

Effect of herbicides on weed control yield, quality and herbicide residue in radish

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ABSTRACT

A field experiment was carried out at Ludhiana during winter 2007-2008 to find out effective and safe herbicides for radish (*Raphanus sativus* L.). Pre-emergence herbicides viz., pendimethalin (0.37, 0.56 and 0.75 kg/ha), trifluralin (0.6, 0.9 and 1.2 kg/ha), alachlor (1.25, 1.87 and 2.5 kg/ha), oxyfluorfen (0.117, 0.147 and 0.176 kg/ha), vis-a-vis, two hand hoeing (20 and 40 days after sowing) and unweeded control were evaluated. Uncontrolled weeds reduced the radish root yield by 10.7 to 27.1%. All the herbicidal treatments significantly reduced weed density and dry matter. Trifluralin 1.2 kg/ha recorded the highest radish root yield and was at par with trifluralin 0.9 kg, pendimethalin 0.75 kg, alachlor 1.25 and 2.5 kg, oxyfluorfen 0.147 and 0.176 kg/ha and two hand hoeing. The herbicides did not influence the total soluble solids and isothiocyanate content in radish roots. Herbicide residues in crop roots were below detectable level.

Key words : Herbicide residue, Radish, Weed control, Vegetable

Radish (*Raphanus sativus* L.) is a popular winter season root vegetable in northern plains of India. Though it has quick initial growth, still it suffers due to weed infestation leading to 2-41% reduction in root yield (Leela 1987). Weed management through cultivation and hand-weeding causes root damage and is also not economical. Thus, the alternative methods are needed to replace current weed control practices in radish. Very little information is available on root crops in general and radish in particular. Pre-emergence herbicides are beneficial to keep the crop weed free in the early stages and help in increasing the productivity. Herbicides viz. trifluralin 1.5 kg/ha (Jadhao *et al.* 1999), pendimethalin 1.5 kg/ha (Sandhu *et al.* 2002) and alachlor 1.5 kg/ha (Channappagoudar *et al.* 2007) gave effective control of weeds and produced radish root yield at par with two hoeing. However, no study has been done on the residual effects of herbicides. Hence, the study was conducted to find out effective and safe herbicides for radish.

MATERIALS AND METHODS

A field experiment was carried out at Ludhiana during winter 2007-08. The soil was loamy sand, low in organic carbon (0.24%) and available N (180 kg/ha), medium in available P (13.4 kg/ha) and high in available K (252.9 kg K/ha), pH 6.8 and EC 0.15 dS/m. Pre-emergence herbicides, viz., pendimethalin (0.375, 0.56 and 0.75 kg/ha), trifluralin (0.6, 0.9 and 1.2 kg/ha), alachlor (1.25, 1.87 and 2.5 kg/ha), oxyfluorfen (0.117, 0.147 and 0.176 kg/ha), two hand hoeing (20 and 40 days after sowing) and unweeded control were evaluated in RBD in three replications. Radish cv. Punjab Pasand was sown on 30

October, 2007 on ridges spaced at 45 cm using 1.2 kg/ha seed. The field was irrigated immediately after sowing. All the herbicides were applied as pre-emergence at proper soil moisture. The crop was raised with recommended package of practices. Emergence count was recorded at 10 days while root length, diameter and yield at harvest. The weed data were recorded at 35 days and at harvest using a 50 x 50 cm quadrat. The crop was harvested during last week of December. At harvest, five radish roots were taken at random from each plot. From these plants, total soluble solids (TSS) were recorded with hand refractometer, isothiocyanate content measured by Diana *et al.* (1985) method and, herbicide residue in roots analyzed by Gas Chromatography Mass Spectrometry (GCMS) using standard procedures.

RESULTS AND DISCUSSION

Effect on weeds

The relative densities of *Anagallis arvensis* L., *Phalaris minor* Retz., *Oenothera drumendii* Hook., *Coronopus didymus* L. Sm., *Chenopodium album* L. and *Medicago denticulata* Willd in the field were 28.3, 20.0, 16.3, 18.3, 6.6 and 5.0%, respectively. Of these, *P. minor* was the most persistent as it kept germinating till crop harvest. All the weed control treatments significantly reduced weed density and dry matter as compared to unweeded control (Table 1). All the herbicidal treatments were at par with hand hoeing. Pendimethalin 0.75 kg/ha recorded the highest weed control efficiency (68.8%) followed by two hand hoeing (67.9%). Weed density and dry matter did not vary among levels of herbicides. Effective control of weeds during early stages of crop

Table 1. Weed density, dry matter and weed control efficacy of different weed control treatments

Treatment (kg/ha)	Weed density (no./m ²)		Weed dry matter (q/ha)		WCE (%)
	35 days	Harvest	35 days	Harvest	
Pendimethalin 0.37	9.3 (90) [#]	12.4 (153)	1.7 (2.2)	2.1 (3.4)	57.1
Pendimethalin 0.56	8.8 (82)	12.0 (145)	1.7 (1.9)	2.1 (3.3)	57.4
Pendimethalin 0.75	8.0 (63)	11.3 (131)	1.6 (1.6)	1.9 (2.4)	68.8
Trifluralin 0.60	8.0 (63)	11.6 (134)	1.7 (1.8)	2.0 (2.9)	63.6
Trifluralin 0.90	8.0 (63)	12.0 (146)	1.7 (1.8)	2.1 (3.5)	55.0
Trifluralin 1.20	7.3 (52)	11.5 (134)	1.6 (1.6)	2.0 (3.2)	59.5
Alachlor 1.25	10.1 (101)	11.8 (142)	1.7 (2.0)	2.0 (2.8)	63.8
Alachlor 1.87	7.8 (63)	11.1 (127)	1.6 (1.7)	1.9 (2.7)	65.0
Alachlor 2.50	8.3 (78)	11.2 (127)	1.7 (1.8)	1.9 (2.8)	63.8
Oxyfluorfen 0.117	10.6 (116)	12.9 (168)	1.9 (2.6)	2.1 (3.8)	51.9
Oxyfluorfen 0.147	9.6 (97)	12.6 (164)	1.9 (2.6)	1.9 (2.6)	66.9
Oxyfluorfen 0.176	8.9 (82)	11.6 (134)	1.7 (2.0)	2.0 (2.9)	63.1
2 Hand hoeing	6.4 (41)	11.8 (138)	1.6 (1.4)	1.9 (2.5)	67.9
Unweeded control	15.6 (250)	19.0 (362)	2.3 (4.5)	3.0 (7.8)	-
LSD (P=0.05)	4.0	3.4	0.2	0.3	-

[#] Data subjected to $\sqrt{X+1}$ transformation, Figures in parentheses are original values, WCE- Weed control efficiency at harvest

growth improved the availability of resources and helped the crop suppress weed at later stages. Effective weed control in radish with trifluralin 1.5 kg (Jadhao *et al.* 1999), pendimethalin 1.5kg (Sandhu *et al.* 2002) and alachlor 1.5 kg/ha (Channappagoudar *et al.* 2007) has been reported.

Effect on crop

The crop emergence did not vary among different weed control treatments (Table 2). This indicated that all the

herbicides at tested doses are safe for use in radish. All the herbicidal treatments recorded root diameter at par with two hand hoeing and, significantly higher than unweeded control. Root length was also increased with herbicides though the increase was not significant in comparison with unweeded control. The effective control of weeds with herbicides created favorable environment for the crop and root growth improved. Pre-emergence application of alachlor, pendimethalin, trifluralin, oxyfluorfen, butachlor and metolachlor to radish significantly increased leaf area

Table 2. Radish root yield and yield attributes, root quality and herbicide residue under different weed control treatments

Treatment (dose in kg/ha)	Yield and yield attributes			Root quality TSS (%)	Isothio- cyanate	Herbicide residue in roots at harvest (ppm)
	Root length (cm)	Root diameter (cm)	Root yield (q/ha)			
Pendimethalin 0.37	25.9	4.0	236.6	1.0	614.7	BDL
Pendimethalin 0.56	25.4	4.1	241.8	0.9	593.4	BDL
Pendimethalin 0.75	26.8	4.2	271.2	1.0	688.3	BDL
Trifluralin 0.60	26.7	4.0	248.2	0.8	590.1	BDL
Trifluralin 0.90	27.8	4.0	259.5	0.8	540.9	BDL
Trifluralin 1.20	28.5	4.3	285.0	1.0	442.5	BDL
Alachlor 1.25	26.7	4.0	262.1	0.8	393.4	-
Alachlor 1.87	25.3	4.2	251.1	0.9	344.2	-
Alachlor 2.50	27.9	4.1	267.9	0.9	368.8	-
Oxyfluorfen 0.117	26.6	4.1	232.9	0.9	393.4	BDL
Oxyfluorfen 0.147	26.2	3.9	260.8	1.0	417.9	BDL
Oxyfluorfen 0.176	26.5	3.9	278.1	0.8	442.5	BDL
2 Hand hoeing	25.3	4.0	264.8	1.0	614.6	-
Unweeded control	24.4	3.3	207.9	0.8	491.7	-
LSD (P=0.05)	NS	0.4	32.3	NS	NS	-

TSS : Total soluble solids

index, total chlorophyll content, photosynthetic rate and nitrate reductase activity as compared to unweeded control (Channappagoudar *et al.* 2008), that may be the reason for better root diameter and root length in herbicide treated plots.

Uncontrolled weeds reduced the radish root yield by 10.7 to 27.1%. Trifluralin 1.2 kg/ha recorded the highest radish root yield and was at par with its lower level of 0.9 kg, pendimethalin 0.75 kg, alachlor 1.25 kg and 2.5 kg, oxyfluorfen 0.147 kg/ha and two hand hoeing but significantly higher than rest of the treatments. All the herbicidal treatments except oxyfluorfen 0.117 kg/ha produced significantly higher root yield than unweeded control. The higher root yield was reflected in effective weed control which provided optimum proliferation for the crop plants in general and roots in particular. The root yield increased with each increment of herbicides though the difference were significant only for oxyfluorfen 0.117 and 0.176 kg/ha and trifluralin 0.6 and 1.2 kg/ha. Weed dry matter was negatively correlated with root yield ($r = 0.73$) and accounted for 54% variation in root yield (Fig 1). The application of herbicides reduced weeds dry matter accumulation by 51.3 to 66.6% and the root yield increased. Beneficial effect of trifluralin 1.5 kg/ha (Jadhao *et al.*, 1999), pendimethalin 1.5 kg/ha (Sandhu *et al.* 2002), alachlor 1.5 kg/ha (Channappagoudar *et al.* 2007) on radish root yield has been reported. The root quality i.e. total soluble solids (TSS) and isothiocyanate content did not vary statistically among herbicidal treatments and

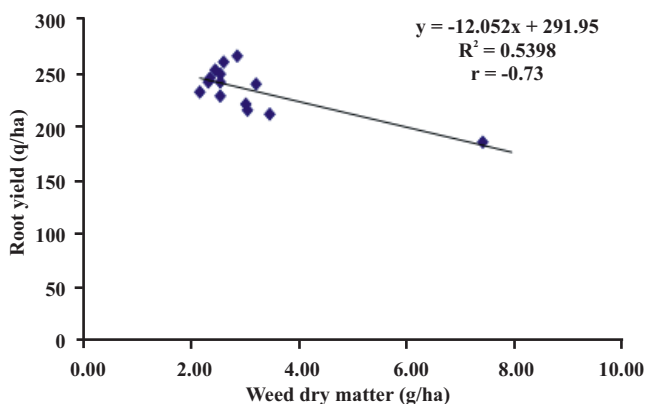


Fig. 1 Correlation between radish root yield and weed dry matter

hand hoeing (Table 2). This indicated that all the herbicides at doses tested are safe from quality point.

Herbicide residue in crop roots

Residues of all the herbicides in crop roots, estimated at time of harvest, were below detectable level (Table 2). This might be due to degradation and leaching down of the herbicide owing to numerous irrigations applied to the crop, precipitation received during the growing period and a long time gap between herbicide application and crop harvest. The results are in agreement with Kole *et al.* (1990) and Pandit and Chowdhury (1994) who reported no harvest time residues of pendimethalin 2.0 kg/ha in onion and groundnut, respectively.

The observations on crop emergence, root yield, root quality and herbicide residue indicated that all the herbicides at doses tested are effective and safe for radish.

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