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Evaluation and Correlation of Economically Important Traits in Exotic Germplasm of Lentil

MUHAMMAD SHAHZAD ANJAM, ASGHAR ALI[1]†, SH. MUHAMMAD IQBAL† AND ABDUL MAJEED HAQQANI†
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad
†*Pulses Programme, Crop Sciences Institute, National Agricultural Research Centre, Park Road, Islamabad-Pakistan*
[1]Corresponding author's e-mail: asgharapk@yahoo.com

ABSTRACT

To evaluate the exotic lentil germplasm for the economically important traits and correlate them to select the genotypes for the targeted breeding programme, fifty-nine exotic lentil genotypes were used in the study. The exotic genotype ILL 9864 with the yield of 1544 kg ha^{-1} was comparable with the local check (Masoor-93) that gave 1727 kg ha^{-1} seed yield and the differences were non-significant ($P > 0.05$). There was a high variation among the genotypes for the traits used for study to evaluate the genotypes. The plant height and pods per plant were significantly ($P < 0.05$) and biomass highly significantly ($P < 0.01$) correlated with the seed yield. The pod dehiscence and viral disease infection were highly negatively correlated with the seed yield. This association of the traits may be used in the breeding programme to exploit the yield potential for enhancing the productivity of the lentil crop and to develop high yielding varieties with ease and target oriented research work.

Key Words: Lentil; *Lens culinaris*; Correlation; Germplasm

INTRODUCTION

Lentil (*Lens culinaris* Medik.) is an annually sown cool season food legume crop. It is nutritionally very rich and contains 25% protein, 2% minerals, 59% other carbohydrates, and 343 calories per 100 g, whereas the fiber and fat contents are only 0.7% each (Singh & Singh, 1994). Pakistan imports a large quantity of lentil to meet domestic requirement putting huge burden on the national exchequer. During 2000/2001 alone, around 40,000 tonnes of lentil was imported (GOP, 2001). Lentil represents only 4% of the total pulses production. The annual lentil production in the country is only 36 thousand tonnes, which is half of the total demand. The requirement is met through import mainly from Australia, Canada or Mediterranean countries. Since the inception of Pakistan, only three varieties Masoor-85, Masoor-93 and Masoor-2002 in Punjab, Mansehra-89, Masoor-2004 and Ratta Kulachi-2004 in NWFP and Shiraz-96 in Balochistan highlands (> 1000 m altitude) were released. To continue this process, it is essential to find new germplasm for either direct introduction in the country after its complete evaluation or use it in the country's different breeding programmes being run at different research centres to develop new high yielding varieties having broad genetic base and minimum vulnerability to various biotic and abiotic stresses for their long-term sustainability in the country. Earlier research work indicated that such approach is useful in developing improved varieties (Ali *et al*., 1991).

A number of previous studies indicate that the plant height, number of pods per plant, pod dehiscence, pods per peduncle, diseases, total dry matter, seed yield and straw yield are the economically important traits that contribute towards the yield of the lentil crop. The seed yield has positive and significant correlation with plant height, number of pods per plant and total dry matter (Begum & Begum, 1996). The seed yield, pods per plant, and straw yield are the characters having the high heritability (Kumar *et al.*, 1999). Plant height has the important role in the combination of different traits used to improve the seed yield (Jain *et al.*, 1991). The total dry matter and pods per plant are also significantly and positively correlated with grain yield (Tyagi, 1985). Lentil suffers from a number of diseases, which are caused by fungi, bacteria and viruses (Khare *et al.*, 1979). These are responsible for the deterioration of seed quality, seed rots, seedling mortality and ultimately affecting the yield tremendously (Makkouk *et al.*, 2001).

The present study was aimed at evaluation of exotic lentil germplasm for economically important traits and to correlate them to select the genotypes for later use in the targeted breeding programme.

MATERIALS AND METHODS

The fifty-nine lentil genotypes, obtained from International Centre for Agricultural Research in the Dry Areas (ICARDA), were used. Masoor-93, a local recommended variety, was included in the experiment as a check. The experiment was conducted under complete rainfed conditions at National Agricultural Research Center (NARC), Islamabad during 2003/2004. There was no supplemental irrigation or fertilizer used in this study. The Randomized Complete Block Design (RCBD) with two replications was used to conduct the experiment. The each plot had two rows of 4 m length and 30 cm width. The experiment was planted in the last week of October, 2003 and harvested in the last week of April, 2004. The seed rate of 400 seeds per plot was used. The data on plant height, number of pods per peduncle, number of pods per plant, pod dehiscence, viral disease, biomass, seed yield and straw yield were recorded for statistical analysis.

RESULTS AND DISCUSSION

The genotype ILL 9864 with the yield of 1544 kg ha^{-1} was comparable with the local check (Masoor-93) that gave 1727 kg ha^{-1} seed yield and the differences were non-significant ($P > 0.05$). There was a high variation among the genotypes for the traits used for study to evaluate the genotypes (Table I). The plant height and pods per plant were significantly ($P < 0.05$) and biomass highly significantly ($P < 0.01$) correlated with the seed yield.

Table I. Mean values of different traits of exotic lentil germplasm studied during 2003/2004 cropping season under natural environmental conditions at NARC, Islamabad

S. No.	Acc. No. (ILL No)	Plant Height (cm)	Pods/ Plant	Pods/Ped.	Pod Deh. (1-9)	Viral Diseases (1-9)	Biomass (kg/ha)	Seed yield (kg/ha)	Straw yield (kg/ha)
1	5883	38	68	3	9	5	5833	673	5160
2	6994	40	43	4	3	5	5365	1008	4356
3	8090	40	40	2	8	2	5000	919	4081
4	8176	44	50	4	7	3	3750	1083	2667
5	9837	38	31	4	3	7	4375	419	3956
6	9838	43	78	3	9	4	5417	796	4621
7	9839	38	57	3	6	4	3854	806	3048
8	9840	38	31	3	4	6	2917	746	2171
9	9841	41	45	3	3	3	3750	1402	2348
10	9846	39	66	4	6	6	4167	896	3271
11	9847	38	30	2	3	4	3125	821	2304
12	9854	44	46	3	5	5	3333	958	2375
13	9858	43	37	3	6	4	2917	892	2025
14	9859	44	143	4	5	5	3125	779	2346
15	9860	39	10	3	4	5	4792	625	4167
16	9861	38	40	3	6	7	1875	325	1550
17	9862	42	41	4	3	7	6458	706	5752
18	9864	44	81	3	4	3	4167	1544	2623
19	9867	42	54	3	4	4	4479	931	3548
20	9897	42	58	2	3	3	3333	723	2610
21	9898	44	39	2	3	5	2917	813	2104
22	9899	43	90	4	3	4	4167	1258	2908
23	9900	43	54	3	3	4	2917	750	2167
24	9901	40	40	3	7	5	5417	669	4748
25	9902	41	23	3	8	7	4167	367	3800
26	9903	41	55	3	9	2	4583	823	3760
27	9904	41	77	2	5	5	3646	767	2879
28	9905	42	53	3	4	3	7292	1158	6133
29	9907	40	72	2	3	3	5625	690	4935
30	9908	37	61	3	2	9	4167	338	3829
31	9911	40	41	3	6	6	2917	931	1985
32	9912	43	51	3	7	6	4167	800	3367
33	9913	38	38	4	3	7	3750	694	3056
34	9914	37	64	3	8	6	2292	535	1756
35	9915	41	68	2	6	5	3125	706	2419
36	9916	43	41	3	5	5	2917	521	2396
37	9917	38	56	3	9	5	3333	973	2360
38	9955	35	72	3	9	5	2813	465	2348
39	9957	40	57	3	3	3	5104	754	4350
40	9958	39	51	3	3	6	4375	858	3517
41	9959	42	51	4	7	3	3958	1040	2919
42	9960	28	70	2	5	4	3958	1023	2935
43	9963	40	126	4	6	4	4167	948	3219
44	9966	44	117	2	6	4	3333	588	2746
45	9967	41	60	2	6	5	2708	356	2352
46	9968	35	76	3	8	6	3958	873	3085
47	9970	42	77	3	2	3	4792	715	4077
48	9973	39	160	3	3	4	3542	927	2615
49	9974	42	61	2	6	6	3125	815	2310
50	9975	39	79	4	5	5	7083	1254	5829
51	9981	42	48	3	3	7	3750	1008	2742
52	9982	42	127	3	4	3	4375	1058	3317
53	9983	40	66	3	6	3	3333	879	2454
54	9987	40	65	3	7	5	1667	333	1333
55	9988	43	32	2	7	4	4792	842	3950
56	9999	42	75	3	6	3	2917	967	1950
57	10000	48	59	3	7	6	2708	340	2369
58	10001	38	43	3	3	3	3542	1071	2471
59	10002	45	73	3	3	4	4792	1483	3308
60	Masoor-93	45	81	3	3	1	6667	1727	4940
Standard error (±)		2	1	0	2	1	799	149	809
Coefficient of variation (%)		7	2	0	42	35	28	25	36
$LSD_{(0.05)}$		6	3	4	4	3	2260	422	2289

Pods/Ped.: Pods per peduncle; Pod Deh.: Pod dehiscence, recorded on 1-9 scale, where 1 was no dehiscence (resistant) and 9 when all plants in a plot show dehiscence of the pods; Viral Diseases: Viral disease infection, recorded on 1-9 scale, where 1 was no disease symptoms (resistant) and 9 with full of disease infection symptoms (highly susceptible)

Table II. Correlation of traits studied in exotic lentil germplasm during 2003/2004 at NARC, Islamabad

	Plant Height	Pods/Peduncle	Pods/Plant	Pod Dehiscence	Viral Diseases	Biomass	Seed Yield	Straw Yield
Plant Height	—	0.017± 0.16	0.075± .688	- 0.120± 0.065	- 0.149 ± 0.046	0.186 *± 38.4	0.179 *± 8.16	0.156 ± 36.53
Pods/Peduncle	—	—	0.073± 4.02	- 0.027 ± 0.381	0.118 ± 0.271	0.119 ± 226.6	0.077 ± 48.313	0.108 ± 214.8
Pods/Plant	—	—	—	- 0.013 ± 0.009	- 0.166 ± 0.006	0.006 ± 5.215	0.188 *± 1.088	- 0.036 ± 4.935
Pod Dehiscence	—	—	—	—	0.071 ± 0.066	- 0.165 ± 54.354	- 0.279* ± 11.239	- 0.111 ± 51.857
Viral Diseases	—	—	—	—	—	- 0.033 ± 76.879	- 0.268 *± 15.739	0.025 ± 72.815
Biomass	—	—	—	—	—	—	0.350 **± 0.018	0.978 **± 0.018
Seed Yield	—	—	—	—	—	—	—	0.145 ± 0.406

* P< 0.05, ** P< 0.01, ± Standard error

Biomass was positively significantly (P < 0.05) correlated with straw yield. The pod dehiscence and viral disease infection were highly negatively correlated with the seed yield (Table II).

Normally, it is not possible for the exotic germplasm to compete with the locally well-adapted genetic material but it provides some unique and useful genes like its bold seededness for incorporation into desirable genetic background. The genotype ILL 9864 was almost at par with the check in yield but can be used as a diverse parent in the breeding programme to broad the genetic base as such germplasm has been used successfully in the earlier research work for developing varieties resistant to abiotic stresses (Ali *et al*., 1991).

The plant height, biomass and pods per plant are the major yield components. Sufficient vegetative growth and branching provides an opportunity to the plants to provide sufficient number of pods and become responsible for high yield. Luthra and Sharma (1990) reported in their two years of study on lentil genotypes that number of pods and biological yield were highly significantly positively correlated with the seed yield Jain *et al*. (1991) in their multiple correlation and regression studies in lentil indicated that height, branches and pods per plant were the best combinations of characters for the improvement of yield Zaman *et al.* (1989) revealed that plant height had a significant positive relationship with time to flowering, time to maturity and seed size in lentil. In this way, the plant height may have contributed towards the high yield of lentil. Saraf *et al.* (1985) found plant height and number of pods per plant highly significantly correlated with the seed yield. Begum and Begum (1996) reported the positive and significant correlation of plant height to seed yield in lentil. Later, the results were confirmed by Abo-Shetaia (1997). Rajput and Sarwar (1989) showed highly positive significant correlation of number of pods per plant and seed yield. Tyagi (1985) and Begum and Begum (1996) confirmed the results of highly positive and significant (P < 0.01) correlation of biomass to seed yield in lentil.

The pod dehiscence and viral disease infection were highly negatively correlated with the seed yield. In pod dehiscence, the seeds drop out from the pod as soon as it matures and almost impossible to harvest. It is very fragile situation. It is obvious that if the seeds would drop from the pod we cannot get any seed yield at all. Furthermore, viral disease infection causes the stunted growth of the plants and poor pod and seed formation. Therefore, negative association of these traits with the seed yield can be expected.

The acquisition of new germplasm and its evaluation is essential to select the new useful genotypes to use them in the breeding program to incorporate desirable genes into desirable genetic background for the development of of new improved varieties. The germplasm used in the study had a great variation among the genotypes as noted from various growth and yield characters. The seed yield had a positive correlation with plant height (P<0.05) and number of pods per plant (P<0.01). The pod debiscence and viral diseases infection were highly negatively correlated with the seed yield. This information can be exploited for enhancing the productivity of the lentil by target oriented variations.

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