

EFFECTS OF NITROGEN FERTILIZER RATES AND INSECTICIDE USE ON MEADOWFOAM TO CONTROL THE MEADOWFOAM FLY, *SCAPTOMYZA APICALIS* HARDY

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Abstract

Relationships of nitrogen fertilizer and insecticide treatment on larval density of *Scaptomyza apicalis* Hardy, flower production, seed set, and seed yield of meadowfoam, *Limnanthes alba* (cv. Floral) were evaluated from September 1997 to August 1998. Combinations of five levels of urea (0, 20, 40, 60 and 80 lb/a, applied once in late February) and two levels of oxydemeton-methyl insecticide at 0.5 lb a.i./a, monthly intervals from February to May, versus no insecticide treatment were arranged in a randomized complete block design with four replications. Larval densities of each treatment were monitored at monthly intervals throughout the experimental period. Flight activity of meadowfoam fly (MFF) was monitored at weekly basis by using yellow sticky traps from October 1997 to September 1998. Flower production of meadowfoam was determined by counting flowers and opening buds in 0.1 m² portion of each plot at full bloom. Mean number of seeds set per flower were determined two weeks prior to harvest. The final seed yields were obtained by harvesting and cleaning seed from each plot with a small plot harvester. Results showed that effects of fertilizer and insecticide were independent of each other in regard to larval density, flower density and seed set. Interaction was detected for seed yield. N fertilization increased larval density, but reduced flower density and seed yield. Insecticide application significantly reduced larval densities, but flower densities, and seed set were not statistically different from unsprayed plots. Any application rate of nitrogen fertilizer tended to reduce seed yields in plots unsprayed with insecticide. Interestingly, seed yield was only increased substantially with insecticide use in the plots receiving N at 20 lb/a. Larval density was not correlated with flower density and seed yield. However, flower density was positively correlated with seed yield ($r = 0.52, p = 0.01, n = 40$).

Introduction

The meadowfoam fly (MFF), *Scaptomyza apicalis* Hardy (F. Drosophilidae) is thus far the only insect pest of significance on meadowfoam. Larval feeding damages both vegetative and reproductive tissues of meadowfoam, *Limnanthes alba* Hartweg ex. Bentham. Early season injury results from large numbers of larvae feeding on and damaging crown tissue. Young plants die in the heavily infestations. Other plants display symptoms including severe stunting, loss of vigor and reduced flower production. Later

season damage results in destroyed stems and flower buds. Significant loss of seed in experimental plots damaged by MFF have been reported (Fiez, et al., 1991 and Jolliff, et al., 1981). Up to 50% loss of seed yield is suspected in fields heavily infested with MFF (Ehrensing et al., 1990).

Rate of nitrogen fertilizer has been suspected to directly correlate with insect damage on meadowfoam. Higher infestation rates with correspondingly lower seed yields were observed in plots and fields with highest nitrogen rates. Jolliff et al. (1993) raised concern about effects of nitrogen fertilizer use on meadowfoam and fly damage. Nitrogen fertilizer applications elevate plant tissue N content, which in turn attracts greater numbers of insect in many plants (Harbaugh et al., 1983). Hart and Young (1986) reported plant tissue N concentrations from 1.5 to 1.7 gm/kg at bloom of meadowfoam (cv. Mermaid) were associated with greatest yields. Concentrations from 1.2 to 1.4 gm/kg were associated with lower yields. Concentrations above 1.8 gm/kg were generally associated with lowest yields.

The objectives of this experiment were to determine the effects of MFF damage on meadowfoam with different nitrogen fertilizer rates and with and without insecticide applications plots on infestation levels of MFF and seed yield.

Materials and Methods

The experiment was conducted on meadowfoam (cv. Floral) at Oregon State University's Hyslop Farm near Corvallis from September 1997 to August 1998. Meadowfoam was seeded at 30-35 lb/a with 6" row spacing in early October. Combinations of five levels of 46-0-0 nitrogen fertilizer (0, 20, 40, 60 and 80 lb/a) with and without oxydemeton-methyl insecticide (Methasystox-R 2EC) applications to plots were arranged in a randomized complete block design with four replications on 9 ft by 20 ft plots. Nitrogen fertilizer was topdressed to the appropriate plots in late February. Insecticide was applied at 0.5 lb. ai/a at monthly intervals from late February to May. Honeybees were placed adjacent to fields at approximately five hives per acre at 20% bloom.

Nine yellow sticky traps were placed throughout the study site to monitor fly activity from September 1997 to July 1998. Numbers of flies trapped were observed and recorded weekly. Larval densities were obtained from plant samples at monthly intervals. Samples of 5 plants each were taken from each plot a week after each insecticide application from February to May 1998. Larvae were extracted from plants using Berlese funnels. Data from the four collection dates were pooled for statistical analysis. Flower density at full bloom and seeds set per flower two weeks before harvesting were recorded in a 0.1 m² portion of each plot. Seed was harvested on July 12, 1998 and soon cleaned and weighed. Each data set was analyzed by two-way ANOVA with FPLSD values used for mean separations. Then, a

two-way factorial was used in order to partition fertilizer and insecticide main effects and interactions. Correlation analysis on larval densities, flower densities and seed yields were performed.

Results and Discussion

The effects of nitrogen fertilizer and insecticide applications on larval density, flower density, and seed set were independent of one another (Table 1). However, interactions occurred in seed yields (Table 1). Even though insecticide applications reduced larval density by 54% (Figure 1), they had no effect on meadowfoam flower density, or seed set per flower (Table 3 and Figure 3). Increasing rates of N fertilization were positively associated with increasing larval densities. However they decreased flower density and seed yield (Table 3, Figure 3 and Figure 4). Seeds set/flower was unaffected by N rate. (Table 4). In unsprayed plots, larval density in 80 lb/a N fertilizer was 28% higher than the unfertilized plots (Figure 1). Flower density and seed yield of fertilized plots were lower than unfertilized plots, up to 61 and 16%, respectively (Table 3, Figure 3 and Figure 4). Average seed set ranged from 2.11 to 2.66 seed/flower in all plots. No significant differences were observed between or among treatments (Table 4). Interaction of nitrogen fertilizer and insecticide was significant as judged by seed yield. Plots with fertilizer generally produced less seed than plots without fertilizer. Insecticide applications increased seed yield in fertilized plots over unfertilized plots for only one N rate, 20 lb/a. Larval density was not correlated with meadowfoam flower density and seed yield (Table 2). But flower density and seed yield were correlated ($r = 0.52, p = 0.01, n = 40$) (Table 2).

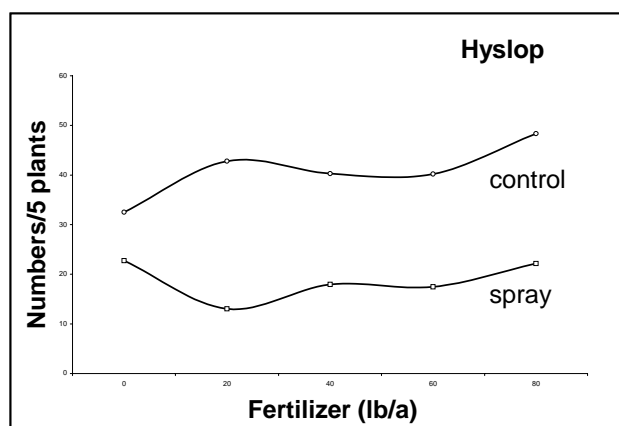


Figure 1. Average larval densities of *Scaptomyza apicalis* Hardy in plots with different nitrogen fertilizer rates and insecticide treatments at Hyslop Farm from February to May 1998 (5 plants/sample, n=4).

Table 1. Analysis of variance for main effects and treatment interactions of nitrogen fertilizer rate and insecticide application effects on *Scaptomyza apicalis* Hardy larval density, meadowfoam (cv. Floral) flower density, seed set and seed yield at Hyslop Farm of crop year 1997-98.

Treatments	Larval density (no./5 plants)	Flower density (0.1 m ²)	Seed set/ flower (0.1 m ²)	Seed yield (lb/a)
Fertilizer rates	**	**	NS	**
Insecticide	**	NS	NS	NS
Interactions	NS	NS	NS	**

**, NS = significantly different at $p = 0.01$, and not significantly different, respectively.

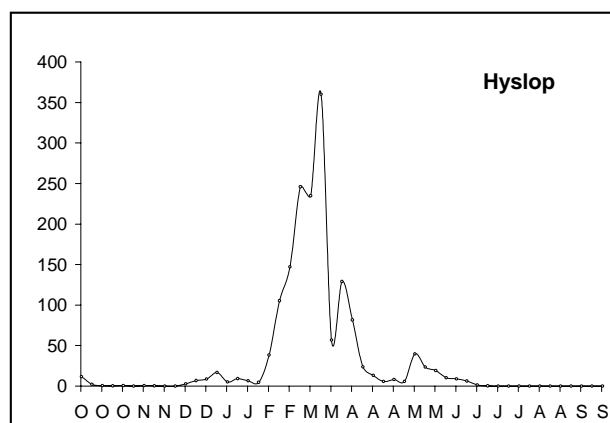


Figure 2. Average numbers of *Scaptomyza apicalis* Hardy flies collected at weekly intervals on yellow sticky traps (n=9) at Hyslop Farm from October 1997 through September 1998.

Table 2. Correlation among larval density of *Scaptomyza apicalis* Hardy, flower density and seed yield of meadowfoam (cv. Floral) at Hyslop Farm of crop year 1997-98.

	Flower density (r)	Seed yield (r)
Larval density	-0.2230 (NS)	-0.0085 (NS)
Flower density		0.5231 (**)

**, NS = significantly different at $p = 0.01$, and not significantly different, respectively.

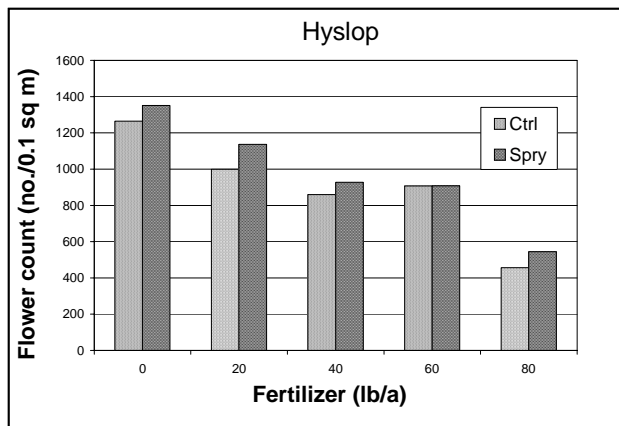


Figure 3. Mean flower density of meadowfoam, *Limnanthes alba* (cv. Floral) in plots of different fertilizer rates, with and without insecticide sprays collected from 0.1 m² at Hyslop Farm of 1997-98.

Table 3. Mean flower density and seed yield of meadowfoam (cv. Floral) in plots of different N fertilizer rates and with and without insecticide (oxydemeton-methyl) collected at Hyslop Farm of 1997-98.

Treatments ¹	Flower density	Seed yield
(Fertilizer/Insecticide)	(no./0.1 m ²)	(lb/a)
0	1,264 ab ²	661 a
0/IA	1,351 a	617 ab
20	998 bc	585 b
20/IA	1,136 abc	651 a
40	860 c	602 ab
40/IA	928 c	622 ab
60	907 c	589 b
60/IA	909 c	575 b
80	457 d	581 b
80/IA	545 d	489 c

¹ = Fertilizer (lb/a)/ Insecticide applied (IA) at 0.5 lb/a, monthly interval.

² = Means with the same letter are not significantly different (ANOVA-LSD, $p = 0.01$, $n = 4$).

Flight activity was generally greatest from February through May. There were four possible peaks. The highest peak was detected in early March (Figure 2). A small peak was detected in October, prior to seedling emergence. Flight activity and larval density gradually decreased as bloom progressed (Figure 1 and Figure 2).

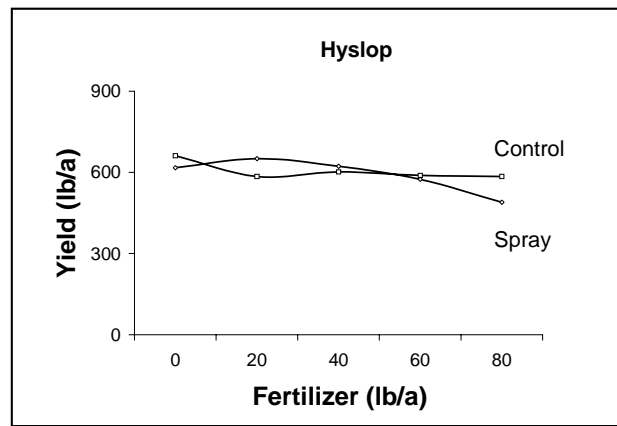


Figure 4. Mean yield of meadowfoam, *Limnanthes alba* (cv. Floral) in plots of different fertilizer rates, with and without insecticide sprays at Hyslop Farm of 1997-98.

Conclusion

Meadowfoam is sensitive to excessive nitrogen fertilization. Treatments with increasing nitrogen rates showed detrimental effects on all yield components. Lodging from excessive nitrogen application (as reported in Mermaid cultivar) was not observed in this experiment. Stands with higher nitrogen rates were distinctively thinner with plants possessing fewer branches than those of the lower rates. Fertilization rates beyond 0 lb/a generally decreased seed yield, except in the 20 lb/a with insecticide application. The significant increase in fly infestations at higher nitrogen rates suggests this insect was preferentially attracted to plants high in N content. Given that seeds set per flower in all treatments were not significantly different suggested that the odd of being pollinated were probably about equal in flowers of different treatments. Interestingly, the use of multiple sprays prior to bloom actually decreased yields in fertilized plots. This suggests that suppression of insect infestation by insecticide did not overcome effects of excessive N application. Moreover, the combination effects of fertilizer and insecticide accelerated the reduction of seed yield. The inverse relationship between nitrogen fertilizer rate and seed yield agrees with previous reports (Jolliff, et al., 1993). However, seeds set/flower was unaffected by nitrogen rate or insecticide.

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Table 4. Distribution and percentages of the seeds set per flower of different fertilizer rates and insecticide treatments on meadowfoam, *Limnanthes alba* (cv. Floral) collected at Hyslop Farm on June 28, 1998.

Treatments ¹	Distribution of seeds set/flower							Average ² (seed/flower)
	0	1	2	3	4	5	> 5	
	------(%)-----							
0	11.16	13.97	18.60	21.32	24.38	10.41	0.16	2.6570
0/IA	18.89	14.48	13.80	18.67	15.61	18.44	0.11	2.5339
20	13.99	16.65	15.08	12.78	26.66	14.84	0.00	2.6598
20/IA	17.68	21.17	14.86	17.57	17.12	11.60	0.00	2.3007
40	20.03	15.18	16.23	14.53	21.33	12.70	0.00	2.4005
40/IA	13.87	15.31	20.10	22.37	19.98	8.25	0.12	2.4450
60	16.94	13.58	17.66	20.73	18.10	12.99	0.00	2.4847
60/IA	14.99	21.48	15.52	18.97	17.90	11.14	0.00	2.3675
80	15.97	14.93	22.05	14.24	18.05	14.76	0.00	2.4774
80/IA	21.22	16.56	21.22	19.29	14.31	7.40	0.00	2.1109
								NS

¹ = Fertilizer (lb/a)/Insecticide application (IA) at 0.5 lb/a, monthly interval.

² = (n = 4).