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Response of Soybean Insects to Foliar Applications of a Chitin Synthesis Inhibitor TH 6040

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Abstract

The activity of TH 6040, a chitin synthesis inhibitor, was determined against velvetbean caterpillar, *Anticarsia gemmatalis* Hübner, and other soybean defoliators in field tests in Georgia, South Carolina, and Brazil. Single applications at rates as low as 75 g AI/ha afforded adequate initial and excellent residual control of *A. gemmatalis* and some suppression of low populations of *Plusia* spp. Two applications at higher rates gave significant control of soybean looper, *Pseudoplusia includens* (Walker), and showed promise against green cloverworm, *Plathypena scabra* (F.), and Mexican bean beetle, *Epilachna varivestis* Mulsant. Populations of geocorids and nabids were lower in 1 test, possibly because of insecticidal activity, scarcity of prey, or both.

Reports by van Daalen et al. (1972) and Wellinga et al. (1973) indicated that 1-(4-chlorophenyl)-3-(2,6-difluorobenzoyl) urea (TH 6040) interfered with cuticle deposition in certain insects. Neal (1974) reported that TH 6040 controlled alfalfa weevil, *Hypera postica* (Gyllenhal), in small field plots.

Foliar activity of TH 6040 against the velvetbean caterpillar, *Anticarsia gemmatilis* Hübner, and other soybean insects was observed in field plots in 1973 at Blackville, South Carolina, and Tifton, Georgia (USA), and in 1974 at Porto Alegre, Rio Grande do Sul, Brazil.

Materials and Methods

We compared TH 6040 with carbaryl in plots replicated 4 times in a randomized block design at Blackville (Test 1) and Porto Alegre (Tests 2 and 3). In Test 1, two separate applications were made to "Hutton" soybeans ca. 1 m high in plots 6 rows (96.5 cm centers) wide by 12.2 m long separated by 2 untreated rows. A knapsack sprayer was used which delivered 77.5 liters/ha at 3.5 kg/cm². Counts were made by beating 2.4 m of row over a ground cloth and recording live insects from the cloth (Shepard et al. 1974). Percent defoliation was estimated independently by 2 people from the middle 4 rows of each plot. In Test 2, methods were similar except the "Davis" variety was used; plots were 4 rows (60 cm centers) wide by 5 m long; 800 liters/ha were delivered; a single application was made; and 2 m of row were counted. In Test 3, the Davis variety was used; plots were 5 rows (60 cm centers) wide by 10 m long; 800 liters/ha were delivered; a single application was made; and 4 m of row were counted. At Tifton (Test 4), TH 6040 was applied at 562 g AI/ha to Hutton soybeans ca. 1 m high in 2 strips 16 rows (91.4 cm centers) wide by 60.9 m long using a high clearance sprayer with 3 nozzles/row which delivered 130.9 liters/ha at 2.8 kg/cm². Separate applications were made on Aug. 22 and Sept. 5. Treated strips were compared with paired checks by counting 2.4 m of row with a ground cloth at 8 locations/strip.

Results

Test 1, Blackville

Two applications of TH 6040 at 281 or 562 g AI/ha (Table 1) afforded excellent control of the velvetbean caterpillar for 35 days posttreatment (Aug. 24–Sept. 25). Carbaryl gave excellent initial control but residual activity was inadequate. Both rates of TH 6040 caused significant reductions in numbers of the soybean looper, *Pseudoplusia includens* (Walker), 14 days posttreatment (Sept. 4). Although differences were not significant, numbers of larvae of the Mexican bean beetle, *Epilachna varivestis* Mulsant, were lower in TH 6040-treated plots after 35 days (Sept. 25). There were no significant differences in yields among treatments, even though defoliation was ca. 5% in the TH 6040 plots compared with ca. 35% in carbaryl or check plots. Numbers of geocorids and nabids 35 days posttreatment (Sept. 25) were significantly lower in TH 6040 plots and intermediate in carbaryl plots compared with untreated checks.

Table 1. Activity of TH 6040 and carbaryl against soybean insects, Test 1, Blackville, South Carolina, 1973^a

Treatment	Rate/ha (g AI) ^b	Avg. no. alive in 2.4 m row (ground cloth)							Geocorids (9/25)	Nabids (9/25)	% Defoliation (10/10)	Yield (kg/ha)
		<i>Anticarsia gemmatilis</i>			<i>Pseudoplusia includens</i>		<i>Epilachna varivestis</i> larvae (9/25)					
		8/24	9/4	9/25	8/21	9/4						
TH 6040 E.C.	281	0.0 a	0.3 a	0.3 a	1.0 ab	8.3 a	0.3 a	3.8 ab	3.3 a	< 5.0	2,124 a	
TH 6040 E.C.	562	0.0 a	0.3 a	0.3 a	0.5 a	6.0 a	1.0 a	1.8 a	3.3 a	5.6	2,344 a	
Carbaryl 80S	673	0.3 a	1.5 a	41.5 b	3.5 b	30.5 b	12.5 a	6.3 b	5.8 ab	35.6	2,110 a	
Check		8.5 b	11.5 b	54.0 b	3.3 b	25.5 b	12.0 a	18.3 c	9.3 b	33.1	2,110 a	

a. Means followed by the same letter are not significantly different at the 5% level (Duncan's multiple range test). Observation dates indicated as month/day.
b. Applied as foliar sprays at indicated rates on Aug. 6 and 21.

Tests 2 and 3, Porto Alegre

A single application of TH 6040 at 75 g AI/ha (Table 2, Test 2) gave significant initial control of the velvetbean caterpillar and caused 20-fold reductions in its numbers at 20 days post-treatment (Feb. 11). Higher rates of TH 6040 (Tests 2 and 3) afforded similar efficacy against this insect. Carbaryl provided good initial control but was not effective 20 days after application (Feb. 11). Populations of *Plusia* spp. were low but some suppression of their numbers by TH 6040 and carbaryl was observed in Test 3.

Table 2. Activity of TH 6040 and carbaryl against *Anticarsia gemmatilis* and *Plusia* spp. on soybeans, Tests 2 and 3, Porto Alegre, R.S., Brazil, 1974^a

Treatment	Rate/ha (g AI) ^b	Avg. no. live insects ^c				Defoliation (%)		Yield (kg/ha)
Test 2 (1/22/74)								
		<i>A. gemmatilis</i>			<i>Plusia</i> spp.			
		1/25	2/1	2/11	(2/1)	2/4	2/28	
TH 6040 25W	75	7.5 a	1.0a	1.0 a	5.0 a	7.5 a	8.8 a	3,239 b
TH 6040 25W	150	9.0 a	0.8 a	1.0a	3.8 a	6.8 a	8.8 a	3,611 b
Carbaryl 80S	250	4.0 a	6.0 a	21.3 b	3.5 a	10.1 a	50.0 b	2,641 a
Check		28.8 b	34.3 b	24.3 b	4.0 a	38.8 b	70.0 c	2,172 a
Test 3 (2/2/74)								
		<i>A. gemmatilis</i>		<i>Plusia</i> spp.				
		2/8	2/22	2/8	2/22	2/19	2/28	
TH 6040 25W	110	2.5 a	0.5 a	3.8 a	1.8 ab	25.0 a	20.0 a	2,757 b
TH 6040 25W	220	0.5 a	1.0a	3.5 a	1.3 ab	26.3 a	22.5 ab	2,509 b
Carbaryl 80S	560	0.8 a	20.3 b	2.0 a	0.8 a	23.8 a	41.3 b	2,348 b
Check		21.8 b	28.0 b	8.5 b	3.0 b	72.5 b	73.8 c	1,267 a

a. Means followed by the same letter are not significantly different at the 5% level (Duncan's multiple range test). Observation dates indicated as month/day.

b. One application as foliar spray: Test 2 on 1/22 and Test 3 on 2/2.

c. Avg. no. alive in 2 m row for Test 2 and 4 m row for Test 3.

In Test 2, estimated defoliation 13 days posttreatment (Feb. 4) was near 10% in treated plots and 40% in untreated checks. At 37 days posttreatment (Feb. 28), defoliation reached 70% in checks, 50% in carbaryl-treated plots, and was unchanged in the TH 6040-treated

plots. Yields were significantly higher from both TH 6040 treatments than from carbaryl or check treatments.

In Test 3, although pretreatment defoliation approached ca. 25%, by 17 days posttreatment (Feb. 19) defoliation was 3 times higher in untreated checks compared with TH 6040 or carbaryl plots which were similar. At 26 days (Feb. 28), defoliation levels were 2 times higher in carbaryl and 3 times higher in check plots than in TH 6040 plots which were near 20%. Yields from treated plots were not significantly different and were ca. double the yields of untreated checks.

Test 4, Tifton

Although replication was inadequate, Test 4 provided additional evidence that TH 6040 can give almost complete protection of foliage (Table 3). Protection in this test resulted primarily from control of the velvetbean caterpillar, some suppression of soybean looper, and a 3-fold reduction in green cloverworm, *Plathypena scabra* (F.).

Table 3. Activity of TH 6040 against *Anticarsia gemmatalis*, *Plathypena scabra*, and *Pseudoplusia includens* on soybeans, Test 4, Tifton, Georgia, 1973

Treatment ^a	Avg. no. alive in 2.4 m row ^b						Defoliation (%)	Yield (kg/ha)	
	<i>Anticarsia gemmatalis</i>			<i>Pseudoplusia includens</i>		<i>Plathypena scabra</i>			
	8/28	9/4	9/13	8/23	9/4	8/28			9/4
TH 6040	0.5	0.8	0.0	2.3	5.5	0.8	7.0	2.0	1,591
Check	20.9	78.1	35.6	3.9	10.4	8.1	20.3	75.0	1,281

a. Two applications at 562 g AI/ha on 8/22 and 9/5

b. In 8 locations in each of 2 treated and 2 untreated strips. Observation dates indicated as month/day.

Discussion

In the 4 tests, TH 6040 gave excellent season-long control of velvetbean caterpillar. Adequate initial control of this insect was obtained in Tests 2 (3 days posttreatment), 3 and 4 (6 days posttreatment). Single applications in Tests 2 and 3 at low rates (75 and 110 g AI/ha, respectively) were as effective against this pest as higher rates or dual applications. TH 6040 (Test 1) afforded significant control of soybean looper and reduced numbers of Mexican bean beetle larvae. It appeared to suppress loopers and offered promise against green cloverworm in Test 4.

Numbers of geocorids and nabids (Test 1) were significantly lower in TH 6040 than in check plots. These lower numbers may have been due to the direct activity of the material against the predators, a reduction in prey, or a combination of both.

TH 6040 showed promise as a good initial and excellent residual material for the control of certain soybean insects. This new inhibitor of chitin synthesis may have particular utility in management systems where velvetbean caterpillar is a major pest species.

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