CORRELATION AND PATH COEFFICIENT ANALYSIS OF ECONOMICALLY IMPORTANT TRAITS IN LENTIL (*Lens culinaris* Medik.) GERMPLASM

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ABSTRACT

The present studies were conducted at Genetics and Plant Breeding Research Farm, N.D. University of Agriculture and Technology, Kumarganj, Faizabad, during rabi (winter) season of 2011-12. Eighty lentil genotypes were evaluated in augmented block design for study the correlation and path coefficient among the agronomical yield and yield contributing traits. Correlation studies showed that seed yield per plant showed highly significant and positive correlation with harvest index, number of pods per plant, plant height, number of secondary branches per plant, biological yield per plant and days to maturity. These characters are strongly associated with seed yield in lentil. Significantly inter correlation among traits is useful for breeding programme to improvement of yield and its components. Path analysis identified biological yield per plant, pods per plant, harvest index, 100-seed weight, plant height and number of seeds per pod as highly desirable components for direct effects on seed yield. The inter-relationship among the characters identified above 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 : *Lens culinaris, correlation, path coefficient, germplasm, lentil*

Lentil (*Lens culinaris* Medik.) with 2n=14, is a self-polllinating annual legume crop in India, generally grown as rainfed crop during rabi season. Nutritionist rank lentil as an excellent source of diet which is high in protein, a major source of complex carbohydrates, high in fibers, rich in vitamins A and B, potassium and iron, low in sodium and fat that regulate growth and development (1). Lentil has been originated in East Mediterranean region. It is relatively tolerant to drought and is grown throughout the world. Globally, lentil represents only 5-6% of the total area under pulse. It is predominantly grown in Asia which accounts for 80-95% global area and production (2), respectively.. In India, lentil occupied 1.59 m ha area with 0.94 mt production and productivity of 591 kg/ha in 2011 (3). About a third of the worldwide production of lentil is from India, most of which is consumed in the domestic market. India has largest cultivated area of pulse in the world, but average productivity is very low, and the production is not sufficient to meet the per capita requirement. The ultimate expression of yield in crop plants is usually dependent upon the action and interaction of a number of important characters (4). This is due to the fact that in the integrated plant structure, most of the characters are interrelated with one another and often a change in one is likely to influence the other, so that the net gain obtained by selection of one may be counterbalanced or even negated by a simultaneous change in the other. Correlation, therefore, is helpful in determining the component characters of a complex trait, like yield. A correlation study coupled with a path analysis is more effective tool in the study of yield attributing characters. Correlation measures the mutual association between two variables, which aids in determining the most effective procedures for selection of superior genotypes. When there is positive association of major yield traits component, breeding would be very effective but on the reverse, it becomes difficult to exercise simultaneous selection for them in developing a variety. (5) reported that seed yield has positive and significant correlation with plant height, number of pods per plant and total dry matter. Number of pods per plant, biological yield and harvest index had positive and significant correlation with seed yield at phenotypic and genotypic level (6). Path analysis is used to determine the amount of direct and indirect effects of the causal components on the complex component (7). (8) reported that total biological yield and number of clusters and pods per plant had high positive direct effects on seed yield. (9) explained that days to flowering, plant height, number of primary branches, biological yield, harvest index and hundred seed weigh had positive direct effects on seed yield. Hence, these traits could be used in breeding for seed yield in lentil.

MATERIALS AND METHODS

The experimental material consisted of eighty genotypes of lentil and three check varieties viz., NDL1, NDL2 and DPL62. These genotypes exhibited wide spectrum of variation for various agronomical and morphological characters which were obtained from Pulse Section Department of Genetics and Plant Breeding, NDUA&T, Kumarganj, Faizabad. The experiment was laid in Augmented Block Design during winter (rabi) season of 2011-2012 under irrigated, normal soil condition at Genetics and Plant Breeding Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.), India. The entire experimental field was divided into 8 blocks of equal size and each block had 13 plots. Out of 13 plots in a block, 10 plots were used for accommodating the test genotypes which were not replicated while remaining 3 were allocated to checks i.e. NDL1, NDL2, DPL62. The three checks were randomly allocated along with the test genotypes in a block. Each plot was consisted of single row of 4 m length, following inter and intra row spacing of 30 cm and 15 cm, respectively. The data were recorded from 5 randomly selected plants from each plot on eleven distinct morphological characters, except days to 50% flowering and days to maturity, where it was observed on complete plot basis. The data on plant height, number of primary branches/plant, number of secondary branches/plant, number of pods/plant, number of seeds/pod, 100-seed weight, seed yield/plant, biological yield/plant and harvest index were recorded for statistical analysis. The correlations between yield and yield related traits were estimated using the method described by (10) and the estimates of direct and indirect contribution of various characteristics to seed yield were calculated through path coefficient analysis as suggested by (11) and elaborated by (12).

RESULTS AND DISCUSSION

Correlation Coefficient

In the present investigation, simple correlation coefficients were computed among 11 characters presented in Table-1. Seed yield per plant showed highly significant and positive association with harvest index (0.945), number of pods per plant (0.876), plant height (0.730), number of secondary branches per plant (0.576) and biological yield per plant (0.4930). Number of pods per plant showed highly significant and positive correlation with seed yield per plant (0.876), harvest index (0.847), secondary branches per plant (0.658) and plant height (0.637). Biological yield per plant showed highly significant positive correlation with seed yield per plant (0.493), plant height (0.394) and harvest index (0.392). Seeds per pod (-0.40), primary branches per plant (-0.274) and days to 50% flowering (-0.263) were highly significant and negatively correlated with biological yield per plant. Harvest index showed highly significant and positive association with seed yield per plant (0.945), pods per plant (0.847), plant height (0.766), secondary branches per plant (0.634), days to maturity (0.540) and biological yield per plant (0.392). Days to 50% flowering showed highly significant and positive association with days to maturity (0.412) and secondary branches/plant (0.390) while it was significantly and negatively associated with biological yield/plant (-0.263). Days to maturity exhibited highly significant and positive correlation with harvest index (0.539), plant height (0.507). Plant height showed highly significant and positive association with harvest index (0.766), seed yield/plant (0.730), pods per plant (0.637), days to maturity (0.507). Number of primary branches per plant showed highly significant and positive correlation with secondary branches per plant (0.315) while Biological yield per plant (-0.274) showed significant and negative correlation with it. Number of secondary branches per plant expressed highly significant positive correlation with pods per plant (0.658), harvest index (0.634), seed yield per plant (0.576), plant height (0.49). Number of seeds per pod showed significant and negative correlation with

Table-1 : Simple correlation coefficients between different characters in Lentil germplasm.

Characters	Days to 50% flowering	Days to maturity	Plant height	No. of primary branches/ plant	No. of secondary branches/ plant	No. of pods/ plant	No. of seeds/ pod	Biological yield/ plant (g)	Harvest index (%)	100-seed weight (g)	Seed yield/ plant (g)
Days to 50% flowering	**1.00**	0.412**	0.195	0.198	0.389**	0.145	0.175	-0.263*	0.199	-0.437	0.066
Days to maturity		**1.00**	0.507**	0.027	0.377**	0.476**	-0.118	0.212	0.539**	-0.182	0.465 **
Plant height			**1.00**	-0.069	0.489**	0.637**	0.019	0.394**	0.766**	-0.087	0.729**
No. of primary branches/plant				**1.00**	0.315**	0.046	0.113	-0.274*	0.006	-0.040	-0.041
No. of secondary branches/ plant					**1.00**	0.658**	0.199	-0.069	0.634**	-0.103	0.576**
No. of pods/plant						**1.00**	0.026	0.151	0.847**	0.115	0.876**
No. of seeds/pod							**1.00**	-0.399**	0.066	-0.073	0.062
Biological yield/plant								**1.00**	0.392**	0.370	0.493**
Harvest index									**1.00**	-0.037	0.945**
100-seed weight										**1.00**	0.253*
Seed yield/plant											**1.00**

*, **, Significant at 5% and 1% probability levels, respectively.

biological yield (-0.40), days to maturity (-0.118) and 100-seed weight (-0.073). 100-seed weight showed significant and positive association with seed yield per plant (0.253).

The correlation coefficient provides symmetrical measurement of degree of association between two variables or characters, helps in understanding the nature and magnitude of association among yield and yield component traits. Seed yield is a complex quantitative character governed by large number of genes and is highly influenced by the environment. Studies on correlation provide an opportunity for critically assessing the relationship of these characters with seed yield. Identification of important yield components and information about their interrelationship with yield and also each other will be very useful in developing high yielding variety. From this point of view, the information on correlation of seed yield with related traits is the prerequisite to form an effective selection strategy aimed at its improvement. (13), reported that 100-seed weight, harvest index and biological yield had positive and highly significant correlation with seed yield at both genotypic and phenotypic levels. (14) revealed that biological yield per plant, pods per plant and seeds per pod were the important traits for realizing enhancement in seed yield in lentil. (6) studies indicated that number of pods per plant, biological yield and harvest index were positively and significantly correlated with seed yield at both phenotypic and genotypic levels. Knowledge of correlation alone is often misleading as the correlation observed may not be always true. Two characters may show correlation just because they are correlated with a common third one. In such cases, it becomes necessary to study a method which takes into account the causal relationship between the variables in addition to the degree of such relationship.

Path Coefficient

The direct and indirect effects of ten characters on seed yield per plant estimated under path coefficient analysis using simple correlations are given in Table 2. It can be noticed from Table-s2 that the highest positive direct effect on seed yield per plant exerted by biological yield per plant (0.638) followed by number of pods per plant (0.286) and harvest index (0.198) while Days to maturity

Table-2 : Direct and indirect effects of different characters on seed yield per plant in Lentil germplasm

Character	Days to 50% Flowering	Days to Maturity	Plant Height	Primary Branches/ Plant	Secondary Branches/ Plant	Pods/ Plant	Seeds/Pod	100 Seed Weight	Biological Yield/Plant	Harvest Index	Seed Yield/ Plant
Days to 50% Flowering	**0.0198**	-0.0072	0.0041	-0.0032	-0.0038	0.0414	0.0154	-0.0412	0.1276	-0.0864	0.0664
Days to Maturity	0.0081	**-0.0174**	0.0106	-0.0004	-0.0037	0.1363	-0.0103	0.0333	0.3445	-0.0361	0.4648
Plant Height	0.0039	-0.0088	**0.0208**	0.0011	-0.0048	0.1823	0.0017	0.0617	0.4889	-0.0171	0.7296
Primary Branches/Plant	0.0039	-0.0005	-0.0014	**-0.0160**	-0.0031	0.0131	0.0099	-0.0429	0.0038	-0.0080	-0.0411
Secondary Branches/Plant	0.0077	-0.0066	0.0102	-0.0050	**-0.0098**	0.1883	0.0175	-0.0109	0.4046	-0.0203	0.5756
Pods/ Plant	0.0029	-0.0083	0.0133	-0.0007	-0.0064	**0.2860**	0.0023	0.0236	0.5407	0.0227	0.8759
Seeds/ Pod	0.0035	0.0021	0.0004	-0.0018	-0.0020	0.0076	**0.0876**	-0.0627	0.0419	-0.0145	0.0622
100 Seed Weight	-0.0052	-0.0037	0.0082	0.0044	0.0007	0.0431	-0.0350	**0.1567**	0.2505	0.0732	0.4929
Biological Yield/ Plant	0.0039	-0.0094	0.0159	-0.0001	-0.0062	0.2422	0.0058	0.0615	**0.6384**	-0.0073	0.9448
Harvest Index	-0.0086	0.0032	-0.0018	0.0006	0.0010	0.0328	-0.0064	0.0580	-0.0235	**0.1977**	0.2529

Residual factor = 0.101 Bold figures indicate the direct effects

(-0.017), primary branches per plant (-0.016) and secondary branches per plant (-0.010) were substantial in negative direct effects on seed yield per plant. Highly positive indirect effects on seed yield per plant exerted by number of pods per plant (0.541), plant height (0.489), secondary branches per plant (0.405), days to maturity (0.344) and 100-seed weight (0.250) via biological yield per plant; biological yield per plant (0.242), secondary branches per plant (0.188), plant height (0.182) and days to maturity (0.136) via number of pods per plant. In contrast, days to 50 % flowering (-0.086) via harvest index; number of seeds per pod (-0.063), primary branches per plant (-0.043) and days to 50 % flowering (-0.041) via 100-seed weight showed highly negative indirect effect on seed yield per plant. The remaining estimates of the indirect effects in the analysis were too low to be considered important. The estimate of residual effect (0.101) was negligible.

Path coefficient analysis measures the direct influence of one variable upon the other and permits separation of correlation coefficients into components of direct and indirect effects. Partitioning of total correlation into direct and indirect effects provides actual information on contribution of characters and thus forms the basis for selection to improve the yield. Path coefficient analysis (Table-2) revealed that the highest positive direct effect on seed yield per plant exerted by biological yield per plant followed by number of pods per plant and harvest index. It means a slight increase in any one of the above traits may directly contribute towards seed yield. Similar results have also been reported by (8, 15). Number of pods per plant, plant height, secondary branches per plant, days to maturity and 100-seed weight exerted substantial positive indirect effect on seed yield per plant via biological yield per plant. This suggests that number of pods per plant, plant height, secondary branches per plant, days to maturity and 100-seed weight were the most important indirect contributors to seed yield per plant via biological yield per plant. Some of the earlier reports have also identified such characters as important indirect contributors towards expression of seed yield in lentil (9, 13). The characters identified above as important direct and indirect contributors on seed yield are helpful for consideration in formulating selection strategy in lentil for developing high yielding varieties. 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 new improved varieties.

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