EFFECTS OF NAPROPAMIDE AND PENDIMETHALIN ON CONNECTICUT TOBACCO, WEED CONTROL, AND FALL-SEEDED RYE (*SECALE CEREALE*)

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The effects of napropamide and pendimethalin herbicides on weed control, broadleaf tobacco tolerance, and fall establishment of rye were investigated in two field experiments over two years in Connecticut. Napropamide (at rates of 1.7 or 2.2 kg a.i./ha), pendimethalin (at rates of 1.1 or 1.7 kg a.i./ha) or both (1.1 and 0.8 kg a.i./ha, respectively) resulted in good weed control compared to untreated plots, with no detriment to the tobacco crop. Fresh- and cured-leaf yields were not affected by herbicide treatment. Rye cover crop vigor was initially reduced, but recovered. There were no differences between the herbicides for weed control, crop vigor, or effect on a rye cover crop following tobacco.

Additional key words: ***Nicotiana tabacum, Secale cereale.***

INTRODUCTION

A number of weeds can compete with Connecticut broadleaf tobacco (*Nicotiana tabacum* L.), and moderate competition can reduce leaf yields by 25 percent (1). In addition to competition for light, water and nutrients, weeds may harbor insects, serve as a reservoir for tobacco mosaic virus (12), and increase populations of the tobacco cyst nematode (*Globodera tabacum tabacum* Lownsbery and Lownsbery, Behrens) (2,5). Mechanical cultivation can aid in weed control, but late cultivation can reduce yields (1), increase the incidence of Fusarium wilt (6), and damage leaves. The use of herbicides in broadleaf tobacco production has been a common practice to supplement the weed control provided by cultivation.

Napropamide (1.4 kg/ha) residues remaining after tomato production reduced the growth of wheat cover crops established in the fall (4). Connecticut tobacco growers have concerns about residual effects of napropamide on rye established in the fall following tobacco production. Pendimethalin has been reported to injure a fall cover crop of wheat after burley production (11). However, pendimethalin has not been evaluated for weed control, broadleaf tobacco tolerance, or effect on a fall rye cover crop in Connecticut. The objectives in these experiments were to determine the effects of napropamide and pendimethalin on weed control, tobacco growth, and fall cover crop establishment.

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Materials and Methods

Napropamide (Devrinol 50W) and pendimethalin (Prowl 4E) were applied to Merrimac sandy loam (Entic Haplorthod, pH = 5.9, 3% organic matter) at the Connecticut (CT) Agricultural Experiment Station Valley Lab, Windsor, CT, in 1992 and 1993. Both herbicides are currently labeled for tobacco. Field plots were chosen which had a history of tobacco production, and had not had any herbicide applied within the last five years. Treatments were applied with a hand-held, CO_2-powered backpack sprayer equipped with 8003VS nozzles (Spraying Systems Inc., Wheaton, IL), calibrated to apply 280 L/ha.

In 1992, the field was prepared and fertilized with 135 kg N/ha of 10:8:10 N:P:K cottonseed meal-based fertilizer. A preplant application of diazinon (2.2 kg a.i./ha) and metalaxyl (1.1 kg a.i./ha) was incorporated into all plots 24 h before planting. On 11 June, four herbicide treatments (napropamide at 1.7 or 2.2 kg a.i./ha; pendimethalin at 1.1 or 1.7 kg a.i./ha; and a nontreated control) were applied to 1.8 by 4.9 m plots separated by 2.0 m borders on each side and 1.3 m borders at the ends of each plot. Treatments were replicated four times in a randomized complete block design. Immediately after herbicide application, the soil was tilled with a spring toothed harrow to a depth of 8.0 to 10 cm with two passes in opposite directions. On 11 June, two-month-old transplants of 'C9' broadleaf tobacco were machine-planted into two rows per plot (10 plants per row). Rows were 1.0 m wide and plants were 0.6 m apart within rows.

Plants were sidedressed with 121 kg N/ha via cottonseed meal-based 10:8:10 and tractor-cultivated on 16 June. Soil was pulled up around each plant with hand hoes after cultivation as per commercial practice. Visual ratings of tobacco vigor were made on 20 July (39 days after transplanting (DAT)) on a scale of 0 to 100 (0 = no live plants and 100 = no growth reduction). Foliar insects were controlled by acephate (1 kg a.i./ha) applied to all plots on 6 July.

Tobacco plants were topped and hand suckered on 10 August and 10 plants per plot were cut, weighed, and hung for air curing on 13 August (63 DAT). The number of harvested leaves and cured-leaf yields were recorded on 4 November.

On 19 August, following harvest, weed control in the plots was rated visually on a scale of 0 to 100 (0 = no control and 100 = 100 percent control). Primary weeds in the nontreated plots in 1992 were common purslane (*Portulacca oleracea* L.) and carpetweed (*Mollugo verticillata* L.).

The plots were uniformly seeded (surface broadcast with a rotary spreader) to a rye cover crop at a seeding rate of 224 kg/ha on 19 August and lightly disked to incorporate seed. Percent injury to the rye was independently rated by two persons on 9 September and averaged. On 30 October, rye shoot growth was removed from two 1.0 m square sample areas in the center of each plot and weighed.

Rainfall during 1992 was 14.4 cm in June, 11.6 cm in July, and 9.0 cm in August. Average rainfall was 8.8, 7.9, and 9.8 cm per month, respectively. Plots were irrigated (1.5 cm) on 27 August.

In 1993, plots were moved to a new location where herbicides had not been applied within the last five years. The same treatments as in 1992 were applied, plus a combination treatment of napropamide and pendimethalin at 1.1 and 0.8 kg a.i./ha. Plot size, design, herbicide applications, and applications of diazinon and metalaxyl were the same as 1992. Plots were fertilized with 150 kg N/ha (10:8:10 N:P:K cottonseed meal-based) prior to herbicide application. Transplants were set on 3 June.

Foliar insects were controlled by acephate (1.0 kg a.i./ha) applied to all plots on 21 June. Plants were sidedressed with 92 kg N/ha via 10:8:10 and cultivated on 24 June. Visual ratings of tobacco vigor were made on 29 July (56 DAT) and weed control ratings were taken 56 and 99 DAT. Plants were topped and suckered on 29 July prior to harvest on 5 August as described above. The most common weeds present in untreated plots in 1993 were large crabgrass (*Digitaria sanguinalis* (L.) Scop.) and prostrate pigweed (*Amaranthus blitoides* S. Wats.). Large crabgrass alone resulted in 90% ground cover in most nontreated plots. In one replicate, prostrate pigweed was the dominant weed and resulted in 90% cover.

Rainfall during 1993 was 6.6 cm in June, 12.3 cm in July, and 4.5 cm in August. Plots were irrigated (1.2 cm) on 2 July.

Plots were seeded to rye as in 1992 on 15 September and rototilled to a depth of 5 to 10 cm. Percent stand and percent injury to the rye was rated by two persons on 6 October and averaged. On 22 November, rye shoot growth was removed from two 1.0 m square sample areas per plot and weighed.

Rating data were analyzed by the nonparametric Kruskal-Wallis test. Rating data were also square root transformed prior to analysis of variance and means were separated by the LSD technique. Percent data were arcsine transformed to stabilize variance prior to analysis of variance.

RESULTS AND DISCUSSION

Weed control was good to excellent in both 1992 and 1993 (**Table 1**). Herbicide treatments did not differ in efficacy in 1992. Pendimethalin resulted in slightly better weed control than napropamide in July 1993, but differences were not significant by September. Tolerance of broadleaf tobacco to both

Table 1. Effect of napropamide and pendimethalin herbicides on weed control in broadleaf tobacco, 1992 and 1993.

Herbicide	kg a.i./ha	weed control rating[ab] 8/19/92	7/29/93	9/14/93
nontreated		0 b	0 c	25 b
napropamide	1.7	89 a	90 b	85 a
	2.2	92 a	90 b	89 a
pendimethalin	1.1	94 a	94 a	90 a
	1.7	95 a	96 a	96 a
napropamide/ pendimethalin	1.1/0.8	-	91 b	93 a
Significance (ANOVA)		0.001	0.001	0.001
Kruskal-Wallis Test		0.002	0.002	0.006

[a]Means within columns followed by the same letter are not significantly different (LSD, $P = 0.05$).

[b]Weed control rating on a scale of 0 to 100; 0 = no control, 100 = complete control.

Table 2. Effect of napropamide and pendimethalin herbicides on broadleaf tobacco growth and yield, 1992 and 1993.

Herbicide	kg a.i./ha	vigor[a] rating 7/20/92	vigor[a] rating 7/29/93	fresh wt. kg/5 plants 1992	fresh wt. kg/5 plants 1993	cured wt. kg/5 plants 1992	cured wt. kg/5 plants 1993
nontreated		90	88	7.3	7.7	0.65	0.68
napropamide	1.7	88	93	8.3	7.9	0.75	0.72
	2.2	85	88	8.2	8.1	0.70	0.73
pendimethalin	1.1	83	90	7.5	7.6	0.70	0.69
	1.7	88	88	8.0	8.3	0.70	0.76
napropamide/ pendimethalin	1.1/0.8	-	90	-	8.5	-	0.77
Sigificance (ANOVA, $P = 0.05$)		ns	ns	ns	ns	ns	ns
Kruskal-Wallis Test		ns	ns				

[a]Vigor rating on a scale of 0 to 100; 0 = no live plants, 100 = no growth reduction.

herbicides was good; there were no differences in vigor, and no phytotoxicity was apparent at 39 or 56 DAT or at any time during the season (**Table 2**). In fact, volunteer tobacco seedlings were present in many plots in 1992 with no indication of seedling injury. Fresh- and cured-leaf yield did not differ between treatments.

Residual herbicide activity affected early growth and establishment of the rye cover crop. Visual ratings in September of 1992 indicated that pendimethalin injured the rye more than napropamide at the higher application rate (**Table 3**). By October, there were no significant differences in rye fresh shoot weight. Similar results were observed in 1993. Percent stand was reduced, and injury ratings in early October were greater for pendimethalin than napropamide. However, there were no significant differences in fresh weight of the rye cover crop by November 1993. The rye cover crop appears to recover after reduced early stand density and early injury, resulting in sufficient growth that can reduce soil erosion. Residual activity of pendimethalin was previously reported to be one to two months in field soils (7).

Experience with napropamide (Devrinol) and other herbicides indicates that deep disking or plowing in the fall before planting can reduce injury to the cover crop (Ahrens, unpublished). Deep tillage dilutes the herbicide and makes it less available to the cover crop (4). Also, accelerated biodegradation of certain herbicides is known to occur with repeated annual use (3,8,10). Using napropamide on the same nursery fields for several years resulted in more rapid herbicide degradation and reduced effects on a fall cover crop (Ahrens, unpublished data). Rate of application can be an important factor in determining the residual effects of herbicides. Using the lowest labeled rate for the soil type can reduce the risk to the cover crop. In addition, other factors such as the excessive use

Table 3. Effect of napropamide and pendimethalin herbicides on the establishment and growth of a rye cover crop after broadleaf tobacco, 1992 and 1993.

Herbicide	kg a.i./ha	percent injury 9/9/92	fresh wt g/m^2 10/30/92	percent injury 10/6/93	percent stand 10/6/93	fresh wt g/m^2 11/22/93
nontreated		0 a[a]	720	0 a	84 a	513
napropamide	1.7	37 b	711	18 ab	69 a	510
	2.2	36 b	713	15 ab	60 ab	535
pendimethalin	1.1	46 b	628	28 b	58 b	429
	1.7	79 c	631	43 b	38 b	441
napropamide/ pendimethalin	1.1/0.8	-	-	33 b	50 b	423
Significance (ANOVA)		0.001	ns	0.01	0.03	ns
Kruskal-Wallis Test		0.03		0.02		

[a]Means within columns followed by the same letter are not significantly different (LSD, $P = 0.05$).

of certain chemical sucker controls have also been shown to reduce cover crop growth (9,11), and need to be considered. The use of alternative methods of reducing cover crop damage, such as deep tilling or plowing after harvest and before planting rye, may be more important than choice of herbicide, and deserves further investigation.

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