Plant Archives Vol. 17 No. 1, 2017 pp. 715-719 *ISSN 0972-5210*

TO STUDY THE PERFORMANCE OF LENTIL (*LENS CULINARIS* M.) VARIETIES UNDER RAINFED CONDITIONS

A. C. Yadav, Ashwani Kumar[1], O. P. Rai, R. N. Maurya, H. C. Yadav[2] and R. S. Yadav[3]

Department of Agronomy, N.D.U.A. & T., Kumarganj, Faizabad - 224 229, (U.P.), India.
[1]U.P. Council of Agricultural Reseaarch (UPCAR), Lucknow - 226 010 (U.P.), India.
[2]Department of Seed Science & Technology, N.D.U.A. & T., Faizabad - 224 229 (U.P.), India.
[3]Department of Botany, K.K. P.G. College, Etawah (U.P.), India.

Abstract

The field experiment was conducted at Agronomy Research Farm of N.D.U.A. & T., Kumarganj, Faizabad during *Rabi* season of 2013-14 to study the performance of lentil varieties under rainfed condition in respect of growth and development, yield and yield contributing characters, quality and economics. Twelve varieties of lentil IPL-81, K-75, NDL-1, IPL-406, DPL-15, PL-5, PL-234, PL-4, DPL-62, PL-406, PL-63 and HUL-57 were tested in Randomized Block Design (RBD) with three replications. The performance of PL-406 variety of lentil was found significantly superior over rest of the varieties in respect of all growth, yield and yield contributing characters except plant height and test weight. The maximum plant height was recorded in IPL-406 variety while the higher test weight (g) was recorded in DPL-62 variety. The highest net return (Rs. 73743 ha^{-1}) and B:C ratio (4.3) was obtained with PL-406 variety of lentil under the rainfed condition.

Key words : Yield contributing characters, uptake studies, economics.

Introduction

Pulses are the second most important group of crop after cereals. Globally more than two dozen pulse crops are grown. Endowed with unique ability to trap atmospheric nitrogen in their root nodules in association with rhizobium bacteria and thrives well under harsh and fragile ecosystem. Pulses are very important source of protein in Indian diets as majority of population are vegetarian. Pulses are very nutritive leguminous crops that provide a high value protein. Lentil grains are used mostly as 'dal'. Its grain contains about 11% water, 25% protein & 60% carbohydrate. It is also rich in calcium, iron & niacin. It plays a vital role in improving soil fertility & reserve natural resource which are essential for sustainable agriculture. To alleviate protein–energy mal nutrition, a minimum of 50g pulses per capita should be available in addition to other source of proteins such as cereals, milk, meat and eggs (Mehta *et al*., 2005). Recommended the per capita availability of pulses is 65g/day/capita. The Indian council of medical research in 2008. Whereas FAO/WHO recommendation of minimum requirement is 80g /day/person. It is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Bihar and West Bengal. In Uttar Pradesh around the area 12.32 million hectare with production of 8.26 million tones and productivity of 715.46 kg ha^{-1} (NFSM, 2012-2013).

It is hardy and capable of withstanding extremes of weather and soil conditions. Uttar Pradesh accounts 40% of area and 45% of the total lentil production. Therefore, raising productivity may be the important option to deal with it Kokate *et al.* (2013).

Lentil predominantly rainfed crop grown in constrained and limiting factor environment. Several causes are responsible for low yield of lentil of which the use of traditional local cultivars, low plant density $unit^{-1}$ area, weed infestation and poor crop management practices constitute the major ones. Use of the modern lentil cultivars and maintenance of proper plant density $unit^{-1}$ area would thus help in increasing the yield from $unit^{-1}$ area. Seed rate is one of the main factors that have an important role on growth, yield and quality of lentil. Optimum spacing can ensure proper growth of the aerial and underground parts of the plant through efficient utilization of solar radiation, nutrients, land as well as air spaces. Spacing for line sowing is recommended to maintain the required number of plant population and to

Table 1 : To study the performance of lentil (*Lens culinaris.* M.) varieties under rainfed conditions.

Treatment	Growth characters																		
	Plant height (cm) Days after sowing				Initial plant population (No. m^{-2})	Dry matter accumulation (g plant^{-1})				Number of branches plant^{-1} Days after sowing				Days taken to 50% flowering and maturity		Number of Nodules		Fresh weight of Nodules (g) plant^{-1}	
	30	60	90	At harvest		30	60	90	At harvest	30	60	90	At harvest	Days taken to 50% flowering	Days taken to maturity	40	60	40	60
Varieties																			
IPL-81	16.70	24.20	36.80	41.80	72.85	0.04	0.41	2.15	2.66	2.05	16.20	16.30	16.10	75	142	9.00	12.30	0.56	0.70
K-75	15.75	22.90	34.70	39.40	73.62	0.06	0.53	2.77	3.44	2.65	20.75	21.00	20.70	77	146	11.40	15.80	0.72	0.90
NDL-1	14.50	21.00	31.90	36.20	75.17	0.07	0.65	3.45	4.29	3.30	24.90	25.20	24.80	74	141	14.00	19.80	0.91	1.13
IPL-406	17.40	25.20	38.20	43.40	75.95	0.07	0.61	3.24	4.03	3.15	24.70	25.00	24.70	76	145	13.40	18.80	0.86	1.08
DPL-15	17.00	24.60	37.30	42.40	76.72	0.06	0.56	2.94	3.65	2.85	22.30	22.40	22.20	78	149	12.00	16.90	0.77	0.97
PL-5	13.10	19.00	28.80	32.80	75.33	0.06	0.54	2.85	3.54	2.80	22.00	22.20	21.90	72	137	11.80	16.70	0.76	0.95
PL-234	15.00	21.80	33.10	37.60	75.95	0.06	0.57	3.02	3.75	2.90	22.70	23.00	22.70	78	148	12.20	17.20	0.79	0.99
PL-4	15.50	22.50	34.20	38.80	74.40	0.07	0.61	3.20	3.97	3.05	23.90	24.20	23.90	76	145	12.90	18.20	0.83	1.04
DPL-62	13.70	19.80	30.10	34.20	76.72	0.06	0.54	2.84	3.53	2.75	21.60	21.80	21.50	75	141	12.60	16.40	0.75	0.94
PL-406	16.00	23.20	35.20	40.00	77.50	0.07	0.67	3.52	4.37	3.45	25.60	25.90	25.60	80	150	14.50	20.50	0.94	1.17
PL-63	16.10	23.30	35.60	40.00	75.36	0.05	0.44	2.31	2.86	2.25	17.60	17.75	17.40	77	145	9.60	13.40	0.61	0.76
HUL-57	14.30	20.70	31.50	35.60	77.50	0.05	0.48	2.51	3.11	2.45	19.00	19.40	19.10	76	144	10.30	14.50	0.67	0.83
SEm±	0.52	0.81	1.46	1.53	2.57	0.02	0.02	0.18	0.16	0.14	0.68	0.94	0.90	3.45	5.69	0.41	0.71	0.03	0.04
CD at 5%	**1.52**	**2.37**	**4.29**	**4.50**	**NS**	**NS**	**0.06**	**0.34**	**0.46**	**0.41**	**1.99**	**2.77**	**2.66**	**NS**	**NS**	**1.20**	**2.08**	**0.09**	**0.12**

undertake intercultural operations for harvesting a higher yield (Shukla *et al.*, 2001).

The major constraints under rainfed lentil cultivation of eastern Uttar Pradesh are non availability of superior genotypes, reduced plant population due to reduced soil moisture and delayed sowing. The development of high yielding varieties of lentil for the rainfed areas is one of the major concerns of the scientist because, the use of improved variety results in increase in productivity of any crop. Generally short duration varieties are more suitable for rainfed conditions. The use of improved varieties alone accounts for 20-25% increase in productivity of lentil crop. The rainfed agriculture is characterized by limited availability of moisture. If the availability of moisture is not proper at the time of germination, the poor germination due to lack of moisture ultimately adversely affects the yield of crop. The moisture stored in rhizosphere of the soils of rainfed areas generally determines the crop growth. If the profile stored soil moisture is properly exploited by judicious management practices, then good crop yield may be expected from rainfed areas also for the efficient utilization of stored soil moisture under rainfed conditions. The present investigation to study the performance of lentil (*Lens culinaris* M.) varieties under rainfed conditions.

Materials and Methods

A field experiment was conducted during *Rabi* season of 2013-2014 at Agronomy Research Farm of NDUAT, Faizabad (U.P.), India. There were 12 treatments, which were laid out in Randomized Block Design with three replications net plot size was 2.40m × 4.40m with 30cm row spacing respectively. Soil of the experimental field was silt loam in texture with 7.9pH and electrical conductivity 0.33dSm^{-1} slightly alkaline in reaction with 7.9 pH low in organic carbon (0.32%) and low in available nitrogen (108.4 kg ha^{-1}),

Table 2 : To study the performance of lentil (*Lens culinaris.* M.) varieties under rainfed conditions.

Treatment	Yield contributing characters															
	Number of pod plant^{-1}	Number of grains Pod^{-1}	1000-seed weight (g)	Grain yield (kg plot^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Nitrogen content in grain (%)	Nitrogen content in straw (%)	Protein content in grain (%)	Nitrogen uptake (kg ha^{-1}) by		Total nitrogen uptake (kg ha^{-1})	Phosphorous uptake (kg ha^{-1}) by		Total phosphorous uptake (kg ha^{-1})
											Grain	Straw		Grain	Straw	
Varieties																
IPL-81	87.15	1.33	24.20	0.90	8.50	10.65	44.30	3.95	1.52	24.69	33.56	16.17	49.73	2.29	0.61	2.90
K-75	112.00	1.67	19.70	1.27	12.00	15.28	43.93	3.97	1.50	24.81	47.62	22.87	70.49	2.88	0.92	3.80
NDL-1	140.00	2.00	17.10	1.70	16.07	20.24	44.29	3.95	1.53	24.69	63.57	30.95	94.52	4.02	1.17	5.19
IPL-406	133.35	1.00	23.50	1.60	15.12	18.59	44.90	3.94	1.48	24.63	59.64	27.57	87.21	3.94	1.14	5.07
DPL-15	119.70	1.33	28.30	1.39	13.14	16.43	45.37	3.95	1.52	24.69	51.88	24.99	76.87	3.02	0.99	4.01
PL-5	118.30	1.33	22.10	1.37	12.95	15.66	45.21	3.97	1.55	24.81	51.35	24.30	75.65	3.88	0.99	4.87
PL-234	122.15	1.67	27.50	1.43	13.51	17.10	44.11	3.90	1.53	24.38	52.90	26.11	79.02	3.80	1.06	4.86
PL-4	128.80	1.67	18.10	1.53	14.46	18.40	43.89	3.92	1.50	24.50	56.53	27.59	84.12	4.18	1.05	5.23
DPL-62	116.20	1.33	30.50	1.34	12.66	15.72	44.60	3.97	1.54	24.81	50.20	24.18	74.38	3.41	0.96	4.37
PL-406	145.25	1.67	19.90	1.78	16.83	20.54	45.06	3.98	1.52	24.88	66.86	31.28	98.14	5.21	1.32	6.52
PL-63	94.50	2.00	22.50	1.01	9.55	11.83	44.73	3.95	1.55	24.69	37.70	18.39	56.09	2.77	0.72	3.49
HUL-57	103.25	1.67	19.30	1.04	10.77	13.27	44.82	3.93	1.54	24.56	42.38	20.49	62.87	2.81	0.84	3.65
SEm±	5.40	0.06	1.12	0.07	0.71	0.69	1.72	0.10	0.04	0.67	3.13	1.33	3.28	0.21	0.05	0.23
CD at 5%	**15.84**	**0.17**	**3.21**	**0.22**	**2.08**	**2.02**	**NS**	**NS**	**NS**	**NS**	**9.20**	**3.92**	**9.64**	**0.63**	**0.16**	**0.68**

phosphorous (18.4 Kg ha^{-1}), medium in potassium (290 Kg ha^{-1}), available Sulphur 7.3 (ppm) and available Zinc 0.59(ppm). The crop was sown on 20 November 2013 and harvested on 6 April 2014. Data on growth, yield, protein content etc. were recorded as per standard procedures. Economics of the different treatments was also computed as per standard procedures.

Results and Discussion

Among varieties maximum plant height was recorded in lentil variety IPL-406 closely followed by variety DPL-15, which were at par with IPL-81, PL-406 and PL-63 but significantly higher than other varieties at all the growth stages. The smallest plants were found in the lentil varieties PL-5. Similar results also reported by Shukla *et al*. (2001).

The plant population m^{-2}, recorded at 15 days after sowing of lentil. The plant population at initial stage was not affected significantly due to various varieties. It is due to the fact that the germination capacity of all the varieties of lentil was almost found the similar results as regarded by Shukla *et al.* (2001).

The dry matter accumulation increased with increase in the age of the crop. The dry matter accumulation (g plant^{-1}) was significantly affected due to various varieties at all the stages of crop growth, except at 30 DAS. The maximum dry matter accumulation was recorded with in PL-406 which was at par with varieties NDL-1, IPL-406 and PL-4 and significantly superior over rest of the varieties at 60, 90 and at harvest stages. Supported from the results, Shukla *et al.* (2001) and Gunes *et al*. (2007).

Number of branches plant^{-1} varied from 2.05 to 3.45 at 30 DAS, 16.20 to 25.60 at 60 DAS, 16.30 to 25.90 at 90 DAS and 16.10 to 25.60 at harvest stage. The maximum branching i.e. 3.45 plant^{-1} was noted with variety PL-406 followed by NDL-1 and IPL-406, which was significantly higher over other most of the varieties at 30 DAS. The same trend was recorded at 60, 90 and at harvest stages of crop. The number of branches enhanced maximum in between 30 to 60 days stage. Singh and Gupta (2005) also found the similar results.

A perusal of data clearly indicated that maximum days taken to 50% flowering were recorded 80 days in the variety PL-406 followed by 78 days with DPL-15 and PL-234, there were no significant difference noted due to any variety. Minimum days taken to 50% flowering were recorded with 72 days by PL-5.The maximum days to maturity was noted with variety PL-406 followed by DPL-15 and PL-234. The minimum was recorded with PL-5. Such difference may be due to varieties characters the similar results were also obtained by Singh and Gupta (2005).

The variety PL-406 produced more number of nodules plant^{-1} being at par with NDL-1 and it was significantly superior over rest of the varieties. The lowest number of nodules plant^{-1} was recorded in IPL-81 at 40 and 60 DAS. This may due to long duration of these varieties, which provided more nodules of days for nodulation such findings are found similar results by Balyan *et al.* (2005), Singh and Gupta (2005).

The variety PL-406 recorded more fresh weight of nodules (g) plant^{-1} being at par with NDL-1 and it was significantly superior over rest of the varieties. The lowest fresh weight of nodules was recorded in IPL-81at 40 and 60 DAS.

Yield contributing characters

The maximum number of pods plant^{-1} (145.25) was recorded in the variety PL-406 followed by variety NDL-1 (140) and IPL-406 (133.35) which was significantly superior over rest varieties. Minimum number of pods plant^{-1} (87.15) was recorded in variety IPL-81.

The maximum number of grains pod^{-1} was recorded with NDL-1 and PL-63 followed by variety K-75, PL-234, PL-4, PL-406 and HUL-57 (1.67). There was significant differences in varietal performance for number of grains pod^{-1} over IPL-81, DPL-15, PL-5 and DPL-62. Closely results found by Shukla *et al*. (2001) and Singh *et al*. (2002).

The test weight varied from 17.1g to 30.5g. Maximum test weight of 30.5g was recorded with variety DPL-62 followed by DPL-15 (28.3g) and PL-234 (27.5g). This was significantly superior over rest of the other varieties. Singh and Gupta (2005) also reported the similar results.

The variety PL-406 produced more grain yield (1.78 kg plot^{-1}) and it was significantly superior over rest of the varieties. The lowest grain yield (0.90 kg plot^{-1}) was recorded of the variety IPL-81. The maximum grain yield was recorded from PL-406 (16.83 q ha^{-1}) followed by NDL-1 IPL-406 and significantly superior over rest of the varieties. The lowest grain yield was observed with the variety IPL-81 (8.50 q ha^{-1}). Closely results also found by Lal *et al*. (1995) and Singh and Gupta (2005).

Table 3 : To study the performance of lentil (*Lens culinaris* M.) varieties under rainfed conditions.

Varieties	Cost of cultivation (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net return (Rs ha^{-1})	Benefit - cost ratio
IPL-81	16854	45797	28952	1.7
K-75	16854	66692	49838	2.9
NDL-1	16854	86600	69746	4.1
IPL-406	16854	81412	64558	3.8
DPL-15	16854	70792	53938	3.2
PL-5	16854	69689	52835	3.1
PL-234	16854	72817	55693	3.3
PL-4	16854	77952	61098	3.6
DPL-62	16854	68190	51336	3.0
PL-406	16854	90597	73743	4.3
PL-63	16854	51434	34580	2.0
HUL-57	16854	57994	41140	2.4

The maximum straw yield was recorded (20.54 q ha^{-1}) of the variety PL-406, which was significantly superior over rest of the varieties and at par with NDL-1 and IPL-406 variety. The lowest straw yield was recorded (10.65 q ha^{-1}) with the variety IPL-81. Similar findings also reported by Singh *et al*. (1996) and Rai *et al*. (1997).

The maximum value of harvest index was recorded with the variety DPL-15 followed by PL-5 and PL-406 and higher over rest of the varieties. While the minimum value of harvest index was found in PL-4. Rai *et al*. (1997) also reported the similar results.

Uptake studies

The maximum nitrogen and protein content was recorded with variety PL-406 followed by variety K-75, PL-5 and DPL-62. The lowest value of nitrogen and protein content was recorded with variety PL-234 followed by PL-4. Closely result also found Singh *et al*. (1990) and Tomer *et al*. (2007).

The maximum nitrogen uptake by crop was found (98.14 kg ha^{-1}) with the variety PL-406, followed by NDL-1 (94.52 kg ha^{-1}) and it was significantly superior as compared to rest of the varieties. The lowest nitrogen uptake (49.73 kg ha^{-1}) by crop obtained in the variety IPL-81.

The variety PL-406 recorded the higher phosphorous uptake by crop, which was significantly superior over rest of the varieties. The lowest phosphorous uptake by

crop was recorded of the variety IPL-81. Balyan *et al*. (2005) also reported the similar results.

Economics

The cost of cultivation recorded for all the varieties was same. The cost of cultivation of Rs. 16854 ha^{-1} was calculated for all the varieties. The highest gross return of Rs. 90597 ha^{-1} was obtained with PL-406 variety of lentil. It might be due to more yields of seed and straw of this variety. The maximum benefit- cost ratio of 4.3 was also recorded with the same variety. This is due to the increased net return in corresponding to the cost of cultivation.

References

Balyan, J. K. and Mahak Singh (2005). Effect of seed inoculation, different levels of irrigation and phosphorus on nodulation and root growth development of lentil. *Research on Crops*, **6(1)** : 32-34.

Gunes, Aydin, Inal, Ali, Adak Mehmet S., Alpaslan, Mehmet Bagci, G. Esra, Erol, Taskin Pilbeam and J. David (2007). Mineral nutrition of wheat, chickpea and lentil as affected by mixed cropping and soil moisture. *Nutrient Cycling in Agro ecosystems*, **78(1)** : 83-96, April 2007.

Kokate, K. D., A. K. Singh and Lakhan Singh (2013). *Harnessing pulses productivity*. Published by Division of Agriculture Extension, ICAR, New Delhi.

Lal, S. (1985). Lentil-an ideal pulse crop for dry farming. *Indian Farming*, **35(4)** : 23-24.

Mehta, S. L., L. M. Sautha and M. L. Lodha (2005). *Nutritional quality of grain legumes*. Food Legumes of National Security and Sustainable Agriculture, IFLRC-W Oct. 18-22 Delhi pp. 7.

NFSM (2012-13). Formulation of Strategy for Rabi Pulses Production particularly Chickpea and Lentil during 2013-14 NFSM Directorate of Agriculture, Uttar Pradesh Krishi Bhawan, Lucknow.

Rai, C., J. H. Sah, S. K. Varshney, S. S. Mandal and Pramod Kumar (1997). Character association and path analysis in lentil under rainfed eco systems. *J. Oil Seeds Res*., **14(1)** : 27-30.

Shukla, S. R., D. P. Singh and Rabi Shukla (2001). Response of drought tolerance varieties to different nitrogen levels in Tarai region of U.P. *Ann. Agric. Res*., **24(4)** : 856-527.

Singh, Tejbir and K. K. Gupta (2005). Character association analysis in lentil (*Lens culinaris* Medik.). *Plant Archives*, **5(1)** : 261-264.

Shukla, S. R., D. P. Singh and Rabi Shukla (2001). Response of drought tolerance varieties to different nitrogen levels in Tarai region of U.P. *Ann. Agric. Res*., **24(4)** : 856-527.

Singh, S. P., D. S. Chauhan and S. P. Singh (2002). Response of lentil cultivars to sources and levels of sulphur. *Indian Journal of Agronomy*, **47(1)** : 94-97.

Singh, K. P., S. Singh, A. K. Sarkar and R. P. Singh (1996). Status and response of sulphur and micronutrients in soils of Bihar plateau for higher crop productivity. *Fertilizer News*, **41(8)** : 41-47.

Singh, R. P. and V. Singh (1990). Effect of S, Mg and K on yield and uptake by lentil. *Journal of Indian Society Soil Science*, **38** : 169-170.

Tomer, A. K., Kuldeep Tyagi and J. P. Lal (2007). Selection of promising drought tolerant in lentil (*Lens culinaris* Medik.). *Indian Journal of Agronomy*, **67(2)** : 140-144.