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Genetic studies for yield and related traits in micro and macrosperma exotic lentil genotypes

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ABSTRACT. With respect to seed size lentil (*Lens culinaris Medikus*) species usually are distributed into two main groups namely Microsperma (<2.5 g/100-seeds) with small rounded seeds and Macrosperma (>2.5 g/100-seeds) with larger and more flattened seeds. The seeds/pod and pods/plant will decrease as the seed size increases that adversely affect the seed yield. The basic aim of this study was to evolve cultivars having large seed size and high yield potential, by evaluating the genotypes received from ICARDA and to compare them with our local recommended check variety Pb.M-2009. A set of 36 large and small seeded exotic genotypes were studied. Sufficient variability was present in the germplasm. Seed yield and 100 seed weight had high heritability along with high genetic advance and pods/plant and branches/plant with moderate heritability. Plant height and pods/plant showed highly positive and significant association, whereas first pod height and 100 seed weight showed highly negative and significant correlation with seed yield. Seed yield is maximum directly affected by Pods/plant and secondly branches/plant is affected. Yield is negatively but directly affected by first pod height, 100 seed weight and plant height. Pods/plant, 100 seed weight and seed yield were recognized as vital yield contributors, therefore selection should be concentrated on these parameters to improve yield in large seeded lentil.

Keywords: Correlation; Lentil; Macrosperma; Microsperma; Path Analysis.

INTRODUCTION

Lentil is an annual crop belonging to Leguminoseae (Fabaceae) family. Lentil yield include elevated protein essence, and identified the third-greater intensity of protein of any nut, subsequent to soybean and drugs ranges of grain protein substance varies from 22% to 34.6% (Callaway et al., 2009). Masoor is generally used as dense leather, broth and mixed with crops to manufacture bakery products (Zia ul Haq et al., 2011). In Pakistan lentil is cultivated on 14.2 thousand ha with overall production of 6.4 thousand tons and yield 5.23 kg/ha in 2016-17 which is far less than other countries. In the previous years lentil area has been drastically decreased which happen due to low economic return of lentil as compared to other Rabi crops (Anonymous 2016-2017).

Lentil is a short, cylinder; many branched annual legume and generally have a bushy growth which may range from fairly erect to more spreading in habit. On the basis of seed size lentil species are usually divided into two main groups microsperma with small rounded seeds, 2-6mm in diameter, yellow or orange cotyledons and testa of various colours from pale yellow to black whereas, macrosperma with larger more flattened seeds, which normally have yellow cotyledons and a pale green testa which may be speckled. As the seed size increases pods/plant decreases, it adversely affects the seed yield. Usually longer reproductive growth period has been shown by Large seeded genotypes as compared to small seeded genotypes. So it is necessary to study the variability regarding seed size in the available germplasm (C. Webb and G. Hawtin 1981).

MATERIALS AND METHODS

The experiment was designed in RCBD having two replications during rabi 2016-17. Each line were provided accommodations in two rows of 4 m length each spaced at 30 cm. The recommended management practices were followed to raise a healthy crop. Data was recorded on Plant height (cm), pods/plant (#), branches/plant (#), 100 seed weight, First pod height (cm) and seed yield (kg/ha). The qualitative characters e.g. plant type, seed testa colour, cotyledon colour, seed shape and prominent property (No. of pods per node). Data was analysed statistically to work out heritability, genotypic (GCV) and phenotypic (PCV) coefficients of variation as per standard methods. Genotypic and phenotypic coefficients of correlation were analysed by Al-Jibourietal (1958). The correlations were further partitioned into direct and indirect effects as given by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The general mean, range and various parameters related to genetic variability present in Table 1 showed that adequate differences were present in the germplasm for plant height, first pod height, branches/plant, pods/plant, 100 seed weight and seed yield per plant. This variability can be exploited efficiently to develop bold seeded lentil genotypes having bold seed size and high yield potential by hybridization and selection. Phenotypic coefficient of variation (PCV) was the maximum for yield followed by pods/plant, plant height and first pod height whereas branches/plantand100 seed weight had low estimates of PCV. Comparable trend was detected for genotypic coefficient of variation (GCV) for nearly all characters; however they were somewhat low as compared to PCV. These results were comparable with the outcomes of Rao and Yadav (1995).

Table 1. Genetic variability for seed yield and component characters in large and small seeded exotic genotypes of lentil

Character	Mean	Range	GCV (%)	PCV (%)	h^2 (%)
Plant height (cm)	43.31	26.50-56.00	38.18	41.40	0.922
No. of branches per plant	14.64	7.50-30.00	31.90	33.03	0.967
No. of Pods per plant	85.24	16.00-218.00	2781.02	2915.34	0.954
First pod height	26.07	16.00-41.50	34.47	36.28	0.950
100-seed weight (g)	2.74	1.31-3.43	0.22	0.218	0.993
Seed yield per plot (kg/ha)	170.82	101.0-476.0	4767.31	4770.06	0.999

The heritability estimate was the highest for seed yield (99.9%), followed by 100 seed weight and branches/plant. Pods/plant and first pod height showed moderate heritability, whereas plant height showed low estimates of heritability. High estimates of heritabilityfor100 seed weight and seed yield were also observed earlier by Virand Gupta (1998). Though high heritability indicates the effectiveness of selection on the basis of phenotypic performance, it does not show any indication of the amount of genetic progress for selecting the best individuals Table 2.

Table 2. Genotypic (G) correlation coefficients in large and small seeded exotic genotypes of lentil

	PH	NOB	NOP	FPH	Yield	100sw
PH	1.00000	0.06838	-0.20740	0.39153	-0.31160	-0.16951
NOB		1.00000	0.38360	-0.05703	0.16970	0.15180
NOP			1.00000	-0.45031	0.47267	0.01293
FPH				1.00000	-0.60310	0.16514
Yield					1.00000	-0.40685
100sw						1.00000

* P< 0.05, ** P< 0.01

Phenotypic and genotypic coefficients of correlation among various characters are given in Table 3. At phenotypic level, seed yield was highly significantly and positively associated with pods/plant whereas, it was non-significantly associated with no. of branches. It was highly significantly and negatively correlated with all other characters. The phenotypic correlation coefficients were generally less as compared to genotypic correlations and the trend was parallel, which specified the inherent affiliation between the traits and hiding possessions of environments on the genotypic correlations. Whereas doing indirect selection on the basis of interrelated response for grain yield, proper statistical design and tools should be used to decrease confusing effect of environmental features and their collaboration with lentil genotypes.

Table 3. Phenotypic (P) correlation coefficients in large seeded exotic lines of lentil

	PH	NOB	NOP	FPH	Yield	100sw
PH	1.00000	0.06368	-0.19576	0.36188	-0.29940	-0.16027
NOB		1.00000	0.37548	-0.05159	0.16660	0.15053
NOP			1.00000	-0.43409	0.46282	0.02334
FPH				1.00000	-0.58902	0.16206
Yield					1.00000	0.40476
100sw						1.00000

* P< 0.05, ** P< 0.01

The conclusions gained from path coefficient analysis on phenotypic and genotypic points taking yield as dependent variable and further traits as independent variables are offered in Table 4. Seed yield (0.226) is positively and directly affected by pods/plant and branches/plant (0.140) and plant height (-0.209), first pod height (-0.344) and 100 seed weight (-0.410) exhibited negative direct effect on seed yield. Although seeds per pod had negative direct effect on seed yield but it had positive indirect effect on seed yield through harvest index. Pods/plant and first pod height had also positive indirect effect on seed yield via no. of branches. Similar observations were also recorded by Yadav et al. (2003). The negative contribution of plant height and first pod height specifies that our selection standards should be concentrated on short stature genotypes to increase yield.

Table 4. Direct (in bold) and indirect effects at genotypic (G) and phenotypic (P) level of different component characters on seed yield in large seeded lentil

Bhattacharya (2001) also identified biological yield as important character for determining lentil seed yield.

	PH	NOB	NOP	FPH	100sw
PH	**-0.20911**	0.00956	-0.04691	-0.13459	0.06945
NOB	-0.01430	**0.13983**	0.08676	0.01960	-0.06219
NOP	0.04337	0.05364	**0.22616**	0.15479	-0.00530
FPH	-0.08188	-0.00797	-0.10184	**-0.34375**	-0.06766
100sw	0.03545	0.02123	0.00292	-0.05677	**-0.40968**

Dugassa et al. (2014) estimated the contribution of the inconsistency in harvest, genetic advance and heritability lentil. Data was collected under RCBD for 12 morpho-agronomic traits. The heritability fluctuated from 4.3% (hundred seed weight)-94.3% (days to emergency) for the 12 characters and for plant height, days to appearance, biomass yield, pods/plant were more than 60%. Singh et al., (2009) investigated that seed/pod and pods/plants decreases when the seed size is increased which adversely affected plant yield as they observed the two groups of lentil regarding macrosperma and microsperma. 63 large seeded diverse advanced breeding lines were obtained from ICARDA to study variability and association. In the germplasm, sufficient variability existed for days to flowering, pods/plant, plant height, biological yield, seed yield, 100 seed weight and harvest index. 100 kernel mass, yield index in addition to seed harvest had extraordinary heritability as well as pods for each plant with reasonable heritability as well as high genetic development. Seed yield was negatively direct correlated with the days to flowering, 100 seed mass while extreme shortest consequence on kernel harvest was experiential by crop index, biological harvest, seeds for each pod and pods for every plant Table 5.

Table 5. Different traits of exotic lentil germplasm studied during 2017/2018 cropping season under natural environmental conditions at PRI, AARI, Faisalabad

Qualitative Parameters					
Entries	**plant type**	**prominent property**	**Seed testa**	**cotyledon colour**	**seed shape**
31101	Erect	3 pods/node	Spotted brown	Yellow	bold
31102	Bushy	3 pods/node	Spotted brown	Yellow	bold
31103	Bushy	3 pods/node	spotted light brown	Yellow	bold
31104	Bushy	3 pods/node	spotted orange	Yellow	bold
31105	Bushy	3 pods/node	Spotted brown	Yellow	bold
31106	semi erect	3 pods/node	Orange	Yellow	bold
31107	semi erect	3 pods/node	spotted orange	Yellow	bold
31108	Bushy	3 pods/node	light brown	Yellow	bold
31109	Bushy	3 pods/node	Creamy	Yellow	Bold
31110	Bushy	3 pods/node	Creamy	Yellow	bold
31111	Bushy	3 pods/node	light brown	Yellow	bold
31112	semi erect	4 pods/node	Creamy	Yellow	bold
31113	semi bushy	4 pods/node	Creamy	Yellow	bold
31114	Bushy	3 pods/node	Creamy	Yellow	bold
31115	semi erect	3 pods/node	Creamy	Yellow	bold
31116	semi erect	3 pods/node	spotted brown	Orange	normal
31117	Busy	4 pods/node	Creamy	Yellow	bold
31118	Busy	4 pods/node	Creamy	Yellow	bold
31119	Busy	3 pods/node	light brown	light orange	bold
31120	semi bushy	4 pods/node	Creamy	Yellow	bold
31121	semi bushy	3 pods/node	Creamy	bright yellow	bold
31122	Bushy	3 pods/node	Creamy	Yellow	bold
31123	Bushy	4 pods/node	light brown	Yellow	bold
31124	semi erect	3 pods/node	Creamy	Yellow	bold
31125	Bushy	4 pods/node	Creamy	Yellow	bold
31126	semi erect	3 pods/node	spotted brown	Yellow	bold
31127	semi erect	3 pods/node	Creamy	Yellow	bold
31128	semi erect	4 pods/node	Creamy	Yellow	bold
31129	semi erect	4 pods/node	Creamy	Yellow	bold
31130	semi erect	4 pods/node	spotted creamy	Yellow	bold
31131	semi erect	3 pods/node	Orange	Orange	medium bold
31132	Bushy	3 pods/node	spotted light brown	Yellow	bold
31133	Bushy	4 pods/node	spotted creamy	Yellow	bold
31134	Bushy	4 pods/node	Creamy	Yellow	bold
31135	Bushy	3 pods/node	light brown	Yellow	bold
31136	semi erect	3 pods/node	Brown	Yellow	normal

After the study of correlation and path coefficient analysis, it can be concluded that no. of branches and pods/plant are important yield contributing traits. Hence, during selection of required genotypes for higher seed yield in bold seeded lentil these should be considered. Meanwhile lentils developed under the declining moisture circumstances in Rabi season, short stature with maximum no. of pod bearing branches should also be taken into account for future breeding programs.

Out of 36 exotic entries, plant type of 19 entries was bushy, 13 were semi-erect type, 3 genotypes were of semi-bushy and only one was of erect type. One of prominent property of these genotypes was its no. of pods per node. Generally lentil crop has 3 pods/node but in this germplasm 12 entries were found with 4 pods/node. As we talked about type of seed testa following types of variations were found; spotted brown, spotted light brown, brown, spotted orange, spotted dark orange, creamy and spotted blackish grey. Similarly, seed shape of these genotypes were also studied, seed shape of 1 genotype was of medium bold seeded, 2 entries were found normal and rest of 33 bold seeded. Usually lentil seed has orange cotyledon colour. It is preferred in Pakistan, out of these 36 genotypes, 32 were of yellow coloured cotyledon, 1 has bright yellow, 2 has orange and only 1 light orange.

A lot of variation was also found in cotyledon colour, following categories were found in cotyledon colour e.g. 17 genotypes were of creamy colour, 5 were light brown, 5 were spotted brown, 2 spotted light brown, 2 spotted orange, 2 orange, 2 spotted creamy and only one of them was of brown colour.

CONCLUSION

From the above study it can be concluded that seed size is negatively associated with yield potential of exotic genotypes. So, while selection for hybridization we should concentrate on genotypes having medium seed size with high yield potential.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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