LABORATORY EVALUATIONS OF COTTON INSECTICIDES FOR CONTROL OF STINK BUGS

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RESEARCH PROBLEM

The eradication of the boll weevil, expanding use of first- and second-generation transgenic *Bt* cotton varieties, and increasing focus on development and registration of target-specific insecticides have and will continue to create a "low-spray" environment, virtually free of broad-spectrum insecticide use for major pest groups, that will allow other insects, such as stink bugs, to thrive with the benefits of coincidental suppression eliminated. Predominant phytophagous (plant-feeding) stink bugs in the southeast and much of the mid-South are similar and include the green stink bug, *Acrosternum hilare* (Say), the southern green stink bug, *Nezara viridula* (L.), and the brown stink bug, *Euschistus servus* (Say). In 2001, we continued investigations, in laboratory bioassays, into the effects of several new chemistries with those of established materials on mortality of two important species: the green stink bug (GSB), and the brown stink bug (BSB).

BACKGROUND INFORMATION

The importance of stink bugs in cotton-producing regions of the mid-South will increase in the coming years because of various factors. The first will be the eradication of the boll weevil, *Anthonomus grandis* Boheman. In southeast Arkansas, the Boll Weevil Eradication Program (BWEP) completed its second growing season in 2001 with improvements in technology, personnel, and efficiency. Overall, previous cold winter temperatures combined with productive BWEP operations produced favorable results. Once eradicated, insecticide sprays (e.g. malathion) used during or before BWEP for weevil control will no longer be the standard, and coincidental suppression of stink bugs will be removed.

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Secondly, use of transgenic cotton varieties continues to increase, and producers of transgenic *Bt* cotton are aware that the modified cotton has no activity on stink bugs. But more important in *Bt* cotton is the further reduction of broad-spectrum insecticide use for worm (Lepidoptera) control. With conventional varieties, insecticide applications (many pyrethroids) for bollworm/budworm control during mid-to-late season suppress numbers of stink bugs as a side benefit. In the absence of these control measures, stink bugs are more of a problem in terms of reduced yield and quality. Since the commercial introduction of *Bt* cotton in 1996, acreage planted to the transgenic crop has and likely will continue to increase, and as it does, so will the impact of stink bugs on the crop. Furthermore, in university and company trials, second-generation *Bt* varieties are enhanced in controlling worm pests, offering potential for additional reductions in insecticide usage.

Thirdly, insecticide chemistries that target worm pests in conventional non-*Bt* varieties have been and continue to be developed. These foliar, lep-selective materials offer little or no control of stink bugs, basically functioning similar to *Bt* cotton with regard to stink bug populations. When increasing use of these target-specific materials, growing *Bt* cotton acreage, and a successful BWEP are added up, the sum equals problems with once secondary pests such as stink bugs. Entomologists have been addressing this problem for several years now and have generated some useful information concerning management of stink bugs in cotton (Greene et al., 1999; Greene et al., 2001a,b).

MATERIALS AND METHODS

Adults and nymphs of the green stink bug and the brown stink bug were collected from soybeans with a sweepnet and held overnight in an environmental chamber at 27°C, 60% RH, and a photoperiod of 14:10 (L:D) h. They were provided with water and green beans (Harris and Todd, 1981), and the following day, adults and fifth instars of each species were placed singly in 30-ml plastic diet cups with a 3- to 4-cm section of green bean before topical assays.

Doses of each insecticide simulated the concentrations of field-use rates applied at a total volume of 10 gal per acre. Mixtures using 1 ml or 1 g of material were made for the following insecticides and field-use rates: dicrotophos (Bidrin 8, Amvac, Los Angeles, CA, 0.33 and 0.50 lb ai/acre); cyfluthrin (Baythroid 2, Bayer, Kansas City, MO, 0.04 lb ai/acre); spinosad (Tracer 4, Dow AgroSciences, Indianapolis, IN, 0.067 lb ai/acre); indoxacarb (Steward 1.25, DuPont, Wilmington, DE, 0.11 lb ai/acre); emamectin benzoate (Denim 0.16, Syngenta, Greensboro, NC, 0.0125 lb ai/acre); zetacypermethrin (Fury 1.5, FMC, Philadelphia, PA, 0.0445 lb ai/acre); methoxyfenozide (Intrepid 2F, Rohm and Haas, Philadelphia, PA, 0.06 lb ai/acre); bifenthrin (Capture 2, FMC, 0.06 lb ai/acre); thiacloprid (Calypso 4, Bayer, 0.094 lb ai/acre); imidacloprid/cyfluthrin (Leverage 2.7, Bayer, 0.0634 lb ai/acre); acephate (Orthene 97, Valent, Walnut Creek, CA, 0.5

and 0.75 lb ai/acre); lambda-cyhalothrin (Karate 2.08, Syngenta, 0.03 lb ai/acre); thiamethoxam (Centric 25WG, Syngenta, 0.05); acetamiprid (Assail 70WP, Aventis Crop Science, Research Triangle Park, NC, 0.025 and 0.05 lb ai/acre); malathion (Malathion 5, Terra International, Sioux City, IO, 0.773 lb ai/acre); and profenofos (Curacron 8E, Syngenta, 0.75 lb ai/acre). To simulate practical efficacy in the field, 1µl of each insecticide mixture was applied to the ventral abdominal segments of each insect. Each bug was returned to its respective diet cup following treatment. A bug was considered dead if in a supine position and no coordinated movement was observed after agitating its cup. Mortality was recorded 24, 48, 72, and 96 hr after treatment.

RESULTS

The predominant species of stink bugs in cotton in southeast Arkansas during 2001 were the green stink bug (GSB) and the brown stink bug (BSB). The southern green stink bug (SGSB) was uncommon in the state during 2001, most likely due to cold temperatures (Elsey 1993) experienced during the previous winter. Bidrin provided excellent control (96 to 100% mortality) of GSB and BSB (Tables 1 to 4) at both rates (0.33 and 0.50 lb ai/acre). The pyrethroid insecticides provided good control (74 to 97%) of GSB nymphs and adults 24 hr after treatment (Tables 1 and 2), but poor control (43 to 75%) of BSB (Tables 3 and 4), except for Capture which provided 85% and 96% mortality of BSB nymphs and adults, respectively. Lep-specific materials (Intrepid, Tracer, Denim, and Steward) offered little or no control of both species, but increased mortality (78%) of BSB immatures (Table 3) after 72 hr. Insecticides designed for sucking pests (Centric, Assail, and Calypso) provided variable results. Centric provided excellent control of immatures of both species, but poor/fair control of adults. Assail and Calypso offered little control in topical assays. Malathion, at a rate commonly used in boll weevil eradication programs, provided poor control (27 to 38% mortality) of both species at 24 hr. Cumulative mortalities for several treatments fluctuated slightly and, in some cases, decreased over time because some bugs recorded as dead apparently recovered from initial "knockdown". These results were consistent with those found previously concerning SGSB and BSB (Greene and Herzog, 2000; Greene et al., 2001a).

PRACTICAL APPLICATION

In laboratory bioassays, dicrotophos (Bidrin), a standard organophosphate used for control of bug pests, provided excellent control (96 to 100% mortality) of field-collected fifth instars and adults of the green stink bug (GSB) and the brown stink bug (BSB); remained efficacious at a reduced rate (0.33 lb ai/acre); and is relatively inexpensive. Zetacypermethrin (Fury), bifenthrin (Capture), lambda-cyhalothrin (Karate), and cyfluthrin (Baythroid), standard pyrethroids used for control of worm pests, provided good/excellent control of GSB but poor/fair control of BSB, except for Capture, which

provided excellent control of BSB. Comparatively, acephate (Orthene) and Capture were more effective on BSB than on GSB and could be alternatives to Bidrin in controlling this species if necessary.

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DISCLAIMER

The mention of trade names in this report is for informational purposes only and does not imply an endorsement by the University of Arkansas Cooperative Extension Service.

LITERATURE CITED

Elsey, K.D. 1993. Cold tolerance of the southern green stink bug (Heteroptera: Pentatomidae). Environ. Entomol. 22:567-570.

Greene, J.K., S.G. Turnipseed, M.J. Sullivan, and G.A. Herzog. 1999. Boll damage by southern green stink bug (Hemiptera: Pentatomidae) and tarnished plant bug (Hemiptera: Miridae) caged on transgenic *Bacillus thuringiensis* cotton. J. Econ. Entomol. 92:941-944.

Greene, J.K., and G.A. Herzog. 2000. Mortality of southern green stink bug exposed to new cotton insecticides in laboratory bioassays and field comparisons of insecticides and stink bug damage to cotton. 1999 Georgia Cotton Research and Extension Reports. UGA/CPES Research-Extension Publication No.4:251-255.

Greene, J.K., G.A. Herzog, and P.M. Roberts. 2001a. Management decisions for stink bugs. *In:* Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. 2:913-917.

Greene, J.K., S.G. Turnipseed, M.J. Sullivan, and O.L. May. 2001b. Treatment thresholds for stink bugs (Hemiptera: Pentatomidae) in cotton. J. Econ. Entomol. 94:403-409.

Harris, V.E., and J.W. Todd. 1981. Rearing the southern green stink bug, *Nezara viridula*, with relevant aspects of its biology. J. Ga. Entomol. Soc. 16:203-210.

Table 1. Cumulative mortality of field-collected fifth instars of the green stink bug, *Acrosternum hilare* (Say), over a 4-d interval following exposure to insecticides (1-ml to ventral abdominal segments) in laboratory bioassays.

			% cumulative mortality			
Treatment	Reps	$/acre/application	24 hr	48 hr	72 hr	96 hr
UTC	127	$0.00	12	27	43	46
Denim (0.0125)	127	14.41	10	27	51	63
Steward (0.11)	127	14.56	9	26	49	65
Tracer (0.067)	127	12.26	9	27	40	47
Intrepid (0.06)	127	5.58	8	17	35	39
Karate (0.03)	127	6.02	80	83	91	94
Capture (0.06)	127	11.05	74	82	93	95
Fury (0.0445)	127	5.84	90	94	97	98
Baythroid (0.04)	127	7.23	87	88	96	98
Leverage (0.0634)	127	9.04	95	98	98	99
Bidrin (0.33)	127	3.74	98	99	100	100
Bidrin (0.5)	127	5.67	100	100	100	100
Orthene (0.5)	127	5.28	68	78	87	91
Orthene (0.75)	127	8.16	78	95	98	99
Centric (0.05)	127	9.45	96	98	98	98
Assail (0.025)	127	N/A	50	51	67	73
Assail (0.05)	127	N/A	63	70	83	88
Calypso (0.094)	127	N/A	23	39	51	51
Malathion (0.773)	48	3.61	38	58	73	73
Curacron (0.75)	106	9.02	20	42	58	67

Table 2. Cumulative mortality of field-collected adults of the green stink bug, *Acrosternum hilare* (Say), over a 4-d interval following exposure to insecticides (1-ml to ventral abdominal segments) in laboratory bioassays.

			% cumulative mortality			
Treatment	Reps	$/acre/application	24 hr	48 hr	72 hr	96 hr
UTC	34	0.00	21	29	38	41
Denim (0.0125)	34	14.41	35	41	50	50
Steward (0.11)	34	14.56	24	38	47	53
Tracer (0.067)	34	12.26	15	29	35	38
Intrepid (0.06)	34	5.58	24	35	41	44
Karate (0.03)	34	6.02	82	88	91	94
Capture (0.06)	34	11.05	97	97	97	97
Fury (0.0445)	34	5.84	91	94	97	97
Baythroid (0.04)	34	7.23	85	91	97	97
Leverage (0.0634)	34	9.04	97	91	97	97
Bidrin (0.33)	34	3.74	100	100	100	100
Bidrin (0.5)	34	5.67	100	100	100	100
Orthene (0.5)	34	5.28	29	68	76	76
Orthene (0.75)	34	8.16	47	76	85	88
Centric (0.05)	34	9.45	50	68	74	74
Assail (0.025)	34	N/A	29	38	41	50
Assail (0.05)	34	N/A	50	56	59	62
Calypso (0.094)	34	N/A	15	26	32	32
Malathion (0.773)	197	3.61	27	38	50	53
Curacron (0.75)	29	9.02	34	55	69	69

Table 3. Cumulative mortality of field-collected fifth instars of the brown stink bug, *Euschistus servus* (Say), over a 4-d interval following exposure to insecticides (1-ml to ventral abdominal segments) in laboratory bioassays.

			% cumulative mortality			
Treatment	Reps	$/acre/application	24 hr	48 hr	72 hr	96 hr
UTC	40	0.00	8	15	15	23
Denim (0.0125)	40	14.41	23	45	78	78
Steward (0.11)	40	14.56	10	20	28	35
Tracer (0.067)	40	12.26	10	20	43	48
Intrepid (0.06)	40	5.58	5	15	23	33
Karate (0.03)	40	6.02	43	60	80	83
Capture (0.06)	40	11.05	85	98	100	100
Fury (0.0445)	40	5.84	75	83	85	85
Baythroid (0.04)	40	7.23	43	55	63	73
Leverage (0.0634)	40	9.04	88	88	88	88
Bidrin (0.33)	40	3.74	100	100	100	100
Bidrin (0.5)	40	5.67	100	100	100	100
Orthene (0.5)	40	5.28	80	90	95	95
Orthene (0.75)	40	8.16	80	98	98	98
Centric (0.05)	40	9.45	93	90	90	90
Assail (0.025)	40	N/A	38	43	43	45
Assail (0.05)	40	N/A	53	58	58	58
Calypso (0.094)	40	N/A	15	23	28	30
Malathion (0.773)	25	3.61	32	40	48	52
Curacron (0.75)	40	9.02	20	30	50	63

Table 4. Cumulative mortality of field-collected adults of the brown stink bug, *Euschistus servus* (Say), over a 4-d interval following exposure to insecticides (1-ml to ventral abdominal segments) in laboratory bioassays.

			% cumulative mortality			
Treatment	Reps	$/acre/application	24 hr	48 hr	72 hr	96 hr
UTC	73	0.00	14	25	32	33
Denim (0.0125)	73	14.41	22	33	37	40
Steward (0.11)	73	14.56	10	16	22	23
Tracer (0.067)	73	12.26	8	29	36	41
Intrepid (0.06)	73	5.58	10	18	23	34
Karate (0.03)	73	6.02	47	47	51	59
Capture (0.06)	73	11.05	96	95	95	96
Fury (0.0445)	73	5.84	53	51	52	55
Baythroid (0.04)	73	7.23	49	40	40	38
Leverage (0.0634)	73	9.04	75	68	67	67
Bidrin (0.33)	73	3.74	96	97	97	97
Bidrin (0.5)	73	5.67	99	99	99	99
Orthene (0.5)	73	5.28	60	77	82	82
Orthene (0.75)	73	8.16	73	90	95	96
Centric (0.05)	73	9.45	73	75	77	74
Assail (0.025)	73	N/A	10	14	16	16
Assail (0.05)	73	N/A	16	19	23	23
Calypso (0.094)	73	N/A	10	12	14	14
Malathion (0.773)	182	3.61	38	53	63	66
Curacron (0.75)	70	9.02	20	34	39	40