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Grain Yield Potential of Lentils Germplasm

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Abstract: Grain yield potential in relation to other important agronomic characters of 20 lentils (*L. culinaris*) germplasm collected from FATA (Federally Administered Tribal Areas) and neglected pockets of NWFP was tested at the Research Farm of NWFP Agricultural University Peshawar during 1999-2000 growing season. Based on the grain yield potential, the germplasm were divided into three groups in descending order.
Germplasm LT-05 ranked first by producing maximum yield of 1459 kg ha^{-1}, while germplasm LT-03 with 1070 kg ha^{-1} ranked second. Minimum yield of 180 kg ha^{-1} was obtained by LT-04, followed by LT-01 with 209 kg ha^{-1}% The germplasm in group I viz. LT-05 and LT-03 gave 64 and 82% higher yield than group II and group III, respectively. The average values of grain yield decreased in descending order from 1264 kg ha^{-1} in group 1 to 456 kg ha^{-1} in group II and then further decreased to 231 kg ha^{-1} in group III. Similarly, the average values of branches per plant 100-seed weight, pods per plant and harvest index decreased in descending order and showed positive relationship with grain yield. The association of days to maturity, plant height, and dry matter yield with grain yield was negative because their average values increased in descending order in group I to group III.

Key words: Lentils, *L. culinaris*, germplasm, yield components

Introduction

Malnutrition one of the major problem in Pakistan is mainly due to protein deficiency in our diet. Pulses are the major and cheaper source of protein as compared to animals. The production of pulses which are high yielding, disease resistant and environmentally adaptable is the key to overcome the malnutrition problem. The development of such cultivars need an ample and diversified gene bank of pulses germplasm.

Lens culinaris Medic, which is known lentil (English), lentile (French), lense (German), lenteige (Spanish), adas (Arab), mercimek (Turk), masur (Hindi) and naskan in the major growing areas of NWFP (Bajawar, Swat and Dir) is probably one of the first pulse crops to be domesticated. Lentil may be consumed whole, decorticated and split (dhal) or ground into flour besan. However, it may be deep fried and consumed as snack, or mixed with cereal flour for preparing breads and cakes, young pods and leaves are used as vegetable in some countries. The straw and pod wall residues from threshing have good feed value, containing 4% protein. Lentil is occasionally used as fodder and as green manure crop. Despite being a nutritious crop (25.1% protein and 69% carbohydrates) it is mostly grown on marginal lands without much care and input. There are much strains which could grow on moderately saline and alkaline soil but could also grow well in slightly acidic soils. The crop possesses great diversity in adaptability, thus can be a potential crop from marginal situations largely found in NWFP. Average lentil yields in Pakistan is low because of poor crop management and low yield potential of land races. The lack of improved varieties has been one of the major production constraints. Rahman and Rahman (1989) found that short duration lines were higher yielding compared to long duration lines. Ramgry *et al*. (1989) reported high heritability for grain yield and harvest index and found positive correlation of grain yield with plant weight and harvest index. Fatema (1989) found significant variation in 1000 seed weight and grain yield. Bakhsh *et al*. (1991b) reported that some genotypes of lentils are more stable and adaptable to changes in environment but some genotypes performed well only in favorable environments. Bakhsh *et al*. (1991a) reported positive correlation of grain yield with number of pods, number of branches and 1000 grain weight. Plant height and days to 50% flowering showed negative correlation with grain yield. EL-Attar (1991) reported genetic variation for pods per plant and seed per plant. Out of 198 lines of lentils under study Bakhsh *et al.* (1992) proposed three short and early maturing lines for the development of high yielding varieties. Rajput and Sarwar (1992) found genetic advance and heritability for pods per plant, plant height 100 grain weight and grain yield per plant. Pods per plant showed positive correlation with pods per plant. Keeping in view the importance of lentils in Pakistan in general and NWFP in particular the present study was therefore initiated to study and compare yield and yield components, to identify the desirable traits, to maintain and conserve the selected germplasm to prevent their possible extinction and to supply the selected germpiasm to users for various research purposes.

Materials and Methods

An experiment consisted of twenty lentils germplasm including eight from Swat (LT-2, 3, 8, 9, 10, 11, 12 and 20), six from Gilgit (LT-13, 14, 15, 16, 17 and 18), three from Dir (LT-6, 7 and 19), two from Gilgit (LT-1 and 4) and one from Mensehra (LT-05) was carried out during 1999-2000 growing season at the Research Farm of NWFP Agricultural University, Peshawar. Each germplasm was considered as treatment and planted in randomized complete block design with three replications by assigning each individual germplasm to a plot of 2.4 m^2. Each plot consisted of 4 rows, 2 meter long and 0.3 meter apart. Seedbed was prepared at proper vattar conditions. A basal dose of 25 kg N and 64 kg N and 64 kg P_2O_5 per hectare was applied as DAP and incorporated into the soil during ploughing. Irrigation was applied when required. Weeds were controlled manually at the proper time.

Data were collected on days to maturity, plant height (cm), branches and pods per plant, seeds per pod, pod length (cm), 100-seed weight (g), grain yield (kg ha^{-1}), dry matter yield (kg ha^{-1}) and harvest index (%).

Days to maturity were recorded from the date of emergence up to the maturity of first few pods (5-6). Plant height was measured in cm from base to the tip of the plants by selecting ten plants at random within each treatment and then average was worked out. Similarly, branches per plant and pods per plant were counted by selecting three plants at random within each treatment and then average was worked out. Pod length was measured in cm and seeds per pod were counted from 10 randomly selected pods with each treatment and then average was worked out. After harvesting, the materials were dried up to constant weight and weighted by spring balance to record dry matter yield. The seeds were separated manually and weighted by spring balance to record dry matter yield. The seeds were separated manually and weighted by electronic balance to record grain yield. Data on 100-seed weight (g) was recorded by electronic balance. Harvest index (%) was calculated by the following formula:

$$\text{Harvest index (\%)} = \frac{\text{Grain yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \times 100$$

Data were analyzed statistically and means were compared using LSD test.

Results

It was very difficult to correlate the performance of individual germplasm in grain yield with other agronomic characters, therefore, the germplasm were first arranged in descending order and then divided into three groups on the basis of grain yield (kg ha^{-1}) to interpret meaningful results.

Statistical analysis of the data showed that days to maturity, plant height, branches per plant and dry matter yield varied significantly at 5% level of probability in different germplasm (Table 1).

Days to maturity varied significantly from 154-182 days. Average values in groups increased in descending order from 154 in group 1 to 167 in group I to 167 in group II and then further increased to 176 days in group III. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Moreover, this variation could be due to the genetic variability of different germplasm. Days to maturity showed negative correlation with grain yield. These results are in conformity with those of Rahman and Rahman (1989) and Bakhsh *et al.* (1992). Bakhsh *et al.* (1991a) found negative correlation between days to 50 96 flowering and grain yield. Plant height varied significantly from 20 cm for LT-03 to 182 cm for LT-04. Average values in groups increased in descending order from 24 cm in group Ito 37 cm in group II and than further increased to 39 cm in group III. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Moreover, this variation could be due to the genetic variability of different germplasm. Similar results were reported by Rajput and Sarwar (1992). Positive relationship was observed between plant height and maturity. Plant height showed negative relationship with grain yield. Similar results were reported by Bakhsh *et al*. (1991a).

Branches per plant varied significantly from 8 to 22 in different germplasm. Average values in group decreased from 14 in group I to 13 in group II and then further decreased to 11 in group III. The relationship of branches per plant and grain yield was positive. These results are in conformity with those of Bakhsh *et al.* (1991a). As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Moreover, this variation could be due to the genetic variability of different germplasm.

Dry matter yield varied significantly 4166 kg ha^{-1} for LT-03 to 1110 kg ha^{-1} for LT-01. Average values in groups increased in descending order from 5207 kg ha^{-1} in group I to 7157 kg ha^{-1} in group II and than further increased to 9999 kg ha^{-1} in group III. The differences in dry matter was mainly due to days to maturity and plant height. The germplasm with late maturity and taller plants gave significantly higher dry matter yield and vice versa. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Moreover, this variation could be due to the genetic variability of different germplasm. The relationship of dry matter with grain yield was negative. However, Ramgry *et al*. (1989) found positive correlation of dry matter with grain yield.

Statistical analysis of the data (Table 2) revealed that 100-seed weight, pods per plant, grain yield and harvest index were significantly different at 596 level of probability. 100-seed weight varied significantly from 1.5 g (LT-06) to

Table 1: Days to maturity, plant height, branches per plant and dry matter yield lentils germplasm

Germplasm	Days to maturity	Plant height (cm)	Branches/plant	DM yield (kg ha^{-1})
LT-05	154 f	28 j	13de	8249ef
LT-03	154 f	20 j	1 5cd	4166f
Mean group I	154	24	14	5207
LT-11	154 f	40 cde	8h	6249ef
LT-13	162 e	32 hi	18b	6943de
LT-12	155 f	40 cde	10gh	6943de
LT-19	LT-19	162 a	40 cde	6943de
LT-07	172 c	40 cde	10fgh	6943de
LT-16	172 c	32 hi	8h	7638cde
LT-14	177 h	35 fgh	1 2efg	8332b-a
LT-08	187 d	47 ab	10fgh	6943de
LT-20	187 d	37 efg	12efg	7838cde
LT-17	169 d	33 gh	9h	833213-e
LT-10	172 c	42 cd	22a	6943dc
LT-02	172 c	33 gh	13def	8249ef
LT-15	172c	35 fgh	1613c	6943de
Mean group II	167	37	13	7157
LT-09	167 d	32 hi	10gh	9026a-d
LT-18	177 b	37 efg	8h	9721abc
LT-06	177 b	48 a	1 2efg	9721abc
LT-01	177 b	38 def	18 be	11110a
LT-04	182 a	43 be	8h	10420ab
Mean group III	176	39	11	9999
LSD at %	2.034	3.558	2.729	2332

Mean values in the same column carrying similar letters do not differ significantly at 5% level of probability using LSD test

Table 2: 100-seed weight, pods per plant. grain yield and harvest index of lentils germplasm

Germplasm	100-seed weight a	Pods per plant	Grain yield (kg ha^{-1})	Harvest index (%)
LT-06	2.63 a	133 a	1459 a	23 a
LT-03	2.36 b	117 b	1070 b	28 e
Mean group I	2.5	1.25	1264	24
LT-11	1.56 ef	80 d	639 c	11 b
LT-13	2.16c	80 c	579 cd	9 bc
LT-12	1.80 d	83 c	583 cd	9 bc
LT-19	1.80 ef	47 def	514 cde	7 bcd
LT-07	2.13 c	53 de	488 c-f	7 bcd
LT-16	1.60 ef	37 f-l	486 c-f	8 c-f
LT-14	1.65 ef	40 e-h	472 c-f	6 c-f
LT-08	2.23 bc	33 f-l	389 c-g	5 c-g
LT-20	2.30 bc	43 efg	375 d-g	5 c-g
LT-17	1.73 de	35 f-l	361 d-g	4 d-g
LT-10	1.65 def	41 e-h	354 d-g	5 c-g
LT-02	1.60 d	31 ghi	347 d-g	5 c-g
LT-15	1.60 d	35 fi	347 d-g	5 c-g
Mean group II	1.8	47	456	6
LT-09	1.70 de	35 fi	264 efg	3 efg
LT-18	1.83 d	30 ghi	250 fg	2 fg
LT-00	1.50 f	23 l	250 fg	2 fg
LT-01	1.58 ef	28 hi	209 g	2 fg
LT-04	1.56 ef	25 l	180 g	2 fg
Mean group III	1.6	28	231	2
LSD at 5%	0.194	14.935	251.6	2

Mean values in the same column carrying similar letters do not differ significantly at 5% level of probability using LSD test

2.63 g (LT-05). Average values in groups decreased in descending order from 2.5 g in group II and then further decreased to 1.6 g in group III. 100-seed weight showed negative association with days to maturity and plant height with the exception of few germplasm. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Moreover, this variation could be due to the genetic variability of different germplasm. Similar results were reported by Rajput and Sarwar (1992). The relationship of 100-seed weighty with grain yield was positive. These results are in conformity with those of Bakhsh *et al.* (1991a).

Pods per plant varied significantly from 23 (LT-60) to 133 (LT-05). It ranged from 117-133 in group I, 31-83 in group II and 23-35 in group III. Average values in groups decreased in descending order from 125 in group I to 47 in group II and then further decreased to 28 in group III. Pods per plant showed negative association with days to maturity and plant height with the exception of few germplasm. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Moreover, this variation could be due to the genetic variability of different germplasm. Similar results were reported by El-Attar (1991) and Rajput and Sarwar (1992). Pods per plant showed positive correlation with grain yield. Similar results were reported by Bakhsh *et al.* (1991a) and Rajput and Sarwar (1992).

Grain yield varied significantly from 180-1459 kg ha^{-1} in different germplasm. Germplasm LT-05 gave maximum yield (1459 kg ha^{-1}), followed by germplasm LT-03 (1070 kg ha^{-1}), while the lowest yield was recorded for germplasm LT-04 (180 kg ha^{-1}), followed by germplasm LT-01 (209 kg ha^{-1}). It ranged from 1070-1459 kg ha^{-1} in group I, 343939 kg ha^{-1} in group II and 180-264 kg ha^{-1} in group III. Average values in groups decreased in descending order from 1284 kg ha^{-1} in group Ito 456 kg ha^{-1} in group II and then further decreased to 231 kg ha^{-1} in group III. Grain yield showed positive relationship with 100-seed weight, pods par plant and harvest index while, negative association was established with days to maturity, plant height and dry matter yield. These results are in conformity with those of several workers. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Bakhsh *et al*. (1991a) reported that some genotypes of lentils performed well only in favourable environments. Moreover, this variation could be due to the genetic variability of different germplasm. Similar results were reported by Rajput and Sarwar (1992) and El-Attar (1991).

Harvest index varied significantly from 2 to 26%. Average values in groups decreased in descending order from 24% in group I to 6% in group II and then further decreased to 2% group III. The relationship of harvest index with grain yield was significantly positive. Similar results were reported by Ramgry *et al.* (1989). As these germplasm were collected from different climatic conditions, so the rate of acclimatization of a germplasm may be considered the possible cause of this variation. Moreover, this variation could be due to the genetic variability of different germplasm. Ramgry *et al*. (1989) high heritability for harvest index.

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