Section V

Mortality of spotted cutworms, *Amathes c-nigrum*, fed different concentrations of tebufenozide-treated foliage

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Introduction

The spotted cutworm, *Amathes c-nigrum*, is an early season pest of several crops in central Washington including developing grape buds and the tips of asparagus spears. Cutworm injury to grape buds frequently include the loss of primary and secondary buds [Dibble et al. (1979), Cone & Brummond (1974)]. Spotted cutworms overwinter as partially grown larvae (second or third instar) and are ready to feed as soon as new growth begins in early spring. Larvae may feed on winter annual weeds (*Brassica* spp., *Descuraina* spp. and others) during periods of above freezing weather in late winter. Tomaki et al. (1975) documented the association of cutworms with patches of weeds in asparagus fields. Walton, Long and Spivey (1994) found that tebufenozide at 0.5 pints of formulation/A gave excellent control of beet armyworm, *Spodoptera exigua*, on cotton. They used tebufenozide mixed with Latron CS-7 (25% v/v) or crop oil concentrate at 1 quart/A as a tank mix. They found equal effectiveness with aerial application (5 or 10 gallons/A) or ground application (10, 15 or 20 gallons/A). Residual activity under those conditions was 12-16 days. This study was an attempt to demonstrate the effect of tebufenozide (Confirm®) as an insect growth regulator and assess its potential as a management tool for spotted cutworms.

Materials and Methods

Cutworms were collected at night from Badger Mt. Vineyards near Kennewick, Washington (Benton County) using a mechanical device developed by the vineyard owner. This process is described in a separate paper. Cutworms and plant debris (small pieces of bark, dead twigs, etc.) were collected in 5-gallon pails and transported to the laboratory the morning after collection. The cutworms were sorted from the plant debris, placed in 1 qt. plastic containers and held at 40 F for 5 days to determine injury or mortality due to the collection process.

For the feeding trials, square Petri dishes were provided with a sheet of absorbent paper cut to fit the dish, and 10 cutworms were placed in each dish. Treatments consisted of tender side branches of tansey mustard (*Descurainia pinnata* Walt) dipped in water solutions containing different concentrations of tebufenozide, allowing the foliage to drain momentarily and then placing the foliage in a Petri dish containing cutworms. Each concentration and an untreated check were replicated four times (n=40).

Cutworms in Petri dishes were observed every 24 h to determine mortality. Cutworms were determined to be dead if no movement could be observed after being gently prodded with a dull probe. Trials were run a minimum of 6 days.

Tansey mustard foliage to be dipped was weighed to insure each set of 10 cutworms had an equal opportunity to consume foliage. Each dish received between 7 and 8 g of foliage (mean=7.6 g).

Exposure trials began on April 24 using cutworms that had been collected as early as April 15. The cutworms were sorted into third, fourth and fifth instar and held at 40 F for 5 days to determine mechanical injury due to the violent method by which they were captured. Worms that had obvious injuries, were dark or shriveled were discarded. Worms collected between April 15 and April 24 were held at 40 F but not fed tansey mustard foliage. Those captured after April 24 were sorted and fed while being held at 40 F. Each trial consisted of three rates of tebufenozide plus an untreated control replicated four times (n=160). Six trials were conducted using a total of 960 cutworms.

Calculations for trials:
Tebufenozide (Confirm®) was furnished as a 2 lb/gal flowable formulation. To approximate field rates concentrations were prepared based on the use of 363 l/ha (=40 gal/A) of water. Target field rates for several crops range from 0.11-0.33 Kg AI/ha. The 0.11 rate equaled 4.54 mls of formulation/3784 mls or 0.6 mls in 500 mls of water. A 10x stock solution was prepared using 6 mls of formulation in 500 mls water. A second stock solution was prepared using 50 mls of stock solution 1 in 500 mls of water (=0.11 Kg AI/ha or ca 30 ppm). Most of the lower concentrations of tebufenozide tested were prepared using stock solution 2. The rates of tebufenozide and the cutworm instars tested are presented in Table 1.

Dosage levels in ppm were transformed to base 10 logarithms and the relationship of dose to percent mortality was determined by probit analysis, which was computer using the PORBIT procedure (SAS Institute 1988). The natural or threshold response rate was not adjusted by the mortality in the control group.

Results and Discussion
Cutworms ceased feeding within 24 h and frequently, at the higher rates, were dead within 48 h. Observation of affected cutworms at 10x magnification showed breakage of old cuticle around the head capsule and the sternal area of the first two thoracic segments. Tebufenozide appeared to affect the anterior end of cutworms more than the rest of the body. As the trials progressed, the anterior end of the cutworms darkened while the rest of the body appeared normal. Figures 1 and 2 taken from Rohm and Haas Technical Information Bulletin for Confirm® 2F represent the observations made in these trials.

Cutworm mortality in these trials occurred quite rapidly, usually in 24-48 h. There was no difference in age group, i.e. fifth instars were as susceptible as third or fourth instars at comparable doses. Data sets from all six trials were combined for the probit analysis with mortality observations through day 6 in each trial. Those data are presented in Table 2.

The probit intercept was -0.223 (Chi Square = 6.20, df = 1, $P = 0.013$), and the slope was 1.081 (Chi Square = 131.94, df = 1, $P = 0.0001$). Pearson Chi-Square goodness-of fit test indicated that the probit model fit the data (Chi-Square = 20.54, df = 15, $P = 0.152$).

From Table 2 one can observe that the LD_{50} was 1.6 ppm and the LD_{95} was 53.5 ppm. The approximate field rates in terms of ppm are 0.11 Kg AI/ha (= 30 ppm), 0.22 Kg AI/ha (= 60 ppm), and 0.33 Kg AI/ha (= 90 ppm). This agrees very closely with field rates listed in technical data sheets for control of a number of lepidopteran pests of apples, corn, cotton, soybeans, sugar beets, tree nuts, vegetable crops and a range of ornamental plants. In the case of spotted cutworm 0.11 Kg AI/A seems adequate to kill more than 90%, 0.22 Kg AI/ha would kill more than 95%, and 0.33 Kg AI/ha would kill 97%. This would give users some latitude in planning a pest management program regarding amount of chemical versus level of kill.

References:

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Walton, L.C., J.W. Long, and J.A. Spivey. 1995. Use of Confirm insecticide for control of beet armyworm in cotton under Section 18 in Mississippi and Alabama. pp. 46-47. In Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, Tennessee.

Table 1.

Trial No.	Rate			Cutworm [1]instar condition
	ppm	Kg AI/ha	lbs AI/A	
1	287.6	0.11	0.1	4th instar - starved
1	144.0	0.058	0.05	4th instar - starved
3	86.3	0.034	0.03	4th instar - fed
1	71.9	0.029	0.025	4th instar - starved
2	57.5	0.023	0.02	4th instar - fed
3	43.1	0.017	0.015	4th instar - fed
2	28.8	0.011	0.01	4th instar - fed
2	14.4	0.0057	0.005	4th instar - fed
6	11.5	0.0046	0.004	5th instar - fed
3,4	8.63	0.0034	0.003	4th instar - fed
5	5.75	0.0023	0.002	4th instar - fed
4	2.88	0.0011	0.001	3rd instar - fed
5	2.30	0.0009	0.0008	4th instar - fed
6	1.73	0.0007	0.0006	5th instar - fed
4	1.44	0.0006	0.0005	3rd instar - fed
5	1.15	0.0005	0.0004	4th instar - fed
6	0.86	0.0003	0.0003	5th instar - fed
1-6	0	0	0	

[1] n=40 except Trials 3-4, n=80. Observations were made at 24 h intervals for at least 6 days with the number of living cutworms recorded.

Table 2. Probit analysis of mortality data for spotted cutworms, *Amathes c-nigrum*, treated with concentrations of tebufenozide. WSU-IAREC, Prosser, WA. 1998.

Mortality Probability	Dose	95 percent fiducial limits	
	(ppm)	lower	upper
0.01	0.01132	0.00310	0.02854
0.02	0.02024	0.00624	0.04701
0.03	0.02925	0.00970	0.06454
0.04	0.03860	0.01353	0.08192
0.05	0.04836	0.01773	0.09948
0.06	0.05860	0.02232	0.11737
0.07	0.06933	0.02730	0.13571
0.08	0. 08061	0.03270	0.15455
0.09	0.09245	0.03852	0.17396
0.10	0.10488	0.04479	0.19400
0.15	0.17681	0.08358	0.30490
0.20	0.26777	0.13702	0.43732
0.25	0.38231	0.20913	0.59669
0.30	0.52638	0.30529	0.78983
0.35	0.70793	0.43280	1.02584
0.40	0.93780	0.60157	1.31716
0.45	1.23101	0.82533	1.68145
0.55	2.10289	1.52278	2.74622
0.60	2.76037	2.06341	3.54955
0.65	3.65667	2.80425	4.66126
0.70	4.91790	3.83734	6.27188
0.75	6.77113	5.31768	8.74577
0.80	9.66746	7.53874	12.84694
0.85	14.64122	11.15028	20.42460
0.90	24.68262	17.95592	37.19325
0.91	28.00102	20.10893	43.06590
0.92	32.11349	22.72766	50.53179
0.93	37.33585	25.98603	60.28113
0.94	44.17847	30.16019	73.45815
0.96	67.06464	43.53766	120.23963
0.97	88.48821	55.47786	167.03120
0.98	127.91617	76.46703	258.89399
0.99	228.64846	126.52394	517.65231