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Effect of lentil ((*Lens culinaris*) varieties under various methods of establishment in rainfed drought-prone condition of Bihar.

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ABSTRCT
A field experiment was conducted to Effect of lentil varieties under various methods of establishment in rainfed drought-prone condition of Bihar. The field experiments were carried out at the KVK, Aurangabad and farmers' field (Latitude: 24.50^0 N, Longitude: 84.70^0 E, Mean sea level height: 332ft) during rabi season 2013-14 in rainfed lowland having clay loam soil type. Performance of three varieties; HUl-57, PL-06 and PL-08 were evaluated under different method of establishment viz; line sowing with seed drill and sowing with Zero tillage with BMP cultivation practices. The experiment was laid out in a split plot design (SPD) with five replications at KVK and five at farmers' field. Significantly maximum grain yield (1577kg ha^{-1}) was 3.99 % higher compared to line sowing with seed drill, net return(Rs49,790ha^{-1}) and B:C ratio(4.13) were recorded with zero till drill sown method over line sowing. Biological, grain and straw yields were 33.37, 33.39 and 33.39%, more in PL-08 and 29.52, 30.36 and28.47% in HUL-57 than PL-06, respectively. Maximum net return (Rs 61176/ha) and benefit cost ratio (4.61) recorded with PL-08 being at par with HUL-57 gross return (Rs 76486.50/ha), net return (Rs 59417/ha) and benefit cost ratio (4.52) both were significantly more over PL-06 gross return (Rs 38264/ha), net return (Rs 204934/ha) and benefit cost ratio (2.16) .
Keywords: *Lentil, Varietal performance, Yield attributes, Method of Establishment*

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INTRODUCTION

Lentil (*Lens culinaris*) is the fourth most important pulse crop of the world after beans, pea and chickpea. It is a bushy annual plant of the legume family, grown for its lens-shaped seeds. It is the important pulse crop mainly grown on residual soil moisture and prominent source of vegetable protein [15]. In India, lentil occupies 1.51 million ha area with a production of 1.13 million ton. Average annual growth in area, production and yield of lentil has increased steadily from 2008 to 2014 in the tune of 2.5 %, 7.9 % and 5.7 % respectively [6]. Besides fixing atmospheric N and benefitting the succeeding crop with residual nitrogen in soil, lentils also adapted to local climatic and soil fertility conditions [17]. Lentil has the potentiality to fix up to 120 kg N ha-1 in the soil [1]. Lentil has a very good potential for increasing farm income as well as cropping intensity [6]. Lentil is a major legume crop and main source of dietary protein in eastern region [1, 15]. Lentil is one of the most nutritious cool season legumes and ranks next only to Chickpea in India. Lentil contains about 24% - 26% protein, 1.3% fat, 2.1% minerals, 3.2% fiber and 57% carbohydrate [1]. Lentils are deficient in two essential amino acids, methionine and cysteine. Lentil seed contain protein 2.5 per cent, fat 1.5 per cent and carbohydrates 56.6 per cent [13]. Lentil has high saponin content (3.7-4.6 g kg-1 seed), which reduces the cholesterol levels in the blood. Lentil is not only grown as an important rabi pulse in Bihar, it is a potential crop in the adjoining provinces of India (West Bengal, Jharkhand and Uttaranchal) as well as abroad (Nepal, Pakistan and Bangladesh) because of consumer's preference [14]. In Bihar lentil seeds are generally broadcasted (as paira crop) in the standing crop of rice 10-15 days before harvesting (relay crop ping) to capitalize on residual moisture and ensure timely sowing as well as to get good germination and skipping off the tillage operations during lentil growing.

The response of promising lentil varieties viz. yielded the highest (1332.71 kg ha^{-1}), exhibiting yield advantages to the tune of about 49- 70% over the others and its superiority could be explained on the basis of higher podding potentiality (110.63 pods $plant^{-1}$) [14].

In Bihar, agriculture is of intensive in nature and rice- wheat rotation is dominating the agriculture scenario and besides its contribution of food grain it created many problems like depleting of soil water, weed infestation and deterioration in soil health, attack of insect pests, diseases, intensive use of energy and marketing problems. Pulse cultivation seems to be viable and economical solution to overcome these problems because of nitrogen fixation, low water and herbicide requirement. Further the cost of lentil cultivation can be minimized by adopting no tillage. The timely planting of any crop is important for better plant growth, development and grain yield. With suitable residue management, zero tilled fields can be sown timely than conventional tilled fields. So it is imperative to find out optimum sowing time for maximum yield potential of lentil. Since the information on the Effect of lentil varieties under various methods of establishment in rainfed drought-prone condition of Bihar.

MATERIALS AND METHODS

A field experiment was conducted to Effect of lentil varieties under various methods of establishment in rainfed drought-prone condition of Bihar. The field experiments were carried out at the KVK, Aurangabad and farmers' field (Latitude: 24.50^0 N, Longitude: 84.70^0 E, Mean sea level height: 332ft) during rabi season 2013-14 in rainfed lowland having clay loam soil type. Performance of three varieties; HUL-57, PL-06 and PL-08 were evaluated under different method of establishment viz; line sowing with seed drill and sowing with Zero tillage with BMP cultivation practices. The experiment was laid out in a split plot design (SPD) with five replications at KVK and five at farmers' field. The soil analysis revealed that the soil of the experimental field was clay loam in texture, well drained with of organic carbon (0.58 %), available nitrogen (210.50 kg ha^{-1}) and potassium (195.23 kg ha^{-1}) content and low in available phosphorus (15.23 kg ha^{-1}). The soil was slightly alkaline in nature (pH 7.8) in reaction. Soil samples were collected from the plough layer at the beginning of the experiment. These samples were air dried, ground, sieved and then used in chemical analysis for determination of soil organic-C content, available N, P and K content of the soil. Treatments comprised of three different varieties of lentil viz. HUL-57, PL-08 and PL-06 under two methods of establishment *i.e.*, line sowing and zero till drill sown method was studied in a split plot design. The treatments were allocated randomly to different plots. To obtain a fine seed bed to sowing the lentil crop seed the land was ploughed two times with the help of tractor with cultivator, and two times with tractor with rotavator. Then the clods, stones and weeds were removed from the experimental field. Planking was done to break clods and level the field after final tillage in line sowing treatment. In zero till drill sown plot field was not prepare lentil crop sown just after of paddy harvesting. A general recommended dose of N: P_2O : K_2O for lentil was applied uniformly to each plot at the rate of 20:40:40 kg ha^{-1}. All the fertilizers were given in the plots uniformly at the time of sowing. Sowing was done uniformly with 3-4 cm depth in all the plots by seed drill and zero till drill machine by using 40 kg seeds ha^{-1}. All the standard agronomic management practices were followed as per the requirements. In this experiment Maximum plant height (cm), number of branches $plant^{-1}$, grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield (kg ha^{-1}), and harvest index (%) were measured.

RESULT AND DISCUSSION

Effect of planting methods:

Plant population/m^2 (65.03) was also recorded maximum in Zero till drill sown which was significantly higher than line sown seed drill method (62.90). Number of branch/plant (13.40) was recorded maximum in ZTD sown method, which was significantly higher over line sown with seed drill method (12.13).Number of pods/plant (61.13) was recorded maximum in Zero till drill sown method which was significantly higher over line sown with seed drill method (58.67).However, plant height was recorded maximum in seed drill sown method (45.31cm) which was no significant deference between ZTD sown method (45.12cm). No of grain/pod (1.64) and test weight (25.22 g) were recorded maximum with ZTD sown method but there is no significant deference with seed drill sown method in both characters. These findings are in line with those of Balusamy *et al*. [4] and Blackshaw *et al*. [5].

Days taken to maturity (122.93) were recorded maximum in Seed drill sown method and significantly higher over ZTD sown method (119.40) (Table 2).Biological yield in ZTD (3016 kg/ha) was 3.95% higher than seed drill sown methods .Similarly, the grain yield (1577kg/ha) in ZTD was 3.99 % higher compared to line sowing with seed drill. Straw yield (1440 kg/ha) in ZTD was 3.98% more over seed drill sown method. However, harvest index not significantly influenced by ZTD and seed drill sown method. Guy *et al*. [7] reported that several factors contribute to the reduced yield including cooler soil conditions, poor

stand establishment and slow growth. According to Guy and Wu [8], Balasubramanian *et al*. [3], Nieya *et al*. [12] and Blackshaw *et al*. [4] reduced early growth in no tillage was due to cooler soil conditions probably contributed to reduced biomass and plant height. Low dry matter accumulation lead to lower seed yield. Lopez-Bellido *et al*. [11] reported similar results. Improved rooting condition and water extraction in zero tillage condition results in better plant growth and higher yield as reported by Izaurralde *et al*.[9].

Gross return, net return and benefit- cast ratio recorded maximum with ZTD sown method. Maximum gross return was recorded with ZTD sown method (Rs. 65843/ha) was significantly more over seed drill sown method (Rs.62821/ha) .Similarly, net return was also recorded significantly higher with (Rs.49790/ha) over seed drill sown method (Rs.44268/ha). B:C ratio recorded maximum with ZTD sown method (4.13) which was significantly higher over seed drill sown method(3.40)

Effect of varieties:

Plant height, plant population at harvest, No. of branch/plant, No. of pods/plant, No. of grain/pod ,test weight (table 1), days taken to maturity , biological yield, grain yield ,straw yield, Harvest Index, gross return, net return and B:C ratio(Table 2, Table 3) were also significantly influenced by the different varieties of lentil. Plant height of PL-08 (48.28cm) was significantly higher over HUL-57 (44.26cm) and PL-06(43.12cm) (Table 1). Kundu *et al.* [10] observed significant differences in plant height, dry matter accumulation of the lentil crop variety Plant population at harvest stage was recorded higher with PL-08 (70.60) was significantly higher over HUL-57 (66.65) and PL-06 (54.65). Number of branch/plant recorded maximum in PL-08 (14.75) which was significantly higher over HUL-57(13.30) and PL-06 (10.25).Number of pods/plant (66.40) in PL-08 was significantly higher over HUL-57(62.90) and PL-06 (50.40). Number of grain/pod was also recorded maximum with HUL-57(1.7) being at par with PL-08 (1.69) and both were significantly more over PL-06(1.51). However, test weight was recorded maximum in PL-06 (32.17g) was significantly higher over HUL-57 (22.71g) and PL-08 (17.86).

Days taken to maturity(128.60) were significantly more in PL-08 being at par with HUL-57(127.40) both were significantly higher over PL-06 (107.50) at maturity (Table 2) Biological yield (3263 kg/ha), grain yield (1701kg/ha) and straw yield (1562 kg/ha) recorded higher with PL-08 being at par with HUL-57 biological yield (3168 kg/ha), grain yield (1663 kg/ha) and straw yield (1504 kg/ha), which were significantly more over PL-06 biological yield (2446 kg/ha), grain yield (1275 kg/ha) and straw yield (1171 kg/ha) (Table 2). Biological, grain and straw yields were 33.37, 33.39 and 33.39%, more in PL-08 and 29.52, 30.36 and 28.47% in HUL-57 than PL-06, respectively. However, HI in three varieties was statistically similar. Kundu *et al.* [10] also ob- served significant differences in yield of the lentil crop variety through a study to assess the performances of sixteen pre-released and two standard varieties of bold seeded lentil for their productivity potential.

Maximum gross return (Rs 78246/ha), net return (Rs 61176/ha) and benefit cost ratio (4.61) recorded with PL-08 being at par with HUL-57 gross return (Rs 76487/ha), net return (Rs 59417/ha) and benefit cost ratio (4.52) both were significantly more over PL-06 gross return (Rs 38264/ha), net return (Rs 20494/ha) and benefit cost ratio (2.16) (Table 3).

Table 1: Effect of method of establishment and Varieties on yield attributing characters of Lentil.

Treatment	Plant height (cm)	Plant population	N0. of branches	No. of pods/plant	No. of grain/pod	Test weight (g)
Method of Establishment						
Line Sowing	45.31	62.90	12.13	58.67	1.63	23.27
Zero till drill	45.12	65.03	13.40	61.13	1.64	25.22
LSD =0.05	NS	2.15	1.04	1.76	NS	NS
Varieties						
HUL-57	44.26	66.65	13.300	62.90	1.70	22.71
PL-06	43.12	54.65	10.250	50.40	1.51	32.17
PL-08	48.28	70.60	14.750	66.40	1.69	17.86
LSD =0.05	1.07	2.85	0.98	2.29	0.07	4.94

Table 2:Effect of method of establishment and Varieties on growth and yield of Lentil.

Treatment	Days taken to maturity	Biological Yield (Kg/ha)	Grain Yield (Kg/ha)	Straw Yield (Kg/ha)	Harvest Index
Method of Establishment					
Line Sowing	122.93	2,902	1,516	1,384	52.30
Zero till drill	119.40	3,016	1,577	1,440	52.21
LSD =0.05	1.90	78.18	40.472	46.70	NS
Varieties					
HUL-57	127.40	3,168	1,663	1,503	52.48
PL-06	107.50	2,446	1,275	1,171	52.13
PL-08	128.60	3,263	1,701	1,562	52.16
LSD =0.05	1.60	111.49	59.69	60.55	NS

Table 3:Effect of method of establishment and Varieties on economics of Lentil.

Treatment	Coast of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio (Rs/ha)
Method of Establishment				
Line Sowing	18553	62,821	44,268	3.40
Zero till drill	16053	65,843	49,790	4.13
LSD =0.05	-	1,549	1,549	0.09
Varieties				
HUL-57	17070	76,487	59,417	4.52
PL-06	17770	38,264	20,494	2.16
PL-08	17070	78,246	61,176	4.61
LSD =0.05	-	2,409	2,409	0.14

CONCLUSION

From the above result, it may be concluded that the grain yield (1576.67 kg/ha) in ZTD was 3.99 % higher compared to line sowing with seed drill. Net return was also recorded significantly higher with (Rs.49789.60/ha) over seed drill sown method (Rs.44267.73/ha). B:C ratio recorded maximum with ZTD sown method (4.13) which was significantly higher over seed drill sown method(3.40). Biological, grain and straw yields were 33.37, 33.39 and 33.39%, more in PL-08 and 29.52, 30.36 and28.47% in HUL-57 than PL-06, respectively. Net return (Rs 61176.00/ha) and benefit cost ratio (4.61) recorded with PL-08 being at par with HUL-57 gross return (Rs 76486.50/ha), net return (Rs 59416.50/ha) and benefit cost ratio (4.52) both were significantly more over PL-06

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