Plain View

AWPM for Wheat is a pest management program for greenbugs and Russian Wheat aphids

Summer 2004

In the coming months, we will make several changes in how we communicate with you. See page 2, What's Happening Around, for more information. Left: Windmill in Okeene, Okla. Picture by Rural Sociologist Sean Keenan.

Inside this issue:

Imaging the world of aphids

Program participants at Texas A&M have a unique perspective on AWPM for Wheat -- they see it from above.

Over the last year, Mustafa Mirik, along with others at Texas A&M, collected aphid density and spectral reflectance information from stressed and unstressed wheat fields. They also collected the reflectance data with a hyperspectral ground spectrometer over aphid infested wheat and uninfested wheat.

As part of their participation in AWPM for Wheat, the Entomology Program in Amarillo is using an airborne hyperspectral spectrometer for detecting aphid infestations. The work is conducted as part of the Precision Agriculture Initiative at Texas A&M in cooperation with Oklahoma State University and the USDA-ARS.

Remote sensing is the art and science of collecting information about the earth's surface using some portions of the electromagnetic spectrum from ground, air and space platforms without physical contact with the objects under surveillance.

It can be used to generate spatial, up-to-date information over time and space in combination with statistical tools such as GIS.

In addition to collecting data using the spectrometer, they also collected at least 30 tillers in each plot; tillers were cut at ground level and

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Left: Program participants collecting field data

Our project is a collaborative effort, teaming the USDA Agricultural Research Service with growers and universities in Texas, Oklahoma, Kansas, Colorado, Nebraska and Wyoming.

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What's Happening Around

In the coming months, you will notice some changes in how we communicate with you. To this point, we have used a quarterly update and a website to communicate information about our program.

However, as our program evolves so will the information that we provide you. Rather than sending a quarterly update, we hope to provide you with information that you can use. We hope to do this in three ways.

We will send a monthly publication, revamp our website and send a biannual report. Each of these will provide you with up-to-date, interesting information about growers and demonstration elements across our program region. As always, your input is also welcome.

Our main goal is to collaborate with wheat producers in evaluating and demonstrating non-chemical pest management techniques, with particular emphasis on the management of the Russian wheat aphid and the greenbug. Our demonstration elements include crop diversification, host plant resistance, biocontrol and field scouting, and other best management practices, like conservation tillage. Many of the changes will reflect our goal and demonstration elements.

New Logos: You may see a difference in our logos. We've changed their look to keep up with changes in the program.

Yielding Results by innovating & educating

Changes to look for:

1. Monthly mailing:

Beginning in September, we will send out a monthly mailing with a grower of the month and a round up from extension agents in the AWPM for Wheat region. We will also post these on the website.

2. Biannual report:

Rather than updating the programs' progress quarterly, we will send out a report twice a year, with information that is helpful to you as well as interesting. This report will include what we've found in our interviews and updates on resistant wheat, scouting and other management techniques.

3. Website update:

We are in the process of updating the website so that it provides better information for you. We are changing from one server to another, so the address will change. We will let you know when this happens so you can change your bookmark!

Making difficult choices easier

The Virtual Field Scout and High Plains IPM Guide are two resources for growers in the high plains region of AWPM for Wheat.

Over the past few updates, we have featured Glance N' Go, which is designed to help producers make control decisions based on economic thresholds. We also would like to highlight two other valuable resources for producers, the Virtual Field Scout and the High Plains IPM Guide.

For example, the High Plains IPM Guide outlines three elements that comprise integrated pest managment. They include maintaining insect populations below levels causing economic damage, using multiple tactics to manage insect populations, and conserving environmental quality.

Both the Virtual Field Scout and the High Plains IPM Guide serve to help you achieve these needs. They contain publications aimed at explaining each of these components.

The Virtual Field Guide, which is hosted by the University of Nebraska's South Central Research and Extension Center and Institute of Agriculture and Natural Resources, provides online resources about irrigation, crop managment, and guidelines for handling chemicals safely. Many of the documents on this site contain hotlinks for specific topics within each document. For example, the Signs and Symptoms of Pesticide Poisoning contain links that allow you to navigate easily through the information.

The High Plains IPM Guide is also easy to navigate. The site provides screen and print versions of its publications. Specific chapters are also available, so you can skip to the chapter on crops or you can widen your search to a more general topic, like integrated pest management.

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Here to help

To access the High Plains Pest Managment Guide:

http://www.highplainsipm.org

To access the Virtual Field Scout IPM Manual:

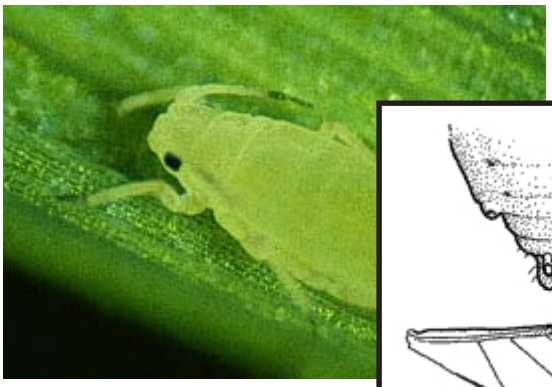
http://screc.unl.edu/IPMManual/index.htm

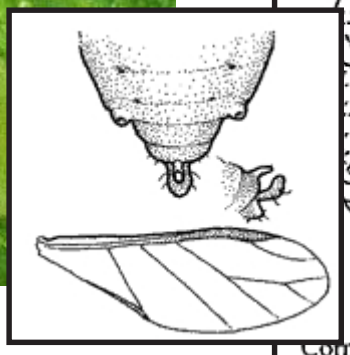
- ✓Pest and insect identification
- ✓Scouting and biocontrol
- ✓Host plant resistance

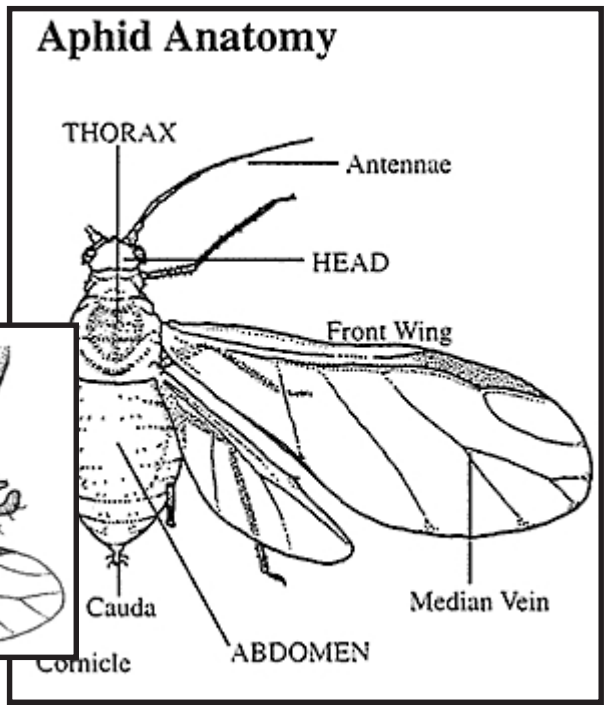
For specific information, please see pages 4 and 5.

Tools for Choices

The Virtual Field Scout has many fact sheets with information about pests, weeds and diseases. Far right: The anatomy of the aphid; near right and below: Russian wheat aphid.







"Plant viruses also can be injected into the plants during aphid feeding. Barley yellow dwarf virus can be transmitted to wheat and barley by bird-cherry/oat aphid, corn leaf aphid, greenbug, and English grain aphid. The bird-cherry/oat aphid, corn leaf aphid and greenbug also transmit maize dwarf mosaic virus to corn and sorghum in Nebraska."

✓Pest and insect identification

Among the reasons for identifying pests and beneficial insects, producers should try to estimate a trait of the pest population or commodity that is a good indicator of the damage potential of the pest, such as estimating pest population density or percentage of damaged plants in a cropping system. Producers should determine some basic information before creating an informal or formal sampling plan. Knowledge of the life history and identification features of the pest are both important. Producers will often look for insects in the incorrect stages. Proper identification can be crucial in determining management tactics.

"Another crucial aspect of pre-sampling knowledge is an understanding of *pest/plant interaction*. Plant response to pest damage may not only vary by the species of pest, but also by the species or cultivar of the plant, the growth stage of the plant, and the health/vigor of the plant at the time of pest infestation."

✓Scouting and biocontrol

Producers should note the difference between natural biocontrol and applied biocontrol. Natural biocontrol, or fortuitous biocontrol, involves the reduction in a species' population by natural enemies without man's manipulation. Conversely, applied biocontrol involves reducing the species' populations by natural enemies when man manipulates the natural enemy populations to control the population. Though producers are typically concerned with applied biological control in pest management, two important features of natural biocontrol should be understood. First, natural biocontrol is a common phenomenon, both in natural and agricultural ecosystems. Secondly, disruption of natural biocontrol is one of the most common ways pest problems occur or worsen. Not only do broad-spectrum insecticides control a pest population, they also suppress benefical insects.

Under favorable conditions, lady beetles can feed on aphids as a single food source

Producers can use a decision tree to determine which varieties would work best for them. The decision tree is for both dryland and irrigated crops in Colorado. You can access this decision tree at the Colorado Wheat Variety Performance Database. http://www.colostate.edu/Depts/SoilCrop/extension/CropVar/

✓Host plant resistance

Ankor, Halt, Prairie Red, Prowers99, Stanton and Yumar are six resistant varieties available for production in areas with high risk of Russian wheat aphid infestation. Producers can use a decision tree and other information to help select varieties for their situation. Chemical control of RWA has not been necessary on these varieties under controlled research conditions. Keep in mind that these varieties are resistant only to RWA and would still need to be treated for other pests should infestations occur.

There are also important differences among the small grain crop species. Oats are resistant to RWA. Although heavy infestations have been observed, little economic damage has been detected. For feed grain production, consider replacing barley, the most susceptible small grain, with triticale, which is moderately resistant to RWA.

To the right: Texas researchers prepare plots for imagery. Far right: a closer look at how the plots are prepared. Below: Aphid-stressed wheat after researchers used ASSESS software to outline wheat that aphids damaged.

Pinpointing Aphids: From the sky to the field

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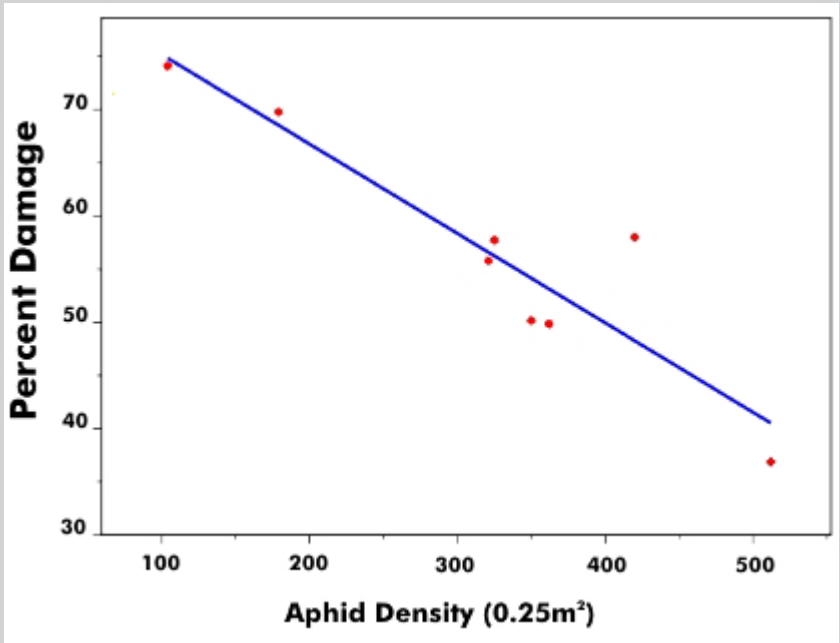
taken to the laboratory to count aphids. The remaining tillers in each plot were tallied to estimate aphid density. They also determined aphid density by counting all the aphids within the plots during the early growing season or clipping all the plants and counting aphids in the laboriatory during the late growing season.

What can this tell us?

Using spectral reflectance, Mustafa can accurately detect and discriminate from the soil, abiotic stress and non-stressed wheat fields in air-borne and space-borne remote sensing platforms at an appropriate scale.

A graph illustrating stress and non-stress wheat can be seen on the next page. They found eight spots heavily damaged by aphids, greenbugs and bird-cherry oat aphids. Sample pictures were analyzed using ASSESS: Image Analysis Software for Plant Disease Quantificiation to determine the percent damage caused by aphid feeding on wheat. In the picture above, aphid damage was outlined and percent damage was estimated on wheat leaves.

A mean comparison of reflectance data for healthy, combination of aphid and abiotic stress and aphid stress alone illustrated statistically significant differences across the visible and Near Infrared spectrum. They also found similar outcomes for Russian wheat aphid stressed wheat and healthy wheat. This strongly supports the idea that hyperspectral imaging can help show aphid

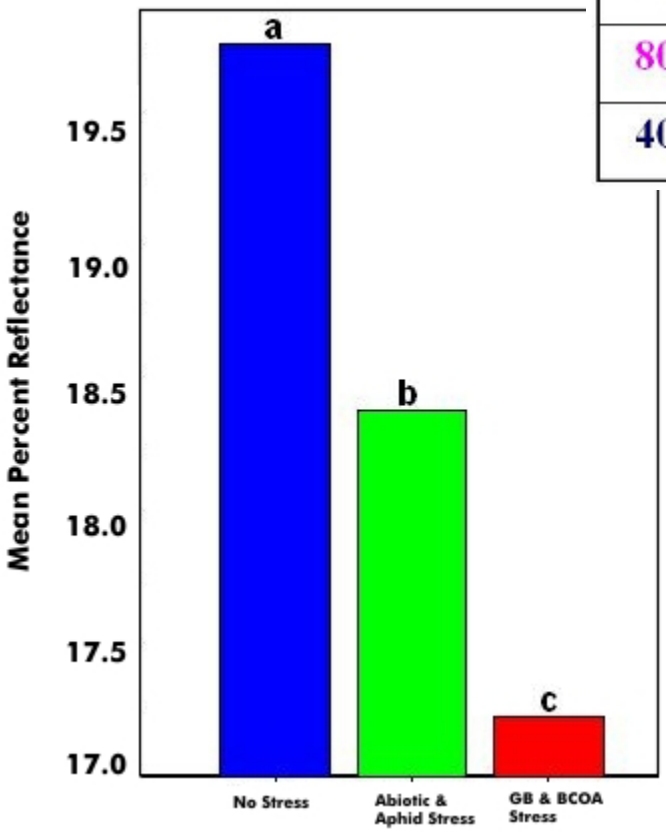


Above: This graph show strong correlation found between percent aphid damage and total aphid density, greenbug and bird-cherry oat aphid, (R^2 = 0.85)

Researchers at Texas A&M went into the fields to collect samples and count aphids from the field. Left shows aphids collected from one wheat plot. Right: Researchers are counting the aphids.

These graphs depict sampling of wheat under three different levels of stress: healthy plants, plants stressed by greenbug alone, and plants stressed by a combination of greenbug and abiotic factors. As seen below, there were statistically significant differences in the reflectance from each of the wheat conditions. A similar comparison of wheat stressed by Russian wheat aphid versus healthy plants also showed significant differences in reflected light, at right. This suggests that we can use air- and space-borne imageries to detect aphid stress.

Wavelength (nm)	RWA Stress	No Stress
400 - 500	a	b
500 - 600	a	b
600 - 700	a	b
700 - 800	a	b
800 - 900	a	b
400 - 900	a	a



infestations because all imagery analyses are based on statistical similarities and/or dissimilarities between the surface objects found in an image. For our program, surface targets, or objects, are aphid stress, other types of stress or non-stressed wheat in fields. Remote sensing helps detect greenbug infestations in wheat fields and helps demonstrate alternatives to costly spraying. We hope to detect infestations before wheat fields would require insecticide application to protect the crop from economic losses.

"Last year, we collected essential baseline data so as to correlate observed aphid density and damage in wheat to ground-base remote sensing data," Mustafa said. "These preliminary results showing established correlations strongly force us to move forward. In addition to these, remote sensing technologies and techniques are highly promising to detect aphid stress in other field crops."

The future holds a great deal for this technology. In the coming year, our partners in Texas plan to move from the ground-based remote sensing to air-borne hyperspectral and/or satellite multispectral remote sensing.

"We expect to use hypersectral or multispectral imageries to detect aphid-induced stress in wheat and sorghum, and possibly other crops at larger scales if the conditions permit."

Areawide Pest Managment for Wheat
Managment of Russian wheat aphids & greenbugs
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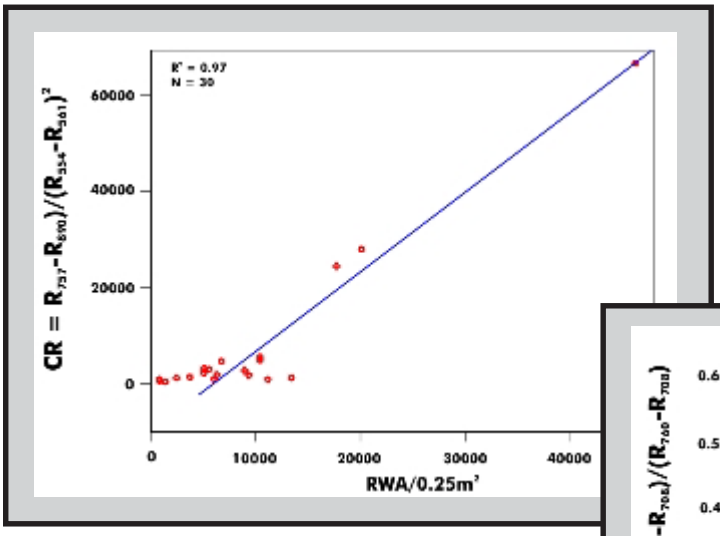
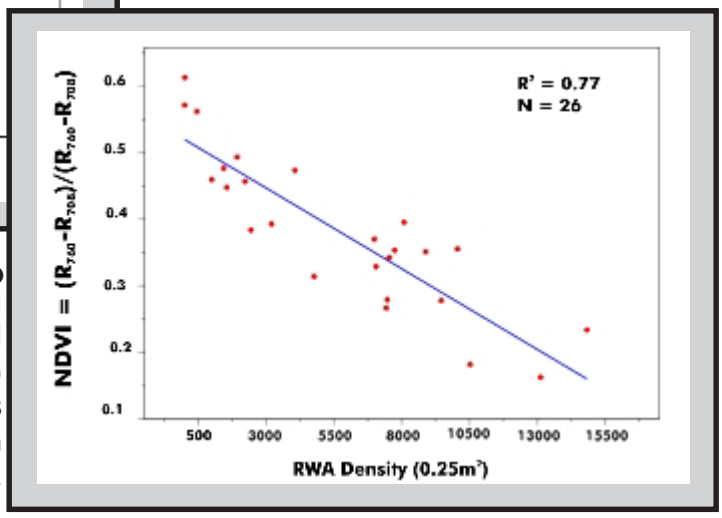
Relationship between Remote Imaging and Aphid Density



Texas

The graph to the left shows a strong linear relationship found between RWA density and spectral vegetation indices in winter wheat fields. The correlation for Texas was 97 percent.



Colorado

The graph to the right also shows a strong linear relationship found between Russian wheat aphid (RWA) density and spectral vegetation indices in winter wheat fields. The correlation for Colorado was 77 percent.