The Effects of Black Plastic Mulch and Weed Control Strategies on Herb Yield

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Abstract. Black polyethylene mulch and weed control strategies were evaluated for potential use by small acreage herb producers. In both 1988 and 1989, the mulch greatly increased fresh and dry weight yields of basil (*Ocimum basilicum* L.) and rosemary (*Rosmarinus officinalis* L.). Parsley (*Petroselinum crispum* Nym.) yield did not respond to the mulch. Preplant application of napropamide provided weed control for 2 weeks, but was subsequently not effective on a heavy infestation of purslane (*Portulaca oleracea* L.). Hand-hoed and glyphosate-treated plots (both with and without plastic) produced equivalent yields. Chemical names used: *N, N*-diethyl-2(1-naphthalenoxy)-propanamide (napropamide); *N*-(phosphonomethyl) glycine (glyphosate).

Although herbs have been produced commercially for centuries, very little research has been done on their production and cultural requirements (Simon, 1986), and little

technical information is available for the commercial grower. With the advent of "cottage" herb industries, there is a need for accurate, helpful horticultural information to optimize herb production.

Weed control in herbs is a particular problem since most herbs cannot successfully compete with weeds (Weller, 1986). Few herbicides are registered for use in herbs (Weller, 1987), and it is difficult and expensive to obtain pesticide registrations for minor crops, such as herbs (Frank et al., 1987). Glyphosate is a relatively nontoxic, nonselective herbicide that can be applied directly to the weeds after crop establishment (post-directed). Preliminary research has shown that napropamide and diphenamid (*N,N*-dimethyl-phenyl-benzeneacetamide) can be used on basil in the field (Weller, 1986), but many

herb growers may prefer to use nonchemical weed control practices and sell "pesticide-free" herbs. Frequent mechanical cultivation can damage delicate herb roots and disrupt plant growth (McPheeters and Noland, 1988). Therefore, the use of black plastic mulch could effectively and nonchemically provide weed control while possibly improving crop growth.

Benefits derived from the use of black plastic mulch are well-documented. In addition to controlling weeds, mulches can reduce leaching loss of nutrients and conserve moisture (Ashworth and Harrison, 1983). Soil compaction is decreased, and the CO₂ level around the plant is increased when plastic mulch is used (Bonanno and Lament, 1987; Clarkson and Frazier, 1960). Another benefit of polyethylene mulch is an increase in soil temperature under the plastic, which can lead to earlier production than would occur with bare soil (Clarkson and Frazier, 1960; Wien and Minotti, 1987). The environmental changes associated with plastic mulch can lead to increased crop yields (Bonanno and Lament, 1987; Ricotta and Masiunas, 1988; Wien and Minotti, 1987).

We investigated the effect of black polyethylene mulch on weed control and yield of basil, parsley, and rosemary. Also, the use of napropamide applied before transplanting, hand-hoeing, and directed glyphosate wicking were evaluated as potential weed control strategies.

Basil, parsley, and rosemary seeds were sown into plastic cell trays (6 ml/cell) containing moist peat-vermiculite soilless mix (Terra-Lite Redi-Earth, W.R. Grace, Memphis, Term.) and placed in a greenhouse with an average day/night cycle of 24/18C. The soil in the field plots was a Flannagan silt loam (fine montmorillonitic, mesic, Aquic Argiudoll) with 4% to 5% organic matter. No fertilizer was applied. Napropamide at 2.2 kg-ha⁻¹ was applied to half the plots after plastic laying and immediately before

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Table 1. Herb vigor ratings^a, 1988.

Mulch	Herbicide ^y	Weeks after transplanting		
		2	5	10
<i>Basil</i>				
Yes	Yes	8.5 a ^y	9.8 a	9.9 a
Yes	No	6.3 ab	7.8 b	8.8 b
No	Yes	9.0 a	8.8 ab	9.0 b
No	No	5.0 b	7.8 b	8.5 b
<i>Rosemary</i>				
Yes	Yes	8.8 a	9.0 a	8.5 a
Yes	No	4.8 b	6.0 b	6.3 b
No	Yes	8.0 a	7.8 a	7.3 b
No	No	6.3 b	4.8 b	3.7 c
<i>Parsley</i>				
Yes	Yes	6.8 a	7.3 a	7.3 a
Yes	No	5.3 a	5.5 a	6.3 a
No	Yes	6.0 a	5.5 a	6.0 a
No	No	5.0 a	5.5 a	5.0 a

^aMulch and herbicide interactions significant at $P = 0.05$. Mean separation within columns by interaction (mulch $\times$ herbicide) LSD, $P = 0.05$. Vigor was visually evaluated with a rating scale of 10 = large and robust, to 1 = small and weak.

^bNapropamide applied preplant; no-herbicide plots were hoed.

transplanting. A CO₂-pressurized backpack sprayer was used, delivering 240 liters·ha⁻¹ at 206 kPa. The spray was directed to the center of the bare ground plots and in 30-cm bands adjacent to either side of the plastic. Four- to 6-week-old seedlings were transplanted (6 June 1988 and 15 June 1989) by hand into bare ground or holes punched into the black polyethylene mulch (0.102 mm thick, 91 cm wide). The entire plot was

sprinkler irrigated immediately after transplanting.

Napropamide was initially effective in preventing weed emergence, but, after 2 weeks, the extremely heavy purslane infestation required additional mechanical cultivation of the napropamide-treated areas. The dissipation of herbicidal activity may have been caused by inadequate watering-in and subsequent napropamide photodecomposition. The remaining plots were hand-hoed at 4, 8, and 12 weeks after transplanting. Vigor of the herbs was visually evaluated 2, 5, and 10 weeks after transplanting, with a rating scale of 10 = large and robust, to 1 = small and weak. In 1989, plots were either hand-hoed or treated with glyphosate (0.58 acid equivalents glyphosate/liter of H₂O) in a wick applicator (wicking) at 3, 6, 9, and 12 weeks after transplanting; weed control was rated 3 and 10 weeks after transplanting (1 = no control, 10 = complete control).

In both years, the experiment was sprinkler-irrigated to provide adequate moisture. All harvesting was done by hand, and fresh weights were taken immediately. In 1988, basil was harvested on 5 Aug. and the remaining herbs on 15 Sept. In 1989, all herbs were harvested on 15 Sept. Herbs dried for 4 days at 60°C before dry weight determination.

Treatments were arranged as a 2 $\times$ 2 factorial in a completely random design with four replications. Analysis of variance was performed on vigor and weed control ratings and fresh and dry weights. The 2 $\times$ 2 factorial allowed the interaction of mulch and

herbicide (in 1988, napropamide; in 1989, glyphosate) to be evaluated. Mean separations were performed using the interaction least significant difference (Steel and Torrie, 1980).

1988. There was no visible crop injury from napropamide. Napropamide inhibited common purslane emergence for at least 2 weeks, allowing basil and rosemary to grow more vigorously than in the hand-hoed plots (Table 1). From 5 to 10 weeks after transplanting, the differences in vigor were not as distinct except in the rosemary. Basil and rosemary grown on bare ground with no herbicide were less vigorous than when grown on plastic with herbicide. Mulch and herbicide treatments did not affect the vigor of the parsley.

Results were similar for both fresh and dry weights (Table 2). Many small-volume herb growers sell only fresh herbs that require no packaging, so only the fresh weight data will be discussed. Napropamide treatment did not affect the basil yield. However, there were differences in basil yield between plastic and bare-ground plots, suggesting a yield increase due to plastic mulch. Rosemary yields from both plastic and bare-ground napropamide-treated plots were higher than from the untreated plots. The slightly longer weed-free period in the napropamide-treated plots presumably improved rosemary growth. The yield of rosemary grown on untreated bare ground was only 25% of the yield from the napropamide-plastic treatment. There were no significant differences in the parsley yield from any treatment.

1989. Three weeks after transplanting, hoeing generally provided better weed control than wicking in the rosemary and parsley plots (Table 3). However, at 10 weeks, the bare soil plots where glyphosate was applied had better weed control than the hoed, bare-soil plots. Glyphosate will translocate and kill plant meristems, preventing regrowth, while hoed plants will often regrow. In general, plastic mulch provided the best weed control within the rows, although some weeds did emerge through the holes in the plastic.

Overall yields were greater in 1989 than in 1988, presumably because of more rainfall and moderate temperatures (Table 2). The beneficial effect of the plastic was again evident in 1989. Yield of the herbs in the bare ground-glyphosate plots was reduced compared to the plastic mulched-hoed plots. This difference was due to inadvertent glyphosate contact with the herbs, and illustrates a problem growers might encounter. Rosemary produced significantly greater yields on plastic-covered than on bare soil. There was no difference in rosemary yield between hoed or glyphosate-treated plots within mulch treatments. Rosemary is a woody rather than herbaceous plant, thus less susceptible to glyphosate damage. In both 1988 and 1989, parsley yields from plastic and hoed, bare-ground plots were not significantly different, indicating that plastic mulch did not have a stimulator effect on the cool-season herb.

The results of these studies indicate that the use of black polyethylene mulch can im-

Table 2. Herb fresh and dry weights as influenced by black plastic mulch and weed control method.^a

Mulch	Herbicide ^y	Basil		Rosemary		Parsley	
		Wt (g/plant)		Wt (g/plant)		Wt (g/plant)	
		Fresh	Dry	Fresh	Dry	Fresh	Dry
1988							
Yes	Yes	504 a	108 a	69 a	25 a	111 a	35 a
Yes	No	378 ab	80 b	42 b	18 b	86 a	19 a
No	Yes	319 b	65 b	41 b	16 bc	79 a	21 a
No	No	277 b	58 b	17 c	11 c	73 a	23 a
1989							
Yes	Yes	749 a	188 a	137 a	66 a	354 ab	127 ab
Yes	No	840 a	227 a	156 a	80 a	478 a	165 a
No	Yes	393 b	85 b	85 b	47 b	227 b	77 b
No	No	658 ab	151 ab	85 b	51 b	368 ab	137 ab

^aMulch and herbicide interactions significant at $P = 0.05$. Mean separation within columns and year by interaction (mulch $\times$ herbicide) LSD, $P = 0.05$.

^bIn 1988, herbicide was napropamide applied preplant; in 1989, herbicide was glyphosate applied with a wick applicator. No-herbicide plots were hoed.

Table 3. Weed control ratings^a, 1989.

Mulch	Herbicide ^b	Basil		Rosemary		Parsley	
		Weeks postplant		Weeks postplant		Weeks postplant	
		3	10	3	10	3	10
Yes	Yes	8.5 a	7.8 a	6.5 b	7.2 a	6.8 b	7.0 a
Yes	No	9.2 a	7.0 a	9.0 a	8.5 a	7.8 a	6.8 a
No	Yes	4.5 b	7.0 a	4.0 c	7.8 a	1.8 c	6.5 a
No	No	6.5 b	5.0 b	6.2 b	5.8 b	6.3 b	6.0 b

^aMulch and herbicide interactions significant at $P = 0.05$. Mean separation within columns by interaction (mulch $\times$ herbicide) LSD, $P = 0.05$. Weed control rating based on 1 (no control) to 10 (complete control).

^bGlyphosate applied with a wick applicator. No-herbicide plots were hoed.

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