Table 1. *Pythium* species isolated from small carrot roots at Zellwood, Florida, that were pathogenic to carrots in greenhouse tests.

Species	Pathogenic isolates (%)[z]	Isolated from PV plates
P. irregulare Buisman	30	yes
P. debaryanum Hesse	13	yes
P. ultimum Trow	13	yes
Unidentified	13	?
P. megalacanthicum deBary	10	rarely
P. sulcatum	7	rarely
P. vexans deBary	7	no
P. aphanidermatum (Edson) Fitzpatrick	3	yes

[z]Per cent of 36 total pathogenic isolates.

to confirm this notion. Thus, fallow flooding appears to be a valuable cultural practice where it is feasible to implement. A better understanding of the processes of flooding involved in reducing populations of *Pythium* species and other pests would contribute to a more efficient use of water resources required.

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WEED CONTROL IN ROOT CROPS GROWN ON ORGANIC SOILS[1]

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Additional index words. radish, *Raphanus sativus*, carrot, *Daucus carota*, herbicide.

Abstract. **During a 3-yr period herbicides were evaluated for weed control efficacy and carrot** (Daucus carota **L.**) **and radish** (Raphanus sativus **L.**) **crop tolerance grown on organic soils. In radishes preemergence applications of CDEC (2.0 lb./acre), propachlor (4.0 lb./acre), metolachlor (1.5-3.0 lb./acre), thiobencarb (4.0 lb./acre), alachlor (2.0 lb./acre), pendimethalin (1.0-2.0 lb./acre) and diethatyl-ethyl (4.0 lb./acre) provided adequate control of goosegrass** (Eleusine indica **(L.) Gaertn**), **spiny amaranth** (Amaranthus spinosus **L.**), **lambsquarter** (Chenopodium album **L.**), **and purslane** (Portulaca oleracea **L.**). **Almost all herbicide treatments resulted in reduced yields. In carrots, preemergence applications of metolachlor (3.0 lb./acre), alachlor (3.0-6.0 lb./acre), thiobencarb (4.0-8.0 lb./acre), metribuzin (0.25-0.5 lb./acre), propachlor (2.0 lb./acre), linuron (1.0-2.0 lb./acre), and diethatyl-ethyl (4.0-6.0 lb./acre) provided acceptable control of spiny amaranth and purslane for 4 weeks. However, propachlor and metribuzin reduced crop vigor. Preemergence applications of metolachlor, propachlor, and diethatyl-ethyl provided acceptable control of goosegrass and broadleaf panicum** (Panicum adspersum **Trin.**) **4 weeks after treatment. Postemergence applications of fluazifop-butyl (0.125-0.25 lb./acre), sethoxydim (0.15-0.3 lb./acre), haloxyfop-methyl (0.15-0.3 lb./acre) and DPX-Y6202 (DuPont Chemical Co.) (0.25 lb./acre) provided excellent control of the grass weed species. Combination postemergence applica-**

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tions of linuron (1.0 lb./acre) or thiobencarb (4.0-6.0 lb./acre) plus fluazifop-butyl (0.25 lb./acre) provided excellent control of all weed species for the entire growing season.

In Florida, there are 30,000 acres of radishes produced exclusively on high organic or muck soils. Herbicides are not available for weed control in radishes (4). Carrots are currently produced on 11,000 acres of organic soil. Presently, only linuron and paraquat are available for weed control in Florida carrots (4). Linuron is not effective on all weeds and at times reduces crop yield. Paraquat can only be used as a shielded application leaving weeds within rows still present and there is a considerable risk for crop damage. It is difficult to determine the total effect of weeds on root crop production. Weeds compete for space, light, moisture, and nutrients as well as act as hosts for pathogens, insects, and nematodes. Weeds also interfere with harvesting procedures and reduce quality.

McCollum et al. (3) found that the yields of carrots were 14% greater with the application of a preemergence herbicide followed by a linuron layby treatment. Numerous chemical compounds have been evaluated during the past 3 years (1, 2) for weed control efficacy and their effects upon radish and carrot crop vigor. The results of some of those studies are presented here.

Materials and Methods

Radish. Herbicide evaluation trials for radish grown on organic soils were conducted during the fall of 1981 ('Red Prince'), the spring of 1982 ('Red Prince'), and spring of 1983 ('Red Devil'). Radishes were planted according to standard grower practices. Plots were 20 ft by 4.5 ft and were arranged in a randomized block design with 3 replications. Preemergence herbicide applications were made with a CO_2 charged back-pack sprayer with 11004 flat fan nozzle tips operated at 30 psi and 3 mph with an output of 30 gal/acre. Weed control and crop vigor ratings were made 2 weeks after treatment and at the time of harvest (28 days after planting) when root yields were recorded.

Carrot. Preemergence and postemergence herbicide trials for carrots grown on organic soils were conducted in the spring of 1982 and spring of 1983. Carrots ('Scarlet Nantes') were direct seeded according to grower standards. Plots were 20 ft by 6 ft and were arranged in a randomized complete block design with 3 replications. Herbicide applications in 1982 were made using a tractor mounted sprayer operated at 30 psi and 3 mph with an output of 37.5 gal/acre. In 1983, herbicide applications were made using a CO_2 back-pack sprayer operated at 30 psi and 3 mph to obtain an output of 30 gal/acre. Weed control ratings and crop vigor ratings were made periodically during the growing period. Total yields were recorded in 1983.

Weed control ratings were made for both radish and carrot trials using a 0 to 10 system with 0 being equal to no control and 10 being equal to 100% control. Crop vigor ratings were made in a similar manner, with 0 meaning 100% damage and 10 equalling no crop damage.

Results and Discussion

The major weed infestation in the fall 1981 radish study area were goosegrass, spiny amaranth and purslane. During the spring of 1982 the major weed infestations were lambsquarter, spiny amaranth, and goosegrass. In the 1983 spring the major weeds were spiny amaranth and purslane. Excellent goosegrass control (>80%) was provided by preemergence applications of CDEC (2.0 lb./acre), metolachlor (1.5-3.0 lb./acre), alachlor (2.0-4.0 lb./acre) and pendimethalin (1.0-2.0 lb./acre) in the fall 1981 study 4 weeks after treatment (Table 1). Applications of the same rates of metolachlor and alachlor controlled goosegrass in the spring 1982 study. CDEC and pendimethalin applications did not provide as adequate control as during the previous trial. Application of propachlor (4.0 lb./acre), thiobencarb (4.0 lb./acre) and diethatyl-ethyl (6.0 lb./acre) also controlled more than 80% of the goosegrass.

In the fall 1981, CDEC (2.0 lb./acre), metolachlor (1.5-3.0 lb./acre), alachlor (2.0-4.0 lb./acre) and pendimethalin (1.0-2.0 lb./acre) all provided greater than 92% control of spiny amaranth and purslane. In 1982, CDEC, alachlor and pendimethalin again provided adequate control (>82%) of the broadleaf weeds, spiny amaranth and lambsquarter, whereas, metolachlor applications did not. Propachlor (2.0-4.0 lb./acre) and thiobencarb (4.0 lb./acre) also provided adequate control of these weeds. In 1983, application of these same compounds resulted in greater than 80% control of spiny amaranth and purslane except the low rate of pendimethalin. Metribuzin applications did not provide adequate weed control and resulted in a loss in crop vigor.

In the fall of 1981, the highest radish yields for the

Table 1. Influence of preemergence herbicide treatments upon weed control and radish crop vigor.

		Weed control and crop vigor ratings[z]							
	Rate	FALL 1981			Spring 1982			Spring 1983	
Herbicide	(lb. a.i./acre)	GR	BL	CV[y]	GR	BL	CV	BL	CV
Check	—	0.0	0.0	10.0	0.0	0.0	10.0	0.0	10.0
CDEC	2.0	9.0	9.5	9.0	5.5	8.5	9.5	8.7	9.8
Metolachlor	1.5	8.7	9.2	9.8	8.0	4.7	10.0	8.7	9.5
Metolachlor	3.0	8.8	9.3	9.8	9.0	7.0	10.0	9.5	9.3
Alachlor	2.0	9.3	9.5	9.7	8.8	8.7	9.8	9.5	9.3
Alachlor	4.0	9.0	9.5	9.7	9.3	9.7	9.7	9.8	9.2
Propachlor	2.0	—	—	—	7.8	8.0	9.5	8.5	9.7
Propachlor	4.0	—	—	—	9.0	9.2	9.7	9.4	9.7
Pendimethalin	1.0	8.7	9.5	10.0	5.7	8.2	9.5	6.3	9.5
Pendimethalin	2.0	9.3	9.7	9.7	7.2	9.4	9.3	8.2	9.5
Thiobencarb	2.0	—	—	—	4.0	4.0	9.8	8.5	9.7
Thiobencarb	4.0	—	—	—	9.0	8.0	9.7	9.0	9.8
Metribuzin	0.25	—	—	—	—	—	—	5.2	7.0
Metribuzin	0.5	—	—	—	—	—	—	6.8	2.0
Diethatyl-ethyl	4.0	—	—	—	7.8	6.0	10.0	—	—
Diethatyl-ethyl	6.0	—	—	—	8.2	5.2	9.3	—	—
LSD (0.05)		1.9	0.5	1.5	1.0	2.1	0.5	1.8	0.9

[z]Weed control 0 = 0% control, 10 = 100% control; Crop vigor 0 = dead, 10 = no damage.
[y]GR = grass weeds; BL = broadloaf weeds; CV = crop vigor.

treated plots were obtained from CDEC (2.0 lb./acre) and pendimethalin (2.0 lb./acre) (Table 2). However, yield with the checks was also high, out producing all treatments except pendimethalin. In all the trials reported herein the checks were always one of the highest producers indicating crop toxicity from the herbicides even though there was no apparent reduction in crop vigor. It also appears that the weeds did not compete severely with radishes during the short growing period of 28 days so to affect yield. However, producers consider some weed control method desirable to prevent loss of radish quality and interference with harvesting procedures. In these studies the radishes were not graded as to size. Visual observations were made as to quality and there was no apparent loss in color or increased cracking due to treatment. With less than adequate weed control, total yield differences may not be observed but quality as to size may be affected. Herbicides such as alachlor and metribuzin did reduce total crop yield significantly. More research is needed to determine the effects of herbicide treatments on weed control and total crop yield as well as quality.

Preemergence herbicide applications in 1982 of linuron (1.0-2.0 lb./acre), thiobencarb (4.0 lb./acre), and diethatyl-ethyl (4.0-6.0 lb./acre) provided greater than 80% control of spiny amaranth and purslane in carrots 6 weeks after treatments (Table 3). In 1983 only metolachlor (1.5-3.0 lb./acre) provided adequate spiny amaranth control. Propachlor applications resulted in a loss of crop vigor in 1982 and 1983 as did alachlor and metribuzin in 1983.

Goosegrass control (>80%) was achieved by applications of propachlor (2.0-4.0 lb./acre) and diethatyl-ethyl (6.0 lb./acre) in 1982. However, propachlor was toxic to carrots. In 1983, goosegrass and broadleaf panicum were controlled by applications of propachlor (2.0-4.0 lb./acre), metolachlor (3.0 lb./acre), thiobencarb (4.0-8.0 lb./acre), alachlor (3.0-6.0 lb./acre), and metribuzin (0.5 lb./acre). Propachlor, alachlor, and metribuzin resulted in loss of crop vigor and yield.

Loss in yield due to weed competition or herbicide toxicity to carrots was observed (Table 3). Highest yields were obtained with preemergence applications of linuron, metolachlor at the lowest rate, thiobencarb, pendimethalin at the highest rate, and low rates of metribuzin. Although there was no apparent loss in crop vigor, some herbicides resulted in significant yield losses. The 3.0 lb. a.i./acre rate of metolachlor provided adequate weed control with no apparent loss in crop vigor but a loss in crop yield was observed.

Postemergence applications in another study of the grass herbicides, fluazifop-butyl, haloxyfop-methyl, DPX-Y6202, and sethoxydim provided excellent grass control for 4 weeks after application with no loss in crop vigor or yield (Table 4). Combination postemergence applications of linuron or thiobencarb plus fluazifop-butyl provided excellent control of spiny amaranth, goosegrass and broadleaf panicum with no significant loss in crop vigor or yield. All postemergence herbicide treatments resulted in higher yields than the check. The combination of thiobencarb (6.0 lb./acre) plus fluazifop-butyl (0.25 lb./acre) provided the highest yield.

Further studies are needed to determine the effects of herbicide applications upon weed control efficacy, crop vigor and yield in radishes and carrots. From these studies it appears that metolachlor, propachlor, pendimethalin, and thiobencarb may be feasible weed control herbicides to be used in radish production. Metolachlor, thiobencarb, diethatyl-ethyl and metribuzin as well as the new class of

Table 2. Influence of herbicides upon radish yields.

Treatment	Rate (lb. a.i./acre)	Radish yields (lb./acre) Fall 1981	Spring 1982	Spring 1983
Check	—	5316	9575	12421
CDEC	2.0	5055	9425	11489
Metolachlor	1.5	4488	9950	10158
Metolachlor	3.0	4763	9050	11223
Alachlor	2.0	4522	9500	8827
Alachlor	4.0	4118	8375	7853
Propachlor	2.0	—	9675	10557
Propachlor	4.0	—	9750	10824
Pendimethalin	1.0	4448	8700	11271
Pendimethalin	2.0	6200	7675	10515
Thiobencarb	2.0	—	8950	9849
Thiobencarb	4.0	—	9250	11670
Metribuzin	0.25	—	—	7187
Metribuzin	0.5	—	—	3285
Diethatyl-ethyl	4.0	—	8325	—
Diethatyl-ethyl	6.0	—	8675	—
LSD (0.05)		165	625	346

Table 3. Influence of preemergence herbicides upon weed control carrot crop vigor and yield.

Treatment	Rate (lb. a.i./acre)	Weed control and crop vigor ratings[z] Spring 1982 BL	GR	CV[y]	Spring 1983 BL	GR	CV	Yield (lb./acre)[x]
Check	—	0.0	0.0	8.9	0.0	0.0	9.3	9202
Linuron	1.0	9.5	4.3	9.4	4.3	5.0	9.3	12546
Linuron	2.0	9.5	6.6	9.6	3.7	6.0	9.5	14271
Propachlor	2.0	8.4	8.2	0.0	6.8	9.2	8.7	10054
Propachlor	4.0	9.3	9.5	0.0	6.0	8.3	6.0	4729
Metolachlor	1.5	7.3	3.5	9.6	8.2	7.8	9.3	12929
Metolachlor	3.0	8.2	7.6	9.4	8.0	8.3	9.3	7412
Thiobencarb	4.0	8.2	7.7	9.7	7.3	8.3	9.2	10544
Thiobencarb	8.0	—	—	—	8.8	8.5	9.2	10288
Pendimethalin	1.0	—	—	—	4.7	7.3	9.3	7029
Pendimethalin	2.0	—	—	—	5.8	7.7	9.3	14250
Alachlor	3.0	—	—	—	8.5	8.3	4.8	5708
Alachlor	6.0	—	—	—	9.8	10.0	3.0	2641
Diethatyl-ethyl	4.0	9.4	7.9	9.4	—	—	—	—
Diethatyl-ethyl	6.0	9.3	8.2	9.6	—	—	—	—
Metribuzin	0.25	—	—	—	6.7	7.0	8.8	14314
Metribuzin	0.5	—	—	—	7.3	9.0	6.8	9713
LSD (0.05)		1.2	2.3	1.4	1.6	2.1	1.0	547

[z]Weed Control 0 = 0% control, 10 = 100% control; Crop vigor 0 = dead, 10 = no damage.
[y]BL = broadleaf weeds; GR = grass weeds; CV = crop vigor; evaluations made 6 weeks after treatment.
[x]Harvested 60 days after planting.

Table 4. Influence of postemergence herbicide treatments upon weed control, crop vigor and yield of carrot in 1983.

Treatment[y]	Rate (lb. a.i./acre)	Weed control and crop vigor ratings[z] BL	GR	CV[x]	Carrot yield (lb./acre)[w]
Check	—	0.0	0.0	9.0	11745
Fluazifop-butyl + oil	0.125	0.0	9.7	9.5	14575
Fluazifop-butyl + oil	0.25	0.0	9.4	9.8	18794
Fluazifop-butyl + oil	0.5	0.0	9.7	9.5	17755
Haloxyfop-methyl + oil	0.075	0.0	9.7	9.5	18465
Haloxyfop-methyl + oil	0.15	0.0	9.5	9.2	18200
Haloxyfop-methyl + oil	0.3	0.0	9.6	9.2	18550
DPX-Y 6202 + surfactant	0.014	0.0	8.8	9.0	15635
DPX-Y 6202 + surfactant	0.028	0.0	8.3	9.3	14490
Sethoxydim + oil	0.3	0.0	9.5	9.5	18635
Linuron	1.0	9.5	8.3	9.0	15285
Linuron + fluazifop-butyl	1.0 0.25	9.5	9.7	9.3	15720
Thiobencarb + fluazifop-butyl	4.0 0.25	9.2	9.8	9.2	18020
Thiobencarb + fluazifop-butyl	6.0 0.25	8.5	9.6	9.3	21910
LSD (0.05)		0.6	0.9	0.7	800

[z]Weed control 0 = 0% control, 10 = 100% control; Crop vigor 0 = dead, 10 = no damage.
[y]Oil = Agridex (1% v/v); surfactant = WK (0.25% v/v).
[x]BL = broadleaf weeds; GR = grass weeds; CV = crop vigor; 4 weeks after treatment.
[w]Harvested 60 days after planting.

postemergence grass herbicides may be possible herbicides for carrot production. Cost is the major consideration in radishes since it is only a 28 day crop. Hand weeding is unfeasible. Cost is also a consideration in carrot production but the growing season is much longer and a weed management program might be utilized such as preemergence applications of thiobencarb followed by a combination of thiobencarb and fluazifop-butyl. At the present, hand weeding is being used to maintain carrots weed-free and the costs are astronomical ($200–600/acre). Weeds reduce quality, yield, and interfere with harvesting procedures. A weed management program is necessary and herbicides would be economically feasible.

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WEED CONTROL IN MULCHED STRAWBERRY PRODUCTION[1]

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Abstract. **Preplant applications of 1 and 2 lb./acre of alachlor and 2 and 4 lb./acre of ethofumesate and postemergence applications of 0.5 lb./acre of 2 formulations of acifluorfen (Blazer and Tackle) were evaluated for weed control and crop toxicity in mulched 'Tufts' strawberries** (Fragaria x ananassa **Duch.) during the 1982-1983 production season. Alachlor and ethofumesate provided excellent early season grass and broadleaf weed control. Acifluorfen (both formulations) provided good control of Carolina geranium** (Geranium carolinianum **L.), but did not control grasses. Strawberry plant vigor was reduced by the higher rate of alachlor and both formulations of acifluorfen; however, the effect of acifluorfen was confined to the foliage present at treatment and plants soon overcame the visible injury. None of the treatments provided season-long weed control. Fewer fruit were produced in herbicide treated plots than in the untreated control plots.**

Weed control in strawberry production fields is a major

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