Panhandle Pest Update

Texas A&M AgriLife Extension

Dr. Ed Bynum, Extension Entomologist
Texas A&M AgriLife Extension Service, 6500 Amarillo Blvd., West
Amarillo, TX 79106
Ebynum@ag.tamu.edu, 806.677.5600 ext. 612

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Chlorpyrifos Resistant Greenbugs

This past week Monti Vandiver, IPM Extension agent for Bailey and Parmer counties, received calls from a couple of producers that each had treated a field with chlorpyrifos and did not get good control of the greenbugs. We discussed the situation and how to determine if the aphids were resistant. I suggested using a diagnostic resistant kit to assay the greenbugs. I had developed the technique back in the mid-1990's when we were having trouble with resistant greenbugs in grain sorghum (Bynum and Archer. 2000. Journal of Economic Entomology 93 (4): 1286-1292). I prepared a few kits for Monti and he tested greenbugs from one of the fields. The results from the test is shown in the following table. At the rates used to test for resistance, greenbugs would be considered susceptible to chlorpyrifos if mortality is ≥85%. If mortality is ≤ 40% then the greenbug population in the field can be considered resistant. The assay showed that greenbugs collected exhibit resistance to chlorpyrifos.

Diagnostic Assay for Resistance

Concentration	Alive	Dead	% Mortality
Check	**30**	**0**	**0**
30 ppm	**21**	**9**	**30.0**
100 ppm	**23**	**7**	**23.3**

I would suspect that if a field application was made correctly at the recommended rate of chlorpyrifos, 1 pt/ac, in 3 gal to 5 gal spray by air and greater than 5 gal by a ground rig the control should be very good, unless there are resistant aphids in the field. The question then is what can be done if you have control failures. Once a field has been treated and the control is ineffective, spraying the field again with the chlorpyrifos is unlikely to provide any better control. The list of registered products mainly belong to two insecticide classifications, organophosphate and pyrethroids. The primary organophosphate products are chlorpyrifos, dimethoate, malathion, methyl-parathion, and encapsulated methyl-parathion and the pyrethroid products are *gama*-cyhalothrin (Proaxis© and Declare©), *lambda*-cyhalothrin (Warrior w/ Zeon technology© and Karate w/ Zeon technology©), and *zeta*-cypermethrin (Mustang Max©). And, there are newer products with a mixture of chlorpyrifos with a pyrethroid. These are Cobalt© (chlorpyrifos + *gama*-cyhalothrin) and Stallion© (chlorpyrifos + *zeta*-cypermethrin). There have not been any recent trials with dimethoate, malathion, methyl-parathion, and encapsulated methyl-parathion in the Texas High Plains. The most recent trials have been with some of the other pyrethroids and newer formulations of Cobalt Advance© and Lorsban Advance© (See tables on page 3 & 4). However, these efficacy of these products in these trials were not against chlorpyrifos resistant greenbugs. Except for trials conducted from the early to mid-90s for greenbugs on grain sorghum, there is very little data on what will control field populations of chlorpyrifos resistant greenbugs. At that time laboratory studies showed that greenbugs collected from a field in Parmer County were resistant to carbofuran, chlorpyrifos, and malathion. Additional assays

with mixtures of a pyrethroid (esfenvalerate) or dimethoate or malathion plus chlorpyrifos showed the addition of the pyrethroid or malathion provided slight synergistic activity (improved mortality). But, dimethoate/chlorpyrifos mixture was antagonistic (less mortality) (Archer et al. 1994. Journal Economic Entomology 87(6): 1437-1440).

Another study was conducted from 1994 - 1996 to identify best mixtures of insecticides that were available at that time and how to use insecticide mixtures for resistant greenbugs (GB) after a failure of chlorpyrifos, or as the 1st application if resistant greenbugs are expected to be in the field (Archer et al. 1999. Journal Economic Entomology 92(4): 794-803). The insecticides used in this study were chlorpyrifos, carbofuran, and malathion. Since we do not have carbofuran now, the results from the chlorpyrifos/malathion mixtures may help us in managing our resistant greenbugs. The rates for the insecticides were chlorpyrifos (4E) at 1 pt/acre and malathion (5E) at 12.8 fl. oz/acre. In summary the findings showed:

- **Before any insecticide application**, but GBs were a mix of resistant and susceptible GBs
  - The mixture of chlorpyrifos/malathion gave good initial control (86%) but tapered off by 10 days after treatment and numbers were increasing again.
  - A second application of the mixture 11 days after the initial application provided good control of the remaining GBs (94% to 83%) for another 10 days.

- **After chlorpyrifos had already been applied**
  - The application of the chlorpyrifos/malathion mixture did not provide good control of the remaining GBs for 10 days after spraying
  - A second application of the mixture 11 days after the mixture application did provide good control (94% to 82%) for 10 days.

These data provide some evidence that chlorpyrifos/malathion mixtures may be used to improve control of fields if the greenbug infestation has some resistant greenbugs.

Unfortunately, there is no available information on how well the newer products, such as Cobalt and Stallion, will control resistant greenbugs and we do not have any good solutions when there is a control failure with chlorpyrifos. Our options are very limited, but we do know that applying multiple applications of chlorpyrifos will not control the resistant greenbugs.

Greenbug damaged spots from field with chlorpyrifos resistant greenbugs. Photos: Courtesy of Monti Vandiver.

Table 1. Mean number of greenbugs pre-treatment (Pre) and at 2, 7, and 10 days after treatment (DAT)-2009.

Treatment	Rate ai lb/ac	Mean no. GB from 4 linear ft. sections per plot[a] (% Control)[b]			
		Pre trt	2 DAT	7 DAT[c]	10 DAT
Declare® 1.25 CS	0.0075	39.7 a	5.3 ab (49.9)	4.7 ab (71.1)	1.0 a (71.8)
Declare® 1.25 CS	0.01	17.0 a	2.7 ab (41.5)	3.3 ab (51.8)	1.7 a (0.0)
Declare® 1.25 CS	0.0125	19.0 a	1.7 ab (67.3)	5.3 ab (30.9)	0.3 a (80.4)
Declare® 1.25 CS	0.015	25.7 a	1.7 ab (75.8)	4.7 ab (55.3)	0.3 a (85.5)
Declare® 1.25 CS	0.03	42.0 a	2.0 ab (82.3)	7.3 ab (57.0)	0.3 a (91.1)
Declare® 1.25 CS + Nufos® 4E	0.0125 0.75	20.3 a	1.0 b (81.7)	0.0 c (100)	0.0 a (100)
MustangMax®	0.0125	25.0 a	2.0 ab (70.2)	0.7 bc (93.4)	2.3 a (0.0)
Nufos® 4E	1.0	34.3 a	1.3 b (85.5)	0.0 c (100)	0.0 a (100)
Check		41.0 a	11.0 a -------	16.7 a -------	3.7 a -------

[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.10, SAS Institute 1993).

[b] Percent control determined from the formula by Henderson and Tilton (1955).

[c] Values were corrected using the formula Log(x + 1.0) prior to conducting ANOVA.

Table 2. Mean number of greenbugs at 1 day pre-treatment (Pre-trt) and at 4, 6, and 12 days after treatment (DAT). 2010.

Treatment	Rate / ac	Mean no. GB[ab] from three linear ft. drill row / plot (% Control[c])			
		Pre-trt[ab]	4 DAT	6 DAT	12 DAT
Check		148.83 a	91.67 a ------	103.42 a -------	94.00 a ------
Mustang Max	0.0125 lb ai	124.33 a	98.42 a (0.0)	69.58 b (19.5)	73.00 a (7.0)
Declare 1.25 CS	0.01 lb ai	88.58 a	14.08 b (74.2)	10.83 b (82.4)	3.08 b (94.5)
Declare 1.25 CS	0.0125 lb ai	102.83 a	8.67 b (86.3)	16.75 b (76.6)	4.08 b (93.7)
Declare 1.25 CS	0.015 lb ai	134.58 a	12.33 b (85.1)	4.67 bc (95.0)	1.83 b (97.8)
Declare 1.25 CS + Nufos 4E	0.01 lb ai + 0.375 lb ai	98.67 a	0.50 c (99.2)	0.50 cd (99.3)	0.42 b (99.3)
Cobalt[d]	13 fl oz	95.5 a	0.92 c (98.4)	0.00 d (100)	0.50 b (99.2)
Nufos 4E	0.5 lb ai	125.5 a	0.92 c (98.8)	0.33 cd (99.6)	3.00 b (96.2)
CV		18.5640	49.3181	55.3714	56.6755
Rep(Prob F)		0.1661	0.0006	0.0085	0.0008
Trt(Prob F)		0.6664	0.0001	0.0001	0.0001

[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.10, SAS Institute 2009).

[b] Values were corrected using the formula Log(x + 1.0) prior to conducting ANOVA.

[c] Percent control determined from the formula by Henderson and Tilton (1955).

[d] Cobalt application rate was equivalent to 0.25 lb ai/ac of chlorpyrifos and 0.0046 lb ai/ac of gamma-cyhalothrin.

Table 3. Mean number of greenbugs at 3 days pre-treatment (Pre-trt) and at 3, 7, and 11days after treatment (DAT) - 2011.

Treatment	Rate lb ai / ac	Mean no. GB[a] from two linear ft. drill row / plot (% Control[b]) Pre-trt	3 DAT	7 DAT	11 DAT
Declare	0.0125	32.0 a	1.0 b (93.5)	7.8 ab (56.9)	5.13 b (63.2)
Declare	0.015	50.9 a	4.3 ab (82.4)	7.5 ab (73.9)	0.75 b (96.6)
Declare + Nufos	0.01 + 0.188	36.5 a	2.3 b (86.9)	5.0 b (75.8)	0.5 b (96.9)
Transform	0.011	41.3 a	10.2 ab (48.5)	6.5 b (72.1)	1.5 b (91.6)
Transform	0. 016	36.3 a	9.8 ab (43.7)	6.1 b (70.2)	2.75 b (82.6)
Transform	0.022	34.9 a	3.67 b (78.1)	4.1 b (79.2)	0.63 b (95.9)
Transform	0.033	42.6 a	6.3 ab (69.2)	3.6 b (85.1)	0.5 b (97.3)
Lorsban Advance	0.25	32.0 a	1.0 b (93.5)	0.8 b (95.6)	1.13 b (91.9)
Warrior II	0. 031	63.0 a	2.8 b (90.7)	0.4 b (98.9)	2.5 b (90.9)
Untreated		28.1 a	13.5 a --------	15.9 a --------	12.25 a --------
CV		62.0734	88.3204	101.6040	124.4492
Rep(Prob F)		0.4023	0.0167	0.2484	0.2456
Trt(Prob F)		0.1949	0.0002	<0.0001	<0.0001

[a]Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).
[b] Percent control determined from the formula by Henderson and Tilton (1955).

Table 4. Mean number of greenbugs at 1days pre-treatment (Pre-trt) and at 4, 8, and 11days after treatment (DAT) - 2012.

Treatment	Rate fl oz/ ac	Mean no. GB[a] from three linear ft. drill row / plot (% Control[b]) Pre-trt	4 DAT	8 DAT	11 DAT
Cobalt Advanced	6	81.8 a	0.5 a (99.4)	0.2 a (99.5)	0.0 b (100)
Cobalt Advanced	8	82.9 a	0.1 a (99.9)	0.0 a (100)	0.0 b (100)
Lorsban Advanced	12	83.3 a	1.0 a (98.8)	0.7 a (98.1)	0.2 b (97.2)
Untreated	-	76.8 a	79.0 a --------	34.5 a --------	6.6 a --------
CV		24.9502	136.0726	141.2198	87.3018
Rep(Prob F)		0.0649	0.4487	0.4199	0.3787
Trt(Prob F)		0.9644	0.0061	0.0080	0.0038

[a] Means in a column followed by the same letter are not significantly different according to Tukey's studentized range test (P=0.05, SAS Institute 2009).
[b] Percent control determined from the formula by Henderson and Tilton (1955).