Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 1084-1087
Received: 03-07-2020
Accepted: 30-08-2020

Dinesh Sah
Department of Agronomy, College of Agriculture, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India

Mukul Kumar
Department of Genetics and Plant Breeding, College of Agriculture, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India

Siddhartha Singh
Department of Basic Sciences and Humanities, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh, India

Corresponding Author:
Mukul Kumar
Department of Genetics and Plant Breeding, College of Agriculture, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India

Evaluation of lentil varieties under foot hill of north east agro-ecological region of India

Dinesh Sah, Mukul Kumar and Siddhartha Singh

DOI: https://doi.org/10.22271/phyto.2020.v9.i5o.12376

Abstract
Lentil (*Lens culinaris* Medik) is the important pulse crop grown mainly on residual soil moisture in *rabi* season. There is an ample scope for expansion of area under pulse crop like lentil in conserved soil moisture in North Eastern Hill Region of India where a large part of area remains fallow after the *kharif* season rice. In view of this, a field evaluation of nine most promising lentil varieties was conducted under conserved soil moisture at College of Horticulture & Forestry, Pasighat, Arunachal Pradesh, India during 2015-16 and 2016-17 to identify the most suitable lentil varieties under residual soil moisture condition in rice fallows. The data of two year experiment revealed that lentil variety IPL-316 exhibited maximum seed yield (11.03 q/ha) with minimum days to maturity (116 days). The other varieties with considerably fair seed yield performance were DPL 62 (6.49 q/ha), HUL 57 (6.10 q/ha) and WBL 77 (5.68 q/ha) with 127, 118 and 130 days to maturity. Linear relationship of seed yield with branches/plant and pods/plant indicated that these two traits should be considered for selection of high yielding varieties/lines, however, a quadratic relationship of seeds/pod and 1000 seed weight was observed with seed yield. The significant yield performance of lentil varieties clearly showed that there is enough opportunity of lentil cultivation in rice fallow with appropriate technologies for enhancing farmers' income as well as food and nutritional security of the region.

Keywords: Evaluation, lentil varieties, yield attributes, NEH region, rice fallow

1. Introduction

The North East Region (NER) of sub-tropical India covers the states of Arunachal Pradesh, Assam, Tripura, Meghalaya, Manipur, Mizoram, Nagaland and Sikkim with a cultivated area of about 2 million hectares (Sanwal *et al*. 2007) [10]. Communities in NER are predominately agrarian and practice subsistence agriculture. Development of sustainable farming systems is the key to prosperity of this region and requires crop diversification by involving pulses. The region has more than 80% area under acid soils and hence, the importance of legumes is better understood than in other parts of the country. Pulses, in fact, constitute the most common source of non-cereal protein, where the frequency of pulse consumption is higher than that of any other protein source. Pulses play a key role in improvement of soil fertility through biological nitrogen fixation mediated through *Rhizobium* bacteria in the root nodules. Subsequent crops raised in rotation to pulses exhibit a yield increase of 20-40% (Joshi, 1998) [5]. Cultivation of pulses are also an effective means of restoring degraded soils and can contribute significantly to achieving the twin objectives of increasing productivity as well as improving the sustainability of cereal-based cropping systems (Yadav *et al*. 1998) [12]. The per capita pulse availability in NER is hardly 12.5 g against 43.3 g at national level. Considering the recommended per head dietary pulse intake of 50 g, the pulse production in this region needs to be increased by almost 10 times to make this region self-sufficient in pulses (Das *et al*. 2016) [3].

The fact that the productivity of the pulses in this region (886 kg/ha) is higher than that of country's (728 kg/ha) indicated that this region suits well to pulse production (Annual Report 2016) [1]. In north eastern region, where a large part of land remains fallow after the *kharif* rice, there is enough scope to utilize these areas under pulse crops like lentil in rice fallows on residual soil moisture. Due to lack of irrigation facility and early onset of rains (March-April), the early maturing high yielding lentil varieties may escape the drought and coincidence of pre monsoon rains during maturity to avoid poor quality of seed, and thus could convert mono-cropped areas in to double crop area to increase legume production and sustain productivity of the rice based systems. The introduction of promising and early maturing high yielding lentil varieties may be significant to increase the productivity with more income to farmers and achieving self-sufficiency in this region.

Therefore, the study was carried out to find out most suitable early maturing high yielding lentil varieties suitable under the residual moisture condition after *kharif* rice fallow areas of NEH region.

2. Materials and Methods

A field experiment was conducted at agronomy block of College of Horticulture & Forestry, Pasighat, Arunachal Pradesh, India (28°07′ N latitude and 95°33′ E longitude). The soil of experimental site was sandy loam in texture, strongly acidic in reaction (pH 5.5) with organic carbon (OC) content 23.4 g kg^{-1}, cation exchange capacity (CEC) 14.5 cmol (p+) kg^{-1}, available nitrogen (N) 338 kg ha^{-1}, available phosphorus 28.4 kg P_2O_5 ha^{-1} and available potassium (K) 165.7 kg K_2O ha^{-1}. The experimental area was under humid subtropical climate with average annual rainfall of 4200 mm and mean annual temperature of 23^0C.

The experiment consisted of nine varieties of Lentil *viz*, HUL 57, IPL 316, IPL 406, DPL 62, DPL 15, IPL 81, Tripura LS-1, WBL 77 and Pant lentil 7 collected from IIPR Kanpur, Uttar Pradesh under promotion of pulses in north east hill region of India. These varieties of lentil were tested in complete randomized block design (CRBD) and replicated thrice during *rabi* season of 2015-16 and 2016-17. The seeds of nine lentil varieties were sown at 30 cm row spacing in 4 x 3 sqm plot under residual soil moisture condition. A recommended dose of 20 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha through urea, SSP and MOP, respectively were applied in furrows before sowing of lentil seeds and covered the seed with soil to give a good seed-soil contact. The crop was grown under rainfed condition and only one life saving irrigation was given before flowering for better performance.

The Phenology (50 per cent flowering and 80 per cent maturity) were recorded on plot basis while five randomly selected plants in each plot were harvested for taking observation on branches/plant, pods/plant, seeds/pod and 1000 seed weight. The three central rows in each plot were harvested to determine seed yield.

The pooled over experimental data of two years pertaining to each parameter of study were subjected to statistical analysis by using the technique of analysis of variance (Gomez and Gomez, 1984) [4]. The means were tested by Duncan's Multiple Range Test (DMRT) at 5% probability (p=0.05) level using DSSATAT. Microsoft excel was used for regression and graphical presentation. The hierarchical clustering by Ward's linkage method and measurement of dissimilarity through Euclidean distance was used to understand the relationships among lentil varieties based on phenotypic data. The clustering analysis was performed using SPSS (version 16.0).

3. Results and Discussion

3.1. Crop phenology

All the lentil varieties showed significant differences for days of 50% flowering (Table 1). The variety, IPL-316 took minimum number of days to 50% flowering (54 days). HUL 57 and DPL 15 were statistically at par with 58.7 and 60.3 days to 50% flowering, respectively. The maximum number of days for 50% flowering was with Pant Lentil -7 (67.7days) which was statistically insignificant with WBL 77, DPL 62 and IPL 81 having equal number of 65 days to 50% flowering. The 50% flowering up to 65 days was also observed by Layek *et al.* (2014) [8]. The days to eighty percent pod maturation also varied significantly among the varieties studied. Variety IPL -316 took the earliest (116.3 days) days to 80% maturity and it was statistically at par with HUL 57 (118.3 days), while Pant Lentil -7 took maximum number of days (134) for 80% pod maturity. The development of early maturing varieties with high yield potential to be one of the important objective in crop breeding program as early genotypes escape terminal drought (Kumar and Srivastava, 2015) [7].

3.2. Yield attributes

The pods/plant and 100-seed weight differed significantly while branches/plant and seeds/pod showed comparatively less variation among varieties studied (Table 1). The similar results were also observed by Yadav *et al.* (2015) [11] under similar agro ecological region of India. The highest number of branches/plant was recorded in DPL 62 (6.73) followed by with same statistical rank in WBL 77, DPL 15, IPL 316, HUL 57 and Pant lentil 7. The low and statistically similar number of branches/plant was observed in IPL 81 (5.0), Tripura LS -1 (5.56) and IPL 406 (5.2). The non significant difference for branch production among the mutants/mother variety was also reported by Mondal *et al*. (2013) [9] in lentil. The highest and statistically at par numbers of pods/plant were recorded in HUL 57 (87.5) and IPL 316 (86.1) followed by DPL 62 (55.9) and DPL 15 (58.4), however the minimum number of pods/plant was shown by Pant lentil 7 (28.5) and Tripura LS 1 (27.1). Among the varieties, the seeds/pod ranged from 1.5 (DPL 62) to 1.8 (IPL 406) with similar number of seeds/pod (1.7) in HUL 75, IPL 81 and WBL 77. The highest 1000 seed weight was recorded in IPL-406 (38.2g) followed by in IPL-316 (29.7g) followed by DPL 15 (27.9 g) and IPL 81 (27.5 g) with same statistical rank. The lowest 1000 seed weight with 22.9 g was recorded in HUL-57.

3.3. Seed Yield

Different varieties exhibited significant difference in seed yield (Table 1 and Fig 1). The results revealed that the highest seed yield was obtained in IPL 316 (11.03 q/ha) and followed by statistically at par seed yield in DPL 62 (6.49 q/ha) and HUL 57 (6.10 q/ha) while the lowest (3.53 q/ha) was produced by IPL 406. Except the variety WBL 77 with seed yield of 5.68 q/ha, rest of the varieties recorded seed yield in between 4.26 to 4.54 q/ha and showed statistically at par value among them.

3.4. Relationship of yield and its attributes

The regression analysis was carried out (Fig 2) to understand the functional relationship between yield and its attributing traits. The analysis revealed that branches/plant and pods/plant had linear regression with seed yield, indicating the higher values of these two characters towards increase higher seed yield. The increment of seed yield with increased number of branches and pods was also reported by many workers in lentil (Yadav *et al*. 2003 [13]; Anzam *et al.* 2005 [2]; Karadavut, 2009 [6] and Mondal *et al*. 2013 [9]).

On the other hand, the quadratic regression of seeds/pod and 1000 seed weight with seed yield suggested that the increase in number of seeds/pod and their weight has limitation to enhance the seed yield. The meager response of 1000 seed weight on seed yield was also reported by Yadav *et al*. (2015) [11].

The hierarchical clustering through Ward's linkage method based on days to 80% maturity, seed yield and its attributing traits showed three sub clusters containing with 4, 3 and 2 varieties, respectively (Fig.3). The clustering pattern clearly depicted the genetic differences between high and low performing varieties and suggested that the studied characters should be considered to find out the genetic differences and formulation of breeding strategy for varietal development programme in lentil.

Table 1: Phenology, yield and its attributes of different varieties of lentil (Pooled data of two year)

Varieties	Days to 50% flowering	Days to 80% maturity	Branches/plant	Pods/plant	Seeds/pod	1000 seed weight (g)	Seed yield (q/ha)
HUL 57	58.7^{b}	118.3^{ab}	6.23^{ab}	87.63^{a}	1.68^{abc}	22.90^{d}	6.10^{bc}
IPL 316	54.0^{a}	116.3^{a}	6.26^{ab}	86.13^{a}	1.63^{bcd}	29.76^{b}	11.03^{a}
IPL 406	61.7^{c}	121.3^{bc}	5.20^{cd}	14.70^{f}	1.77^{a}	38.26^{a}	3.53^{e}
DPL 62	65.0^{de}	127.7^{de}	6.73^{a}	55.87^{bc}	1.52^{d}	26.03^{cd}	6.49^{b}
DPL 15	60.3^{bc}	122.7^{c}	6.46^{ab}	58.40^{b}	1.58^{cd}	27.90^{bc}	4.26^{de}
IPL 81	65.0^{de}	124.3^{cd}	5.00^{d}	49.03^{cd}	1.72^{ab}	27.50^{bc}	4.53^{d}
Tripura LS 1	62.3^{cd}	127.7^{de}	5.56^{bcd}	27.07^{e}	1.58^{cd}	23.50^{d}	4.49^{d}
WBL 77	65.0^{de}	130.0^{e}	6.46^{ab}	43.63^{d}	1.72^{ab}	23.06^{d}	5.68^{c}
Pant Lentil 7	67.7^{e}	134.0^{f}	5.96^{abc}	28.53^{e}	1.63^{bcd}	25.10^{cd}	4.54^{d}
LSD (p=0.05)	2.48	3.44	0.81	8.57	0.09	3.45	0.65
SEm±	0.82	1.14	0.27	2.86	0.03	1.15	0.21

Means within the column followed by the same letter (s) do not differ significantly at p=0.05 level by DMRT

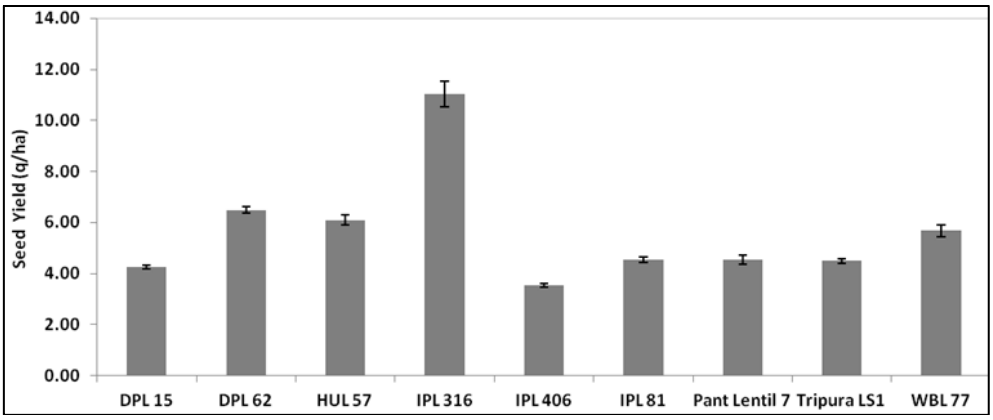

Fig 1: Seed yield produced by different lentil varieties

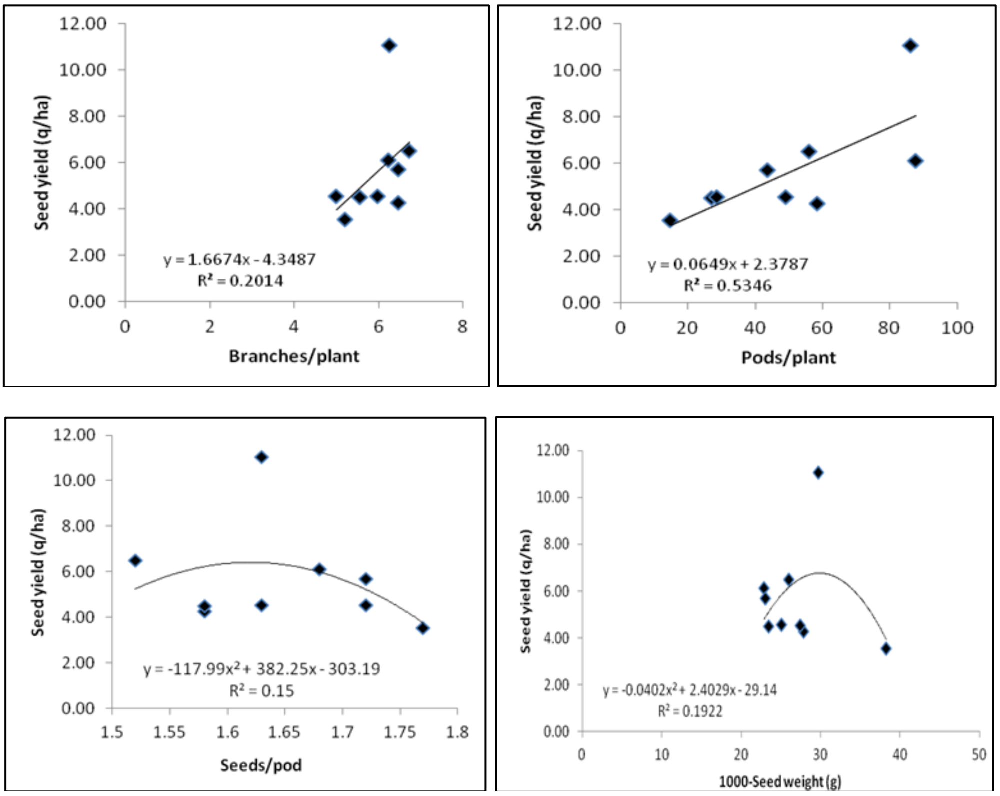

Fig 2: Relationship among the seed yield and its attributing traits

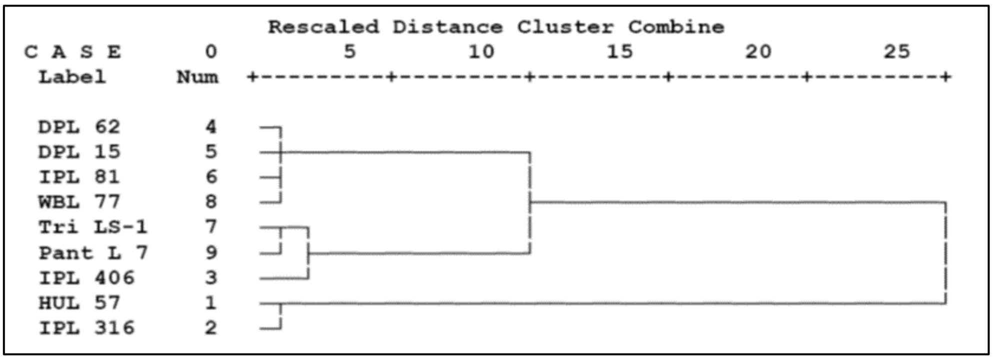

Fig 3: Clustering pattern (Ward's linkage) of nine lentil varieties based on phenotypic traits

4. Conclusions

Lentil a small seeded grain legume but nutritionally mighty member of legume family requires popularization and adoption in the North Eastern Region of the country. Development of agronomical practices for the cultivation of lentils in rice fallow may provide an opportunity for the socio-economical development of the tribal population. The present study exhibited significant yield performance of IPL 316 followed by HUL 57 with early maturity suggesting potentiality for the cultivation of lentil in rice fallow situation by adopting early maturing high yielding varieties under agro climatic condition of NEH region. However, more number of varieties/lines with appropriate technology is needed to test under rice fallow conditions for selection of high yielding early maturing varieties for this region.

5. Acknowledgement

The authors are thankful to the Director of Research, CAU, Imphal and Director, ICAR-IIPR, Kanpur, India, respectively for providing seed and other necessary facilities to conduct this research.

6. References

1. Annual Report. Annual report on Promotion of pulses in NEH Region (2015-2016).
2. ICAR-Indian Institute of Pulse Research, Kanpur 208 024, U.P., India, 2016, 29-32.
3. Anzam MS, Ali A, Iqbal SM, Haqqani AM. Evaluation and correlation of economically important traits in exotic germplasm of lentil. Int. J of Agric. & Bio. 2005; 7:959-961.
4. Das A, Babu S, Yadav GS, Ansari M, Singh R, Baishya LK *et al*. Status and strategies for pulses production for food and nutritional security in north-eastern region of India. Indian Journal of Agronomy. 2016; 61(Special issue):43-57.
5. Gomez KA, Gomez AA. Statistical procedures for agricultural research. A Wiley Interscience Publication, John Wiley and Sons, New York, 1984.
6. Joshi PK. Performance of grain legume in the Indo zangatic plain, In Rao JVDK Kumar Johason C (ed.) Residual effect of legume in rice wheat cropping system of Indo gangatic plain,International Crop Research Institutes for Semi-Arid Tropics (ICRISAT), Oxford and IBH publication Co. Ltd, New Delhi, 1998; IBSN 81-204-1297-4, pp 3-12.
7. Karadavut U. Path analysis for yield and yield components in lentil. Turkish Journal of Field Crops. 2009; 14:97-104.
8. Kumar J, Srivastava E. Impact of reproductive duration on yield and its component traits in lentil. Legume Research. 2015; 38 (2):139-148.
9. Layek J, Chowdhury S, Ramkrushna GI, Das A. Evaluation of Different Lentil Cultivars in Lowland Rice Fallow under No-Till System for Enhancing Cropping Intensity and Productivity. Indian Journal of Hill Farming. 2014; 27(2):4-9.
10. Mondal MMA, Puteh AB, Malek MA, Roy S, Yusop MA. Contribution of morpho-physiological traits on yield of lentil (*Lens culinaris* Medik). Australian Journal of Crop Science. 2013; 7(8):1167-1172.
11. Sanwal SK, Yadav RK, Singh PK. Effect of types of organic manure on growth, yield and quality parameters of ginger (*Zinger officinale*). Indian Journal of Agricultural Sciences. 2007; 77 (2):67-72.
12. Yadav GS, Datta M, Saha P, Debbarma C. Evaluation of lentil varieties/lines for utilization of rice fallow in Tripura. Indian Journal of Hill Farming. 2015; 28(2):90-95.
13. Yadav Rl, Dwivedi BS, Gangwar KS, Prasad K. Over view and prospects for enhancing residual benefits of legumes in rice and wheat cropping systems in India, In Rao JVDK Kumar, Johansen C (ed.) Residual Effects of Legumes in Rice and Wheat Cropping systems of the Indo-Gangetic Plain, International Crop Research Institutes for Semi-Arid Tropics (ICRISTAT). Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, 1998; ISBN 81-204-1297-4, pp. 207-226.
14. Yadav SS, Phogat DS, Solanki IS, Tomar TS. Character association and path analysis in lentil. Indian Journal Pulses Research. 2003; 16:22-24.