SECTION XI: SOIL AND ENVIRONMENTAL ASPECTS OF WEED SCIENCE

EMPLOYING REMOTE SENSING TO EVALUATE CHANGES IN LAND USE AND ESTIMATE PROBABLE PESTICIDE RUNOFF TO SURFACE WATERS. M.L. Mortimer, J.H. Massey, D.R. Shaw, J.R. Steil, J.A. Ballweber, and M.C. Smith, Department of Plant and Soil Sciences, Remote Sensing Technologies Center, and Mississippi Water Resources Research Institute, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

In an effort to control and eventually reduce nonpoint-source pollution, the Environmental Protection Agency (EPA) recently decided to implement the Total Maximum Daily Load (TMDL) requirement of the 1972 Clean Water Act, beginning in 2001. As a result of the EPA's actions, there has been an effort to determine alternative methods of evaluating bodies of surface water on the 303(d) list of impaired waterbodies other than traditional manual water sampling. Laboratory analysis for traditional water samples is time consuming and expensive, and manual sampling is difficult to do over an entire watershed. There are various other issues that are associated with the TMDL implementation procedure, such as how the EPA might standardize the method of listing bodies of surface waters as impaired, as well as how TMDLs will be established and enforced.

Remotely-sensed images in combination with pre-existing databases may form an effective decision support system, which can be used to prioritize waterbodies on Mississippi's 303(d) list that can potentially be de-listed. The previously existing data and the imagery can also provide inputs to water quality predictive models. For example, databases containing information on pesticide usage, land cover classification, precipitation, soils, and possibly other types of environmentally relevant data, such as digital elevation models (DEMs), can be arranged in thematic layers over remotely-sensed images in a GIS database. In an experimental pilot project at Mississippi State University, this procedure will be performed for both 1987 imagery and 2001 imagery for the upper portions of the Pearl River watershed. The remotely-sensed images, along with the corresponding environmental data for each set of images, will show the changes in land use over time. Land cover often determines pesticide use, and pesticide use usually changes as land use or land cover changes. Ground-truthed data will be correlated to parameters in the multispectral imagery. Once this correlation is established, selected features from remotely sensed images can provide inputs to water quality models. Using remote sensing with pre-existing databases from a diversity of sources can determine inputs for water quality models and show the effect of land use changes on surface water quality. Remote sensing, with the aid of previously existing data, can potentially save time, money, and resources in the effort to evaluate impaired bodies of water and eventually establish TMDLs for these waterbodies.

THE EFFECT OF MULCHING SYSTEMS ON HERBICIDE MOBILITY. S.L. File, P.R. Knight, and D.B. Reynolds. Mississippi State University, Mississippi MS 39762.

ABSTRACT

Increased pesticide use in ornamental horticultural crop applications has heightened concern over the fate of herbicides and their potential accumulation in surface and groundwater supplies. Production of horticultural crops in sandy soils under heavy irrigation regimes has resulted in a high potential for some herbicides to leach into groundwater. Mulches are commonly utilized in landscape practices but little is known about their effect on herbicide efficacy and mobility. Therefore the objective of this research was to evaluate the mobility of three commonly used herbicides when applied over various mulching systems.

Treatments were arranged in a three (pendimethalin, isoxaben, and metolachlor) x four (bare soil, newspaper pellets, pine bark, and pine straw) factorial in a randomized complete block design with four replications. The experiment was repeated and all data were subjected to analysis of variance to test for significance. Acetate tubing (5cm x 30cm) was filled with a sandy loam soil in 100g increments before being covered with two inches of mulch. Columns were irrigated with 250 ml of deionized water under saturated-flow conditions and then allowed to drain for 24h before treatments were applied. All ^{14}C- labeled herbicides were applied in 1000µl of deionized water to each column in a cross-hatch pattern. Following herbicide application, columns drained for 24 h before leachate volume was recorded and sampled. Two 1 µl aliquots from each leachate sample were combined with scintillation cocktail and analyzed by liquid scintillation spectrometry. Columns were then frozen and sectioned with a 2 inch PVC cutter into the following segments: mulch if applicable, 0-5, 5-10, 10-15, 15-20, and 20-25 cm soil sections. Soil segments were air dried and mixed throughly before three 2-g samples were taken from each and combusted with a biological oxidizer at 900^0 C for 4 min. Mobility was determined by calculating percent of herbicide collected at different soil depths and in the leachate, relative to amount applied.

All three herbicides had over 85% recovery and showed no differences among herbicide treatments when averaged over mulching system. When averaged over herbicides, newspaper pellets adsorbed more ^{14}C-herbicide compared to any other mulch. Recovery of ^{14}C-herbicide was lower with pine bark when compared to any other mulch. Compared with pendimethalin and isoxaben, metolachlor leached more from the mulch layer into the soil profile,

indicating a higher leaching potential. These data indicate that these mulches decrease leaching regardless of herbicide used. These results also demonstrate that newspaper pellets reduced herbicide movement compared to other mulching system examined. These data indicate that mulches may aid in decreasing herbicide movement into surface and groundwater from landscape beds.

USING A DISC-FLOW METHOD TO BETTER UNDERSTAND HERBICIDE-SOIL INTERACTIONS.
M.C. Smith, D.R. Shaw, M. Boyette, W.L. Kingery, J.H. Massey, and M.L. Mortimer, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Thin-disk flow experiments may provide both kinetic and equilibrium data on solute-soil interactions in a more natural environment than batch experiments. The objective of this research was to determine the feasibility of using thin-disc flow to explore imazaquin-soil interactions. Soil used throughout these experiments was a Brooksville silty clay, pH 6.8. Batch equilibrium studies used "cold" and ^{14}C-labeled imazaquin at initial solution concentrations from 0.075 to 150 μM imazaquin in 5 mM $CaCl_2$. The solution to soil ratio was 2:1. Samples reached equilibrium by 24 hr on a horizontal shaker and were centrifuged at 4500 rpm for 30 min. With equilibrium solution concentrations less than 2.0 μM, the resulting linear adsorption isotherm K_d averaged 0.34. However, if equilibrium concentration was above 2.0 μM, the resulting isotherm fit a Freundlich isotherm with $K_f = 0.35$ and n = 0.86.

In the saturated breakthrough concentration (BTC) thin-disc studies, 3.0 g air-dry soil was place on a 0.20 μm filter and sealed in a 47 mm Nalgene® In-Line Filter Holder. Soil was conditioned with 200 ml deionized water followed by 200 ml 0.5-M $CaCl_2$ followed by 1000 ml 5-mM $CaCl_2$. Imazaquin at 3.0 and 29.3 μM in 5-mM $CaCl_2$ plus KBr was then pumped at 3 ml min^{-1} through the soil-disc. Effluent was collected in 5 or 10 ml fractions. After collecting 500 ml effluent, flow was stopped and remained static for 24 hr. When flow resumed, fractions were collected for an additional 500 ml. Imazaquin concentration was determined by HPLC analysis. Dilution within the system was negated by using Br^- as a conservative tracer. The BTC curves were equivalent for the 3.0 and 29.3 :M imazaquin solutions. Imazaquin was present in the initial samples at approximately 38% of the influent concentration (C_o). At a cumulative volume of 50 ml, the effluent concentration was 99% of C_o for the imazaquin solutions. When herbicide solution flow was resumed after the 24 hr stoppage, imazaquin concentration in the effluent decreased by approximately 15%. The decrease demonstrated equilibrium was not achieved prior to the stoppage. The adsorption and desorption of imazaquin in saturated soil followed first-order kinetics. Collectively, these data suggest sorption kinetics are driving the imazaquin-soil interaction.

In separate studies, moist soil (7.5% water wt wt^{-1}) was treated with 133 g ae ha^{-1} ^{14}C-imazaquin (0.015 μCi g^{-1} soil) and incubated for 24, 72, and 168 hr. After incubation, 3.25 g moist soil was placed in the thin-disc filter apparatus and desorbed with 5.0-mM $CaCl_2$. All three incubation times were desorbed with a flow rate of 1.0 ml min^{-1}. The 72 hr-incubation time was also desorbed with additional flow rates of 0.33 and 0.67 ml min^{-1}. A total of 50 ml effluent was collected in 1.0 ml fractions. Flow was stopped for 24 hr, then resumed using the identical flow rate. Imazaquin solution concentration was determined by liquid scintillation counting and purity was confirmed with HPLC analysis. The herbicide concentration in soil was inferred by subtracting herbicide detected in the effluent from the initial soil concentration. Desorption kinetics were calculated by graphing imazaquin soil concentration on the y-axis versus the pore volume of effluent passing through the soil-disc on the x-axis. With all incubation times and flow rates, soil concentration decreased curvilinearly as pore volumes increased. Thus, the natural logarithm of soil concentration was plotted to test for first-order kinetics fit. The graph of the natural logarithm plot was also curvilinear. However, within the desorption curve, three distinct linear phases were present for each incubation time and flow rate. The R^2 of linear regression of these data averaged 0.98. This strongly suggests that each desorption curve was multiphasic, with each phase having first-order rate kinetics. When averaged over the 3 phases of desorption, incubation time greatly influenced desorption kinetics. Desorption rate (k) for the 24 hr incubation time was 0.088 ln(μmol kg^{-1}) / pore volume [ln(μmol kg^{-1}) pv^{-1}], compared to k = 0.069 ln(μmol kg^{-1}) pv^{-1} for the 72 and 168 hr incubation times. Thus, the kinetics of the shortest incubation time was 1.28 times faster than the longer incubation times. However, flow rate did not affect kinetics, with all three flow rates of the 72 hr incubation time averaging k = 0.070 ln(μmol kg^{-1}) pv^{-1}. When averaged over the 3 incubation times, the first desorption phase averaged k = 0.144 ln(μmol kg^{-1}) pv^{-1}. However, k decreased to 0.053 and 0.030 ln(μmol kg^{-1}) pv^{-1} for the intermediate and late desorption phases, respectively. Thus, initial desorption rate was approximately 5 times higher than the late phase. An imazaquin partitioning coefficient (K_d) was calculated by comparing the soil and solution concentration of imazaquin after the 24 hr stop-flow period. This K_d was 0.47, compared to 0.34 with the batch equilibrium experiments. These data indicate that desorption of field application rates of imazaquin are multiphasic. It is probable that initial desorption is from the most weakly adsorptive sites, and later herbicide loss if from the most tightly bound sites.

PREDICTION OF PERENNIAL WEED OCCURRENCE USING TERRAIN MODELING AND SOIL ATTRIBUTES IN Kentucky NO-TILL FIELDS. C.L. Brommer and W.W. Witt. Department of Agronomy, University of Kentucky, Lexington, KY 40546.

ABSTRACT

Conservation tillage practices have increased in row crops across the United States and no-till agriculture makes up 50% of the total row crop acreage in Kentucky. These tillage practices have many benefits to producers over the use of traditional tillage practices. There are problems associated with no-till fields in Kentucky and one of these is higher relative population of perennial weeds. The perennial weed population establishes primarily because of the lack of preplant tillage to disrupt the taproots of many broadleaf perennial weeds. Extension personnel and producers alike have noticed that perennial weed communities establish in similar areas in many different fields. These areas may include low or bottom portions of fields and in places where water would be more available. Producers also face the problem of having more acreage to manage to stay solvent. The added land area decreases the amount of time a producer can scout fields and make herbicide applications. With these observations in mind, a study was established to try and correlate the terrain attributes of no-till fields with occurrence of perennial weed populations.

One of the University of Kentucky's agricultural research farms, located in Woodford Co., was used as the initial site for these studies. A field was selected which had been in no-till production for several years and was currently planted in soybean. Populations of hemp dogbane, trumpetcreeper, and hedge bindweed were located and their position documented with a Starlink® GPS backpack unit. Digital elevation maps (DEM) were created from landform surveys. From the DEM a series of hydrological and terrain maps were creates using ARCINFO. Data from these maps were used in conjunction with regression modeling to monitor the correlation between hydrology, terrain factors and perennial weed population. Terrain factors included slope gradient, profile curvature, plan curvature, tangential curvature, specific catchment area, upslope length, distance to local depression, elevation above local depression, and secondary terrain attributes of compound topographic index, stream power index, sediment transport capacity, and depression proximity index.

A correlation was drawn between the location of trumpet creeper (*Campsis radicans*) and with the catchment area (0.31) and the slope index (0.41) as well as, Hedge bindweed (*Calystegia sepium* (L.) R. Br.) with the catchment area (0.38) and the slope index (0.40). All correlation values were at the 0.01 level. Both of these values are indicators of run off and topography in a field. Soil factors did not have close correlations to weed presence. Data collected for soil-perennial weed correlation were not above (0.03). No correlations were found between Hemp dogbane and any of the terrain characteristics or with the soil attributes. Future research will also include top soil and subsoil characteristics and the relation to perennial weed occurrence. Research at different sites throughout the state of Kentucky will be conducted in the coming months to validate the models created at the Woodford Co. site.

NURSERY IRRIGATION PRACTICES IMPACT PESTICIDE LEVELS IN RUNOFF WATER. J.A. Briggs, T. Whitwell, and M.B. Riley. Clemson University, Clemson, SC.

ABSTRACT

Field research was conducted at a wholesale container plant nursery near Chesnee, SC, in the summer of 2000, to determine the effects of reduced irrigation amounts following fungicide and herbicide applications on pesticide levels in runoff water. In the Southeast US, irrigation is applied to container plants on a daily basis during the growing season. Irrigation follows fungicide and insecticide applications within 24 hours and immediately follows herbicide applications. Treatments were spray applications of a fungicide and herbicide followed by reduced (0.3 cm) or pulsed (1.8 cm) irrigation volumes. Pulsed treatment consisted of three 30 minute irrigation cycles with 90 minute rest periods between cycles. The fungicide, thiophanate-methyl was applied to production beds at the rate of 0.4 kg ha^{-1} using an air blast sprayer 20 hours before irrigation treatments. The preemergence herbicide oryzalin was spray applied to beds at a rate of 2.9 kg ha^{-1} on the day of irrigation treatment. Following the day of application, pulsed irrigation was applied to both treatments. Runoff samples were collected at 15 minute intervals from both treatments through three days of pulse irrigation. Samples were analyzed by HPLC after pesticide extraction onto solid phase extraction columns.

Oryzalin was detected in all runoff samples from both treatments. Highest concentrations noted were from the first samples on the day of treatment and were 3.5 and 3.9 mg ml^{-1} for the reduced and pulsed irrigation treatments, respectively. Concentrations decreased throughout subsequent sampling periods and sampling days. On one day after treatment, concentrations were higher from the reduced treatment for the majority of runoff samples. At two days after treatment, concentrations were similar among treatments for all but one sample. Total amounts of oryzalin detected in runoff water were greater from the reduced treatment on one day after application, but similar among treatments as a total for the study. As a percent of applied amount, 7% of oryzalin was detected as leaving application site in runoff water. Thiophanate-methyl was detected on only the day of treatment for the pulsed irrigation treatment and through one day after treatment in the reduced irrigation treatment. Greatest concentrations noted were 1.4 and 2mg ml^{-1} in the reduced and pulsed treatments, respectively. Total amounts of thiophanate-

methyl in runoff water were lower from the reduced irrigation treatment, 0.2 g as compared to 0.6 g from the pulsed irrigation treatment. As a percent of amount applied, 0.2 and 0.9% of thiophanate-methyl was detected as leaving application site in runoff water from the reduced and pulsed irrigation treatments, respectively.

A reduction in post pesticide application irrigation volumes lowered amounts of thiophanate-methyl in runoff water but did not affect amounts of oryzalin. Thiophanate-methyl has a water solubility ten times greater than oryzalin, and quickly degrades to carbendazim. Oryzalin is a stable herbicide with a very low vapor pressure. Reductions in irrigation volume following pesticide application may reduce quantities of soluble, readily degradable pesticides that leave application site in runoff water.

RELATIONSHIPS OF SOIL/SOLUTION DISTRIBUTION COEFFICIENTS (K VALUES) AND SELECTED SOIL PROPERTIES FOR WEAKLY BASIC HERBICIDES. J.B. Weber, G.G. Wilkerson, and R.B. Leidy, North Carolina State University, Raleigh, NC 27695

ABSTRACT

Statistical evaluation of pesticide soil/solution distribution coefficients (K_d or K_f values) with selected soil parameters [% organic matter (OM), % clay mineral (CM), and 1:1 soil:water pH] revealed that the K values were only weakly correlated with the soil parameters when all pesticides were selected, but were highly correlated when only weakly basic chemicals were selected. Equations were developed for calculating K values for nine weakly basic herbicides, including atrazine, cyanazine, fluridone, metribuzin, prometon, prometryn, propazine, simazine, and terbutryn when the three soil parameters are known for a given soil.

TILLAGE SYSTEMS AND FILTER STRIPS AFFECT HERBICIDE LOSSES IN SURFACE RUNOFF. S.B. Blanche, D.R. Shaw, J.H. Massey, M. Boyette, and T.H. Koger, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Field studies were conducted in 1999 and 2000 to evaluate the effectiveness of vegetative filter strips in conjunction with three different tillage systems: a conventionally tilled system (CT), a no-till system (NT), and a no-till with wheat (*Triticum aestivum* L.) residue system (NTR) for reducing runoff volume, sediment, fluometuron and norflurazon in surface runoff. Trials were conducted on runoff plots 4 m x 22 m in Brooksville, MS, on a Brooksville silty clay (fine montmorillinitic, thermic Aquic Chromudert, 3% slope, 3.2% organic matter content, pH 6.3 in Ap horizon). Cotton (*Gossypium hirsutum* L.) was planted in 76-cm rows and all plots received 1.7 kg ai/ha fluometuron and norflurazon PRE. Treatments consisted of a 1 m filter strip of switchgrass (*Panicum virgatum* L.), a perennial grass with a stiff, erect growth habit. The filter strips were installed at the base of each tillage system and an adjacent, unfiltered plot was paired with it for comparison. The samples were analyzed using liquid-liquid extraction and HPLC methodology to determine fluometuron and norflurazon concentrations in runoff. Average extraction efficiency for fluometuron and norflurazon was 87 and 93%, respectively.

In the initial runoff event 0 days after treatment (DAT) in 1999, sediment losses were reduced 86, 79, and 93% by adding a filter strip to CT, NT and NTR systems, respectively, when compared to a NT system without a filter strip. Across tillage systems in 1999, cumulative fluometuron loss was reduced 44% when a filter strip was present. In 1999, cumulative norflurazon loss was reduced 47% by adding a filter strip, regardless of tillage system. In the first runoff event of 2000, there were no differences between any treatment with respect to fluometuron, norflurazon and sediment losses in surface runoff. Across all treatments, fluometuron loss in the initial runoff event was between 80 and 89% of the cumulative loss over the 1999 growing season. Flometuron losses were between 3.6 and 15.6% of the amount applied in 1999 and between 3.1 and 6.0% of the amount applied in 2000. Total norflurazon loss in the initial runoff event, regardless of treatment, was between 88 and 98% of the cumulative loss over the 1999 growing season. Norflurazon losses were 1.0 to 9.9% of the amount applied in 1999 and 1.9 to 5.2% of the amount applied in 2000. In the first runoff event, more herbicide was available to enter solution than in subsequent runoff events due to insufficient time for adsorption to soil colloids, and for degradation. At 0 DAT in 2000, fluometuron loss was between 60 an 86%, and norflurazon loss was between 61 and 81% of the total loss over the entire growing season. In NT systems in 1999, sediment losses were reduced 80% when a filter strip was present.

ASSESSING SOYBEAN RESPONSE TO HERBICIDE APPLICATION USING MULTISPECTRAL IMAGERY. C.S. Bray, D.R. Shaw, J.A. Mills, and S.B. Blanche, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762; and Monsanto Agricultural Products Co., Collierville, TN 38017.

ABSTRACT

Even though many herbicides are labeled for application over-the-top of soybean, at times there are adverse reactions to these applications. Multispectral remote sensing images may be useful in determining levels of crop stress induced by herbicides. Vegetation Indices (VI) may be used to create ratios between the specified wavelength bands collected by remote sensing to evaluate plant canopy reflectance response to the herbicide applications.

An experiment was conducted using multispectral imagery to observe soybean response to various postemergence herbicides. Images were collected throughout the growing season using an aerial multispectral camera with 1-m resolution, and ground-reference data were collected using a hand-held hyperspectral sensor. Multispectral imagery was collected six weeks after single herbicide applications and four weeks after sequential applications. Hand-held data were collected 2 weeks after treatment for single applications and 2 days after treatment for sequential applications. Exact locations for sample collection were pinpointed with GPS. Plots were 7.7 m wide and 365 m long, making each plot 0.28 ha. There were fourteen treatments in the trial including single and sequential applications, a weedy check, and a weed-free check. Single applications consisted of 840 g ae/ha glyphosate (Roundup Ultra), 840g/ha glyphosate (Roundup Ultra Max), 840 g/ha glyphosate (Roundup Ultra Dry), 840 g/ha sulfosate, 630 g/ha glyphosate plus 4 g ai/ha Chlorimuron, 630 g/ha glyphosate plus 10 g ai/ha cloransulam, and 630 g/ha glyphosate plus 140 g ai/ha acifluorfen. Sequential application consisted of 840 g/ha glyphosate (Roundup Ultra) followed by (fb) 630 g/ha glyphosate (Roundup Ultra), 840 g/ha glyphosate (Roundup Ultra Max) fb 630 g/ha glyphosate (Roundup Ultra Max), 840 g/ha glyphosate (Roundup Ultra Dry) fb 630 g/ha glyphosate (Roundup Ultra Dry), 840 g/ha sulfosate fb 630 g/ha sulfosate, 630 g/ha glyphosate plus 4 g/ha chlorimuron fb 630 g/ha glyphosate plus 4 g/ha chlorimuron, 630 g/ha glyphosate plus 10 g/ha cloransulam fb 630 g/ha glyphosate plus 10 g/ha cloransulam, and 630 g/ha glyphosate plus 140 g/ha acifluorfen fb 630 g/ha glyphosate plus 140 g/ha acifluorfen.

Vegetation indices were calculated using band values from data sets in the multispectral image and hand-held data. Vegetation indices include Red Vegetation Index (RVI), Normalized Difference Vegetation Index (NDVI), Difference Vegetation Index (DVI), Normalized Difference Vegetation Index green (NDVIg), Soil Adjusted Vegetation Index (SAVI), and Global Environmental Monitoring Index (GEMI). Although data were collected using hyperspectral sensor, the data were converted to multispectral bands. Using vegetation indices, patterns were classified for comparisons of treatments. Treatment comparisons include glyphosate and herbicide-free checks, single and sequential applications of glyphosate, single and sequential applications of glyphosate formulations, single applications and sequential applications of tank mixtures, glyphosate to single and sequential tank mixtures, and comparisons of weed-free and weedy check to herbicide treatments. Treatments were classified by numerical values assigned to the pixels at the sampling locations in the multispectral aerial and hand-held data. Resubstitution Summary using a Linear Discriminant Function was used to classify the reflectance response from the multispectral imagery and hand-held data.

Hand-held data and aerial data were classified correctly 100% for comparisons between glyphosate applications and herbicide-free areas, as well as the comparison of single and sequential applications of glyphosate. Hand-held data for sequential applications of glyphosate formulations were correctly classified 100% of the time, whereas the aerial data were only classified correctly 75% of the time. For single applications of glyphosate formulations, hand-held data were classified correctly only 59%, and aerial 66%, of instances tested. Thus, glyphosate formulations can be differentiated with sequential treatments, but single applications were difficult to delineate. This may be partially attributed to the reduction in response with the longer period of time after treatment. Hand-held data for the tank-mix treatments were classified 100%, whereas the data from aerial data were classified correctly 89%. Single tank mixtures were classified correctly 88% of the time with hand-held data and 89% of the time with aerial images. When glyphosate was compared to tank mixtures, hand-held and aerial imagery were only classified correctly 55% of the time. Therefore, multispectral remote sensing imagery has the potential to identify fields or portions of fields stressed by herbicides, at times even when visible injury was not present.

VALIDATION OF MSU-HADSS COTTON WEED CONTROLS IN MISSISSIPPI. W.F. Bloodworth, A. Rankins, Jr., and D.B. Reynolds. Mississippi State University, Mississippi State, MS.

ABSTRACT

Weed control continues to be an integral part of cotton production. The introduction of computerized decision aides may allow growers, consultants, and pesticide applicators to make more accurate weed control recommendations. These applications are designed to help the user select the most efficacious and most economical product available. Herbicide Application Decision Support System (HADSS), developed by North Carolina State University, is one such product. HADSS selects the best treatments on a cost to benefit basis, which can be very economical and environmentally beneficial to the producer.

Successful validation has been completed in Mississippi for use in soybean. The purpose of this study was to modify and validate the accuracy of postemergent recommendations by HADSS in cotton production. Herbicide ratings and crop competitiveness have been taken from data collected from university trials. These data were manipulated by WeedEd, a database editor, to enable HADSS to predict the most beneficial treatment.

Studies were conducted in 1999 and 2000 at four locations across Mississippi. Treatments were arranged as a split-split-plot in a randomized complete block design with four replications. Main plots were comprised of Roundup Ready, BXN and a conventional cotton variety, sub-plots were no-preemergence or Cotoran 1.25 lbs ai/A PRE and sub-sub-plots consisted of an early postemergence (early-POST) HADSS recommendation, a mid-postemergence (mid-post) HADSS recommendation, a weedy check, and a weed free check. These treatments were evaluated for efficacy, crop safety, and yield. Treatments included: 1) prowl at 1 lb ai/A plus cotoran at 1.25 lb ai/A followed by (fb) an early season postemergence HADSS recommendation (PRE fb early POST (HADSS)); 2) prowl at 1 lb ai/A plus cotoran at 1.25 lb ai/A followed by (fb) a mid-season postemergence HADSS recommendation (PRE fb mid-POST (HADSS)); 3) early postemergence HADSS recommendation (early- POST) only; 4) mid- postemergence HADSS recommendation (mid- POST) only; weed free and untreated check for both PRE and POST only treatments. Weed populations were quantified, recommendations were generated by HADSS and treatments were applied at the 2-4 and 6-8 leaf stages.

HADSS recommendations containing preemergence treatments provided better than 90% control. Treatments void of a preemergence application gave at least 80% control except for a single recommendation in the BXN system. The yield from the weed free plots did not yield significantly more than the two herbicide recommendations. Thus these data indicate that yields were optimized when utilizing the HADSS recommendations. The use of this decision-aid should facilitate the use of the most efficacious and economical treatment in Roundup Ready, BXN, and conventional cotton varieties.

THE EFFECT OF CGA-362622 ON GRAMINICIDE EFFICACY. D.G. Wilson, Jr., D.B. Reynolds, J.C. Sanders, and E.L. Sanders. Mississippi State University, Mississippi State, MS

ABSTRACT

Experiments were conducted at the Plant Science Research Center, Starkville, MS, to evaluate johnsongrass control with tank mixtures and sequential applications of 2.15 g ai/A CGA-362622 with 0.069 lbs ai/A Assure (quizalofop-P), 0.188 lbs ai/A Fusilade (fluazifop-P), and 0.125 lbs ai/A Select (clethodim). Treatments were arranged as a two factor factorial in a randomized complete block design. Factor A consisted of application timings of CGA-362622 7, 3, and 1 day before and after application of each graminicide. At day 0 (when the graminicide was applied) CGA-362622 was also tankmixed with each graminicide. Additionally, each graminicide was applied alone for comparison with the sequential and tankmixture applications. Factor B consisted of graminicides, all of which were applied at day 0 to minimize differences in control due to johnsongrass size.

Johnsongrass control 28 days after treatment (DAT), with all graminicides, was reduced (14 - 54%) when tankmixed with CGA 362622. Tank mixtures with Select resulted in 54% antagonism 28 DAT, which was greater than with any other graminicide. Johnsongrass control was reduced more when CGA-362622 was applied 1 or 3 days prior to Assure or Fusilade than when applied 1 or 3 days after. Johnsongrass control was generally affected the same by CGA-362622 applied before or after applications of Select. Based upon these preliminary data it would appear that CGA-362622 should not be tankmixed with a graminicide. It also appears that less antagonism occurs when the graminicide is applied first than when applied sequentially with CGA-362622. Overall it would appear that at least a 3 day interval should be allowed following graminicide application before application of CGA-362622. If CGA-362622 is applied first then at least a 7 day interval before application of graminicides is needed to reduce chances of antagonism.

EFFECT OF CARRIER VOLUME ON CROP RESPONSE TO SIMULATED DRIFT OF GLYPHOSATE AND GLUFOSINATE. J.M. Ellis, J.L. Griffin, C.A. Jones, and E.P. Webster, Louisiana State University Ag Center, Baton Rouge, LA 70803, and J.L. Godley, R & D Research, Inc., Washington, LA 70589.

ABSTRACT

Field experiments were conducted at the Ben Hur Research Farm near Baton Rouge, LA, and the R & D Research Farm near Washington, LA, to evaluate corn and soybean response to simulated drift of glyphosate (Roundup Ultra) and glufosinate (Liberty). Past research investigating simulated drift has evaluated a series of herbicide rates using a constant carrier volume. However, this is not what occurs in a field situation. Consequently, crop response to simulated drift rates was compared using both constant carrier volume and carrier volumes varied proportionally to the herbicide rates. The experimental design was a randomized complete block with a three-factor factorial treatment arrangement with four replications. The first and second factors were herbicide and herbicide drift rate. Drift rates represented 1/8 and 1/16 of the use rates of 1.0 lb ai/A glyphosate and 0.38 lb ai/A glufosinate. The third factor was carrier volume. Simulated drift rates for each herbicide were applied in constant carrier volume of 25

gallons/A and in variable carrier volumes of 3.1 gallons/A for the 1/8 rate and 1.6 gallons/A for the 1/16. Herbicide treatments were applied using a tractor mounted compressed air sprayer with a spray pressure of 27 psi. A TurboTeejet® 110005 nozzle was used for all treatments and tractor speed was adjusted to obtain the desired carrier volumes. Tractor speed was 0.6 mph for the constant carrier volume and 5 and 10 mph for the 3.1 and 1.6 gallons/A proportional carrier volumes, respectively. Treatments were applied to 6 lf 'Dekalb 687' corn and 2 to 3 trifoliate 'DPL 3588' soybeans. Data collected included crop injury and height 7, 14, and 28 days after treatment (DAT) and crop yield. Data were subjected to analysis of variance to test for significance of main effects for each factor and interactions and means separated using Fisher's protected Least Significant Difference (LSD) at the 5% level of probability.

Differences in corn injury and height, and yield reductions were not herbicide dependent, therefore data were averaged across herbicides. At 7 DAT, corn height was reduced more when the 1/8 rate was applied in proportional carrier volume (29%) compared to constant carrier volume (23%). The 1/16 rate did not reduce corn height when applied in either constant or proportional carrier volume. Corn injury 7 DAT increased from 32 to 45% for the 1/8 rate and 18 to 36% for the 1/16 rate when the carrier volume was adjusted proportionally with the herbicide drift rate. Corn height 28 DAT was reduced 18% when the 1/8 rate was applied in constant carrier volume and 42% when applied in proportional carrier volume. Corn height was reduced only 10% when the 1/16 rate was applied in constant carrier volume, but reduced 38% when applied in proportional carrier volume. Corn injury was 33% when 1/8 of the use rate was applied in constant carrier volume and increased to 46% when applied in proportional carrier volume. Corn injury for the 1/16 rate doubled (18 to 37%) when the carrier volume was adjusted proportionally to the herbicide drift rate. For the 1/8 and 1/16 rates, corn yield reduction was 1.6 and 1.8 times greater for the proportional spray volume compared to the constant spray volume.

Unlike corn, differences in soybean response were not affected by carrier volume, but could be attributed to the herbicides. Soybean height averaged across carrier volumes was reduced by the 0.125 rate of glyphosate 23, 20, and 16% at 7, 14, and 28 DAT, respectively. Neither of the simulated drift rates of glufosinate and the 0.063 rate of glyphosate reduced soybean height at the three evaluation dates. The 1/8 and 1/16 rates of glyphosate injured soybeans 31 and 19%, 7 DAT. Glufosinate applied at the 1/8 and 1/16 rates injured soybeans 26 and 16%, respectively. By 28 DAT, the 1/8 and 1/16 rates of glyphosate injured soybeans 13 and 7%. Only the 1/8 rate of glufosinate resulted in soybean injury (3%). Soybean recovery from herbicide injury was rapid and yield was not affected.

In conclusion, corn was much more sensitive than soybeans to carrier volume for the simulated drift rates of glyphosate and glufosinate. Results indicate that simulated drift research where carrier volume is maintained constant over a rate range may underestimate the negative effect on sensitive crops.

DETECTION, CLASSIFICATION, AND QUANTIFICATION OF HERBICIDE DRIFT UTILIZING SPECTRAL SIGNATURES. K.M. Bloodworth, L.M. Bruce, C.D. Rowland, and D.B. Reynolds. Mississippi State University, Mississippi State, MS.

ABSTRACT

The increased use of non-selective herbicides in transgenic cotton has led to increased herbicide drift onto non-transgenic cotton. Increased interest in the use of remote sensing in agriculture as heightened interest in the potential for the detection and quantification of herbicide drift using hyperspectral imagery. These images have the potential to provide not only evidence of drift events but may also quantify degree of injury and potential yield reductions. In previous research, plant height was found to be a leading indicator of herbicide injury and yield reduction where no visual injury was observed. The use of hyperspectral imagery for assessing large areas for herbicide drift may be useful in discerning small differences that are not discernable by visual inspection.

Research was conducted in 2000 to evaluate the potential use of data obtained from hand held spectroradiometers in detection of drift as compared to visual injury ratings and reduced cotton yields. The experimental design was a randomized complete block with a two factor factorial arrangement of treatments. Factor A was Roundup Ultra (glyphosate) applied at rates of 0.375, 0.187, 0.093, 0.046, and 0.023 lbs ai/A. Factor B consisted of application timings at cotyledon, pinhead square, and first bloom. Visual injury ratings were taken on seven day intervals after treatments were applied. Spectroradiometer data were taken on fourteen day intervals using a FieldSpec Pro. Data were analyzed using the Proc Discrim feature in SAS with cross validation (leave one out testing) and resubstitution options. This procedure was used to classify each treatment by spray and no-spray, application timing, and high and low rates based on spectral data.

The cotton displayed no visual injury at any rating interval. When spectroradiometer data were analyzed, treatments were classified by injury correctly 65-66% of the time even when no visual injury was observed. When classified according to timing, the untreated could be distinguished from the cotyledon and square treatments 81% of the time. These preliminary data indicate that hyperspectral data may be useful in detection and quantification of drift injury in nontransgenic cotton.

PLANTING METHODS TO AVOID HERBICIDE CARRYOVER INJURY ON GRAIN SORGHUM. K.A. Hollon and T.F. Peeper. Oklahoma State University, Stillwater, Oklahoma.

ABSTRACT

The objective of this study was to determine whether planting methods affect Maverick herbicide carryover injury to grain sorghum. Experimental design was a 2x2x3 factorial arrangement of treatments with the following factors: A = planting method, B = treatment, C = depth. The planting methods were rotary trash whips or conservation furrowers in front of the double disk openers on a John Deere Max Emerge no-till planter with 30-inch row spacing. The treatments were Maverick or no treatment. Depth was three separate settings for both the rotary trash whips (0, 0.25, and 0.5 inches) and the conservation furrowers (0, 1.5, and 3.0 inches). Maverick was applied to treated plots the second week of January 2000 at three locations (Perry, Lahoma, and Chickasha, Oklahoma). Maverick rate was 0.031 lbs ai/acre. Wheat growth stage at application was 1 to 6 tiller. During February 2000 all plots were fertilized for a yield goal of 40 bushels/acre. In April 2000 all plots were sprayed with 1.5 lbs ai/acre Roundup Ultra to simulate crop failure, reduce residue at planting, and conserve moisture. Between April 25 and May 15, 2000 all plots (2 rows x 25 feet) were seeded with 54000 seeds/acre of DK-36 grain sorghum. After seeding all plots were sprayed with 1.5 lbs ai/acre Roundup Ultra and 0.71 lbs ai/acre Dual II Magnum. All plots received 200 lbs/acre 46-0-0 at planting. Sorghum plant density/acre and plant height was measured in June 2000 approximately 2 weeks after emergence. Sorghum plant height and head density/acre was measured in July 2000. The Perry and Lahoma locations were harvested August 22 and 23, 2000 with a small plot combine. All samples were cleaned with a small industrial seed cleaner using a 12/64-inch top screen and a 1/20-inch bottom screen then weighed. Test weight and moisture percentage was determined for each sample. All yields were adjusted to 13.5% moisture content. All plots at Chickasha were hand harvested by clipping all sorghum heads from each plot and weighing. This was done due to extreme bird feeding damage at this site. Results showed the rotary trash whips at all depths to be an ineffective means of eliminating Maverick herbicide carryover injury to grain sorghum. Grain sorghum plant density was significantly lower in Maverick-treated plots than in untreated plots. Yield increased in Maverick-treated plots as conservation furrower depth increased.

INTERACTION OF ALS INHIBITING HERBICIDES WITH ULV APPLICATIONS OF MALATHION. W.F. Bloodworth, K.M. Bloodworth, and D.B. Reynolds. Mississippi State University, Mississippi State, MS.

ABSTRACT

As a selective postemergence over the top (POST) herbicide labeled in cotton, pyrithiobac {2-chloro-6-[4,6-dimethoxy-2-pyrimidinyl)thio]benzoic acid} controls several problematic weeds including pitted morningglory (*Ipomoea lacunosa* L.), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula* Gray), common cocklebur (*Xanthium strumarium* L.), velvetleaf (*Abutilon theophrasti* Medik.), and hemp sesbania (*Sesbania exaltata* (Raf.) Rydb. Ex A.W. Hill). Pyrithiobac is applied as an early POST treatment which coincides with the application of many insecticides. One of these insecticides is malathion {O,O-dimethyl s-(1,2-dicarbethoxyethyl) phosphorodithioate}, which is the current insecticide of choice for the boll weevil (*Anthonomus grandis* Boheman) eradication program. These classes of pesticides can induce beneficial or detrimental interactions when used in combination with herbicides. CGA-362622 is a broad spectrum ALS inhibiting herbicide with the proposed common name of trifloxysulfuron sodium. Previous research with CGA-362622 has shown similar effects as pyrithiobac in postemergence applications. It is suspected that the presence of malathion in cotton plants affects the ability of the plant to metabolize the active parent herbicide molecule into inactive metabolites.

There has been concern over these interactions in certain areas of Mississippi and other states currently involved in boll weevil eradication programs because of the uncertainty of when malathion applications will be made relative to pyrithiobac and potential CGA-362622 applications on various production areas. Producers using pyrithiobac and CGA-362622 based weed control programs in boll weevil eradication areas have no way of knowing when malathion applications will be made or whether an interaction may occur. Producers need to know the essential time interval between insecticide and herbicide applications to ensure crop safety. Research has shown there to be a detrimental interaction between applications of malathion and these herbicides when applied to cotton. Previous research has shown significant visual injury, but this injury has had little effect on fruiting or yield. In these studies, malathion was applied in high volume applications and also as a tank mix with pyrithiobac. Further laboratory research has shown increased injury when pyrithiobac and malathion are applied in cool conditions. Therefore, the objectives of this research were to determine the interaction of applications of pyrithiobac and CGA-362622 made at various time intervals before and after ultra low volume (ULV) malathion applications under field conditions. Research was conducted in 1999 and 2000 at the Plant Science Research Center near Starkville, MS, and the Black Belt Branch Experiment Station near Brooksville, MS, to evaluate ULV applications of malathion with pyrithiobac and CGA-362622. Aerial malathion applications were made by the Southeastern Boll Weevil Eradication Foundation at 0.76 lbs ai/A. Applications of 1.0 oz ai/A pyrithiobac and 0.076 oz ai/A CGA-362622 were made with a CO_2 backpack sprayer delivering 15 gallons per acre. Treatments consisted of topical applications of pyrithiobac and CGA-362622 at 24, 8, 4, 2, 1, 0.5 h before or 0.5, 1, 2, 4, 8, and 24 h after the malathion application. The pyrithiobac and CGA-362622 treatment was applied within 5 minutes of the malathion treatment at the 0-h time interval.

Data included visual injury (0-100 scale), nodes above white flower (NAWF), nodes above cracked boll (NACB), and yield in the pyrithiobac experiment. In the CGA-362622 experiment, data included visual injury (0-100 scale) and yield. No visual injury was observed at 7, 14, or 28 DAT rating intervals. NAWF, NACB, and yield exhibited no significant difference between treatments. The results of these preliminary studies indicate that there is no detrimental effect of ULV malathion applications made to cotton when pyrithiobac and CGA-362622 have been applied. The reason these results differ from previous research may be due to using an ultra low application volume rather than standard (e.g. 15 GPA) application volumes of malathion, and no tank true tank-mixture. Also, lower injury may be the result of applications being made under warmer field conditions. These data indicate that ULV malathion applications applied at the rates used by the BWEP in Mississippi do not adversely interact with pyrithiobac or CGA-362622 applications.