AERIAL APPLICATION OF FIPRONIL (REGENT®) VS. MALATHION IN A REPLICATED FIELD TEST FOR BOLL WEEVIL

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Abstract

Fipronil (Regent® insecticide) was shown in a replicated field trial using ULV aerial application methods to be superior to malathion for boll weevil control as measured by leaf-disk bioassay and field observations. Such superiority was exhibited by higher weevil mortality and longer residual control in the bioassay and fewer boll weevil punctures in the field. Also, malathion caused a resurgence of aphids to a point where an aphicide application was necessary to prevent sticky cotton, while fipronil caused a decrease in aphid populations. There was little difference in beneficial populations between the two treatments, but this and other tests have shown that *Orius sp.* are relatively unharmed by fipronil.

Fipronil would seem to be an ideal alternative for use in the boll weevil eradication program, providing superior mortality of the target insect while preserving natural enemies. The additional benefits with aphid suppression warrant a close look at this material for such usage.

Introduction

The cotton boll weevil is or has been a serious pest of cotton in most of the growing areas across the cotton belt. Eradication efforts have been ongoing for several years with spectacular results in some regions, but with many problems evident in other regions. The basic problem with the eradication efforts has been that malathion, the insecticide of choice for many reasons, can severely deplete the normal complement of natural enemies (England et. al.. 1997) and cause a resurgence of secondary pests such as aphids.

This experiment was done to determine the efficacy of fipronil (Regent® insecticide), a member of a new family of insecticides called phenyl pyrazoles (Colliot et al. 1992). This material has been tested for several years as both EC and WP formulations with excellent results against boll weevil with minimal effect on natural enemies (Burris et al. 1994, Martinez-Carrillo and Pacheco-Covarrubias, 1997, Shaw and Yang. 1996, Sparks, et al.. 1997, and Spurgeon, et al., 1997). This is the first test with this material using ultra low volume aerial application over a large area allowed under an Experimental Use Permit.

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Materials and Methods

The experiment was conducted in two fields farmed by Carl Gulker of Colorado City, Texas, planted with HS-200 cotton on May 22-23, 1997. A randomized block design was used to evaluate three replications of three treatments. Each replication consisted of approximately 10 acres being 210 ft wide by about 1500 ft long with a 50 foot buffer in-between plots to minimize possible drift contamination. Two replications were placed in one field and one replication in the other field. Treatments evaluated were an untreated check, malathion (97% ai) and fipronil 2.5EC at 0.05 lbs ai/a applied in cotton seed oil. Insecticides were applied by a single aircraft in 70ft swaths calibrated to deliver 12 ozs/acre total volume. Applications were made on the mornings of August 8, 14, 21, and 29, 1997 on a scheduled timing agreeing with the procedures used by the Texas Boll Weevil Eradication Foundation.

Boll weevil efficacy of the treatments was determined by leaf bioassay and punctured fruiting counts. 100 squares were collected per replication 2-3 times after each application (2-3, 4-5 and 6-7 days after treatment) and examined for feeding or ovipositional punctures. Small bolls were also included in the 100 count fruit sample as the plants reached cutout by the last application.

Leaf bioassays of the treatments consisted of placing three leaves in prelabeled petri dishes (1.5 x 90 cm) and later introducing five laboratory reared adult boll weevils, assessing mortality at 24, 48 and 72 hours. Leaves were clipped from plants in an established line perpendicular to the application swath in the middle of the plot and were collected at 0, 2, 4 and 6 days after application. At 0 day, petiole leaves were taken and nodal position marked so treated leaves were always collected on subsequent samples. Weevils were obtained from the Gast Rearing Facility at Mississippi State University with weekly shipments coinciding with application dates. Ten dishes per plot per evaluation date were used and maintained at room temperature. Another untreated area was established outside the plots in an adjacent field where leaves for the bioassay could be collected for a control without having any potential for insecticide contamination. From this area an equal number of leaves were collected at the same intervals as the replicated checks from within the plot design.

Observations were also made of aphid numbers by picking 100 leaves per plot and determining percent infestation. Actual numbers were determined by counting aphids on 10 leaves per plot. At the time of assessing square and/or boll damage, 50 sweeps were made in each plot and the identity and number of beneficial species were determined.

Data for damaged fruit and aphids were submitted to ANOVA and GLM was obtained using SAS Procedures. Bioassay data were submitted to Abbott's Formula (1925) for percentage mortality within the petri-dishes.

Results and Discussion

Results of the experiment are presented in the tables and graphs. Fipronil was shown to be highly effective in the leaf bioassay studies, providing good initial knockdown as well as residual control of boll weevil adults (Table 1-5). Mortality was consistently greater with fipronil than malathion at the 24 hour evaluation. Residual control at 6 days after application was also consistently greater with fipronil than malathion, especially at evaluation intervals of < than 72 hours (Tables 1-3).

Field samples of cotton fruit revealed that both feeding and ovipositional damage from weevils was minor until after the third insecticide application (Graphs 1 and 2). Thereafter migratory weevil populations caused significant damage. Feeding and ovipositional damage was comparable between fipronil and malathion, but both insecticides had significantly less damage that the untreated check late in the season.

Insecticidal impact on secondary pests varied between treatments. Malathion flared aphids while aphid populations in the fipronil plots remained constant (Graph 3). Both the presence and number of aphids were significantly greater in the malathion plots than the fipronil or check plots. The amount of honey dew increased to the point that the farmer felt it was necessary to apply an aphicide on the malathion treated plots 8 days after the last malathion application to prevent sticky cotton and possible crop loss. The lack of aphid flaring by fipronil isn't surprising as nonflaring action or even control has been previously observed in replicated small plot trials (Reed and Christian unpublished data). From the sweep net samples, *lygus sp.* counts were consistently less in the insecticide treatments than the check (Graph 4) showing both products provided comparable incidental control. However, only fipronil reduced stink bug numbers over the check, while malathion appeared not to have any stink bug activity at all (Graph 4). Worms were never a problem during the trial.

Beneficial arthropod numbers sampled during the test are presented in Tables 6 and 7 which indicate that there was little difference between numbers captured in the fipronil and malathion plots. Fipronil was extremely easy on lady beetles and softer on *Orius* than malathion., but harder on big eyed bugs and spiders. There were significantly higher numbers of assassin bugs and nabids in the check plots.

Results of this experiment show that Regent would be an ideal choice for use in the boll weevil eradication program since it shows superior mortality to weevils, while suppressing aphids, *lygus sp.* and stink bugs and having minimal impact on beneficial insects.

Acknowledgments

Grateful appreciation is expressed to Carl Gulker for his willingness to participate in innovative research and Debbie Miller for her dedication to excellence with leaf bioassay procedures. Finally, last but not least, George Holy of Kidd Crop Dusting for his invaluable flying services.

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Table 1. Mean percent daily adult boll weevil mortality after the first application at 0, 2, 4 and 6 days after treatment with leaf bioassay.

	% Boll Weevil Mortality (DAT*)							
	24 Hour Evaluation**				48 Hour Evaluation			
	0	2	4	6	0	2	4	6
Regent	91	56	71	73	100	70	99	95
Malathion	70	65	10	7	85	67	29	37
Untreated	.	.	0	2	.	.	0	6

*DAT = Days after treatment (0, 2, 4 & 6) when leaves were collected and adult weevils introduced.
**First evaluation of weevil mortality after leaf collection.

Table 1. Cont.

	% Boll Weevil Mortality (DAT)			
	72 Hour Evaluation			
	0	2	4	6
Regent	100	76	99	99
Malathion	93	70	29	44
Untreated	.	.	8	12

Table 2. Mean percent daily adult boll weevil mortality after the first application at 0, 2, 4 and 6 days after treatment with leaf bioassay.

	% Boll Weevil Mortality (DAT*)							
	24 Hour Evaluation**				48 Hour Evaluation			
	0	2	4	6	0	2	4	6
Regent	98	94	91	94	100	100	97	100
Malathion	99	100	68	29	100	100	89	48
Untreated	1	0	1	2	2	1	3	3

*DAT = Days after treatment (0, 2, 4 & 6) when leaves were collected and adult weevils introduced.
**First evaluation of weevil mortality after leaf collection.

Table 2. Cont.

	% Boll Weevil Mortality (DAT)			
	72 Hour Evaluation			
	0	2	4	6
Regent	100	100	100	1 0 0
Malathion	100	100	96	61
Untreated	3	7	7	4

Table 3. Mean percent daily adult boll weevil mortality after the first application at 0, 2, 4 and 6 days after treatment with leaf bioassay.

	% Boll Weevil Mortality (DAT*)							
	24 Hour Evaluation**				48 Hour Evaluation			
	0	2	4	6	0	2	4	6
Regent	97	97	71	71	99	92	95	95
Malathion	79	67	43	49	96	81	56	79
Untreated	1	0	3	0	3	1	11	3

*DAT = Days after treatment (0, 2, 4 & 6) when leaves were collected and adult weevils introduced.
**First evaluation of weevil mortality after leaf collection.

Table 3. Cont.

	% Boll Weevil Mortality (DAT)			
	72 Hour Evaluation			
	0	2	4	6
Regent	100	100	100	100
Malathion	99	92	80	90
Untreated	5	3	20	7

Table 4. Mean percent daily adult boll weevil mortality after the first application at 0, 2, 4 and 6 days after treatment with leaf bioassay.

	% Boll Weevil Mortality (DAT*)							
	24 Hour Evaluation**				48 Hour Evaluation			
	0	2	4	6	0	2	4	6
Regent	93	91	95	81	100	100	98	95
Malathion	99	100	100	100	100	100	100	100
Untreated	1	0	3	4	1	3	10	11

*DAT = Days after treatment (0, 2, 4 & 6) when leaves were collected and adult weevils introduced.
**First evaluation of weevil mortality after leaf collection.

Table 4. Cont.

	% Boll Weevil Mortality (DAT)			
	72 Hour Evaluation			
	0	2	4	6
Regent	100	100	99	98
Malathion	100	100	100	100
Untreated	8	4	29	33

Table 5. Mean percent daily adult boll weevil mortality of all 4 applications at 0, 2, 4 and 6 days after treatment with leaf bioassay.

	% Boll Weevil Mortality (DAT*)							
	24 Hour Evaluation**				48 Hour Evaluation			
	0	2	4	6	0	2	4	6
Regent	95	85	82	80	100	92	97	97
Malathion	87	83	55	46	95	87	69	66
Untreated	1	0	2	2	2	2	6	6

*DAT = Days after treatment (0, 2, 4 & 6) when leaves were collected and adult weevils introduced.
**First evaluation of weevil mortality after leaf collection.

Table 5. Cont.

	% Boll Weevil Mortality (DAT)			
	72 Hour Evaluation			
	0	2	4	6
Regent	100	94	100	99
Malathion	98	91	76	74
Untreated	5	5	16	14

Table 6. Mean number of beneficial arthropods/50 sweeps collected from all sample dates.

	# Beneficial Arthropods/50 Sweeps				
	LB*	BEB	OR	LW	Scy
Regent	14.3a	0.3a	2.7b	4.7	3.7
Malathion	11.7b	1.3ab	1.9c	5.3	4.7
Untreated	13.7b	4.0b	4.3c	6.7	3.7

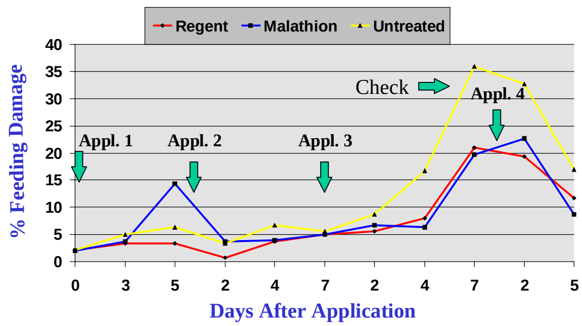
*LB = lady beetle, BEB = big eyed bug, OR = *Orius*, LW = lace wing, and Scy = scymnus.

Table 7. Mean number of beneficial arthropods/50 sweeps collected from all sample dates.

	# Beneficial Arthropods/50 Sweeps			
	Nab	RCB	Assn	Spid
Regent	0a	2.3a	6.0a	5.0a
Malathion	03a	4.3b	5.3a	8.3ab
Untreated	1.0b	4.0ab	13b	14.6b

*Nab = nabids, RCB = red cross beetle, Assn = assassin bug and Spid = spiders.

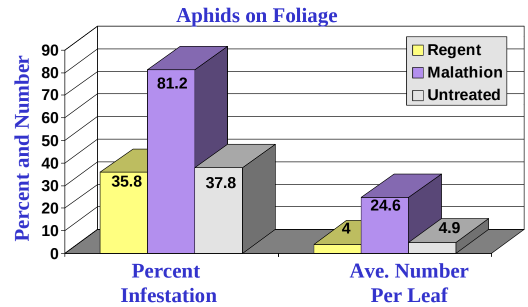
Mean % Feeding Damage of Fruit After Application



Application Dates: August 8, 14, 21 & 29 Colorado City, TX 1997

Graph 1

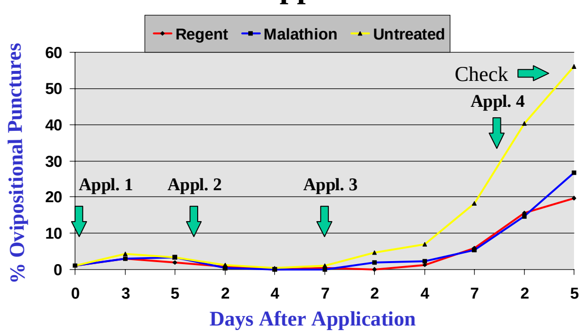
Impact of Insecticides Applied ULV on Cotton Aphids



Mean of all evaluations Colorado City, TX 1997

Graph 3

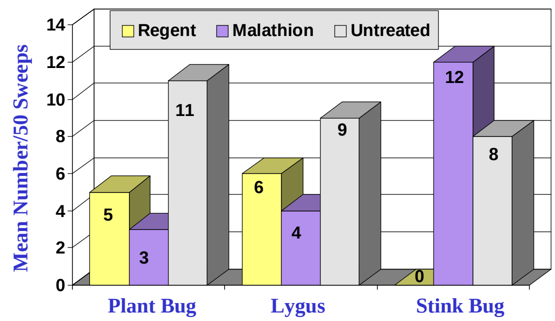
Mean % Ovipositional Punctures of Fruit After Application



Application Dates: August 8, 14, 21 & 29 Colorado City, TX 1997

Graph 2

Impact of Insecticides Applied ULV on Plant and Stink Bugs



Mean of all evaluations Colorado City, TX 1997

Graph 4