

EVALUATION OF MORPHO-YIELD TRAITS AND THEIR CORRELATION WITH SEED YIELD IN LENTIL (*LENS CULINARIS*) GENOTYPES

*Muhammad Siddique Depar¹, Nisar Ahmed Soomro², Ali Sher Chandio¹, Hamz Ali Samoon¹, Behari Lal Meghwar¹, Attaullah Khan Pathan¹ and Muhammad Waseem Kalroo¹

¹Arid Zone Research Institute, (PARC), Umerkot, Pakistan

²Social Sciences Research Institute Tandojam, Pakistan

*Corresponding Author: Muhammad Siddique Depar

Cell. No. +92-300-3075841, e-mail: msdepar@yahoo.com

ABSTRACT: Morpho-yield traits of various *Lens culinaris* genotypes were evaluated under field conditions at Hafeez Halipoto farm Umerkot, during 2013-14 in an experiment laid out in a three replicated randomized complete block design, using nine genotypes evolved at NARC and other research centers (Masoor-85, VM-111, DL-111, 9-6, Masoor-25, NARC-101, NARC-108, 8-10, M-93) and compared their performance with Local Masoor to assess genotypic development. The genotypes differed significantly ($P < 0.05$) for their morpho-yield traits under climatic conditions of Umerkot. Highest (502.00 kg) seed yield ha^{-1} was produced by VM-111, followed by M-93 with seed yield of 459.00 kg ha^{-1} , while genotypes DL-111 and NARC-108 produced 457 and 418.67 kg ha^{-1} , seed yield respectively. The minimum seed yield of 351.00 kg ha^{-1} was found in Masoor-85. It was concluded that lentil genotype VM-111 was most promising genotype, followed by M-93, DL-111, NARC-108, 9-6, NARC-101 and 8-10, while Local Masoor and Masoor-25 were relatively lower in performance than. The correlation study concludes that increase in seed yield ha^{-1} was mainly associated with the increase in seed germination percentage, pods plant⁻¹ and seed index; while prolonged flowering and maturity in lentil crop did adverse effect on seed yield ha^{-1} .

Key words: Lentil, *Lens culinaris*, genotypes, morpho-yield traits, correlation

1. INTRODUCTION

Lentil *Lens culinaris*, is one of the most important pulses cultivated and consumed in Pakistan. In Pakistan, the area under lentil during the year 2011-2012 was 22.8 thousand hectares with production of 11.0 thousand tons; while during the year 2012-2013, the area decreased to 19.0 thousand hectares with a production of 9.8 thousand tons, showing a decrease of 11.8 percent, where during 2013-14, the area again decreased to 17.8 thousand hectares with a production of 9.3 thousand tons, showing a decrease of 5.1 percent in the production means in 2011-12 to 2013-14 it was decreased by 16.9 percent [1, 2].

New drought-tolerant and high yielding lentil varieties that do well even in dry years have been widely adopted by farmers. Varieties have great significance in crop production, so they are developed to achieve higher pulse yields unit⁻¹ area. The research on the development of new high yielding varieties under Sindh conditions is scarce and the situation demands relatively more attention towards this major aspect. There is need to examine the relationship among various characters especially yield and related characters. Selection for high yielding varieties is the integral part of breeding program. Selection criterion gives information on relationship among characters and their relation of agronomic characters with grain yield and their influence on yield. Tufail *et. al.* [3] reported that Masoor 93 genotype was a cross of ILL4400 and 18-12 with yield potential of 3843 kg ha^{-1} and wide adaptability due to its wide genetic base. Singh *et. al.* [4] concluded that lentil variety MV-111 produced significantly higher seed yield of 1830 kg ha^{-1} and lowest (610 kg ha^{-1}) by Masoor-85. Kessel [5] noted that Hadley-93 gave slightly higher yields about 2250 kg per hectare at some locations, while in some ecological regions the promising cultivar MV-98 surpassed the standard cultivar Hadley-93. Mikhov and Stoyanova [6] found that lentil line Naslada appeared best for breeding varieties combining high seed yields. The present investigation was conducted on the evaluation of morpho-

yield traits and their correlation with seed yield in lentil (*Lens culinaris*) genotypes under agro-ecological conditions of Umerkot district of Pakistan.

2. MATERIALS AND METHODS

The experiment was conducted to evaluate the performance of ten different lentil varieties viz; Masoor-85, VM-111, DL-111, 9-6, Masoor-25, NARC-101, NARC-108, 8-10, M-93, and Local Masoor at Hafeez Halipoto farm near Umerkot, during the year 2013-14 in a three replicated Randomized Complete Block (RCB) Design, with plot size of 4.0 m x 1.2m (4.80m²) and with 30 cm row to row spacing. A recommended dose of Nitrogen in the form of urea and phosphorus in the form of single super phosphate was applied. The weeds were removed manually in all the plots. Ten plants per replication from each genotype were randomly selected for recording observations.

The collected data was statistically analyzed following the methods developed by [7] as to sort out differences in the genotypes. While the association of traits by Simple correlation coefficients (r) were calculated using the following formula given by [8].

3. RESULTS AND DISCUSSION

Development of varieties is a major aspect in improvement of crop yields. Unfortunately in the case of pulses there is no significant increase in yield, particularly in lentil crop. For this purpose present investigation was performed to screen 10 lentil varieties selected from the available germplasm at the Arid Zone Research Institute (AZRI) PARC, Umerkot to assess extent of association between seed yield and its traits. Results showed significant differences among the varieties (Table 1) corresponding their traits i.e., germination percentage, days to flowering, days to maturity, Plant Height, No. of Pods plant⁻¹, seed index and seed yield ha^{-1} .

3.1 Germination percentage

Higher germination percentage 77.41 % was observed in variety

M-93 followed by varieties VM-111, NARC-101, NARC-108 and DL-111 with average germination percentage of 76.47, 73.69, 73.39 and 70.86 percent, respectively (Table 2). Varieties 8-10 and Masoor-25 had average germination of 69.57 and 69.03 percent, respectively; while varieties Masoor-85 and Local Masoor had average germination of 68.12 and 68.07 percent, respectively. However, the lowest germination 62.82 percent was recorded in case of variety 9-6. Tyagi and Khan [9] observed higher germination percentage upto 99 % in lentil varieties.

3.2 Days to 50% flowering

Lentil early flowering varieties 8-10 and 9-6 take significantly minimum number of days 71.00 and 71.67 respectively to 50% flowering followed by variety M-93 which took 75.67 days to 50% flowering (Table 2). Both varieties NARC-101 and NARC-108 took 78.33 days to 50% flowering followed by varieties DL-111, Masoor-85 and VM-3 with 79.00, 79.00 and 79.67 number of days taken to 50% flowering respectively, where variety Local Masoor take 80.33 days to 50% flowering. While late flowering variety was Masoor-25 which took significantly greater number of days 81.67 for 50% flowering. Nazir *et. al.* [10] also observed early flowering in lentil varieties.

3.3 Days to maturity

Lentil variety M-93 taken lowest number of days 90.00 to reach 90 % maturity and is the early maturing variety followed by variety Masoor-25 which took 99.00 number of days to reach maturity. Varieties 9-6, 8-10 took 100.00 and 102.00 number of days to reach maturity, respectively. Varieties VM-111 and DL-111 took 108.00 and 109.00 number of days to reach maturity, respectively (Table 2). Whereas varieties NARC-101, Masoor-85 and Local Masoor took 115.00, 117.33 and 119.00 number of days to reach 90 % maturity, respectively. While NARC-108 took significantly greater number of days 120.00 to reach 90 % maturity and is late maturing variety. Moslem *et. al.* [11], Kumar *et. al.* [12] and Geletu *et. al.* [13] examined early maturing lentil varieties and their results were in line with present study.

3.4 Plant height (cm)

Plant height was significantly maximum 50.88 for variety M-93 followed by NARC-108 which was 44.44 cm tall. Plant height of NARC-101, 8-10, and Masoor-25 was 41.89, 41.88 and 40.24 cm, respectively. The plant height was moderately lower i.e. 37.90 cm and 35.40 cm in case of varieties DL-111 and 9-6, respectively, while variety Local Masoor produced plant height of 34.66 cm. However, plant height was almost equal and lowest in case of lentil varieties VM-111 (32.63 cm) and Masoor-85 with 32.21 cm plant height (Table 2). Moslem *et. al.* [11] and Kumar *et. al.* [12] as well reported higher plant height in lentil varieties.

3.5 Number of pods plant⁻¹

Number of pods plant⁻¹ was significantly greater in variety VM-111 produced significantly greater 29.00 number of pods plant⁻¹, followed by varieties NARC-101, NARC-108 and M-93 which produced 26.67, 26.33 and 26.00 number of pods plant⁻¹ respectively. Moslem *et. al.* [11] also reported higher

pods plant⁻¹ in lentil varieties. Lentil varieties DL-111 and 8-10 produced 25.67 and 25.33 number of pods plant⁻¹, while variety 9-6 produced 23.00 number of pods plant⁻¹. Number of pods plant⁻¹ was equal and moderately on lower side in varieties Masoor-85 and Masoor-25 with 22.00 and 22.00 number of pods plant⁻¹, respectively (Table 2). However, the lowest 19.00 number of pods plant⁻¹ was noted in variety Local Masoor.

3.6 Seed index (1000 seed weight g)

Seed index value was significantly maximum 17.97 g, in case of lentil variety VM-111, followed by variety M-93 with seed index value of 17.29 g, while varieties DL-111 and NARC-108 produced seed index value of 16.60 g and 16.13 g, respectively. Among other promising lentil varieties, NARC-101, 8-10, Masoor-85 and Local Masoor produced seed index values of 15.97 g, 15.72 g, 15.13 g and 15.07 g, respectively (Table 2). Among rest of the varieties experimented, Masoor-25 produced average seed index value of 14.93 g, while the minimum seed index value of 14.63 g was recorded in case of lentil variety 9-6. Similar results were also described by [12, 13,14] for seed index in lentils.

3.7 Seed yield ha⁻¹

Seed yield ha⁻¹ of lentil was significantly highest 502.00 kg ha⁻¹ in case of lentil variety VM-111 (Table 2), followed by varieties M-93 with seed yield of 459.00 kg ha⁻¹, while varieties DL-111 and NARC-108 produced seed yield of 457.00 kg ha⁻¹ and 418.67 kg ha⁻¹, respectively. Among other promising lentil varieties, 9-6, NARC-101 and 8-10 produced seed yield of 414.00 kg ha⁻¹, 409.33 kg ha⁻¹ and 401.67 kg ha⁻¹, respectively. Among rest of the varieties examined Local Masoor and Masoor-25 produced seed yield of 395.33 kg ha⁻¹ and 377.00 kg ha⁻¹, respectively. However, the minimum seed yield of 351.00 kg ha⁻¹ was recorded in case of lentil variety Masoor-85. Kessel [5], Moslem *et. al.* [11], Kumar *et. al.* [12], Geletu *et. al.* [13] and Tripathi *et. al.* [15] informed higher yields in lentil varieties.

3.8 Correlation

The correlation coefficient (r) indicates the association of traits of economic importance studied and the seed yield of lentil (Table 3). There was strong positive (P<0.01) association of germination percentage (r=0.6436**), number of pods plant⁻¹ (r=0.7438**) and seed index (r= 0.8745**) with the seed yield of lentil varieties. Ezzat *et. al.* [16] and Luthra and Sharma [17] perceived similar results of positive correlation between similar traits with seed yield in lentil; and it was assumed that increase seed yield ha⁻¹ was mainly associated with the increase in seed germination percentage, pods plant⁻¹ and seed index. However, negative but non-significant (P>0.05) correlation with seed yield ha⁻¹ was found for days to 50% flowering (r= -0.0483^{NS}) and days to maturity (r= -0.2960^{NS}) which suggested that prolonged flowering and maturity in lentil crop did adverse effect on seed yield ha⁻¹. Abo-Hegazy *et. al.* [18] and Eissa *et. al.* [19] also found negative correlation of days to flowering and days to maturity with seed yield plant⁻¹.

Table 1: Mean squares corresponding to average germination percentage, days taken to flowering, days to maturity,

May-June

Plant Height, No. of Pods plant⁻¹, seed index and seed yield ha⁻¹ of different lentil varieties

Source of variation	D.F	Germination %	Days to flowering	Days to maturity	Plant Height	Pods plant ⁻¹	seed index	seed yield ha ⁻¹
Replications	2	2.133	4.133	4.433	0.369	0.700	0.073	108.133
Varieties	9	37.467**	37.467**	302.356**	54.921**	25.870**	3.537**	5719.259**
Error	18	1.356	2.356	10.544	2.138	0.737	0.1570	123.393

Table 2: Average germination percentage, days taken to flowering, days to maturity, plant height (cm), number of pods plant⁻¹, seed index, seed yield (kg ha⁻¹) of different lentil varieties

Varieties	Germination %	Days to flowering	Days to maturity	Plant height	Pods plant ⁻¹	Seed index (g)	Seed yield (kg ha ⁻¹)
Masoor-85	68.12 b	79.00 b	117.33 a	32.21 de	22.00 c	15.13 c	351.00 e
VM-111	76.47 a	79.67 ab	108.00 b	32.63 de	29.00 a	17.97 a	502.00 a
DL-111	70.86 b	79.00 b	109.00 b	37.90 c	25.67 b	16.60 b	457.00 b
9-6	62.82 c	71.67 d	100.00 c	35.40 d	23.00 c	14.63 d	414.67 c
Masoor-25	69.03 b	81.67 a	99.00 c	40.24 c	22.00 c	14.93 d	377.00 d
NARC-101	73.69 a	78.33 b	115.00 a	41.89 bc	26.67 b	15.97 c	409.33 c
NARC-108	73.39 a	78.33 b	120.00 a	44.44 b	26.33 b	16.13 b	418.67 c
8-10	69.57 b	71.00 d	102.00 c	41.88 bc	25.33 b	15.72 cd	401.67 cd
M-93	77.41 a	75.67 c	90.00 d	50.88 a	26.00 b	17.29 ab	459.00 b
Local Masoor	68.07 b	80.33 a	119.00 a	34.66 d	19.00 d	15.07 c	395.33 cd
SE±	1.6337	0.3682	1.0269	0.4624	0.2715	0.1251	3.5127
LSD 0.05	4.321	1.942	5.415	2.438	1.432	0.6607	18.520
LSD 0.01	6.132	2.615	7.291	3.283	1.928	0.8897	24.94
CV%	7.28	1.51	3.01	3.83	3.50	2.48	2.65

Table 3: Correlation coefficient (r) of various traits of economic importance and seed yield ha⁻¹ of lentil

Sr#	Correlating traits	Correlation with seed yield ha ⁻¹
1.	Germination (%)	0.6436**
2.	Days to 50% flowering	-0.0483 ^{NS}
3.	Days to maturity	-0.2960 ^{NS}
4.	Plant height	0.2410 ^{NS}
5.	Number of pods plant ⁻¹	0.7438**
6.	Seed index	0.8745**

4. CONCLUSIONS AND RECOMMENDATIONS

It was concluded that seed yield ha⁻¹ was significantly highest 502.00 kg ha⁻¹ in variety VM-111, followed by M-93 with 459.00 kg ha⁻¹, DL-111 with 457.00 kg ha⁻¹ and NARC-108 with 418.67 kg ha⁻¹. Whereas varieties, 9-6, NARC-101 and 8-10 showed better performance, while varieties Local Masoor and Masoor-25 showed poor performance as compared to variety VM-111 or other better performing varieties. The correlation study concludes that increase in seed yield ha⁻¹ was mainly associated with the increase in seed germination percentage, pods plant⁻¹ and seed index; while prolonged flowering and maturity in lentil crop did adverse effect on seed yield ha⁻¹. Therefore it is recommended on the basis of results that variety VM-111 is the best performing and recommended for cultivation for areas Umerkot.

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