RESEARCH PAPER | Asian Journal of Bio Science, Volume 9 | Issue 1 | April, 2014 | 39-42
Received : 17.02.2014; **Revised :** 02.03.2014; **Accepted :** 11.03.2014

Diversity analysis of lentil (*Lens culinaris* Medik.) germplasm using morphological markers

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Diversity analysis among the seventy six germplasm of lentil (*Lens culinaris* Medik.) was estimated using morphological markers. Morphological characterization was done based on different parameters like plant height, primary and secondary branches per plant, number of leaves per plant and fresh weights carried out at different stages of the crop and showed wide variability. Dry matter partitioning *viz.*, leaf dry weight, pods dry weight, total dry weight, yield and yield components, pod per plant, seed per plant, 100 seeds weight and seed yield per plant, were recorded at the time of harvest. The results of present investigation suggested that genetic relationships in lentil germplasm using morphological data may be useful for plant improvement and an efficient way to conserve genetic resources of lentil.

Key words : Diversity, Germplasm, Lentil, Morphological marker

How to cite this paper : Singh, Amit Kumar, Kumar, Pankaj, Singh, Jitendra, Rani, Rosy, Rani, Anchal, Shukla, Pradeep and Misra, Pragati (2014). Diversity analysis of lentil (*Lens culinaris* Medik.) germplasm using morphological markers. *Asian J. Bio. Sci.*, **9** (1) : 39-42.

INTRODUCTION

Lentil (*Lens culinaris* Medik.) is an important cool-season crop in North Africa, West Asia, the Middle East, the Indian Subcontinent and North America (Erskine, 1996). It is a highly valued annual food legume crop that coevolved with wheat, barley and other cool season pulses in the Near East arc about 8000 years ago (Cubero, 1981; Ladizinsky, 1979). It is an important source of dietary protein (25 %) in both human and animal diets, second only to soybeans as a source of usable protein (CGIAR). Lentil ranks seventh among grain legumes and is grown on over 3.5 million hectares in over 48 countries with a total production of over 3 million metric tons. The major lentil producing regions are Asia (58 % of the area) and the West Asia-North Africa region (37 % of the acreage of developing countries). Lentil is also known as masur dhal and tillseed in India. It is sometimes called “poor man’s meat” in the East and is consumed in several ways. It may be eaten as a green vegetable, whole seed, or after dehulling and splitting (Bhatty, 1995).

The botanical features of *Lens culinaris* (cultivated lentil) can be described as annual bushy herb, slender almost erect or suberect, much-branched, softly hairy; stems slender, angular, 15-75 cm height (Duke, 1981; Muehlbauer *et al*., 1985). Ten to sixteen leaflets are subtended on the rachis (40-50 mm); upper leaves have simple tendrils while lower leaves are mucronate (Muehlbauer *et al*., 1985). The leaves are alternate, compound, pinnate, usually ending in a tendril or bristly; leaflets 4-7 pairs, alternate or opposite; oval, sessile, 1-2 cm long; stipules small, entire; stipules absent; pods oblong, flattened or compressed, smooth, to 1.3 cm long, 1-2-seeded; seed biconvex, rounded, small, 4-8 mm × 2.2-3 mm, lens-shaped, green, greenish-brown or light red speckled with black; the weight of 100 seeds range from 2 to 8 g; cotyledons red, orange, yellow, or green, bleaching to yellow, often showing through the testa, influencing its apparent color (Kay, 1979; Duke, 1981; and Muehlbauer *et al*., 1985). Flowers are small, pale blue, purple, white or pink, in auxillary 1-4-flowered racemes; 1-4 flowers are borne on a single peduncle and a single plant can produce upto 10-150 peduncles each being 2.5-5 cm long (Muehlbauer *et al*., 1985).

Identification of genotypes for desirable traits has become increasingly important for breeding and research

programs. The genetic improvement in nay quantitative trait depends upon effective selection among individual that differ in phenotypic value. Effective selection is possible only when genetic variability existed among the population to be explored. To utilize germplasm efficiently and effectively, it is important to investigate the genetic variation it contains. Many tools are now available for identifying desirable variation in the germplasm including total seed protein, isozymes and various types of DNA markers. However, morphological characterization is the first step in the description and classification of crop germplasm (Smith and Smith, 1989; Singh and Tripathi, 1989). In this context present study was conducted with 76 germplasm of lentil, which were used for diversity analysis based on morphological markers.

RESEARCH METHODOLOGY

The experiment was conducted during 2011-12 *Rabi* season with seventy six lentil germplasm, which was collected from different sources (Table 1) and grown at Crop Research

Table 1: Germplasm of lentil (*Lens culinaris* Medik.) collected from different sources used for analysis

Sr. No.	Germplasm	Source	Sr. No.	Germplasm	Source
1.	IPL-110	CSA, Kanpur	39.	P-722	GBPUAT, Pant Nagar
2.	IPL-114	CSA, Kanpur	40.	P-768	GBPUAT, Pant Nagar
3.	IPL-401	CSA, Kanpur	41.	P-867	GBPUAT, Pant Nagar
4.	IPL-139	CSA, Kanpur	42.	P-869	GBPUAT, Pant Nagar
5.	IPL-202	CSA, Kanpur	43.	P-870	GBPUAT, Pant Nagar
6.	IPL-203	CSA, Kanpur	44.	VL-515	GBPUAT, Pant Nagar
7.	IPL-204	CSA, Kanpur	45.	VL-133	GBPUAT, Pant Nagar
8.	IPL-128	CSA, Kanpur	46.	L-4603	GBPUAT, Pant Nagar
9.	IPL-404	CSA, Kanpur	47.	P-888	GBPUAT, Pant Nagar
10.	IPL-406	CSA, Kanpur	48.	VL-125	GBPUAT, Pant Nagar
11.	IPL-2016	CSA, Kanpur	49.	VLM-4	GBPUAT, Pant Nagar
12.	VK5-1771	CSA, Kanpur	50.	VL-134	GBPUAT, Pant Nagar
13.	ILL-7616	CSA, Kanpur	51.	VL-135	GBPUAT, Pant Nagar
14.	ILL-639	CSA, Kanpur	52.	PL-2	GBPUAT, Pant Nagar
15.	ILL-6002	CSA, Kanpur	53.	VL-516	GBPUAT, Pant Nagar
16.	ILL-7723	CSA, Kanpur	54.	Pl-406	GBPUAT, Pant Nagar
17.	ILL-8114	CSA, Kanpur	55.	VL-507	GBPUAT, Pant Nagar
18.	VR5-16/11	CSA, Kanpur	56.	IC-248966	NBPGR, New Delhi
19.	KLB-8611	CSA, Kanpur	57.	EC299676	NBPGR, New Delhi
20.	KLB-8617	CSA, Kanpur	58.	IC243364	NBPGR, New Delhi
21.	K-75	CSA, Kanpur	59.	IC208337	NBPGR, New Delhi
22.	KL5-218	CSA, Kanpur	60.	IC201683	NBPGR, New Delhi
23.	LL-492	CSA, Kanpur	61.	IC201743	NBPGR, New Delhi
24.	P-319	CSA, Kanpur	62.	IC208327	NBPGR, New Delhi
25.	P-334	CSA, Kanpur	63.	IC201655	NBPGR, New Delhi
26.	P-364	CSA, Kanpur	64.	IC201777	NBPGR, New Delhi
27.	P-390	CSA, Kanpur	65.	IC248956	NBPGR, New Delhi
28.	PL-639	CSA, Kanpur	66.	IC201793	NBPGR, New Delhi
29.	P-434	CSA, Kanpur	67.	IC218359	NBPGR, New Delhi
30.	KL-133	GBPUAT, Pant Nagar	68.	IC248964	NBPGR, New Delhi
31.	P-508	GBPUAT, Pant Nagar	69.	EC299646	NBPGR, New Delhi
32.	P-509	GBPUAT, Pant Nagar	70.	IC208331	NBPGR, New Delhi
33.	KL5-137	GBPUAT, Pant Nagar	71.	IC201699	NBPGR, New Delhi
34.	L-4076	GBPUAT, Pant Nagar	72.	IC248963	NBPGR, New Delhi
35.	P-582	GBPUAT, Pant Nagar	73.	IC201798	NBPGR, New Delhi
36.	P-589	GBPUAT, Pant Nagar	74.	IC201786	NBPGR, New Delhi
37.	P-635	GBPUAT, Pant Nagar	75.	IC248959	NBPGR, New Delhi
38.	P-7101	GBPUAT, Pant Nagar	76.	IC212688	NBPGR, New Delhi

Centre (CRC), Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, (India). Five plants from each variety were randomly uprooted at 30, 60, 90, 120 DAS and at harvest. The morphological observation *viz.,* plant height (cm), primary and secondary branches per plant, number of leaves per plant and fresh weights (g) were recorded. Dry matter production and its partitioning were also recorded from uprooted plants for their component parts *viz.,* leaves, stems, roots and pods. Yield and yield components *viz.,* pod per plant, seed per plant, 100 seeds weight (g) and seed yield per plant were also recorded. Hundred seeds were counted from the sample and their weight was recorded in grams.

RESEARCH FINDINGS AND ANALYSIS

The continuing need for improved crops to meet new environmental challenges and changing consumers' demands create a constant requirement for genetic diversity, but the pool of natural diversity is shrinking with time largely because of the negative actions of humans (Guarino, 1999). The loss of genetic diversity commonly referred to as genetic erosion, results in the increasing vulnerability of crops to changing abiotic and biotic stresses and threatens global food security (Hawkes *et al.,* 2000). Plant breeders and geneticist have addressed these stresses by identifying resistance/tolerance germplasm, determining the genetics involved and the genetic map positions of the resistance genes (Muehlbauer *et al.,* 2006), therefore, genetic studies important to answer specific question relative to germplasm resources, types of genetic effects and modified selection methods to enhance cultivar development and upgrade the germplasm pools (Dudley and Moll, 1969; Moll and Stuber, 1974; Dudley, 1997).

The germplasm were evaluated for the assessment of genetic variation and to identify the major traits contributing to the variation for their potential use in the breeding programme. Yield contributing characters such as plant height, branches and harvest index were observed more important trait to be used for the improvement of lentil seed yield. The collection, description and utilization of genetic resources for agronomic and morphological plant characteristics are important to conduct successful and effective breeding programs for the majority of crops (Duvick, 1984; Lazaro *et al.,* 2001; Naghavi and Johansouz, 2005). In this view the morphological characterization of seventy six lentil germplasm were studied and revealed significant differences among the material used in the investigation. The plant height of lentil at 30 DAS showed wide range between 4.339-5.352 with the mean value of 4.750 among the 76 germplasm of lentil, plant height at 60 DAS showed range between 8.581-15.368 with the mean value of 12.483, plant height at 90 DAS (range 12.419-23.904 and mean value 21.625), plant height at harvest (range 20.704-25.757 and mean value 23.334). The IPL-202 showed lowest height (13.087) and P-768 showed highest height (*i.e.* 16.671) at all stages of growth. The number of leaves at 30 DAS showed range 6.853-10.933 with the mean value of 8.962, at 60 DAS (range 32.667-54.333 and mean value 44.118), at 90 DAS (range 139.528-262.333 and mean 185.243), at harvest (range 262.336-629.117 and mean 437.856). The VL-515 showed lowest number of leaves (121.806) and IC-201798 showed highest number of leaves (*i.e.* 210.111) at all the stages of growth. Number of primary branches showed range 2.272-2.914 with mean value of 2.561, number of secondary branches showed (range 7.045-9.405 and mean value of 8.044), Fresh weight showed range between 4.810-6.384 with the mean value of 5.472, leaf dry weight (range 0.078-0.204 and mean value of 0.132), pod dry weight (range 1.198-2.015 and mean value of 1.534), total dry weight (range 2.057-3.343 and mean value of 2.765), pods per plant (range 18.880-48.093 and mean value of 37.019), seeds per plant (range 45.947-83.115 and mean 66.468), 100 seed weight (range 1.18-3.15 and mean value 2.011) and seed yield per plant showed range 1.763-2.597 with the mean value of 2.247. The information on variability of seed yield and its components is essential for the successful use of the material, and for defining criteria in the plant improvement programme. In this study, result showed that the germplasm was amenable as a range of genetic variability was observed in all the characters showing highly difference. Various researchers (Balyan and Singh, 1986; Bicer and Saker, 2004; Erskine, 1985; Erskine *et al.,* 1990 and 1994; Mia *et al.,* 1986; Shahi *et al.,* 1986; Singh and Rana, 1993; Stoilova and Pereira, 1999; Tullu *et al.,* 2001; Zaman *et al.,* 1989) have described wide ranges of variation for different phonological and morphological plant characteristics including seed yield per plant to identify the most promising genotypes for their use in the lentil improvement programme, and breed higher biomass and seed yielding cultivars. Significant genetic variations for plant growth characters and specific adaptation have also been observed in germplasm collections for crop improvement (Cutforth *et al.,* 2007).

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