Effect of Insects and Slugs on No-till Seeding of Ladino Clover in Grass Pastures

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Introduction

The establishment of forage legumes in grass pastures is desirable to improve forage quality and reduce the need for nitrogen fertilization. No-tillage establishment or sod-seeding of forage legumes such as ladino clover *(Trifolium repens* L.) and alfalfa *(Medicago sativa* L.) into grass sod reduces soil erosion during establishment, but grass competition. insect and slug damage can limit seedling establishment (Grant et al. 1982; Hoveland et al. 1982; Rogers et al. 1983, 1985: Wolf et al. 1983).

Suppression of grass competition by band or broadcast applications of paraquat or glyphosate enchances legume seedling survival and growth when interseeded into grass sod. Insects also have been associated with reduced legume seedling establishment in grass sod with damage often being associated with crickets, primarily *Allonemobius* spp, and *Gryllus* spp. (Grant et al. 1982; Rogers et al. 1983, 1985: Byers et al. 1985).Grasshoppers, armyworms, leafhoppers and plant bugs also may injure sod-seeded forage legume seedlings. Slugs can substantially reduce no-tillage establishment of legume seedlings in grass sod in the northern United States (Grant et al. 1982, Byers and Templeton, 1988). Insect and slug populations often are largest in late summer and early autumn, consequently late fall, winter and spring plantings usually avoid severe insect and slug damage (Rogers el al. 1983. 1985; Byers et al. 1985: Byers and Templeton 1988). At-planting application of a systemic insecticide and broadcast applications of a molluscicide have been found to reduce losses by insects and slugs to sod-seeded legumes (Rogers et al. 1983, 1985).

Sod seeding of ladino clover into tall fescue *(Festuca arundiacea* Schreb.) sod bas limited success in the Piedmont region of Georgia. Insect and slug damage are suspected as factors limiting no tillage establishment of forage legumes. We examined the effect of these factors and time of planting on the establishment of ladino clover seedlings in grass sod.

Materials and Methods

The effect of planting time. insect and slug control on the no-till establishment of 'Regal' ladino clover in a grass pasture was examined during 1985-1986 at the Beckham Research Farm located near Griffin, GA. The pasture was a 20 years old stand of tall fescue that had been managed mostly for hay production. Soil type was a cecil sandy clay loam (Typic Hapludult). Clover was slot-seeded in 10 inch rows at 5 lb of seed/acre using a Tye Pasture Pleaser grain drill. Vegatation was suppressed in a 4 inch band over the row in all treatments with Paraquat at *0.5* lb (Al)/acre plus X-77 . Treatments were three planting times (9 October, l November and 25 February) and a factorial combinaton of insect and slug control. Insects were suppressed with a broadcast application of carbofuran (Furadan) 15G at 2 lb (AI)iacre and a foliar application of carbofuran 4F at l.0 lb (AI)iacre on the day after planting and 10 days after planting, respectively. Slugs were controlled by broadcasting metaldyhde bait (3.3%) at 2 Ib (AI)/acre at l and 10 days after planting. A split plot experimental design was used with whole plots as planting dates and split plots as a factorial combination of insect and slug control. Whole plots were arranged in a randomized complete block design with four blocks with split plots measuring 20 x 30 ft.

Clover seedling number was measured periodically after planting by counting the number of plants in four randomly selected 1.6 ft. sections of row in each subplot. Foliage inhabiting insects also were sampled with a 15 inch diam. sweep net by taking 10 pendulum sweepsisubplot. Cricket populations were assessed by sampling all crickets in 2 randomly selected 2.69 $ft.^2$ area/subplot. Slugs were trapped using a shingle trap which consisted of a 5 inch diam. x 6 inch hole in the soil covered with a 1 ft roofing shingle that was wrapped in aluminium foil (Schrim and Byers 1980). Shingles were left in the field, and traps were sampled when clover counts were made.

Plant number at about 4 weeks (27-33 days) after planting and insect counts after about 2.5 weeks (15-19 days) after planting were analyzed with an overall analysis of variance to assess the effect of planting date. Plant and insect counts also were analyzed by planting date and sample period with an

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analysis of variance for a factorial design. Very few slugs were collected throughout the study and insect populations were not affected ($P > 0.05$), therefore results were pooled among slug control teatments. Insect control means were compared using Least Significant Difference (LSD).

Effect of method of applying carbofuran at planting to control insects in seedling 'Regal' ladino clover seedlings interseeded into grass pasture was examined in a second study at the Dempsey Research Farm located near Griffin, Ga. The pasture consisted of a 25-year-old stand of primarily tall fescue. Soil type was the same as in the first study. Clover was seeded and grass was suppressed with Paraquat as described in the in the planting date study. Carbofuran was applied at planting by three methods: granules (15G) broadcast, granules applied in furrow, and broadcast foliar application of Furadan 4F. Granules were broadcast with a hand-held shaker, and in-furrow applications were made with a fertilizer box mounted on the grain drill. Foliar spray was applied with a small-plot sprayer equipped with No. 4 flat fan nozzels which delivered 29 gal/acre. Carbofuran was applied by each method at rates of 0.5, 1.0 and 2.0 Ib (AI)/acre. Treatments were a factorial arrangement of application method and rate with an untreated control also included. Treatments were arranged in a randomized complete block design with four replications.

Clover was interseeded on 25 September 1985, and clover densities were sampled 23, 30, and 43 days after planting. Insect populations were sampled on the first two dates. Clover and insect sampling procedures were the same as in the planting date study. Plant and insect counts were analyzed by sample period with an analysis of variance of all treatments. If the treatment F-value was significant ($P < 0.05$) main effects of application method and rate were analyzed using an analysis of variance for a factorial design.

Results and Discussion

The predominant foliage inhabiting insects were leafhoppers and aphids, primarily the pea aphid, *Acrythosiphon pisum* (Harris). Predominant leafhoppers were *Exitianus exitious* (Uhler), *Graminella nigrifrons* (Forbes), *Graminella sonora* (Ball), *Polyamia weedi* (Van Duzee) and the clover leafhopper, *Aceratagallia sanguinolenta* (Provancher). *A. sanguinolenta* feeds mostly on legumes whereas the other species feed primarily on grasses Predominant cricket species were *Allonemobius fasciatus* DeGeer) and *Gryllus* spp. and grasshoppers were mostly *Melanoplus* spp. Very few

Table 1. Effect of insect control at planting with carbofuran in insect populations in ladino clover interseeded into tall fescue sod.

Planting date	Sample period (days after planting)	Insectide treatment	Taxa			
			Crickets	Leafhoppers	Aphids	Grasshoppers
Oct. 9	9	Untreated	5.0	20.1	0	0.1
		Treated	1.6	10.5	0	0.1
		LSD	3.2	8.9	NS	NS
	16	Untreated	3.3	26.1	0	0.4
		Treated	2.0	13.5	0	0.1
		LSD	NS	NS	NS	NS
	21	Untreated	2.9	6.1	1.0	0.4
		Treated	1.5	4.9	0.5	0
		LSD	NS	NS	NS	0.3
Nov 1	19	Untreated	1.5	18.1	141.0	0.1
		Treated	0.8	5.4	3.4	0
		LSD	NS	8.0	27.2	NS
	29	Untreated	2.3	3.6	1.1	0
		Treated	1.8	1.3	0.9	0
		LSD	NS	2.0	NS	NS
	57	Untreated	0	0	0	0
		Treated	0	0	0	0
		LSD	NS	NS	NS	NS
Feb 25	15	Untreated	0	1.8	6.6	0
		Treated	0	0.1	0.3	0
		LSD	NS	1.0	4.8	NS
	22	Untreated	0	2.0	5.5	0
		Treated	0	2.1	1.4	0
		LSD	NS	NS	NS	NS
	33	Untreated	0	3.2	7.3	0
		Treated	0	3.1	4.2	0
		LSD	NS	NS	NS	NS

NS = Not significant ($P = 0.05$; LSD).

slugs, *Deroceras* spp., were collected during the fall planting but none was collected in the winter planting.

Planting date significantly affected leafhopper ($F = 8.12$, $P = 0.02$) and aphid ($F = 96.71$. $P < 0.01$) densities with leafhoppers being most abundant in the 9 October planting and aphids being most abundant during the 1 November planting (Table 1). Grasshoppers were collected in low number only during the first fall planting. Crickets were significantly ($F = 8.39$, $P = 0.02$) more abundant during the fall plantings than the winter planting when none was collected. Insecticide usage significantly reduced leafhopper and aphid numbers at the first sample time in all plantings (Table 1). Cricket numbers were lower in treated than untreated plots in all sample where crickets were collected, but the reduction was significant ($P < 0.05$) only for the initial sample time in the October planting (Table 1).

Plant density reached a peak 2-3 weeks (Days 15-19)after planting and declined thereafter in all plantings (Table 2). Plant density about 4 weeks (27 — 33 days) after planting was significantly ($F = 18.77$, $P < 0.01$) greater in the February than the fall plantings. Plant number was not significantly ($P = 0.05$ - 0.92) affected by insect or slug control in any planting date. Futhermore, the rate of decline in seedling number from the peak number was not affected by pesticide usuage (Table 2). Clover density declined on average by 50.0, 60.3 and 50.8 % in the October, November, and February plantings, respectively. Despite a similar rate of stand lost, the February planting resulted in many more seedlings than the fall plantings with few seedlings remaining on the last sample period in the fall plantings.

Predominant foliage inhabiting insects in the second study were leathoppers and crickets. Foliar applications of carbofuran reduced leafhopper densities at 18 days after planting but not at 30 days after planting. Granular treatments did not consistently reduce leafhopper numbers on either sample date. Cricket, primarily *A. fasciatus* numbers generally were lower in treated than untreated plots, but were not significantly ($P < 0.05$) different between treatments on any date (data not shown).

Clover plant number in the second study peaked at 30 days after planting and declined thereafter (Table 3). Plant density was not significantly different between treatments at 23 and

Table 2. Effect of insecticide (IN) and molluscicide (MO) application at planting of the stand density of ladino clover interseeded into tall fescue sod at three planting dates.

Planting date	Sample date[a] (days after planting)	Treatment None	IN	MO	IN+MO	P>F
		~ L /row m				
Oct. 9	9	13.6	12.1	13.7	14.5	NS
	16	22.8	21.1	17.9	17.3	NS
	27	10.3	10.4	8.7	9.Y	NS
	48	2.1	2.0	2.0	2.5	NS
	Reduction (%)	54.8	50.7	51.7	42.8	NS
Nov 1	19	8.5	6.8	7.5	11.0	NS
	29	1.9	3.5	3.6	4.1	NS
	57	.06	0.4	0.1	0.3	NS
	Reduction (%)	77.7	48.4	52.0	62.8	NS
Feb. 25	15	82.9	99.9	93.5	80.0	NS
	22	78.8	68.3	65.4	67.5	NS
	33	43.9	52.9	35.3	42.X	NS
	Reduction (%)	471	471	6213	4616	NS

[a] Reductions were calculated from days 16-27, days 19-29, and days 15-33 after planting for the Oct 9. Nov 1. and Feb 25 plantings. respectively

Table 3. Effect of application method and rate of carhofuran at planting on ladino clover plant number when interseeded into grass sod.

Application method[a]	Rate (lb(AI)/acre)	Days after planting 23	30	43	Stand Reduction[b]
		Plants/ No./row m			%
Untreated		34.7	50.0abc	21.5a	57.5ab
BC granules	0.5	37.2a	50.8abc	19.3a	61.6ab
	1.0	26.9a	44.1ab	24.1a	43.3bc
	2.0	33.7a	45.0ab	18.3a	59.9ab
IF granules	0.5	25.4a	39.5a	12.1a	71.2a
	1.0	29.8a	66.9c	21.0a	68.9a
	2.0	31.7a	58.5bc	25.6a	59.0ab
BC foliar	0.5	30.7a	50.7abc	20.5a	59.3ab
	1.0	29.4a	41.8ab	27.6a	35.1c
	2.0	25.3a	50.3abc	19.6a	60.3ab
P-values					
Method (M)		0.34	0.23	0.67	0.04
Rate (R)		0.73	0.54	0.04	0.02
M x R		0.24	0.01*	0.11	0.09

Means followed by the same letter are not significatly different ($P = 0.05$; LSD).
[a] BC = broadcast, IF = in-furrow
[b] Reduction from day 30 to day 43 after planting.

43 days after planting. Significant ($P = 0.03$) differences in plant number occurred between treatments at 30 days after planting, but no treatment was significantly different than the untreated control. The percentage reduction in plant number from 30 to 43 after planting was significantly ($P = 0.01$) affected by application method with stand reduction in the in-furrow treatments being greater than the reduction in the other methods and the untreated control. Use of carbofuran in this study did not enhance the establishment of ladino clover in grass sod regardless of the application method or rate.

These initial studies indicate that insects and slugs had little effect on the no-tillage establishment of ladino clover seedlings in grass sod. Fall no-till establishment of ladino clover was poor regardless of insect or slug control. The planting date study indicated that seedling establishment was greatest during the winter (February). Winter planting avoided most insect and potential slug damage. The consistent decline in seedling numbers after planting in the fall suggests a that some factor other than insects, slugs and grass competition reduced seedling establishment. Soil-borne pathogens or edaphic factors including seed-soil contract and moisture stress may limit no-till establishment of legume sedlings. Insect populations are sporadic and may substantially reduce establishment of sod-seeded legumes (Hoveland, 1981) but insect damage can be minimized by planting later in the fall or during the winter.

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