high protein content that are used as confectionery sunflower. Romania has the largest area of cultivated sunflower in the EU. Each year it cultivates around 1 million hectares. Also, Romania has the highest sunflower seed production in EU. In 2017 on 1.010 million hectares it produced 3.16 million tones. Unfortunately, 60% of the seed goes to export, and only 40% is processed in the country. Romania also exports sunflower oil, exporting 2.7 times more oil than importing. There are many oil factories producing very high quality oil with good color, good smell, high nutritive value (90% unsaturated fatty acids), high stability, and high capacity for a long period of use. The oil factories have different processing capacities from 150 to 2,200 tones/day. In recent years there have been factories developed for producing sunflower crude oil by using a cold pressing method. Many of these are small family factories, but they are producing very healthy and high quality oil (many receiving Awards at some International Exhibitions). In Romania, confection hybrids are produced, but not enough to meet the consumption demand. People know the benefits of sunflower seeds referring to therapeutic and nutritive value (many vitamins and minerals), and as a valuable source of quality protein. There are many small factories for dehulling and for packing sunflower seeds. Much of the confectionery type sunflower seed is imported from Bulgaria, Turkey or Spain.

Key words*:* sunflower, seed production, market, processing

罗马尼亚葵花籽的生产和加工

Maria Joita-Pacureanu
National Agricultural Research and Development Institute, Fundulea, 1 Nicolae Titulescu, Fundulea, Calarasi County, Romania
Email:pacurean@ricic.ro; mariapacureanu2@yahoo.com

摘要

由于具有籽粒产量高、含油量高等多种优良性状，向日葵在世界农业中具有很重要的地位。葵花籽在工业上被用来作为供人类使用的食用油，还被用作动物饲料。自从第一个具有高油向日葵杂交种被培育成功，向日葵在世界上的种植面积显著增加，罗马尼亚就是其中之一。此外，育种家还培育出含油量低且蛋白质含量高的向日葵杂交种，被用作食用向日葵。

罗马尼亚是欧洲向日葵种植面积最大的国家。全国每年种植面积在 100 万公顷左右。罗马尼亚的葵花籽产量也在欧洲占比例最高。2017 年，罗马尼亚全国种植了 101 万公顷向日葵，葵花籽产量达 316 万吨。遗憾的是，收获的葵花籽中，60%用于出口，仅有 40%留在国内进行加工。罗马尼亚也出口葵花油，使得每年的食用油出口量比进口高出 2.7 倍。

罗马尼亚有很多工厂生产高品质的葵花籽油，它们具有以下优点：色泽好、味道好、营养价值高（含 90%不饱和脂肪酸）、稳定性好、及储存时间长。不同工厂对油的加工能力不同，每天的加工量在 150-2200 吨之间。

过去几年，我国涌现出多家通过低温压榨生产葵花籽原油的工厂。这些工厂中，虽然许多属于家族企业，但是能生产非常健康和高品质的食用油（它们在国际展览会上已获得很多奖项）。

罗马尼亚也种植食用向日葵杂交种，但是不能满足消费。人们已经了解了葵花籽有益健康和具有较高的营养价值的好处（如富含维生素和矿物质），并且是高质量蛋白质的有益来源。罗马尼亚国内分布有多家规模较小的葵花籽去壳和包装的工厂。然而，多数食用型葵花籽还需要从保加利亚、土耳其和西班牙进口。

关键词：向日葵，种子生产，市场，加工

Applications of Molecular Breeding Technologies in Commercial Crop Breeding

Jinhua Xiao
Huazhi Rice Bio-Tech Co., LTD, Changsha, China
Email: Jinhua.Xiao@wiserice.com.cn

Abstract

Molecular breeding is a new field that emerged in the early 1990s evolving from plant genomics, molecular biology, molecular genetics, quantitative genetics, and breeding. In a broad sense, it is the application of molecular marker, transgene, and gene editing technologies in traditional plant breeding. Molecular breeding technologies, innovating breeding methodologies and discovering/creating novel genetic variation, have been widely applied to commercial breeding programs of large multi-national seed companies since the discovery of SNPs and the advent of high throughput SNP genotyping technologies, and are the competitive advantages of the world's largest seed companies. In this talk, molecular breeding technologies will be seamlessly integrated into all aspects of traditional breeding process, including genetic diversity assessment of breeding materials, parental line selection and cross design of segregating breeding populations, marker-assisted selection (MAS) of major genes/QTL, marker-assisted recurrent selection (MARS), linkage drag elimination or minimization, marker-assisted backcross conversion (MABC), genome-wide selection (GWS) of polygenic traits, GWS-guided creation of heterotic hybrids, SNP marker-based assessment of genetic purity of advanced breeding lines and hybrid seeds, and DNA fingerprint-based protection of proprietary varieties or hybrids will be presented. Trends in molecular breeding will also be discussed.

Key words: crop breeding, molecular breeding, marker-assisted selection,

分子育种技术在商业育种上的应用

肖金华
华智水稻生物技术有限公司, 中国湖南长沙
Email: Jinhua.Xiao@wiserice.com.cn

摘要

分子育种作为全新的领域最早出现在 20 世纪 90 年代，涉及植物基因组学、分子生物学、分子遗传学、数量遗传学和育种学。广义上讲，分子育种是分子标记、转基因和基因编辑技术在常规植物育种中的应用。因为 SNPs 的以及高通量 SNP 基因分型技术的出现，分子育种技术、新的育种方法以及发现和创造新的遗传变异已经广泛运用于许多跨国种业巨头公司的商业育种中并成为世界种业巨头竞争的优势。本演讲中，分子育种技术完全融入传统育种的各个方面，包括育种材料遗传多样性的评估、亲本自交系的选择和分离育种群体的杂交设计、主效基因或 QTL 分子标记辅助选择（MAS）、标记辅助轮回选择（MARS）、去连锁累赘或连锁累赘最小化、分子标记回交转育（MABC）、对多基因性状的全基因组选择（GWS）、基于全基因组选择的优势杂种的选育、基于 SNP 标记的高代自交系及杂种的遗传纯度评估，基于 DNA 指纹图谱的自主研发的品种或杂种的知识产权的保护。并进一步讨论分子育种的未来趋势。

关键词：作物育种、分子育种、分子标记选择

Assessment of Genetic Variability for Yield and Other Characters in Confectionery Sunflower (*Helianthus annuus* L.)

Mysore Shivappa Uma* and Girishraj Urs
AICRP on Sunflower, ZARS, GKVK, Bengaluru- 560065,
Karnataka, India
E-mail: umauas@gmail.com

Abstract

A study was undertaken at the University of Agricultural Sciences, Bangalore, Karnataka, India to assess the genetic variability, correlation, path coefficient analysis, and diversity in confectionery sunflower (*Helianthus annuus* L.) germplasm. The study material consisted of 48 genotypes including 47 confectionery sunflower germplasm lines and a check variety Surya. They were evaluated for ten characters: days to 50% flowering; plant height; head diameter; per cent seed filling; seed yield per plant; 100 seed weight; 100 kernel weight; hull content; oil content; and protein content. The study revealed a wide range of variability and high heritability for all the characters. Phenotypic coefficient of variation was found to be more than genotypic coefficient of variance with respect to all the characters studied. The expected genetic advance as a per cent of the mean was high for plant height, head diameter, seed yield per plant, 100 seed yield, 100 kernel weight, hull content and protein content. Correlation studies revealed that seed yield per plant was positively associated with all other characters, except with hull content and oil content. The maximum direct effect on seed yield per plant at the phenotypic level was accounted by head diameter. D^2 analysis of all ten characters revealed that protein content contributed greatly to genetic divergence. Twenty five sunflower specific SSR primers were used for genetic characterization of the 48 confectionery sunflower germplasms. Of the 25 SSR primers used, 10 primer pairs (ORS331, ORS694, ORS728, ORS785, ORS807, ORS878, ORS 378, ORS1265, ORS1265, and ORS1242) showed polymorphism. A high level of polymorphism

(66.66%) was reported in this studying with the number of alleles in SSR loci ranging from 2 to 4, with an average of 2.5. The present study identified five the promising confectionery sunflower lines, EC 734807, EC 734808, EC 734810, EC734860 and EC 734817 for protein, yield and other desirable confectionery characters. Hence, these genotypes can be selected and advanced for further breeding and can be used as potential donors' in future sunflower hybridization programs.

Key words: sunflower, confectionery, germplasm, SSR markers

食用向日葵产量和其它性状遗传变异评估

Mysore Shivappa Uma* and Girishraj Urs
AICRP on Sunflower, ZARS, GKVK, Bengaluru- 560065,
Karnataka, India
E-mail: umauas@gmail.com

摘要

本研究中，我们在印度卡纳塔克邦班加罗尔农业科技大学对食用向日葵种质的遗传变异、相关性、通径系数和多样性进行了评估。本研究以47个食用向日葵种质自交系，并使用Surya为对照材料。对48个材料的10个性状进行了评估，包括：50%的植株开花的时间、株高、花盘直径、籽粒灌浆百分率、单株籽粒产量、百粒重、籽仁百粒重、壳含量、含油量和蛋白质含量。研究表明，这些性状的变异范围宽且遗传力高。本研究中所有性状的表型变异系数均大于基因型变异系数。株高、花盘直径、单株籽粒产量、百粒重、籽仁百粒重、壳含量及蛋白质含量的预期遗传进度均较高。相关性研究表明，单株籽粒产量与所有性状呈正相关，但壳含量和含油量除外。花盘直径从表型上对单株籽粒产量的影响最大且最直接。对10个性状的D2分析表明，蛋白质含量对遗传分化的贡献最大。使用25个特定的SSR引物评估了48个食用向日葵种质的遗传特性。在25对引物中，10对引物（ORS331，ORS694，ORS728，ORS785，ORS807，ORS878，ORS378，ORS1265，ORS1265，ORS1242）具有多态性。该结果呈现了高水平的多态性（66.66%），SSR位点等位基因的数目在2-4之间变化，平均为2.5。本研究表明，食用向日葵自交系EC734807, EC734808，EC 734810，EC734860 和 EC 734817在蛋白质和产量方面具有理想的食用向日葵性状。因此可以将这些基因型作为潜在的基因供体，在未来的育种和杂交实践中加以应用。

关键词：食用向日葵、种质、SSR标记

Achievements and Future Prospects of NS Confectionery Breeding Program

Nada Hladni*, Vladimir Miklič, Siniša Jocić, Dragana Miladinović, Aleksandra Dimitrijević, Milan Jocković, Sandra Cvejić, Boško Dedić, Ana Marjanović Jeromela
Institute of Field and Vegetable Crops (IFVCNS), Novi Sad, Serbia
Email: nada.hladni@ifvcns.ns.ac.rs

Abstract

In the past decade confectionery sunflower has become an essential part of human nutrition and diet programs. Confectionery sunflower breeding is characterized by the fact that different markets have different demands regarding seed size, hull color and other traits, which makes this process more difficult and costly. When creating confectionery hybrids, it is very important to combine genes responsible for high yield potential and good technical and technological traits of the seed. It is expected that highly-productive confectionery hybrids will replace confectionery varieties, which will influence the production of confectionery sunflower. Market demands for confectionery sunflower seeds convinced the Institute of Field and Vegetable Crops, Novi Sad to initiate a special breeding program with the aim of developing modern confectionery open-pollinated hybrids. The specific breeding goals for confectionery sunflower are: increase of protein content and quality >25%; low oil content <40%; oil stability with increase of kernel ratio and decrease of hull ratio; 1000 seed weight >100g; easy dehulling; uniformity of seed size; shape and color; as well as tolerance to dominant diseases and broomrape in regions of cultivation and seed quality maintenance during long term storage. An important part of the breeding program is testing new genotypes and finding genotypes that are distinguished by the stability of the tested properties in different agroecological conditions for easier choices and recommendation of confectionery sunflower hybrids. Continuous work on the creation of new highly productive low-oil sunflower hybrids of the confectionery type resulted in an assortment of

hybrids offered by IFVCNS in both Serbian and for the world market. In Serbia, domestic and foreign confectionery varieties with large black seeds have been replaced by NS confectionery hybrids, such as NS Gricko, NS Slatki, NS Garavi and NS Leviathan. These hybrids have lower oil content compared to standard hybrids (below 40%) with a protein content of over 20% and good stability and adaptability. The cooperation and exchange of breeding material from different breeding centers, as well as creation of joint hybrids has gained importance in recent years as a tool for creation of new, more resilient and productive confectionery hybrids, ready to face both challenges from the market and changing climate.

Key words: confectionery sunflower, seed yield, breeding goals, market request

食葵育种体系的成就与展望

Nada Hladni*, Vladimir Miklič, Siniša Jocić, Dragana Miladinović, Aleksandra Dimitrijević, Milan Jocković, Sandra Cvejić, Boško Dedić, Ana Marjanović Jeromela
Institute of Field and Vegetable Crops (IFVCNS), Novi Sad, Serbia
Email: nada.hladni@ifvcns.ns.ac.rs

摘要

在过去的十年里，食葵已经成为人类营养和饮食必不可少的一部分。食葵育种的特点是基于不同市场的不同需求，包括种子大小、种壳色泽和其它性状，这使得育种的进程变得较困难，费用较高。在培育新的食葵杂交种时，结合控制种子高产潜力的基因、高新技术以及技术特征是很重要的。预计具有高产的食葵杂交种会取代自留食葵品种，使食葵产量增加。食葵种子的市场需求也影响了大田和蔬菜作物研究所，因此在 Novi Sad 发起了一项特殊的育种项目，目的是改进现代食葵开放授粉的杂交品种。食葵具体的育种目标是: 提高蛋白质的含量和质量> 25%、低油量< 40%、稳定的含油量、提高种仁比、降低果壳率，千粒重> 100 克、易脱壳、种子大小、形状及颜色一致，在种植地区耐主要的病害和列当以及种子易长期保存。育种项目的一个重要部分是测试新品种的基因型及在不同的农业生态条件下的稳定性，为食葵杂交种选育不同的基因型提供便利。不断致力于创造新的高产低含油量食葵杂交种，使得 IFVCNS 在塞尔维亚和世界市场上提供的品种不断变化。在塞尔维亚，大量黑色籽粒的国内外食葵品种已被 NS 食葵杂种取代，比如 NS Gricko、NS Slatki、NS Garavi 和 NS Leviathan。含油量较标准（低于 40%）低，这些杂交种的蛋白质含量大于 20%，稳定性好且适应性强。近年来，不同育种中心的合作及育种材料的交换，以及共同培育杂交种都变得很重要，这已成为新的育种工具，可以创造更多的有抗性且高产的食葵杂交种，去面对来自市场和气候变化的挑战。

关键词：食葵、产量、育种目标、市场需求

Effect of Floret Whorls and Culture Media on Anther Culture in Sunflower

Khamsee Saensee[1], Thitiporn Machikowa[2], Yalcin Kaya[3], Nooduan Muangsan[1,*]
[1] School of Biology, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand
[2] School of Crop Production Technology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand
[3] Genetic and Bioengineering Department, Engineering Faculty, Trakya University, Edine, 22030, Turkey
Email: nooduan@sut.ac.th

Abstract

The main aim of this research was to investigate the effect of floret whorls and culture media on haploid plant production via anther culture in sunflower. Three outermost unopened disk florets of the flower head at the R5.1 reproductive stage of three sunflower varieties including S473, Pacific 22 and Prado Red were used in this study. For haploid plant production via anther culture, anthers were cultured on various callus induction media for 30 days, and the anther-derived embryogenic calli were subsequently induced on shoot induction medium for 14 days. Then, the embryogenic calli were immerged in 100 and 300 μM of colchicine solution for 3 and 6 hours for chromosome doubling. The polyploidy level was determined with flow cytometry. It was found that callus growth parameters (callus size, fresh weight, and dry weight), the percentage of callus and the percentage of embryogenic calli were significantly affected by medium types. MS medium supplemented with 2 mg/l NAA, 1 mg/l BAP and 10% (v/v) CW induced the highest percentage of calli for all three varieties with the highest frequency of 65.48%. For shoot induction study, embryogenic calli gave the best response on MS medium supplemented with 2 mg/l BAP, 500 mg/l CH and 0.2% activated charcoal. Some embryogenic calli could develop into shoot or root but not a complete plant. Colchicine concentrations and treatment durations had a significant effect on the survival rate and growth of callus. Optimization of anther culture with regard to high efficiency shoot regeneration needs to be further investigated.

Key words: sunflower, microspore, colchicine, *in vitro* regeneration, anther

轮生花和培养基对向日葵花药培养的影响

Khamsee Saensee[1], Thitiporn Machikowa[2], Yalcin Kaya[3], **Nooduan Muangsan[1, *]**

[1] School of Biology, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand

[2] School of Crop Production Technology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand

[3] Genetic and Bioengineering Department, Engineering Faculty, Trakya University, Edine, 22030, Turkey

Email: nooduan@sut.ac.th

摘　要

本研究的主要目的是通过向日葵花药培养，探究轮生花和培养基对单倍体植株产生的影响。试验选用S473、Pacific 22 和 Prado Red 三个向日葵品种，在R5.1生殖生长期选花盘最外面未开放的管状花为材料。通过花药培养增加单倍体植株，将花药在不同的愈伤组织诱导培养基上培养30天，随后由花药得到的的胚性愈伤组织在芽诱导培养基上培养14天。之后将胚性愈伤组织在 100和300 μM的秋水仙素溶液中分别浸泡3小时和6小时，进行染色体加倍。用流式细胞术测定染色体倍数。结果表明培养基类型对愈伤组织的生长参数（愈伤组织大小、鲜重和干重），愈伤组织的百分比和胚性愈伤组织的百分比具有显著影响。MS培养基中添加2mg/lNAA，1mg/lBAP和10%（v/v）CW对三个品种愈伤组织的诱导百分比最高，为 65.48%。在芽诱导试验中，胚性愈伤组织在添加2mg/lBAP/500mg/l CH和0.2％活性炭的MS培养基上表现最佳。一些胚性愈伤组织可以发育成芽或根，但不能发育成完整的植株。秋水仙素的浓度和处理时间对愈伤组织的存活率和生长具有显著影响。关于花药培养对高效的芽的再生和优化还需进一步研究。

关键词：向日葵，花粉粒，秋水仙素，离体再生，花药

Prebreeding and Genetic Enhancement of Cultivated Sunflower (*Helianthus annuus* L.)

Hari Prakash Meena*, Sujatha Mulpuri, Mangesh Y. Dudhe and A. Vishnuvardhan Reddy
ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad-500 030, India
Email: meena.hp@icar.gov.in

Abstract

The production and productivity of a sunflower crop is adversely affected by different biotic and abiotic stresses, and reliable genetic sources with high levels of resistance or tolerance to biotic (SND, Leaf curl virus, Alternaria and powdery mildew) and abiotic stresses (drought and salinity) are not available in the cultivated sunflower. In contrast, wild *Helianthus* species having potential to thrive well under climatic extremes and harbour many useful genes for exploitation in breeding programmes. Pre-breeding activities using promising wild sunflowers and popular cultivars have been initiated at the ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, to increase the frequency of useful genes, wider adaptability, and to provide a broad genetic base. Towards this goal, we have used six accessions of *Helianthus annuus* (wild) (ANN-232, ANN-243, ANN-1270, ANN-1272, ANN-1486 and ANN-1624) for improvement in seed yield and oil content; four accessions of silver leaf sunflower *H. argophyllus* (ARG-153, ARG-1317, ARG-1575 and ARG-2126) for incorporation of tolerance to powdery mildew, downy mildew, drought and leaf hopper; two accessions of *H. praecox* (PRA-1823 and PRA-1154) for powdery mildew tolerance; two accessions of *H. debilis* (DEB-369 and DEB-691) for powdery mildew resistance and high seed yield, and one accession of *H. petiolaris* (PET-1910) for seed yield and oil content. Wider variability was observed for cytomorphological traits besides disease reactions within species and between species in interspecific hybrids (F_1s), BC_1F_1, BC_2F_1, and BC_2F_2 generations. Interspecific cross combinations with *H. praecox* (PRA-

1823) and *H. debilis* (DEB-369) were found to be resistant to powdery mildew in F_1 as well as in the advanced generations. Seed yield was reported high in combinations with *H. annuus* (wild) (91.0 g/plant), *H. petiolaris* (64.2 g/plant), *H. debilis* (73.0 g/plant) and *H. argophyllus* (65.2 g/plant). The highest oil content (38.9%) was reported in combination with *H. praecox* (PRA-1154). Generation advancement and introgression of resistance to biotic and abiotic stresses is under way. Evaluation of a few populations for biotic stresses and yield related traits resulted in the identification of desirable introgression lines that have been shared with the All India Coordinated Research Project (AICRP) centres for use in breeding programs. Overall, prebreeding ensures a continuous supply of novel and diverse genetic variability derived from wild species in readily usable form into the breeding pipeline to develop new climate-resilient cultivars with a broad genetic base.

Key words: diploid annuals, interspecific derivatives, meiotic configurations, prebreeding, wild sunflowers

栽培向日葵(*Helianthus annuus* L.) 的前育种和遗传改良

Hari Prakash Meena*, Sujatha Mulpuri, Mangesh Y. Dudhe and A. Vishnuvardhan Reddy
ICAR-Indian Institute of Oilseeds Research, Rajendranagar, India
Email: meena.hp@icar.gov.in

摘要

向日葵作物的生产和生产力受到不同生物和非植物胁迫的不利影响, 稳定的遗传来源对生物胁迫(叶卷曲病毒、斑点和白粉病)和非生物胁迫(干旱和盐度) 具有较高水平的抗性或耐受性，但栽培向日葵不具此特点。相反，野生向日葵在极端的气候条件下具有良好的生长潜力并具体很多有用基因可以用于育种中。在ICAR海得拉巴印度油籽研究所,已经启动了研究项目用一些有潜力的野生向日葵和常规品系去提高有效基因的频率，拓宽它的适应性，提供一个广泛的遗传基础。基于这一目标，我们使用6个编号分别为(ANN-232, ANN-243, ANN-1270, ANN-1272, ANN-1486 和ANN-1624)的野生向日葵，提高种子产量和含油量；4个编号为 (ARG-153, ARG-1317, ARG-1575 和 ARG-2126)的银叶向日葵用于白粉病抗性、霜霉病、抗性和叶蝉的研究；编号为(PRA-1823和PRA-1154)的向日葵用于白粉病抗性研究；编号为(DEB-369和DEB-691)的品系用于向日葵高产抗白粉病研究；编号为(PET-1910)的品系用于种子产量和含油量研究。

在种内和种间杂交种中，除病害反应外，(F_1s), BC_1F_1, BC_2F_1, 和 BC_2F_2代的细胞形态特征表现广泛变异。种间杂交组合*H. praecox* (PRA-1823) 和*H. debilis* (DEB-369) 的F_1代及后续的几代中发现抗白粉病品系。在野生品系*H. annuus* (wild) (91.0 g/plant), *H. petiolaris* (64.2 g/plant), *H. debilis* (73.0 g/plant) 和*H. argophyllus* (65.2 g/plant)的杂交中发现高产特性。报道称在与 *H. praecox* (PRA-1154)的杂交中含油量最高(38.9%)。目前正在进行加代繁殖并导入生物和非生物胁迫抗性基因。对生物胁迫和与产量相关的性状进行评估并与印度协调研究项目(AICRP)中心共享这些资源。总之，前育种项目确保了充分利用野生种中存在的新的广泛的遗传多样性，以培育适应气候变化的栽培新品种。

关键词：二倍体一年生植物、种间杂交衍生、减数分裂构型、前育种、野生向日葵

Application of Precision Irrigation Technology for Sunflower Water Saving in the Hetao Irrigation District

Sheng-Feng Kuo
KangNing University, Taiwan, China
Email: kuosf123@gmail.com

Abstract

The Hetao Irrigation District diverts 50 billion cubic meters of water annually from the Yellow River for irrigation, which exceeds its water rights by 10 billion cubic meters. Thus, the annual supply of irrigation water was 25% insufficient in this area. Due to an annual average rainfall of only 130~150 mm and evaporation of up to 2000~2400 mm, irrigation is important for crop production in this area. The irrigated area is 48 million hectares and the sunflower planted area accounts for up to one quarter of the total water use in the Hetao Irrigation District. Sunflower is an important economic crop for farmers and this region.

Precision irrigation, integrated with Internet of Things (IoT) technology, can achieve the goal of irrigation water saving. The elements and procedures include: (1) installation of on-farm sensors and transmitters (e.g. soil moisture, water meter, agricultural weather station), (2) creation of Internet of Things (IoT) systems (e.g. LoRa, NbIot), (3) development of a precision irrigation platform to analyze large data and perform optimal irrigation decisions, and (4) development of a mobile phone APP for farmers and managers to receive on-farm real-time information. Recently, many countries have developed precision irrigation systems for efficient utilization of water resources, including as follows: (1) the American Climate Company developed the California Irrigation Management Information System (CIMIS) to perform smart irrigation management, (2) the Euro Union developed the Flexible and Precise Irrigation Platform to Improve Farm Scale Water Production (FIGARO) to promote irrigation water management for high water consumption crops.

Sunflower belongs to high water consumption crops with seasonal irrigation water requirements up to 558 mm in the Hetao Irrigation District. It is an important theme of applying precision irrigation technology to promote irrigation water efficiency, increase sunflower production and quality, enhance farmers' income, and maintain sustainable environment development.

Keywords: precision irrigation, water saving, Hetao irrigation district

精准灌溉技术应用于河套灌区向日葵节水灌溉概念

郭胜丰*
中国台湾康宁大学
Email: kuosf123@gmail.com

摘要

河套灌区年引黄河 50 亿立方公尺水量进行灌溉，超过核定水量约 10 亿立方公尺，灌溉水量不足达 25%。该区年平均降雨量仅 130~150 公厘，年蒸发量达 2000~2400 公厘，作物生产高度仰赖灌溉系统进行灌溉。河套灌区灌溉面积约 48 万公顷，向日葵种植面积占该区总面积约四分之一，向日葵为该区重要经济作物及农民主要经济来源之一。

精准灌溉为结合物联网进行节水灌溉技术，组成项目包括: (1)田间设置传感器及发送器(气象站，土壤水分，水量)，(2)物联网系统 (LoRa 及 NbIot)接收田间数据，(3)精准灌溉平台，接收物联网田间实时数据，进行大数据分析及节水灌溉决策，(4)手机 App，农民及灌溉管理者实时掌握田间信息。精准灌溉为近年世界各国发展趋势以有效率使用有限水资源，包括: (1)美国加州灌溉管理信息系统(California Irrigation Management Information System, CIMIS)，由美国天气大数据公司建置，进行农业灌溉用水的智慧管理，(2)欧盟发展精准灌溉平台(Flexible and Precise Irrigation Platform to Improve Farm Scale Water Production ，FIGARO)，提升向日葵等高耗水作物灌溉管理。

河套灌区向日葵每季灌溉需水量达 558 公厘，属于高耗水作物，河套灌区应用精准节水灌溉技术于提升灌溉用水效率，提高向日葵产量与质量，增进农民收入，维持促进永续环境发展为重要课题。

关键词: 向日葵、精准灌溉、节水灌溉、物联网、河套灌区

The Analysis Report about the Sunflower Sales Market in China

Dafeng Oil Food Co. Ltd., Wuyuan China
Jie Zhao

Abstract

Our company was founded in 1995 and was named Wuyuan County Dafeng Oil Food Co., Ltd. in 2009. It is a private enterprise which conducts comprehensive research on the development of seeds, deep processing of sunflower seeds, pumpkin seeds, roasting seeds, and leisure foods. We have nine processing lines for pumpkin seeds and kernels, sunflower seeds and kernels, and two lines for roasted seeds. We have passed the requirements of the GB/T22000-2006/ISO 22000:2005 international quality management system certification and organic food certification.

In the past three years, the national planting area in 2016 was about 11.5 million mu. According to the National Bureau of Statistics, the total output was 2,889,900 tons. Amongst the total production, our Inner Mongolia output was more than 1.66 million tons, which is three times higher than that of the second ranking output of 530,000 tons in Xinjiang Autonomous Region. In that same year, due to the impact of the "El-Niño" meteorological condition, the quality of northern-grown sunflower seeds declined, and the sales plummeted. The backlog caused a sharp fluctuation in prices. Although there are more than 300,000 tons of export support from enterprises across the country, 30% of the products remained unsalable.

At present, the domestic market of roasted seeds and nuts is mainly based on high-quality varieties such as 363, 361, 601, and others. From the past, the whole-seed snack foods have gradually transitioned to the seed kernels and further deep processing, and baked sunflower kernel desserts like moon cakes, as well as candy-like sunflower kernels, have promoted the flourishing development of the sunflower industry.

Foreign trade exports are mainly exported to Iran, Egypt, Iraq, and some other Middle East regions, as well as Asia, Vietnam, Myanmar, Japan, South Korea, and other countries and regions.

Current problems in foreign trade exports:

First, the brand strategy. Second, the price war.

In order to avoid the above problems, we should establish a nationally unified "Sunflower Seeds Association" to sell the high-quality sunflower seeds "brand" in China, so that China's "Sunflower Seed Kingdom" can begin a healthy expansion.

中国葵花销售市场分析报告

五原县大丰粮油食品有限责任公司
赵杰

摘要

我公司始创于 1995 年，于 2009 年成立五原县大丰粮油食品有限责任公司，是一家以籽种研发及培育，葵花及南瓜子籽仁精深加工，炒货及休闲食品深加工为一体的综合性民营性企业。现拥有年产量为 8 万吨的南瓜籽、籽仁，葵花籽、籽仁九条生产线，两条炒货生产线，并均已通过 GB/T22000-2006/ISO 22000:2005 国际质量管理体系认证及有机食品认证。

近三年来，2016 年全国种植面积约为 1150 万亩，据国家统计局数据显示，总产量为 298.89 万吨。其中我们内蒙古产量为 166 万多吨，是排名第二新疆产量 53 万吨的三倍之多，当年由于受“厄尔尼诺”气象条件的影响，造成了北方葵花籽品质的下滑，销售骤降，产品积压，导致价格的剧烈波动。虽有全国各大企业 30 多万吨的出口支持，当年仍滞销 30%。

目前，国内炒货销售市场，主要以 363，361,601 等皮毛光亮，粒大饱满等高品质的品种为主，食用葵每年基本消费量 100 万吨。随着我国经济的飞速发展，人民生活水平的提高，同时也在改变着饮食习惯，由过去带皮休闲食品逐步在向籽仁类过度，并进一步深加工开发出了，面包葵仁点心、月饼及糖果类葵仁，促进了葵花产业的蓬勃发展。

外贸出口主要销往伊朗、埃及、伊拉克等中东地区，以及亚洲的越南、缅甸、日本、韩国等三十多个国家及地区。

当前存在的现状：一是品牌战略；二是价格战。

为了避免上述存在的问题，我们应建立全国统一的“葵花籽”协会，把我国优质的葵花籽“品牌”，价格卖出去，使我国“葵花籽王国”能健康良性发展。

目前出口主要存在的问题是：1.没有统一的品牌 2.价格战。为了避免上述存在的问题，我们应建立全国统一的“葵花籽”协会，使我国“葵花籽王国”能健康良性发展。

Sunflower Insect Pests Management by KEYUN® Biocontrol Products

Henan Jiyuan Baiyun Industry Co., Ltd.
Shengli Kong

Abstract

The sunflower moth, *Homoeosoma electellum* and the cotton bollworm, *Helicoverpa amigera* are two important and destructive pests of the sunflower during its flowering and seeding period. Due to insect pollinator and blossomy flower being very sensitive to conventional chemical insect pesticides, means to control those pests should be biological and pollinator-safe. Biocontrol products manufactured by Henan Jiyuan Baiyun Industry Co., Ltd., such as *Helicoverpa amigera* nucleopolyhedrovirus (HaNPV), trichogramma and insect pheromone traps, et al., owe to their advantages of safety, high-efficiency and chemical residues free, are competitive measures to manage the insect pests of the sunflower.

(1) HaNPV: KEYUN® HaNPV is a leading biological product to kill the larvae of cotton bollworm infesting in the sunflower. When the viral particles of HaNPV sprayed onto surface of the sunflower are eaten by the cotton bollworm, they will replicate inside the body of the pest and spread out all parts of the body rapidly, which lead to the death of the pest and a fatal plague epidemic of the next generation of cotton bollworm.

(2) Trichogramma: It is a tiny egg-parasitoid wasp that parasitizes the eggs of the sunflower moth and cotton bollworm and other noctuid pests. Monitoring by KEYUN® insect pheromone traps, the pinnacle oviposition stage of the respective pests are determine, at which stage trichogramma should be released. The wasps are able to actively search, find and subsequently oviposit their own eggs into the pest eggs, which effectively kill the eggs before their hatching.

(3) KEYUN® Insect Pheromone Traps: The field population dynamics of the sunflower moth and cotton bollworm are monitored by KEYUN® insect pheromone traps. The data from the traps will provide most suitable control windows for spraying HaNPV or releasing trichogramma. By this integrated management, efficient and safe control results will be obtained. Also, the traps themselves could be used to attract and kill the moths directly.

科云产品防治向日葵虫害

河南省济源白云实业有限公司

孔胜利

摘要

向日葵螟和棉铃虫是向日葵开花结果期的重要害虫。防治向日葵螟和棉铃虫时应选择对蜜蜂等传粉昆虫无害的低毒生物农药；此外，向日葵开花盛期对药剂非常敏感，应选择合适的药剂以防引起向日葵药害影响产量。河南省济源白云实业有限公司生产的棉铃虫核型多角体病毒、赤眼蜂和昆虫诱捕器属低毒生物农药，具有安全、高效、无残留等优势，是防治向日葵虫害的理想措施。

（1）棉铃虫核型多角体病毒：科云棉铃虫核型多角体病毒（HaNPV）主要用于防治向日葵上的棉铃虫。产品喷施到向日葵上被棉铃虫取食后，病毒在虫体内大量复制增殖，迅速扩散到害虫全身各个部位，使其害虫染病而死，并在害虫中形成瘟疫。

（2）赤眼蜂：是一类微小的卵寄生蜂，能寄生向日葵螟、棉铃虫等鳞翅目害虫的卵。通过科云昆虫诱捕器监测，在害虫卵高峰期时释放赤眼蜂，可主动搜索到害虫卵并在其中产卵、繁殖，起到持续控制和消灭害虫的作用。

（3）科云昆虫诱捕器：科云昆虫诱捕器配合昆虫性诱剂用于监测向日葵葵螟和棉铃虫田间发生动态，根据诱捕到的葵螟和棉铃虫蛾高峰期来指导大田精准用药，确保棉铃虫病毒、赤眼蜂等的防治效果；也可通过大量诱捕成虫，有效降低虫口基数，辅助向日葵害虫田间防治。

天赋河套
TIAN FU HE TAO
天下黄河 唯富一套