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Efficacy of mechanical, cultural and chemical methods on weed suppression and yield of lentil

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ABSTRACT

A field experiment was conducted during *rabi* season of 2007-08 and 2008-09 on the mollisols of Pantnagar (Uttrakhand). Twelve treatments consisted of two tillage practices (zero and conventional), two varieties (small seeded-*Pant L-4* and bold seeded- *Pant L-5*) and three levels of weed management (weedy check, hand weeding, (HW) 30 DAS and pendimethalin 1 kg/ha as PRE) were set out in split plot design keeping tillage practices and variety in the main plot and weed management practices in sub plots with four replications. Results revealed that zero tillage recorded higher weeds density viz, *Cyperus rotundus* and total dry matter of weeds per unit area than that of conventional tillage. Weed density and dry weight remained unaffected under both the varieties. Hand weeding done at 30 DAS controlled the weeds more effectively than PRE application of pendimethalin 1 kg/ha. Conventional tillage out yielded zero tillage. Most of the yields attributing characters were higher in conventional tillage. Small seeded variety *Pant L-4* gave significantly higher grain yield than that of bold seeded *Pant L-5* during both the years. HW 30 DAS and PRE application of pendimethalin 1 kg/ha being on par produced significantly more grain yield of lentil than weedy check during the first year at 30 DAS out yielded remaining weed management practices.

Key words: Conventional tillage, Zero tillage, Cultural methods , Lentil, Weed management

Among the various pulses grown in India, lentil (*Lens culinaris* Medic.) holds an important position because of its wider climatic and edaphic adaptations. At the global level, though India's share in lentil production is quite large (30%), yet the productivity level in the country is substantially low. The low average yield might be due to poor level of crop management. To explore the yield potential, manipulation of soil to establish adequate plant stand, selection of suitable variety and effective weed management at critical time of crop-weed competition is important. Repeated tillage operations after *kharif* crop (especially rice) increase the expenditure and consume time and energy, which often delays the sowing of lentil resulting in low yields particularly in intensive cropping system.

Lentil has limited varietal umbrella, which is not suitable for delayed planting. Moreover, no specific variety is available with the farmers, which could harness the available resources after paddy harvesting. Yield losses in lentil due to uncontrolled weeds may go up to 66.5% (Singh *et al.* 1985). Front line demonstrations conducted throughout the country have revealed that adoption of weed management practices alone may increase the yield of lentil to the tune of 24.5% (Ali and Kumar 2007). The information on integration of above aspects for microsperma and macrosperma varieties of lentil with regard to weed control are meager. Considering the severity of the problem, an experiment was, therefore, carried out with above considerations.

MATERIALS AND METHODS

A field experiment was conducted at the Norman E. Borlaug Crop Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar during *rabi* seasons of 2007-08 and 2008-09. The soil of the experimental plot was sandy loam in texture, having medium organic carbon (0.56%), available phosphorus (17.30 kg/ha) and exchangeable potassium (201.5 kg/ha) contents with neutral soil reaction (pH 7.39). Treatments comprising two tillage practices (zero and conventional), two varieties (Small seeded-*Pant L-4* and Bold seeded-*Pant L-5*) and three levels of weed management (weedy check, hand weeding (HW) 30 DAS and pre-emergence (PRE) application of pendimethalin 1 kg/ha) were laid out in split plot design, keeping tillage practice and variety in the main plot and weed management practices in sub plots with four replications in plot size of 3x5 m. Data on weeds were collected by using 50x50 cm quadrate and converted to meter^2. Log transformation (x+1) was used instead of square root. The data was analyzed using anova for statistical differences. The crop was sown, 30 cm apart, with the application of 100 kg DAP/ha as basal on

December 2nd and December 6th during 2007-08 and 2008-09 and harvested on April 12th, 2008 and April 8th, 2009 respectively. The total rainfall received during the crop season was 27.4 and 35.6 mm during 2007-08 and 2008-09, respectively.

RESULTS AND DISCUSSION

Effect on total weed density

The major weed flora observed in the experimental field comprised of sedges, grasses, and broad leaf weeds. *Cyperus rotundus* was dominant weed in the experimental field which contributed on an average of 55 % to the total weed density. The density of *C. rotundus* and total weeds at 75 DAS was significantly higher under zero tillage (ZT) than that of conventional tillage (CT) during both the years of experiment (Table 1). Varieties did not bring significant difference on weed population/unit area during both the years because of similar growth habit. HW 30 DAS, recorded the lowest number of all types of weeds/unit area and was significantly superior to pendimethalin 1 kg/ha Pre and weedy check treatment. It was observed that majority of weeds emerged before the 75 DAS and after that with increase in competition among weeds themselves and with the crop plants, there was reduction in weed population. The low population of *C. rotundus* in later stage was a result of drying during subsequent growing period of crop. Faroda and Singh (1981) have also reported smothering effect of crop on late germinated weeds. Pendimethalin 1 kg/ha PRE, reduced weed population significantly over control. This indicated the wide weed control efficiency of pendimethalin at initial stage of crop growth.

Effect on total dry matter of weeds

Differences in total dry matter of weeds were significant due to tillage practices at 75 DAS of crop growth. CT significantly reduced the dry matter of weeds per unit area as compared to ZT during the first year, while in the second year tillage practices failed to bring a significant difference on total dry matter of weeds. Analogus to weed density, weed dry matter was also not affected by varieties. One HW, 30 DAS followed by pendimethalin 1 kg/ha PRE reduced weed dry matter significantly over weedy check.

Crop yield and yield attributes

CT produced significantly higher values of yield attributes and yield than ZT during both the years of experiment. Increase in the values of yield attributes and yield might be due to reduced weed growth, improved rooting conditions of crop, better soil structure and aeration and more nutrient extraction, which ultimately reflected on better crop growth. As crop yield is a function of yield attributes *viz.,* number of pods/plant, grains/pod and 1000-grain weight, the higher the values of these under

Table 1. It was observed density as influenced by different treatments at 75 DAS of crop growth

Treatment	Weed density (no./m²)						Total dry matter of weed (g/m²)	
	Total Weeds		*Cyperus rotundus*		Other Weeds			
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Tillage practice								
Zero (ZT)	(112.69) 4.61	(121.50) 4.68	4.15 (71.77)	4.11 (71.43)	3.64 (40.91)	3.83 (50.07)	3.45 (37.19)	3.78 (52.47)
Conventional (CT)	(100.04) 4.49	(103.04) 4.51	4.01 (63.90)	3.95 (59.42)	3.52 (36.14)	3.67 (43.61)	3.29 (32.59)	3.63 (47.84)
LSD (P=0.05)	0.06	0.09	0.07	0.08	0.10	0.13	0.08	NS
Variety								
Pant L-4	4.56 (107.08)	4.62 (114.32)	4.09 (67.97)	4.05 (66.70)	3.60 (39.11)	3.78 (47.61	3.39 (35.58)	3.73 (51.18)
Pant L-5	4.54 (105.65)	4.57 (110.23)	4.07 (67.70)	4.01 (64.15)	3.57 (37.94)	3.72 (46.07)	3.34 (34.20)	3.68 (49.13)
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Weed management								
Weedy	5.10 (164.27)	5.19 (184.21)	4.67 (107.19)	4.65 (108.41)	4.05 (57.07)	4.29 (75.80)	4.11 (60.56)	4.44 (87.89)
HW, 30 DAS	3.89 (48.55)	4.03 (56.17)	3.35 (28.12)	3.35 (27.94)	3.05 (20.43)	3.35 (28.22)	2.49 (11.36)	2.86 (16.92)
Pendimethalin 1kg/ha PRE	4.66 (106.27)	4.57 (96.43)	4.22 (68.19)	4.09 (59.92)	3.65 (38.08)	3.60 (36.51)	3.50 (32.76)	3.82 (45.66)
LSD (P=0.05)	0.09	0.13	0.12	0.15	0.11	0.19	0.13	0.18

*Original values are given in parenthesis

Table 2. No. of pod/plant and grain yield as influenced by different treatments

Treatment	No. of pods/plant		Grain yield (g/plant)		1000 grain weight (g)		Grain yield (kg/ha)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Tillage practice								
Zero (ZT)	43.1	34.5	1.79	1.21	22.84	21.89	1243	1028
Conventional (CT)	46.2	39.1	2.69	1.46	22.95	22.20	1381	1234
LSD (P=0.05)	2.9	2.2	0.17	0.13	NS	NS	83	89
Variety								
Pant L-4	48.5	39.3	2.36	1.43	21.42	20.25	1369	1221
Pant L-5	40.8	34.3	2.12	1.24	24.37	23.84	1255	1041
LSD (P=0.05)	2.9	2.2	0.17	0.13	1.84	1.49	83	89
Weed management								
Weedy	39.9	32.5	1.60	1.12	22.35	21.53	1146	944
HW, 30 DAS	49.2	40.8	2.93	1.56	23.44	22.50	1410	1356
Pendimethalin 1 kg /ha (PRE)	44.9	39.9	2.19	1.33	22.89	22.11	1380	1093
LSD (P=0.05)	2.9	2.3	0.27	0.12	NS	NS	136	90

CT might have an edge on grain yield production over ZT. More mobilization of photosynthates to grain under CT, because of higher harvest index might also have led to increase in yield. Lopez-Ballido *et al.* (2003) and Izaurralde *et al.* (1993) also reported similar results.

Pant L-4 gave significantly higher grain yield/ha than that of *Pant L-5* variety during both the years(Table-2). Resolving the yield to its basic components, it would be observed that per plant yield of *Pant L-4* was higher than *Pant L-5*. Number of pods/plant recorded under *Pant L-4* was significantly higher than *Pant L-5*, which had a positive response in manifestation of yield/ plant and yield per unit area. More 1000-grain weight of *Pant L-5* was not able to equalize the combined effect of pods/plant, grains/pod and grain yield/plant recorded under small seeded variety *Pant L-4*. Tripathi and Singh (1987) and Ahmad *et al.* (1992) have also reported variations in grain yield under different lentil varieties.

Uncontrolled weeds led to 23.0,43.6 and 20.4 and 15.8% reduction in the grain yield of lentil, as compared to HW, 30 DAS and pendimethalin 1 kg/ha PRE during first and second year, respectively. One hand weeding, 30 DAS and pre-emergence application of pendimethalin 1 kg/ha produced significantly more grain yield of lentil than weedy check (Table 2). During the first year, differences in grain yield recorded under one HW 30 DAS and pendimethalin 1 kg/ha PRE was not significant. The values of yield attributes were also the lowest under weedy check conditions. Luxuriant growth of weeds under weedy check condition increased the competition with crop plants for natural resources like space, light, water and nutrient, which reduced the values of yield attributes and yield. Effect of pendimethalin lasts for 30-35 days after its application during winter. However, critical period prolongs up to 55-60 DAS b/c of slow initial growth of lentil. Therefore, HW-30 DAS has resulted in more weed suppression for longer period and yielded higher. In fact, crop plants might have got ample space under hand weeding for spreading there source (leaves), which trapped solar radiation more efficiently than pendimethalin 1 kg/ha PRE and weedy check. By the time the HW was performed, the effect of pendimethalin might have been over, and provided sufficient time to second flush of weeds to germinate. This increase in competition at later stage of the crop plant might have reduced the advantage of early weed control by pendimethalin in terms of yield and yield attributes. Kumar and Kolar (1989) also observed the increased response of lentil to in comparison to herbicide application.

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