CCA CERTIFIED CROP ADVISER

ADVANTAGE

UNLOCKING the secrets of rust

Unlocking the secrets of soybean rust resistance has yielded more questions than answers for the international research community. Even so, a trio of researchers from the Midwest and South are dedicated to solving the puzzle.

Brian Diers says Roger Boerma, a University of Georgia researcher, found soybean lines in Georgia that show rust resistance and there are lines in Paraguay also showing resistance. Diers, a University of Illinois researcher, says, "The problem is, the rust pathogen is highly variable and it can quickly overcome resistance. Beans that show resistance this year may not be resistant next year."

Diers is partnering on a rust resistance research project with Boerma and Glen Hartman, University of Illinois. Between them, they have accumulated an impressive amount of knowledge, but Diers says, "We still need to know more about the diversity of the rust pathogen that is currently in the U.S. and what soybean genotypes give resistance to rust currently here. It has been especially difficult for researchers in the northern U.S. to study resistance to soybean rust because the pathogen has not yet arrived in this region."

In search of answers to these questions, Hartman traveled to North and South Vietnam with a group of University of Missouri researchers to study the rust pathogen in its Asian habitat. "Rust research programs have been strong for a number of years in Asia," he says. "Vietnam had a research program before the U.S. and has been very cooperative in trading materials and data. Thailand's researchers have shared data from as far back as the mid 1970s, and Taiwan has actively worked with USDA researchers."

According to Hartman, Reid Frederick, USDA-ARS, has screened 18,000 soybean lines at the Fort Dietrick, Md., quarantine center, but China has an additional 40,000 to 50,000 soybean lines that the United States doesn't have access to. "Asian soybean rust has been in China for a long time, but their growing conditions and wind patterns limit the pathogen's impact in their northern soybean growing provinces. Rust doesn't overwinter in that area, and the mountains of Central China protect the north from rust-bearing southern winds. In addition, China doesn't have continuous soybean from south to north like the United States and Canada do. For this reason, China hasn't established a strong research program and isn't active in global efforts to study the pathogen."

For many North American CCAs, the Asian soybean rust threat was a new phenomenon in 2005, but U.S. soybean researchers have been monitoring and preparing for rust for more than a decade. Hartman reported that in 1992 he did a bibliography on Asian Soybean Rust and found more than 500 books with information, including one in Chinese.

No one knows why rust was confined to the Eastern Hemisphere until 1995 when it spread to Hawaii, and then two years later to South America. Brazil has learned to manage its rust through the application of fungicides, but the fight has significantly increased their cost of production. Soybean rust could make the U.S. and Canada more competitive in world markets if the dryer growing conditions in this region results in less need for fungicide applications than in Brazil.

Will rust be a threat to other legumes in North America? Hartman doesn't think so. "Rust has been found in Florida on several species of green bean, but the pathogen really seems to prefer kudzu," he said. "Another popular legume, sweet pea, likes cool weather, which inhibits the development of warm-weather-dependent rust. No one has reported finding the pathogen on alfalfa. In addition, growers are used to applying fungicide on some of these crops; they just never had to spray on beans before."

Both Diers and Hartman agree the goal is to develop soybean varieties with enough durable resistance to slow the rust pathogen down and to allow cost-effective management. Diers concludes, "Soybean growers shouldn't expect a silver bullet anytime soon. But with vigilance and good management, they can still grow beans and sleep at night." AG

CCA ADVANTAGE

by Luther Smith, executive director

CEU requirements streamlined

The ICCA Board of Directors had their semi-annual meeting in Washington, D.C., the end of February. Significant changes were made to streamline the continuing education process for all CCAs without lowering the creditability.

Over the past 14 years of the program, continuing education requirements have been adjusted. The original requirements were 40 total CEUs every two years with at least five in each of the four categories and of this 40 total, at least 20 had to be CCA board-approved CEUs. Professional development and self-study CEUs did not exist when the program started and the local CCA boards had the option to increase the requirements but not lower them. The board took into account what CCAs said in the survey, the strategic planning goal of standardization and decided to return the CEU requirements closer to what they were when the program started.

Beginning Jan. 1, 2006, the CEU requirements for all CCAs are a total minimum of 40 CEUs every two years with at least five in each of the four categories and of this 40 total at least 20 must be board approved. The professional development category cap of five CEUs was removed so there is no limit on professional development CEUs as long as the other CEU minimums are met. There is still a maximum of 20 board-approved self study CEUs. Self-study CEUs have to be board approved, so this is not a change. There is no limit on self-reported CEUs as long as the other minimums are met.

Another change is that all local boards must accept all board-approved CEUs. As long as a CCA board reviews the application and grants CEUs, regardless of where it is held, it will count for all CCAs.

You might be thinking that nothing has changed for me. That is true for 19 of the 37 local CCA boards. The other 18 boards had raised the minimums over time and/or disallowed self-reported CEUs. Now self-reported CEUs are available for all CCAs. A self-reported CEU is the same type of event as a board-approved CEU, but no one ever sent in the application to be reviewed by a CCA board.

These changes should streamline the CEU process and make it consistent between states and provinces.

Under the new rules, if you want to attend an educational event that is held outside of your state or province, it is no longer an issue; it will count toward your CCA CEUs. Also if the event vendor never sent in the CEU application for board-approved CEUs, you can now report those CEUs on your own by using the self-reporting form found on the Web site. But you still need at least 20 board-approved CEUs every two years and all self-study CEUs are board approved. Always look for "CCA Board Approved CEUs" and encourage vendors to apply for CCA CEU approval.

The ICCA Board is listening to your comments and is very aware of maintaining high standards for the program that are creditable and realistic. They will be evaluating other structural related features to meet a high standard for quality. Contact your CCA representative in the Madison office with any questions. AG

The ICCA Board of Directors recently met at their semi-annual meeting in Washington, D.C., to help streamline the educational process for all CCAs.

Successful 2005 for Louisiana CCA

BY JOHN FONTANE, CHAIR OF THE BOARD, LOUISIANA CCA

The Louisiana CCA Program has achieved many of the goals established by its board in 2005. As required by International CCA Policy, the board increased its members to eight. Currently serving are Fran Deville, Mike Venable, Marty Pousson, J. Stevens, John Fontane, Lloyd Glenn, Steve Nipper and Robert Prince.

The board held four meetings throughout the year to plan educational sessions and establish policy. Our January meeting was attended by Luther Smith, Executive Director of the International CCA program. He suggested ways to increase recognition of the CCA certification and program improvements the board could make.

In February and August, the Lousiana CCA program administered state and international exams. Prior to the exams, study sessions were conducted by Cliff Synder, Potash and Phosphate Institute, and Johnny Saichuk, LSU Ag Center. We were pleased to welcome five CCAs to our ranks, bringing Louisiana's total to 95.

Another of the Louisiana CCA board's goals was to upgrade educational sessions available to our members. To accomplish this, the Louisiana CCA Program sponsored four educational sessions including:

- February: A Back-to-Basics Fertilizer seminar held in Alexandria, conducted by J. Stevens, Louisiana State University (LSU) Ag Center.
- March: A Rice Fertility session was held in Crowley and conducted by Cliff Synder, PPI and Jason Bond, LSU Ag Center.
- June: A Rice Weed Identification Program was held in Crowley. We asked people in the agricultural industry to bring in weeds normally found in a south Louisiana rice field. Ron Levy, Howard Cormier, Jason Bond and Johnny Saichuk, all with the LSU Ag Center, showed attendees how to identify the weeds. Also at this session, Steve Zaunbrecher discussed soil types.
- November: We held a session in Alexandria devoted almost entirely to Soil Conservation. Rick Norman, University of Arkansas spoke on how to attack newly laser-leveled fields. Steve Nipper and Jerry Daigle talked about Louisiana soil types and their formation.

A new Web site that CCAs and their potential customers can access at www.louisianacca.org greatly increased the program's visibility and services. The site includes contact information for each board member and all 95 Lousiana CCA members. It offers links to many sites featuring information related to Louisiana's diverse crops.

The Louisiana board has strived to increase the visibility of the CCA program and to communicate to our clients that when they deal with a CCA, they are working with a professional. We gave each of our members a truck decal with the CCA logo.

Our internal communications efforts were enhanced when we established an e-mail list of more than 200 contacts in the agricultural industry. This facilitates timely notification for upcoming exams, educational sessions and up-to-the-minute agricultural information.

The Louisiana CCA board is planning to sponsor at least two educational sessions in 2006. We will continue to spread the word that the CCA Program was developed to make crop advisers better stewards of our soil and water resources. Our continuing education requirements assure our customers that we are up to date on the latest advancements in this challenging agricultural world. Finally, we uphold the code of ethics that infuses us with professionalism and distinguishes us from our competitors. AG

CCA CERTIFIED CROP ADVISER
ADVANTAGE

Continuing Education Self-Study Course

distribution & persistenc SEDIME

BY J. GAN*, S.J. LEE, W.P. LIU, D.L. HAVER, AND J.N. KABASHIMA

Runoff of agrochemicals during storm and irrigation events is of significant concern from the standpoint of surface water quality. Delivery of pesticides into the surface water via runoff may contribute to acute or chronic ecotoxicological effects. Earlier studies show that transport of agrochemicals in runoff to the surface stream is facilitated primarily by sediment movement, and sediment-bound nutrients may account for up to 90 percent of the total amount transported in runoff. In recent studies, residues of pyrethroids were found to move with runoff into surface streams. Pyrethroids usually have high toxicity to a wide range of water column and benthic aquatic organisms. Their strong affinity for the solid phase suggests that off-site transport of pyrethroids is probably mediated by sediment movement. Therefore, to understand the ecotoxicological significance of runoff-borne pyrethroids, it is essential to characterize their downstream distribution and persistence in the sediment phase.

Enrichment is an important phenomenon that occurs in the process of sorbed chemical movement by sediment in overland flow. It was observed that concentrations of phosphorus and nitrogen were richer in the eroded sediment than the source soil. Enrichment is considered to be a result of selective or preferential erosion of organic matter and chemically rich fine particles during runoff. The magnitude of enrichment is quantified by the enrichment ratio (ER) that is the ratio of concentration in eroded sediment to that of the source matrix.

Earlier compounds from the pyrethroid class were known to be relatively unstable due to their susceptibility to photodegradation. The newer pyrethroids, such as bifenthrin, however, generally have enhanced environmental stability. The persistence of pyrethroids has been well studied in soil, but is poorly characterized in sediment. Knowledge on pesticide persistence in the sediment along a runoff path is critical for predicting the likelihood and also magnitude of pesticide export to a downstream water body.

In this study, spatial distribution and enrichment of bifenthrin (BF) and permethrin (PM) were determined in the sediment phase along a 260-m (853 ft) runoff path, and pesticide persistence in sediment was evaluated under both aerobic and anaerobic conditions. Findings from this study will be useful for understanding the behavior of these pyrethroids and other strongly adsorbing pesticides in surface runoff and the potential for their transport to the surface water.

CHEMICALS AND SEDIMENTS

Standards of bifenthrin and permethrin were purchased from Chem Service. Sediment samples were taken from different locations along a concrete-lined 260-m drainage channel receiving runoff water from a large nursery located near Irvine, Calif. Sediments were collected from the 0- to 5-cm (0-2 in) surface layer into glass jars and immediately transported to the laboratory. After processing, the sediment samples were analyzed for textural and chemical properties.

MEASUREMENT OF PESTICIDE DISTRIBUTION IN SEDIMENTS

Aliquots of the sediment samples were air-dried and then passed through a 1-mm sieve. The air-dried sediments were used for analysis of BF and PM in the whole sediment along the runoff path and for determining in situ adsorption coefficient K_d. A two-step extraction procedure was used, from which the aqueous phase (C_w) and adsorbed phase (C_s) concentrations were quantified. Briefly, 5.0 g (dry weight equivalent) of sediment was placed in a 250-mL glass centrifuge bottle and mixed with 200 mL of 0.01 *M* $CaCl_2$ solution at high speed for 24 h on a mechanical shaker. The sediment slurry was centrifuged to separate the aqueous and solid phases. The solution was decanted into a 1-L glass separatory funnel and was extracted with ethyl acetate by manual mixing. The solvent phase was collected, and the remaining aqueous phase was extracted for two additional times with fresh solvent. The solvent extracts were combined, dried with 50 g of anhydrous sodium sulfate, and then concentrated to near dryness on a rotary evaporator at 60°C. Pesticide residues were dissolved in 5.0 mL of hexane–acetone (1:1, v/v), and an aliquot was analyzed on gas chromatography (GC) to determine C_w (μg/L). The sediment phase was transferred to a 50-mL Teflon centrifuge tube, and was mixed with 5 g of anhydrous sodium sulfate and 10 mL of hexane–acetone (1:1) at high speed for 2 h. After centrifugation, an aliquot of the solvent extract was used for GC analysis to determine the adsorbed phase concentration C_s (μg/kg). The measured C_s and C_w

e of pyrethroids in runoff

NTS

were combined to derive the total concentration C (μg/kg). The C_w and C_s values were further used to calculate K_d, using $K_d = C_s/C_w$.

CHEMICAL ANALYSIS

An Agilent 6890N GC system was used for the detection and quantification of BF and PM. An HP-5 column (30 m x 0.32 mm x 0.25 μm) was used with helium as the carrier gas at 2.1 mL/min. An aliquot of 1.0 μL was injected into the GC for analysis.

PESTICIDE ENRICHMENT IN SEDIMENT

The sediment samples were taken from a concrete-lined channel receiving surface runoff from a large commercial nursery, where products of BF and PM had been continuously used for ant control in plant containers. The pesticides were typically incorporated into potting mix before seeding or transplanting. The intensive irrigation as required for nursery production resulted in widespread surface runoff, which carried ingredients of the potting mix (i.e., sand, silt, and organic matter) and pesticides, first to a sedimentation pond and then through the drainage channel before the runoff water was discharged. It was observed that as the runoff water moved through the sedimentation pond and the drainage channel, suspended solids settled out under gravity and gradually formed a sediment layer along the runoff path.

In this study, distribution of BF and PM in the sediment bed was examined along the drainage channel, using the sedimentation pond as the source point. Pesticide concentrations generally increased with increasing distance downstream from the source. Using the concentration for the sedimentation pond as the reference value, the relative enrichment ratio (ER) was calculated for the different locations. Assuming ER was 1.0 for the sedimentation pond, ER for BF increased to 6.9 at 104 m, and further to 25.7 to 32.2 after 145 m. The ER for *cis* and *trans* isomers of PM also increased with increasing distance from the source, although at rates smaller than those for BF.

Measurement of pesticide concentrations in the aqueous and sediment phases after phase separation allowed the calculation of K_d as a function of sediment location. K_d values in the thousands or tens of thousands were obtained for both BF and PM, validating that these compounds have exceptionally high affinity for sediment. For the same compound, K_d invariably increased with the distance from the sedimentation pond. Using the pond as a reference point, K_d for BF increased by approximately 8 times at 104 m, and by 22.7 to 43.9 times after 145 m. Increases in K_d were also observed for PM isomers.

Concurrent to increases in ER and K_d in the sediment phase, sediment organic carbon content (OC) and clay content also increased with distance from the source. The ER for sediment OC increased to 3.6 at 104 m, and further to 7.0 to 9.8 after 145 m. The ER for sediment clay fraction also increased to 3.8 to 4.6 for the 145- to 210-m section. This analysis suggests that sediment movement in the drainage channel was a selective process, in which organic matter and chemical-rich fine particles transported downstream preferentially in relation to the organic matter and chemical-poor large particles. The selection may be attributable to size selection caused by gravity-driven sediment settling. It is also likely that the impact of water movement may have caused breakdown of large aggregates, and that the disaggregated fine particles and organic matter traveled further downstream. Linear regression between the total pesticide concentration and sediment OC or clay content showed that distribution of BF in the sediment was closely correlated with sediment OC (r^2

= 0.98) or clay content (r^2 = 0.96). Distribution of PM isomers in the sediment phase was also dependent on sediment OC or clay content (r^2 = 0.50–0.79). Regression between K_d and sediment OC and clay contents yielded moderately positive relationships, with r^2 ranging from 0.49 to 0.74. Coincidence between enrichment of OC or clay and enrichment of nutrients (e.g., phosphorus) has frequently been found during soil erosion and sediment movement. The ER was found to generally decrease with rainfall intensity and sediment export rate, but increase with time and distance. Ghadiri and Rose (1991) found that the outer coat of soil aggregates contained chlorinated insecticides at levels significantly higher than in the inner core, and that peeling off of the outer layer during runoff contributed to pesticide enrichment in eroded sediment.

Enrichment of pyrethroids during runoff may have important implications. For instance, although the concentration of a pyrethroid compound in the source may be low, the significant enrichment potential may result in high pesticide levels entering the surface water during irrigation or storm-induced runoff.

In a recent study, Weston et al. (2004) detected residues of several pyrethroids in the sediment from waterways in the agriculture-dominated Central Valley of California. The finding appeared to contradict the assumption that pyrethroids are generally immobile in the environment due to their strong adsorption to soil. Formation and transport of chemically-enriched fine particles during runoff as observed in this study may offer an explanation to the recent pesticide detections.

As evident from this study, sediment is probably the predominant carrier for compounds such as BF and PM. Therefore, sedimentation-based mitigation practices may be valuable for reducing surface water contamination by pyrethroids through runoff. Such mitigation practices may include sedimentation traps, sedimentation ponds, vegetative filters, and use of flocculants to cause settling out of suspended solids. Because sedimentation ponds or similar practices are effective only at retaining large particles, practices aiming at reducing transport of fine particles may be essential for preventing pyrethroids from entering surface water streams.

PESTICIDE PERSISTENCE IN THE SEDIMENT PHASE

Persistence of BF, *cis*-PM, and *trans*-PM was measured in previously contaminated runoff sediments under different oxidation (aerobic and anaerobic) and temperature (4 and 20°C) conditions. The dissipation of pesticide residues over time was fitted to a first-order decay model to estimate the first-order rate constant k and half-life ($t_{1/2}$). Under aerobic conditions, $t_{1/2}$ was over one year for BF, and ranged from a few months to over one year for PM. The $t_{1/2}$ was longer at 20 °C than at 4°C. Degradation of BF was slightly enhanced under anaerobic conditions, but the over persistence of BF and PM was also very long. Therefore, it may be expected that pyrethroid compounds exhibit moderate to long persistence in sediments under most conditions, and the long persistence may contribute to offsite movement of pyrethroid residues into surface waters.

CONCLUSIONS

Pyrethroids are commonly used insecticides, and their importance may further increase as they replace some of the organophosphate insecticides. The high toxicity of pyrethroids to aquatic organisms and their recent detections in sediments from surface streams dictate that their fate and distribution in the sediment phase be better understood. In this study, BF and PM were found to be enriched during runoff transport, resulting in progressively higher pesticide levels in the sediment downstream from the source. The enrichment was attributed to size selection during settling of runoff-borne sediments, and probably also to disaggregation of large sediment particles. The enrichment of BF and PM was found to coincide with enrichment in sediment OC and clay fractions. This finding suggests that the chemically enriched fine sediment may have the greatest potential for surface water contamination, and that its role in ecotoxicological effects should be further evaluated. Both BF and PM exhibited long persistence in sediments under aerobic or anaerobic conditions. The limited degradation was probably a result of the strong adsorption of these compounds on the sediment phase. The long persistence implies that although pyrethroids are known for their immobility in soil, surface erosion and runoff may ultimately lead to significant off-site pesticide movement to surface streams over a sufficiently long time scale. It is expected that practices reducing sediment export should be also effective in mitigating off-site pyrethroid movement through runoff. Such mitigation strategies should be evaluated and promoted.

Distribution and persistence of pyrethroids in runoff sediments

April Self-Study Examination

DETACH HERE

1. **Pyrethroids are a class of compounds most commonly used as**
[ ] a. fungicides.
[ ] b. insecticides.
[ ] c. herbicides.
[ ] d. fumigants.

2. **Results of this study will be useful for**
[ ] a. understanding the behavior of strongly adsorbed pesticides in surface runoff.
[ ] b. determining the toxicity of lipid-soluble pesticides.
[ ] c. estimating off-site spray drift patterns related to temperature inversions.
[ ] d. determining how mode of activity affects pest dispersal.

3. **Pyrethroids moving off site pose the greatest threat to the environment by their effect on**
[ ] a. subterranean insects.
[ ] b. freshwater plants.
[ ] c. aquatic organisms.
[ ] d. nightcrawlers and redworms.

4. **The source of the pesticides in this study was a**
[ ] a. large commercial nursery.
[ ] b. farrow-to-finish hog operation.
[ ] c. vineyard.
[ ] d. commercial crop field.

5. **The half-life of BF in sediment was**
[ ] a. over one year.
[ ] b. a few weeks.
[ ] c. a few months.
[ ] d. Many years.

6. **A finding of this study was that pesticide concentrations in sediment increased as the**
[ ] a. volume of runoff water increased.
[ ] b. volume of runoff water decreased.
[ ] c. distance from the source increased.
[ ] d. distance from the source decreased.

7. **After stormwater carries pyrethroids into a creek, most of the chemicals can be found in the**
[ ] a. water column.
[ ] b. aquatic plants.
[ ] c. algae.
[ ] d. bed sediment.

8. **The enrichment of pyrethroids coincided with the enrichment of soil**
[ ] a. sand fractions.
[ ] b. microflora.
[ ] c. limiting layers.
[ ] d. organic carbon and clay.

9. **Mitigation strategies for pyrethroid pesticides should be concentrated on**
[ ] a. decreasing the off-site movement of sediment and organic matter.
[ ] b. decreasing the overall rates used.
[ ] c. using pyrethroids only for foliar applications.
[ ] d. limiting pyrethroid applications to periods when temperatures exceed 35 C.

10. **The relative enrichment ratio for BF at the 145m furthest sampling location as compared to the retention pond was approximately**
[ ] a. 10.
[ ] b. 25.
[ ] c. 100.
[ ] d. 250.

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Rating Scale: 1=Poor 5=Excellent

Information presented will be useful in my daily crop advising activities: 1 2 3 4 5

Information was organized and logical: 1 2 3 4 5

Graphics/tables were appropriate and enhanced my learning: 1 2 3 4 5

I was stimulated to think how to use and apply the information presented: 1 2 3 4 5

This article addressed the stated competency area and performance objective(s): 1 2 3 4 5

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