ENTOMOLOGY EXTENSION EDUCATION: DETERMINING COMPETENCY DIFFERENCES IN LEARNING APPROACHES FOR SUGARCANE APHID (HEMIPTERA: APHIDIDAE)

A Thesis

by

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ABSTRACT

Agricultural extension services have long held the role of disseminating and streamlining education about emerging research to serve the public's needs. Accomplishing this mission can be done through varying presentation methods. The goal of this study was to determine if there are differences in post-training performance between professional demonstrational video productions and slideshow presentations, two common extension practices. Using the current issue of the invasive species, sugarcane aphid [*Melanaphis sacchari* (Zehntner)] on sorghum, training materials were developed to provide south Texas clientele outreach educational opportunities around identification of the pest and estimating populations, two key skills necessary to manage this pest. Audiences gathered from areas of southern Texas were pre-evaluated in their ability to accomplish these two tasks, then they viewed either the video or slideshow training. Both skills were then re-evaluated to determine learning differences. The numerical trends for both groups suggested improvement off skills. The overall results showed a significant change for the better in the ability of participants who viewed the demonstrational training video to estimate closer to actual pest densities. The same was not found for the slideshow group, though it had a similar trend. Nevertheless, when scores were compared between the two groups there was no significant difference. The value of demonstrational training videos is that they can be viewed multiple times, typically have a shorter viewing time, but they require greater investment from extension personnel. The value of slideshow presentations is that they require minimal investment

from extension personnel, but they cannot be easily re-viewed and typically require greater time investment from learners. The results also reveal the tendency of managers to underestimate pest densities and the difficulty of the tasks which are expected of pest managers. Additional training opportunities like hands-on training are warranted to further improve performance.

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Contributors

Part 1, faculty committee recognition

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Part 2, student/collaborator contributions

Video content and survey development was reviewed and supervised by Robert Bowling and Michael Brewer. Robert Bowling also assisted in administering surveys at all locations. Yellow sugarcane aphids [*Sipha flava* (Forbes)], greenbug aphids [*Schizaphis graminum* (Rondani)] and corn leaf aphids [*Rhopalosiphum maidis* (Fitch)] used for footage were reared by Dr. J. Scott Armstrong from the USDA-ARS in Stillwater, OK. Trent Wilson and Josh Lightfoot assisted with filming by helping handle live aphids.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

One of the great challenges of agricultural research is ensuring that the content produced by researchers reaches stakeholders. This is traditionally done through the Agricultural Extension System (Rivera 2003). One common outreach programming activity is informal verbal presentations. This method is typically inexpensive and requires minimal preparation on the part of the educator, but learners are only given one opportunity to learn everything. Often the skills and tools being shared will not be used until hours, days or months later. Though commonly practiced, the efficiency of these presentations is largely unknown compared to other emerging technologies.

In 2011, the American Association for Agricultural Educators released their agenda including priorities and goals for the next four years. Three of their top priorities were educating the public about agricultural systems, adapting outreach activities by using new technology opportunities and providing the public with emotionally engaging experiences (Doerfert 2011).

A platform with the potential to reach these goals is YouTube ™, an online network designed for sharing video productions. Incorporating videos into meaningful education experiences can enhance the behavior of individuals. For example, patients suffering from heart failure showed significant behavioral changes when they watched instructional health videos in addition to receiving traditional verbal and written instructions compared to those who only received verbal and written instructions (Albert

2007). In Bangladesh, where synthetic pesticides are often misused, educators trained villages using varying styles. Villages trained with videos showed significant changes in pesticide use compared to those trained solely through informal workshops (Chowdhury 2015).

One current challenge facing many insect pest managers in the southern United States is the sugarcane aphid, Melanaphis sacchari (Zehntner). Large sugarcane aphid populations can cause a 30-100% yield loss in sorghum. Additional yield loss and damage to harvesting equipment occurs when honeydew, a sticky waste product produced by the aphid, accumulates on machinery (Bowling 2016a). With such potential high production losses, pest managers invested in sorghum can struggle. A key challenge with any pest is spraying pesticides at the right time. Spraying too early or too late makes pesticide usage much less effective. To spray at the correct times, managers must correctly identify the sugarcane aphid, estimate its density within a field and compare this estimate to tolerance limits known as economic thresholds. The economic threshold is a decision-making tool that tells a manager when to treat for insects. Reaching this point tells a manager that if he does not take action against the pest, that the population will likely reach levels that will cause more damage than it would cost to pay for controls (Pedigo 1999). To improve aphid density estimation techniques a scouting card was recently developed which categorizes population density estimations into six groups. This tool is meant to help farmers compare the field estimate of aphid density to the known economic threshold (Bowling 2016b)..

Pest identification and estimation skills are both critical to the management of the sugarcane aphid. The objective of the current study was to determine whether a demonstrational training video or slideshow presentation would help farmers and pest managers perform better on aphid identification and density estimation tests completed before and after receiving their respective training. Greater understanding about what types of methods work best for audiences could lead to better training development and allocation of educational resources. Such improvements may translate into greater changes in behavior for learners.

Our main **hypothesis** is to determine if south Texas pest managers perform better when they view a demonstrational training video or a slideshow presentation. Our **null** hypothesis was that when south Texas pest managers are trained using a slideshow presentation, there is no significant change in skills following training.

$H_{skill\ change}=0$

The corresponding **alternative** hypothesis was that when south Texas pest managers are trained using a slideshow presentation, there is a significant improvement in skills following training.

$H_{skill\ change}> 0$

Another **null** hypothesis was that when south Texas pest managers are trained using a demonstrational training video, there is no significant change in skills following training.

$H_{skill\ change}=0$

The corresponding **alternative** hypothesis was that when south Texas pest managers are trained using a demonstrational training video, there is a significant improvement in skills following training.

$H_{skill\ change} > 0$

Another **null** hypothesis was that the average change in performance gained after pest managers view a demonstrational training video is equal to the average change in performance gained by pest managers who view a slideshow presentation about the same content.

$H_{DTV} = H_{SSP}$

The corresponding **alternative** hypothesis is shown below.

$H_{DTV} > H_{SSP}$

CHAPTER II

MATERIALS AND METHODS

Video Equipment

All videos for this study were recorded using professional lighting equipment including a CowboyStudio© (Carrollton, TX) lighting kit. This kit included 5500k light bulbs and stands to hold the lights. This kit was used to improve the quality of the recording of the slideshow presentation. A Generay© (Brooklyn, NY) 5600K LED light was used primarily for macro and micro clips. The camera used to produce all videos was a Canon© (Melville, NY) XA20 HD camcorder. A Tiffen© (Hauppauge, NY) lens set with +1, +2 and +4 diopter strengths was used to magnify macro shots. A Raynox© (Tokyo, Japan) super macro lens was used to achieve the greatest magnification for close-up shots of aphids. A Varizoom© (Austin, Texas) tripod was used to stabilize the camera. Audio was recorded using a high-quality Blue © Yeti™ USB Microphone (Westlake Village, CA) and in the field with a mobile Olympus© (Center Valley, PA) voice recorder. Videos, audio and graphics were edited and designed using the Adobe© (Adobe Systems Incorporated, San Jose, CA) Creative Cloud Suite of programs including Adobe© Premiere, Adobe© After Effects, Adobe© Audition, Adobe © Illustrator and Adobe© Photoshop.

Identification Skill Test Video Design

To record clips of the aphids used for the aphid identification skills competency test all three Tiffen© lenses were attached to the camera which was held in place by the tripod. The camera and tripod were placed near the edge of a table. Fresh sorghum leaves were placed on the edge of the table. The camera and lighting were focused onto a portion of the leaf referred to as the 'stage'. Aphids were either moved to the stage from rearing chambers or fresh sorghum leaves from the field using fine tipped paint brushes. Leaves with aphids were also moved around on the table until the clusters of wandering or feeding aphids came into focus. If aphids left the stage assisting personnel coaxed them back to the stage with a paintbrush while the camera operator kept video subjects in focus. A human thumbnail was used for the stage in some shots to provide extra contrast.

In addition to sugarcane, other common aphids found on sorghum used were corn leaf aphids (*Rhopalosiphum maidis*), yellow sugarcane aphids (*Sipha flava*) and greenbug aphids (*Schizaphis graminum*). Specimens were overnighted in a cooled package to ensure aphid survival. Each aphid species was stored and labeled in a separate moistened petri dish with a few small sorghum leaves. Sugarcane aphids and sorghum leaves were collected from infested field plots in Corpus Christi, TX . Once specimens were obtained they were filmed at varying magnifications as described above. Video was edited and sifted to select the footage that best represented what a farm manager would experience in the field with a portable hand lens. A duration of eight seconds was used for these clips.

Density Estimation Skill Test Video Design

The intent of the estimation skills test was to create footage of varying amounts of aphid densities on sorghum leaves to see how well managers could estimate each aphid density. Sugarcane aphid density estimation videos were produced with procedures as described above with few exceptions. Aphids were removed from sorghum leaves by using a fine tipped brush to create different population sizes on different leaves for testing.

The first section of a clip was wide-angle shots of a leaf taken without adding magnification lenses to the camera. A follow-up shot of the same leaf that panned across the leaf was produced using the Tiffen© lenses with the zoom of the camera set so the entire width of the leaf would be visible on the screen. Once the zoom was set, the leaf was moved so the base of the leaf was visible on camera. The panning motion required the use of two hands to slowly drag leaves in a straight line in front of the camera. One hand was pulling on the leaf to the left side of the camera's view and the other was pushing the right side of the leaf towards the left. Video of the panning shots was motion stabilized using the editing software to make movement look more smooth.

Video revealing fingers were edited out. The amount of time chosen for the over-view of the leaf was four seconds and was a still image. The over-view of the leaf was shown at the beginning and end of each aphid density estimation question. The duration of each panning clip was seventeen seconds. Exact counts of sugarcane aphid populations on the leaves used for testing was made by slowing down the video footage and freezing frames by sections.

Demonstrational Training Video Design

The materials for the two training videos were developed by first making a script containing the key concepts required for pest managers to properly identify the sugarcane aphid and estimate the number of aphids per leaf (Table 1). Rationale for the selected concepts was based off of the previous work of researchers (Bowling 2016b).

Using these key concepts as a guide, a demonstrational training video was produced following the style of an existing insect pest management YouTube series (Thomas 2017). To make the videos more engaging a spy theme was added to all videos in this series. Similarly, the demonstrational training video was produced using thematic elements such a light thematic music, graphics and an introduction to the video to capture viewers' attention. Motion graphics were also added to maintain viewers' attention, and video clips with movement were selected over still images of equal quality.

A script was created with the key concepts explained in full sentences. The sentences were designed to be short and simple. To help with key concepts a mnemonic was created to assist in memorization of key principles required for aphid identification. The mnemonic phrase was, "Are there sugarcane aphids in your sorghum to track? Make sure to remember the FACT is black." This was created to remind viewers that sugarcane aphids have certain distinct black parts on their body namely the tips of tarsi, antennae and cornicles (Fig.1). The word feet was used in place of tarsi to simplify the concept for managers and create a working mnemonic. This script was later used to record audio in a sound proofed room using the Blue© microphone. The Olympus© mobile recorder was also used to record audio. Video footage was evaluated to match the scripts with video content. Appropriate diagrams were also designed to supplement the script and viewing experience.

Most video footage of aphids was recorded as described earlier using lights, a stage and sorghum leaves. Paper and a blue poster board were also used as a stage in the video to create some contrast for shots. Any footage that was used in the skills tests was not shown in the demonstrational training video or slideshow presentation. Other footage was captured by setting up the camera on the tripod in the field and using a variety of the lenses described previously for different sugarcane aphid shots. Some videos were taken of workers in the field to briefly demonstrate some tasks associated with the skills being taught. Aerial shots of a sorghum field were captured using a boom truck, the camera and the tripod.

Slideshow Presentation Video Design

The slideshow presentation was produced by recording with the Yeti recorder in a small sound proofed room with the Cowboy Studio© lighting kit. Much of the video screen was used to display still images as would be done in a typical slideshow presentation (Bowling 2015). Images were extracted from the demonstrational training video clips, but the graphic design was minimized. The images were used to help guide the narration through the same sequence as the video but with a slower pace. In the bottom, right corner of the screen was shown video footage of the presenter talking to simulate viewing the presenter of the slideshow presentation.

The key concepts were used as a guide to lead the presentation to the key points. Repetition and greater conversational details were used to discuss the key concepts. Because oral slideshow presentations are typically longer, the slideshow presentation was longer in duration to match the observed norm. The tone for the slideshow presentation was more relaxed than the demonstrational training video which was paced much more quickly to give the key information in less time. Personal experiences and thoughts were also shared in the slideshow presentation that were not shared in the demonstrational training video, though these moments were brief and not crucial for understanding. The duration was set at a maximum of twenty minutes and only major errors were edited out of the original presentation. The same mnemonic was used in both presentations and important key concepts were discussed in both videos.

Participants

Participants were volunteers selected from farmers and pest managers in regions of south Texas who were invited to three extension meetings which offered Continuing Educational Units (CEU). The three extension meetings were held at Weslaco, Wharton and Corpus Christi, TX. Participants were invited to the training meetings by extension personnel and through digitally dispersed flyers.

Though not all participants chose to give their demographic information, a breakdown of information collected is summarized in Table 2. Data were not considered for participants who did not enter a whole number (i.e. a response of 30+ years) for the years of experience.

Procedures

As part of common extension programing many meetings are held offering CEUs which are mandatory training credits for pesticide applicator licenses. As part of these meetings, arrangements were made with county extension personnel so CEUs could be offered. With the meeting leader's permission and a site authorization for non-university locations a fifty-minute time slot was used to carry out the study.

Prior to the date of each meeting, all training materials were prepared and finalized. Training materials including videos used for testing were loaded onto two separate laptop computers for fast access and delivery at meeting locations. At each meeting location, a projector along with speakers were set up in two different rooms so videos could be shown to the participants. Desks or tables were provided for the participants to facilitate completion of surveys.

Meetings were held on different dates corresponding to preplanned meetings or meeting times recommended by extension personnel to maximize participant turnout. The meeting in Wharton was held on November 17th, 2016. The meeting in Corpus Christi was held on January 12th, 2017, and the meeting at Weslaco was held January 24th, 2017.

Surveys

To record responses a survey packet was handed out to each participant. Each survey was numbered at the bottom with either a 'one' or 'two' to indicate groups for divisions which were carried out at a later point. Before surveys were handed out they were pre-sorted to have every other survey with a different number on the bottom to ensure that a more equal number of participants would be separated into each of the two groups. The first part of the survey was an information sheet which gave participants details about the study and clearly stated that participation was optional.

Pre-tests

After completing the demographic information shown in Table 1, participants were given the aphid identification skill pretest. The lighting was adjusted to show four different eight second video clips of aphid species found on sorghum (Fig. 2). The participants were told that the aphid species shown were commonly found on sorghum. They were then asked to determine whether the species shown was a sugarcane aphid or not by responding with a 'yes' or 'no' for each question. After each clip was shown, the lighting was adjusted and time was set aside so participants could circle their response before the next clip was shown.

Following the aphid identification portion of the survey, participants were given a sugarcane aphid density estimation skill pretest. The lighting was adjusted to show four different twenty-five second video clips of sugarcane aphid populations on sorghum leaves. The four leaves shown to the participants had exact aphid counts of ninety-four, thirty, one hundred thirty-four and fifty-three. Participants were asked to estimate the number of aphids present on the leaf using the categories described in the *Scouting Sugarcane Aphids* publication (Bowling 2016b). Their options were: (a) 1-25; (b) 25-50; (c) 51-100; (d) 101-500; (e) 501-1000; (f) over 1000 aphids per leaf.

Experimental Group Divisions and Training

After completing their pretests, the entire group was split into two equal sized and randomized sub-groups using the numbers at the bottom of their surveys. The subgroups were moved to a separate room under the direction of one of the researchers to view a slideshow or video training. These survey responses were counted and the data was used based on the training they received.

Once participants were separated into their respective rooms, training videos were immediately shown to them. One subgroup watched the short demonstrational training video on sugarcane aphid identification and density estimation of aphid populations lasting six minutes, twenty seconds. The other subgroup watched a video recording of a slideshow presentation on the same topics that lasted nineteen minutes, seventeen seconds. A video recording of a slideshow presentation was used to ensure that the content was identical each time it was shared.

After watching the training, participants were given a post-test consisting of the same sugarcane aphid identification and aphid density estimation skills tests as noted above except video clips were randomized. Once participants completed their post-tests they were asked to provide their contact information to send out an optional follow up survey.

Data Storage and Analyses

Upon completion, the pre-test and post-test surveys were collected by the researchers and coded with the training group and meeting location. All personally identifiable information was removed from physically and responses were stored digitally.

The experiment was designed to be a randomized design of the two treatment groups, slideshow presentation and demonstrational training video, and replicated for the participants at each location. The data for each location was analyzed together and separately by location.

Aphid identification scores were assigned to participants by giving a score of one for each correctly answered question and a zero for each incorrectly answered question. The total possible points to be earned was four if all aphid identification questions were answered correctly and the lowest possible score was a zero if all were answered incorrectly.

Aphid density estimation scores were calculated in several ways to consider different risks in making decisions. The first was to use a similar model as above assigning a one to a correct estimation answer (i.e., selecting the correct density category) and a zero to all incorrect estimation answers. The total possible points to be earned was four if all estimation questions were answered correctly and the lowest possible score was a zero.

Since getting close to the correct density category is relevant to pest management decision making several scales were also used to give information about how close participants got to the correct answer. Using an unweighted scale if a participant selected the exact category to which the aphids belonged they were given a score of zero. If the participant was above or below by one category they were assigned a one. If they were two categories from the correct category below they were assigned a two and so forth up to a maximum of four if they were four categories from the correct one. The best possible total score a participant could receive was a zero, meaning they were 100% accurate with their aphid density estimations. The worst possible score a participant could get using these parameters was a thirteen by estimating the wrong group with the greatest distance from each correct answer. A score of thirteen meant that on average the participant was guessing 3.25 categories away from the actual density.

A weighted scale was developed to magnify the risk of underestimating the density compared to the risk of overestimating the sugarcane aphid density (Table 3). When a manager underestimates population densities then they are at risk to not use an insecticide when it is warranted. This decision could lead to lower potential yields and rapid aphid population growth. Over-estimations of aphid density were assured to carry a lower risk because the added cost of spraying when not needed was assured to be lower than the lost value of yield loss when not controlling an economic population. If a participant selected the exact group to which the aphids belonged in a question they were given a score of zero. Each category guessed above the actual count was given an unweighted value equal to the number of categories off from the correct answer. Each category below the actual count was calculated similarly, but the number of categories away from the correct answer was multiplied by 1.5. The best possible total score a participant could receive was a zero, meaning they were 100% accurate with their aphid density estimations. The worst possible score a participant could get when consistently overestimating at the greatest distance from the correct answer was a twelve and when underestimating was also a twelve.

The last scale used was the unweighted estimation scale but assigned negative values to those answers below the correct estimation group and positive values to those above the correct group. This model was created to determine whether sorghum managers tended to under or over-estimate populations. Only participants who stated that they had one or more years of sorghum experience were used for this test.

The total pre-test and post-test scores were calculated for each participant using the scoring models above. If an individual did not clearly answer one or more specific questions, their results for the corresponding questions were also discarded. One sample T-tests comparing the mean differences between each participant's total post-test scores minus their total pre-test scores were calculated for the two groups divided by training. The aphid identification scores data were analyzed to determine if differences were greater than zero suggesting an increase in aphid identification success to the training. For the scores calculated using the unweighted and weighted scales, data were analyzed to determine if differences were significantly less than zero meaning a more accurate aphid density estimation following the training.

To determine whether there was a significant difference between the change in scores between the demonstrational training video and slideshow presentation groups an independent sample T-test was carried out between the two groups using the aphid identification scores and the unweighted scale for aphid density estimation scores (Table 4).

Responses and all statistics were analyzed using SPSS statistical software (IBM 2016). An alpha level of 5% was used for all statistical tests. Results were analyzed in aggregate across locations and also separately (Figs. 6-9).

CHAPTER III

RESULTS

A total of 106 surveys were collected from participants at the three meetings. Twenty one were collected from Wharton, 41 from Corpus Christi and 44 from Weslaco. At all locations, some attendees did not fill out surveys. Of all the surveys collected 71 participants responded to all questions in a clear manner. Thirty-five participants either chose not to answer one or more questions or failed to clearly circle or indicate their answer on one or more of their responses.

Aphid Identification

There was insufficient evidence that the participants performed significantly better at identifying aphids after viewing either the slideshow presentation (t=1.157: p=0.127: df=44) or demonstrational training video (t=1.188: p=0.120: df=54) trainings (Fig. 3).

When based on training and location alone there was sufficient evidence that Corpus Christi slideshow presentation group (t=3.034: p=0.004: df=18) performed significantly better on their aphid identification test after training, but there was insufficient evidence that participants of the Wharton slideshow presentation (t=0.612: p=.021: df=9), Wharton demonstrational training video (t=0.688: p=0.254: df=9), Corpus Christi demonstrational training video (t=1.000: p=0.165: df=19), Weslaco slideshow presentation (t=-2.236: p=.021: df=15) Weslaco demonstrational training video groups (t=0.464: p=.323: df=24) performed significantly better on their aphid identification test after training (Fig. 7).

Density Estimation

When only correct responses were counted, there was insufficient evidence that participants performed significantly better at estimating populations after viewing either the slideshow presentation (t=.84: p=0.203: df=44) or demonstrational training video (t=.598: p=0.276: df=53) (Fig. 4).

When an unweighted scale was used for aphid density estimation scores, there was sufficient evidence that the demonstrational training video (t= -1.829: p=0.037: df=53) group performed significantly better at estimating sugarcane aphid populations after training, but there was insufficient evidence that the slideshow presentation (t= -1.479: p=0.073: df=44) group improved their ability to estimate sugarcane aphid populations following training (Fig.5).

When a weighted scale was used for sugarcane aphid density estimation scores, there was insufficient evidence that the slideshow presentation (t= -.614: p=0.271: df=44) or demonstrational training video (t=-0.695: p=0.245: df=53) groups performed significantly better after training (Fig.6).

When based on training and location, there was insufficient evidence that participants of both the slideshow and video groups performed significantly better on their ability to estimate sugarcane aphid populations after training when aphid density estimation scores were only counted for exact answers (p >0.20) (Fig.8).

When based on training and location alone there was sufficient evidence to suggest that the Weslaco slideshow presentation (t= -2.048: p=0.030: df=15) group did significantly better at their aphid density estimations after training, but there was insufficient evidence that participants of all other groups (p >.060) (Fig. 9).

When based on training and location alone there was insufficient evidence that participants of the demonstrational training video and slideshow presentation groups performed significantly better on their estimation of sugarcane aphid populations after training when aphid density estimation scores were counted using a weighted scale (p > .20) (Fig. 10).

Density Estimation Tendencies of Sorghum Managers

When estimation scores were considered positive or negatively, in value equal to the distance above or below the correct category, and compared to zero there was sufficient evidence that sorghum managers (t=-5.115: p < .001: df=63) had the tendency to underestimate on their post-test. There was sufficient evidence that the sorghum managers (t=-2.392: p=0.010: df=63) who attended the training had the tendency to underestimate more after the training. There was insufficient evidence that participants with sorghum experience had the tendency to underestimate on their pre-test (t=-1.274: p=0.103725: df=63) (Table 4).

Differences Between Trainings

Comparing aphid identification scores differences between the demonstrational training video and slideshow presentation, equal variances were not assumed using Levene's Test for Equality of Variances (F=5.379: p=0.022: df=98). There was insufficient evidence (t=-0.358: p=0.361: df=98) to conclude that there was a significant difference between change in performance of the demonstrational training video and slideshow presentation groups following training.

Comparing unweighted aphid density estimation score differences between the two groups, equal variance was assumed using Levene's Test for Equality of Variances (F=0.002: p= 0.961: df=97). There was insufficient evidence (t=-.073: p= 0.471: df=97) to conclude that there was a significant difference in the change of estimation scores following training (table 4).

CHAPTER IV

DISCUSSION

Value of Training Methods

The evidence found from this study suggests that the demonstrational training video did offer value beyond the slideshow presentation. Although the general trend of aphid density estimations for both groups was low, participants viewing the demonstrational training video estimated significantly closer to the actual amounts after viewing the training than those in the slideshow presentation training (Fig 5). It would have been better to see changes in the weighted scores, but the closer a farmer can estimate, even if low, the more accurately he will be able to treat for aphids in his field. The lower the estimate from the actual count the more likely aphid populations will reach unmanageable amounts. Though the other differences in scores after viewing the demonstrational training were not significant, the numerical trend was that learners were getting better at the two skills being taught after training.

All of these benefits were gained from the demonstrational training video in one third of the training time compared to the slideshow presentation with the availability to view multiple times after training. The greater cost with the videos comes from equipment costs and the extra work put into their development, over thirty hours of work beyond research in our case, which is more than triple the time needed to produce a similar slideshow presentation of professional quality. Our results support the idea of allocating educational resources towards demonstrational training videos because they offer benefits to learners that the slideshow presentation did not and in a much shorter amount of viewing time for learners.

If learning time is not an important factor, our results suggest that both the demonstrational training video and slideshow presentation can perform almost equally in terms of learning. Perhaps the greatest benefit to using slideshow presentations is the simplicity to create and low cost to educators, but we must note that the amount of time and effort put into our slideshow presentation was probably beyond the norm of most extension educators. The slideshow presentation used for this research took about ten hours' worth of work to develop in its entirety, not including research, and did make use of professional video equipment and editing software.

Challenges with a slideshow presentation include the risk of losing an audience's attention, especially when content is irrelevant or drawn out, and are typically not accessible for reviewing post-training. Even when they are available, finding the right spot in the slideshow presentation with the information a manager may need takes more time because of the average length.

Estimation Trends of Sorghum Managers

Results of the current study showed a trend for farm owners and managers to underestimate sugarcane aphid populations (Table 5). The pre-test results suggest that participants were simply guessing at the sugarcane aphid populations because they had no direction on how to conduct estimates of sugarcane aphid populations. Once given direction, as a group, they were more consistent in their population estimates, although participants were underestimating sugarcane aphid densities.

Managers need to feel confident about estimating sugarcane aphid populations, but also need to be aware of the consequences of underestimating densities when making management decisions. Underestimating sugarcane aphid populations will delay treating for the sugarcane aphid allowing time for rapid aphid population growth. A delay in treatment leads to a greater chance of economic loss of yield and makes controlling the aphids more difficult. Estimating populations is also a difficult task and takes time to master. Even research personnel experienced with sugarcane aphid underestimated populations. New training methods or tools need development to help managers more accurately estimate sugarcane aphid populations.

Follow-Up Training

Results of the current research suggests professional training via the demonstrational training video and slideshow presentation are helpful, but not stand-alone methods for training clientele on aphid identification in sorghum. Identifying small subject matter such as aphids is difficult for managers and there is a great need for supplementary materials and programming to assist farmers with these tasks.

Subsequent research is needed to determine the ability of a farmer to identify aphids when provided more time and the videos in-hand to compare with what they are seeing in the field. Farmers could benefit from the demonstrational training video while in the field scouting for the sugarcane aphid. It is possible that those inexperienced with aphid identification need additional information to professional classroom and video training that they can take with them to the field. For this reason, greater emphasis and in-field contact with clientele should be encouraged of extension personnel to enrich outreach experiences with clientele, such as turn-row meetings and one-on-one contact. Though these activities require more time and effort, they provide hands-on opportunities for clientele.

Behavioral Changes Influenced by Training

Though the efficacy of video productions in education is still being researched in various fields, there does appear to be a value to them that influences behavior. In 2007, evidence was found that suggested the usage of videos along with traditional training methods caused significant changes in self-care behavior. Although statistically significant, we note that the actual changes in behavior of the patients was determined by self-reporting using a Likert scale (Albert 2007). The changes in behavior in the Bangladesh study about the adoption of botanical pesticides also used self-reports filled out by the participants (Chowdhury 2015). In our study, our scoring system was more complex. It was designed to track the actual behavioral changes which we learned are much harder to modify compared to self-reports of behavioral changes. Self-reporting could mean that learners tried to change their behavior and could be influenced by their opinion of the behavior, but to what degree or how well they carried out their tasks was not determined.

Overall, we can confidently say that demonstrational training videos have the potential to help learners perform equally if not slightly better than those trained using slideshow presentations. Decisions as to which training method should be used for specific extension programs need to take into account the availability of educational resources, time available for training and the long term educational benefits associated with the reusability of videos. We also acknowledge that these training methods should be supported by other tools and educational activities to help managers in the management of pests in their crops.

CHAPTER V

RECOMMENDATIONS AND FUTURE RESEARCH

Recommendation 1

More educational resources should be spent on the development of demonstrational training videos in place of slideshow presentations. Our results suggest that, a well-developed video can improve skill just as well as a slideshow presentation that is three times the duration. The amount of time taken for a typical slideshow presentation could be used to show multiple videos and give learners even more information and learning opportunities. Videos also offer long term benefits to extension programs because of their ability to be viewed as many times as the learner desires and at times when the learner would benefit most from the information, like when making management decisions.

Recommendation 2

Demonstrational training videos should be incorporated into face to face extension workshops. One activity we did not discuss in our study was the usage of question and answer periods. We do note that demonstrational training videos, hosted on websites like YouTube, do have the ability to allow users to comment or ask questions, but we do not suggest that these types of online communications can replace face to face question and answer periods with managers. When learners ask questions, they become active learners and will process and retain more information (Rosenshine, et. al 1996). In order to give audience members more time to ask relevant questions and be active learners, concise demonstrational training videos like the one created in this study could prove beneficial to extension workshops. This extra time for discussion will allow extension educators to learn more about their audience, increase learner engagement and address regional issues that may not be relevant to learners of other regions. We also note that in the Bangladesh study, when video training was combined with discussions this showed learning benefits beyond the video training alone (Chowdhury 2015).

Recommendation 3

Extension educators responsible for long distance areas are justified in using resources to develop demonstrational training videos. Some extension programs service large areas across a state or region. With these programs a large portion of resources including time and travel money can be quickly spent to hold traditional slideshow presentations with learners. These resources can alternatively be spent on the development of demonstrational training videos. We suggest that in these situations demonstrational training videos can perform equally as well as said meetings. We do not suggest using demonstrational training videos to supplement face to face discussions, but according to our findings participants gained as much as they would have from a slide show presentation. To supplement audience engagement, an educator needs to invest time and resources into tools like blogs, Facebook © or forums to use in conjunction with demonstrational video trainings.

Future Research Considerations

Future researchers should do all that is possible to increase the sample size of similar educational research. A part of the limitation of our sample size was the unanticipated work to approve research with the Institutional Review Board (IRB) and working around agricultural growing settings. To increase sample size for any human testing, researchers should become familiar with the IRB protocol so these guidelines can be built into the research from the beginning. A failure to start this work early could result in rushes to meet protocol and less options for surveying participants.

Discussions with extension personnel about growing seasons, meeting schedules and regional audience should take place early so the best meetings can be utilized with the highest number of attendees. We found that most attendees participated in the surveys, but attendance was lower than anticipated in our study. Optimally, a meeting would be selected that has an established attendance record of around three hundred participants. In this condition, there is less likelihood for location based variations. If more time were available and plans were made earlier, then our research could have taken advantage of more or even better surveying opportunities.

Further research should also consider different types of extension training materials and their ability to translate into improvement following training. Other mediums that could be tested are fact sheets, pamphlets and blog posts. Future tests should consider these educational mediums and could test changes when different combinations of assignments including one oral training type (demonstrational training video or slideshow) and one print material (fact sheet, pamphlet or blog post). Future tests should also compare hands on in the field training to see how this compares with other teaching methods. Usage of demonstrational training videos in the field should also be tested to see how well managers can carry out the key skills necessary to make management decisions when they have more time and a video to help them.

CHAPTER VI

CONCLUSIONS

The intentions of this study were to determine the efficacy of slideshow presentations compared to demonstrational training videos as educational tools to modify the behavior of pest managers. This was carried out by evaluating manager's skills at aphid identification and aphid population density estimations of the recent pest the sugarcane aphid [*melanaphis sacchari* (Zehntner)]. The skills were evaluated before and after training to determine differences between the two trainings.

Overall the key difference was that the demonstrational training video helped managers estimate population densities closer to the actual count, but we conclude that in terms of learning, demonstrational training videos perform slightly better if not equally to slideshow presentations. The real value of the demonstrational training videos comes in the form of replayability and short viewing time required of learners, but this comes with the cost of greater investment compared to slideshow presentations. The evidence also suggested that following training, pest managers tended to underestimate the populations of this pest following training.

I recommend that future studies should make plans to ensure that the viewing experience of video based skills test is the best possible option and that all tests are carried out in the same location. The overall aphid density estimation trends of sorghum managers suggest that more education activities and trainings need to be developed to help managers deal with the risks of underestimating pest populations. Though evidence suggested that the demonstrational training video influenced participants to make closer aphid density estimations, we cannot conclude, based on this fact alone, that this type of training is clearly better than slideshow presentation. We also can conclude that more training materials need to be made to supplement slideshow presentations and demonstrational training videos to facilitate changes in behavior. Educators can use these tools to help managers in the process of gaining new skills, but more tools need to be provided to them so they can more efficiently manage pests like the sugarcane aphid.

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(https://www.youtube.com/playlist?list=PL98ugcsVDglxwkEmJWq3ELtygs1BvzCnt)

APPENDIX A

FIGURES

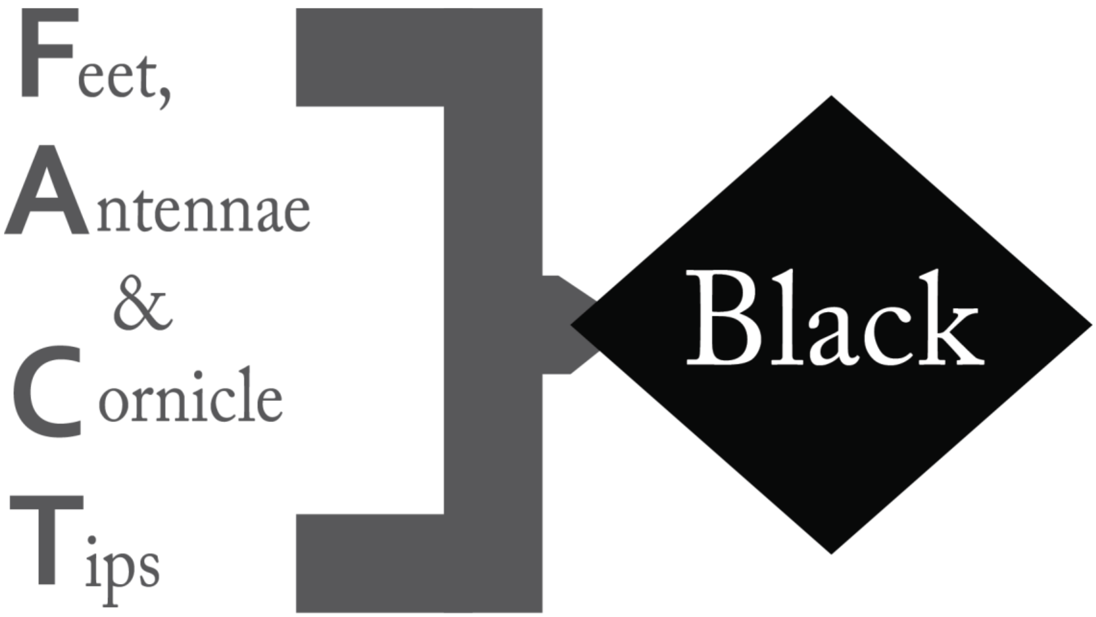

Fig. 1: The FACT Is Black.
The fact is black. A mnemonic was created by the researchers to help managers remember the key areas to look at to identify a sugarcane aphid compared to other found on sorghum. If the tips of the feet, antennae and cornicles are black then the aphid is a sugarcane aphid.

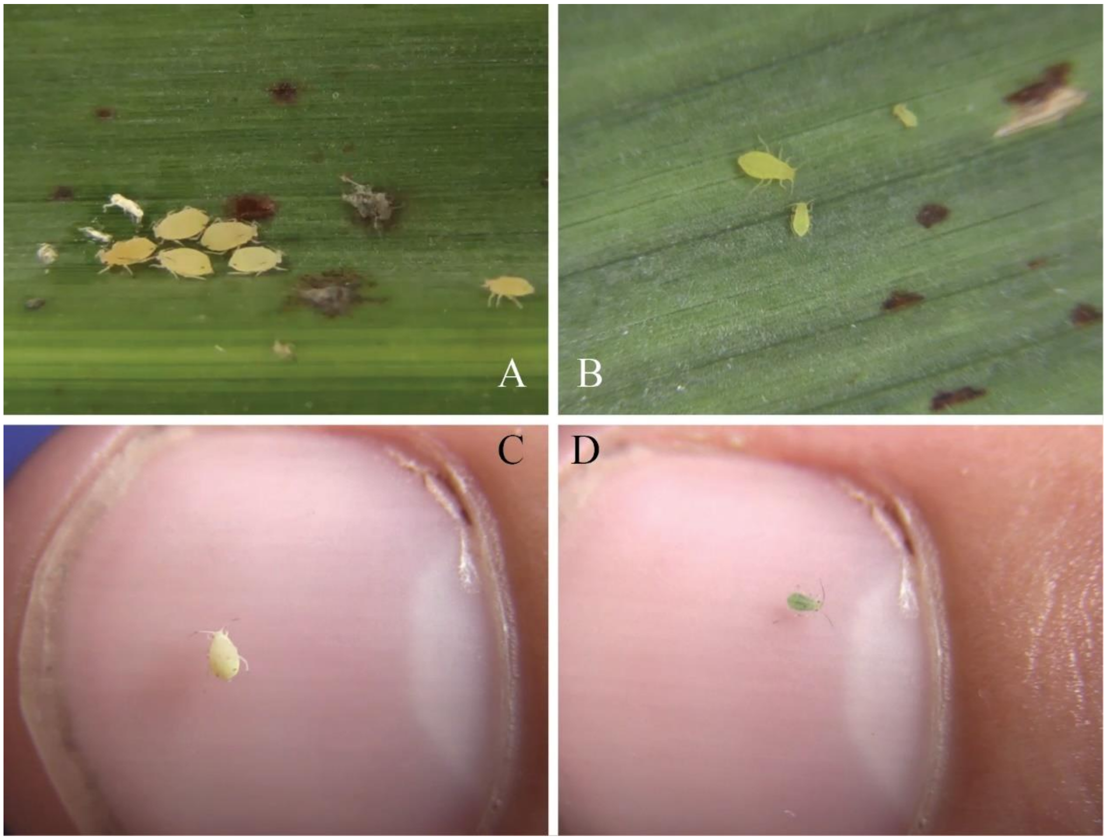

Fig. 2: Identification Skills Test.
Identification Skills Test. Images extracted from the aphid identification skills test in which participants were asked if the shown specimens were sugarcane aphids or not. (A) A group of sugarcane aphids [Melanaphis sacchari (Zehntner)] on a sorghum leaf. (B) A group of yellow sugarcane aphids [Sipha flava (Forbes)] on a sorghum leaf. (C) A single sugarcane aphid on a thumbnail. (D) A single greenbug aphid [Schizaphis graminum (Rondani)] on a thumbnail.

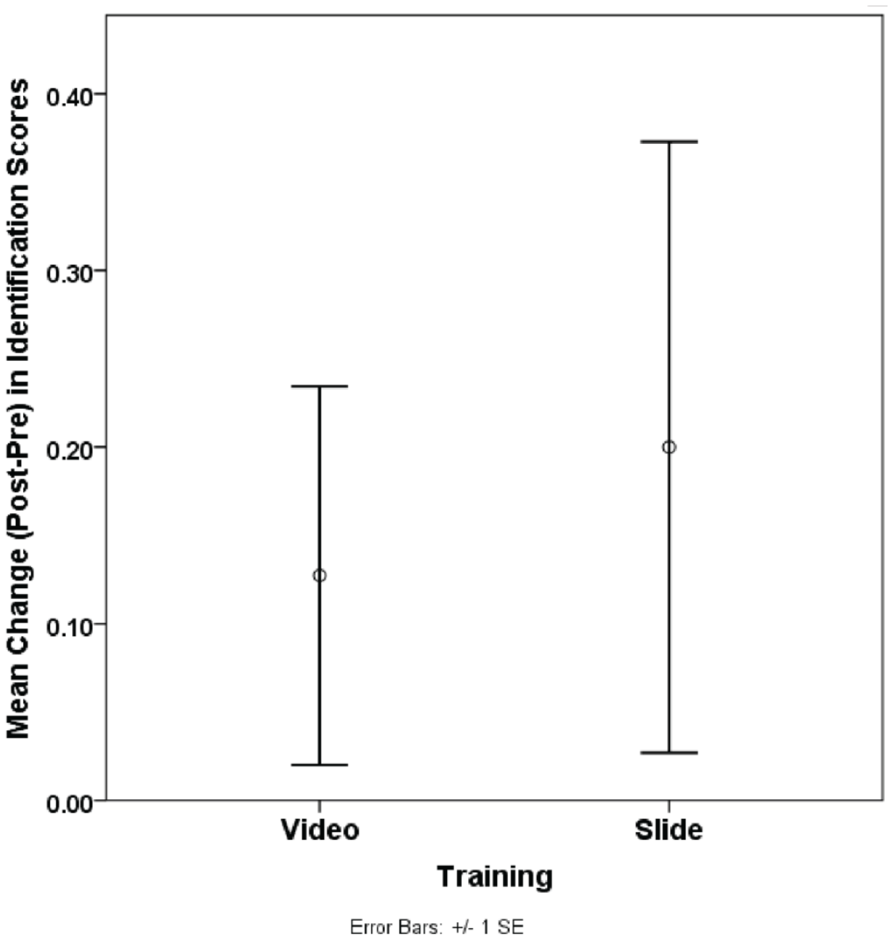

Fig. 3: Identification Skills Test Results by Training.
Identification Skills Test Results by Training. Comparison of the mean aphid identification score changes (post-pre) after training using two learning approaches: demonstrational training video (video) (t=1.188: p=0.120: df=54) and slideshow presentation (slide) (t=1.157: p=0.127: df=44).

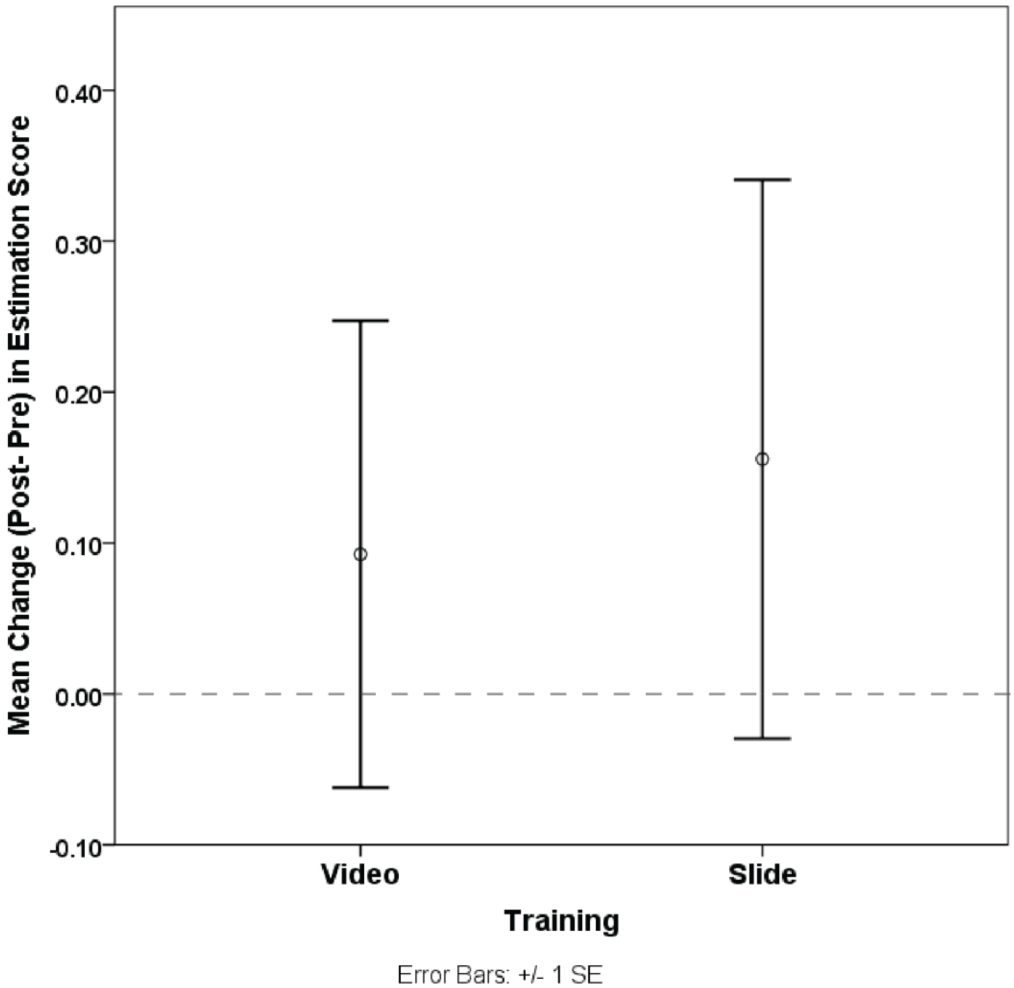

Fig. 4: Estimation Skills Test Results by Training.
Estimation Skills Test Results by Training. Comparison of the mean estimation score changes (post-pre) after training using two learning approaches: demonstrational training video (video) (t=.598: p=0.276: df=53) and slideshow presentation (slide) (t=.84: p=0.203: df=44).

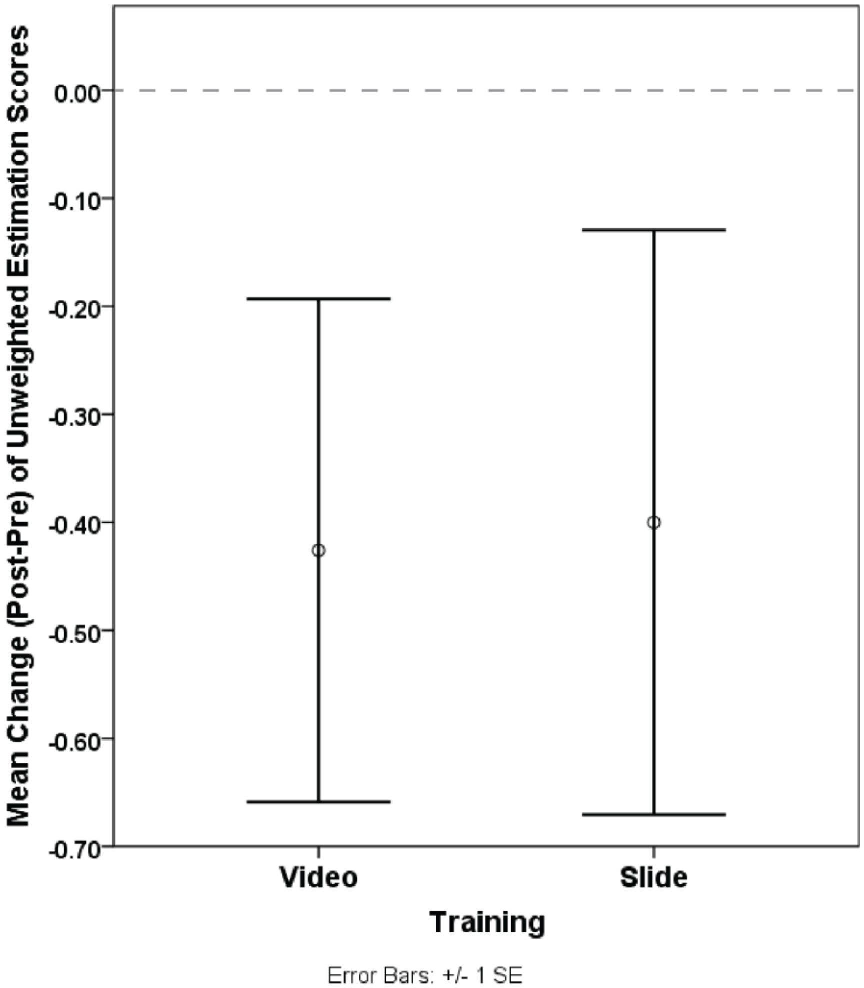

Fig. 5: Unweighted Scale Estimation Skills Test Results by Training.
Unweighted Scale Estimation Skills Test Results by Training. Comparison of the mean unweighted scale estimation score changes (post-pre) after training using two learning approaches: demonstrational training video (video) (t= -1.829: p=0.037: df=53) and slideshow presentation (slide) (t= -1.479: p=0.073: df=44). Correct responses were assigned a score of zero and incorrect responses above or below the correct answer were assigned a value equal to the categorical distance from the correct answer

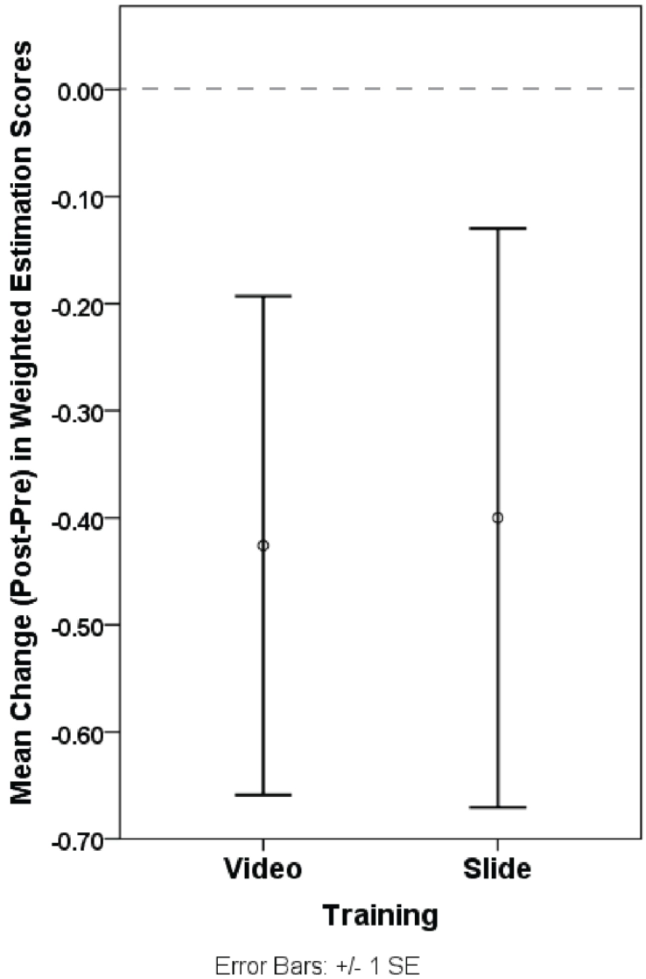

Fig. 6: Weighted Scale Estimation Skills Test Results by Training.
Weighted Scale Estimation Skills Test Results by Training. Comparison of the mean weighted scale estimation score changes (post-pre) after training using two learning approaches: demonstrational training video (video) (t=-0.695: p=0.245: df=53) and slideshow presentation (slide) (t= -.614: p=0.271: df=44). Correct responses were assigned a score of zero and incorrect responses above the correct answer were assigned a value equal to the categorical distance from the correct answer. Incorrect responses below the correct answer were given a value equal to their categorical distance multiplied by 1.5.

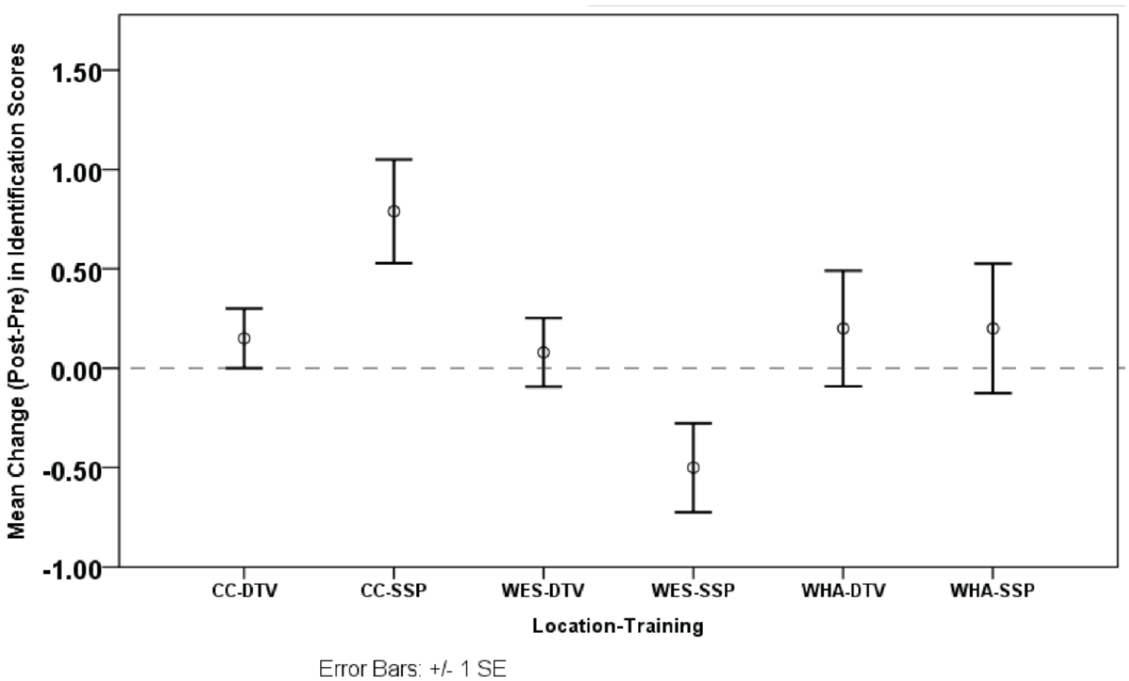

Fig. 7: Identification Skills Test Results by Training and Location. Identification Skills Test Results by Training and Location. Comparison of aphid identification score changes by training group and location. Involved were the Wharton slideshow presentation (WHA-SSP) (t=0.612: p=.021:df=9), Wharton demonstrational training video (WHA-DTV) (t=0.688: p=0.254: df=9), Corpus Christi slideshow presentation (CC-SSP) (t=3.034: p=0.004: df=18), Corpus Christi demonstrational training video (CC-DTV) (t=1.000: p=0.165: df=19), Weslaco slideshow presentation (WES-SSP) (t=-2.236: p=.021: df=15) and Weslaco demonstrational training video (WES-DTV) (t=0.464: p=.323: df=24) groups.

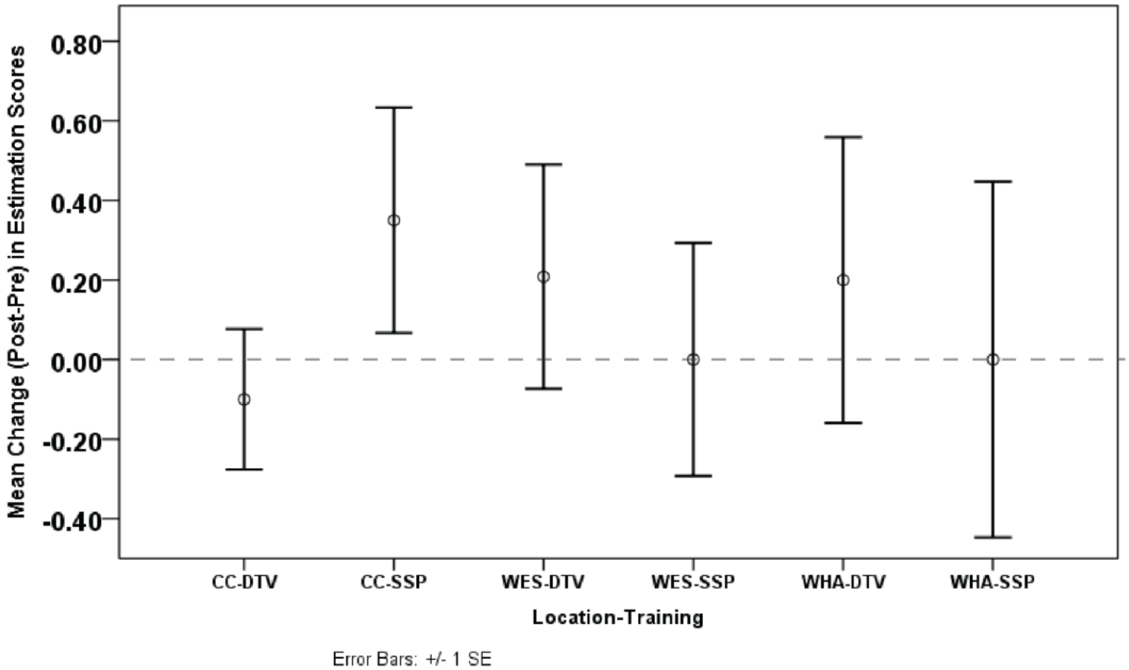

Fig. 8: Estimation Skills Test Results by Training and Location.
Estimation Skills Test Results by Training and Location. Comparison of estimation score changes by group and location where only exact answers were counted towards scores. Involved were the Wharton slideshow presentation (WHA-SSP) (t=0: p=0.500: df=9), Wharton demonstrational training video (WHA-DTV) (t=0.557: p=0.296: df=9), Corpus Christi slideshow presentation (CC-SSP) (t=1.234: p=0.116: df=19), Corpus Christi demonstrational training video (CC-DTV) (t=-.567: p=0.289: df=19), Weslaco slideshow presentation (WES-SSP) (t=0: p=0.500: df=14) and Weslaco demonstrational training video (WES-DTV) (t=0.738: p=0.234: df=15) groups.

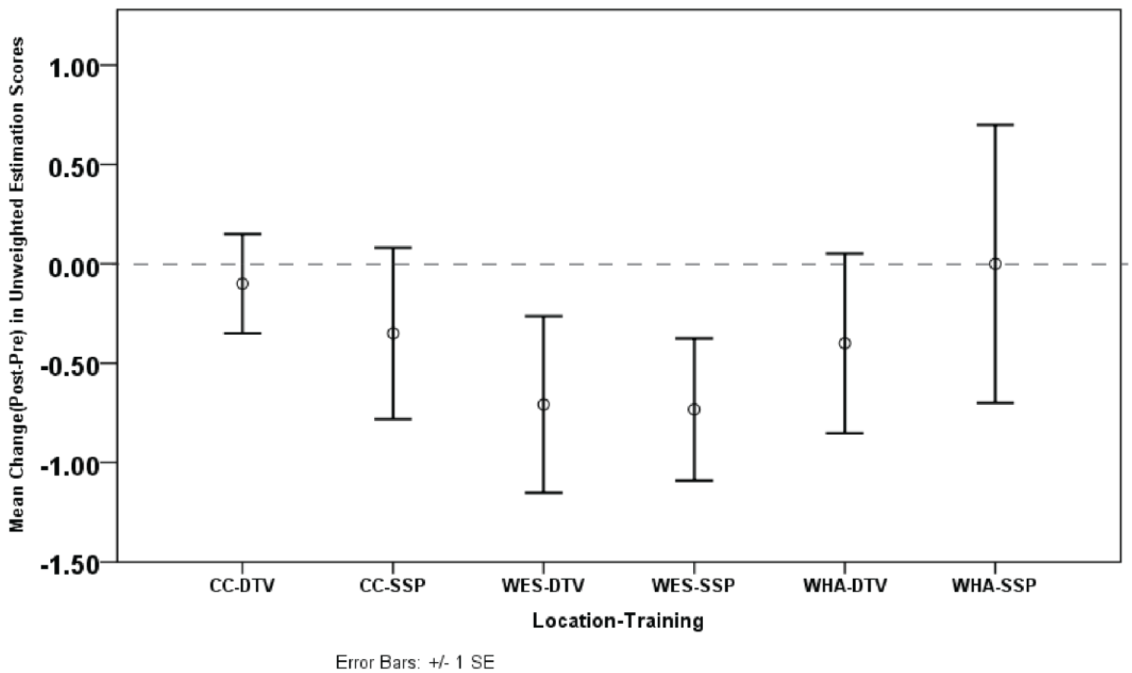

Fig. 9: Unweighted Scale Estimation Skills Test Results by Training and Location. Unweighted Scale Estimation Skills Test Results by Training and Location. Comparison of estimation score changes by group and location where only exact answers were scored as a zero and incorrect responses were assigned a number equal to their distance from the correct answer. Lower scores on the post-test means more accuracy in estimation. Involved were the Wharton slideshow presentation (WHA-SSP) (t=0: p=0.500: df=9), Wharton demonstrational training video (WHA-DTV) (t=-0.885: p=0.200: df=9), Corpus Christi slideshow presentation (CC-SSP) (t=-0.812: p=0.213: df=19), Corpus Christi demonstrational training video (CC-DTV) (t=-0.40: p=0.347: df=19), Weslaco slideshow presentation (WES-SSP) (t= -2.048: p=0.030:df=15) and Weslaco demonstrational training video (WES-DTV) (t=-1.594: p=0.062: df=24) groups.

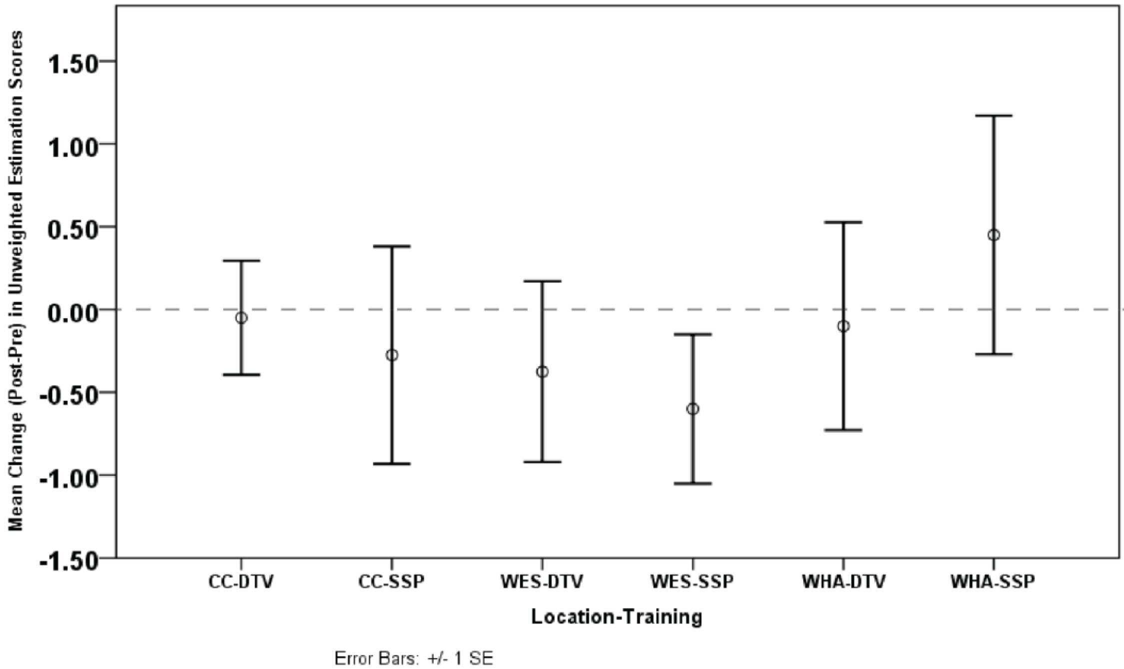

Fig. 10: Weighted Scale Estimation Skills Test Results by Training and Location. Weighted Scale Estimation Skills Test Results by Training and Location. Comparison of estimation score changes by group and location where exact answers were scored as a zero and incorrect responses above the correct category was assigned a number equal to their distance from the correct answer. Incorrect responses below the correct answer were scored with the same scale but were multiplied by 1.5 to account for greater risk. Lower scores on the posttest means more accuracy in estimation. Involved were the Wharton slideshow presentation (WHA-SSP) (t=0.625: p=.274: df=9), Wharton demonstrational training video (WHA-DTV) (t=-0.159: p=.438: df=9), Corpus Christi slideshow presentation (CC-SSP) (t=-0.419: p=0.340: df=19), Corpus Christi demonstrational training video (CC-DTV) (t=-0.40: p=.347: df=19), Weslaco slideshow presentation (WES-SSP) (t=-1.332, p=0.102: df=9) and Weslaco demonstrational training video (WES-DTV) (t=-0.688: p=0.249: df=23) groups.

APPENDIX B

TABLES

Table 1: Key Concepts.

Key Concepts
General Body Size of Aphids
Basic Aphid Anatomy
How to Magnify View of Aphids in the Field
Wingless Adults Are Easiest to Identify
Unique Characteristics About Sugarcane Aphids Compared to Other Aphids Found in Sorghum
Reliance on Color Alone for Identification Is Not Always Accurate
Counting All Aphids in a Field Is Impossible
Top and Bottom Leaves Give the Best Indicators for Aphid Population Estimations
Estimation Starts with Ballpark Estimates
Estimating Using Manageable Groups

Key Concepts. Learning objectives used to make the trainings. They were determined by research entomologists as the most important concepts to be able to successfully identify and estimate aphid populations on sorghum leaves.

Table 2: Participant Demographics.

# Years Work Experience in Agriculture						# Years Work Experience with Sorghum				
Location	min	mean	max	std dev	n	min	mean	max	std dev	n
WHA	5	34.47	61	15.343	15	0	27.67	61	18.976	15
CC	0	25.73	56	16.414	37	0	21.65	56	16.488	37
WES	0	23.18	50	16.691	38	0	7.67	45	13.112	39

Participant Demographics. A breakdown of general agriculture and sorghum experience among the three locations where volunteers participated in surveys. WHA represents Wharton participants, CC represents the Corpus Christi participants and WES represents the Weslaco participants.

Table 3: Weighted Scale for Estimation Scores.

Weighted Scale for Estimation Scores	
Estimation Answer	Score Assigned
Below by 3	4.5
Below by 2	3
Below by 1	1.5
Correct Answer	0
Above by 1	1
Above by 2	2
Above by 3	3
Above by 4	4

Weighted Scale for Estimation Scores. One way answers were scored was using a weighted scale shown above to take into account the greater risk of underestimating aphid populations by increasing the scale more for response below the correct one.

Table 4: Independent Sample T-test for Score Changes by Group.

Independent Sample T-test for Score Changes (Post-Pre) by Group

	SSP		DTV		Equality of Variances (Levene's test)		t test for equality of means	
Test Scores	Mean	Std Dev	Mean	Std Dev	F	p-value	t	p-value
Identification	0.200	1.160	0.127	0.795	5.379	0.022	-0.371	0.360857
Unweighted Estimation	-0.400	1.814	-0.426	1.71125	0.002	0.961	-0.073	0.4709635

Independent Sample T-test for Score Changes by Group. Compares the differences between the demonstrational training video group (DTV) and slideshow presentation (SSP) in aphid identification & unweighted estimation scores after training and whether they are significantly different. Includes the F and p-values of Levene's test for equality of variance and the t and p-values for equality of means. The degrees of freedom for the comparison of the aphid identification scores was 98 and 97 for the unweighted estimation scores.

Table 5: Estimation Tendencies Among Sorghum Managers.

Mean Estimation Tendencies for Sorghum Managers Compared to Zero					
Test	N	Mean	Std. Dev.	t	p-value
Pre-Estimation	64	-0.39	2.45	-1.274	0.103725
Post-Estimation	64	-1.22	1.91	-5.115	1.5x10^-6
Change (Post- Pre)	64	-0.83	2.77	-2.392	0.01

Estimation Tendencies Among Sorghum Managers. To look for patterns in sorghum managers scores were assigned as zero for correct responses, responses below the correct group were assigned a negative value equal to the distance from the correct answer and similar but positive values for answers above the correct answer. The p-value is for a one tailed test to see if managers significantly underestimate.

APPENDIX C

LIST OF VIDEO LINKS

Video Name Link

Video 1: Insect Lockdown Pest Profiles: Cotton Fleahoppers…...(http://bit.ly/cttnflhppr)

Video 2: Aphid Identification Skill Test Video……………..…..(http://bit.ly/scaidentify)

Video 3: Aphid Density Estimation Skill Test Videos……..……(http://bit.ly/scaestimate)

Video 4: Demonstrational Training Video (DTV)……....(http://bit.ly/sugarcaneaphiddtv)

Video 5: Slideshow Presentation (SSP)………………..…..(http://bit.ly/sugarcaneaphidssp)

The list above shares information for readers to access the videos associated with this study. The videos are stored on YouTube and can be accessed on any digital device with access to this platform.