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Residues of Selected Insecticides Recommended for Greenbug Control under Oklahoma Climatic Conditions in 1994

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Introduction:

During the months of January and February 1994, the Oklahoma Animal Disease Diagnostic Laboratory investigated 27 cases of illness in cattle grazing wheat pasture in Western Oklahoma These cases all involved wheat pasture sprayed with dimethoate in late December 1993 or January 1994 for greenbug control The average herd size was 124 and ranged from 10 to 1,000 head The average percent of cattle showing clinical signs were 26 percent and the death loss was less than 1 percent (personal communications with W C Edwards, OADDL Director July, 1994)

The case histories suggest in all but two instances, the 14-day grazing restriction was not observed The cattle were primarily stockers that first exhibited clinical signs after grazing the sprayed wheat for four to 10 days The clinical signs were ataxia, incoordination, rear limb stiffness and reluctance to move Many cattle became gaunt and collapsed Calcium and magnesium levels for sick animals were in the normal range Typically calcium levels range between 9 7 - 12 4 mg/dl and magnesium levels range between 1 8 - 2 3 mg/dl for healthy livestock (Howard, 1993) Some of the animals that were necropsied had heavy edematous lungs but no other gross or histopathologic lesions

The cholinesterase activity of the blood ranged from 0 003 to 0 240 pH units/hour with an average of 0 06 pH units/hour on affected cattle tested from the 27 herds The control blood for the laboratory study averaged 0 93 pH units/hour

Seven wheat samples collected on February 7 were analyzed by GC-mass spectrophotometry and were found to contain 1 42 to 16 47 ppm dimethoate with an average of 8 75 ppm dimethoate on a wet basis Established tolerances for total residues of dimethoate in wheat are 2ppm for green fodder and wheat straw (40 CFR 1, 7-1-93 Edition)

Insecticide Residue Briefs

- Residue levels decreased with time
- Residue levels varied between locations
- No residues exceeded legal tolerances at the Kiowa County site
-Residues of three of the four insecticides exceeded legal tolerance after grazing restriction expired at the Blaine County site

Cattle were removed from the sprayed wheat and fed supplementally Response to atropine was erratic but generally considered beneficial Several studies were initiated to monitor cholinesterase activity in livestock and dimethoate levels in the wheat to determine when the cattle could be put back on the wheat There were several instances where the cattle appeared normal within one to two weeks and were turned out on the wheat pasture only to relapse in four to five days

There were several unique circumstances that contributed to this residue problem In prior years the primary organophosphate insecticides used for

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greenbugs were ethyl or methyl parathion and while it had a 15-day grazing restriction, ranchers were generally aware that they could safely graze the wheat before the grazing restriction expired without adverse effects Further EPA restrictions on parathion and rising production costs allowed other insecticides to capture a larger portion of the greenbug market Dimethoate is annually used in Oklahoma to control greenbugs, but not to the extent as used during the winter of 1993-94 Wheat producers and ranchers presumed that dimethoate had a similar mode of action as parathion since both insecticides are organic phosphates However dimethoate shows contact, residual, and systemic activity where parathion has primarily contact activity The systemic activity of dimethoate is not considered significant when applied to actively growing wheat because biodegradation occurs However under unfavorable growing conditions (drought and low temperatures) the biodegradation processes slow, increasing the chance of higher residue levels persisting in the plant

The fall and winter of 1993 were extremely dry and in many instances, spotty and scant plant stands resulted Limited moisture from November to March restricted plant growth and development causing sparse forage for grazing Dormant, drought stressed wheat plants had little potential to take up the dimethoate and biodegrade it The sparse wheat and reduced biomass required the cattle to graze a much larger surface area to achieve a fill This increased the chances of consuming sufficient residues to cause poisoning

As livestock toxicity surfaced, immediate concerns were grazing restrictions and the rate that dimethoate was applied Most of the producers indicated grazing restrictions were followed or cattle were removed for seven to 10 days Producers also reported using the highest labeled rate to insure controlled greenbugs on drought-stressed wheat At this point, a news release was developed outlining steps to reduce the chance of further poisoning Switching to non-systemic organophosphate insecticides (malathion, methyl parathion and Lorsban) and using low labeled rates were stressed

Limited information is available on insecticide residues on drought-stressed wheat. This test was initiated to develop baseline information concerning insecticide residues in drought-stressed wheat and to determine if insecticide residue levels exceeded the legal tolerance allowed after the grazing restriction elapsed.

Methods and Materials:

Wheat fields in two locations (Kiowa County and Blaine County) in west central Oklahoma were chosen as sites for these insecticide residue tests Fields were selected that were approximately the same age and growth, ungrazed, and unsprayed Plants in both fields were in the tiller stage with 3 to 6 inches of growth Insecticide treatments included malathion 1 0 lb AI/acre, dimethoate 0 15 lb AI/acre, Lorsban 0 5 lb AI/acre, ethyl parathion 0 5 lb AI/acre and a Check - no insecticide These rates are lower than rates normally used by producers and applicators across the state to control greenbugs Plot size was 15 ft x 100 ft, and arranged in a randomized complete block design with three replications.

Treatments were applied using ground equipment calibrated to deliver 10 gallons finished spray per acre using nozzles 8002, 20 psi, at 3 5 mph Temperatures on the day plots were sprayed (January 25, 1994) ranged from 36°F to 48 5°F, and wind speed varied between 4 8 mph and 8 7 mph

Greenbug numbers per linear foot, and wheat cuttings were taken 9, 14, and
21 days after treatment (DAT) Wheat samples were taken from the middle of each plot minimize spray contamination

Approximately 2 quarts of plant material were collected and placed in a labeled plastic bag and stored in an ice chest for transport to the Oklahoma Animal Disease Diagnostic Lab Forage samples were analyzed by GC-Mass spectroscopy using the California EPA extraction method

Results and Conclusions:

Treatment thresholds vary with the size of the plant and conditions. Insecticidal control is justified when greenbug numbers approach 125 to 300 aphids per row foot for plants averaging 3 to 6 inches tall Greenbug numbers remained below the economic threshold throughout the sampling period at both locations (Table 1)

Table 1. Greenbug populations at two locations in west central Oklahoma in 1994.

	Greenbugs per linear row foot					
	Kiowa County			Blaine County		
Treatment[1]	9DAT[2]	14DAT	21DAT	9DAT	14DAT	21DAT
Malathion	4 4	5 4	15 4	4.2	11 5	24.7
Ethyl parathion	1 1	3 0	10 0	3 0	5 3	13 7
Lorsban	2 1	3 5	8 0	6 4	13.1	20 0
Dimethoate	2.4	3 9	5 8	6 0	6 7	13 0
Check	7 8	16 2	25 9	9 7	20 0	24 3

[1]Plots sprayed January 25, 1994

[2]DAT= days after treatment.

Insecticide residues in the wheat clippings declined over time at both locations (Table 2)

Table 2. Insecticide residues (ppm) levels in wheat in two locations in west central Oklahoma in Spring, 1994.

		Average Residue (ppm) Treatment					
	Legal[1]	8DAT		14DAT		21DAT	
Treatment	Tolerance ppm	Kiowa	Blaine	Kiowa	Blaine	Kiowa	Blaine
Malathion	8	7 23	40.04[2]	2 34	26 44	0 13	3.96
Ethyl Para.	1	0 10	0 37	0 06	0 13	0.12	0 06
Lorsban	3	12.74	4.53	1 09	12.18	0 15	4.68
Dimethoate	2	0 90	7 70	1 88	4.37	0.43	0.72

No residue found in check

[1]Legal tolerance for insecticides in wheat forage

[2]Above legal tolerance: After labeled grazing restrictions, Malathion - 7 days, Ethyl Parathion - 15 days, Lorsban - 15 days, and Dimethoate - 14 days

Higher residue levels occurred at the Blaine County field than the Kiowa County field except for the ethyl parathion 0 5 lb AI/acre 21DAT 0 12 ppm and 0 06 ppm

Since both plots were treated identically, it is surprising to see differences in residues between Kiowa County and Blaine County fields. At the Kiowa County field, all insecticide residuals were below the legal tolerance after the grazing restriction had expired However only ethyl parathion was below its legal tolerance at the Blaine County field

Drought conditions persisted throughout the sampling (Table 3)

Table 3. Rainfall amounts at two locations in west central OK between January 25, and February 15, 1994

	Precipitation Amounts (inches)	
Weekly Totals	Kiowa County	Blaine County
1/25-1/31	0 15	0 28
2/1-2/8	0 03	0 01
2/9-2/15	0 00	0 00
Total	**0.18**	**0.29**

Blaine County received the most precipitation, but was not enough to allow the wheat to overcome the effects of the prolonged drought Livestock poisoning was a possibility at the Blaine County field regardless if the grazing restriction was followed

Applying higher rates to insure adequate greenbug c when wheat is drought-stressed may enhance the chance livestock toxicity Higher residue levels are likely as the insecticide rate increases, especially with systemic insecticides like dimethoate The average field rate for dimethoate applied in 1993 ranged between 0 33 lb/acre and 0 5 lb/acre which is 2 22 times and 3.33 times the amount applied in this test

Steps to reduce the chance of excessive insecticide residues in drought stressed wheat include
- spray only when greenbugs exceed the economic threshold
-calibrate spray equipment to insure that the proper insecticide rate is applied
- apply a non-systemic insecticide
- apply the lowest labeled rates to obtain adequate control
-obey grazing restrictions

Literature Cited

Howard J L , 1993 Current Veterinary Therapy 3 Food Animal Practice. W B Saunders Company Philadelphia, PA pp 920

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