

North Central Soybean Research Program

Soybean Entomology Research and Extension in the North Central Region Project

Farmers' Needs Related to Soybean Insect Pests

Focus Group Interviews with Soybean Growers & Crop Consultants

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Table of Contents

Executive Summary.....	3
Purpose	5
Methods.....	5
Findings	7
Question 1: What is your biggest concern or problem when it comes to soybean insect pests?	7
Typical soybean insect pests.....	7
New pests.....	8
Unpredictability of pests.....	8
Pesticide resistance.....	9
Question 2a: What kind of research do farmers need when it comes to soybean insect pests?	10
Economic thresholds and the economics of cultural practices	10
Insecticide resistance; expanding and maintaining tools for dealing with insect pests.....	11
Environmental impacts	12
Insect pests	12
Question 2b. What kind of information do farmers need when it comes to soybean insect pests?	13
Early warnings of potential pest problems	13
Constant reminders and “preaching” about resistance	13
Training on scouting.....	14
Certified crop advisors want:.....	16
Help combatting the “industry propaganda machines.....	16
Updated information on which insecticides to use for what	16
Help knowing when to trust statistical data	16
Research and information that they can trust.....	16
Question 3: We asked participants to review some pest management resources prior to the focus groups. In the groups we asked, what were your reactions to the materials you reviewed? What advice do you have for soybean entomologists when they design new educational materials ?	17
Make growers aware of resources that already exist.....	17
Make digital resources easy to find	18
Update materials and make them easy to use	19
Question 4: What kind of electronic tools would be helpful to farmers?.....	20
Alerts (described in Question 5)	20

Apps to use when scouting	20
Question 5. How should Extension get out urgent information ? If there is a new pest or growing infestations, how should we get that information out to farmers?	22
Information to include in an early warning system:	22
Ways to get out urgent information	24
It is important to have personal ways of giving and receiving information	24
Advice on how frequently to send information.....	25
Question 6: What are your go-to places for information or decision-making tools and why do you like them?	25
Go-to sources of information.....	25
Go-to people for information	26
7a. What keeps farmers from using Extension's IPM recommendations, like only spraying when insects reach an economic threshold or using recommended sampling strategies?	27
Some farmers don't scout because	27
Some farmers aren't doing their own scouting, so they	27
Some farmers don't believe IPM recommendations	27
Some farmers make decisions based on emotions	28
Some farmers add insecticide when applying other pesticides even when insect pests aren't present or at threshold because:	28
Some dealers have a "go-out-and-get-'em" approach to pests	28
7b. What could Extension do to get more farmers to follow IPM recommendations?	35
Don't get farmers worked up about potential pests; it just increases misuse of insecticides.	35
Send timely, proactive alerts might increase adoption of IPM recommendations	35
Gain the confidence of farmers so they don't rely so much on retailers	35
Educate farmers; repeatedly "preach" your message.....	35
Make adhering to the recommendations easier	36
The use of farm chemicals is a political, social, and environmental issue that Extension and universities need to play a key role in.	36
Things to Consider	40

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Executive Summary

In February and March 2021, as part of the North Central Soybean Research Program Project “Soybean Entomology Research and Extension in the North Central Region”, four focus group interviews were conducted with soybean growers among 11 states who are leaders in state soybean associations or boards, and one focus group interview with crop consultants.

The purpose of the study was to find about farmers thoughts and feelings regarding soybean insect pests and what they desire from University entomologists to aid in management. The findings of this study will be used by Research and Extension entomologists to:

- Improve current pest management information, tools, and delivery methods
- Create new pest management information, tools, and delivery methods
- Guide future research

We heard **two main concerns/requests**:

- **Farmers and crop consultants would like real-time “alerts”** about current pest pressure, dispersal direction, and management options. farmers and crop consultants do not like surprises, particularly when it comes to insect pests. They want pests to be predictable and controllable.
- **Farmers and crop consultants are concerned about the overapplication of pesticides that is leading to resistance. They would like help from land grant universities and Extension to increase adoption of IPM recommendations.** As one crop consultant said, “See a bug, kill a bug” is not a strategy anyone should be using. Some farmers and crop consultants are concerned about retailers who promote excessive spraying. According to participants, adding insecticide to the tank when applying another pesticide, even when insect pests are not present or near economic thresholds, “happens pretty regularly.” The practice is marketed as preventative, an “insurance policy,” a time and money saver, a way to sleep easier.

These are potentially conflicting requests. The danger is that sending “alerts” would alarm farmers, fuel aggressive retailers, and unintentionally increase the misuse of insecticides. Therefore, alerts should contain threshold information and remind growers of resistance issues related to over spraying.

We heard example after example of how decisions related to insecticide applications are not based on scouting and economic thresholds. Instead, participants said applications are sometimes based on fear, cheap insecticides, easy applications, or a bandwagon effect—if farmers see others spraying, they think they should, too. One farmer expressed concern that alerts may just get people worked up. Others said retailers already get farmers worked up about potential problems.

While some might argue that an alert would spur more scouting (a recommended IPM practice), several farmers suggested that it might spur inaccurate scouting or spraying without scouting:

If we are sending out an alert, we need to send out the thresholds and make it clear that if you do see a pest, when is the proper time to spray rather than just getting people worked up that there could be a problem. Sometimes it is, 'Let's look for aphids,' and you go out there and you see aphids. Probably pretty much every year you can go out and see some aphids if you are really looking for them. It does look bad but if you know what the threshold is, you can say, 'Well, we don't need to be too concerned yet.' So, along with an alert to be on the lookout, also an alert to know where we stand on the timing of spraying. (NE MI 2)

Farmers need an app that tells them, 'Hey, make sure you check before you go spray and spend all that money and have problems with the neighbors. Make sure the threshold is there.' Because ... as soon as something shows up, everyone is going to get excited and start spraying. (NE WI 1)

NCSRP entomologists will need to consider how to provide information about pests without contributing to the problem of overapplication of pesticides.

In addition, farmers and crop consultants would like:

- Technology that will make scouting easier, including:
 - Apps to ID insects, calculate economic thresholds, and know how to manage pests
 - Drone programs that can ID problem sites, insect pests, and calculate populations
- information that makes IPM recommendations easier to follow
- Educational resources that are easy to find (where to store information on the web was an issue), easy to use on different devices, and up to date
- Research on:
 - New and troublesome pests, like the soybean gall midge, resistant soybean cyst nematodes, Dectes stem borer
 - Economic thresholds, return on investment, and economics of cultural practices—a few participants argued that IPM economic thresholds should be lower
 - Insecticide resistance
 - Environmental impacts of insecticide use
- Information/training on:
 - What information is already available and where to locate accurate information
 - Why resistance is a problem and what farmers can do mitigate the potential of resistance
 - Training on scouting
 - Knowing when to trust statistical data

Many of the participants in these focus group interviews said they trust land grant universities (LGUs) and Extension. They believe LGUs and Extension play an unbiased role and state the truth. Farmers are sensitive to how they are perceived by their neighbors and the urban public. They are concerned about the health of their own families. They are stewards of the land. But as numbers of Extension professionals dwindle, farmers are relying on their local retailers for management advice. Some farmers are concerned that this heavy reliance on salespeople results in overapplication of many products. The use of farm chemicals is a political, social, economic, and environmental issue. Participants said they want Extension and land grant universities to play an unbiased role. They believe land grants and Extension look out for the growers' best interest.

Purpose

The purpose of this study was to:

1. Better characterize farmers' perceptions of the most important soybean pest management issues
2. Identify the kinds of information farmers need, and the way(s) they prefer receiving information
3. Determine the value farmers place on pest management information, tools, and delivery methods developed through the NCSRP

The findings of the study will be used to:

- Improve current pest management information, tools, and delivery methods
- Create new pest management information, tools, and delivery methods
- Guide future research

Methods

Our primary research team included:

- Tom Hunt, PhD, Extension Entomologist, University of Nebraska
- Kevin Rice, PhD, Extension Entomologist, University of Missouri
- Mary Anne Casey, PhD, Consultant specializing in focus group interviewing

We conducted five online focus groups using the Zoom platform with 4-5 participants in each group.

In focus groups, we use purposeful samples, recruiting participants who have characteristics or experiences that make them "information rich" about the topic we wish to explore. In four of the five focus groups, we chose to listen to people with these characteristics:

- Soybean growers
- In the North Central region
- Who are currently or recently been active in their state's soybean association or board

In the fifth group we chose to listen to people with these characteristics:

- Crop consultants
- In the North Central region
- Who work with soybean growers

Tom Hunt, NCSRP researcher, contacted entomologists from each state to obtain names and contact information for people who fit the selection criteria. Tom Hunt pooled those names into lists for:

- Southeast states in the NC group (IL, MO, OH)
- Southwest states in the NC group (MO, NE, IA)
- Northwest states in the NC group (ND, SD, MN, IA)
- Northeast states in the NC group (WI, MI, IL)
- Consultants in the entire NC region (NE, MI, IL, IN, MN)

Mary Anne Casey recruited participants from those lists, trying to get representation from each state included in each list. Each potential participant was initially sent an email invitation to join the study, followed by a phone call. The incentives to participate were \$50 and a chance to hear how others in their region were thinking about soybean insect pests.

We recruited five people per Zoom session. Four to five participants is the recommended size for telephone and Zoom focus groups. If groups are larger, some participants say little. If groups have fewer than four participants, the range of ideas generated tends to be limited. We recruited 25 participants; 22 participated. An 88% participation rate is excellent.

Groups were held in February and March 2021, prior to the growing season. Mary Anne Casey moderated. Tom Hunt and Kevin Rice assisted with each call. The focus groups were scheduled for, and lasted, 90 minutes.

Each call was recorded and transcribed. Transcripts were analyzed using the constant comparative method (Glazer and Strauss, 1967; Krueger and Casey, 2015). This process requires the researcher to constantly compare each new bit of data to what has been said earlier by participants. This rigorous process limits cherry-picking or only remembering comments one agrees with or finds favorable.

This study could be considered a needs assessment—identifying what types of research, tools, and information are needed by farmers. In a needs assessment that uses quantitative methods, it is not unusual for researchers to assume that the box with the highest number of ticks (highest frequency) is the most important.

However, when using qualitative methods to identify needs, researchers typically pay attention to the range of needs or ideas. While we keep an eye on frequency, we do not automatically assume that the thing that was discussed most frequently or extensively is the most important. The thing that is mentioned most often may be the thing that people are most aware of. However, there may be problems or needs on the horizon that only one person can see yet, due to their particular experiences. A need may be mentioned by only one person in a qualitative study, but be given attention due to the nature of the need and the experiences of the participant. (Think of the first doctor to raise concerns about COVID 19. Because of his expertise and where he was located, he was able to see a problem before others. But he was dismissed because others had not experienced it yet.)

The Findings section presents the range of what participants shared in these focus groups. It is up to the users of the information—the NCSRP entomologists—to interpret the findings, and decide how to prioritize their efforts based on the insights of these information-rich participants.

Go to the Supporting Documents file for a more detailed description of methods.

Findings

This section summarizes what growers, researchers, and consultants shared in the focus groups. Findings are presented question by question. Quotes illustrate participants' ideas. When possible, quotes are identified by the region and the state of the speaker. For example, NE MI 2 means the quote is from the Northeast group, and the participant was one of two people in that group from Michigan. CC IL means the comment was made by a crop consultant from Illinois.

Question 1: What is your **biggest concern** or problem when it comes to soybean insect pests?

Participants are concerned about:

- Typical pests
- New pests
- The unpredictability of pests
- Pesticide resistance

Typical soybean insect pests are those that growers and consultants commonly see in their area. Some growers said they are lucky; soybean pests rarely reach economic thresholds in their areas. Others named a variety of pests that arrive annually or often enough that they are familiar with them, the damage they cause, and how to treat them. These pests are a worry, but people know how to deal with them.

“On my farm, insect pests have been nonexistent. I remember we had aphids, 10 plus years ago and that was a big [deal], everybody was talking about it and there were definitely aphids in the field, and we sprayed some and left some, but we really didn't see that we were hurt by aphids. Year after year we really rarely see anything as far insect pests. You always see the Japanese Beetle and a little bit of defoliation, but it never seems to be very widespread. Some small local spots. We have seen spider mites at times, but it is hardly ever an issue that I have seen.” (NE MI 2)

“I'll pipe up on the aphids. We've had aphids since 2000 in western WI. I think of the last 22 plus years we have probably sprayed at least 15 of the years for soybean aphids. It is probably our number 1 pest. ... It seems like we are a hot spot in western WI. They started here. The university people couldn't believe we had them as bad as we did. We started on our beans at the first and second trifoliolate. So that tells me they build up fairly quick.” (NE WI 2)

New pests seemed to be a bigger concern than typical pests. New pests are those farmers have only recently experienced, or pests that they have heard about but have not yet been seen in their area. They listed things like soybean gall midge, Dectes stem borer, and soybean cyst nematodes. They do not want these pests to move into their areas. They worry about how to spot them and how to control them.

“The new black box, the one that a lot of the entomologists are trying to work on is soybean gall midge. ... The unknown nature of it takes me back to when soybean aphids hit 20 years ago.” (CC MN)

“...There is gall midge—that is probably carrying the most weight at the moment in western Iowa, along the river. High concern. Have I seen it? I don’t think we have it and I have been scouting. I haven’t seen it yet, but I think that is a ‘yet.’ So, obviously very concerned in that regard.” (SW IA 2)

Unpredictability of pests is a concern. Some pests show up sporadically. Growers and consultants fear the unknown and worry about not detecting pests early. They worry about how much damage pests can do in a short time before discovered.

“Migratory pests are always nerve-racking for us, the ones that don’t overwinter in South Dakota, Minnesota. Can we catch them early enough when we are out scouting? Unfortunately, funding isn’t that fantastic in the upper Midwest from the university land grant standpoint for traps and things like that. They have leaned on industry partners and things. So, we are trying to improve that between the Department of Ag, the University of MN, SDSU. It is a little big hit and miss right now. The sporadic ones, the alarm goes off from one consultant area and we spread it like wildfire internally, so grasshoppers, spider mites, corn aphids are definitely on the increase the last 5/10 years. Bean leaf beetles have been sporadic. We have seen thistle caterpillars. We get slugs in no-till soybeans.” (CC MN)

“Over the last 10 to 15 years, we always seem to have one bug that is an issue every year, but it is never the same bug and it seems to be rotating. The latest one that has been more of a problem in our area is the Japanese Beetle, in specific fields, it seems like they can defoliate a ton of beans really fast. But we have dealt with aphids. We have dealt with spider mites, bean leaf beetles. We even have the corn rootworm variant beetle that feeds on beans in our area. That one carries viruses that damage the seeds, so we have seen damage from that. My frustration is just what bug is it going to be and where is it going to be? Trying to keep track of it all. That is the hardest part.” (SE IL)

“We are concerned about gall midge—more because it is an unknown rather than that it is a real problem. We’re finding out it is spread out to the SW corner of the state and in a county just south of the Red River. There is some concern that once it gets in the Red River it will go all the way to Canada quickly. Right now, there is a lot that we don’t know about the beast. We have seen the damage from the photographs out of Nebraska and it is a problem we don’t need, so we need to address it now.” (NW MN 1)

Pesticide resistance and how to maintain chemicals is the primary concern of some people. Participants named examples of pests (insect and non-insect) that have developed resistance—aphids, soybean cyst nematodes, corn rootworm, marestalk. Participants believe current commonly used practices, often recommended by retailers, are contributing to resistance.

“For the most part, we can handle aphids in Iowa. We know how to take care of them. But resistance weighs in the back of our minds. But soybean cyst nematodes, basically because of ignorance. Soybeans are relatively new in NE Iowa. We do not have a heavy presence of soybean cyst nematodes in my corner of the world. But as mobile as farmers are with equipment, I am afraid it is going to be moving in and pests are becoming resistant. Resistance is always in the back of the mind.” (NW IA 1)

“Pyrethroid resistance is very real. We’ve seen it firsthand. It is amazing how fast it spread in one year because of the life cycle and the movement of the aphids. So how many products are we really left with? There are absolutely no new products. We are fighting on the insecticide side; we are fighting EPA and legislation on every single one. There are going to be very little, or probably no, new insecticides. So, we go to the organophosphates, it is probably only a matter of time. They can be harder on some of the beneficials and so on. I appreciate the cocktail comment, but to clarify it for this conversation, a cocktail of organophosphates and pyrethroids only compounds our problem. And if we don’t have other products, we have to look at other cultural methods. But losing the pyrethroids is a big deal. They are economical, they are pretty safe for the user and so on. That is a tough real deal. Hopefully, we don’t have a real outbreak of aphids year after year because that will really speed up the frequency of the resistance. I agree with everyone but I’m reinforcing how bad an issue that is. We are on the 49th parallel. I never DREAMED we would have pyrethroid resistance like we did so fast. It literally blew up in one year in July. Two years ago.” (NW MN 2)

Question 2a: What kind of **research** do farmers need when it comes to soybean insect pests?

Participants want research on:

- Economic thresholds and the economics of cultural practices
- Insecticide resistance; expanding and maintaining tools for dealing with insect pests
- Environmental impacts
- Insect pests

Economic thresholds and the economics of cultural practices. Participants want research on:

- Updated economic threshold and return on investment data
- Economic thresholds for multiple insect pests feeding, individually each below thresholds, but what is the threshold when combined
- Thresholds for pests at different stages of plant development (e.g., Is marmorated stink bug worth treating late in the season?)
- Thresholds for fungicides (a disease issue, but mentioned related to tank mixing insecticides)
- Economics of different cultural practices and treatments

There was a lot of discussion of economic thresholds throughout the focus groups. Some farmers believe IPM insect pest thresholds are too high; they would like to see them lowered. They believe farmers are losing money by adhering to IPM recommendations. Others believe too many farmers are not adhering to IPM recommendations. Still others said the recommendations need updating because they are based on research that is decades old, or based on research done several states away.

“There is lack of economic threshold data for certain pests across certain states. I know a lot of times we will rely on these sporadic pests for research information that might be 30/40/50 years old and might be from 4 to 5 to 10 states away at times. And we try to glean what we can from understanding biology of the pest and crop development and make it applicable for our local environment. Certainly, the ROI.” (CC MN)

“Thresholds are tricky because we have plenty of folks who are like, ‘I really don’t want to spend the money; I don’t want to do this [spray for late season insects].’ But they are losing more than they think. Even though they don’t believe they are at threshold. And part of that is their personal scouting and what they want to do. I think those are real issues when we talk about thresholds.” (SW IA 2)

“Here in southern Illinois, we have a lot of defoliation from cabbage looper and green clover worm to go with thistle caterpillar and some of those, it doesn’t look like a whole lot, it might be 5 to 10 percent. But when you start adding all those together, what is that economic loss you are seeing there?” (CC IL)

“As far as research, ... I agree with these comments on the late season, it doesn't take a lot of feeding on pods to justify a treatment. That is something that seems to get overlooked.” (SW MO 1)

[We need] “statistics on return on investments in the actual yield projected rather than simple bar chart or piano graphs. Did the treatment actually provide the true yield response? ... Is this quality data or propaganda data? There are a lot of PhD and masters people working in industry that would rather put up a simple bar chart, or piano graph on 78% of the time winning. They don't put any statistical analysis to it. We fail to do that with our growers plenty of days, too. ‘I got a three-bushel advantage; I got a good response.’ Well, we might have just measured field variability, not actually pest control. Few of us like statistics. But that is something I spend a lot of energy with internally with our consultants—challenge the data when it is presented. Read the fine print. Did it really matter? A 30-bushel advantage in corn will catch anyone's attention. But it may be statistically invalid, insignificant, because it is a limited data set, limited site years, things like that. That is an area we can improve upon from the university to the industry to boots in the field type of work and hand in hand with the growers as well.” (CC MN)

Insecticide resistance; expanding and maintaining tools for dealing with insect pests. Participants want research on:

- Cultural practices for dealing with insects—how not to rely on insecticides. For example:
 - Trap crops
 - Earlier planting to beat the life cycle
 - Rotation
 - Look back at old research for dealing with pests

- Insecticide resistance

“I am going to reiterate; we need to work on resistance. ... What can we do as far as cultural practices? And it is not just aphids. Whatever the case may be. Cyst nematodes. Gall midge. Root worms. Whatever. But we have to have immediate research, but then also looking out for the future.” (NW IA 1)

“In MI, we are continuing to have a problem with soybean cyst nematode on sandier soils. We are seeing some failures of the resistant types, the PI 88788 and more recently the Peking resistance is starting to fail. So, any additional research in that area. Coming up with different types of resistance would be very beneficial, not only for MI but for most of the Midwest area.” (NE MI 1)

Environmental impacts of:

- Using insecticides when pests have not reached economic threshold
- Insecticides on the water we swim in and drink

“I would say [we need research on] the environmental effects on everything. We do live in this world; we swim and drink the same water. We are the stewards of the land; we have to be. I think everyone takes that very serious. ... We need a strong social and environmental relationship, which, if you had asked me 10 years ago, I would have scoffed at. ... It is self-serving. We want to do it so we can maintain these products and or develop new ones.” (NW MN 2)

“With regards to research, from our aspect here in IL, [we need] stronger economic and environmental impacts [data]. We have guys that it is just easier to throw generic [pyrethroid] in for \$1.50 an acre and spray and pray without scouting fields. That defeats the purpose, in my opinion. We try to get that point across, but it still falls on deaf ears at times. If we can get something more concrete out there that shows—scout that field before you throw the insecticide in, that may help. I know with the environmental regulation coming down the pipe, we have fought this battle for years with the monarch butterfly and that. Those can still be brought to the forefront rather quickly by broadly applying insecticide without scouting. And I think we have to see the economics to go along with that.” (CC IL)

Insect pests. Participants want research on controlling pests.

- Immediate pests like aphids, Japanese beetles, spider mites
- Emerging threats, like soybean gall midge, Dectes stem borer, soybean cyst nematode

Question 2b. What kind of **information** do farmers need when it comes to soybean insect pests?

Participants said farmers need:

Early warnings of potential pest problems (Go to Question 5 to see more about early warnings)

Constant reminders and “preaching” about resistance (for both insecticides and fungicides) including:

- If we lose chemicals, we limit our options for controlling pests
- The consequences of using sub-lethal rates
- The consequences of adding insecticide to tank mix when insects aren't at threshold
- The consequences of applying insecticides that insects are resistant to
- The importance of using different pest management strategies
- Basic IPM 101 training—“See a bug, kill a bug” is not a recommended strategy for growers, advisors, or consultants

Comments on resistance from a crop consultant:

[People need] “constant reminders that resistance is out there. ... ‘See a bug, kill a bug’ is not the strategy for growers to use or your advisor or consultants to have in their head. We have got to focus on these key reminders. ... Pyrethroid resistance and fungicide resistance. We don't have tons of pests that overwinter; we freeze up for three to five months. If we look at some of these migratory pests that overwinter in the gulf states, we got resistance issues that have been documented in the southwest of the state or 3-4-5 states to the south. That is a key watch. If you are fighting soybean aphid resistance with pyrethroids—a couple of comments have been made that it is only \$1.50 an acre for a generic Warrior; that doesn't make it work any better if there is a resistance issue. I don't care if it is free. It is still not going to do the job and that is clouding tank mix recommendations. We are starting to see too many things go out at sublethal rates; we are relying too much on the effective product at a lower rate to do the job from a control standpoint. ... We are on the entomology side, but I will use the example of frogeye leafspot. For 25 years of my career, I joked around with all the southern counties I worked with on frogeye down in Missouri. For the last three years, it is almost impossible to walk in a soybean field and not identify low infection levels of frogeye. Through the little university research, through Iowa, South Dakota, Iowa, it is 80 plus resistant to the strobilurins. So, we have got to implement a completely different strategy, not only for identification but a pest management strategy too. ... Those problems can manifest externally quickly, and I think in our line of work, consulting, if you miss it and it is a resistance issue, we come back three, five, seven, 10 days later, the problem is now out of hand and economic loss might be occurring very, very quickly.” (CC MN)

Participants said farmers need:

Training on scouting—perhaps offer scouting schools. Cover:

- The importance of scouting
- How to scout. Cover:
 - Easier, less time-consuming ways to scout
 - How to notice things that are not obvious
 - Why you can't just look at the edge of the field
- Pest identification
 - At different developmental stages
 - Include photos they can hold next to insects for ID
- Pest damage
 - How pests damage crops
 - How to identify damage
 - Levels of damage
 - Whether to worry about the damage
 - That defoliation might not be as bad as it looks
 - When to check back
- When, during the season, pests tend to cause economic damage
- Thresholds
- How to control pests
 - What product to use, if needed
 - Natural ways to control insect pests
- Beneficial insects
 - How to identify beneficial insects, particularly predatory insects
 - The role they play
- Why it is important not to spray unless you reach threshold
 - Wastes money
 - Increases likelihood of resistance
 - Kills beneficials
 - Causes problems with neighbors
- How to use a drone for scouting

Comments related to scouting:

“It is hard to get growers to actually scout their own fields. That is great for our line of work, it feeds right into our business model, but it is very, very true.” (CC MN)

“A lot of farmers are complacent. ... I think farmers need an app that tells them, ‘Hey, make sure you check before you go spray and spend all that money and have problems with the neighbors. Make sure the threshold is there.’ Because ... as soon as something shows up, everyone is going to get excited and start spraying.” (NE WI 1)

“A lot of growers rely on the retail. When your salesperson takes you to the edge of your field and says, ‘Here, look at all this feeding/defoliation you have. You need to spray.’ It is easy to say, ‘Yeah, go get your rig ... because there is going to be nothing left.’ If you would have walked out into the center of the field and done the samples like you guys suggest, it would be, ‘Well, we are not at threshold yet. You shouldn’t have to spray.’ If someone is there with them saying, ‘You need to do it,’ it is hard to not do it. It is easy to believe what you see if you are not going all the way [to the middle of the field]. If they know before they go to the field, ‘Oh, we need to really do a good scouting job and go out there and take more samples than what our salesperson is suggesting,’ it might be beneficial. But how do you get your sales guy to show you how to do proper scouting? That might be a challenge. ... Going through ... [the video on] defoliation ... was something. ... You walk out in the field and you look at the leaves and say, ‘Wow, they are really chewing on that.’ Going through how it was described and how to take samples and look them over. It is really eye opening, the difference from just taking a look at the edge of the field and going out and getting 20 samples. Growers need to know how scout like that. How do you get that to them?” (NE MI 2)

“For me personally, and I think this goes for a lot of people, [we need information on] identification. How do we know it is a soybean aphid versus a Greenleaf aphid? What time of year are they coming in? When does it affect the crop? When does it pay to control them? If they come early in the season? Late in the season are you able to get by with not controlling them? Is there a natural way to control them?” (NW ND 1)

[Farmers need] “research on different methods of scouting. Kevin Rice has done some good work on traps with stink bugs. Providing good ways for scouting and making scouting, perhaps, easier. In Missouri we have worked with some scouting schools for diseases; I think that could fit right in with insects also...I think scouting schools, field days, alerts.” (SW MO 1)

“As far as scouting, if there is a way to have the beneficial bugs and the predators in a different form that is something they can look at. ... As far as identifying the beneficial ones, I get called out because they have lightning bugs in the field or the lady bugs, Asian beetles—things that eat the other predators. You have to tell them, ‘No, these are the GOOD ones!’” (CC MI)

“We have a lot of blanket applications that happen in our area as far as fungicide and insecticide combinations both in corn and soybeans. A lot of the growers just aren’t educated on disease identification and why they are spraying products. Frogeye leafspot is an issue down in my area and that seems to move in with wind currents and storms. That is the primary soybean disease that we spray for.” (CC IN)

“There are times that you kill the good pests, too. There are the natural predators of the aphids and you are going to take them all out; nobody ever really talks about that. If you are going to kill all the insects in the field, a lot of those insects are helping you, not hurting you. We never hear too much talked about that. That is something too, to let farmers know that when they are spraying that they are also killing the beneficial ones that help you.” (NE MI 2)

Certified crop advisors want:

Help combatting the “industry propaganda machines” that over-sensationalize problems, leading to fear and the over application of insecticides

Updated information on which insecticides to use for what—An updated “control book” (While some consultants recommend insecticide treatments to clients, others are reluctant to recommend treatments and suggest farmers go to their co-op for advice on chemicals)

Help knowing when to trust statistical data. Is it reliable or propaganda? Are we really getting a ROI or are we measuring field variability?

Research and information that they can trust. A number of participants said they rely on Extension and land grant universities because they are unbiased and independent.

Consultants' comments about what they want:

“Maybe one of the biggest pests I should have mentioned is the industry propaganda machines—that might be my biggest pest to management every year. Sound science. IPM 101 versus the fear factor, the over sensationalizing of ‘This problem is running wild and it is going to destroy your entire crop if you don’t manage it.’ That leads to over applications a lot of times, which has plenty of ramifications from the environmental side and the regulatory side.” (CC MN)

“The fear factor needs to be addressed. ... The fear factor comes in when someone found an army worm in a corn field and [the fear is] everybody is going to have it. You scout and it is in one isolated area, where they had a whole bunch of rye or something before. So, the people themselves create it, ‘Oh my god, the world is coming to an end!’” (CC IN)

“I am not conformable making insecticide recommendations. I leave that up to the cooperator and his co-op. I may find a product that works exceptionally well, but the co-op that they deal with may not handle that particular product, so it is hard for me to make recommendations. One of the links in the original email, talking about herbicides, the different groups of herbicides and resistant weed species, things like that. It is very concise, it is brief, it is easy to understand. [I’d like] information on particular insecticides that work better. We can get the University’s weed management guide and it has a lot of information about fungicides and insecticides in there. But when I don’t deal with it on a daily basis and there are new products coming out, well, *quote* new products, new formulations of products, it is hard to make a sound decision. You are making a risk of trial and error, so a little more information from the university side about insecticide x is not going to do you any good if you have an aphid problem. My understanding is, for stem borer and gall midge I don’t know if there is a darn thing we can do about them anyway.” (CC NE)

Question 3: We asked participants to review some pest management resources prior to the focus groups. In the groups we asked, what were your reactions to the materials you reviewed? What advice do you have for soybean entomologists when they design **new educational materials**?

Participants suggested that their priority would not be creating new educational materials. Instead, they suggested that the priorities are to:

- Make growers aware of resources that already exist
- Make digital resources easy to find
- Update existing materials and making them easy to use

People are busy. They don't have long attention spans. They tend to search out information when they are in the field, trying to diagnose a problem and make a decision—'Do I worry about this or not?' Update, store, and distribute materials that make it easy to make sound decisions about pests.

Make growers aware of resources that already exist

- Use a variety of ways to get information to people
 - People want different things depending on whether:
 - It is winter and they are passively getting updated
 - Open to longer explanations, more in-depth information
 - They are in the field actively trying to solve a problem
 - They want short/sweet, immediate answers to their questions
 - Some people prefer hardcopy notebooks and field guides for reference
 - Others prefer accessing information using technology
 - Google
 - YouTube
 - Email
 - Texts
 - Apps
 - Social media platforms, like Facebook, Twitter, YouTube
 - Have an entomologist monitor AgTalk
 - University websites
 - NCSRP Soybean Information Network
 - Podcasts
 - Growers in some areas listen to farm radio networks—Extension specialists need to know their radio people
 - Some growers prefer contacting a person they trust for information and advice
- Make resources easy to get; if in hardcopy, distribute extensively
- A number of participants offered that soybean boards and associations can help with publicizing, distributing, and storing information

Make digital resources easy to find

- This prompted discussions of where to store digital information. Do individual universities house their own information or does NC work together?
- Consider developing a one-stop shop
- Provide regional information (meaning regions within states, across state)
- Consider collaborating with United Soybean Board to create a one-stop website

Comments related to making growers aware of resources and making them easy to find:

“I sit on a board and the biggest trouble we have is getting information to producers. ... Our goal is to touch more farmers and it is one of the toughest things to do. It is crazy when they are making the contributions that they do to check off.” (SW IA 2)

“There is a lot of good information but how do we get people to know about it? It is amazing. You can tell people that this information is out there and they just stare at you with glassy eyes—like they never heard of it.” (SW IA 1)

“You could put it [the defoliation video] on a website, but there are a lot of growers out there that don't [look at websites]. I am having trouble trying to find a way, how do we get that to them? I guess that is what your issue is.” (NE MI 2)

“We need to do pre-training, maybe with grower webinars, through the winter when I am looking for things to do. Maybe a quick half-hour webinar. ... I don't have enough time during the growing season because I have so many things coming at me.” (NE IL 1)

“Part of the problem is, it is easier to google than go to a website. Google will take you right to what you need. Sometimes navigating websites is tedious.” (SW IA 1)

“We all want to be that one website that all farmers go to. We struggle with it at Missouri Soybean. We want to get out to the farmers that, ‘Here is how we are spending your money, come look at our website. We have all the information you need.’ But MU and Purdue want that same thing. North Central is wonderful. It has so much good information, but it would be really neat to have one spot to go to. I know it is not going to happen because we are all competitive and we all want to be that one spot. It is a challenge and a concern. When farmers google it, 100 things pop up. It would sure be nice to go to one website but that is probably one of those dreams.” (SE MO)

“A one-stop shop is good if you can figure out a way to define by region. Someone in eastern Iowa or IL is not looking for the same information I am. If you have one spot, where I know if I go there, I am going to find the information I need, that is the Holy Grail.” (SW NE 1)

“That is your answer to this puzzle. I think USB would be a better approach because they can lean on the state boards and say, ‘Hey, we need to do this.’” (SE)

Update materials and make them easy to use

Participants suggested:

- Update materials
 - Make sure hyperlinks work
 - Make sure tools are up to date with the newest technology—Do they work on new operating systems?
 - Update the chemical guidebook
- Think about how to adapt information to devices
 - Keep websites simple to navigate
 - Resources accessed by phone need to be short and sweet—little scrolling
 - Do not require too many clicks (a couple of people said if it takes more than two clicks, they quit)
 - Consider layering information, so users can go deeper into material if users choose (which would require more clicks)
- Keep things to one page
- Make resources easy to read. Not academic. Not long paragraphs.
- Keep videos short. A 10- to 15-minute video is too long

Question 4: What kind of **electronic tools** would be helpful to farmers?

Participant said they would like:

Alerts (described in Question 5)

Apps to use when scouting

- An app that provides information to help identify insects, thresholds, and treatment (like a fact sheet turned to an app?)
- An app that allows a farmer to upload a photo and the app would ID the insect (or the photo is uploaded to a university clinic and a staff member IDs the insect and provides advice)
- An app that identifies insects, does insect counts, geolocates problems, and records the data by field
- An app that allows people to share photos of what they are seeing in the field and help others know what to look for
- A decision-making app like Sporebuster, but for insects, where farmers could input the price of beans, the cost of the treatment, etc., to determine return on investment

Comments on apps:

“We have apps where we can take a picture of a weed and it will help you identify it. Is there a way to take a picture [of insects] and it gives you a quick rough count? For the people who don't want to do the counts?” (SW IA 1)

“Is there an easy way to enter in the price of soybeans and roughly what a treatment is going to cost to figure whether it is economically feasible? It seems like when we are on the line there, we are not certain whether it is going to be worth it.” (NW SD 1)

“If you could take a picture of that pest and the app scanned it and identify it for you. Sometimes you might think it is one thing and the agronomist in town or Extension agent or somebody says, ‘That is not at all what it is! You were controlling something that you didn't even need to worry about.’ On the app, I would like it to ID it and tell what the economic threshold is. It would also be helpful to have a list of chemicals that we would be potentially able to use, whether it is name brand or generics.” (NW ND 1)

“I wonder how useful it would be if you had a way people could share pictures from their actual field. If you guys [entomologists] go out in a field to help someone find it, ... if you could show what it looks like that year, or what someone is actually looking for. ... If you can say, ‘Check a couple of plants. Look for this. This is what we are actually seeing right now.’” (SW IA 1)

“I like what he said about texting a picture and have them talk to someone to get a confirmation of what we are seeing. In the summer, we are very busy. There is a lot of stuff coming at us and we have to make quick decisions. I don't have a lot of time to do in-depth analysis on whatever insect is the word of the day in the coffee shop.” (NE IL 1)

“I will put my dream out there. We were introduced to some apps from Wisconsin for soybean population studies. You just take a picture with your phone and it literally calculates the standing population along with a geo reference in the field. Tools like that, where you can go out into a field and take a picture of the bug and somehow the programming automatically identifies the bug and counts the bugs, are where we are going. That would be awesome. It would save a lot of time ... I would just make a comparison. We have been using GPS records for all of our planting and harvesting for 10 years. It is all finally combined on one app on my phone. So, I can just have my phone with me and walk out in a field and have all this historical data when I am scouting. I can see when beans were in that field last. I can see the yield. I can pull up maps of that field and see where there were maybe problems four or five years ago. Those are things that I can't remember in my head, but I literally now am carrying it around in my phone. So, if there is a spot I want to flag, I can flag it on my phone and it is there until I delete that data. So, next year I can come back and find that flag, go to that exact spot, and see what is happening. Putting all the different functions on your phone together and being able to use it, instead of trying to remember everything.” (SE IL)

- Apps should be:
 - Free
 - Easy to use
 - Simple—each app only does one thing
 - Fast—Farmers cannot wait days for information. If an app sends photos to a university, farmers want to interact with someone immediately. Otherwise, they will go to their retailer.

Comments on what farmers want in apps:

“Keep apps simple. Keep it very simple. Have it do one function. Like Sporecaster. It is easy to use. It does one thing and that is it. You get your task accomplished and you move on. There are apps out there that dig deep and that is great but when you are out in the field and you want to look at something, you want something that is fast and easy. Moderator: What do you want to app to do? Participant: Make me money! It has to serve my purpose—a function. Like I said, Sporecaster is great. It is simple, it gives me the information I need for my field for white mold and I move on. ... There are a lot of fun things you can do on some of these apps, but is it really necessary for the amount of time that I have to spend on it? I am going back to Sporecaster. Shawn Conley created that out of UW. Sporecaster helps you decide if you are going to have an issue [with white mold]. With Sporebuster you can input the chemistry you want to use, dollars, the price, everything. Sporebuster is a completely different app than Sporecaster. I like that. It is simple. It does one thing and you move on.” (NW IA 1)

“Really cheap/free, easy apps. Where you can just click on it, it opens up, it does what you want it to do and provides you with the information. ... You could punch in soybean price, what it costs you to spray, and chemical price and that could be the simplest thing right on the screen. ... So there again, think easy.” (NW MN 2)

Question 5. How should Extension get out **urgent information**? If there is a new pest or growing infestations, how should we get that information out to farmers?

Participants offered advice on:

- What information to include in an early warning system
- Ways to get information out
 - Impersonal methods
 - Personal methods
- Frequency of alerts

Below are the all the types of information participants said they would like in early warnings. How much information is included will depend on what form the early warning system takes. Some people gave advice as if the warning were a weekly email newsletter; others imagined it as an infrequent text alert. Some participants want a lot of information. Others want a “short and sweet” text: “Aphids are on the rise in northcentral North Dakota. Click for more info.”

Information to include in an early warning system:

- Real-time information on “Here is what we are seeing” in our region:
 - New pests
 - Based on weather conditions, the pest is headed this direction
 - Maps indicating movement of migratory pests, such as:
 - South to north
 - Across state lines
 - Up the Mississippi flyway
 - Around Lake Michigan
 - Warnings across state lines
 - Consider crop reporting districts for the size of reporting areas
 - Click for:
 - ID of insect pest
 - Associated beneficial insects
 - ID of damage
 - Thresholds and whether these vary by time of year
 - Recommended treatments
 - Recommended cultural practices
 - Links for more information

Comments about early warning systems:

"I like early warning kind of stuff... Two years ago, we had thistle caterpillar and we have never had that before; it was BAD. We didn't know what thresholds were; we didn't know how to deal with them. We got information relatively quickly, but it is one of those things—like gall midge, they come out of nowhere. I like warnings, especially if it is nearby. 'Hey, we are seeing this.' And then how do we get preemptive research because at least thistle caterpillar is easy to deal with. The gall midge is a threat in our area, too. It has started to creep closer all the time and I don't know that anyone has a real effective way to deal with it." (SW IA 1)

"Through Tamra Jackson [UNL plant pathologist], we can see maps. They will post counties when Southern rust starts moving in, bacterial leaf streak. If there is a way there could be some reporting by the agronomic field out here to the University, if there could be some more maps, when we are starting to see insects move from southern areas and travel up on our wind streams. If we could get a heads up that we are starting to see things that hit the southern part of Nebraska or southern part of anybody's region, whichever way the predominant winds are blowing these pests in from. So we don't get caught off guard. We can talk to our customers and maybe give them a heads up. 'Step out in your fields once a week and check things out.'" (CC NE)

"An agronomist that worked with the co-op would send out a weekly text in three or four sentences; what he was seeing, what to keep your eye out for, and then what guide I had to use. He would say, 'We are starting to see a migration of X. This is the guidebook to look for. We will update you if we see something breaking.' ... If they got more intense by Wednesday or Thursday, he would send out a reminder, 'This is really starting to become an issue. You need to take a look at your fields.' Then I would concentrate on that. I would send it to my CCA as a text and say, 'Hey, I just got an alert. Where are we at on X?' It was piece of mind, knowing what I needed to look for, instead of looking for everything. (SW IA 2)

Ways to get out urgent information:

- Texts or emails
 - During the busy season, some people said they are not as diligent about reading email. But they do read texts. Other people said they always read certain weekly emails because they provided useful information.
 - Do not allow people to group reply
 - One person suggested that it may be difficult to get growers' emails or cell numbers
- Phone app
- Social media, including Facebook, AgTalk, Twitter
- Collaborate with United Soybean Board and state soybean association or board websites
- Farm radio networks in certain regions
- Get information to crop consultants so they can spread the word
- Evening cable TV

[The guys I work with don't go to Extension.] "You guys won't have a lot of their cell phone numbers, so you couldn't send something by text. Nor do you have their emails. Social media may be a good answer; Facebook is what they are using." (CC IN)

"For me, texting is going to take over a lot more than emails, Facebook, Twitter; you still have to monitor everything you get. It is information overload." (CC MN)

"IL Soybean Association has a huge email database; there is information going out every week. ... Everybody looks at that for more focused soybean-related information. That might be a place, state associations." (NE IL 1)

It is important to have personal ways of giving and receiving information between crop consultants, farmers, and Extension:

- In addition to getting information out, there need to be ways to get information into Extension—Ways for "boots in the field" (e.g., farmers, crop consultants) to funnel information to Extension. Interconnection and the flow of information both ways are important.
- Extension needs to work on building relationships, particularly with younger people who don't feel comfortable calling Extension to get or share information

"One of the most important things for me, in working with Extension, is developing that personal network. Bruce Potter [UMN entomologist] at Lamberton is an example. When I am in doubt, I pick up the phone and have a 5-minute conversation with Bruce. He also is a funnel for us in the industry to provide him a heads up and in his ... newsletters. He will network information. 'X saw this; Y saw this. It might be something to keep your eye open for.' ... This younger generation is more virtual than us, they like apps. ... If you have been in the industry for 15 to 30 years, you have all the key Extension players on your speed dial. But I don't see that connection with the 25-year-old group that I work around every day. They know the name but they don't have the connection to make the

phone call or send an email. ... [We need] interactive communication both ways." (CC MN)

Advice on how frequently to send information:

- Distinguish between weekly updates (a consistent, once or twice a week update) and urgent alerts (only used when something unexpected develops)
- Find a balance
 - Don't send too many alerts
 - But information that is a week old is too old

Question 6: What are your **go-to places for information** or decision-making tools and why do you like them?

Go-to sources of information:

- University sources because they are nonbiased and data driven
 - University websites, Extension, IPM, agronomy, insect monitoring, etc.
 - Purdue's Chat and Chew Café <https://www.agry.purdue.edu/ext/corn/cafe/> collects Extension newsletters from many states
 - Extension articles
- Internet searches
- Soybean related websites
 - Soybean boards or association sites
 - NCSRP website
 - National Soybean Database
 - Soybean Research and Information Network (SRIN)
- Industry websites, like Pioneer
- AgTalk (an online forum where farmers can post questions)

"It is important that there be that nonbiased perspective. So, it is tough to want to go to any of the chemical companies to find a whole lot of information, other than just the basics. ... As I mentioned earlier, being able to go to the best place, which it should be, the land grant university. This is where we want to funnel everyone towards. But as was mentioned before, we need our state staff [for soybean boards and associations] and everyone else to help direct people there." (NW SD 1)

"I like the Extension service; you get more information out to us that is nonbiased. It is generally university data driven and all different universities that they can pull from. I have one hesitancy to go to dealerships, like they said before, a lot of them want to push a product that may not be the right product for the situation, because they get more money on the backside of that particular company or product. So sometimes you don't get good data. I am not saying that they don't have good information; it is just that they don't use it. I think it has got to come from a nonbiased source." (NE WI 2)

“I like the AgTalk forum. Just a google search, or search whatever your issue may be—that seems to be mine [preferred way to get information]. A lot of times I will just search MSU and the problem and you will get a response. Or the soybean board or whatever you are searching for. There is a lot of good information on those sites, too. I would say basically, an internet search is my go-to.” (NE MI 2)

Go-to people for information. Some growers and all of the consultants said they sought out individuals they know and trust. Farmers tended to go to local people. Participants said it is important for university faculty to develop connections with farmers and let growers know they are open to being contacted. Here are the types of people growers and consultants go to—in no particular order:

- Extension
 - Specialists
 - Local Extension
- Their Certified Crop Advisor or crop consultant
- Seed company agronomist
- The local co-op
- Friends

“I work with our [seed dealer] area agronomist quite extensively. I trust him. I trust the information and if I can't get ahold of him, I can go to the website and find the same information. So, it is a trust factor.” (NW IA 1)

“I personally don't [look at other sources]. I have friends who are chemical reps or agronomists; I generally call those people. 'What do you see?' It is more personal. That doesn't help [Extension] for where to go, but personally, it is a little better fit because it varies so much from area to area. If the NDSU Crop and Pest Report ... says that soybean aphids are on the rise, I will just call a friend or somebody I know ... who works for a company or is in the field every day—a crop consultant or somebody. 'What are you guys seeing?' ... I feel confident that is probably as good as anything you can get. You really can't replace that.” (NW ND 1)

“The professors on campus [Michigan State University], like the weed scientists, the entomologists, and so forth, make themselves readily available. It is a good opportunity to call them directly and get your concerns answered directly.” (NE MI 1)

7a. What keeps farmers from using Extension's IPM recommendations, like only spraying when insects reach an economic threshold or using recommended sampling strategies?

A few participants bristled at this question, saying that many farmers do follow IPM recommendations, and are concerned about the environment, their neighbors, and the over-application of pesticides.

However, the majority of participants provided explanations of what keeps farmers from using IPM.

Participants said:

Some farmers do not scout because:

- They don't understand the importance of scouting
- They don't like to walk; they rely on drive-by scouting
- They don't have time because:
 - Farms are getting larger and larger, so operators don't have time to scout their fields
 - They also work in town, so they don't have time to scout
 - They have livestock that requires time

Some farmers are not doing their own scouting, so they:

- Rely on co-ops whose own interest is to sell product
- Make decisions about spraying based on what others are doing—relying on social proof for decision making. The principle of social proof says that “we view behavior as correct . . . to the degree we see other performing it.” (Cialdini, 2009) Or it might be considered the bandwagon effect; if farmers see others spraying, they think they should spray.

Some farmers do not believe IPM recommendations. They:

- Believe universities are too conservative when responding to insect and weed problems; that thresholds are too high
- Believe that if multiple pests are present but each below threshold, cumulatively they are above threshold
- Do not believe the research represents their conditions. They believe that what works in research plots does not apply when you take it to scale. Research plots:
 - Are small
 - Have consistent conditions versus variable soils and environment on farms
 - Are done too far away, so they don't represent my area
 - And some have heard researchers discount their own results
- No longer trust a crop consultants' recommendations because a previous recommendation based on IPM (a few weeds aren't a problem) turned out to be wrong due to a resistant weed
- Believe in “no tolerance” for pests
- Want high-quality food-grade beans, so they have less tolerance for pests
- Believe spraying what pest are below thresholds is justified when commodity prices are high

Some farmers make decisions based on emotions. They:

- Fear that if they don't apply chemicals, they will lose money
- Fear that if they wait to reach threshold, the sprayer or chemical might not be available—and they miss a timely application
- Prefer to deal with problems right away, so they do not wait to reach thresholds; “just attack it now” and sleep better
- Even when they know better, some farmers do not use IPM recommendations

Some farmers add insecticide when applying other pesticides even when insect pests are not present or at threshold because:

- They believe that if their goal is to maximize yields, quality, and profit, there is no good reason not to put an insecticide in when spraying a fungicide, because insecticide is cheap and the application is easy
- This practice is called “an insurance policy”
- Dealers tell farmers if they spray, they will not have to worry about potential insect problems; better to spend \$2 now than \$10 later if they have to come back
- It is less time-consuming than making another pass
- There are claims that combining insecticide with the fungicide has a synergistic effect that results in higher yields
- Some believe the practice reduces rootworm beetle feeding in a 50-50 rotation
- Return on investment is quick
- It is an easy decision to make
- They don't think about killing beneficial insects; “Nobody talks about that”
- They don't know how timing of insecticide applications influences insect populations—so they spray too early or too late
- Emotionally, farmers worry less about damage from potential pests

Some dealers have a “go-out-and-get-‘em” approach to pests. They:

- Recommend spraying when it is not needed just to sell product
- Recommend certain products, that might not be the best for the situation, because they make more money on them
- “Hype the situation and blow it beyond what it is”
- Take farmers to the edge of their field, show them insects, and tell them they should spray; but they do not go into the field and do proper scouting
- Promote insecticide as a “preventative”

Comments on scouting:

“As the farms keep consolidating and getting larger, it is harder to walk every field on a regular basis. I can't see that trend slowing down. ... We are going to have more automated machinery and the farms are going to get bigger with less labor and it is going to be necessary to have some way to scout without the owner/operator in the field.” (NE MI 2)

“Farms are getting bigger and they are not going to have time to search every field but that brings up the question, who then does that work? I see that leaning more towards the consulting group people than the farmers themselves.” (NE MI 1)

“The biggest thing [that keeps farmers from using IPM recommendations] is probably more of a small farmer issue—the 60-mph scouting. Even if they do get out there, ‘Well, it is not as bad as I think and I don't want to spend the money.’ So, it all comes down to accurate scouting or more scouting and maybe the importance of scouting. As I think about the coffeeshop guys, a number of times you go in and you have come out of a field and you have all these bugs and you say, ‘What are things looking like for you?’ And they say, ‘Oh, pretty good, I don't have any.’ But they never took the time to get out of the chair in the coffeeshop and go look. Maybe they don't understand the importance of scouting. Or maybe they keep their head buried in the sand.” (SW NE 1)

Comments on why farmers do not follow IPM recommendations:

“As farmers, the toughest part is maximizing yield. The way the market works, yes, we have thresholds at 8.50 beans, obviously that didn’t work in August. But if you look at the price of soybeans now, how many more acres would have gotten sprayed in a 2020 crop year late in the year? If you are going to spray a fungicide, why aren’t you going to put in an insecticide? It is not that many more dollars. We did because we have had pretty decent results out of fungicide. In turn, we took care of a lot of bug issues early. Later we still had issues with insects that we didn’t go after because we got one rain. Then we had some more infestations but at that time, we were saying, well, we have done what we can do. ... From that quality aspect of what we want to do, and what we want to produce—it is a maximization. ... I think we have too high of insect threshold for what farmers want because, at that time of year, it is a maximization of yield. If I have to spray in August for insects, to me the threshold is lower because ... you can get a return on that investment in 60 days. Whereas a lot of other things we fund, like fertilizer in the fall—say we put on fertilizer in 2020 for the 2021 crop, that is a 13-month window before we get a return on that investment. So that is how I break it out. That is a really fast return on my investment, so to me those thresholds are lower. ... I think threshold numbers are a little too high. If we are within 10 or 20 percent of what the threshold is for one bug, say, bean leaf beetle, I ask my crop scout, ‘How close are we to stink bugs or Japanese beetles adding to that where we have a real problem?’ So, I try to do it as a combination. It will probably help me on the back side of other pests that are probably going to cause us issues. That is the way I look at it. I am trying to make sure I cover my reasoning for the thresholds that I think are a little too high. It is the combination of A, B, and C pest is why we went after A with a little lower threshold than what was put out [recommended].” (SW IA 2)

[Why do not farmers follow IPM recommendations?] “Because a lot of the recommendations come from small plot information where the soils are consistent, the environment is consistent. But when you have a field with lots of variability in fertility, moisture, etc., you are not possibly going to get the same results. Several years ago, X was the soybean specialist at Iowa State. He came up to one of our meetings with our customers and he said, ‘OK, this is the information we have from Iowa State. Remember my researchers start at 8 o’clock in the morning after getting a good night’s rest. They spray their small plots in ideal conditions. They took a break around 10:30. Started back up. Took a noon break. Started back up and finished up at 5:30-6 o’clock.’ So, he said, ‘It is completely different, but this is what they found.’ So, we have that going on and then a lot of times we do not have research in our area. My corner of Iowa is completely different than three quarters of Iowa. The research is primarily done two and a half to three hours away from me. So how can I correlate that information to what is happening in my neck of the woods? Yes, we want to use it as a guideline, but sometimes we can have these pre-conceived notions as to how that research is being done. Versus what is reality out in the field.” (NW IA 1)

“A lot of the crop consultants, including myself, got hurt from [the IPM recommendation that] a couple of weeds in the field isn’t an economic deal. But a couple of weeds turn out to be [glyphosate resistant] marehail and the next year there is a whole bunch more and the third year they are just blown out. From IPM management, a couple of weeds don’t matter. Now they do. You can’t have that. I haven’t gotten in trouble for bugs yet. But they take that into account, too. You say, ‘It isn’t at an economic threshold’ and they say, ‘Well, yeah, but that weed wasn’t either. We need to kill them.’ They remember that part of it. So, they go back and ‘We are not letting a couple get through.’ Growers don’t agree with the numbers they see from IPM. Ultimately, I am going by that [IPM recommendations] but then they are, ‘We are **going** to take care of it.’” (CC MI)

Comments on social proof or the bandwagon effect:

“When people come in, they ask the retailer, ‘What is that plane going to spray?’ ‘It is going to spray Joe’s field because we saw some X.’ ‘Well, I might as well spray mine too.’ I am not saying it is right but that is a lot of what happens in this area. It really does. When one helicopter starts, then all of a sudden, the sky is full of them; it looks like Vietnam.” (SW IA 2)

“People start asking questions as soon as planes start flying. ‘What are they spraying for?’ We raise a lot of seed corn around here and those seed fields naturally are going to get protected much better but the question always comes up, ‘Do I need to be spraying for something?’” (CC NE)

“You will see guys out spraying and you will ask, ‘What is so and so spraying?’ You will hear different things, armyworm in the corn or wheat or aphids. You look around and personally, I couldn’t justify going out in my field, but maybe they do have a problem.” (NE MI 2)

“What is hard, especially when airplanes are spraying and, in the spring, when the planters are rolling, neighbors are going to want to get things sprayed. ... We don’t have a whole lot of 30-inch beans in this area. There are a few. There is still a lot of airplane spraying that is done and that is visible for 30 miles. ... Some are going to be scouting or some will follow the proper practices or look at data. My point is, if someone is spraying, a lot of others think they need to be spraying, regardless.” (NW SD 1)

Comments on adding insecticide to other pesticide applications:

"If your applicator is out there making a pass spraying fungicide on the soybeans, and they say, 'Hey, for a couple of extra bucks an acre, let's just throw it in the mix now and then you don't have to worry about it in two weeks when there is an issue.' They call it an insurance policy. It is probably used more than we would like to admit. ... It is easy to do. It is easy to make that on-the-fly decision based on economics. Spend two bucks now rather than spend ten dollars in a couple of weeks if they have to come back." (NE MI 2)

"I tried that [adding insecticide] a few years ago with a glyphosate application and the soybean aphid wasn't at threshold. But it was up there, 100/150 per plant. It was fairly early and I said, 'We have got to kill them and we might as well throw it in there.' It was the worst field I had with reinfestation. I never paid attention because I thought we had taken care of them. We had to respray but it was too late by the time I realized it should be resprayed and they had already done the damage. ... I knew not to do it, but I did it anyway." (NE WI 2)

"Personally, and I think it would go for a lot of farmers, it is not that we don't always follow the recommendations. But if you are spraying a fungicide on your soybeans, and you've got some aphids in there and they are not all the way to the threshold level—they are close, but not quite there. You look at the economic part of it. I know I should wait. But if I have to come back in here in another week, number 1, I might not have time because of the weather and we can't control that. Number 2, it is going to cost me another trip, so not only do I have my time, but I have my expense and my sprayer. It is going to cost you more money. Sometimes I think you look at those things and think, what are the goods and the bads? I am already making a trip across the field, so I am just going to put it in the tank and spray it out. I am not saying that is right, but I think that happens pretty regularly. Truthfully, I think it is an honest situation, a person-by-person situation for what you have going on. Some other people might have some other reasons but for me personally that is the one thing I look at. If they [insect pests] are there, I am probably going to put it in the spray." (NW ND 1)

"If we are going to talk in a closed group here, the cheap price of insecticide. Sometimes it is easier to throw a couple of dollars' worth in and don't worry. And that is not good and it is going to come back and bite us and the industry. I don't care if it is fifty cents an acre, if you don't need to put that product out there in our environment, you shouldn't. You should be using best management practices no matter how cheap the cost is. I think that is really important and I think we really need to strive to do better." (SE MO)

"In the last 6 or 8 years we have had a lot of fungicide applications to soybeans as a standard practice. There are claims of some synergy of mixing insecticides with that to get a better yield response. I can't validate that—to spray and add insecticide in, but I do believe it has some positive effects on rootworm beetles in our 50-50 rotation. Any of those beetles that might have something to live on, we can knock them back if the timing is right." (NE IL 1)

“Along with the dollars is the timing of it. If you are going through a second pass of Round Up or glyphosate or something and you are on the verge of ‘maybe I need insecticide, maybe I don’t,’ then it is the timing of getting over the field. You don’t want to put an extra tire track in the field. I don’t have an airplane. That is part of the reality of it.” (SE)

Comments on retailers:

“I think that a lot of farmers think that universities or different states are slow at responding to insect or weed or other pressure problems. They think they are too conservative and don’t make good recommendations. They [farmers] listen, which is a mistake, to the local dealers that hype up the situation and blow it beyond what they should. I think there is a fight between conservative, holding back on spraying from universities, and from the go-out-and-get-‘em from the dealerships. There has got to be some fine line in between.” (NE WI 2)

“Sometimes I think it is a little bit of a push on someone to sell some product. It would be helpful to the growers if they did have a place where they could go [to get advice] but a lot of times, I think the growers rely heavily on the salespeople and they get pushed a little bit on certain things.” (NE MI 2)

“I think the retailers drive a lot of the spraying. Maybe not for the right reasons, but to sell product.” (NE IL 1)

“A lot of farmers in this area put too much credit on their local co-op providers. They are going to make recommendations to sell and I am convinced ... there are some out there that are more interested in making a buck and selling product than they are truly taking care of the problem in the field.” (CC NE)

“I think what happens a lot of times is either the chemical company or the applicators seem to push sometimes, ‘We have an issue out there and you need to spray.’ And farmers will go out there and see that there is some feeding by Japanese beetles or there are some aphids out there and then they just go ahead and spray. A lot of times, I think, it is a little premature. It is not really at threshold levels.” (NE MI 2)

Comments about decisions based on emotions:

"I see two levels of producers. Ones that are fearful that they can't be wrong, so they have a tendency to overapply everything—fertility, weed management, seeding rates, whatever it may be. Because they can control that with the checkbook. Then there are the other ones who say, 'I don't want to invest that last dollar if I am not getting a dollar or a dollar ten or a two dollar return on my dollar.'" (CC MN)

"A lot of the decisions made by the farmers is from fear and a lot of that is created at the retail level. There is also a fear of losing money, if we don't apply this product. ... A lot of farmers are operating on pretty tight profit margins. So, they don't want to take that chance." (CC IN)

"A lot of it is the knee jerk. I am going to say that Extension or university probably wants you to take a little slower approach—make sure you figure out what thresholds are, what your costs are, and if there can be opportunities that you are not spraying the whole field, that you are doing partials, those type of aspects. I am not saying those are wrong, because they aren't, but to put it to the field is a little bit different situation in how fast can we get things covered." (SW IA 2)

"The way we handle insect issues may be similar to weed issues; we want to be out there early. We have zero tolerance for weeds, so we spray. Some of that may carry over to insects. If we see a problem, we are going to go get it right away. We don't know what the weather is going to be; we just attack it." (NE IL 1)

"The insect damage looks bad and it feels like you should do something about it. You see all that damage and it makes your gut wrench a little bit." (SE)

"Sometimes it is easier to throw a couple of dollars' worth [of insecticide] in and don't worry." (SE)

"We watch our dollars. We are not just throwing money away. I don't want to think that. But sometimes it is just easy to put that two or three dollars on and then you can sleep well at night." (SE)

7b. What could Extension do to **get more farmers to follow IPM** recommendations?

Do not get farmers worked up about potential pests; it just increases misuse of insecticides.

- “Sometimes it is, ‘Let’s go look for aphids,’ and you’ll find aphids. Pretty much every year you can go out and see some aphids if you are really looking for them. It does look bad but if you know what the threshold is, you can say, ‘Well, we don’t need to be too concerned yet.’”

Send timely, proactive alerts might increase adoption of IPM recommendations if alerts included:

- Encouragement to scout
- Advice to scout for the beneficial/predatory insects in addition to pests
- Thresholds
- Proper spraying times
- The caution that damage can look bad, but may not be at an economic threshold; soybeans can tolerate a lot of damage

Gain the confidence of farmers so they do not rely so much on retailers

- Provide timely information that helps farmers get ahead of problems
- Provide timely information to consultants so they can share the info with clients
- Develop connections with growers so they feel comfortable contacting Extension
- Consider focusing on operators and consultants that represent exceedingly large farms

Educate farmers; repeatedly “preach” your message

- Raise awareness about resistance. Explain:
 - If we lose chemicals, we limit our ways to control pests
 - Consequences of using sub-lethal rates
 - Consequences of adding insecticide to tank mix when insects aren’t present
 - Consequences of applying insecticides that insects are resistant to
 - Importance of using different/cultural pest management strategies
 - Basic IPM 101 training—“‘See a bug, kill a bug’ is not the strategy for growers, advisors, or consultants to use” (Also see “Training on scouting” under Question 2b.)
- Raise awareness of ways to control insects that do not require insecticides
 - Provide cultural solutions like eliminating buckthorn to control aphids
 - Raise awareness about natural predators and that spraying kills them too

Advice about things Extension could do to get more farmers to follow IP recommendations:

Make adhering to the recommendations easier

- Have researchers spend time with farmers, so recommendations are in tune with farm practices
- Is there something easier than making a separate spray application?
- Keep guidelines easy to understand
- Keep guidelines simple to follow
- Make decision making simple
- Teach farmers to use drones to scout (We heard conflicting advice about this. Some participants said consultants and co-ops might use drones, but farmers are unlikely to use them. A few others said this is the way technology is moving, and drones could improve scouting.)
- Help take the emotion out of decision-making

The use of farm chemicals is a political, social, and environmental issue that Extension and universities need to play a key role in.

- Extension and the industry are colliding on who has the right data. Who is really looking out for the growers' interests?
- Extension needs to state the truth; play its unbiased role.
- Farmers are more sensitive to how they are perceived by their neighbors and the urban public. They are concerned about their own families.
- Farmers are concerned about using chemicals appropriately so they can maintain use of products.
- One person said he applauds the University of Minnesota for taking on big business over recommendations related to soybean aphid treatments.

Comments on alerts:

“Working with growers, insect problems are often out of sight, out of mind. You have to scout the fields. I think it goes back to maybe more alerts, better ways to get information out. Some people are going to utilize information and some just aren't. But [I recommend] as much as can be done on alerts.” (SW MO 1)

“A lot of farmer growers that I deal with don't go to a lot of Extension meetings. ... They rely on us for information. I am not sure how the best way for Extension is to get that to the farm level.” (CC IN)

“You are always going to have farmers who are going to pull the trigger earlier than others; there is no way around that. That is just the nature of those people. We struggled with that for years and years in Extension in MI. Do you send out an alert and people will automatically spray or are they going to follow your recommendations? There is no good answer for that. On the other side of the coin, if you don't send out the alert is Extension going to get the reputation that they are not responsive enough to the growers' needs? I think you send out the alert and see what happens.” (NE MI 1)

“If we are sending out an alert, we need to send out the thresholds and make it clear that if you do see a pest, when is the proper time to spray rather than just getting people worked up that there could be a problem. Sometimes it is, ‘Let’s look for aphids,’ and you go out there and you see aphids. Probably pretty much every year you can go out and see some aphids if you are really looking for them. It does look bad but if you know what the threshold is, you can say, ‘Well, we don’t need to be too concerned yet.’ So, I guess along with an alert, to be on the lookout, also an alert to know where we stand on the timing of spraying.” (NE MI 2)

Comments related to educating farmers:

“In Minnesota, the northern farmers have a tendency to follow university recommendations closely. The southern ones, near Iowa, my statement is going to be, [they follow] whoever talked to them last, which is typically the sales agronomist working out of a co-op. So that means Extension guys have got to be very timely and be consistent with their messages. It needs to go out on a regular basis.” (NW MN 1)

“So much of the visual is not the threshold. Beans can take a lot of damage and we just need to be aware that a lot of it is cosmetic. Again, it is getting that information to us.” (SE MO)

“There has been more interest lately in the beneficial insects and the sharing of the knowledge of the beneficials. ‘Hey, when you spray, you are not only killing this bug, but you are killing this other bug and you should be scouting for that as well.’ I think that information is slowly getting out there and being shared.” (SE IL)

“If you want to control the soybean aphid you have to control the buckthorn. It has exploded in our area of the state. If we can get rid of some of that buckthorn, maybe we can slow down the aphid populations.” (NE WI 2)

“The awareness of resistance ... is going to become very important. If you run out of chemicals to use, you are not going to be able to use anything to control them. Maybe have some kind of alert; they have done a pretty good job of this. Letting people know what is out there for natural predators, natural ways to control them. If you have lady bugs or Asian beetles, those are going to eat the aphids, so remember you are going to kill all those also. Keep building that awareness. As you become more aware of it, you are going to talk to your neighbors and friends, they are going to become more aware of it.” (NW ND 1)

“I think one thing that will help speed this up for Extension is if we get the apps out there. You get a newsletter from the university and it was usually two to three weeks after the subject happened. If they could send it out as an app, I think people would be paying more attention to it and get more confidence in it and then maybe not rely so much on their local co-op or whoever is doing their spraying.” (NE WI 1)

Comments on making it easier to follow IPM recommendations:

“The best way to get people to follow guidelines or recommendations is to keep it really simple and easy for them to understand. Make the decision as easy as possible. I have been in some soybean fields with aphids where your pants are so wet you can't walk. You see all that damage and it makes your gut wrench a little bit. If you are out there counting yourself, you might make it seem higher than it actually is. But if you have that technology that says, 'Hey, this looks really bad but you need to walk away for a week—or come back tomorrow—and take another count.' Then maybe it takes that emotion out of the decision for you. It makes it easier to not spray it when you really shouldn't.” (SE IL)

“I think it [not following IPM recommendations/not scouting] is a huge problem. Especially if you have livestock. That is one of the reasons that I have the ability to scout more. That is one less thing I have to do every day. I think time becomes a big issue for people. So, if there is any way they can do it faster or more efficiently.” (SW IA 1)

“You have to be in tune to what farmers are doing. So, let's say we have something that says you are going to have to make a separate spray application for this. Recognize what a separate spray application means. Is there something easier to do? Education but also nimbleness in tune to what the farmers are doing. It just involves talking to a few farmers and going back and thinking back at your desk. 'OK. This is what they are doing. How does this fit in with IPM?' Our researchers up here, they spend time with the farmers. And you don't have to spend time with 100 of them. You spend time with 3 or 4 farmers, pretty soon you have a pretty good representative sample.” (NW MN 2)

“I have a drone I am learning how to run. For scouting, it takes a long time to walk a field. If there was a way we could learn, maybe, in the winter time, have a class that you could use your drone to use, to get low enough to take a picture and be able to do your scouting. You might have to walk it, but it would at least let you know there is nothing out there and to get an exact amount you might have to walk it. I just think, as fast as you could drone a field, I think it would be more accurate.” (NE WI 1)

“At first with ... GPS technology, we didn't know what we were going to get from it, but we decided it was a good idea, so we started using it. Drones are kind of the same thing. Batteries on drones have improved, as well as camera quality on drones. I think they are going to continue to expand. In our area a lot of seed dealers carry drones and they will take aerial photos. I know farmers who are experimenting with them. They will be another tool in the toolbox. Instead of walking half a mile across the field, just send the drone out from where you are on the road and get all the information delivered right to you.” (SE)

Comments on chemical use as a social, environmental, and political issue and that Extension needs to play a key role

“Extension is like the person in the front of the church preaching. You have got to keep preaching. You have got to state the facts. You have got to state the truth. Then you have got to repeat, repeat, repeat. And eventually, more and more are going to listen. They may not follow but they may listen and hopefully they expand it.” (CC MN)

“Our neighbors, our urban neighbors, are really keeping an eye on us and we need to do our part.” (SE)

“We are conscious of what our neighbors think—our nonfarm neighbors. We have become more aware of that in the very recent years.” (SE)

“I do think farmers ... care about protecting the eco-system and keeping it healthy and safe for everyone. That is one of my number one concerns, that the environment be as good for myself as it will be for my kids. I think a lot of farmers feel the same. They wouldn't use something to harm the environment on purpose... On our farm we have put in filter strips for water quality. We put in habitat for pollinators. We put in riparian buffers for birds. I think farmers are doing things to promote a healthy environment.” (SE IL) [Another participant adds] “That is going to be a bigger issue going forward.”

“I am afraid that the people who are going to spray are just going to spray anyway. The co-op is probably going to go right to them and say, ‘There is a pretty good chance you are going to have spider mites this year, so you are going out there with your fungicide, you might as well throw the insecticide in.’ Which I hope, in time, with all the regulations and the bad publicity with spraying, that these co-ops will be more disciplined not to be recommending that as much. They won't entirely quit, but they might get a little more educated in that.” (NE WI 1)

“This is more a political question than a science question. We have Extension over here in left field and the industry that sells products and advises growers in right field; they are colliding in center field on who has the right data, who has the facts, who is really looking out for the growers' best interest. [There is] a huge complication with IPM around resistance, whether it is weeds, insects, diseases. That zero tolerance policy needs to come into play but we also have to remember, how did we get to that zero tolerance? That the sprayer might not get the job done. That it is a manual activity now or a mechanical activity with row crop cultivation, flaming, cover crops, hand weeding, things like that. ... In the upper Midwest two or three of the land grant universities locked horns with a very large industry promoter that sells a crapload of products in a lot of states around soybean aphid recommendations and what that threshold is. That collision is still occurring every single summer. I applaud them for that. Because the facts were being misled and misconstrued to the growers to sell \$1.50 pyrethroid. It is constant, preaching for lack of a better term. Hopefully that preaching turns into better education.” (CC MN)

Things to Consider

When NCSRP entomologists wrote the proposal for these focus groups, they may have intended to get information to help them design their next insect pest management tools or point them to research on the next new pest. And, indeed, we did get insights on those. But we also heard a much larger theme:

Land grant universities and Extension entomologists should play a larger role in promoting IPM.

Farmers and crop consultants want Extension entomologists to play an increasing role in combatting the overuse of pesticides, which has led to resistance. In turn, resistance is leading to increased use of organophosphates, which are less safe for farmers. And ultimately, resistance may lead to the loss of chemistries. Many of these farmers and crop consultants said they trust land grant universities and Extension to support the best interest of farmers. Land grant universities and Extension entomologists may be the last line of defense against the misuse of pesticides.

NCSRP Extension entomologists are dealing with exceedingly complex issues.

The science of soybean insect pests is complex—how to deal with resistance issues; how to deal with new pests; how to make calculating economic thresholds easy despite multiple variables like stage of insect development, stage of plant development, presence of beneficial insects, presence of multiple pests, and on and on.

The complexity is increased because this science must be transmitted to the right people. But in most cases, information based on research is not enough to change our behaviors. As one farmer said when describing an incident in which he added insecticide to a tank before aphids were at threshold, “I knew better, and I did it anyway.”

Persuading farmers to use IPM recommendations isn't just a science and education issue.

University research-based information is not enough to convince farmers to adopt IPM recommendations. Particularly when farmers seem to be relying less on Extension and more on chemical dealers for information and personalized help.

Consider teaming up with experts who know how to change behaviors.

The private sector uses experts (marketing teams) to craft strategies and messages to sell products to farmers. Likewise, entomologists could work with Extension social scientists, behavioral economists, and marketing experts to “nudge” farmers toward decisions that are in their own best interests, and in the interest of the greater good.

These experts can help create:

- The right message for the right people
- Strategies to decrease barriers to using IPM
- Strategies to increase incentives for using IPM

There are land grant university social scientists in the NC region with Extension appointments who do this type of work in agriculture. Here are two well-regarded, experienced researchers who have implemented and studied efforts designed to increase the adoption of conservation practices on farms:

- [Linda Prokopy, Purdue](#)
- [J Arbuckle, Iowa State](#)

And/or consider teaming with a consulting group well-versed in designing behavior change interventions. The advantage of working with consultants is that they tend to be nimble when designing and implementing efforts. Consider planning for a quick turnaround. When working with resistance issues, time is critical. You don't want to take years to come up with a strategy to implement. Consider going to big funders. As one participant suggested, decreasing pesticide use is an issue that many organizations and agencies could get behind.

Extension and land grant universities are uniquely credible to take on a leadership role

No individual, company, or agency is more capable to do this job. Extension has the research, the education platforms, and the reputation for being unbiased and working in the best interest of farmers.

Books to consider:

[*Influence: Science and Practice* by Robert B Cialdini](#) (Cialdini, of the University of Arizona, has spent his career studying, and then explaining, the art of persuasion.)

[*Nudge: Improving Decisions About Health, Wealth, and Happiness* by Richard H Thaler and Cass R Sunstein](#) (Thaler, of the University of Chicago and winner of a Nobel Prize, is considered to be the father of behavioral economics.)