Precision IPM: Developing Robust Tool Sets from Research to Deployment

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Where we must be in five years

- “Young people live smart lives and we need to have smart agriculture.”

- A farmer will open an App, assess the pest damage on their cowpea crop and be delivered solutions in their own language with supporting visuals that give them the correct response at the correct time.

Where we must be in five years

- This simple solution will need to be backed by “big datasets” that drive models that deliver timely solutions within the context of rapidly changing climates.

- Solutions by experts must be made easily available to end users with low transaction costs for both experts and end users.

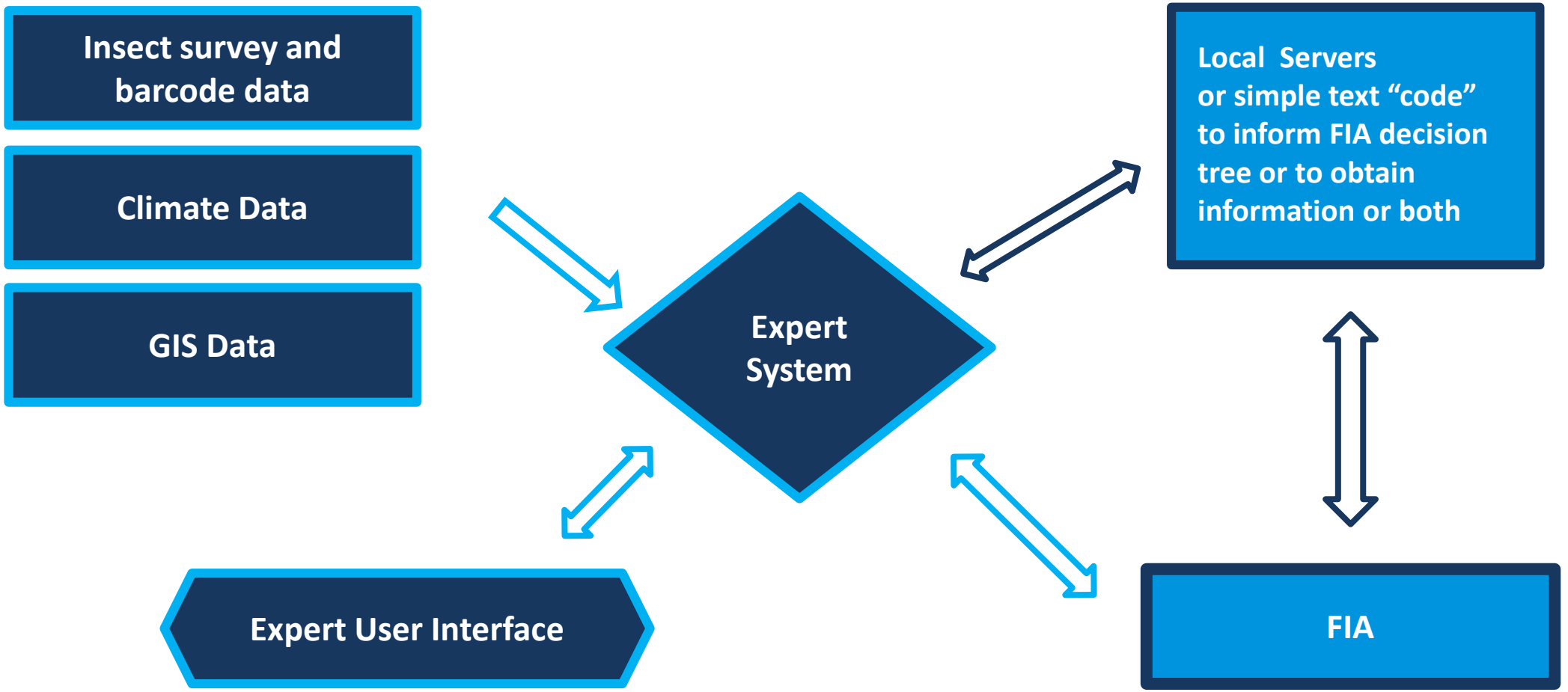
What we need to do to reach this five-year goal

- Technological and social interaction changes open new possibilities for “precision IPM”
  - Collection of data on pest problems
    - Farmer level data
    - Researcher data – field data coupled with molecular markers and GIS data
  - Develop more precise recommendations
  - Precise responses
    - Easily understood by farmers in their own language regardless of literacy levels
    - Easy pass off and buy in for deployers of knowledge

Collection of data on pest problems

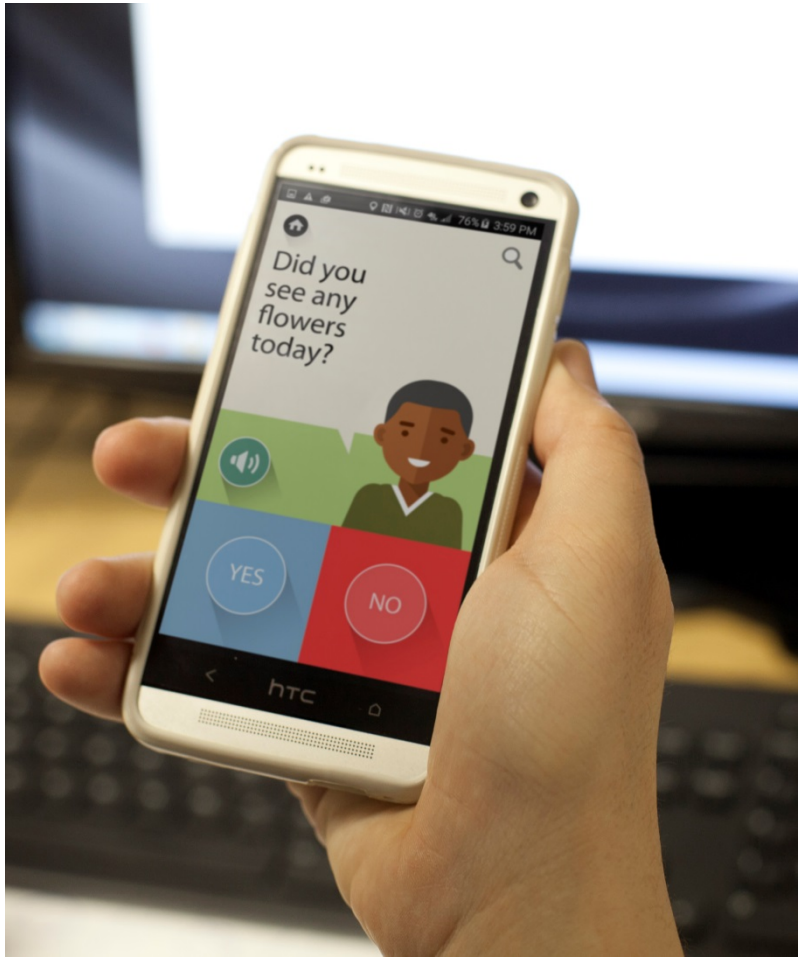
- Farmer level data
  - Need for farmers to collect data on their crops that can be integrated into larger datasets that can be used in driving recommendations
- Researcher data
  - Field data (we need to be thinking towards high throughput systems)
  - Molecular markers to help understand pest population dynamics
  - GIS data

Precision IPM paradigm

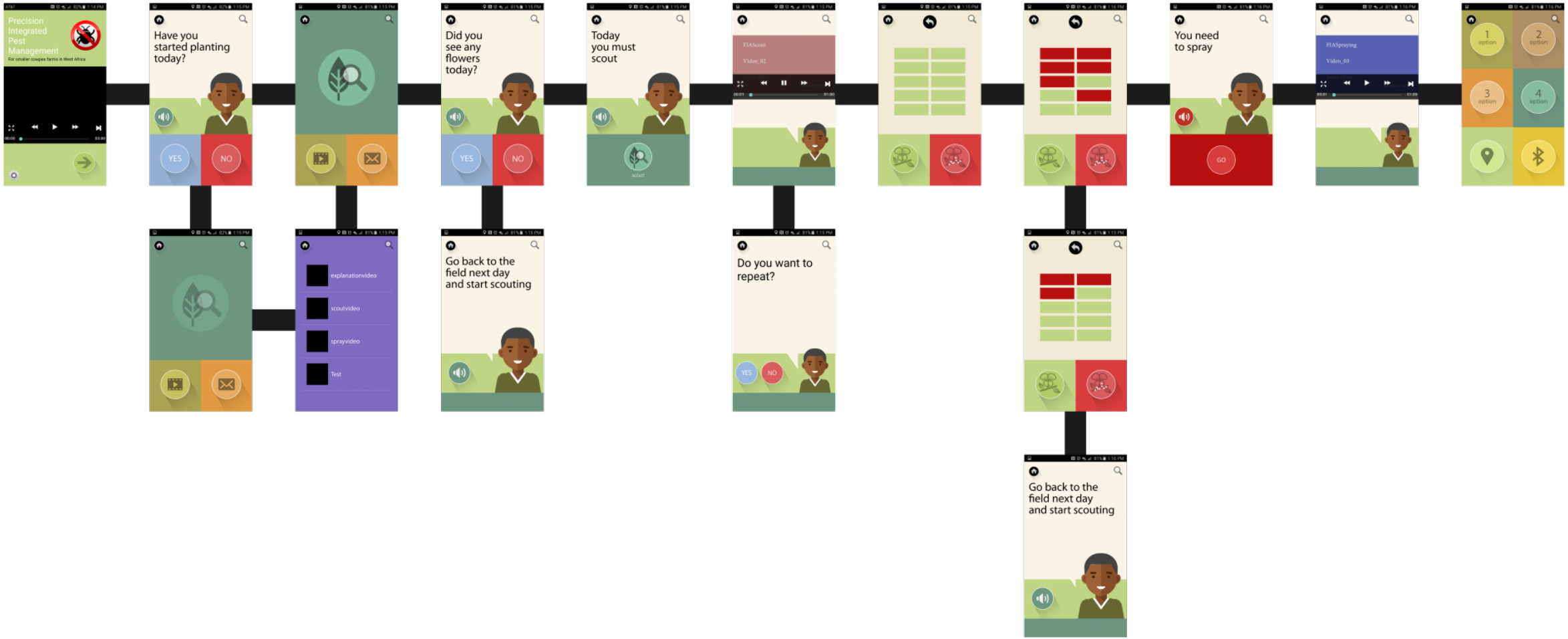


Concept

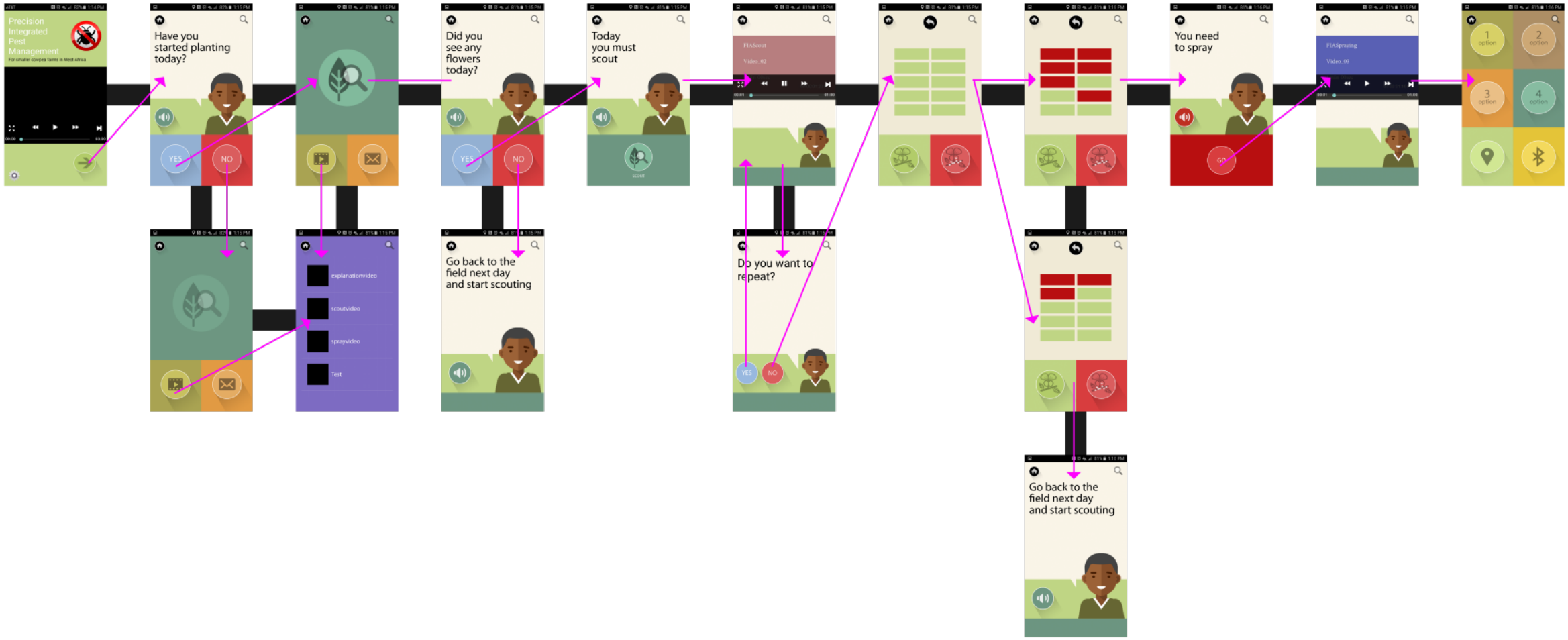
- The Farmer Interface Application (FIA)
- Application to help Farmers identify and prevent insect pest attacks on their crops
- Goal is to create an interlinked community where researcher and farmer data is collected, and used to help other farmers in that area against pests



FIA Prototype – Decision Tree



FIA Prototype – Decision Tree

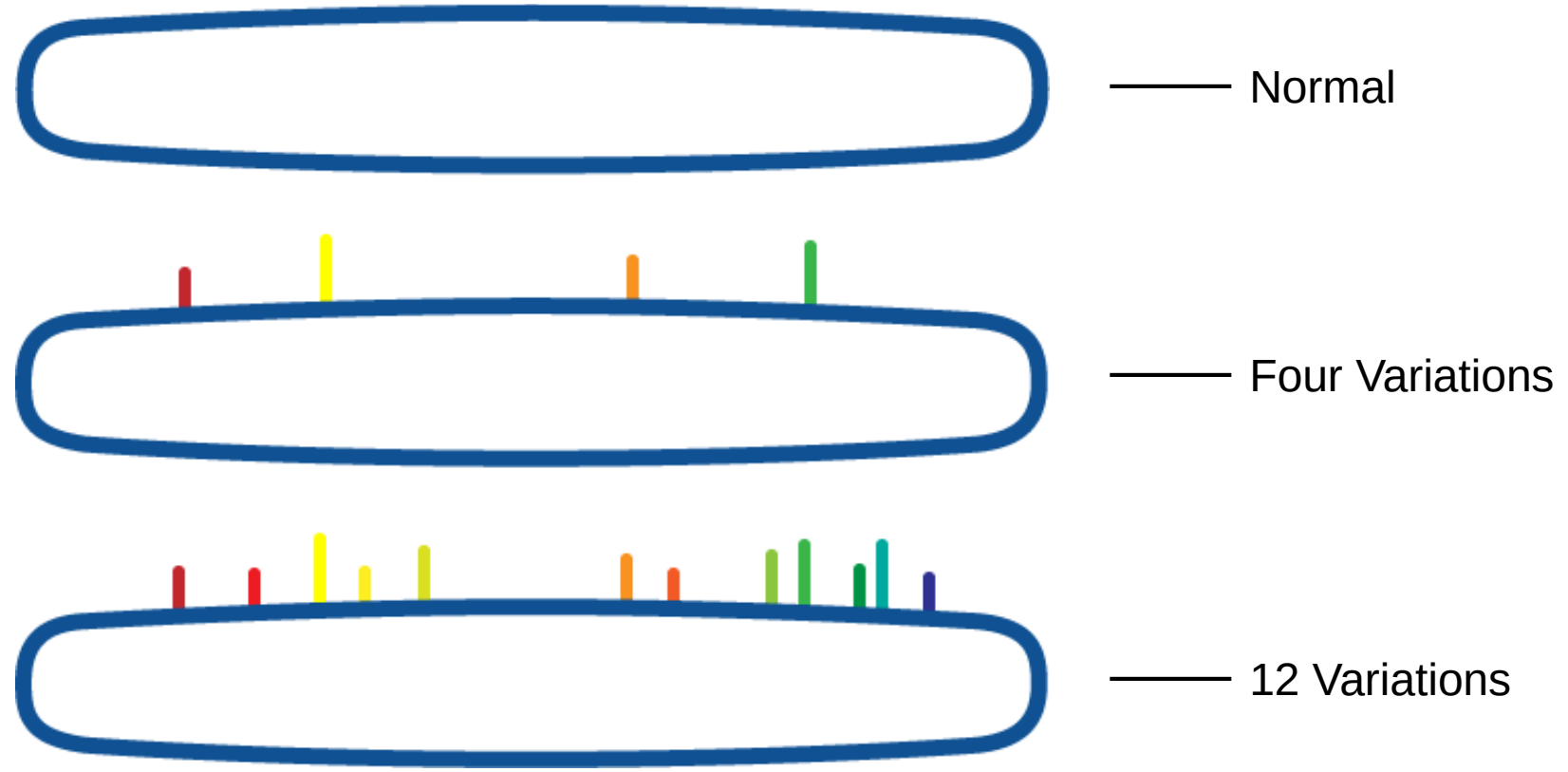


Expert System – Making of & Technical Details

- In total we have 12 data points that are collected and stored in the Expert System's database:
  - Android ID
  - Serial Number
  - Wi-Fi MAC Address
  - Number of Plants with Pests
  - GPS Co-ordinates
  - Known pest locations, timing, host plants and barcoded genotype (researcher data)
  - Elevation
  - Temperature
  - Cloud Cover
  - Precipitation
  - Humidity
  - Wind Speed
  - Wind Direction

- This data can then begin to processed to identify areas that are at risk for infestation

Genotype Difference Identified



Calculation of Genotype Code

	B	C	D	E
sample	1979	2128	2560	2575
0	A	G	T	A
1_1	A	G	T	A
1_2	C	A	C	G
1_3	C	A	C	G
1_4	C	G	T	A
1_5	A	G	T	A
2_1	A	A	T	A
2_2	C	A	C	G
2_3	A	G	T	A
2_4	C	A	C	G
2_5	C	G	T	A
3_1	C	A	C	G
3_2	A	G	T	A

Coded

	B	C	D	E
sample	1979	2128	2560	2575
0	0	0	0	0
1_1	0	0	0	0
1_2	1	1	1	1
1_3	1	1	1	1
1_4	1	0	0	0
1_5	0	0	0	0
2_1	0	1	0	0
2_2	1	1	1	1
2_3	0	0	0	0
2_4	1	1	1	1
2_5	1	0	0	0
3_1	1	1	1	1
3_2	0	0	0	0

Formula

=B2*POWER(2,3)+
C2*POWER(2,2)+
D2*POWER(2,1)+
E2*POWER(2, 0)

Genotype code
0
0
15
15
8
0
4
15
0
15
8
15
0

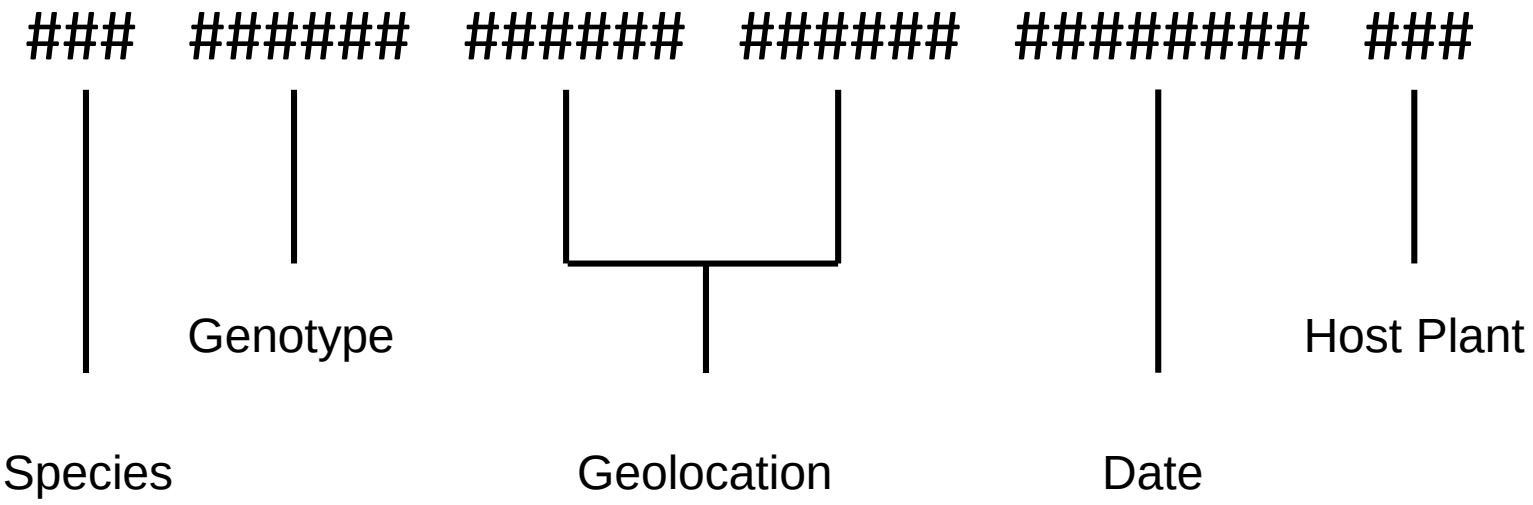
This allows us to assign a number to an insect and that number gives us an idea of how related it might be to another insect. For the ES this allow us to ask - if local populations stay local or do they move around? If they move around, where to they begin and where do they go?

How this Data Feeds into the ES

Code was developed to feed into ES for each insect sample

Code contains

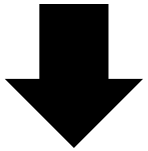
- Date insect sample was collected
- GPS coordinates of collection
- Species of Insect
- Haplotype symbol (Genotype code)
- Host plant



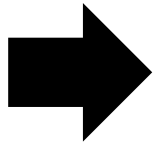
ES Sample Code

Species Code	Genotype Code	Geolocation Code	Date	Host Plant	Sample Site	Insect per Geosite	Insect Number
Maruca vitrata	000256	N 06°39.781, E 02°28.597	03/05/2015	Pterocarpus santalinoides	00001	01	00001

001 | 000256 | 106392812 302282149 | 03052015 | 003 | 00001 | 01 | 00001

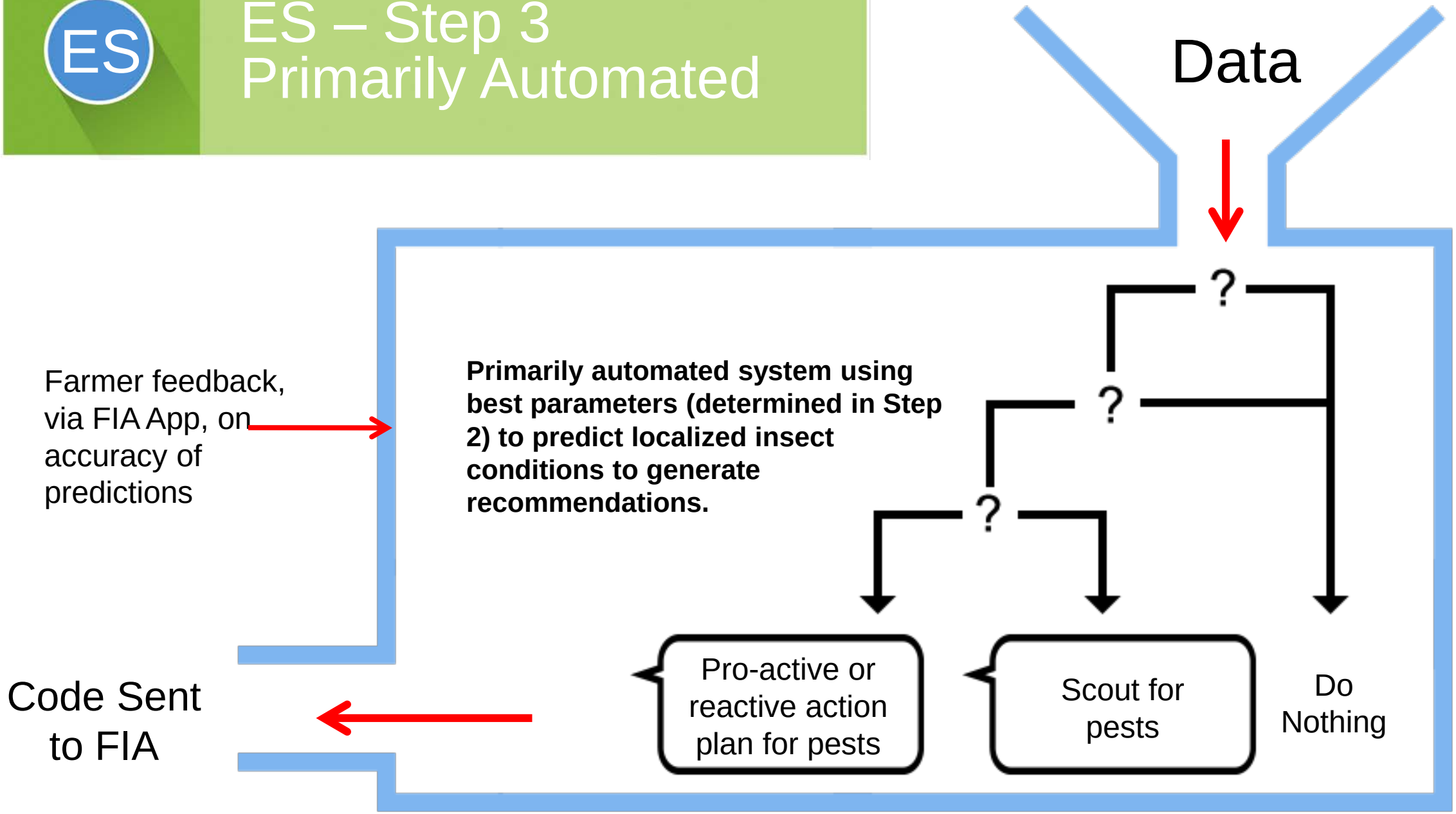


00100025610639281230228214903052015003000010100001



ES

ES – Step 3
Primarily Automated



Knowledge chains

Experts

Content

Scalable Deployment Strategies

End Users

SAWBO system

Experts

Content

Scalable Deployment Strategies

End Users

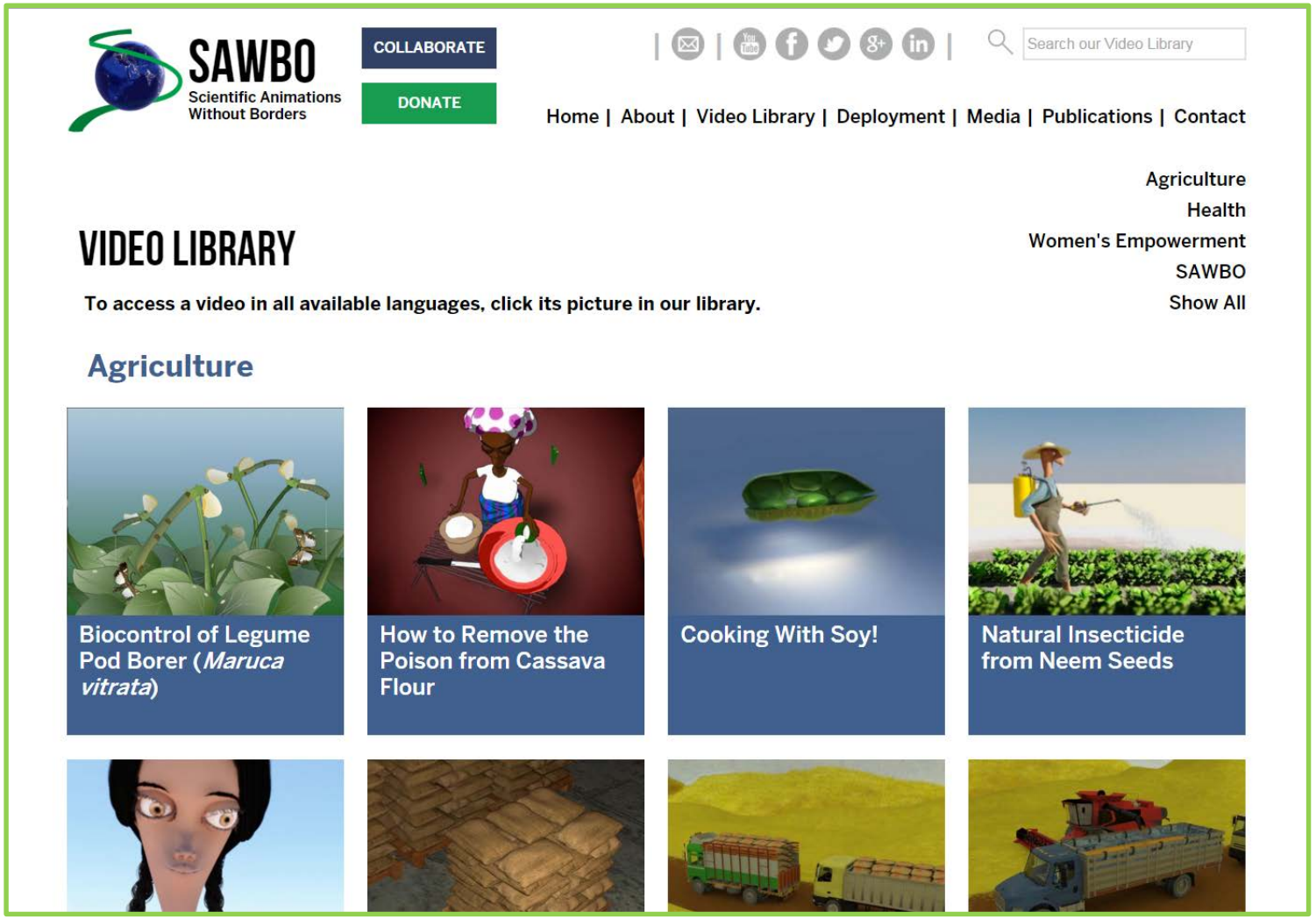
- Virtual collaborations
- Content experts
- Language experts
- Attribution

- Library of animations
- Includes numerous IPM topics
- Over 90 languages

- Deployer
- FIA

- Dozens of countries
- Dozens of partner groups
- Research studies

Highly accessible content

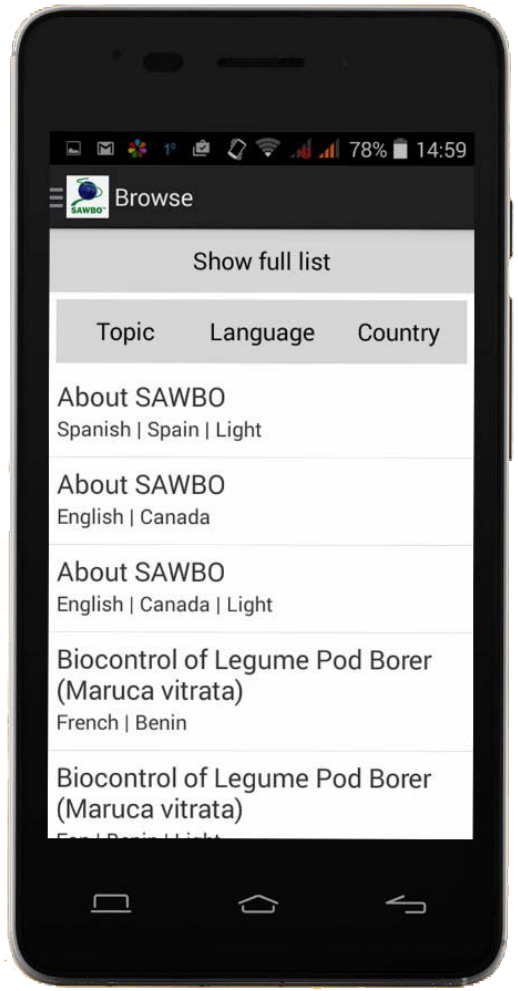


IPM-Content and Supporting Studies

- Field pest control strategies (e.g., neem and biocontrol) and storage solutions for pest management
- Content acceptability studies
- Learning gains studies across multiple countries (collaboration with MSU and ISU)
- Adoption studies in progress

(Studies have been in collaboration with ISU, MSU, IITA, INERA, INRAN, ASTU, IIAM, etc.)

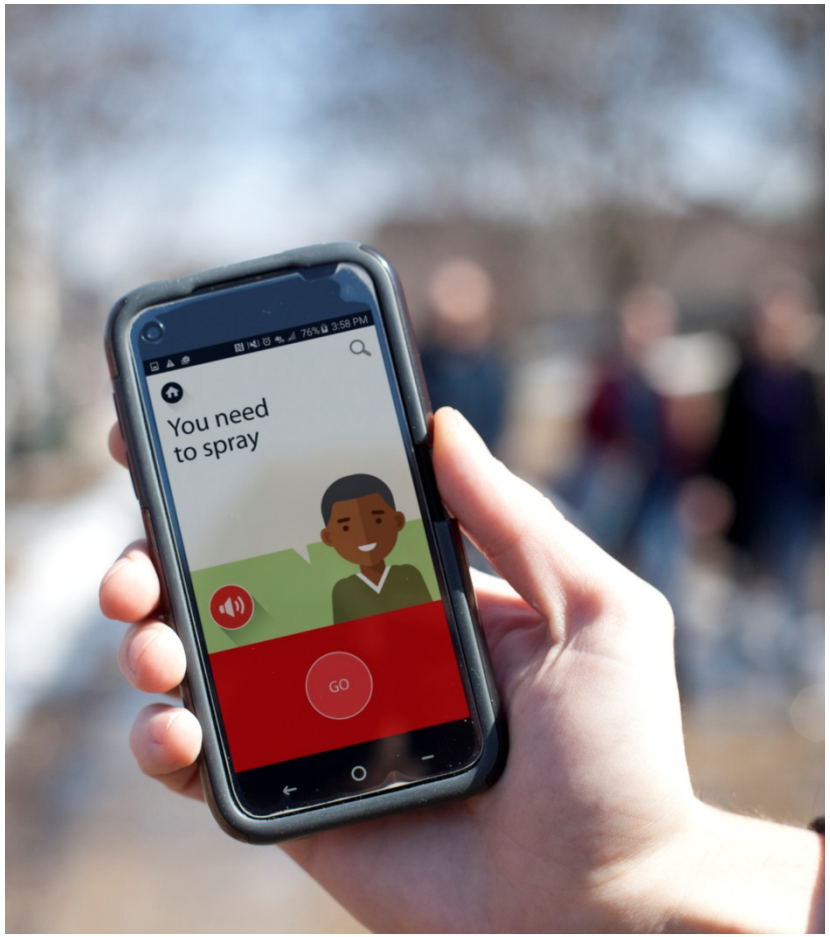
Accessible content for Deployer-to-field tools



Conclusion

- We have developed a high throughput system for educational content across languages

- Prototype FIA and ES systems
  - Built as an expandable system that “learns” to create more accurate recommendations



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