LAMB GRAZING AND EGYPTIAN ALFALFA WEEVIL CONTROL[1]

E. T. Natwick[2], J. N. Guerrero[2], M. I. Lopez[2], and A. R. dos Santos[3]

ABSTRACT: During the winters of 2001 and 2002 at the University of California Desert Research and Extension Center, we conducted a lamb grazing trail to compare the efficacy of lamb grazing to insecticides for insect control on alfalfa. Lambs grazed alfalfa pasture (*Medicago sativa*,var. CUF101) from January through March of each year. Four wethers, mean initial weights 48.7 and 48.8 kg, respectively, grazed paddocks, 20.1 m x 20.1 m, for 10 to 14 d. Lamb grazing was compared to a control, no grazing and no insecticides; and to Furadan® and Lorsban® insecticides for insect control on winter alfalfa. Esophageal cannulas were placed in four wethers to detect the presence of insects in consumed alfalfa forage. During the winter, the insects that are of most concern in alfalfa culture in the irrigated Sonoran Desert are aphids and the Egyptian alfalfa weevil (*Hypera brunneipennis*). During the first three days of grazing on each paddock; from January 28 to January 31, 11.1 weevils g^{-1} extrusa DM, 0.5 weevil eggs g^{-1} extrusa DM, and 205.3 cowpea (*Aphis craccivora* Koch) aphids g^{-1} extrusa DM were detected. From March 16 to March 18, 3.3 weevils g^{-1} extrusa DM, 0.5 weevil eggs g^{-1} extrusa DM, and no cow pea aphids were detected. On March 5, we took estimates of hay production of the December 1999 through February 2001 treated plots. During the December and early January grazing periods there were no ($P > 0.05$) treatment differences in hay yields, as kg/ha hay. For the plots from January 28 to February 9, the grazed plots produced higher ($P < 0.05$) hay yields, 4472 kg/ha; versus the control, 3925 kg/ha; the Furadan®-treated plots, 4216 kg/ha; or the Lorsban®-treated plots, 3603 kg/ha. We conclude that lamb grazing is equally as efficient as insecticides for weevil and aphid control on winter alfalfa, in the irrigated Sonoran Desert.

Key words: sheep, grazing, insect control, Egyptian alfalfa weevil

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INTRODUCTION

Every winter from 200,000 to 400,000 lambs graze non-dormant winter alfalfa in the irrigated Sonoran Desert (Guerrero et al., 1997). Lamb graziers pay alfalfa growers on a head-day basis for grazing privileges. Lambs start to arrive in the irrigated Sonoran Desert from October through November, start leaving to market starting in late January, and are gone by late March. Previous lamb grazing research in the irrigated Sonoran Desert demonstrated that lambs effectively control weeds in alfalfa during the winter grazing season (Bell et al., 1996). Besides weeds, insects also adversely affect spring alfalfa hay yields (Univ. Calif., 1985). Several aphid species attack non-dormant winter alfalfa in the irrigated Sonoran Desert, such as the pea aphid (*Acyrthosiphon pisum*), the blue alfalfa aphid (*Acyrthisiphon kondoi*), the spotted alfalfa aphid (*Therioaphis maculate*), and the cowpea aphid. These sucking insects reduce hay yields by

stunting plant growth. The Egyptian alfalfa weevil reduces hay yields by actually defoliating the alfalfa plant.

The purpose of integrated pest management is to apply insecticides to crops only when necessary (Univ. Calif., 1985). For control of the Egyptian alfalfa weevil, the University of California Integrated Pest Management Program (UC-IPM) suggests that insecticide not be applied to alfalfa until a threshold of 20 larvae per sweep are attained. Several studies (Hatfield et al., 1999; Dowdy et al., 1992; and Buntin and Bouton, 1996) have reported that livestock grazing reduces insect predation of commercial crops. During the winter of 2001, we compared lamb grazing to two insecticides and to a non-grazing control to evaluate the effectiveness of grazing for insect control in non-dormant alfalfa in the irrigated Sonoran Desert.

PROCEDURES

During the winters of 2001 and 2001, we conducted a lamb grazing trial at the University of California Desert Research and Extension Center to evaluate the effectiveness of grazing lambs in controlling insect damage in non-dormant alfalfa. On December 8, 2000 and on December 21, 2001, we received 20 wethers, mean weights 48.7 and 48.8 kg, respectively. We compared lamb grazing to a no-grazing control, and to two insecticides; Furadan® and Lorsban®; for insect control in winter alfalfa. Insecticides were applied according to University of California Integrated Pest Management Guidelines (Univ. Calif., 1985) for control of Egyptian alfalfa weevil (*Hypera brunnipennis*, Boheman; AW). Four wethers, randomly allocated by weight to experimental paddocks, grazed alfalfa paddocks, 20.1 m x 20.1 m, for 10 to 14 d. Each year, each treatment was replicated four times. To quantify lamb consumption of insects, esophageal cannulas (Ellis et al., 1984) were placed in four wethers to detect the presence of insects in extrusa. Animal care procedures for this study were approved by the Animal Use Care Advisory Administrative Committee of the University of California. After an overnight fast, fistulated lambs grazed experimental paddocks for 30 min each morning. Fistulated lambs were daily rotated to different paddocks. Lamb extrusa samples were collected for the first three and last three d of grazing. Immediately after extrusa collection, 5 g of unwashed extrusa were then floated in water in a 25 cm diameter and 5 cm deep glass dish to count insects. A 10x magnifying glass was used to count insects floating in water. Another 5 g of the same extrusa sample were dried in a forced-air oven for 72 h at 50<. Extrusa data were reported as number of insects, or insect parts, per g of extrusa DM. To estimate hay DM yields, at the first alfalfa hay harvest after the cessation of lamb grazing, five 0.1 m^2 quadrats of alfalfa forage on each experimental paddock were clipped at a 2.5 cm height and dried in a forced-air oven for 72 h at 50< and weighed. After being weighed, each alfalfa quadrat sample was manually separated into leaf and stem portions and reweighed.

Egyptian alfalfa weevil (*Hypera brunneipennis)* adults and larvae, bigeyed bug (*Geocoris spp.*), damsel bug (*Nabis spp.*), minute pirate bug (*Orius spp.*), assassin bug (*Zelus and Sinea spp.*), lady beetle (*Hippodamia convergens*), Green lacewing (*Chrysopa carnea*), spiders, collops (*Collops vittatus*), (cowpea aphid (*Aphis craccivora*), blue alfalfa aphid (*Acyrthosiphhon Kondoi*), pea aphid (*Acyrthosiphhon pisum*), spotted alfalfa aphid (*Therioaphis maculata*), alfalfa caterpillar (*Colias eurytheme*) and beet armyworm (*Spodoptera exigua*) populaton levels were estimated from weekly D-vac, stem and sweep samples. We took 10 D-vac (area, 0.25 m^2)

samples per plot. The insects population levels were estimated for weekly samples 20 alfalfa stem cut for each plot. D-vac and stem alfalfa samples were placed in barlese funnels for 72 hours to extract insects (Buntin and Bouton 1996). Insects samples were stored in 70% EtOH and later was identificated and data were logged. The weevil larvae and insects were sampled by sweep net to determine when a treatment threshold of 20 weevil larvae per sweep (Anonymous 1985) was reached for timing of the insecticide application. The rest of the insects were immediately identified and data were logged. Egyptian alfalfa weevil eggs population levels were estimated from weekly samples of alfalfa foliage taken from three random .25 m^2 quadrats of hay per plot. Eggs were extracted from stem via blender extraction method (Pass and VanMeter 1966). Paddocks were sampled for Egyptian alfalfa weevil (adults, larva, eggs) and insects according to the following schedule: (1) weekly pre-grazing; (2) post-grazing immediately after lambs are removed; (3) weekly on regrowth until larvae hatch.

Statistical Analyses. T-tests (Steel and Torrie, 1960) were used to determine treatment differences in extrusa and in alfalfa hay yields.

RESULTS AND DISCUSSION

Figure 1 represents insects found in extrusa during the first 3 d of grazing in each paddock. Aphids routinely attack late winter and spring alfalfa in the irrigated Sonoran Desert. During the first 3 d of grazing, aphids were found in lamb extrusa. Alfalfa weevil adults break aestivation when night temperatures are consistently below 5.5<. Weevil adults then mate and weevil eggs hatch within 5 to 10 d. Lambs first arrive in the irrigated Sonoran Desert for the winter grazing season in October and November and are shipped to market starting in late January and are gone by late March (Guerrero and Marble, 1991). For effective weevil control in alfalfa, it is important that lambs graze the alfalfa fields as weevil eggs hatch before the weevils seriously defoliate the alfalfa. In 2001, we encountered weevil larvae in lamb extrusa during the last week of January and throughout February (Figure 1). During the last 3 d of grazing (Figure 2), when only about 10 cm of alfalfa stem material remained in the paddocks, we found weevil larvae in lamb extrusa in late January and to lesser extents throughout February. If weevil fragments in lamb extrusa are evidence of weevil infestation, the greatest weevil infestations in 2001 occurred in late January.

Alfalfa weevils lay eggs inside the alfalfa stem. For effective weevil control in alfalfa, it is necessary for the lambs to consume all the foliage in the paddocks. We found weevil eggs in lamb extrusa (Figure 1) during the first 3 d of grazing throughout January and February of 2001. During the last 3 d of grazing (Figure 2), we found weevil eggs in lamb extrusa throughout our grazing study.

Several studies have documented the effectiveness of grazing livestock for insect control. Hatfield et al. (1999) reported that grazing sheep reduced the incidence of wheat stem sawfly (*Cephus cinctus*) in wheat stubble. Dowdy et al. (1992) reported that cattle grazing winter alfalfa in Oklahoma reduced weevil eggs by 67%, although weevil larvae numbers were always not reduced by grazing. Cattle grazing spring alfalfa in Georgia reduced weevil larvae numbers by 65% in 'Alphagraze' alfalfa and by 32% in 'Apollo' alfalfa (Buntin and Bouton, 1996). In this study, we documented (Figures 1). and 2) that lambs were controlling weevils and aphids in winter alfalfa in the irrigated Sonoran desert by finding insects in lamb extrusa.

For paddocks grazed in January and February; on March 5, 2001 at the first alfalfa hay harvest after the cessation of grazing, grazed paddocks produced higher ($P < 0.05$) hay yields, 4472 hg/ha; than the control, 3925 kg/ha; the Furadan®-treated plots, 4216 kg/ha; or the Lorsban®-treated plots, 3603 kg/ha. Mitchell et al. (1991) also reported that in the irrigated Sonoran Desert grazed alfalfa produced higher ($P < 0.05$) hay yields at the first harvest after the cessation of grazing than non-grazed controls. Paddocks that were grazed by lambs, at the first hay harvest after the cessation of grazing had a higher ($P < 0.05$) leaf percentage of the hay; 63.2% leaf; than the control plots, 57.5% leaf; the Furadan®-treated plots, 58.6% leaf, or the Lorsban®-treated plots, 57.1% leaf. If leafiness is indicative of alfalfa hay quality, not only did lamb grazing improve hay yields at the first hay cutting, but also improved alfalfa hay quality.

Hay yields and hay quality

In 2001, AW pressure was sufficient for pesticide application. After the cessation of grazing and at the first hay harvest, there were no treatment differences ($P > 0.10$) in hay yields (Table 1). Hay quality, however, was affected by treatment. At the first hay harvest after the cessation of grazing, grazed plots had higher percentage of leaf, lower NDF%, lower ADF%, and a higher CP% ($P < 0.10$, Tables 2 and 3). Results in 2002 were quite different. In 2002, AW threshold levels for pesticide application were not attained so the pesticide treatments were not applied. Only the control and grazing treatments were compared in 2002. At the first hay harvest after the cessation of grazing, the control plots yielded more hay ($P < 1.10$, Table 1) than the grazed plots. There were no differences ($P > 0.10$, Table 3) with regards to hay quality; NDF%, ADF%, or CP%. The grazed plots had a higher ($P < 0.10$, Table 2) percentage of leaf DM in hay than the control plots, although the numerical difference is minimal.

Egyptian alfalfa weevil in lamb extrusa

Grazing lambs do consume insects on alfalfa as they graze. In 2001, during the first three d of grazing, we counted 5.31±0.82 AW larvae and 1.4±0.45 AW eggs per g of extrusa DM. During the last three d of grazing, we counted 24.5±14.5 AW larvae and 1.6±0.46 AW eggs per g of extrusa DM. In 2002 when we did have enough AW to attain the threshold level for pesticide application we found only 1.12±0.03 AW eggs during the first three d of grazing and 0.25±0.09 AW eggs per g of extrusa DM during the last three d of grazing.

Conclusions

In those years when AW pressure is high enough to warrant pesticide application, grazing lambs are as effective as pesticides for AW control. At the first hay harvest after pesticide application or grazing, hay yields were unaffected by treatment, however hay quality in the grazed plots was higher than in the pesticide treated plots.

Implications

Lamb grazing of winter alfalfa in the irrigated Sonoran Desert has been demonstrated to improve hay yields and hay quality at the first harvest after the cessation of grazing. For lamb grazing to effectively control weevil defoliation of alfalfa, lambs must graze alfalfa fields as weevil eggs hatch. Lamb grazing in December and January, the coldest months of the year in the Sonoran Desert, if lambs crop the forage down to ground level, should control weevils by removing

weevil eggs. Lamb grazing in January, February and March should control weevils because the lambs are actually consuming the weevil larvae on the alfalfa foliage and by preventing larvae maturation. However, since lambs start leaving the irrigated Sonoran Desert to market starting in late January, sufficient lamb numbers may always not be available for alfalfa growers for effective weevil control during February and March.

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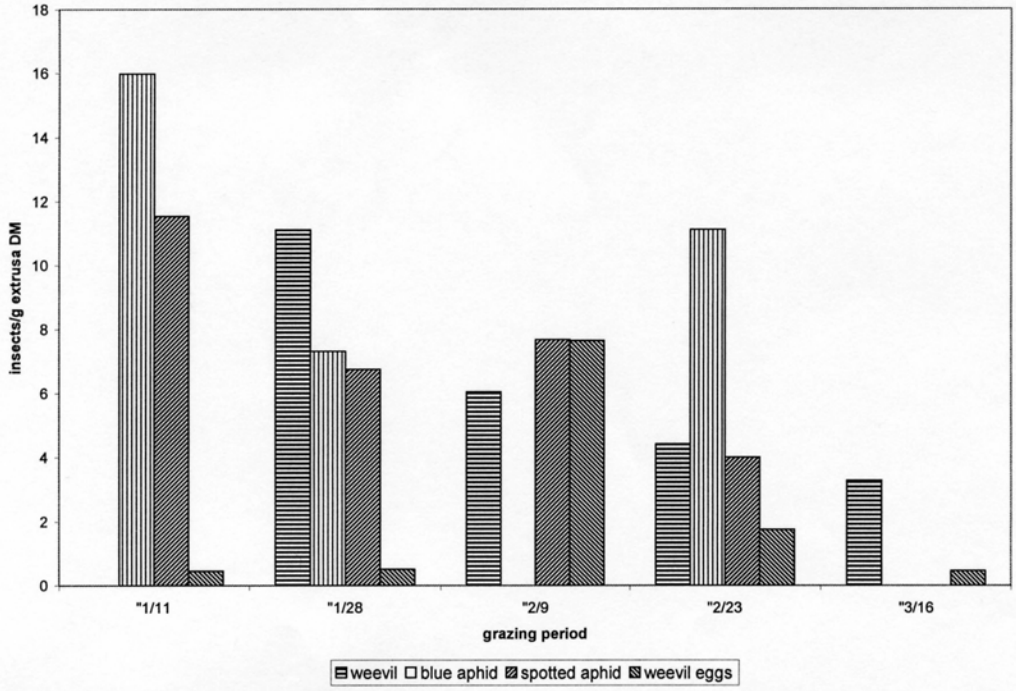

Figure 1. Insects per g of esophageal extrusa for first 3 d of grazing of experimental paddocks during winter grazing of alfalfa in irrigated Sonoran Desert.

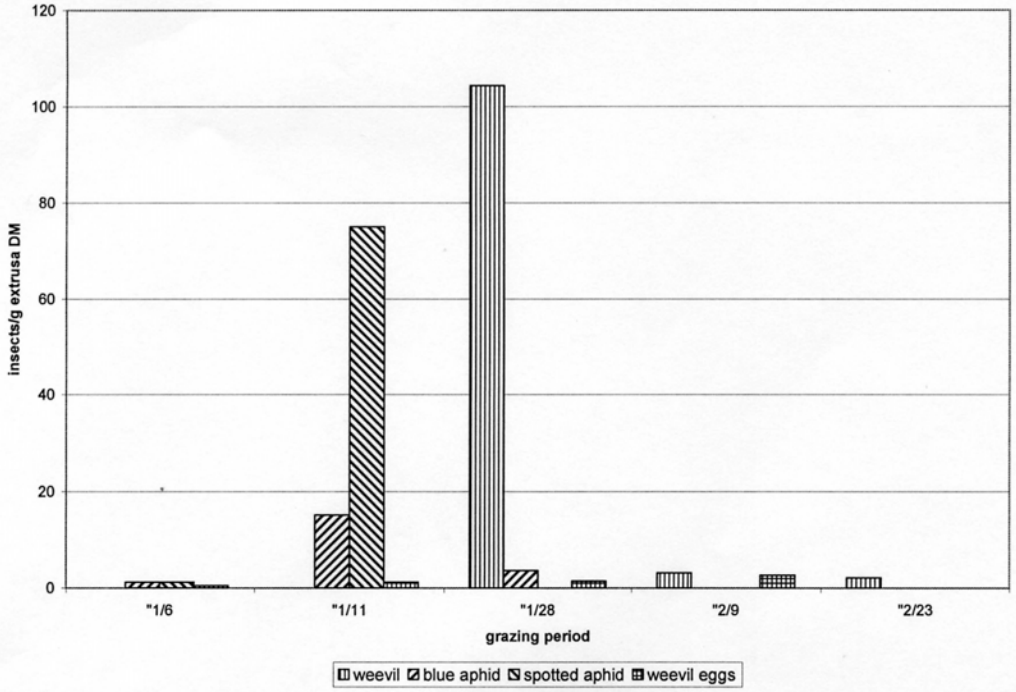

Figure 2. Insects per g of esophageal extrusa for last 3 d of grazing of experimental paddocks during winter grazing of alfalfa in irrigated Sonoran Desert.

Table 1. Alfalfa hay yields after grazing and different insecticide treatments.

	Alfalfa hay kg/ha	
	2001	2002[†]
	Mean ± SE	Mean ± SE
control	3109.6 ± 150.7	5300.9[a] ±152.5
Furadan®	3281.5 ± 128.6	
Lorsban®	2966.0 ± 113.4	
Lamb grz.	3311.9 ± 120.3	4960.9[b] ±117.0

[a] means with different superscripts differ, paired t-tests ($P < 0.10$).
[†] threshold levels for insecticide application not attained, no insecticides applied.

Table 2. Percentage leaf in first cutting hay after grazing and different insecticide treatments.

	% leaf	
	2001	2002[†]
	Mean ± SE	Mean ± SE
control	57.5[a] ± 0.95	59.7[a] ± 0.60
Furadan®	58.6[a] ± 0.75	
Lorsban®	57.1[a] ± 0.65	
Lamb grz.	63.2[b] ± 1.43	61.0[b] ± 0.48

[a] within year and column, means with different superscripts differ, paired t-tests ($P < 0.10$).
[†] threshold levels for insecticide application not attained, no insecticides applied.

Table 3. Alfalfa hay quality at first cutting after grazing or insecticide treatment, 2001.

	%NDF	%ADF	%CP
	Mean ± SE	Mean ± SE	Mean ± SE
control	39.47[a] ± 0.31	27.58[a] ± 0.36	17.04[a] ± 0.15
Furadan®	39.24[a] ± 0.38	27.84[a] ± 0.37	17.00[a,b] ± 0.15
Lorsban®	39.15[a] ± 0.40	28.17[a] ± 0.51	16.66[b] ± 0.14
Lamb grz.	36.75[b] ± 0.34	26.38[b] ± 0.43	17.49[c] ± 0.16
2002[†]			
control	41.66 ± 0.36	31.57 ± 0.35	19.04 ± 0.33
lamb grz.	41.05 ± 0.45	31.78 ± 0.45	19.22 ± 0.30

[a] within year and within column, means with different superscripts differ, paired t-tests ($P < 0.10$).
[†] threshold levels for insecticide application not attained, no insecticides applied.

Table 4. Insects (or parts of) per g of lamb extrusa DM, 2001.

First 3 d of grazing

	1/16-18	1/28-31	2/9-11	2/23-25	entire period
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
AWL*	†	11.1[a] ± 4.67	6.0[a] ± 1.5	4.4[a] ± 0.42	5.31[a] ± 0 .82
CPA‡	453.90[a] ±103.9	205.3[b] ± 32.48	72.7[b] ± 14.1	20.9[b] ± 4.08	209.70[b] ±39.24
BAA§	†	7.3[a] ± 2.97	†	†	12.80[c] ± 3.44
SA¶	11.50[b] ± 0.11	6.7[a] ± 1.50	7.7[a] ± 2.26	4.0[a] ± 1.39	8.30[c,d] ±1.58
eggs**	0.46[c] ± 0.17	0.51[c] ± 0.39	†	1.7[c] ± 0.60	1.40[e] ± 0.45

Last 3 d of grazing

	1/25-28	2/5-7	2/19-22	entire period
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
EAWL*	†	104.3[a] ± 27.37	3.1 ± 0.35	24.5[a] ± 14.15
CPA‡	515.02 ± 341.40	76.8[a,b] ± 46.49	17.8 ± 4.95	167.0[a] ± 77.97
BAA§	†	†	†	6.7[a] ± 4.33
SA¶	†	†	†	20.4[a] ± 25.74
eggs**	1.23 ± 0.30	1.4[b]	2.7 ± 0.85	1.6[b] ± 0.46

* Egyptian alfalfa weevil (*Hypera brunnipennis*, Boheman) larvae
‡ Cowpea aphid (*Aphis craccivora*, Koch)
§ Blue alfalfa aphid (*Acyrthosiphon kondoi*)
¶ Spotted aphid (*Therioaphis maculate*, Buckton)
** Egyptian alfalfa weevil eggs
† none present
[a] within grazing period and within column, means with different superscripts differ, paired t-tests ($P < 0.10$).

Table 5. Insects (or parts of) per g of lamb extrusa DM, 2002.

First 3 d of grazing

	Mean ± SE
CPA*	1.15[a] ± 0.15
BAA†	0.80[a] ± 0.25
SA‡	0.31[c] ± 0.02
eggs§	0.12[b] ± 0.03
Last 3 d grazing	
CPA*	1.73[a] ± 0.37
eggs§	0.25[b] ± 0.09

* Cowpea aphid (*Aphis craccivora*, Koch)
† Blue alfalfa aphid (*Acyrthosiphon kondoi*)
‡ Spotted aphid (*Therioaphis maculate*, Buckton)
§ Egyptian alfalfa weevil (*Hypera brunnipennis*, Boheman) eggs.
[a] within grazing period and within column, means with different superscripts differ, paired t-tests ($P < 0.10$).

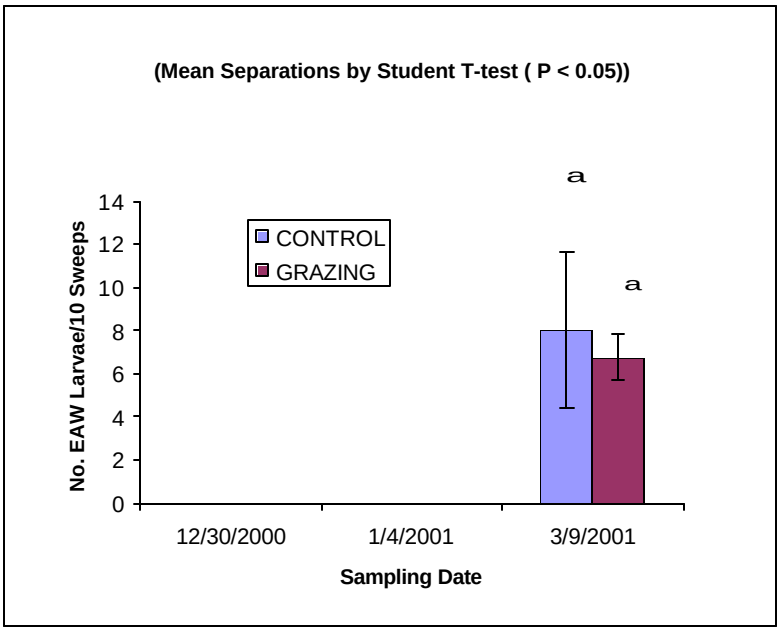

Figure 3. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 19 – 29 Dec 2001.

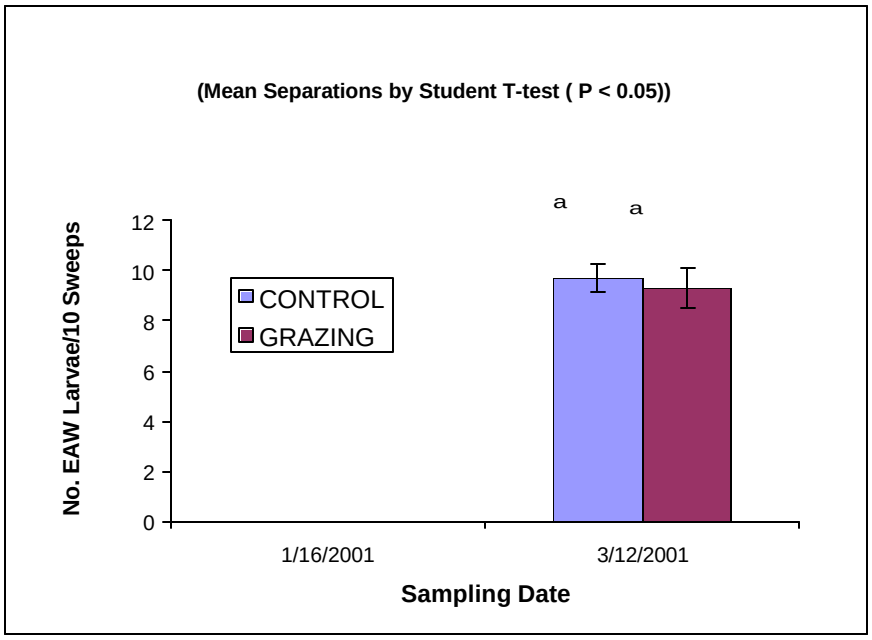

Figure 4. Number of Egyptian alfalfa weevil larvae following Grazing period #2 from 29 Dec – 10 Jan 2001.

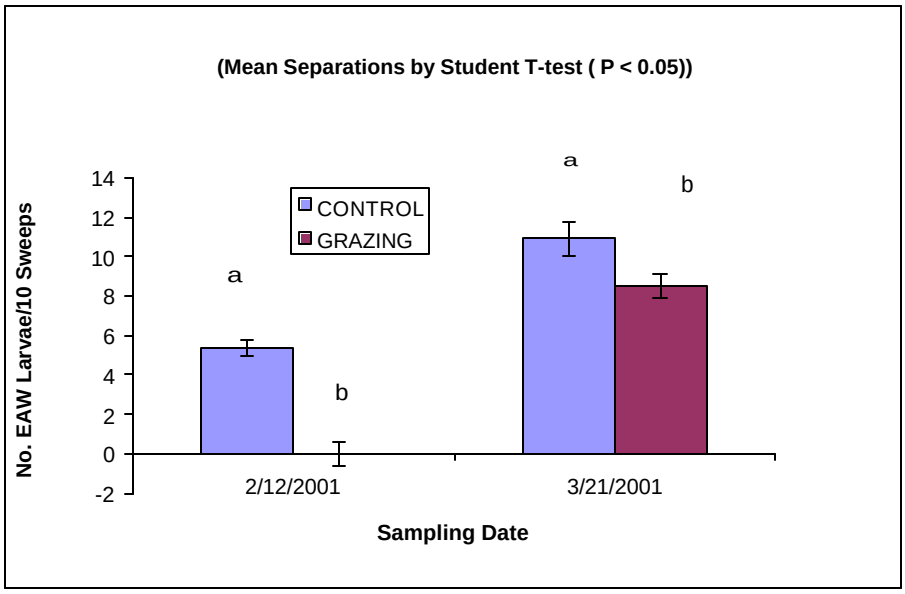

Figure 5. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 28 Jan – 9 Feb 2001.

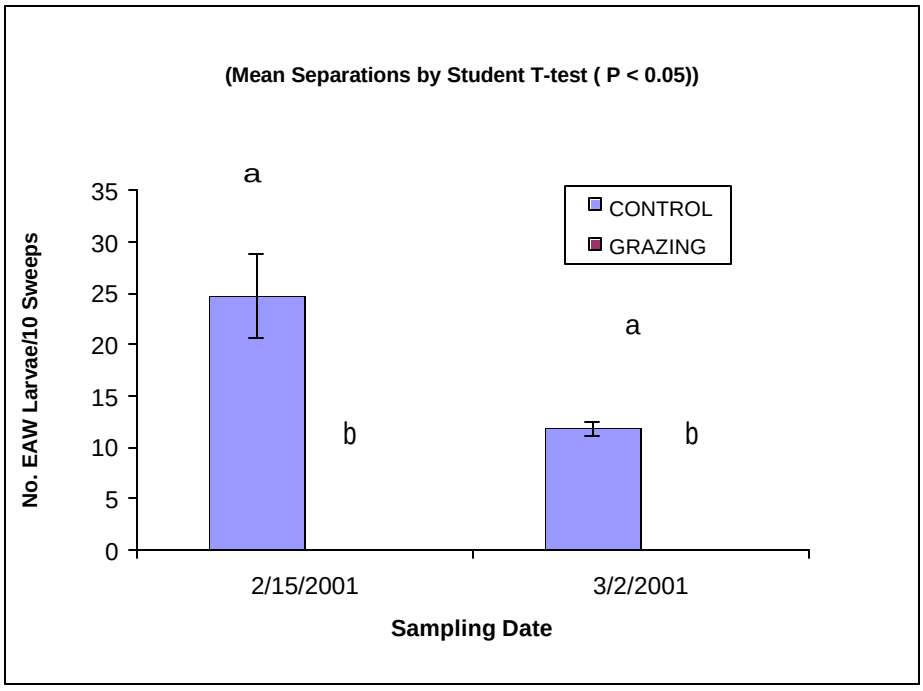

Figure 6. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 9 – 24 Feb 2001.

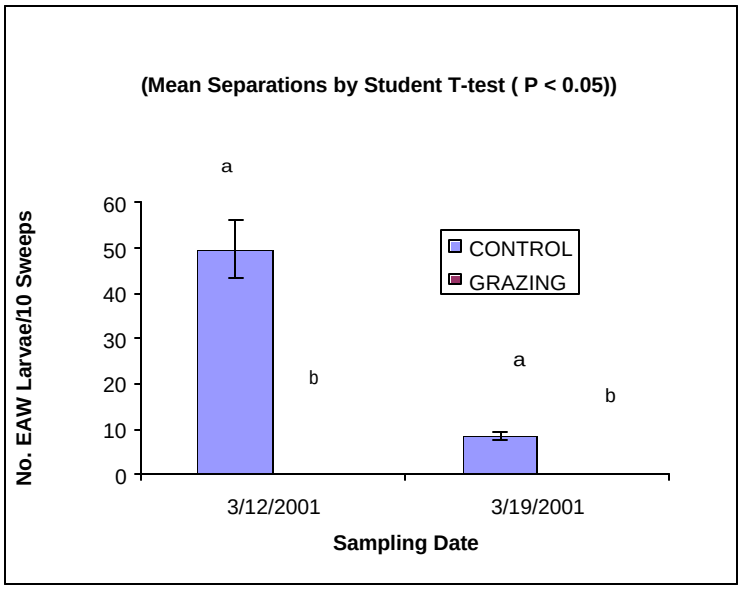

Figure 7. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 24 Feb – 2 Mar 2001.

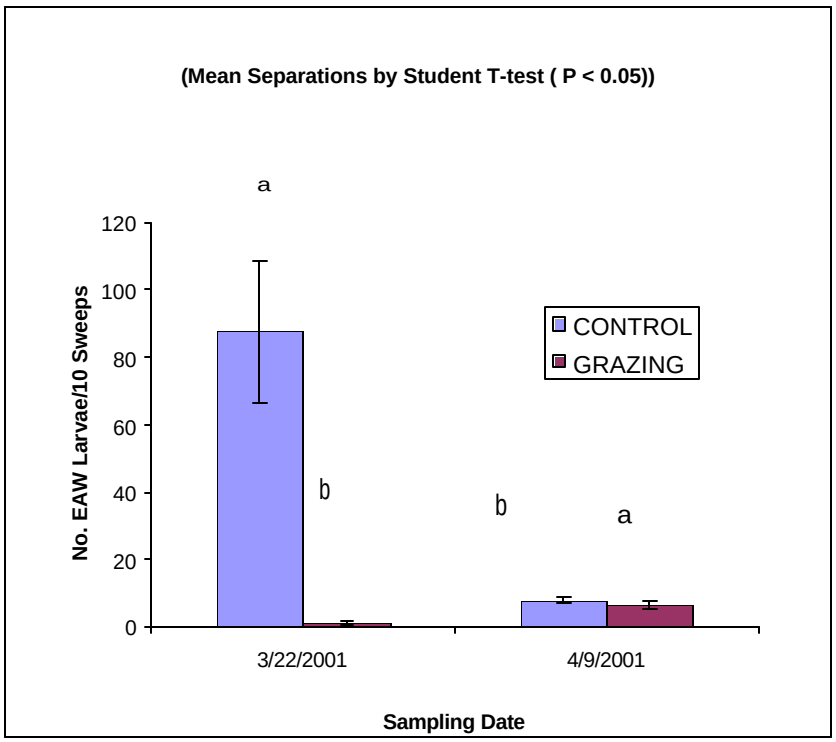

Figure 8. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 2 – 16 Mar 2001.

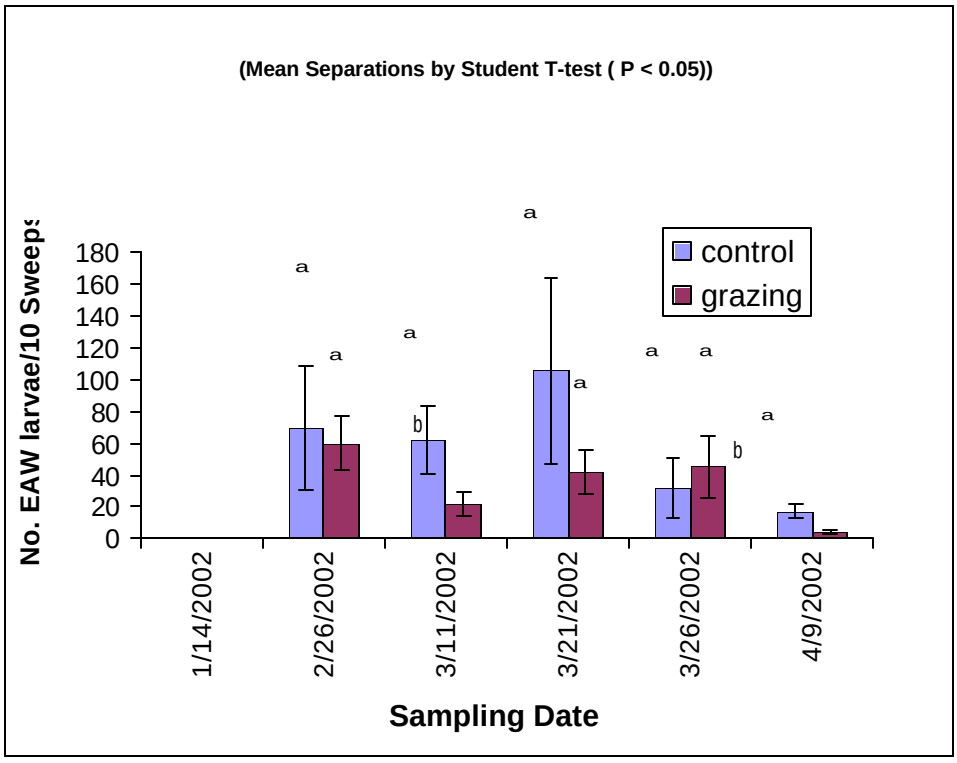

Figure 9. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 3 – 13 Jan 2002.

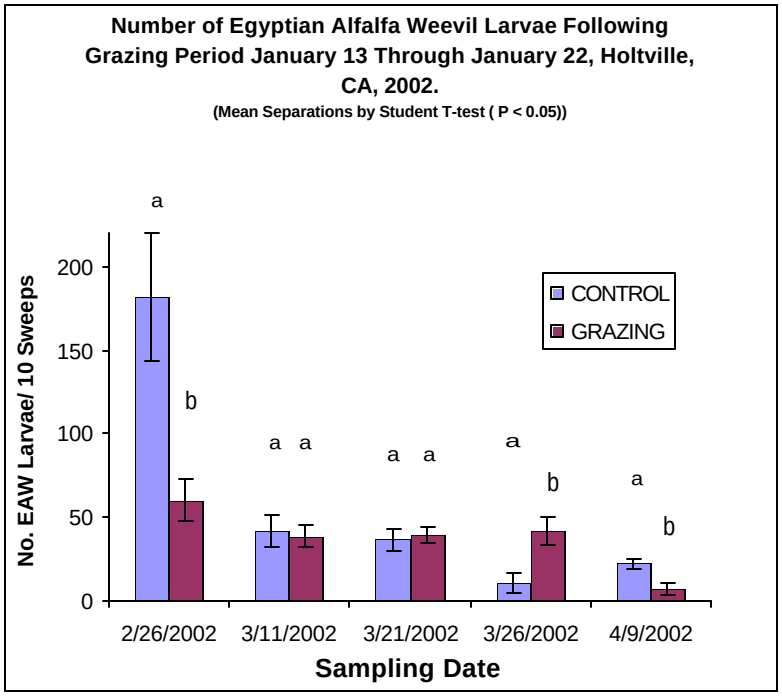

Figure 10. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 13 - 22 Jan 2002.

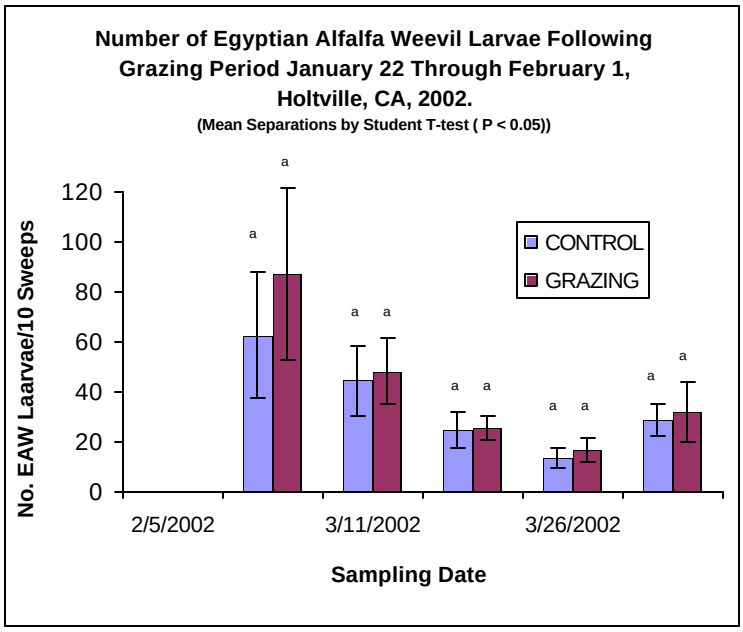

Figure 11. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 22 Jan – 1 Feb 2002.

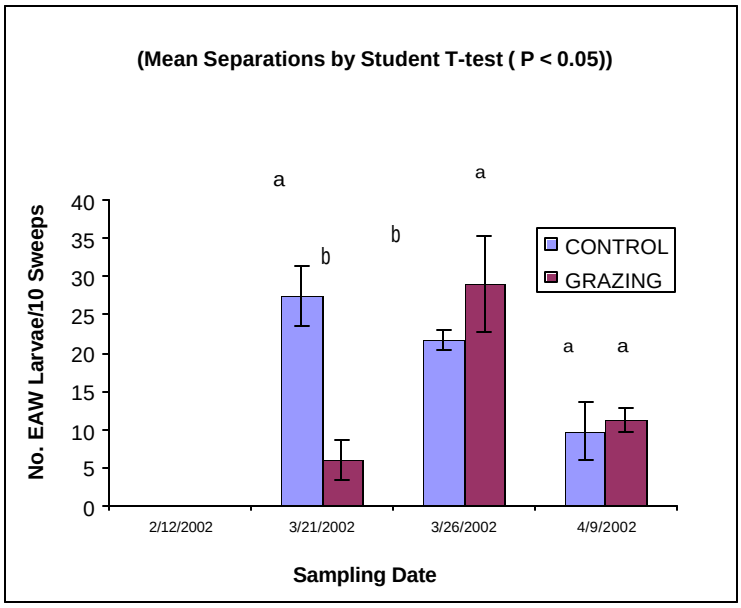

Figure 12. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 1 – 9 Feb 2002.

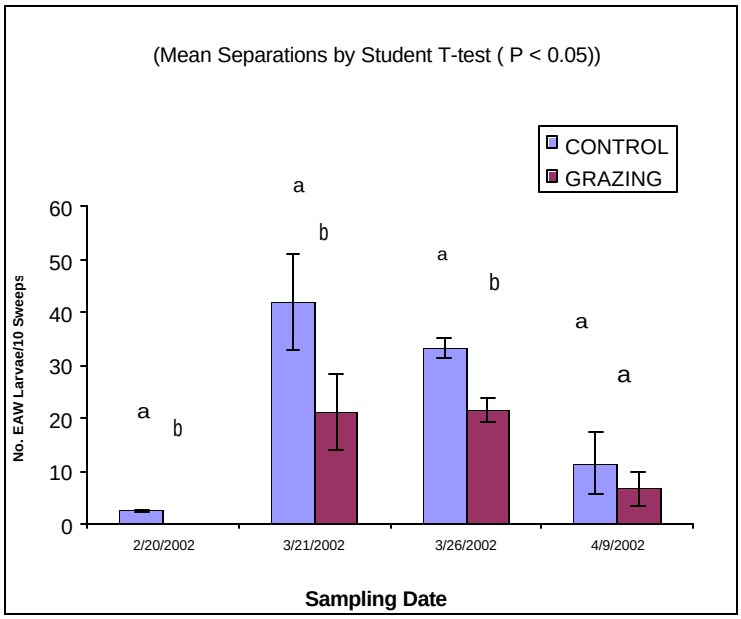

Figure 13. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 9 – 18 Feb 2002.

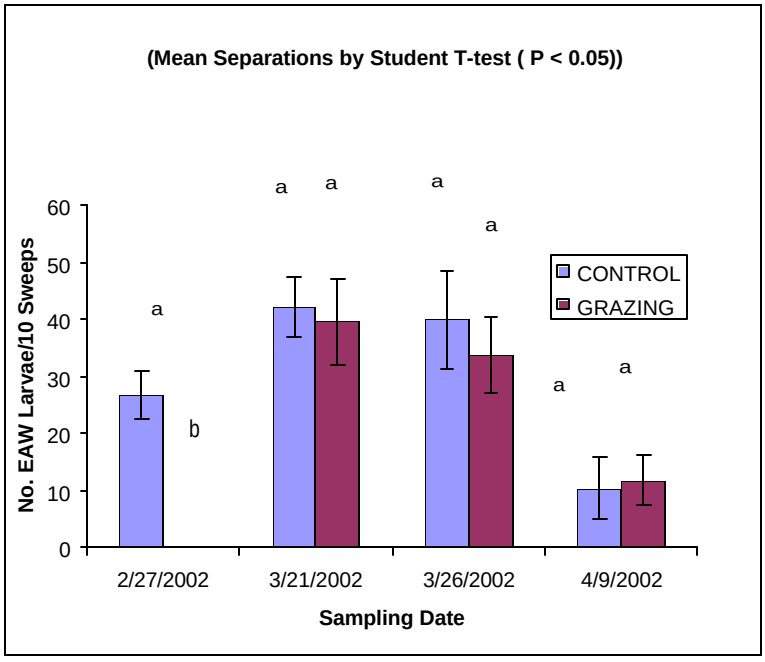

Figure 14. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 18 - 27 Feb 2002.

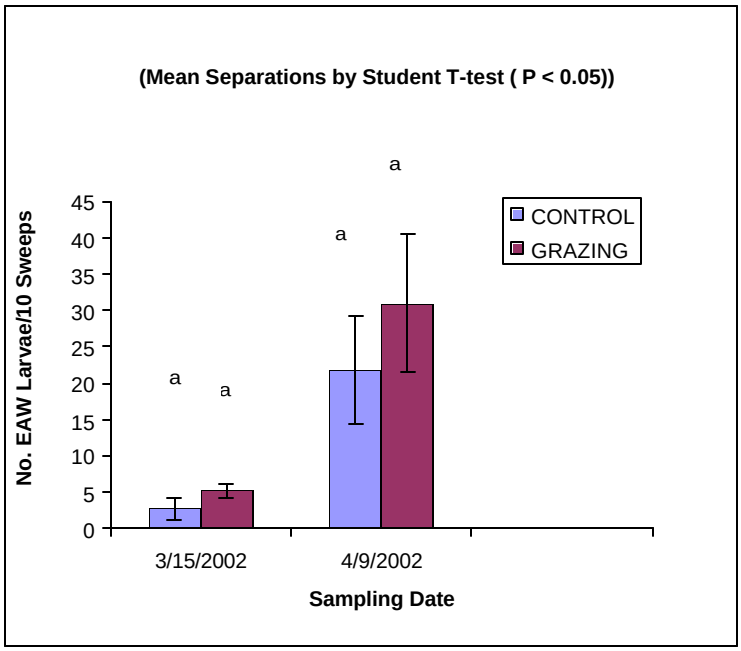

Figure 15. Number of Egyptian alfalfa weevil larvae following Grazing period #1 from 27 Feb – 7 Mar 2002.