



# Status and Innovations in FAW IPM and Biological Control in China



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# Content

- Actions for FAW invasion
- Monitoring and early warning for FAW
- Status and innovations in FAW IPM
- Biological Control for FAW



# Actions for FAW invasion

## ➤ Before FAW invasion

- ❑ Training course sponsored by National Agricultural Technology Extension and Service Centre (NATESC) for the officials and technicians from the provincial Plant Protection Stations from whole country on Dec. 6, 2018 about the identification, and actions should be taken if the FAW invades China



## ➤ **Before FAW invasion**

- ❑ **Dec. 26, 2018:** China Department of Agriculture & Rural Affairs (MARA) sent Notification to DARA of Guangxi and Yunnan Provinces to strengthen the monitoring and early warning of FAW, when confirmed that the FAW invaded in Myanmar.
- ❑ **Jan. 3, 2019:** Notification for prevention of Fall armyworm was issued to provincial Plant Protection Stations nationwide by NATESC, on for preparedness and prevention the invasion of FAW.

## ➤ After FAW invasion

- ❑ Searchlight traps, black light traps and sex pheromone traps for FAW population dynamics monitoring set up in Yunnan, Guangxi and Guangdong provinces where have winter corn growing in January and then in the whole countries as the spring corn seeded in the following months

### 技术参数

- 诱集光源: 1000W金属卤化物灯, 照射高度>500m
- 工作电压: AC220V
- 功率: 1200W, 待机≤5W
- 绝缘电阻: ≥2.5MΩ
- 灯体尺寸: 1920mmx1200mmx900mm
- 灯管启动时间: 2分钟
- 整体结构采用304不锈钢
- 晚上自动开灯, 白天自动关灯, 可设定1-16个工作时间段
- 昆虫处理仓温度控制: 工作10分钟后达到 $85\pm 5^{\circ}\text{C}$ , 温度可调节 (30-110 $^{\circ}\text{C}$ )
- 昆虫处理致死率≥98%, 虫体完整率≥95%



高空测报灯



## ➤ After FAW invasion

□ A workshop on FAW organized by CAAS on Jan.18 2019, research groups were set up, focus on following topics

- ✓ Monitoring and early-warning techniques for FAW population dynamics
- ✓ Chemical control and resistant monitoring
- ✓ Biological control
- ✓ Control techniques by bait trap and light trap
- ✓ Utilization of the resistant varieties
- ✓ Emergency control technique system integration and demonstration for FAW

# ➤ After FAW invasion

## Method of forecast and survey for Fall Armyworm (Trail), issues on 25 Feb 2019 by NATESC

### 全国农业技术推广服务中心

农技植保函〔2019〕49号

#### 全国农技中心关于印发《草地贪夜蛾测报调查方法（试行）》的通知

各省、自治区、直辖市植保（植检、农技）站（局、中心）：

2019年1月11日，确认我国云南省普洱市江城县发现草地贪夜蛾（秋黏虫），随后普洱市澜沧县、宁洱县、孟连县和思茅区、德宏州盈江县、瑞丽市、芒市和陇川县，保山市施甸县、昌宁县和龙陵县，玉溪市元江县、新平县，临沧市永德县，版纳州景洪市冬玉米田见虫，共计6市（州）16县（市）相继查证该虫发生为害，发生面积约7000亩。

根据草地贪夜蛾的发生危害特性，目前周边国家和我国云南省发生危害情况推断，草地贪夜蛾极有可能在我国繁殖蔓延、长期为害，成为我国农业重大害虫。为做好虫情动态监测，我中心组织专家研究制定了《草地贪夜蛾测报调查方法（试行）》。现印发给你们，请参照执行。执行中的有关情况，请及时向我中心病虫害测报处反馈。

联系人：刘杰

联系电话：010-59194520

#### 2019年草地贪夜蛾防控技术方案（试行）

##### 一、防控目标

防治处置率达到90%以上，绿色防控技术应用比例达到30%以上，综合防治效果达到85%以上，危害损失率控制在8%以内。

##### 二、防控策略

云南侵入区坚持生态防控指导思想，加强防控，南方玉米区做好害虫种群动态监测和控制，减少向长江中下游及以北地区迁入的虫源基数，黄淮海和东北主产区加强监测，做好应急防控准备，利用理化诱杀控制成虫种群数量，抓住低龄幼虫防治关键期，加强普查，注重区域联防和统防统治。

##### 三、防控措施

###### （一）监测预警

在云南、广西等西南省（区）设立重点监测点，结合高空测报灯和黑光灯监测成虫迁飞数量和动态。在华南、江南、长江中下游、黄淮海、东北地区开展灯诱、性诱监测成虫发生情况。玉米生长期开展大田普查，确保早发现，早控制。

###### （二）分区防控重点

云南、广西等周年繁殖区加强成虫诱杀、卵和幼虫防控，黄淮海夏玉米区及东北春玉米区加强迁飞成虫监测和防治。

###### （三）主要技术措施

1.生态调控及天敌保护利用：有条件的地区可与非禾本科作物间作套种，保护农田自然环境中的寄生性和捕食性天敌，发挥

生物多样性的自然控制优势，形成生态阻截带。

2.成虫诱杀技术：成虫发生期，集中连片使用杀虫灯诱杀，可搭配性诱剂和食诱剂提升防治效果。

3.幼虫防治技术：抓住低龄幼虫的防控最佳时期，施药时间最好选择在清晨或者傍晚，注意喷药在玉米心叶、穗部和穗轴等部位。（1）生物防治：在卵孵化初期选择喷施白僵菌、绿僵菌、苏云金杆菌制剂以及多杀菌素、苦参碱、印楝素等生物农药。（2）应急防治：玉米田出口密度达到10头/百株时（参考玉米田二代黏虫防控的虫口密度指标），可选用防控夜蛾科害虫的高效低毒的杀虫剂喷雾防治。（联合国粮农组织防控草地贪夜蛾指导手册及国外登记防控该害虫的化学农药有氯虫苯甲酰胺、氟氧氟苯胺、溴氰虫酰胺等。）

抄送：农业农村部种植业管理司（农药管理司）。

全国农技中心办公室

2019年2月25日印发

- 4 -

- 3 -

➤ After FAW invasion



Experts Seminar: Occurrence trend analysis and control strategy for FAW organized by MARA was held on 9 May, 2019

➤ After FAW invasion



**National Video Conference for Arrangement of FAW Control was held on 24 May by MARA. Vice Minister Taolin Zhang attended.**

**National Video Conference for Implementation for FAW Control was held on 13 June by MARA. Minister Chanfu Han attended this conference**



➤ After FAW invasion



Field demonstration, Training for FAW Monitoring and Control Techniques at provincial plant protection station level on 27-28 May held in Yunnan by NATESC

➤ After FAW invasion



**Vice Minister of MARA inspected the FAW control on the spot in Anhui on 5 June, 2019**



## ➤ After FAW invasion



The image shows a screenshot of the official website of the Ministry of Agriculture and Rural Affairs of the People's Republic of China. The header features the ministry's logo and name in Chinese and English. A search bar is located on the right side of the header. Below the header is a navigation menu with various categories. The main content area displays a notification titled "农业农村部办公厅关于做好草地贪夜蛾应急防治用药有关工作的通知" (Notification of the General Office of the Ministry of Agriculture and Rural Affairs on Emergency Measures for Grasshopper Control). The notification includes the document number (农办农〔2019〕13号), the date of release (2019年06月04日), and a summary of the emergency measures.

中华人民共和国农业农村部  
Ministry of Agriculture and Rural Affairs of the People's Republic of China

请输入关键字 搜索

首页 机构 新闻 公开 政务服务 专题 互动 数据 业务管理

当前位置: 首页 > 公开

索引号: 078100412201900278

信息名称: 农业农村部办公厅关于做好草地贪夜蛾应急防治用药有关工作的通知

文号: 农办农〔2019〕13号

信息所属单位: 种植业管理司

生效日期: 2019年06月03日

发布日期: 2019年06月04日

内容概述: 草地贪夜蛾是联合国粮农组织全球预警的跨国界迁飞性农业重大害虫, 主要危害玉米、甘蔗、高粱等作物, 已在近100个国家发生。2019年1月由东南亚侵入我国云南、广西, 目前已在18个省(区、市)发现, 严重威胁我国农业及粮食生产安全。鉴于目前我国无防治该虫的登记农药, 根据《农药管理条例》有关规定, 我部在专家论证的基础上, 提出如下应急用药措施。

农业农村部办公厅关于做好草地贪夜蛾应急防治用药有关工作的通知

Notification for application of insecticides in FAW emergency control released by MARA on 3 June, 2019

## ➤ After FAW invasion

**Lists of 11 chemical pesticides, 6 biopesticides and 8 related compound preparations recommended by MARA for FAW emergency control in 2019**

Individual preparations		
Emamectin Benzoate	Fenpropathrin	<i>Mamestra brassicae nuclear polyhedrosis virus</i>
Indoxacarb	Deltamethrin	<i>Metarhizium anisopliae</i>
Tetrachlorantraniliprole	Acephate	<i>Bacillus thuringiensis</i>
Chlorantraniliprole	Lufenuron	<i>Beauveria bassiana</i>
<b>lambda-cyhalothrin</b>	Chlorfenapyr	<i>Empedobacter brevis</i>
<b>Cyfluthrin</b>		<b>Sex pheromone of FAW</b>

Compound preparation	
Emamectin Benzoate × Indoxacarb	Emamectin Benzoate × Lufenuron
<b>Emamectin Benzoate × Hexaflumuron</b>	Emamectin Benzoate × Tebufenozide
<b>Emamectin Benzoate × Lambda-cyhalothrin</b>	<b>Lambda-cyhalothrin × Chlorantraniliprole</b>
Emamectin Benzoate × Chlorfenapyr	<b>Lambda-cyhalothrin × Diflubenzuron</b>

## ➤ After FAW invasion

# 农业农村部文件

农农发〔2019〕3号

## 农业农村部关于印发《全国草地贪夜蛾防控方案》的通知

近日，为全力抓好草地贪夜蛾防控工作，严防虫害暴发成灾，避免对粮食和农业生产造成不利影响，农业农村部发布关于印发《全国草地贪夜蛾防控方案》（简称《方案》）的通知，同时公布《草地贪夜蛾防治技术要求》、《草地贪夜蛾应急防治用药推荐名单》（详情见文末附件1、附件2）。

Protocol for FAW control nationwide released by MARA on 1 July, 2019

- ✓ The Chinese government allocated RMB 500m for FAW emergency control in June to the FAW invaded and potential provinces.
- ✓ There were 100 thousands monitoring sites for FAW, 20000 plant protection specialists and 1 million farmer technicians jointed the field investigation in China 1n 2019.

## ➤ After FAW invasion

**Lists of 8 chemical pesticides, 6 biopesticides and 14 related compound preparations recommended by MARA for FAW emergency control in 2020**

Individual preparations		
Emamectin Benzoate	<b>Ethyl Polysporin</b>	<i>Mamestra brassicae nuclear polyhedrosis virus</i>
Indoxacarb	<b>Flufenoxamide</b>	<i>Metarhizium anisopliae</i>
Tetrachlorantraniliprole		<i>Bacillus thuringiensis</i>
Chlorantraniliprole		<i>Beauveria bassiana</i>
Lufenuron		<i>Empedobacter brevis</i>
Chlorfenapyr		<b>Sex pheromone of FAW</b>

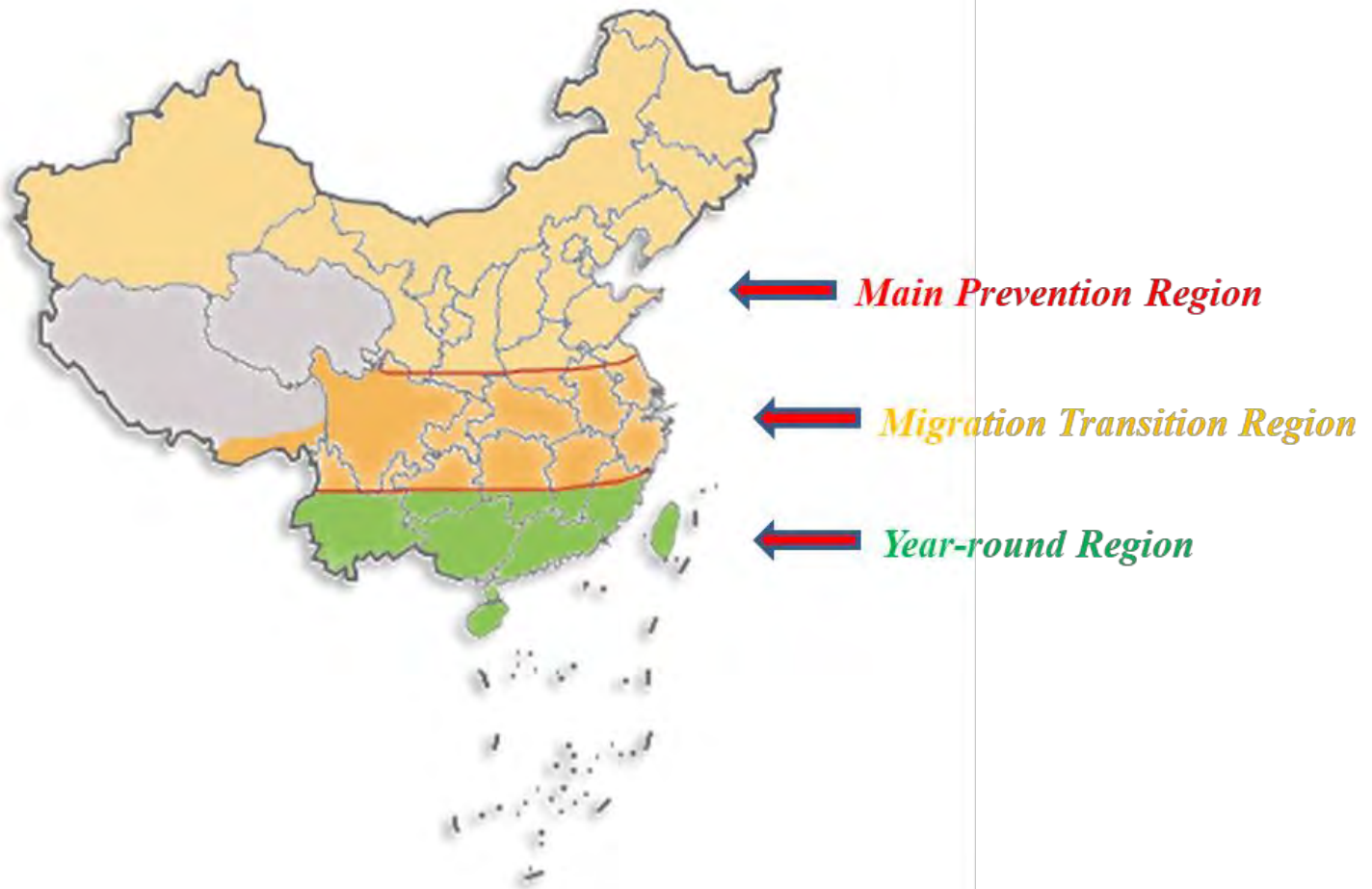
Compound preparation	
Emamectin Benzoate + Indoxacarb	Emamectin Benzoate + Tribenuron
Emamectin Benzoate + Flubenzuron	Chlorantraniliprole + Beta-cyhalothrin
Emamectin Benzoate + Beta-cyhalothrin	Chlorantraniliprole + Avermectin
Emamectin Benzoate + Lufenuron	Flufenoxamide + Emamectin Benzoate
Emamectin Benzoate + Chlorfenapyr	Diflubenzuron + Beta-cyhalothrin
Emamectin Benzoate + Tebufenozide	Flubenzuron + Indoxacarb
Emamectin Benzoate + Methoxyfenozide	Methoxyfenozide + Indoxacarb

## ➤ After FAW invasion

- ❑ Guideline for the recommended pesticides of FAW emergency control use scientifically was released on 18 March by NATESC.
- ❑ The dose for different pesticide preparations, the spray time were recommended.
- ❑ The alternative application of pesticides, frequency of use in different seasons also were specified.

➤ After FAW invasion

- Based on cultivation of corn, climates and migratory pattern of FAW, Regionalization Management Strategy for FAW

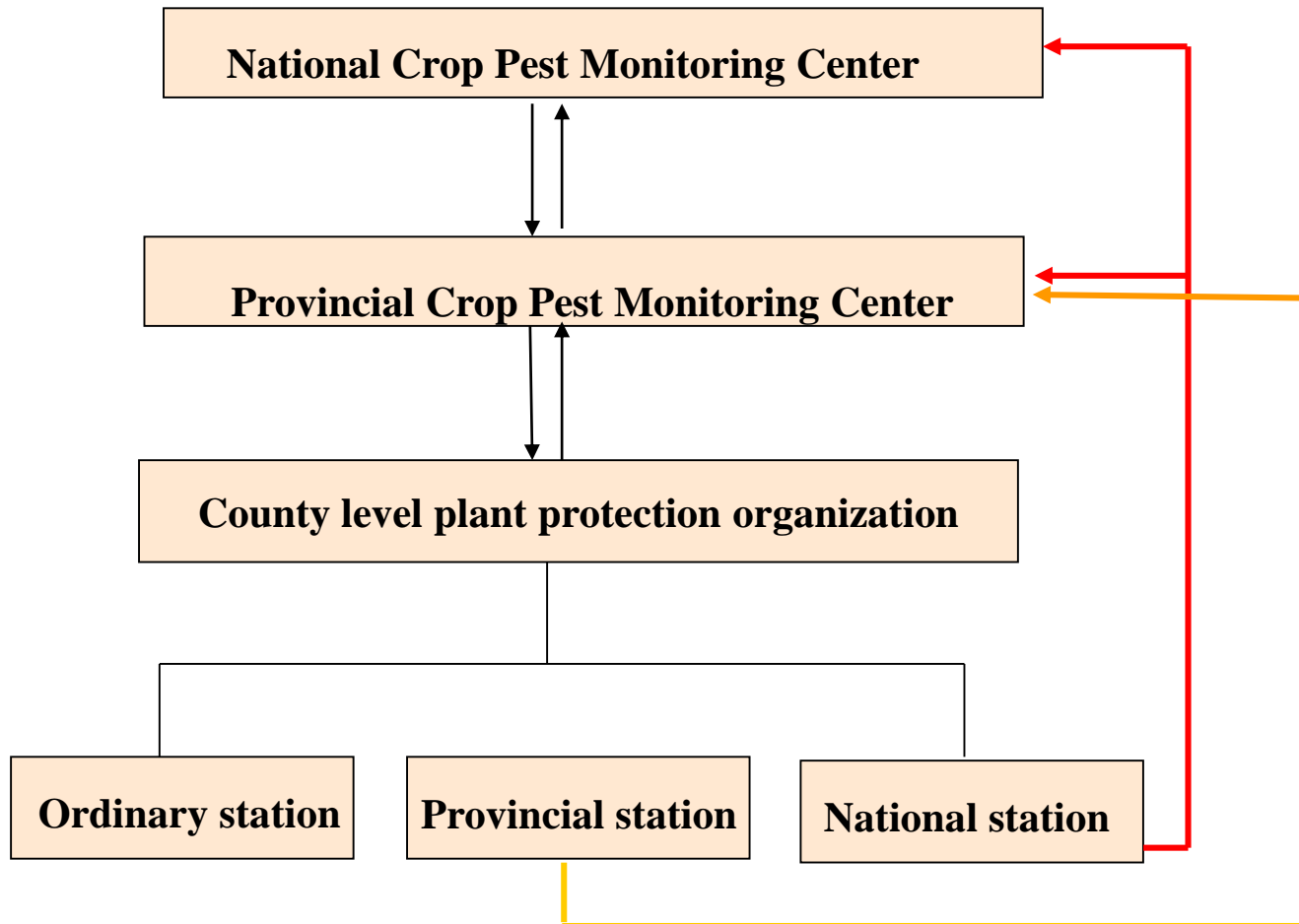




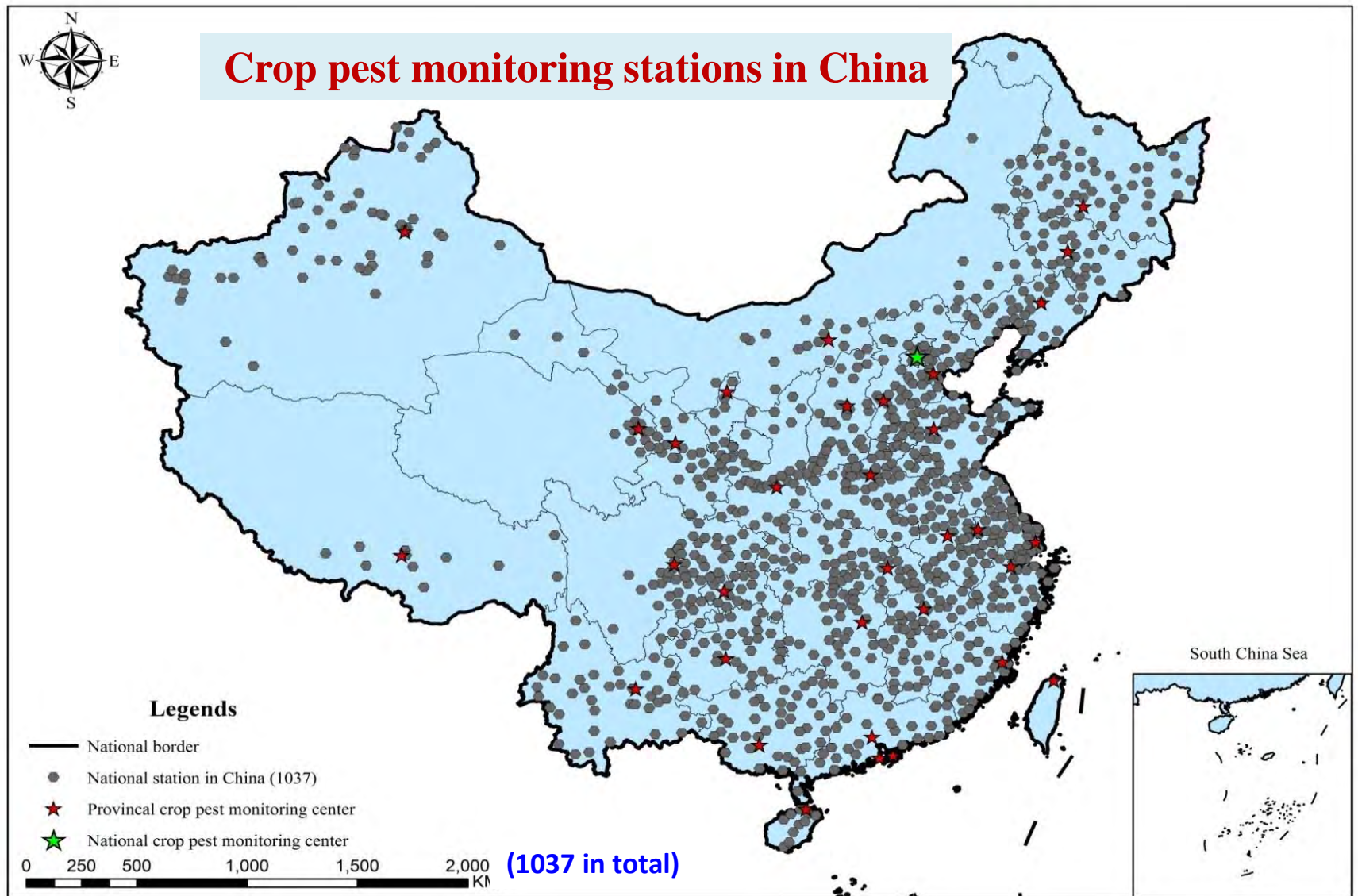
**Monitoring and early warning for FAW**

# Monitoring and Early Warning System for FAW in China

## Crop pest monitoring net in China



# Monitoring and Early Warning System for FAW in China



# Monitoring and Early Warning System for FAW in China



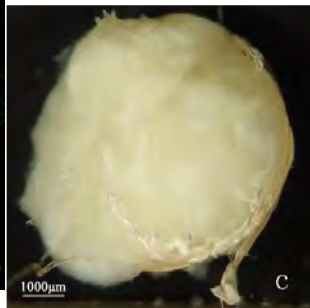
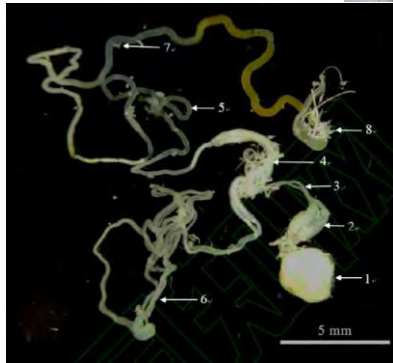
Insect Radar



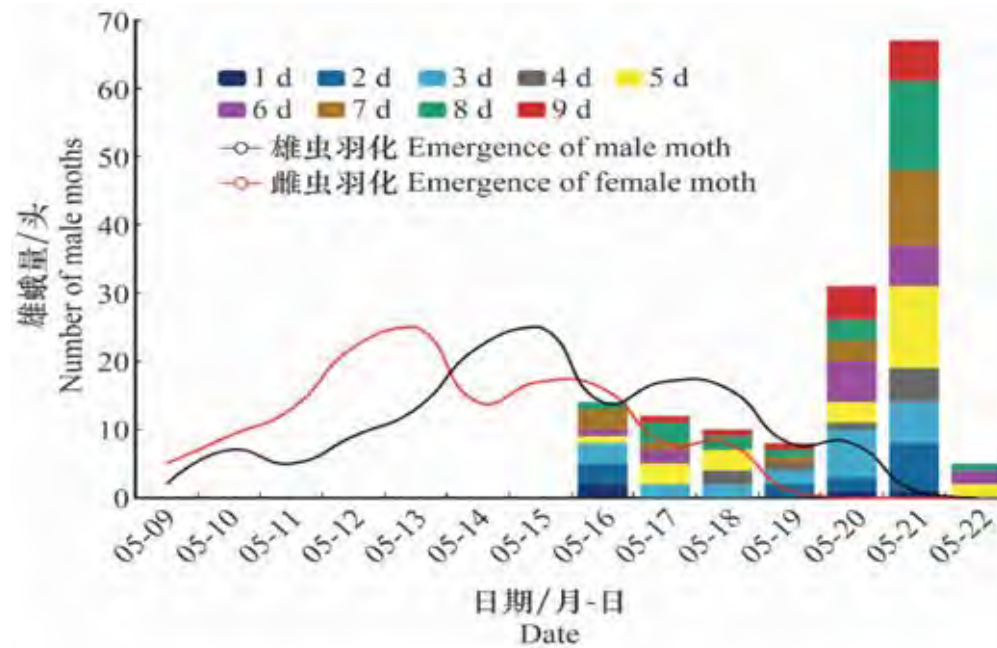
Monitoring by searching light

# Monitoring and Early Warning System for FAW in China

## Monitoring by sex pheromone trap



testis



Reconstructed age structure and eclosion curve of trapped male moths by sex pheromone trap

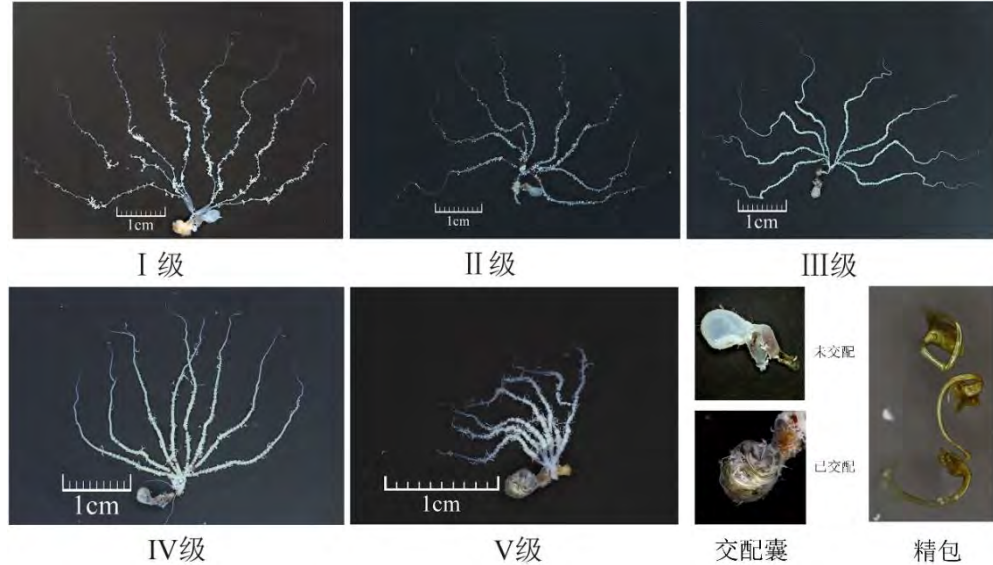
Index of judging the age of male moth according to the major axis length of testis, to predict the emergence time of male and female moth

# Monitoring and Early Warning System for FAW in China

## Monitoring by light trap



Light trap



FAW ovarian development gradation

The methods for ovarian development gradation and reproduction potential prediction of FAW are valuable for the accurate forecast of outbreak time and occurrence quantity of the pest in the field

# Monitoring and Early Warning System for FAW in China



## 农作物重大病虫害数字化监测预警系统

Digital monitoring and early warning system for crop diseases and insect pests

### 用户登录

用户名: 000000-admin

密码: ●●●●●●●●●●

验证码: HG4B HC4B

登录

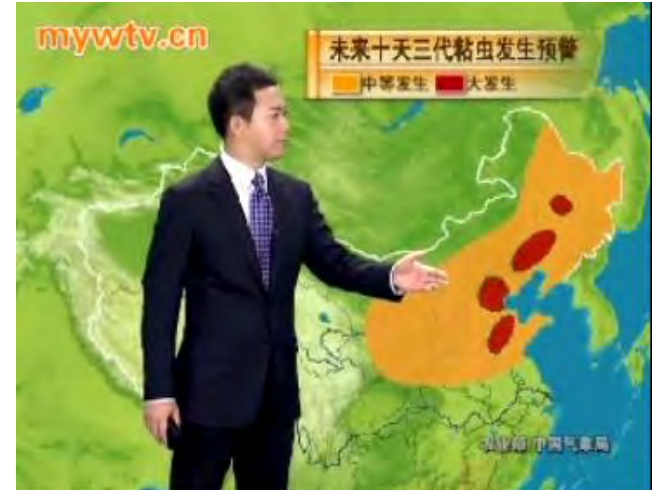
取消



# Monitoring and Early Warning System for FAW in China



WeChat public number



CCTV weather forecast



Radio broadcast

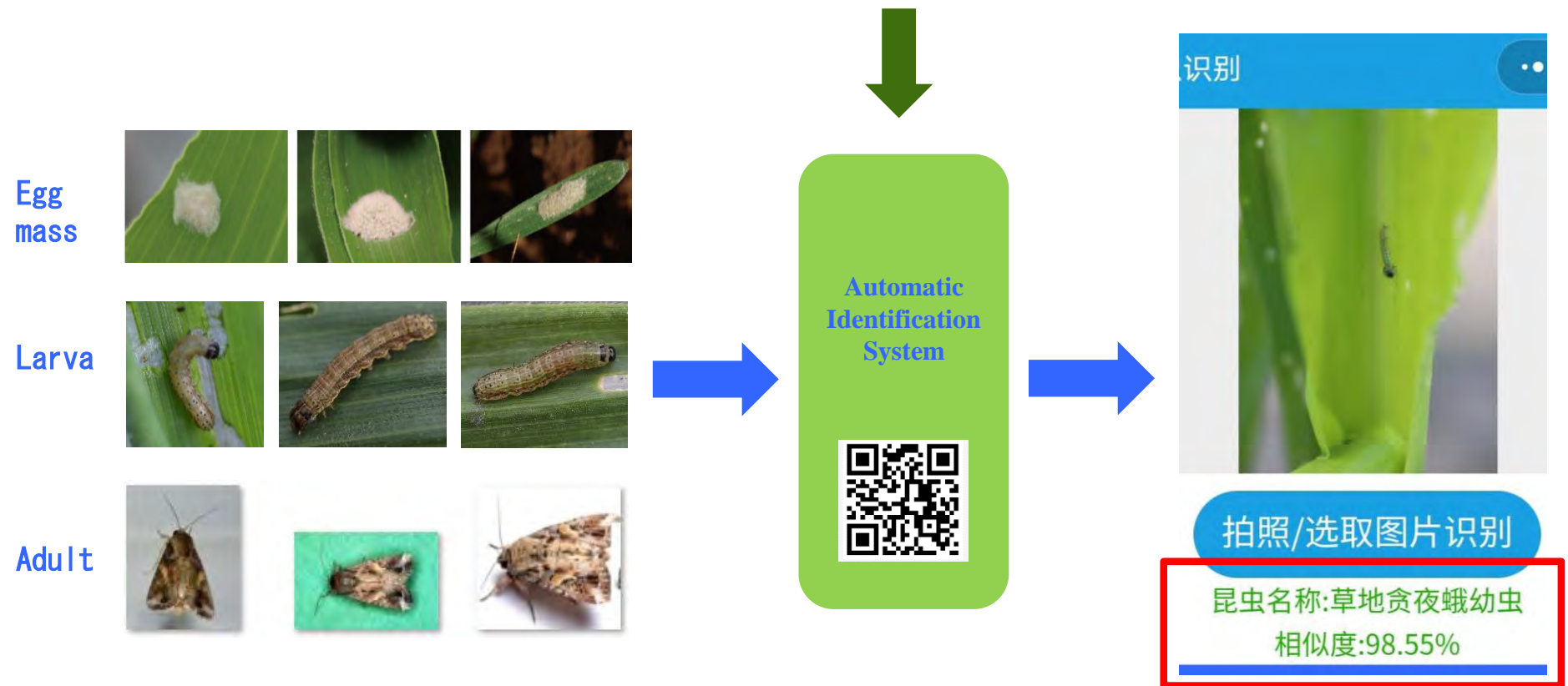


Network

# Monitoring and Early Warning System for FAW in China

## Intelligent identification technology for FAW

<http://migrationinsect.cn>

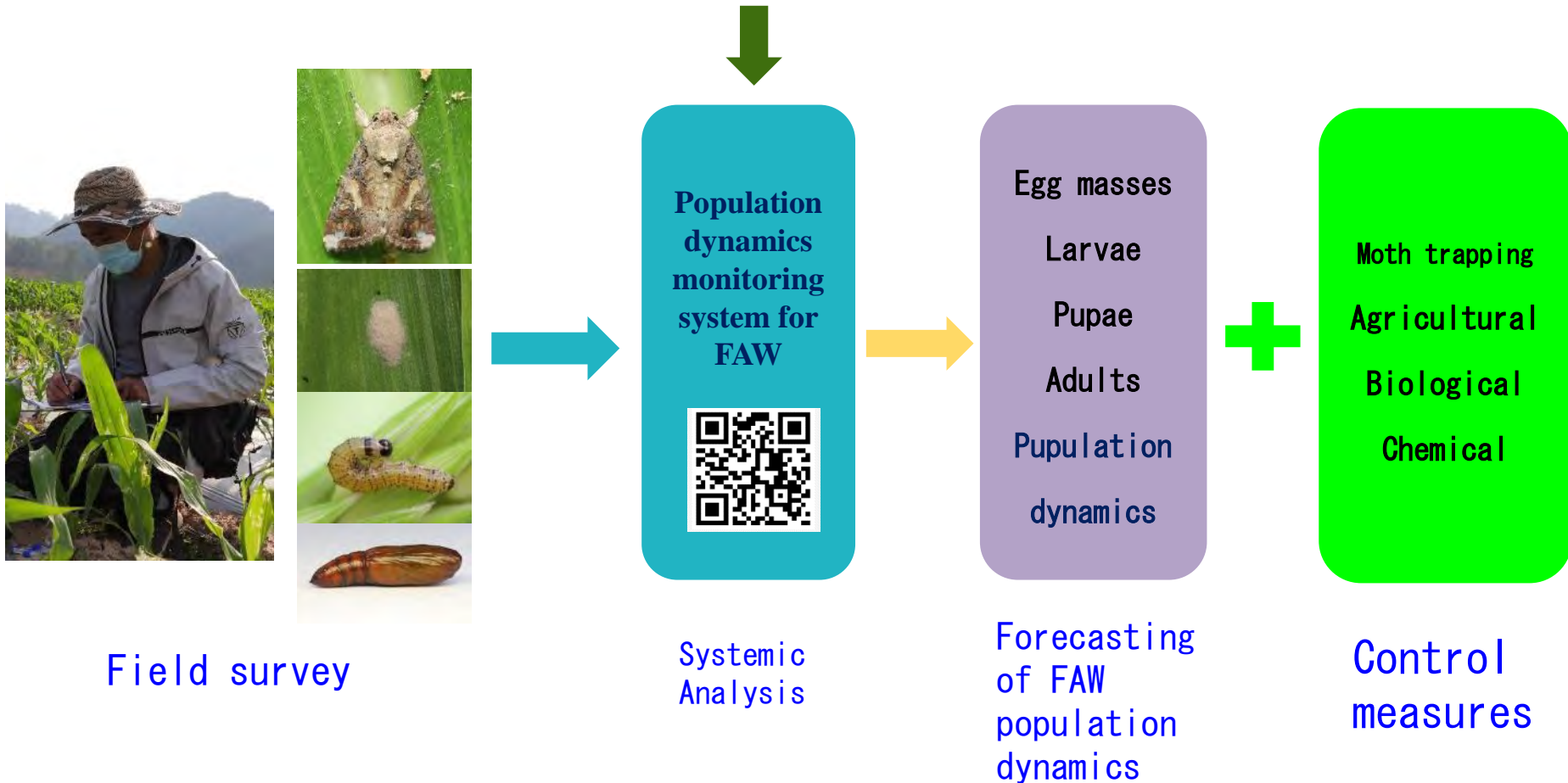


**Quick Identification of FAW by snapshot for scouting in field and forecast**

# Monitoring and Early Warning System for FAW in China

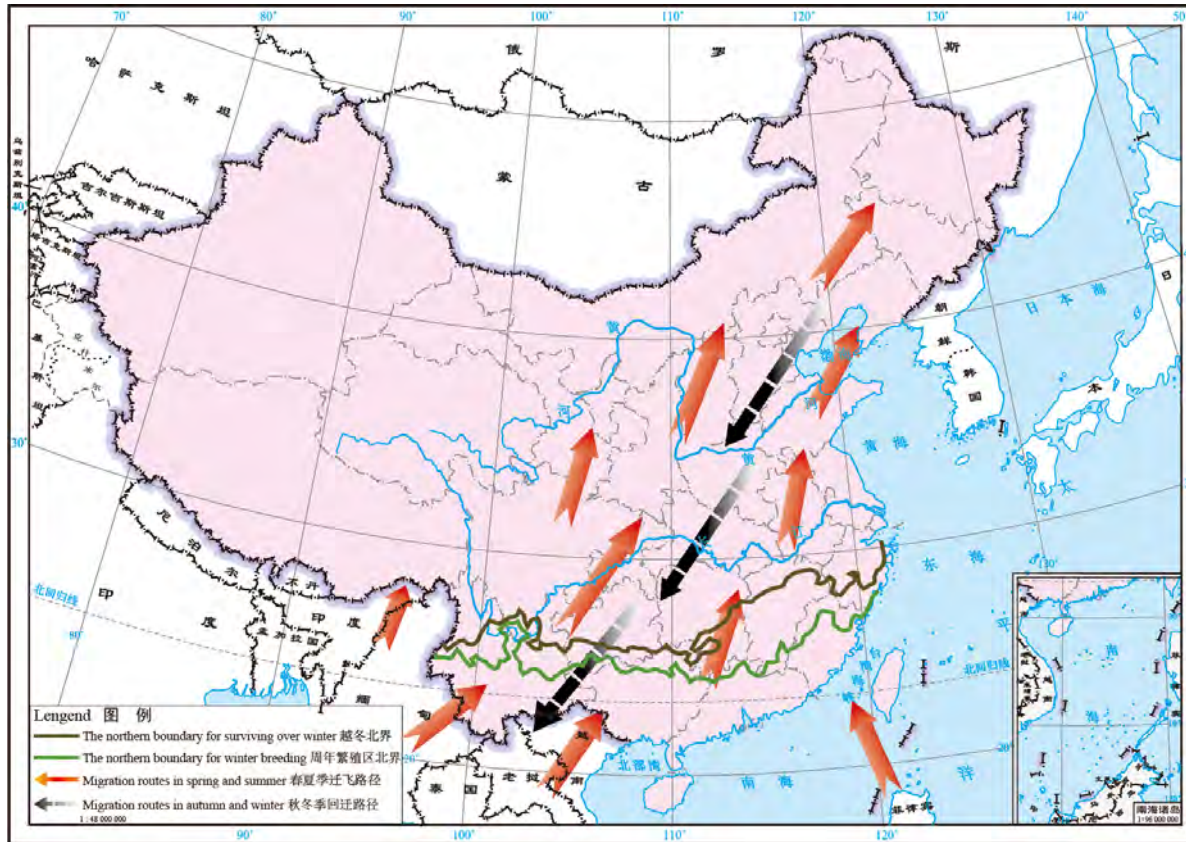
## Population dynamics monitoring system for FAW

<http://migrationinsect.cn>

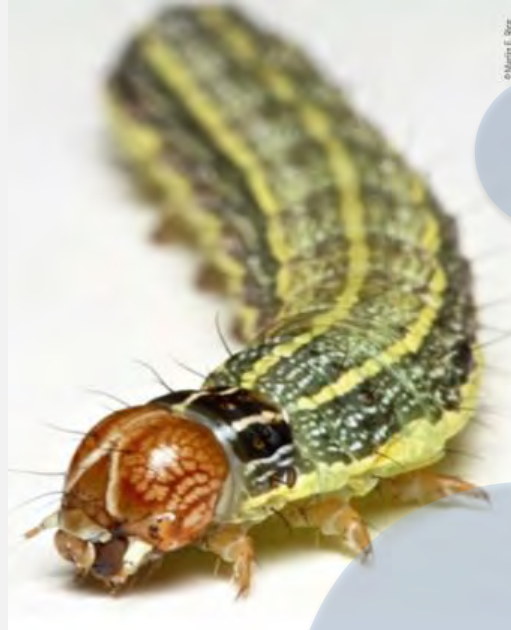


# FAW migration in China

- *A whole map of migration patterns*

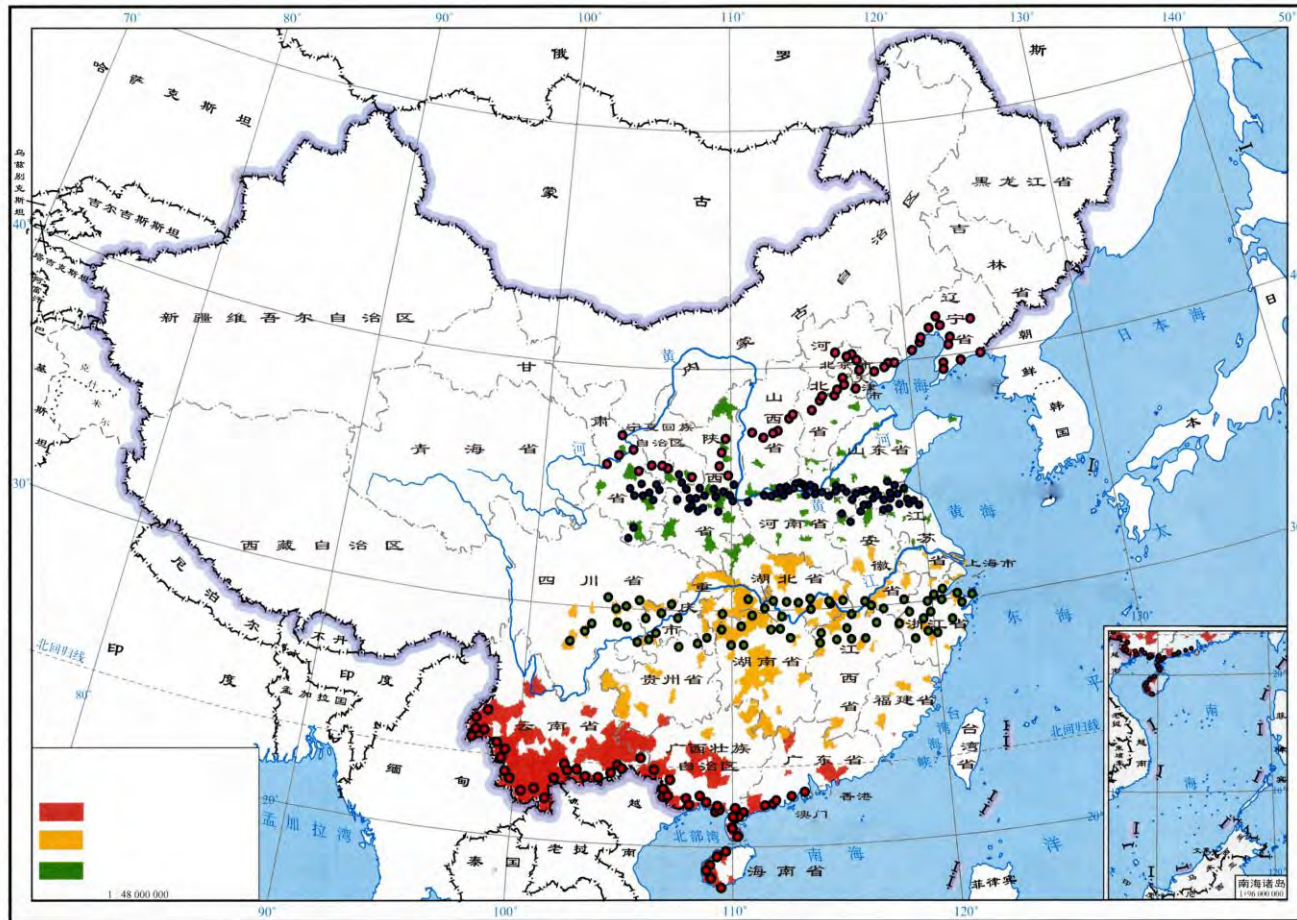


Trajectory modeling revealed a **southwest-northeast & seasonal** migration corridor for FAW in East China. Four ‘crossing-the-borders’ immigration routes were proposed. (i) from India and Myanmar into Tibet Autonomous Region; (ii) from Myanmar into Yunnan province; (iii) from the northeastern Indo-China Peninsula to southern China; (iv) from the Philippines into southeastern coastal region and Taiwan of China. (Wu *et al.*, 2020)



# Status and innovations in FAW IPM

# Physical Control techniques



According to the migratory routes in different seasons of FAW in China, Interception Belts have been set up along the to trap and kill the migratory FAW moths by searchlight traps combined with sex pheromone traps.

## ➤ Screening resistant inbred lines and cultivars

- ✓ Totally 903 inbred lines and 126 cultivars were screened for resistant to FAW.
- ✓ 49 moderate resistant



## ➤ Seed coating

CK

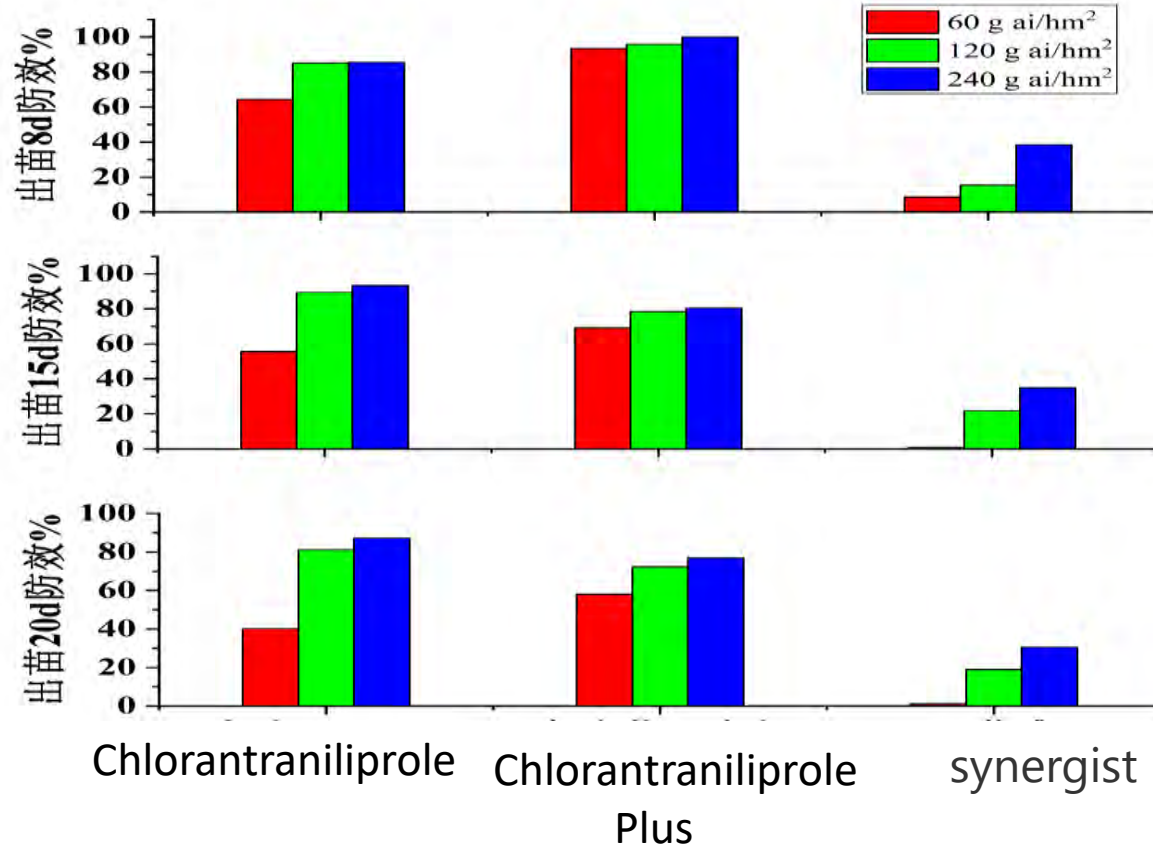


包衣



A new seed coating based on Chlorantraniliprole plus another insecticide was developed by IPP-CAAS with good control efficacy in bioassays, 87.1% 20 days after emergence.

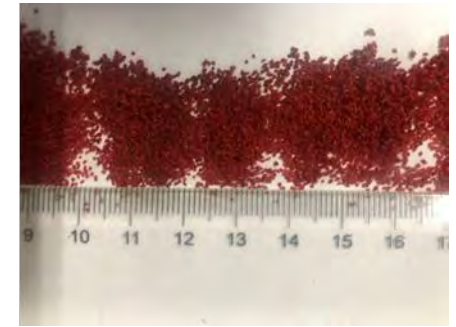
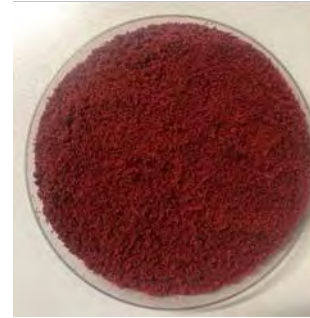
## ➤ Seed coating



The control effect of Chlorantraniliprole Plus is higher than that of Chlorantraniliprole. Over 80% 20 days after emergence

## ➤ New application technique for insecticides

- ✓ IPP-CAAS developed a new granule application technique by drone.



Particle diameters are 0.38 to 0.55 mm  
 $8476 \pm 143$  grains/g



## ➤ New application technique for insecticides

### Control efficacy of granule application by drone

Insecticides	Dose	Total Davis scale	Control efficacy (%)
0.25% CH + 0.15% EB	1000g/666.7m <sup>2</sup>	141	86.4
	2000g/666.7m <sup>2</sup>	125	87.9
	3000g/666.7m <sup>2</sup>	103	90.0
0.55% CH + 0.30% EB	1000g/666.7m <sup>2</sup>	137	86.8
	2000g/666.7m <sup>2</sup>	128	87.5
	3000g/666.7m <sup>2</sup>	74	92.8
0.75% CH + 0.45% EB	1000g/666.7m <sup>2</sup>	130	87.4
	2000g/666.7m <sup>2</sup>	121	88.3
	3000g/666.7m <sup>2</sup>	66	93.6
0.35% CH 7mL+ 0.1% EB 15mL	1000mL water	234	77.4
(Spray)			
Non-Control		1034	

Ch-Chlorantraniliprole, EB-Emamectin benzoate



# Biological Control for FAW

# Biopesticides

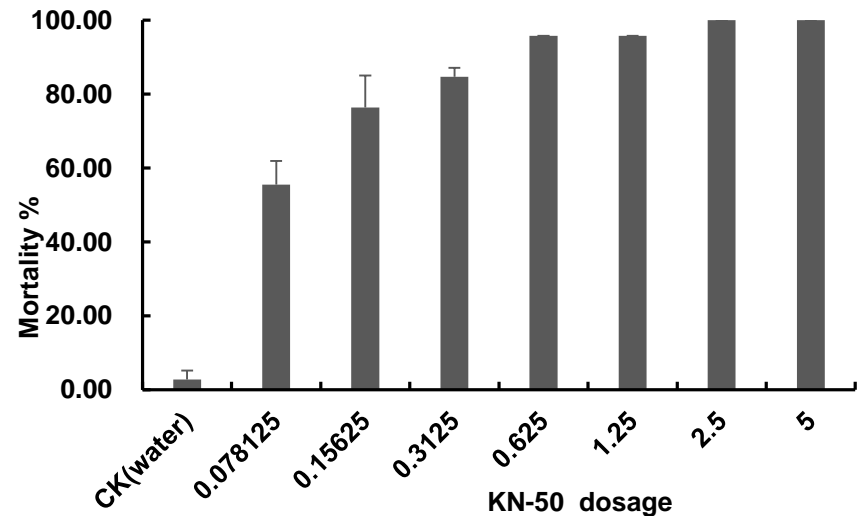
- ✓ *Mamestra brassicae* nuclear polyhedrosis virus
- ✓ *Metarhizium anisopliae*
- ✓ *Bacillus thuringiensis*
- ✓ *Beauveria bassiana*
- ✓ *Empedobacter brevis*

These biopesticides are recommended for FAW control by  
MARA, China

# Control efficacy for FAW by *Bt* product



Bt Strains	LC <sub>50</sub> (g/666.7m <sup>2</sup> )	95% confidence interval
G033A	2.682	1.979-4.854
KNR8	0.431	0.367-0.510
KN40	1.667	0.663-2.997
KN50	0.067	0.036-0.097
KN11	0.244	0.096-0.436

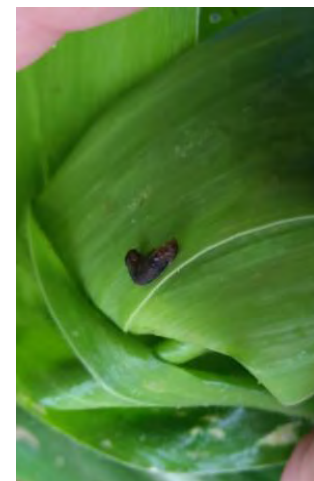


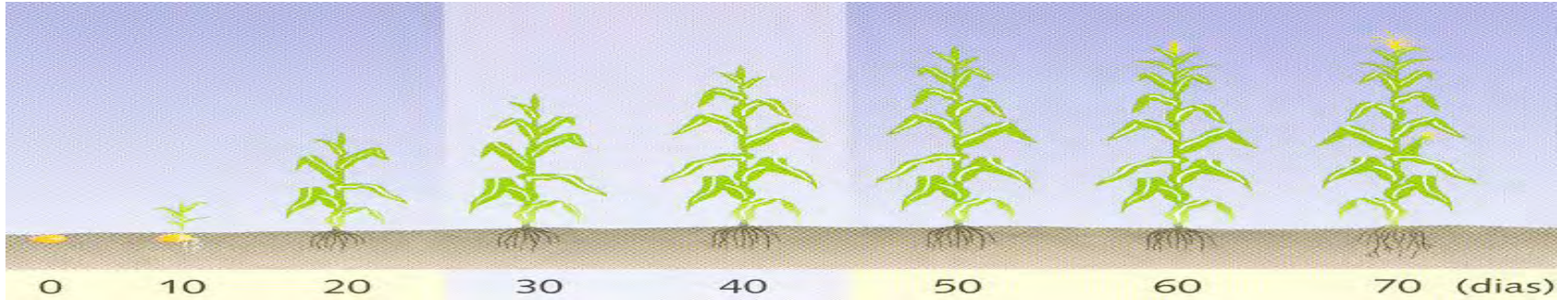
Bioassays

# Control efficacy for FAW by *Bt* product

## Field control efficacy for FAW by G033A

Treatment	Dose (g,mL/666.7 m <sup>2</sup> )	Control efficacy (%)	
		3 days	7 days
32000IU/mg wp G033A	150	44.4 b	83.6 b
	225	47.7 ab	85.2 ab
	300	50.0 a	86.1 a
20%Fenpropathrin	30	43.0 a	88.9 a





Early whorl stage

Late whorl stage

Silking stage

Before hatching

KN11  
( Bt32000IU/mg WP) 1.5kg/ha

KN11  
( Bt32000IU/mg WP) 1.5kg/ha

Chlorantraniliprole/Ethyl Polysporin

FAW larvae

KN11  
( Bt32000IU/mg WP) 3.0kg/ha

KN11  
( Bt32000IU/mg WP) 3.0kg/ha

Chlorantraniliprole/Ethyl Polysporin

Spaying Bt products for FAW control is the key stage before FAW hatch as the FAW neonates are the most sensitive stage to Bt products

Before FAW hatch, 1.5kg/ha for spray, 3.0kg/ha need if the larvae infest the whorls in early or late whorl stage

## Fungal insecticides have good control effects on FAW

Location/FAW stage	Control efficacy %	
	7 days	14 days
Zhunyi, Guizhou/ Egg hatch-2 <sup>nd</sup> instar	72.83	78.39
Zhunyi, Guizhou/ Egg hatch-2 <sup>nd</sup> instar	77.0	73.7
Changsha, Hunan / Egg hatch-2 <sup>nd</sup> instar	70.3	72.9
Guangzhou, Guangdong/ Infested	77.57	76.93

CQMa421 *Metarhizium anisopliae* oil miscible suspension

Synergetic Effects of *Metarhizium anisopliae* combined with *Bt* in bioassays

Treatments	3days(%)	5 days (%)	7days(%)	10days(%)
CQMa421	10.7	21.1	22.9	35.2
G033	54.7	65.5	66.8	70.3
<b>CQMa421+G033</b>	<b>70.9</b>	<b>82.6</b>	<b>88.1</b>	<b>92.3</b>

*Metarhizium anisopliae* combined with *Bt* enhance the control effect

*Bt* and Indoxacar mixture has an excellent control effects (over 90% ) for old FAW larvae

Dose (ha)	No larvae/ 100 plants	Over 4 th instar larvae (%)	3 days			7 days		
			No larvae/ 100 plants	Mortality of low instar larvae %	Larval decrease rate	No larvae/ 100 plants	Mortality of low instar larvae %	Larval decrease rate
<b>32000IU/mg Bt-1 (KN11) 750g</b>	116	46.55%	48	85.48	58.62%	38	88.71	67.24%
<b>32000IU/mg Bt-1 (KN11) 1500g</b>	102	60.78%	35	100.00	65.69%	24	100.00	76.47%
<b>32000IU/mg Bt-2 (G033A) 750g</b>	114	52.63%	52	81.48	54.39%	45	85.19	60.53%
<b>32000IU/mg Bt-2 (G033A) 1500g</b>	106	53.77%	39	89.80	63.20%	27	95.92	74.52%
<b>32000IU/mg Bt-3 (KN50) 750g</b>	108	53.70%	41	94.00	62.08%	30	98.00	72.22%
<b>32000IU/mg Bt-3 (KN50) 1500g</b>	120	56.67%	28	100.00	76.67%	17	100.00	85.88%
<b>5%Bt. Indoxacarb 600ml</b>	128	60.94 %	16	100.00	87.50%	10	100.00	92.19%
<b>6%Ethyl Polysporin SC 225ml</b>	122	51.64 %	19	100.00	84.51%	11	100.00	90.98%

# Survey and identification of natural enemies of FAW

## ➤ Parasitoids

- ✓ Two egg parasitoids , 1 egg-larval, six larval and 1 pupal parasitoids were identified



*Telenomus remus*



*Trichogramma chilonis*

- ✓ The natural parasitized rate for *Telenomus remus* is 28.9%, *Trichogramma chilonis* is 5.0% in Hainan province
- ✓ The highest natural parasitized rate is 12%, 22.3 % and 5.33% for *Microplitis similis*, *Diadegma semiclausum* and *Euplectrus laphygmae*, respectively, in Dehong, Yunnan Province

# Survey and identification of natural enemies of FAW

- Predators

- ✓ Six predatory bugs, two earwigs, one predatory carabid beetle, several ladybird beetles and Lacewings were observed prey FAW larvae.



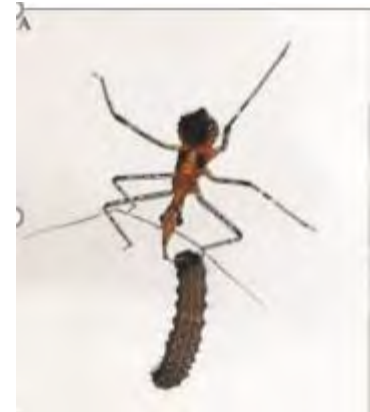
*Picromerus lewisi*



*Arma chinensis*



*Eocanthecona furcellata*



*Sycanus croceovittatus*



*Harmonia axyridis*



*Hippodamia variegata*



*Coccinella septempunctata*



# Survey and identification of natural enemies of FAW

- Predators



*Chlaenius bioculatus*

Predatory carabid beetle



*Eurellia pallipes*

Earwig

# Mass Production of *Trichogramma* by using rice moth eggs



Frames for rearing larvae



A case for collecting adults



A machine for collecting eggs



Clean fresh eggs



Paste eggs on paper



Introducing *Trichogramma*



Parasitized egg paper cards

# Mass Production of *Trichogramma* by using *Sitotroga cereallela*



Rearing larvae



Moth collection



collecting eggs



*Trichogramma*  
mass production

*Sitotroga cereallela* mass production

- A production line for mass rearing of *Trichogramma* by using *Sitotroga cereallela* (Olivier) eggs developed in early of 2000s by Dryland Institute of Hebei Acad. Agri & Forestry Sci adopted from Europe.

# Rearing *Telenomus remus* on egg masses of *Spodoptera litura*



The egg masses of *Spodoptera litura* was screened and used for *Telenomus remus* mass rearing

# Pilot production of *Picromeris lewisi*

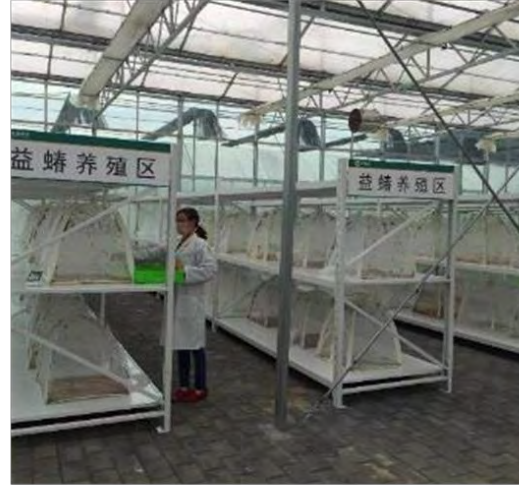


Photo by Dr. Lisheng Zhang

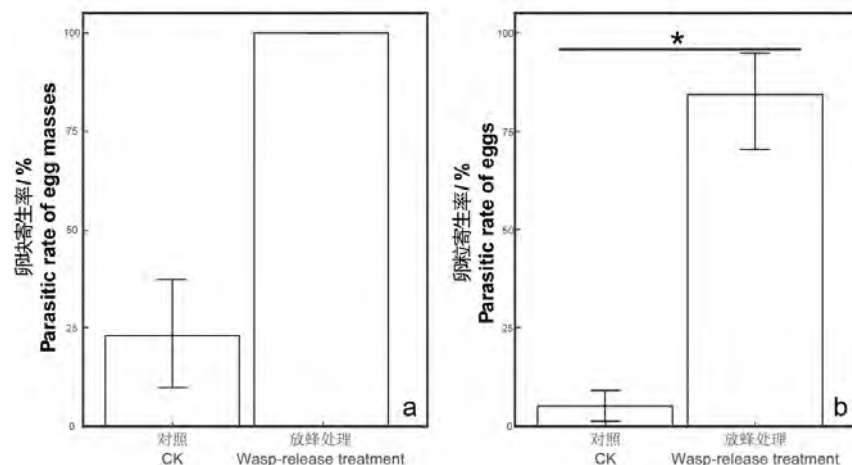
# Control efficacy by releasing *Telenomus remus*



Release *Telenomus remus*



FAW egg mass on paper



The FAW egg masses were taken back 3 days late after *Telenomus remus* release in Kaili, Guizhou Province. The mean parasitization rate of egg masses and eggs is 100% and 84.4%, respectively.

# Control efficacy by releasing *Trichogramma chilonis*

- *Trichogramma chilonis* were released to control FAW in Tengzhou, Shandong Province. The mean parasitization rate of egg masses and eggs is 72.7% and 84.1%, respectively, with the control efficacy of 69.9%.



# Control efficacy by releasing predatory bugs

## Control efficacy by releasing *Arma chinensis*

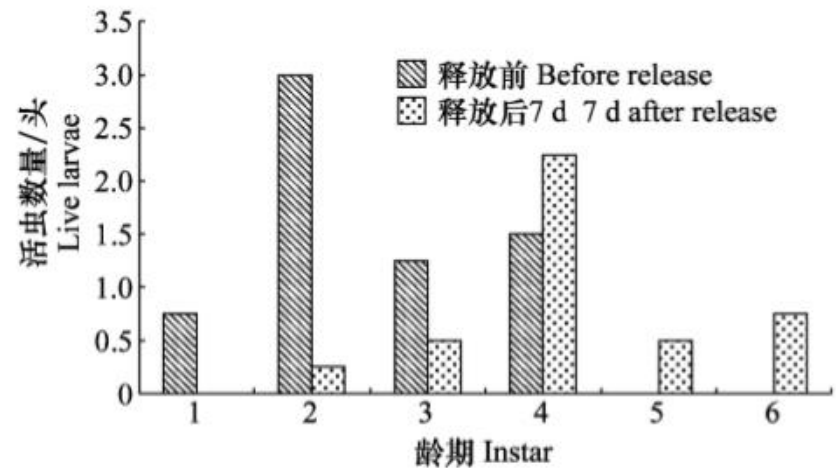
- Field release adults or nymphs of *Arma chinensis* to control FAW were carried out in Yunnan and Guizhou provinces.
- No FAW larvae were observed at the density of 450 adults per ha released 7 days late in Menghai, Yunnan province.
- 76% control efficacy were achieved at the density of 600 nymphs per ha released 7 days late in Zunyi, Guizhou province



Dr. Lisheng Zhang provide these data

# Control efficacy by releasing predatory bugs

The control rate of *Orius sauteri* on FAW was 34.62% at the density of 20 *O. sauteri* per corn plant in field cage test.



Survival of FAW larvae in different instars 7 days after release of *O. sauteri*

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