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Research Article

Effect of different agronomic practices on nutrients of lentil

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Abstract : A pure and healthy seed of lentil genotype LH 90-54 was sown on November 17, 2005 as per planting technique treatments with three replications and total number of treatment combinations 3 x 2 x 3= 18 were tested against the growth parameters of lentil (*Lens culinaris*) at Pulse Research Area of CCS Haryana Agricultural University, Hisar during *Rabi* 2005-06.The nitrogen content in grain and stover remained at par under all the three planting methods. The higher uptake of nitrogen in grain (37.42kg ha^{-1}) as well as in stover (84.77kg ha^{-1}) uptake were significantly higher under raised bed planting. Phosphorus and potassium content in grain and stover were not influenced significantly by planting methods. However, raised bed planting improved both the phosphorus and potassium uptake significantly. Nitrogen content was recorded more in irrigated treatment in both grain and stover over the unirrigated check. However, the phosphorus and potassium content of grain was more in irrigated and unirrigated plot, respectively. The amount of nutrient removed by lentil plants was significantly higher due to weed control measures compared to weedy check. The uptake of nitrogen, phosphorus and potassium by both grain and stover was highest in raised bed planting over the other planting techniques. Irrigation significantly increased the nitrogen, phosphorus and potassium uptake both in grain and stover when lentil was irrigated at flowering stage over the unirrigated treatment. Weed control treatment also significantly influenced the uptake of nitrogen by lentil compared to control whereas pendimethalin treated plot recorded the highest uptake of phosphorus and potassium by grain and Stover, respectively.

Key Words : Lentil, Agronomic practices, Nutrients

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INTRODUCTION

Lentil (*Lens culinaris*) is one of the oldest and valuable human food crop. Mostly it is consumed as a dry grain (decorticated and split). Dehulled lentil grains contain 24-26 per cent protein, 1.3 per cent fat, 2.2 per cent ash, 3.2 per cent fibre and 57 per cent carbohydrate. It is a rich source of calcium (68 mg/100g grain), phosphorus (300 mg/100g grain) and iron (7 mg/100g grain). India represents 50 per cent of the world's acreage and 41 per cent of the world's production. The production of lentil in India is around 1.00 million tonnes from an area of 1.4million hectare with the productivity of 660 kg/hectare (Anonymous, 2005).

Inadequate soil moisture and heavy infestation of weeds are the important factors, which results in poor productivity of this crop. Timely sowing of lentil is very essential for getting higher yield. Lentil can be sown 7-10 days earlier by zero tillage machine directly without any field preparation after the harvest of rice crop by using

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residual soil moisture.

Another technology *i.e.* raised bed planting system that is a form of conventional tillage where in sowing is done on raised beds. The important factor including weed management favours the introduction of bed planting because herbicide resistance is already a serious issue. Thus, this system provides an elbow space for increasing the productivity of dry or limited irrigated areas in the later part of crop growth.

Lentil normally meets most of its water requirement from conserved soil moisture. In the absence of enough stored soil moisture and adequate winter rains, the crop responds very well to supplemental irrigation. Water being the scarce commodity in lentil growing areas of India, it warrants judicious use to achieve higher efficiency.

Weeds in lentil have been reported to offer serious competition and cause yield reduction to the extent of 70 per cent (Singh and Singh, 1985). Weed emergence in lentil begins almost with the crop emergence leading to crop-weed competition from initial stages. Labour requirement to remove weeds manually may not be met due to the peak sowing season and hence, the use of herbicide can be explored to economize the weed control particularly in the initial stage as lentil is a slow growing crop.

EXPERIMENTAL METHODS

The field experiment was conducted during the *Rabi* season of 2005-06 at Pulse Research Area of CCS Haryana Agricultural University, Hisar. The experiment was laid out in split plot design with three replications and total number of treatment combinations were 3 x 2 x 3 = 18. The grass plot size was 2.4 x 1.8 m. The experimental field was prepared for sowing as per planting technique treatment. The field was ploughed with pressure harrow particularly the area allotted to raised bed and flat bed planting treatments. No harrowing or other tillage practices were done in the experimental area allocated for zero till planting treatment. The experimental area allotted for zero tillage treatment was sprayed with non-selective herbicide *i.e.* Glyphosate @ 1 per cent solution 10 days before sowing to check the weeds and left over plants of the previous crop. One pre-sowing irrigation was applied on 13th November 2005. The field was ploughed and prepared as per treatments. Raised bed of 67.5 cm were prepared with tractor drown raised bed planter.

A pure and healthy seed of lentil genotype LH 90-54 was sown on November 17, 2005 as per planting technique treatments. In flat bed, the sowing was done with hand plough, whereas, zero till drill machine was used to sow directly the seeds in zero tillage planting treatment. The seeds on raised beds were sown with the help of raised bed planter having two rows on each raised bed of 67.5 cm. Recommended seed rate (35 kg ha^{-1}) was used for sowing of the crop. In all the planting techniques, the number of rows per plot were kept same.

After two weeks of germination, lentil plants were thinned to keep an intra-row spacing of about 7 cm. Gaps were filled wherever necessary to maintain uniform plant population. No weeding was carried out in weedy check plot, however, one hand weeding at 30DAS and pendimethalin @ 1.0 kg a.i. ha^{-1} (pre-emergence) application were done in their respective treatments. One pre-sowing irrigation was applied for field preparation on 13th November 2005 and one post sowing irrigation was applied at flowering stage on 17th February 2006 as per treatment. To keep the crop free from insects particularly pod borer, first spray of endosulfon @ 1 litre ha^{-1} was done on 17th March and second spray was repeated on 8th April.

The observation on nutrient studies is mentioned below:

Nutrient content and uptake by weeds:

Samples of weeds collected at harvest were used for chemical analysis. Each sample was grinded into fine material and then analysed for nitrogen, phosphorus and potassium contents. The uptake of N, P and K was computed as follows:

$$\text{Uptake of N, P, K} = \frac{\text{N, P and K (\%) in dry weeds} \times \text{Weed dry weight (kg ha}^{-1}\text{)}}{100} \text{(kg ha}^{-1}\text{)}$$

Nutrient studies in crop plants:

N, P and K content and uptake:

Samples of grain and stover of lentil collected at harvest were used for chemical analysis. Each sample was grinded into fine material and then analyzed for nitrogen, phosphorus and potassium contents. The nitrogen content was obtained by Nessler's reagent method (Linder, 1944), phosphorus by Vanadomolybdo- phosphoric acid yellow colour method (Koeing and Johnson, 1942) and potassium by flame photometer method (Richards, 1954).

Soil studies:

Soil analysis for N, P and K before sowing and after harvest:

The composite soil samples were collected from 0-15 and 15-30cm depth before sowing and also after the harvest of the crops (0-15cm) and analyzed for available nitrogen (Jackson, 1973), available, phosphorus (Olsen *et al.*, 1954) and potassium (Richards, 1954).

Statistical analysis:

The experimental data relating to each character were analyzed statistically by applying the technique of 'analysis of variance' for split-plot design and significance was tested by variance ratio 'F value differences' (Cochran and Cox, 1977). Standard error and critical difference (C.D.) were worked out for each character studied to evaluate differences between treatment means.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been presented under following heads :

Soil analysis:

N, P and K content of soil is presented in Table 1. A perusal of the data reveal that the N, P and K content was not significantly influenced by either planting technique, irrigation and weed management treatments at the time of harvesting. However, the nitrogen content in planting technique ranged from 183-184 kg ha^{-1}, that of phosphorus is 13kg ha^{-1}, and potassium content was about 340 kg ha^{-1}. The highest content of nitrogen was noticed in raised bed but the variation in nitrogen content between the planting techniques was very less.

In the irrigation treatment slightly higher content of nitrogen (183.81 kg ha^{-1}), phosphorus (13.29 kg ha^{-1}) and potassium (340.33 kg ha^{-1}) was observed over the unirrigated control.

Table 1 : Effect of different treatments on NPK content of soil after harvesting (kg ha^{-1})

Treatments	N	P	K
Planting technique			
Zero tillage	183.66	12.94	340.72
Raised bed	184.11	13.27	340.00
Flat bed	183.33	13.38	340.05
S.E.±	0.89	0.24	0.47
C.D. (P=0.05)	NS	NS	NS
Irrigation			
No irrigation	183.59	13.11	340.18
One irrigation at flowering	183.81	13.29	340.33
S.E.±	0.73	0.20	0.38
C.D. (P=0.05)	NS	NS	NS
Weed management			
Weedy check	182.94	13.22	340.66
One hand weeding at 30 DAS	183.88	13.11	339.16
Pendimethalin @1.00 kg a.i./ ha (pre-emerg)	184.27	13.27	340.94
S.E.±	0.56	0.61	0.86
C.D. (P=0.05)	NS	NS	NS

NS=Non-significant

Weed management treatment also do not have any significant effect on nutrient content of soil at the time of harvest. The nitrogen content in weed control treatment ranged from 183-184 kg ha^{-1} and that of phosphorus was 13 kg ha^{-1}and potassium ranged from 339 to 341 kg ha^{-1}.

Planting techniques, irrigation and weed management did not significantly influence N, P and K content of soil at the time of harvest because the uptake of nutrients by plants in all the treatments was similar.

N, P and K content of seed and stover:

Data presented in Table 2 on N, P and K content of grain and stover recorded after the harvest of the crop reveal that N, P and K content did not differ significantly either due to planting technique, irrigation and weed management treatments, even then more nitrogen content (3.8 %) in grain and (2.2 %) in stover was noticed in the flat bed over the raised bed and zero till sowing. The nitrogen content in grain and stover (Table 2) remained at par under all the three planting methods. The higher uptake of nitrogen in grain (37.42kg ha^{-1}) as well as in stover (74.77kg ha^{-1}) uptake were significantly higher under raised bed planting in comparison to zero tillage and flat bed planting (Table 3). This could be due to increased dry matter accumulation and yield. Enhanced nitrogen use efficiency of this system had also been reported by Khan *et al.* (1987) and Kumar (2001).

The phosphorus content was almost equal in all the planting techniques in both grain and stover. Raised bed planting resulted in maximum phosphorus content (0.52 %) in grain but in stover it was more in flat bed planting. The potassium content ranged from 1.50 to 1.58 per cent in grain and 2.5 to 2.7 per cent in stover. The potassium content in grain was more in flat bed where as in stover it was more in raised bed over other planting techniques. Phosphorus and potassium content in grain and stover were not influenced significantly by planting methods. However, raised bed planting improved both the phosphorus and potassium uptake significantly. The increase in grain and stover uptake of phosphorus was 29.2, 13.7 and 34.46, 17.12 per cent with raised bed as compared to zero tillage and flat bed (Table 2). The corresponding increase in respect of potassium was 21.5, 5.4 and 33.8, 25.2 per cent (Table 2). This increase was obviously due to higher dry matter accumulation and yield obtained in raised bed planting as compared to other two methods of planting. Similar findings were also reported by Kumar (2001).

In irrigation treatment, the nitrogen content was recorded more in irrigated treatment in both grain and stover over the unirrigated check. However, the phosphorus content of grain was more in irrigated plot that of stover was more in unirrigated plot. The potassium content of grain

Table 2 : Effect of different treatments on NPK content of seed and stover (%)

Treatments	N		P		K	
	Grain	Stover	Grain	Stover	Grain	Stover
Planting technique						
Zero tillage	3.61	2.08	0.515	0.163	1.569	2.66
Raised bed	3.75	2.19	0.521	0.164	1.505	2.71
Flat bed	3.86	2.22	0.518	0.169	1.587	2.54
S E.±	0.13	0.07	0.02	0.001	0.03	0.06
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS
Irrigation						
No irrigation	3.60	2.12	0.516	0.166	1.570	2.62
One irrigation at flowering	3.81	2.21	0.520	0.165	1.537	2.66
S E.±	0.10	0.05	0.019	0.001	0.02	0.05
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS
Weed management						
Weedy check	3.62	2.08	0.522	0.168	1.611	2.60
One hand weeding at 30 DAS	3.68	2.21	0.516	0.158	1.515	2.63
Pendimethalin @1.00 kg a.i./ ha (pre-emerg)	3.82	2.21	0.516	0.170	1.533	2.68
S E.±	0.07	0.07	0.02	0.001	0.04	0.04
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS

NS=Non-significant

Table 3: Effect of different treatments on NPK uptake by seed and stover (kg ha^{-1})

Treatments	N		P		K	
	Grain	Stover	Grain	Stover	Grain	Stover
Planting technique						
Zero tillage	28.80	62.21	4.10	4.12	12.49	75.06
Raised bed	37.42	84.77	5.30	5.54	15.12	100.49
Flat bed	34.61	70.98	4.66	4.73	14.34	80.23
S E.±	1.02	1.47	0.15	0.11	0.53	1.73
C.D. (P=0.05)	3.21	4.64	0.46	0.35	1.68	5.45
Irrigation						
No irrigation	31.40	70.06	4.47	4.57	13.51	81.23
One irrigation at flowering	35.82	75.25	4.90	5.03	14.45	89.30
S E.±	0.83	1.20	0.12	0.18	0.43	1.41
C.D. (P=0.05)	2.62	3.79	0.38	0.57	1.37	4.45
Weed management						
Weedy check	29.20	65.32	4.24	4.32	12.96	75.68
One hand weeding at 30 DAS	34.05	73.66	4.76	4.90	13.94	86.53
Pendimethalin @1.00 kg a.i./ ha (pre-emerg)	37.59	78.98	5.06	5.17	15.04	93.57
S E.±	0.88	0.94	0.17	0.10	0.41	1.26
C.D. (P=0.05)	2.59	2.76	0.51	0.30	1.21	3.67

was more in unirrigated plot that of stover was more in irrigated plot. Significantly, more uptake of nitrogen, phosphorus and potassium by lentil occurred due to irrigation (Table 2). Water supply in general is known to benefit the growth and dry matter production of crops directly as well as indirectly by increasing the availability, uptake and utilization of nutrients up to a certain level (Maris and Weirsma, 1975). Irrigation to legumes is known to improve the soil moisture environment, which is conductive to better survival and mobility of rhizobium (Saxena and Wassimi, 1980), and root nodulation (Nayar *et al.,* 1984) helping thereby in greater availability of fixed nitrogen to plants. The higher grain and stover yield obtained due to irrigation, but not the content in plants resulted in higher uptake of nitrogen, phosphorus and potassium by lentil. Similar results were reported by Das (1985) and Singh and Singh (1986).

Among the weed management practices pendimethalin showed the more amount of nitrogen over hand weeding and weed check. Even then, the nitrogen content in pendimethalin treated plot was at par with the other two treatments. Phosphorus content of both grain and stover was more in weedy check plot over the other weed treatments. The phosphorus content of grain ranged from 0.50 to 0.52 per cent and that of stover was 0.16 to 0.17 per cent. There was a variation in the potassium content of grain observed but the potassium content in all the three weed treatments was almost similar, however, potassium content of grain was more in weedy check and that of stover was more in pendimethalin treated plot. The amount of nutrient removed by lentil plants was significantly higher due to weed control measures compared to weedy check (Table 2). Nutrient uptake in plants depends on the dry matter production and nutrient content in them. In the present study, not much variation was noticed in respect of nitrogen, phosphorus and potassium content in lentil. Nevertheless, controlling weeds provided favourable and comparatively reduced weed infestation that resulted in significant improvement of crop growth leading to higher grain and straw yield and thus the nutrient uptake (Das, 1985).

N, P and K uptake by grain and stover (kg ha^{-1}):

Nitrogen uptake by lentil:

The uptake of nitrogen by lentil at harvest is presented in Table 3. Planting technique increased the nitrogen uptake in both grain and stover significantly. The nitrogen content in the grain ranged from 28 to 37 kg ha^{-1} and 62 to 84 kg ha^{-1} in stover. The uptake of N by both grain and stover was highest in raised bed planting over the other planting techniques. Irrigation significantly increased the nitrogen uptake both in grain and stover. The higher values 35.8 and 75.25 kgha^{-1} in grain and stover were recorded when irrigation was given at the time of flowering.

Weed control treatment also significantly influenced the uptake of nitrogen by lentil compared to control. One hand weeding at 30DAS had significant effect over control. Weeds when controlled with pendimethalin also enhanced the uptake of nitrogen by grain and stover over the weedy check and one hand weeding at 30 DAS also.

Phosphorus uptake by lentil:

The amount of phosphorus removed by lentil as influenced by planting technique, irrigation and weed management was given in Table 3. The highest phosphorus uptake 5.3 and 5.5 kg ha^{-1} in grain and stover, respectively was noted in the raised bed. The uptake of phosphorus in irrigation treatment was highest when lentil was irrigated at flowering stage over the unirrigated treatment.

In the experimentation, pendimethalin recorded the highest *i.e.* 5.06 and 5.17 kg ha^{-1} uptake of phosphorus by grain and stover, respectively and was marginally higher than the uptake recorded in hand weeded plot. The phosphorous uptake in grain and stover ranged from 4.2 to 5.1 kg ha^{-1}.

Potassium uptake by lentil (kg ha^{-1})

The data presented in Table 3 reveal that potassium uptake was significantly influenced by raised bed as compared to other two treatments. The uptake of potassium by grain ranged from 12.5 to 15.1 kg ha^{-1} and the highest uptake of potassium (15.1 and 100.5 kg ha^{-1}) by grain and stover was noticed in raised bed, respectively.

Irrigating the crop at the time of flowering resulted in the more amount of potassium uptake by grain and stover over the unirrigated treatment. The potassium uptake by grain and stover ranged between 13-14 kg ha^{-1} and 81 to 89 kg ha^{-1}, respectively.

The highest uptake of potassium by grain and stover was noticed in pendimethalin treated plot and the potassium uptake by grain and stover ranged between 13 to15 kg ha^{-1} and 75 to 93 kg ha^{-1}, respectively.

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