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Studies on the effect of weed suppression through, mechanical, cultural and chemical method of weed control of the Lentil crop (*Lens culinaris* Medick)

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Abstract
A field experiment conducted during *Rabi* season 2013-2014 at Students Instructional farm, Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.). To find out studies the effect of the weed suppression through, mechanical, cultural and chemical method of weed control of the Lentil crop (*Lens culinaris* Medick) In case of weed management practices viz. different comparison of weedy control plot and second one two hand weeding (30 and 45 DAS), Third weed management practices used pendimethalin @ 1kg ai/ha in different plot. All factors are presented in double split plot design. In case of weeding gives superior results comparison to all of the factors and also gives better yield potential followed by application of pendimethalin @ 1 kg *ai*/ha gives lower yield comparison to two hand weeding. Practices where variety KLS-218 and conventional tillage along with two hand weeding was do naives higher grain and straw yield comparison to all. This experiment was done where soil was sandy loam in texture. Organic carbon was about 0.5% and nitrogen content was low, medium in phosphorus and potassium availability. The pH 7.7 indicates that the soil was slightly alkaline in reaction.

Keywords: weed control of the lentil through, mechanical, cultural and chemical method

Introduction
India is a major pulse growing country in the world sharing 35.56 and 27.28 percent of total area and production of these crops, respectively (Anonymous, 2011-2012) [1]. Pulses are the main source of protein to the vegetarian population of India. More than half of Indian population's vegetarian and such people use pulses to fulfill their protein requirement because they cannot opt for animal protein, as it is very expensive as well as religion and social culture of the country. The lysine rich protein of pulses is considered to supplement the deficiency of amino acid in the cereal dietaries and bring at par with milk protein in term of biological efficiency. It is because of this reason that pulses have also been called the "Poor man's' Meat". As per the report of W.H.O. the minimum requirement of pulse is 85g/day/capita during 2011-12. In India per capita consumption of pulse has been declining sharply due to growth of population, the importance of pulse in our daily diet as well as agricultural food production, unfortunately pulse production has not yet been increase proportionately as increase in cereal production. Lentil was first gown in South West Asia about 7000 B.C., it is best adapted to the cool or temperate zone of the world or the winter season in Mediterranean climates, split lentil (Dal) is an important source of dietary protein in the Mediterranean and South Asian regions. Lentil is a very important pulse crop in Western Canada. It is grown to improve economic returns to producers. Diversity and crop rotations reduce the requirement for nitrogen fertilizer. Lentil is a member of the Legume family. Leguminaseae, can supply a significant part of its nitrogen requirement by fixing nitrogen from the air when inoculated with the appropriate rhizobial inoculants. Lentil is one of the important *rabi* pulse. It has the potential to cover the risk of dry land areas. It is also used as cover crops, to check the soil erosion. It is mostly eaten as "Dal" the pulse is first converted in to split pulse or Dal by removal of the skin and separation of fleshy cotyledon, while pulse grain is also used in some of the dishes. It is cooked early and hence preferred to the dry leaves and stem empty pods and broking bits all are used as cattle feed. Lentil contains about 12% water, 25% protein and 60% carbohydrate.

It is also rich in calcium, iron and Niacin. In India the major lentil producing areas are M.P., U.P., Bihar, Haryana and West Bengal. In U.P. the cultivation of lentil is done about 5.84 Lakh hectare with the production of about 4.50 lakh metric tons with an average yield of 7.70 q / ha. The major lentil producing areas in U.P. are Bundelkhand, Allahabad and Faizabad. Lentil requires cold climate and sown as winter seasons crop. It is very hardy, and can tolerate frost over winter to great extent. It requires cold temperature during vegetative growth and warm at the time of maturity. The optimum temperature for growth is 18-30^{0}C. Weed are the major constraints to lentil production in the central plane zone of U.P. Tillage systems, herbicide and the timing of such operations significantly influence the weed density and yield of lentil.

The important pulses growing countries of the world are Canada, India, Turkey, Syria, Pakistan, Spain and Bangladesh. Lentil is mostly grown in northern plains, central and eastern part of India. In India, lentil is the second most important legume of r*abi* season after chickpea, with an area of 15 lakh ha, with the production of 9.50 lakh tones and productivity of 6.33 q ha^{-1} (Anonymous, 2012) [1]. Area, production and productivity of lentil in U.P. was 5.73 lakh ha, of 4.10 lakh tones and 7.15 q ha^{-1}, respectively (Anonymous, 2011-12) [1]. Lentil is an important winter season pulse crop in India; it is hardier and capable of withstanding extremes of weather and soil conditions. However, due to its short stature, slow initial growth and long duration, its productivity is adversely affected by the presence of weeds as per an estimate of the reduction in yield may be up to 74% (Balyan *et al*. 1997) [2]. Hand weeding and hoeing are the conventional and more effective practices of weed removal in pulses. These practices have certain limitations like non – availability of laborers at right time as well as due to higher wages. Under such situation the use of selective herbicides may provide more effective and economical control of weeds as compared to manual weeding. Weeds compete with plants for natural resources during cultivation and reduce the yield of lentil up to 87% (Punia *et al*., 2003) [3].

Materials and Methods

The present experiment was carried out during *Rabi*, 2013-14 in field number. (7) at Students Instructional Farm, Department of Agronomy, Chandra Shekhar Azad University of Agricultural and Technology, Kanpur. The experiment consists of 12 treatments viz., (T_1) Zero Tillage KLB-320 weedy, (T_2) Zero Tillage, KLB-320, HW (30 &45 DAS), (T_3) Zero Tillage, KLB-320, pendimethalin @ 1 kg ai/ha, (T_4) Zero Tillage, KLS-218, weedy, (T_5) Zero Tillage, KLS-218, HW (30 &45 DAS), (T_6) Zero Tillage, KLS-218,pendimethalin @ 1 kg ai/ha, (T_7) Conventional Tillage, KLB-320, weedy, (T_8) Conventional Tillage, KLB-320, HW (30 &45 DAS), (T_9) Conventional Tillage, KLB-320, pendimethalin @ 1 kg ai/ha, (T_{10}) Conventional Tillage, KLS-218, weedy, (T_{11}) Conventional Tillage, KLS-218, HW (30 &45 DAS) and (T_{12}) Conventional Tillage, KLS-218, pendimethalin @ 1 kg ai/ha. The crop was fed with Urea @ 35.00 kg, DAP 130 kg and MOP 60 kg/ha to supply 40 kg N, 40 kg P_2O_5 and 20 kg/ K_2O/ha. All required fertilizer was applied before sowing as plough sole placement. Application of herbicides pendimethalin @ as per treatments was applied as pre-emergence. Herbicides were sprayed with the help of a hand operated knapsack sprayer fitted with flat fan nozzle using 500 liters water per hectare. The physical and chemical properties of pendimethalin, used in the experiment are being described here as under. To the effect of deferent treatment on weeds and crops, a number of observations on growth and yield contributing characters of crop and weed ecology were recorded at different stages of crop growth. Since it is very difficult to study all the individual of plant population, 3 plants from each plot were selected randomly and tagged for further study. The observations on growth characters of the crop were taken starting from 30 days of sowing to harvest of the crop at the interval of 30 days. Plant population m^{-1} was recorded after 90 days of sowing.

Studies on weeds

1. Weed flora at 30th and 90th Days stage

Broad leaf and grassy weeds were recorded from three places selected at random in each plot.

2. Weed density at 30th and 90 days stage

Broad leaf and grassy weed was recorded from four places selected at random in each plot. A quadrate of 50cm x 50cm was used for recording the weed density and finally it has been reported at number of weeds. The data of weed density were transformed by using$\sqrt{n+1}$.

3. Weed dry weight at 30 and 90th days stage

1. After the counting, the weeds were cut close to the ground surface and dried in oven at 105^{0}C for 48 hours to a constant weight then the weed dry weight was recorded. It was reported in gram.
2. The data of weed dry weight were trans formed by using. $\sqrt{n+1}$

4. Weed control efficiency (W.C.E.)

The weed control efficiency of treatments to control the weeds are compared un-weeded check treatment is termed as weed control efficiency of the treatment. It was calculated on the basis of weed dry weight recorded at 90th day stage of the crop. The formula employed for calculating the WCE is given below.

$$\text{WCE (\%)} = \frac{wo-w1}{wo} \text{ X } 100$$

Where,

Wo - Weed dry weight in weedy plot.
W1 - Weed dry weight in treated plot.

Result and Discussion

The data depicted in table-1. The data pertaining to weed density/ m^2 of broad leaves weeds and grassy weeds at 30 days after sowing of crop were affected by tillage, varieties and weed control practices. It was observed that weed density/m^2 of broad leaves weeds and grassy weeds were not significantly affected by tillage and varieties. In weed control practices the significantly minimum weed density/m^2 of broad leaves weeds and grassy weeds were recorded under hand weeding twice (30 days and 45 days after sowing) followed by under application of pendimethalin @ 1.0 kg ai/ha and significantly maximum weeds were observed in weedy check plot. Similar results were also observed in total weeds.

Table 1: Weed density/m^2 at 30 days after sowing

Treatment	Broad leaf weeds	Grassy weeds	Total weeds
Tillage			
Zero tillage	2.77	3.06	4.00
Conventional tillage	2.49	2.82	3.62
SE(m)±	0.0108	0.098	0.109
C.D. (P=0.05)	NS	NS	NS
Variety			
KLB-320	2.68	3.00	3.89
KLS-218	2.58	2.87	3.73
SE(m) ±	0.048	0.060	0.082
C.D. (P=0.05)	NS	NS	NS
Weed Control			
Weedy	3.12	3.40	4.51
Two hand weeding	2.15	2.53	3.16
Pendimethalin@1kgai/ha	2.62	2.88	3.77
SE(m) ±	0.094	0.083	0.0141
C.D. (P=0.05)	0.281	0249	0.423

The data depicted in table-2. The data pertaining to weed density/m^2 of grassy weeds and broad leaves weeds at 90 days after sowing of crop were affected by tillage, varieties and weed control practices. It was observed that weed density/m^2 of grassy weeds and broad leaves weeds were not significantly affected by tillage and varieties. In weed control practices the significantly minimum weed density/m^2 of grassy weeds and broad leaves weeds were recorded under hand weeding twice (30 and 45 days after sowing) followed by under application of pendimethalin@ 1.0 kg ai/ ha and significantly minimum weeds were observed in weedy check plot. Similar results were also observed in total weeds.

Table 2: Weed density/m^2 at 90 days after sowing

Treatment	Broad leaf weeds	Grassy weeds	Total weeds
Tillage			
Zero tillage	3.061	3.28	4.37
Conventional	2.84	3.05	4.02
SE(m)±	0.096	0.088	0.0134
C.D. (P=0.05)	NS	NS	NS
Variety			
KLB-320	2.99	3.20	4.27
KLS-218	2.87	3.13	4.13
SE(m) ±	0.057	0.045	0.073
C.D. (P=0.05)	NS	NS	NS
Weed Control			
Weedy	3.39	3.58	4.83
Two hand weeding	2.53	2.77	3.61
Pendimethalin@1kgai/ha	2.88	3.15	4.15
SE(m) ±	0.081	0.077	0.113
C.D. (P=0.05)	0.243	0.230	0.340

The data depicted in table-3. The data pertaining to weed dry weight at 30 and 90 days after sowing of crop were affected by tillage, varieties and weed control practices. It was observed that weed dry weight was not significantly affected by varieties. In tillage and weed control practices the significantly minimum weed dry weight was recorded under hand weeding twice (30 and 45 days after sowing) followed by under application of pendimethalin @ 1.0 kg ai/ha and significantly minimum weed dry weight was observed in weedy check plot.

Table 3: Total weeds dry weight (g/m^2)

Treatment	30 DAS	90 DAS
Tillage		
Zero tillage	11.16	13.15
Conventional	9.36	11.77
SE(m)±	0.070	0.037
C.D. (P=0.05)	0.433	0.229
Variety		
KLB-320	10.31	12.56
KLS-218	10.21	12.36
SE(m) ±	0.362	0.244
C.D. (P=0.05)	NS	NS
Weed Control		
Weedy	11.99	13.95
Two hand weeding	8.72	11.26
Pendimethalin@1kgai/ha	10.07	12.17

SE(m) ±	0.512	0.166
C.D. (P=0.05)	0.842	0.499

The data depicted in table-4. The data pertaining to weed control efficiency of 30 and 45 days after sowing of crop were affected by tillage, varieties, and weed control practices. It was observed that weed control efficiency of both 30 and 45 days after sowing were not significantly affected by tillage and varieties. In weed control practices the significantly maximum weed control efficiency was recorded where hand weeding twice (30 and 45 days after sowing)followed by the application of pendimethalin @ 1.0 kg ai/ ha and significantly minimum weed control efficiency were observed in weedy check plot.

Table 4: weed control efficiency (%)

Treatment	WCE (30 DAS)	WCE (90 DAS)
Tillage		
Zero tillage	33.29	23.50
Conventional	22.31	16.22
SE(m)±	4.115	1.823
C.D. (P=0.05)	NS	NS
Variety		
KLB-320	31.45	19.09
KLS-218	24.15	20.63
SE(m) ±	4.510	2.613
C.D. (P=0.05)	NS	NS
Weed Control		
Weedy	0.000	0.000
Two hand weeding	47.79	36.90
Pendimethalin@1kgai/ha	35.61	22.69
SE(m) ±	5.169	2.002
C.D. (P=0.05)	15.500	6.001

Summary and Conclusion

Weeds alone reduced the yields of lentil to the tunes of 29.5 to 32% (Switcher and Yenish, 2012) [4]. There are many methods by which weeds can be controlled prior to and during the growth of crop. Each weed control measure has merits and demerits. For example manual weeding gives better response comparison to other treatment. Two hand weeding found more beneficial and followed by pendimethalin @ 1.0 kg ai/ha. Weedy or untreated control plot recorded minimum yield. Weed control practices is very essential to lentil crops. Observation on weed include weed flora and weed density at 30 and 90 days after sowing and weed dry weight 30 and 90 days after sowing. Weed management practices does not shows significant result in grassy as well as broad leaf weeds. The weed density at 30 and 90 days after sowing affected by tillage, varieties and weed control practices. It was observed that weed density 30 and 90 days after sowing were not significantly affected by tillage and varieties. In weed control practices the significantly minimum weed density was recorded where hand weeding was done twice at 30 and 45 days after sowing, followed by application of pendimethalin @ 1.0 kg ai/ha. Maximum weeds were observed in weedy check plots. Weed dry weight at 30 and 90 days after sowing of crop were affected by tillage, varieties and weed management practices. It was observed that weed dry weight was not significantly affected by varieties. Tillage and weed control practices recorded significantly results. The minimum weed dry weight recorded under conventional tillage whereas, in weed control practices the minimum weed dry weight was recorded under hand weeding twice was done at 30 and 45 days after sowing followed by, under application of pendimethalin @ 1.0 kg ai/ha and significantly minimum dry weight was observed in weedy check plots at 30 and 90 DAS. The weed management practices show significant effect on weed control efficiency whereas, tillage and variety do not show significant effect. Maximum weed control efficiency recorded where two hands weeding at 30 and 45 DAS was done. Minimum weed control efficiency observed in weedy check plot at 30 and 90 DAS among weed control practices two hand weeding at 30 and 45 DAS found to be most effective in controlling weeds in lentil crop to get maximum net return. Pre-emergence application of pendimethalin @ 1.0 kg ai/ha was also found effective to control the weeds and enhance crop yield. Farmer's' can adopt these practice.

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