



## ASEAN Action Plan on Fall Armyworm Biocontrol Webinar Series

### Technology Taster: Drone and Digital IPM for FAW Control

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Grow**Asia**

A recording of the webinar and a copy of the slides will be distributed after the session

# Housekeeping

## 1. Technical issues:

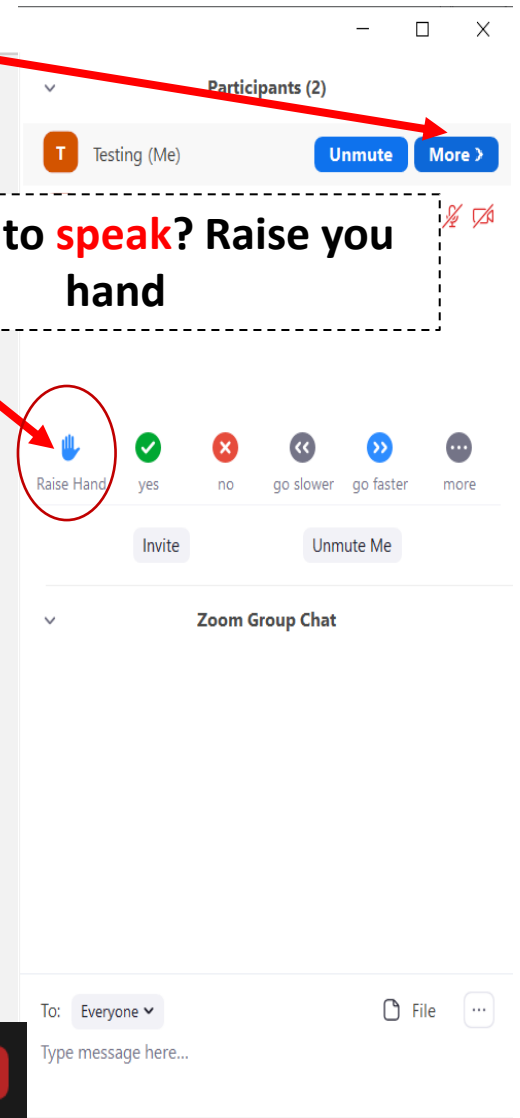
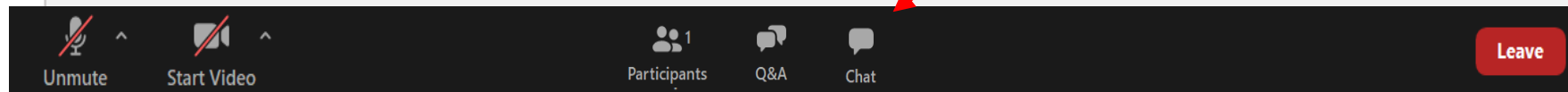
- Try logging off and on
- Send a message to “Grow Asia” in the Chat

3. Use the **Q&A box** to ask questions to the speakers

2. Make sure to **rename** yourself under “More” using the format “Name (Organization)”

5. Want to **speak**? Raise your hand

4. Use **Chat** if you want to just make a comment to everyone (e.g. thank a speaker, share a link, highlight an important point)



Time	Topic	Speaker
10:00	Welcome to the Zoom platform	Alison Watson (GA)
10:02	Introduction from Grow Asia	Grahame Dixie (GA)
10:05	<b>Control against FAW through drone application of tiny granules</b>	Dr Yuan Huizhu (CAAS)
10:15	Q & A	
10:25	<b>FAW damage assessment using drone imagery &amp; AI</b>	Gajendra Babu or Apoorv Vaish (Chloropy Technologies)
10:35	Q & A	
10:45	<b>Experience of PRISE in Africa and opportunities for Southeast Asia</b>	Phil Abrahams (PRISE)
10:55	Q & A	
11:05	<b>Digital IPM: Empowering the grower, agronomist, and agricultural community</b>	Liron Brish (Farm Dog)
11:15	Q & A	
11:25	Summary of key points/messages	Paul Voutier (GA)
11:30	Close	



Photo by G. Goergen, IITA.



## Fall armyworm photo guide – identification



Adult females lay 100-200 eggs on the lower leaves. They change from green to light brown before hatching.



Eggs are covered in protective scales rubbed off from the moth's abdomen.



After hatching, the young caterpillars begin feeding on the leaves.



As they grow, caterpillars change from light green to brown.



Fall armyworms have four dark spots forming a square on the second-to-last body segment.



Fall armyworms have a dark head with a pale, up-side-down Y-shape on the front.



They are at their most damaging when they are 3-4 cm long.



The pupa is shiny brown and usually buried 2-6 cm into the soil.



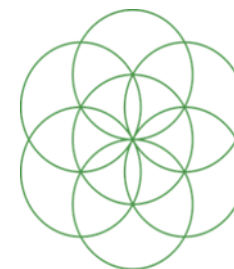
Adult moths (top: female, bottom: male). The females are slightly bigger than the males.

For more info on Fall armyworm please visit:  
[www.plantwise.org/fallarmyworm](http://www.plantwise.org/fallarmyworm)

KNOWLEDGE FOR LIFE

# Poll

## Who are you?

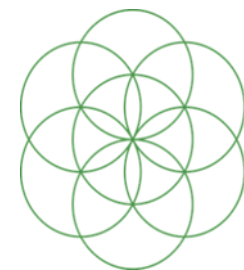


Grow**Asia**



# Welcome

**Grahame Dixie**, Executive Director, Grow Asia



Grow**Asia**



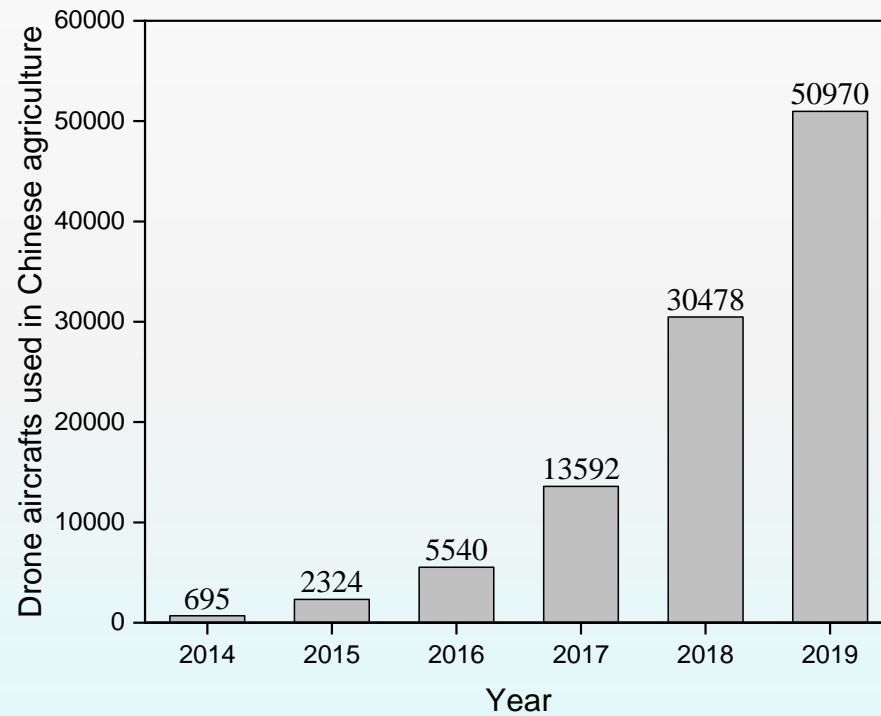


Institute of Plant Protection, CAAS

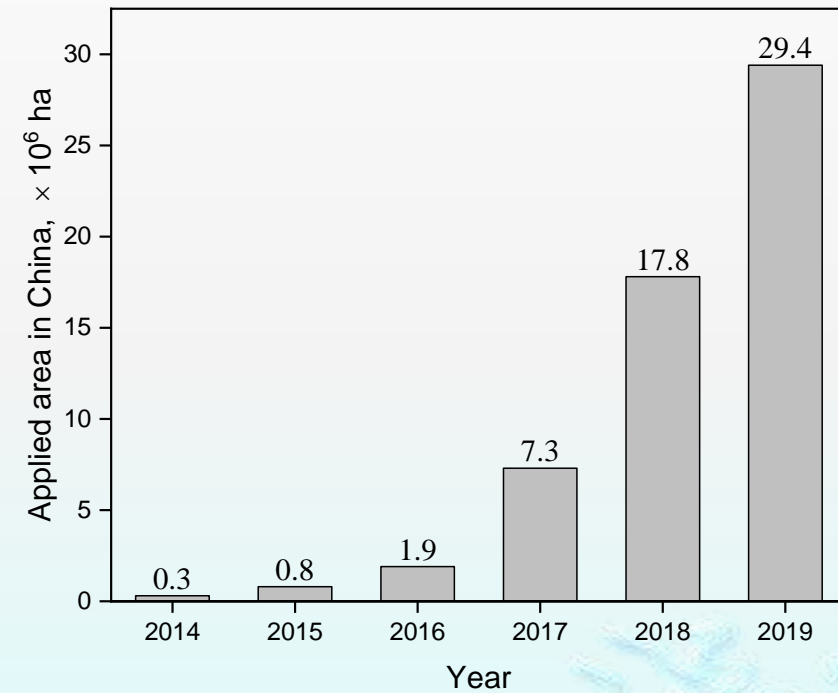
Dr Huizhu Yuan, CAAS  
(Dr Daibin Yang)

**Control against FAW through drone  
application of tiny granules**

# Information of drone spray in China



Number of drone aircrafts used in Chinese agriculture



Applied area of drone spray in China

# Needs of drone spraying for FAW management in China

1. Drone spraying is welcome in mountainous area, including Yunnan Guangxi province where FAW occurs throughout a year.
2. Drone spraying can be employed by smallholder farmers and groups of farmers.
3. Drone spraying is labor-saving and low cost.  
(cost: about 20 us\$/hectare)





# Objectives of alternative drone application of tiny granules

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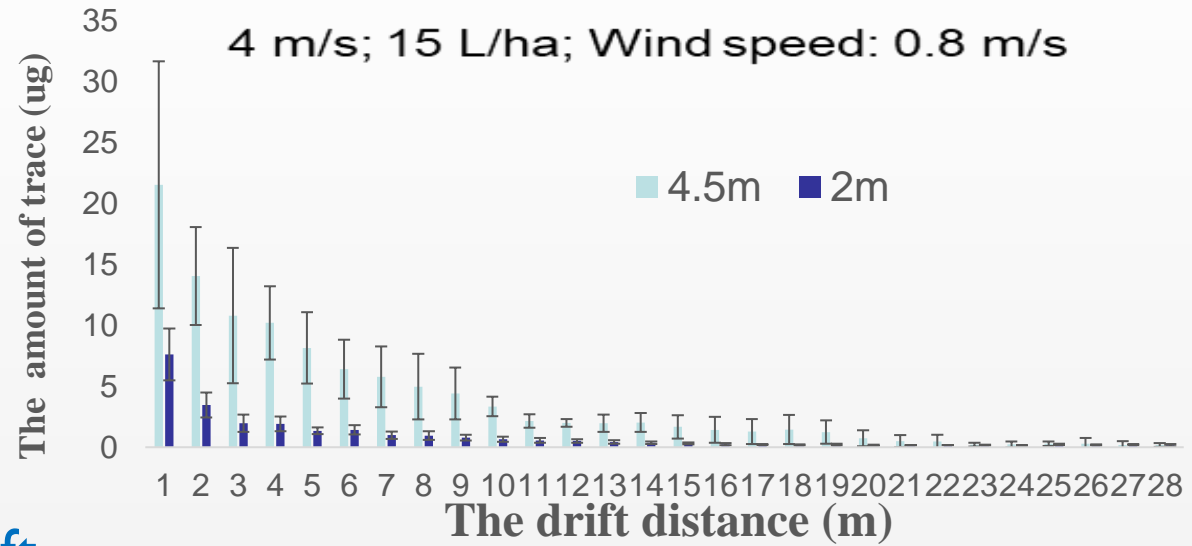
Oviposition is usually on the underside of leaves. FAW larvae migrate to the whorl after emergence.

FAW larvae stay inside the whorl of corn seedlings and kill the growing points.

➡ Spray droplets are hard to reach FAW larvae



# Objectives of alternative drone application of tiny granules



High risk of droplet drift

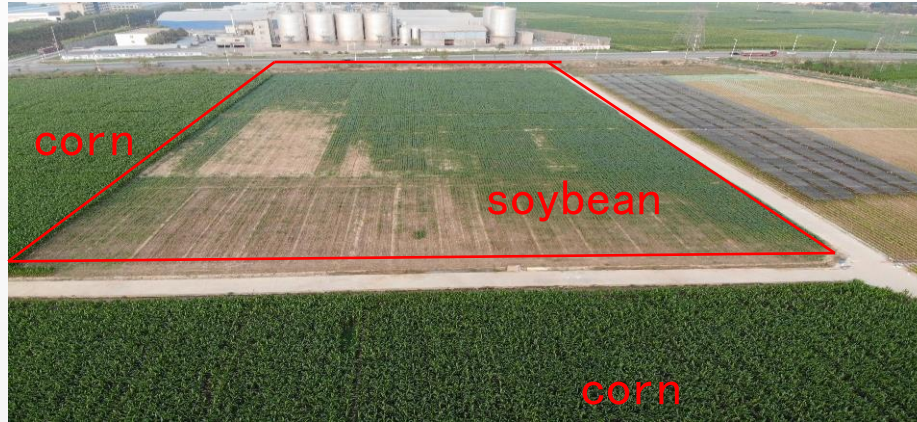
Droplets sprayed by drone can be measured 28 m away from application site





# Objectives of alternative drone application of tiny granules

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Poor soybean stands  
downwind from the application site



Dead crawfish  
200 m away from application site

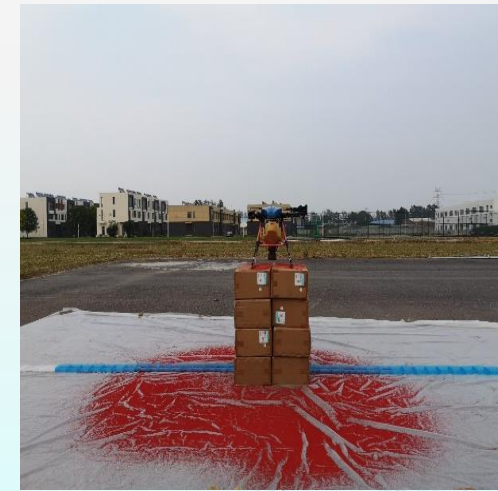


# Objectives of alternative drone application of tiny granules

## 1. Tiny granules can eliminate drift of insecticides

$0.1\text{mm} < \text{diameter} < 1\text{mm}$ , downward wind of drones can facilitate the deposition of tiny granules

In wind, a shift may occur to tiny granules, but no drift!



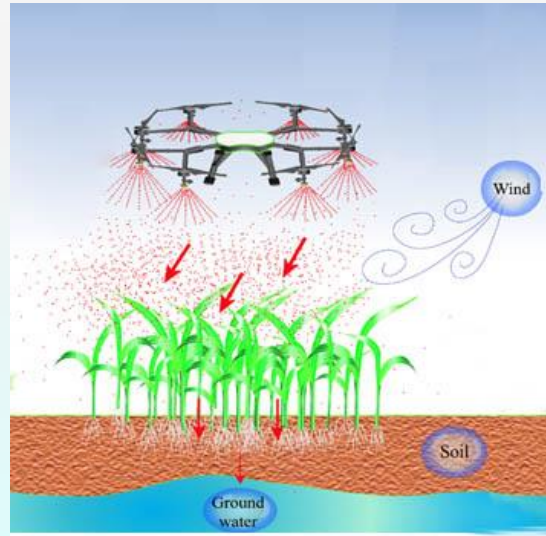
# Objectives of alternative drone application of tiny granules

## 2. Tiny granules can reach out FAW larvae effectively

advantages:

- ① The top unfold leaves and whorl form a natural structure for granule collection in corn canopy
- ② In the downward wind of a drone, granules can be blown into tissues of the whorl, even bottom of whorl tissues.

Natural granule  
collection structure





# Objectives of alternative drone application of tiny granules

## 3. Reduced risk of killing natural enemies by insecticides

***A hypothesis needs to make a confirmation!***

Natural granule  
collection structure





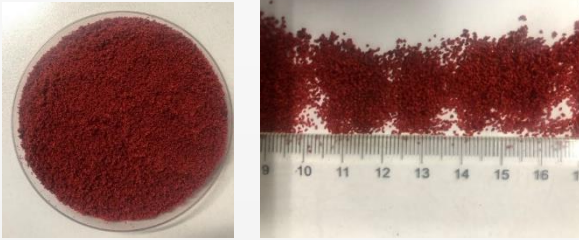
# Characteristics of newly developed tiny granules

Size: 30-40 mesh, 0.38~0.55 mm

Granule numbers:  $8476 \pm 143$  granules/g

density:  $1.3 \text{ g/cm}^3$

Feasible to mimic the spraying droplets!



➡ A breakthrough in FAW management

# The relationship between granule size and its coverage

(Dosage: granules at 15 Kg/ha)

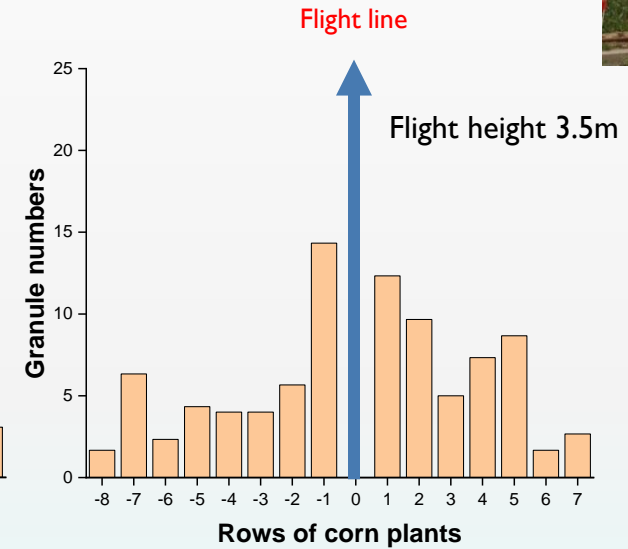
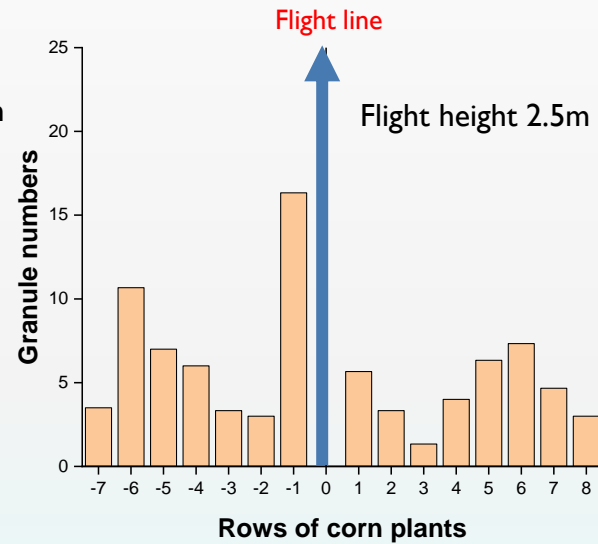
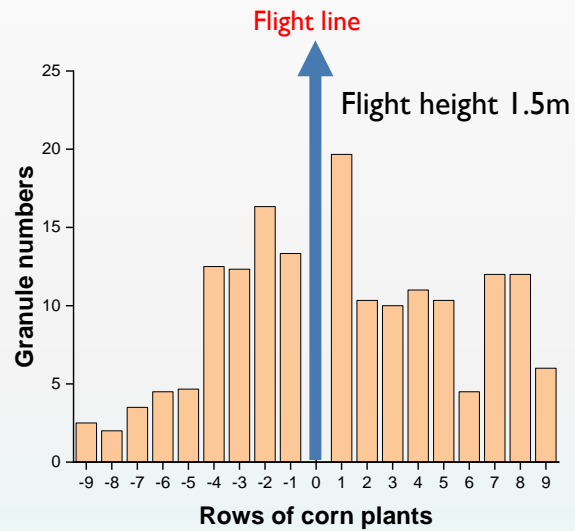
Granules size	Granule number/g	Granule number/Kg, ×1000	Coverage, cm <sup>2</sup> /granule
3.0 mm	35	35	13.8
1.2~1.5 mm	240	2400	5.3
0.6 mm	5300	5300	1.1
0.38~0.55 mm	8674	8670	0.069

For good coverage, < 1 mm granules are needed

Manufacturing < 1 mm granules is a challenge!

# Measured flight parameters

## Relationship between flight height and granule deposition in the whorl



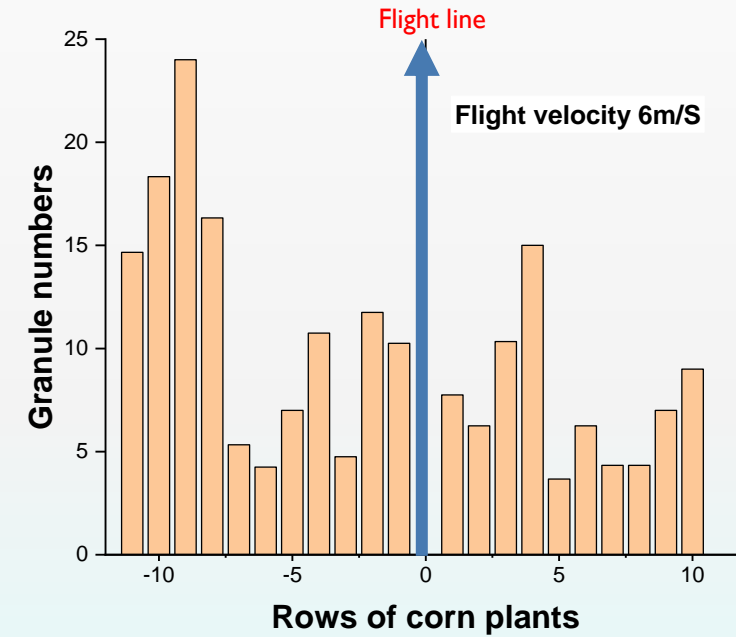
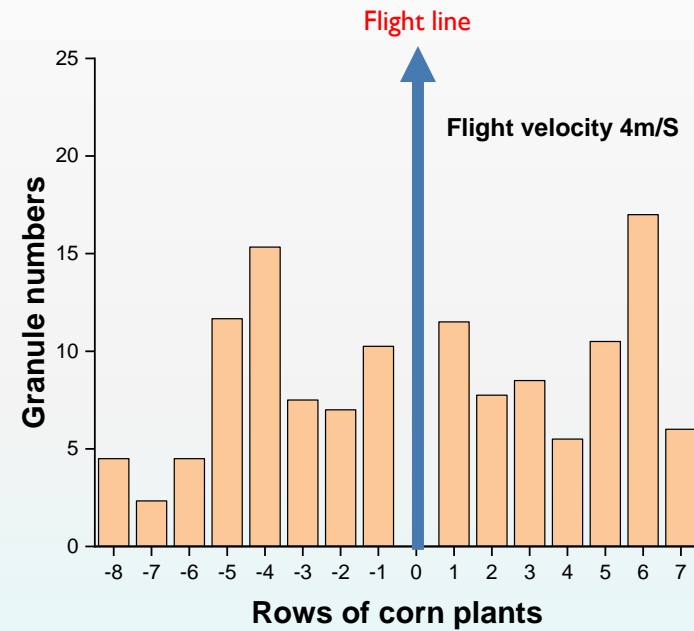
Relatively, a lower flight height can increase the deposition of tiny granules in the whorl





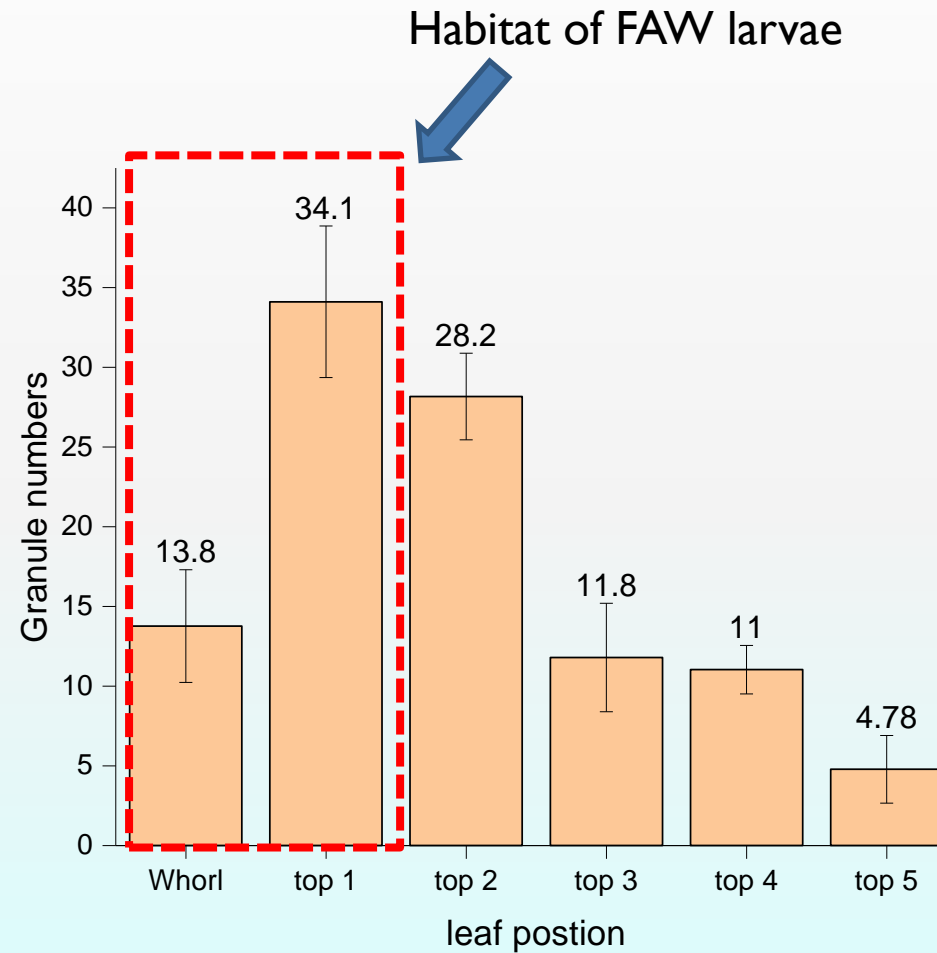
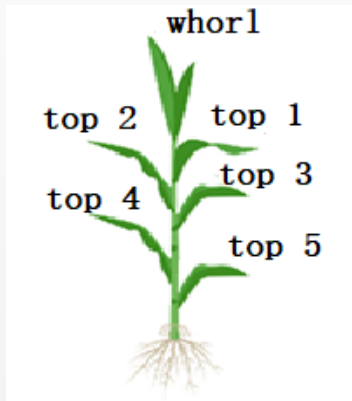
# Measured flight parameters

Relationship between flight velocity and granule deposition in the whorl



飞行速度为4m/S时在心叶中沉积比6 m/S更均匀

# Deposition of tiny granules in leaves at different position



Natural granule collection structure



Effective deposition of tiny granules in FAW habitat

# Bioefficacy of tiny granules through drone application

(Based on Davis scaling, 0-9 scale)

Application pathway	Active ingredients	Dosage	Davis scaling index	Bioefficacy
Granule	0.25% <b>Chlorantraniliprole</b> +0.15% Eamectin	15Kg/ha	141	86.4 a
		30Kg/ha	125	87.9 a
		45Kg/ha	103	90.0 a
	0.50% <b>Chlorantraniliprole</b> +0.30%Eamectin	15Kg/ha	137	86.8 a
		30Kg/ha	129	87.5 ab
		45Kg/ha	74	92.8 b
	0.75% <b>Chlorantraniliprole</b> +0.45%Eamectin	15Kg/ha	130	87.4 a
		30Kg/ha	121	88.3 ab
		45Kg/ha	66	93.6 b
	Bt granules	15Kg/ha	185	82.1 a
		30Kg/ha	167	83.8 a
		45Kg/ha	149	85.6 a
Drone spray	35% <b>Chlorantraniliprole</b> SC7ml+1%Eamectin EC 15ml	15Kg tank solution/ha	234	77.4
	Blank		1034	

Experiment location: Xinxiang, Henan province



# Prospect:

- 1 Corn borer management
- 2 Sugarcane borer management
- 3 soil pest insect management



## Q & A

### Dr Huizhu Yuan, CAAS (Dr Yang Daibin)

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Remember to use the Question and Answer Box to write in your questions.

You can put your hand up to verbally make a brief comment/question





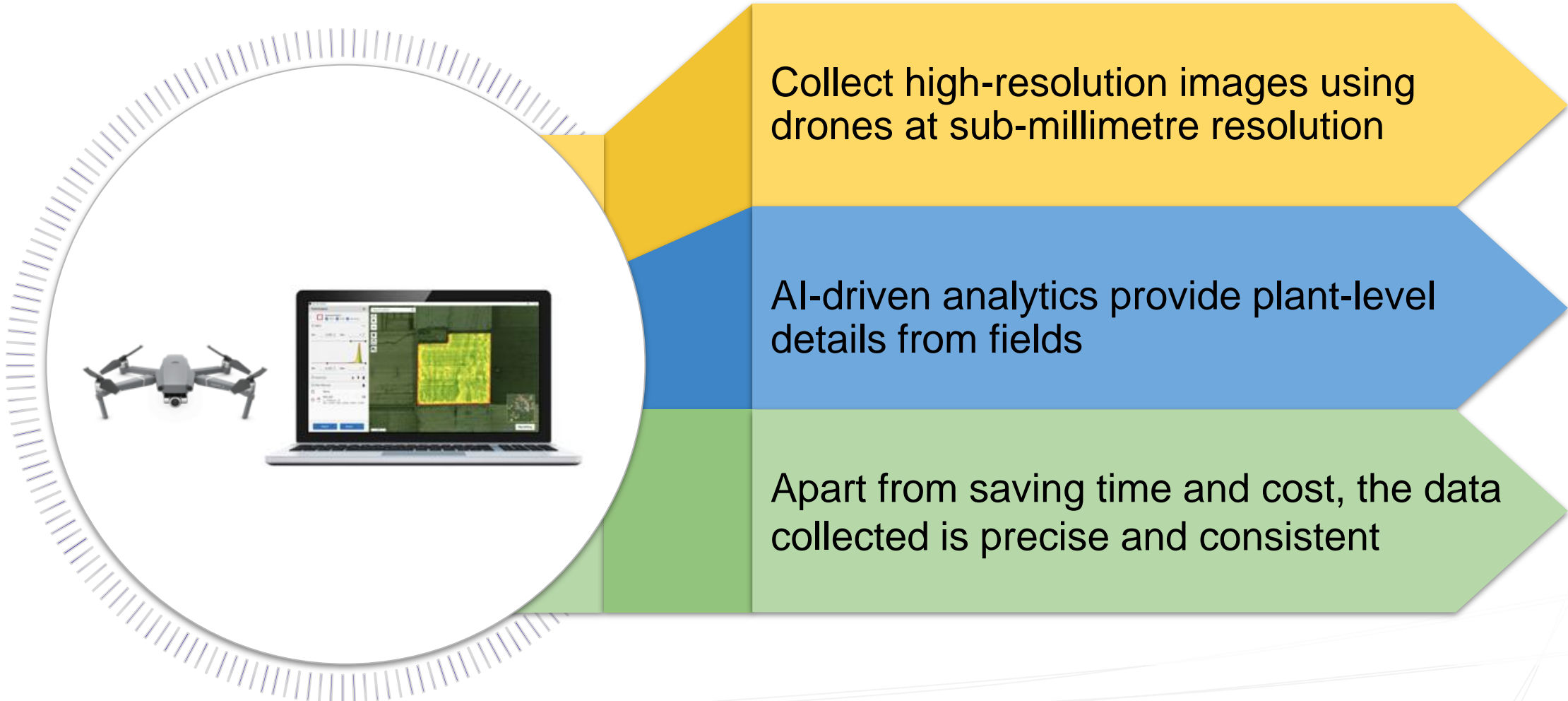
# Gajendra Babu & Apoorv Vaish

chloropy

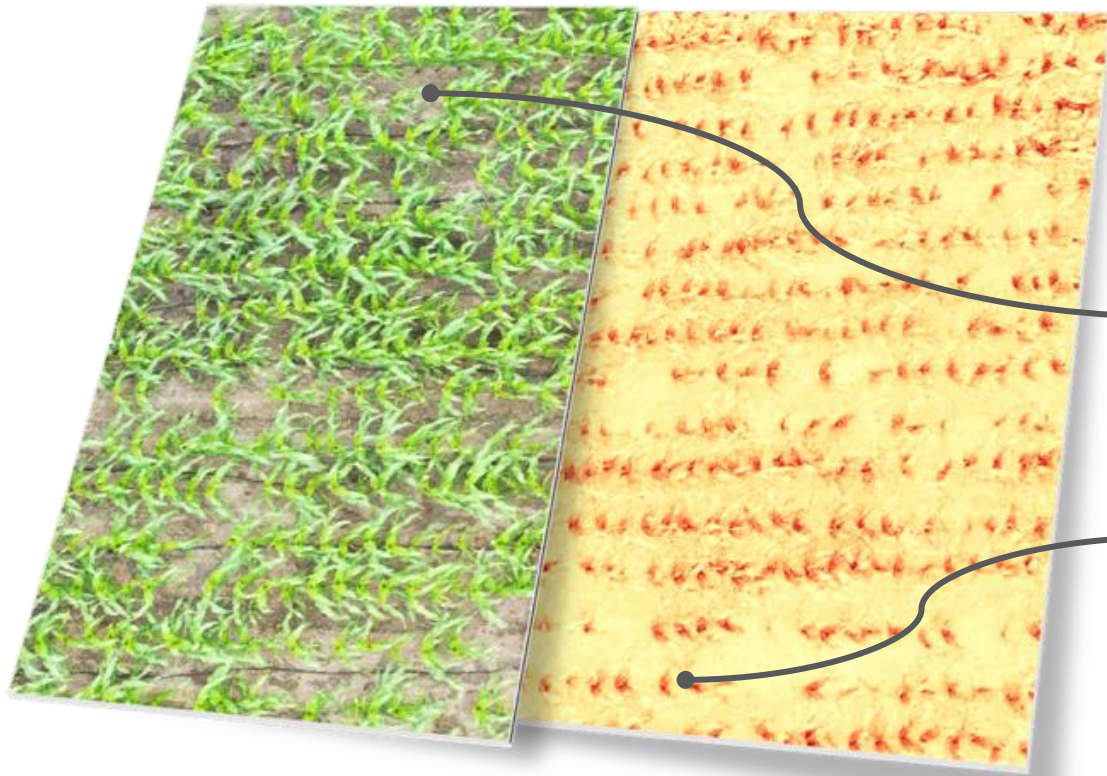
FAW damage assessment using drone imagery & AI



# Drone imagery - overview



# What we do?



Interpret drone imagery into precise insights using proprietary computer-vision/ deep learning algorithms

## **Quantitative parameters**

*Size, shape of plants or plant parts and yield*

## **Qualitative parameters**

*Colour, pest, disease symptoms & quality*

# Chloropy Info Management System (CIMS)

<https://cims.chloropy.com/>

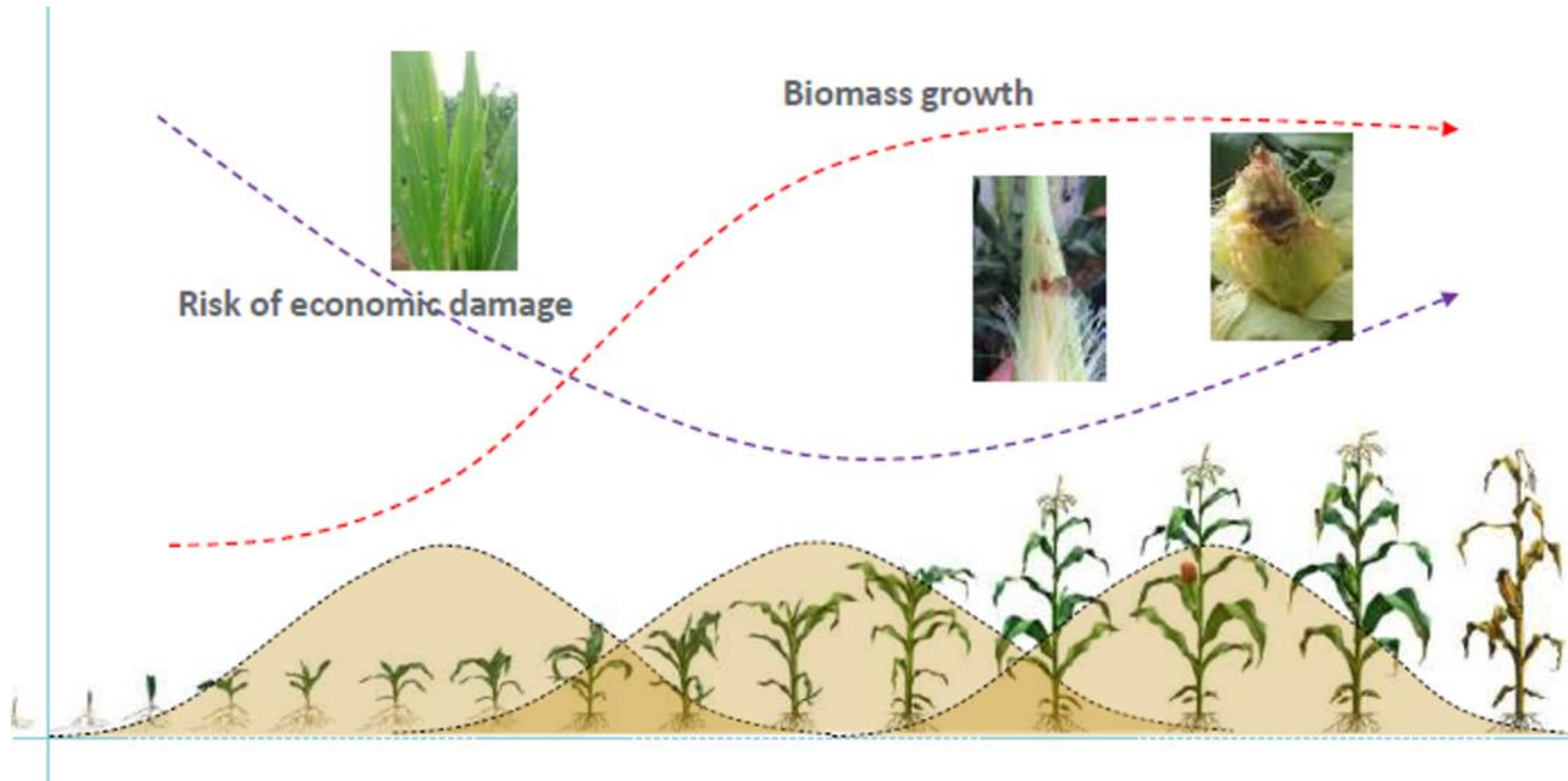


**Crop Analytics**

**Cloud Storage**

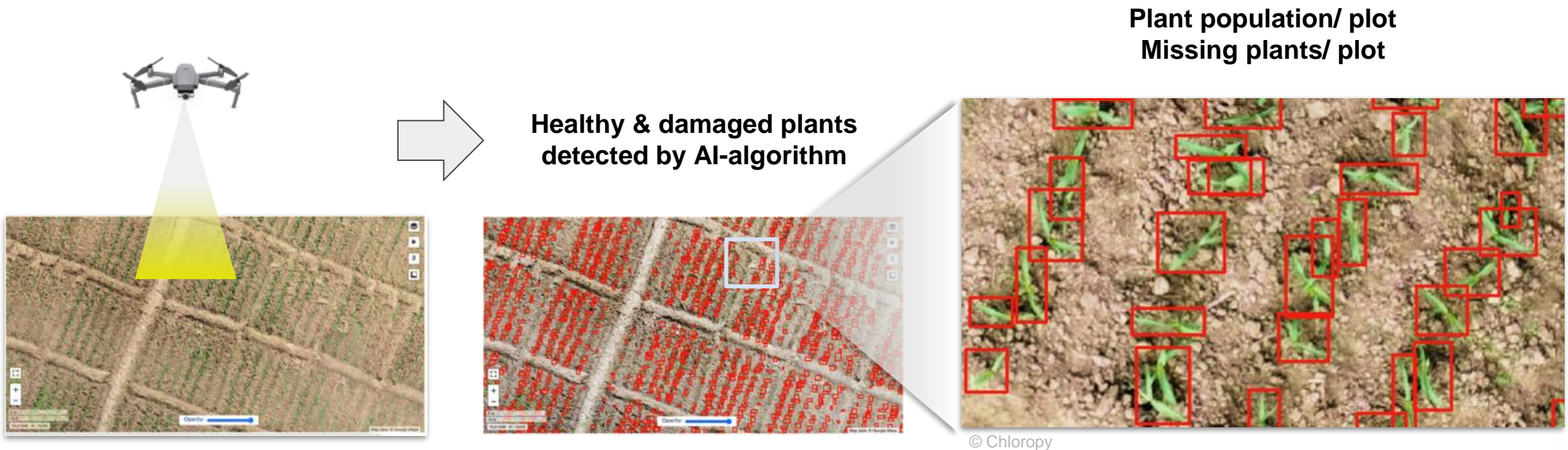


# FAW economic impact



Prasanna et al. (eds). 2018. Fall Armyworm in Africa: A Guide for Integrated Pest Management, First Edition. Mexico, CDMX: CIMMYT.

# FAW damage assessment - early veg stage



Assess efficacy of different control methods, including seed treatments, in large field trials



# FAW damage assessment - veg stage



© Chloropy

Categorise corn plants into damage classes

Healthy



Low damage



Medium damage



Severe damage



# Opportunities for drone-based imagery in FAW IPM

1. **FAW damage assessment at farm level (R&D/ seed production/ commercial)**
  - a. Scouting: assess crop damage, crossing thresholds
  - b. Assess efficacy of control methods
2. **Extrapolate FAW monitoring to regional level by fusing drone & satellite imagery** (looking for partners)
  - a. Monitor geographical spread
  - b. Early warning system to farmers

# Founding Team



## Gajendra Babu (CEO)

Ph.D. in Agricultural Entomology  
16 years in Seed/Pesticide Industry

**syngenta**

**DOW**  
Dow AgroSciences

**PIONEER**

**MONSANTO**

[gajendra@chloropy.com](mailto:gajendra@chloropy.com)



## Apoorv Vaish (CTO)

B.E. Mechanical, BITS Pilani, India  
Masters in Robotics, IaaC Barcelona

**SWT**  
SINGAPORE UNIVERSITY OF  
TECHNOLOGY AND DESIGN

**IaaC** | Institute for  
advanced  
architecture  
of Catalonia | BARCELONA



**BITS Pilani**  
Pilani Campus

[apoorv@chloropy.com](mailto:apoorv@chloropy.com)

# Q & A

with Gajendra Babu (CEO)  
Apoorv Vaish (CTO)



- Remember to use the Question and Answer Box to write in your questions.
- You can put your hand up to verbally make a brief comment/question





# PRISE

Pest Risk Information Service

# PRISE Overview

[https://www.youtube.com/watch?v=X05yvx1th\\_Q](https://www.youtube.com/watch?v=X05yvx1th_Q)

Output: Geo-specific time-to-action alerts for economic optimum-kill

Combining:

- EO data (LST, leaf wetness, vegetation index)
- Plant health modelling – (phenological and statistical)
- Real-time field observations (from ground data loggers and extension staff – e.g. plant doctors)

Operates in Kenya, Ghana, Zambia and Malawi





# Focus Species

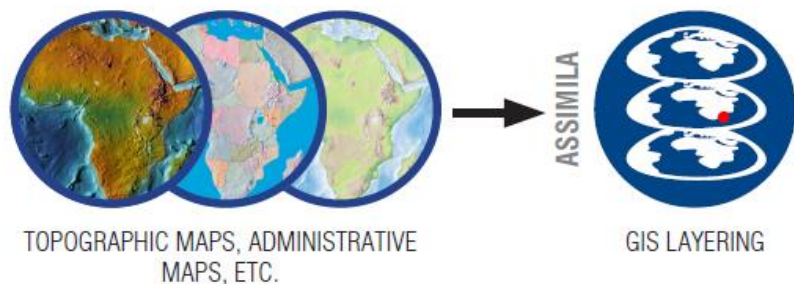
Crop	Species	Scientific name
<b>INSECTS</b>		
<b>Maize</b>	Spotted stem borer	<i>Chilo partellus</i>
	African stalk borer	<i>Busseola fusa</i>
	Fall armyworm	<i>Spodoptera frugiperda</i>
	Bollworm	<i>Heliothis armigera</i>
<b>Beans</b>	Bean fly	<i>Ophiomyia phaseoli</i>
	White fly	<i>Bemisia tabaci</i>
	Pea leafminer	<i>L. huidobrensis</i>
<b>Tomato</b>	Tomato leafminer	<i>Tuta absoluta</i>
	White fly	<i>Bemisia tabaci</i>
	Bollworm	<i>Heliothis armigera</i>
<b>PATHOGENS</b>		
<b>Maize</b>	Gray leaf spot	<i>Cercospora zeae-maydis</i>
<b>Bean</b>	Angular leaf spot	<i>Phaeoisariopsis griseola</i>
<b>Tomato</b>	Early blight	<i>Alternaria solani</i>
	Late blight	<i>Phytophthora infestans</i>



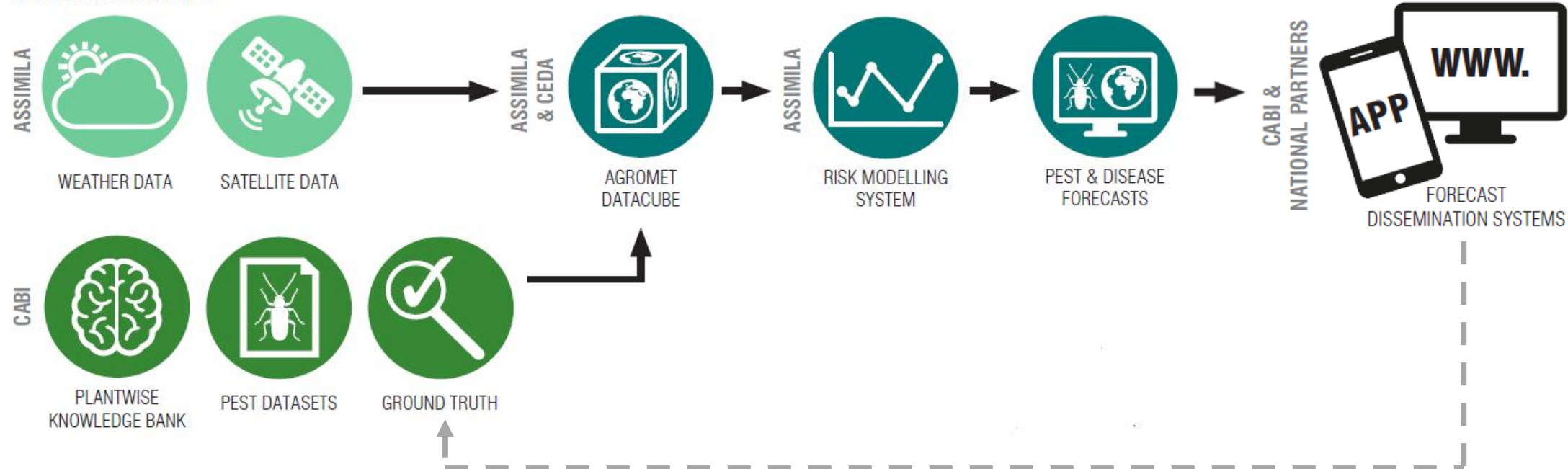


# PRISE End-to-End

## STATIC SOURCES

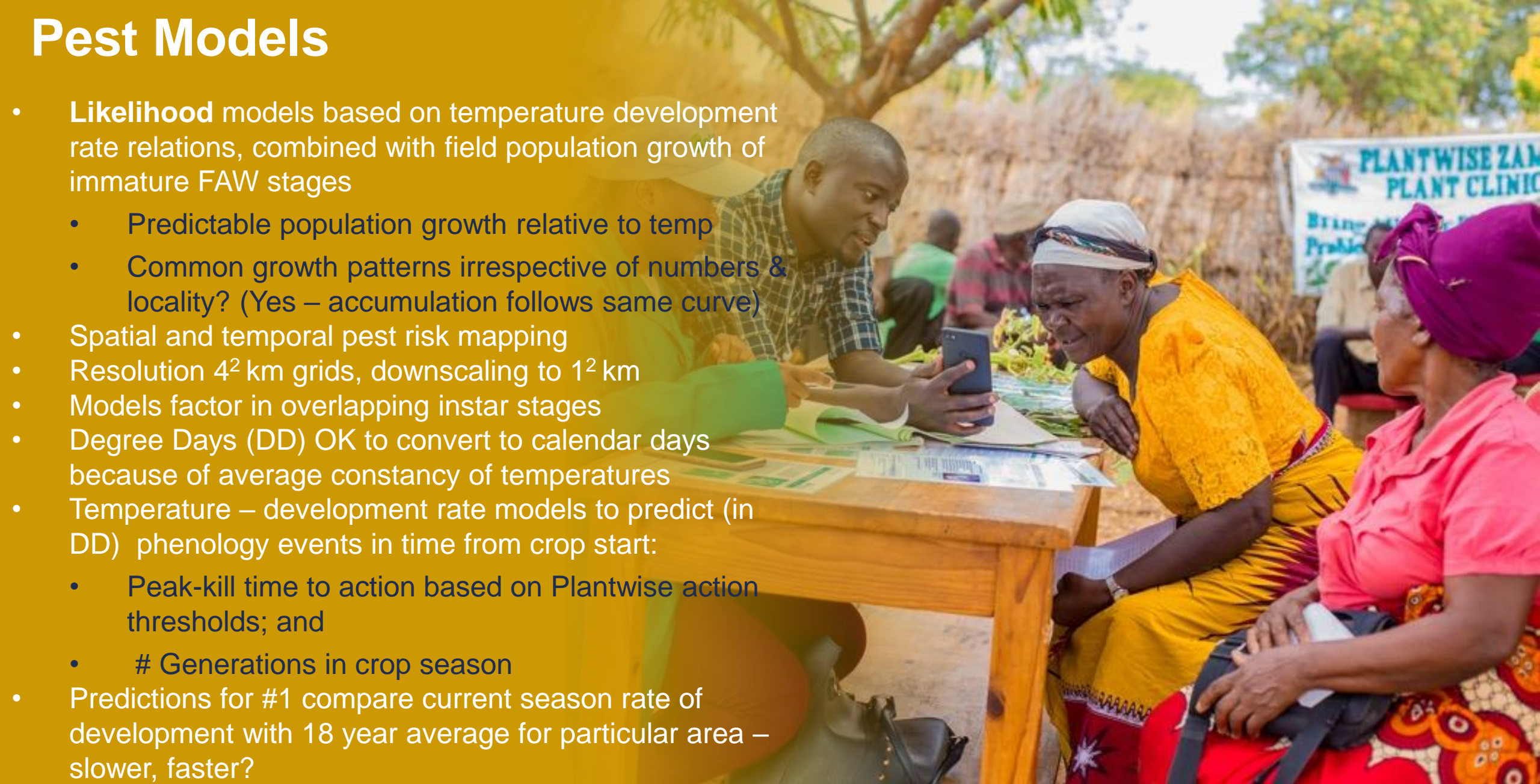


## DYNAMIC SOURCES



# Pest Models

- **Likelihood** models based on temperature development rate relations, combined with field population growth of immature FAW stages
  - Predictable population growth relative to temp
  - Common growth patterns irrespective of numbers & locality? (Yes – accumulation follows same curve)
- Spatial and temporal pest risk mapping
- Resolution 4<sup>2</sup> km grids, downscaling to 1<sup>2</sup> km
- Models factor in overlapping instar stages
- Degree Days (DD) OK to convert to calendar days because of average constancy of temperatures
- Temperature – development rate models to predict (in DD) phenology events in time from crop start:
  - Peak-kill time to action based on Plantwise action thresholds; and
  - # Generations in crop season
- Predictions for #1 compare current season rate of development with 18 year average for particular area – slower, faster?





# Dissemination & Kenya results

- SMS alerts via Mobile partners (e.g. PAD, Esoko, iCow)
- Twice-monthly bulletin report per crop to plant doctors, containing:
  - Mapped pest forecast
  - Plantwise Pest Management Decision Guide recommendations
  - Met department rainfall forecast
- 87% fully understood FAW alerts
- 60% changed practice, +ve outcome
- 43% changed spraying date
- Better awareness and more likely to seek further information





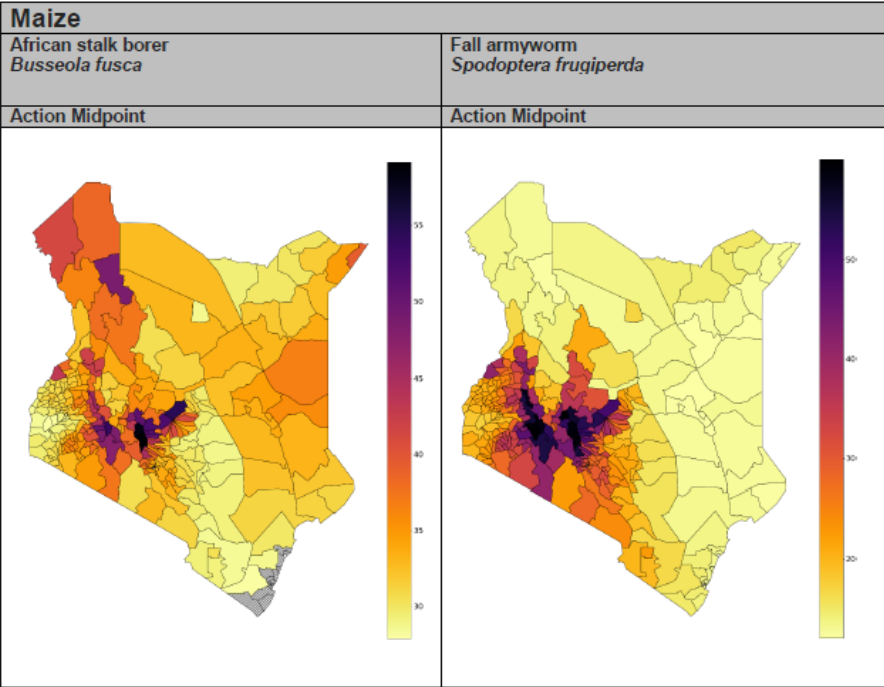
# Example Bulletin

Kenya Update 20/04/20

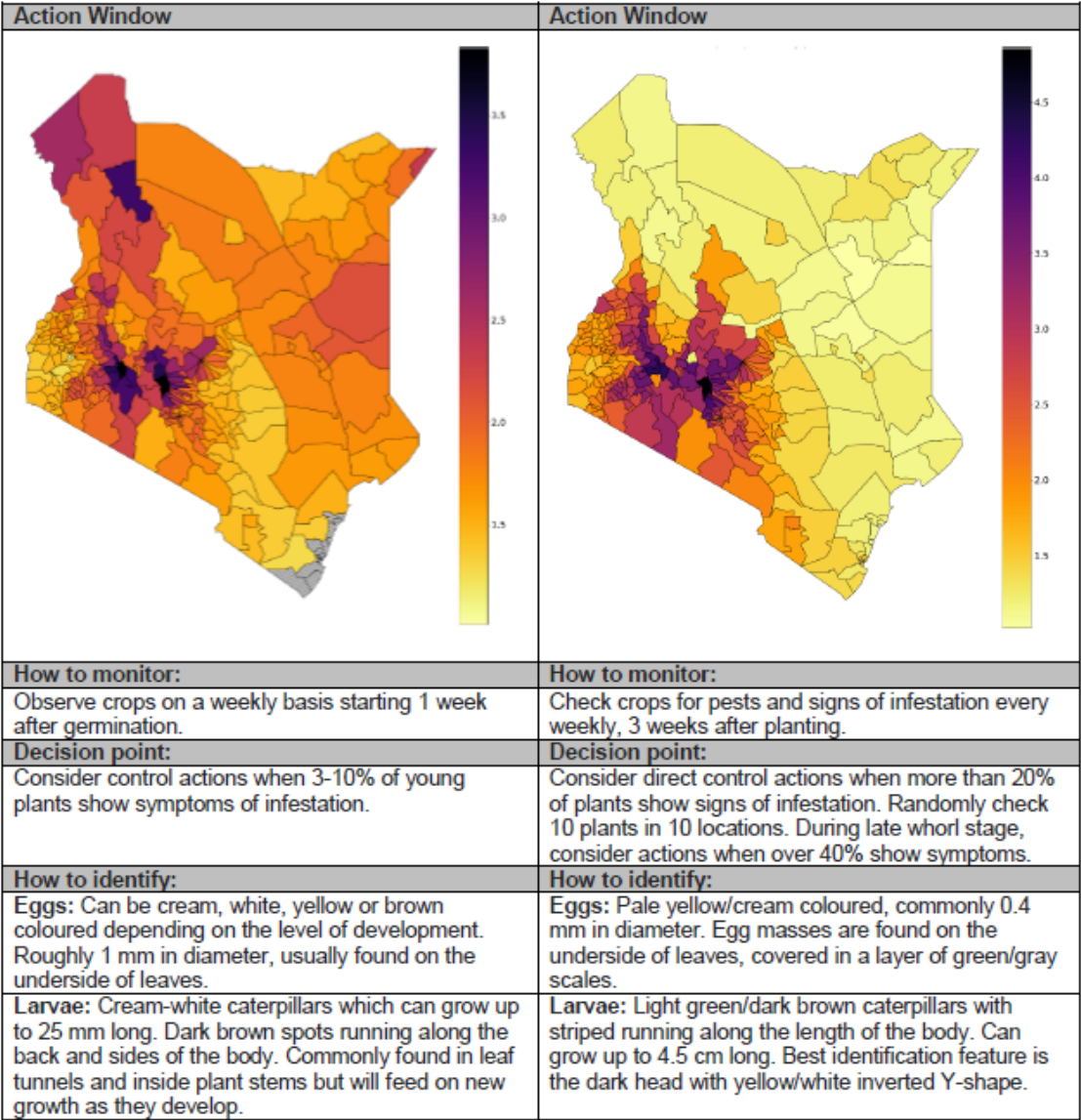
The Pest Risk Information Service (PRISE) bulletin service provides pest information focusing on some of the most damaging pests of maize, tomato and bean crops.

The IPM advice contained in this document has been approved and validated by in-country experts.

Always check for these pests in the field before alerting farmers.



- Midpoint – x days to wait from planting until you should take control actions.
- Window – +/- midpoint value to create range e.g. 20-25 days to wait from planting until taking control actions.



Send feedback on this bulletin to [prise@cabi.org](mailto:prise@cabi.org)

Next bulletin: 04/05/20

# Challenges

- Data, data, data
  - Asian context of FAW geo-presence / 'residency'
  - Calibration, validation and ground-truthing
- User overload and context
  - Clustered alerts are better
  - Action "windows" are better
  - Matching model approach (parameters) to local farming system (Asia is not Africa)
- Sustainability model
  - Who pays?
- Data corrections
  - E.g. pixel resolution, leaf moisture, efficient data logger download
- Unexpected events
  - Physical failure due to people and animals!
  - Data collection constraints



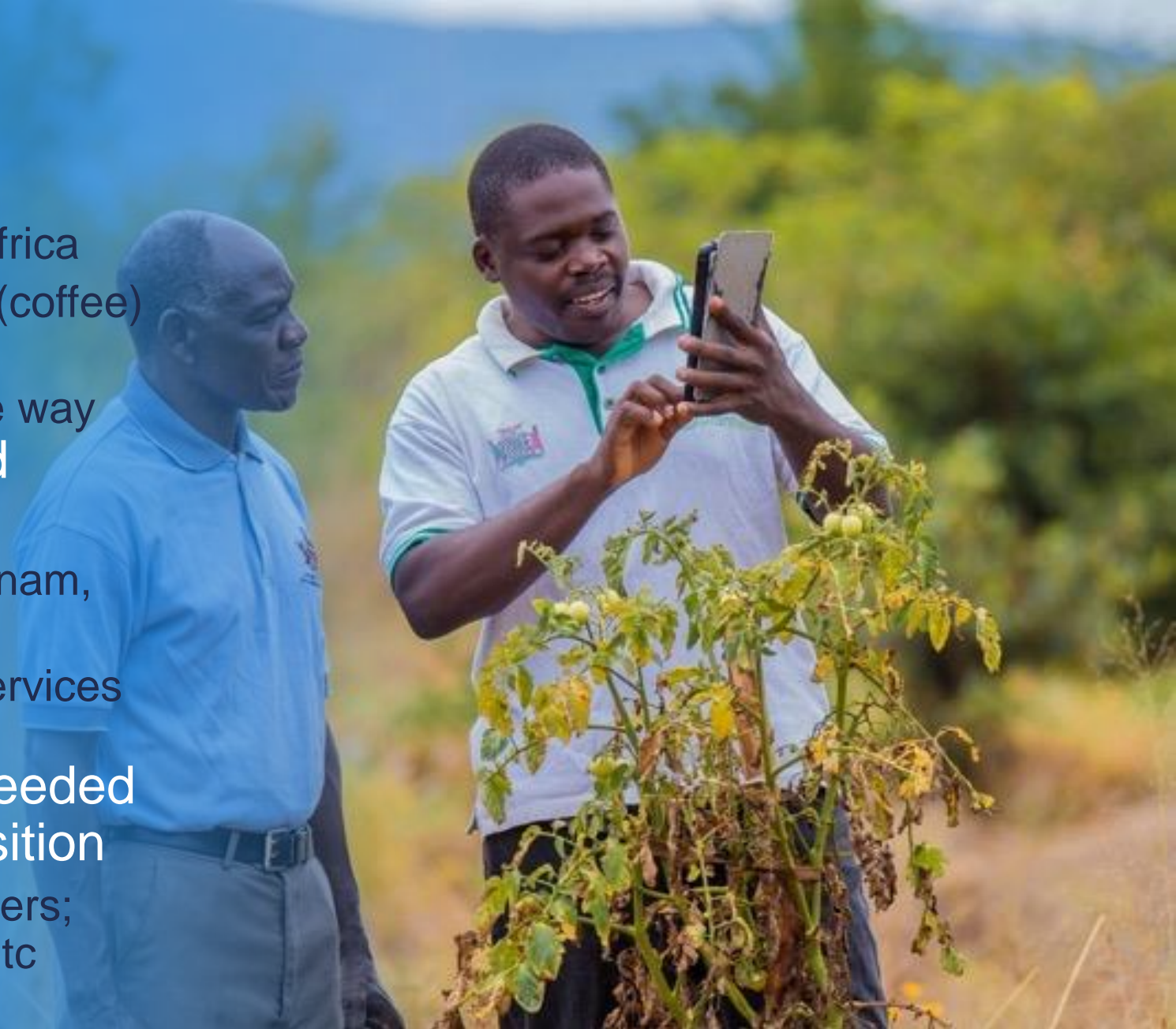
# Value for money

- Cost of alternatives to achieve £1 uplift in yield value
  - Ghana, Kenya, Zambia
  - Maize, bean, groundnut
- **PRISE EO Satellite approach, versus**
  - Manual field-data collection, with weather station networks
  - Drone data collection
  - VfM during project lifetime (2017-21), and for a 2-year legacy period (2017-23)
  - PRISE costs £7.4m (5y) and £8.3m (7y)
- EO approach: £0.03 per £1 uplift (£0.02 over 7y)
- Field approach: £0.22 (£0.17 – 7y)
- Drones: £0.07 (£0.05 – 7y)



# Extending PRISE

- PRISE is transferable
  - Asian FAW is same species as Africa
  - Associated projects in Colombia (coffee) and China (locust biocontrol)
  - Other models (e.g. potato) on the way
- PRISE works best with a mixed farmer-extension model
  - Pilot(s) linked to Plantwise – Vietnam, Cambodia, Myanmar, Thailand?
  - Link to B2C mobile or platform services for IPM-led advice?
- Data- and literature-sourcing needed
- Clear Asian-User driven proposition
  - Financial sector; agri-input suppliers; farmer organisations; off-takers etc





# Thank you

We wish to acknowledge the support of our funders and partners who make PRISE possible

Core donor:



With co-finance from:

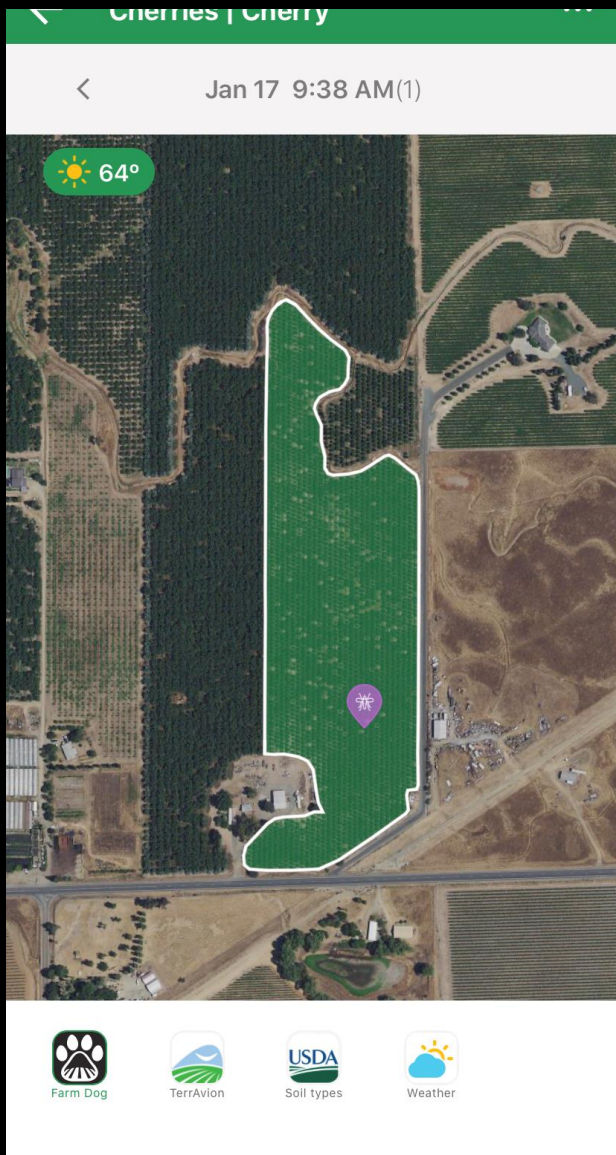


## Q & A with Phil Abrahams

- Remember to use the Question and Answer Box to write in your questions.
- You can put your hand up to verbally make a brief comment/question





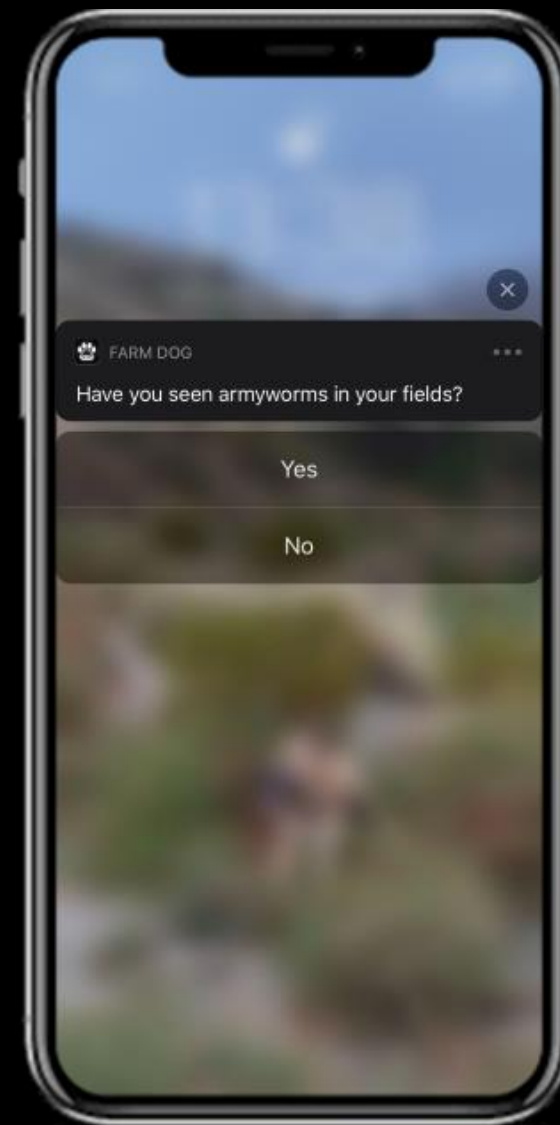


Liron Brish

Digital IPM: Empowering the  
grower, agronomist, and  
agricultural community



FARM DOG





**\$80B** per year on pesticides



**20%-40%** yield loss due to pest and disease  
**(~\$500B)**



Human and environmental dangers

# Farm Dog platform



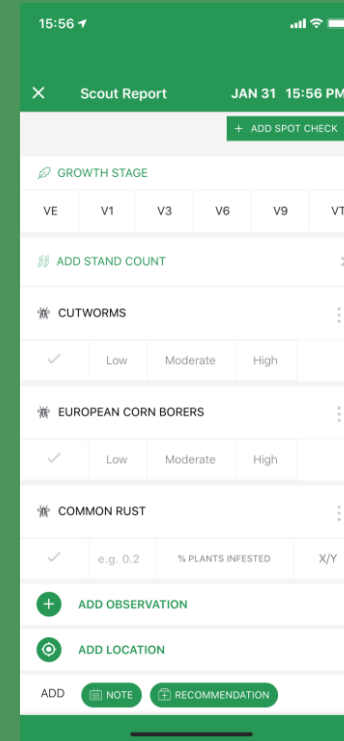
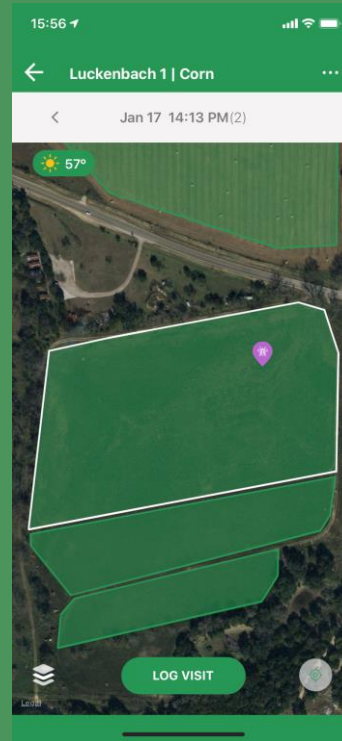
Field management

Verification, compliance,  
and sustainability  
benchmarking

Supply chain integration



# Analog to digital transformation



- Time savings
- Improved communication

# Day 1 value proposition leads to adoption

## CropLife

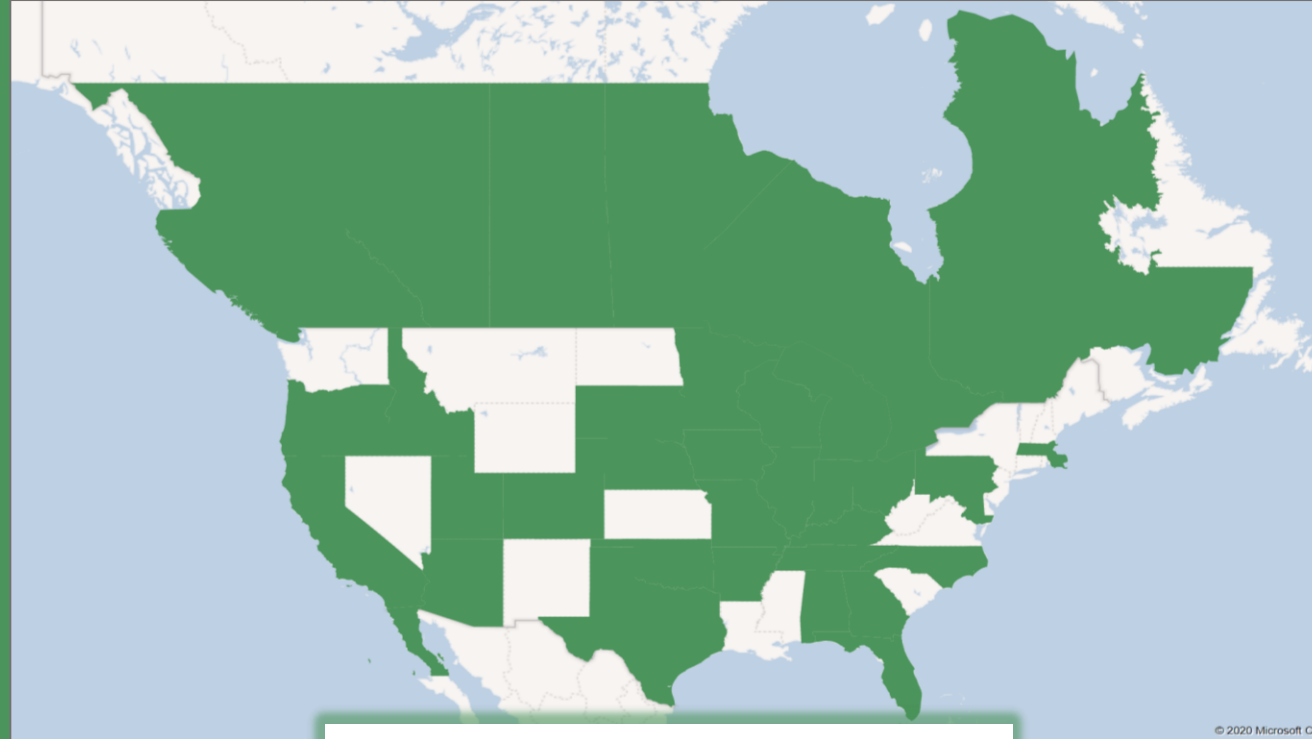
20 Apps You Should  
Know in 2020 and Beyond

Successful  
**Farming**  
at AGRICULTURE.COM™

Top 9 app you shouldn't  
farm without



Top scouting app



### July 2020 Farm Dog North America

- 28 US states
- 6 Canadian provinces
- 1 Mexican state
- 70,000 field observations

“With Farm Dog we  
provide a superior  
product.”

- Chris, Agronomist on  
150K acres

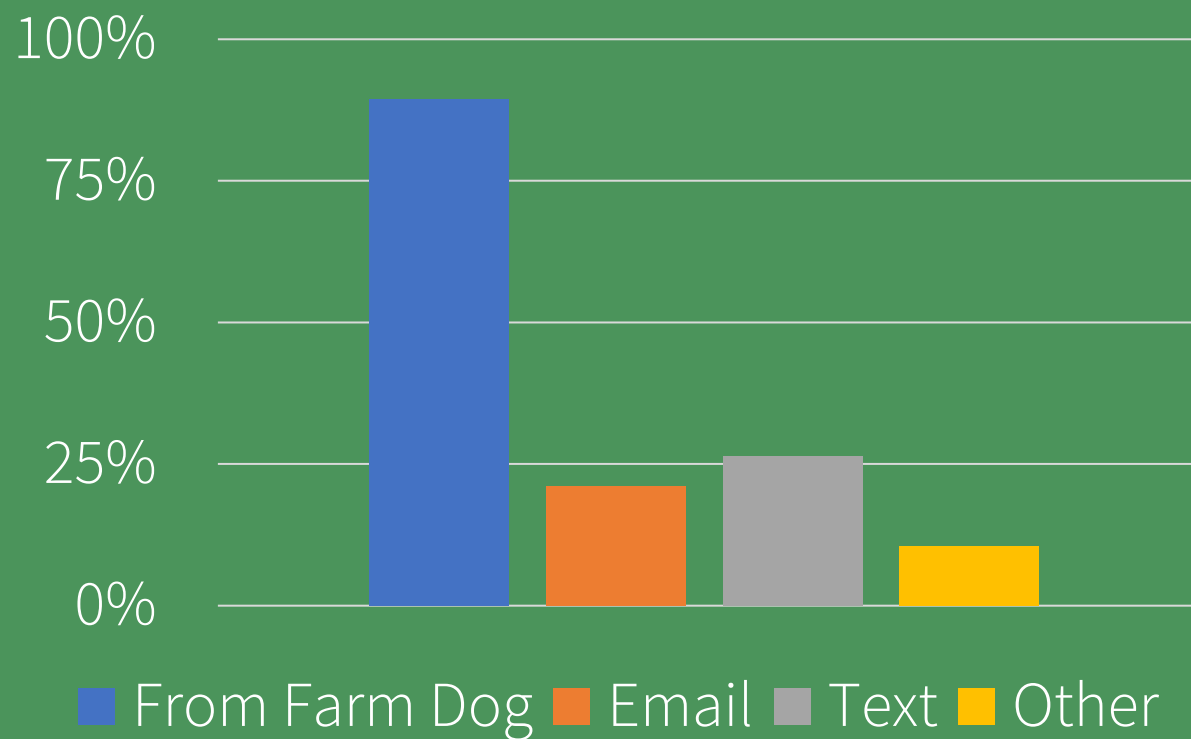
“We save ½ to 1 ½  
hours of valuable  
time”

- Galen, 40 years as  
agronomist

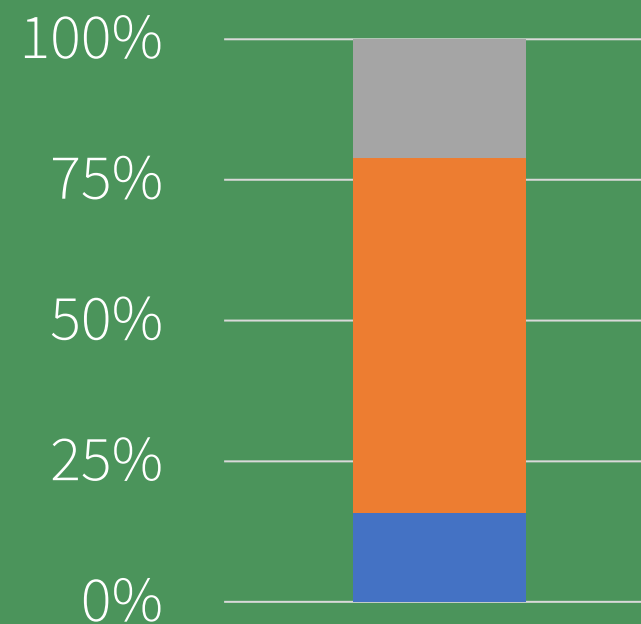
# Extension case study



## How do you share field observations?

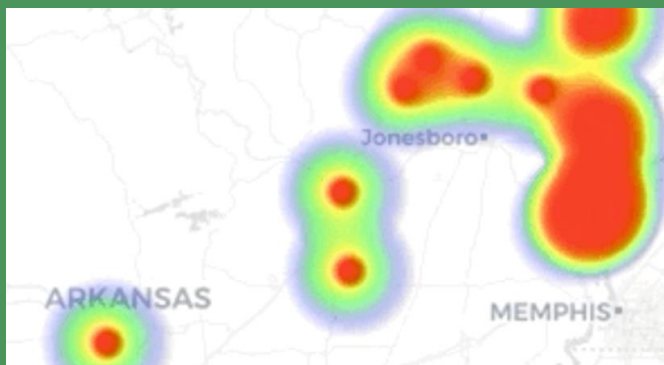


## Is Farm Dog saving you time?

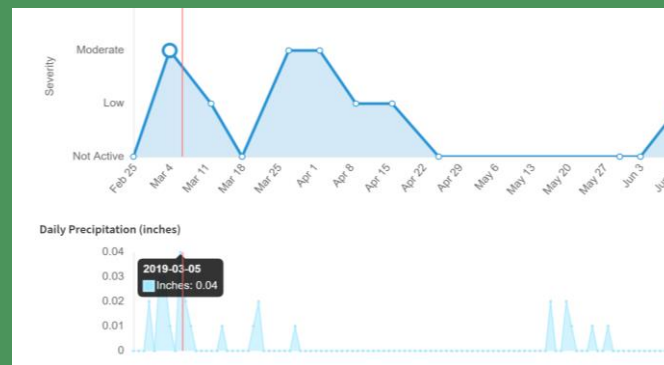




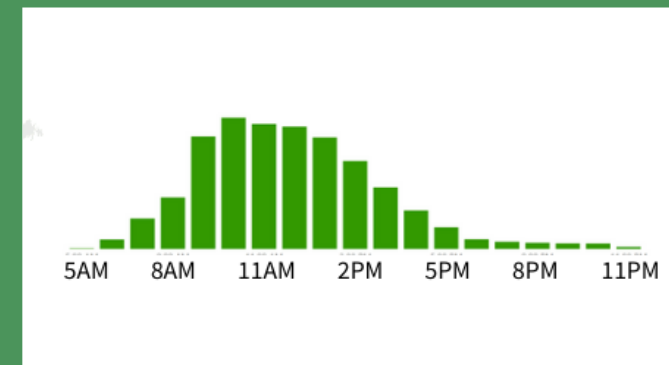
# Adoption leads to data insights



See how pest and disease are moving in your region

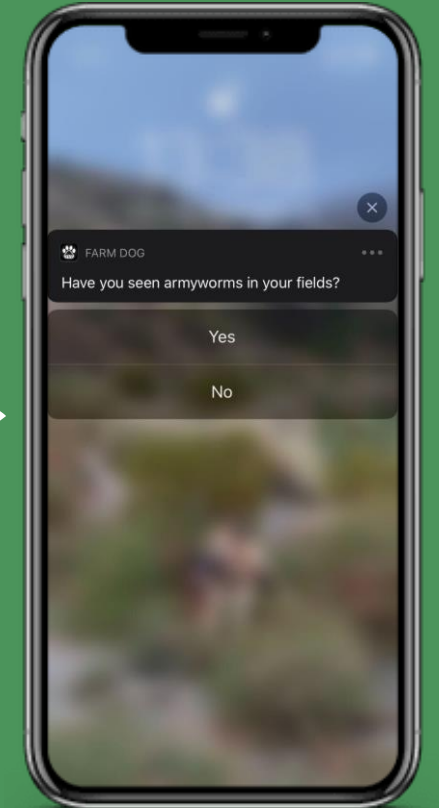
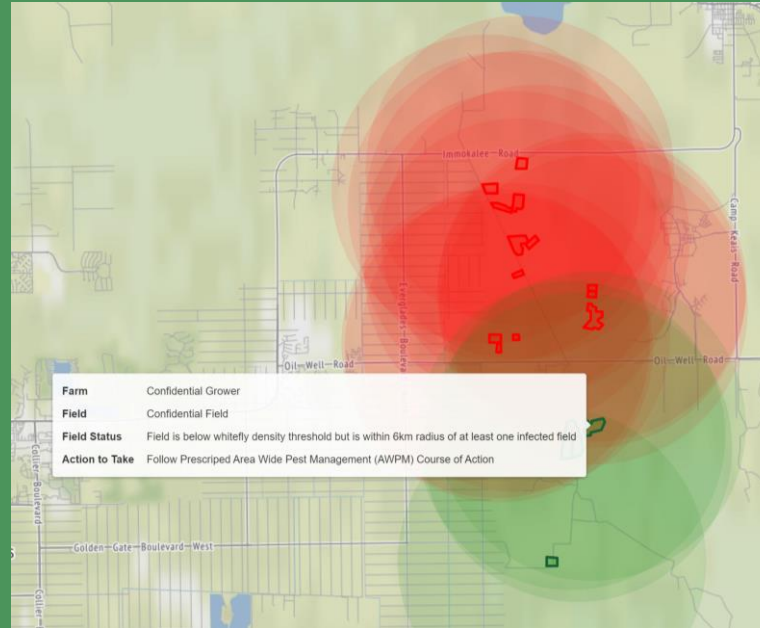
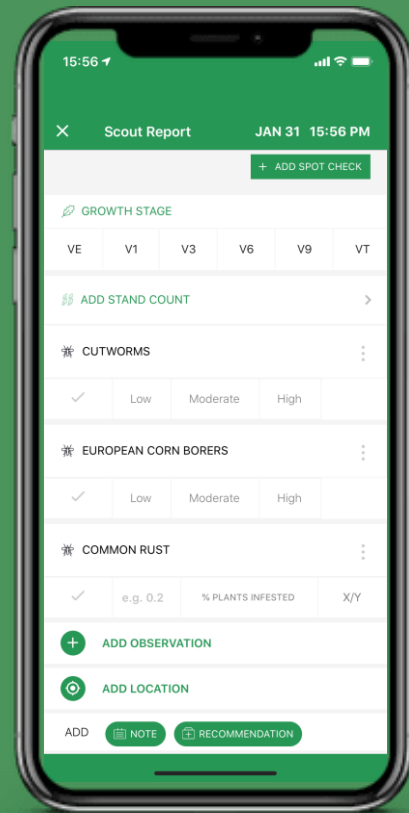


Review in-field efficacy vis-à-vis pest and disease severity



Share operational best practices

# Data insights lead to feedback loops, which lead to better insights



# How do we turn agricultural best practices into digital best practices?

85%

of corn and soybean  
growers in the US scout  
their fields

46%

growers stored and  
managed their data  
primarily on paper records





# Follow the golden rules for digital agriculture

**Easy to use for all  
stakeholders**



**Aligns with  
existing operations**



**Actionable  
insights**



# What does easy to use mean?

Multi-platform  
compatibility



26MB



39MB

Offline  
capability



Customizable



Shareable



Form private-public partnerships



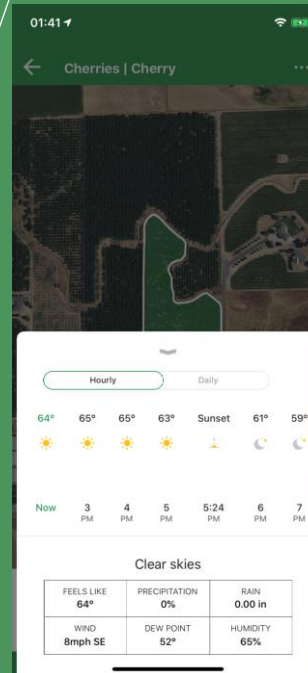
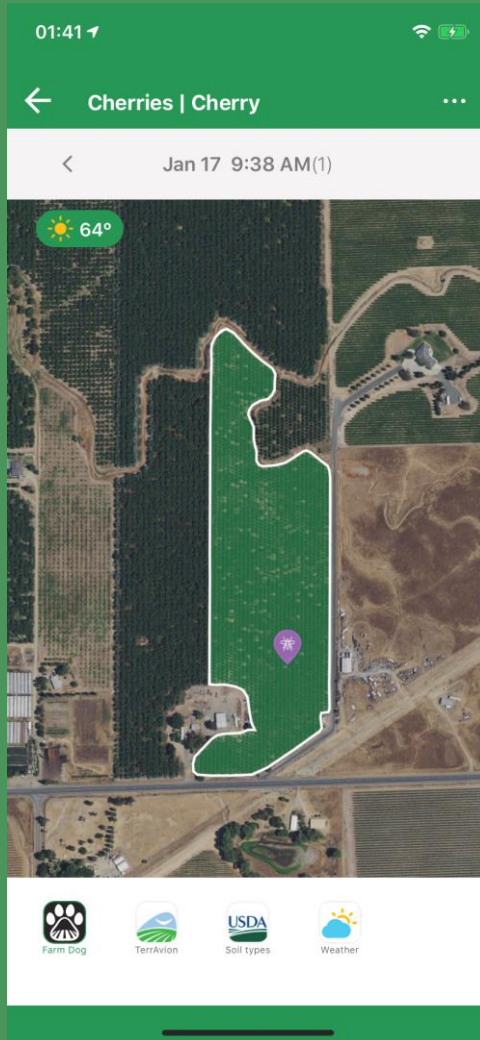
**DIVISION OF AGRICULTURE**  
**RESEARCH & EXTENSION**

*University of Arkansas System*

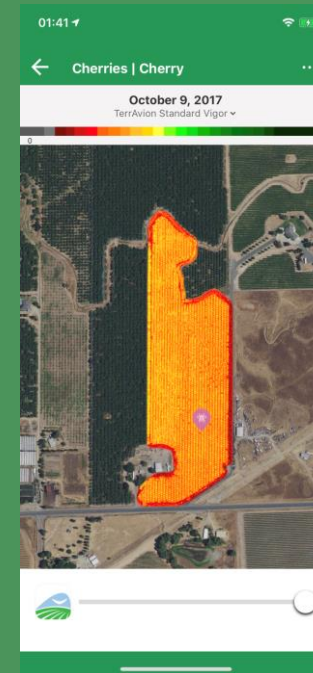




# Form private-private-public partnerships – ecosystem approach



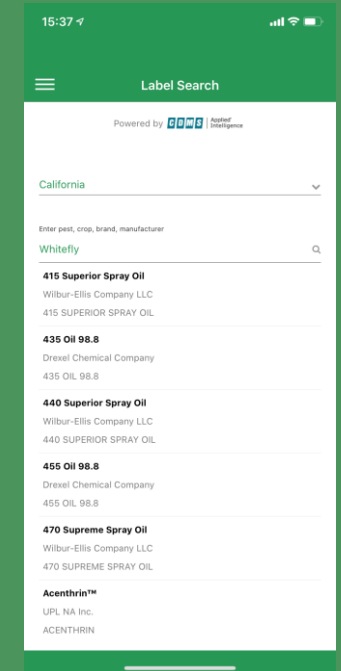
Weather



Aerial imagery



Soil



Pesticide labels

Also:





# FARM DOG

Digital IPM: Empowering the grower,  
agronomist, and agricultural community

Liron Brish, CEO  
[liron@farmdog.ag](mailto:liron@farmdog.ag)







## Q & A with Liron Brish

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Remember to use the Question and Answer Box to write in your questions.

You can put your hand up to verbally make a brief comment/question





Thank you

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# Summary



Paul Voutier, Director , Knowledge and Innovation, Grow Asia



# Biocontrol Webinar Series

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Webinar 2:

## **Biopesticides:**

24 September, 4-5 PM GMT +8 : [bit.ly/FAWBIO2](https://bit.ly/FAWBIO2)

Webinar 3:

## **Augmentation and Conservation**

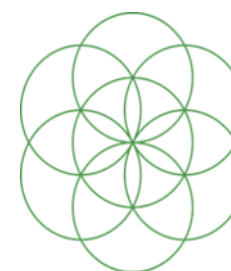
8 October, 4-5 PM GMT +8 : [bit.ly/FAWBIO3](https://bit.ly/FAWBIO3)



Close



Photo by G. Goergen, IITA.



Grow**Asia**