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# Genetic variability analysis for seed yield and its attributing traits in lentil (*Lens culinaris* Medik)

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**Abstract**
The genetic materials were consisted of twenty lentil genotypes. A randomizes block design (RBD) with three replications was used. Experiment was conducted at Farm of Dept of Plant Breeding and Genetics at Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences Naini, Prayagraj Uttar Pradesh in Rabi season 2020-21. Analysis of variance revealed significant differences among the genotypes for all the traits under study indicating the presence of substantial genetic variability. The maximum yield obtained were IPL-316 and LH-7-26. High estimate of heritability were exhibited for number of effective pods per plant followed by seed index, total number of pods per plant, grain yield per plant, harvest index, biological yield per plant, number of secondary branches per plant and number of primary branches per plant. Therefore, it is concluded that the characters which showed high heritability coupled with genetic advance should be considered for direct selection. Here grain yield per plant, number of effective pods per plant, total number of pods per plant, harvest index, the character under study showed high heritability and genetic advance. Thus one should select these characters for direct selection.

**Keywords:** Genetic variability, heritability, genetic advance, agronomic characters and lentil

## Introduction

Lentil (*Lens culinaris Medik*) is edible legume. It is an annual plant known for its lens-shaped seeds so the name lentil came into exist. It is commonly called as masoor. It belongs to family Fabaceae with chromosome number of 2n=14. Legumes represent the second largest family of higher plants, second only to grasses in agricultural importance (Doyle and Luckow, 2003) [6]. Pulses are the principal source of dietary protein among vegetarians and are an integral part of daily diet because of their high protein content and good amino-acid balance in several forms world-wide. On account of balanced amino acid composition of cereals and protein blend, which matches with the milk protein, pulses are often called as life line of human beings. Proteins of grain legumes are generally high in lysine, but deficient in sulphur containing amino acids i.e. methionine and cysteine (Wang *et al.* 2003) [16]. Legumes adapt well to various cropping systems owing to their ability to fix atmospheric nitrogen in symbiosis with soil bacteria of Rhizobium spp. Legumes adapt well to various cropping systems owing to their ability to fix atmospheric nitrogen in symbiosis with soil bacteria of *Rhizobium spp.*

Lentils are made up of 25% protein, which makes them an excellent meat alternative. Lentils are an excellent source of B vitamins, iron, magnesium, potassium and zinc. Lentils, are an inexpensive, healthy source of protein, potassium, and complex carbohydrates, including dietary fiber. Any programme aimed at genetic amelioration of yield is the basic requirement. India is ranks first in area with 39.79% and the second in production with 22.79% in Lentil crop in the world.

Information on the nature and magnitude of variability and heritability in a population is one of the prerequisites for successful breeding program in selecting genotypes with desirable characters. It is therefore, of great importance for breeders to know the heritability of the agronomical characters to improve the yield of the crop effectively.

According to Falconer and Mackay (1996), heritability is defined as the measure of the correspondence between breeding values and phenotypic values. Thus, heritability plays a predictive role in breeding, expressing the reliability of phenotype as a guide to its breeding value. It is the breeding value which determines how much of the phenotype would be passed onto the next generation. There is a direct relationship between heritability and response to selection, which is referred to as genetic advance.

High genetic advance with high heritability estimates offer the most effective condition for selection. The utility of heritability therefore increases when it is used to calculate genetic advance, which indicates the degree of gain in a character obtained under a particular selection pressure. Thus, genetic advance is yet another important selection parameter that aids breeder in a selection programme. Knowledge of the extent and pattern of variability, heritability of the trait and genetic gain present in a population of Lentil. Study was done with the objective to assess the variability, heritability and genetic advance of grain yield and some of its related components to select a more desired trait that may contribute for the improvement of Lentil.

## Methods and Materials

### Location and source of experiment

The experiment was conducted at Farm of Dept of Plant Breeding and Genetics at Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences Naini, Prayagraj Uttar Pradesh in *Rabi,* 2020 – 2021. The genetic materials was consisted of Twenty Lentil genotypes namely IPL – 316, IPL – 534, IPL – 321, IPL – 220, LH – 7 – 26, EL – 78933, L – 4603, IG – 2507, IPL – 98/193, P – 2016, IPLS – 09 – 19, FLIP – 2009 – 55 –L, BHILCHA, BRLS – 2, Tall – 17, IG – 69573, IG – 69513, LL – 864, IG – 3546 and Tall - 10. A randomizes block design (RBD) with three replications was used. The Plant were spaced 5cm within a row and 25 cm between rows. A basal dose of 20 kg N and 40 kg P2O5 ha$^{-1}$ was applied at sowing time All the recommended agronomy inputs and practices were applied to the crop during the season, to raise a healthy crop.

### Observation

The data on seed yield and its components were recorded on five randomly plants taken in each genotypes from each replication for eleven characters *viz.,* plant height (cm), number of primary branches per plant, number of secondary branches per plant, total number of pods per plant, number of effective pods per plant (g), biological yield per plant (g), harvest index (g), seed index (g) and grain yield per plant (g). However, days to 50% flowering, and days of maturity were recorded on plot basis. Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), broad sense heritability and genetic advance in per cent of mean were computed as per standard formulas.

The magnitude of genetic variation existing in a character was estimated by the formula given by Burton (1952) [4]. The PCV and GCV are classified as follows as suggested by Sivasubramanian and Madhavamenon (1973) [14]. Heritability in broad sense ($h^2$) WA calculated using the formula suggested by Burton and DeVane (1953) advance was estimated by the method suggested by Johnson *et al.* (1955) [9].

## Results and Discussion

Analysis of variance revealed significant differences among the genotypes for all the traits under study indicating the presence of substantial genetic variability in lentil (Table-1). The presence of large amount of variability might be due to diverse source of material as well as environmental influence affecting the phenotypes. For each of the traits evaluated, the descriptive statistics including the extreme genotype mean values and the means together with their standard errors obtained on the basis of average data are summarized in Table 2. In general, lentil genotypes showed wide range of variability for most of the characters and all the traits exhibited broad spectrum of ranges between the maximum and minimum genotype mean values. For instance, days to 50% flowering ranged from 87.00 to 79.330 with a grand mean value 83.36. The genotypes BRLS-2, IPL-321 were earliest in terms of days to 50% flowering. Days to maturity ranging from 110.33 to 116.66 with a mean of 113.93 days. Number of pods per plant ranged varied from 175.93 to 65.33 with grand mean value of 124.98. Number pods per plant genotypes identified were L-4603 (175.93) followed by IPL-316 (166.60) and IPL-534 (166.46). These genotypes were significant to all other genotypes. The maximum yield obtained was IPL-316 (4.66g) and LH-7-26 (4.53g) it ranged from 4.66 g to 1.00 g with grand mean value of 2.99 g. Thus, it is possible to succeed in improving seed yield by direct selection. Similar results reported by Fariha *et al.* (2019).

In the present investigation character studied exhibited low, moderate and high PCV and GCV values, (Table-3 and Fig-1). None of traits were exhibited high GCV and PCV for all traits.

The highest genotypic and phenotypic coefficient of variation was recorded for the characters seed yield per plant (34.71g and 36.80) followed by) number of effective pods per plant (28.21 and 29.31) harvest index (26.74 and 29.07) and total number of pods per plant (26.18 and 27.68). Moderate GCV and PCV were recorded for number of secondary branches (14.50 and 16.55) and total number of primary branches (11.56 and 13.22) phenotypic coefficient of variation for plant height (13.18). Whereas, low GCV and PCV was recorded for days to maturity (1.22 and 2.16), days to 50% flowering (2.29 and 3.77. The moderate to high magnitude of phenotypic variation were composed of high genotypic coefficient of variations and less of the environment variations, which indicated high genetic variability for different traits and less influence of environment. Therefore selection on the basis of phenotype alone can be effective for the improvement of these traits. Similar results Alemeyheu *et al*. (2015), Pandey *et al*. (2017) [11], Netra *et al*. (2019) [10].

### Heritability

High heritability helps in the effective selection for a particular character. In the present investigation heritability in broad sense was calculated for all characters under study and is presented in (Table 3). Heritability is classified as high (above60%), medium (30%-60%) and low (below 30%) as suggested by (Johnson *et al*, 1955) [9]. High estimate of heritability were exhibited for number of effective pods per plant (92.60) followed by seed index (89.80), total number of pods per plant (89.40) and grain yield per plant (89.00) harvest index (84.60) biological yield per plant (80.20), number of secondary branches per plant (76.70) and number of primary branches per plant (76.40). The character under study. Moderate heritability was expressed in plant height (56.50) followed by days to 50% flowering (36.80) and days to maturity (32.00). None of traits were exhibited low heritability. Similar finding in lentil have been reported by Reena *et al*. (2018) [13], Hasan MT and Deb AC (2017) [8].

### Genetic advance

The range of genetic advance as percent of mean is classified as suggested by (Johnson *et al.*, 1955) [9]. Low less than 10%, moderate 10-20% and high more than 20%. Genetic advance estimates are depicted in (Table 3). Among the studied characters the high, moderate and low estimates of genetic advance as percent of mean was recorded. The genetic advance as percentage of mean was highest for grain yield per plant (67.46) followed by number of effective pods per plant (55.91), total number of pods per plant (51.00), harvest index (50.67), seed index (45.18) and biological yield per plant (42.95) recorded. However it was recorded moderate for number of secondary branches per plant (26.16) number of primary branches per plant (20.81), plant height (15.35). Low genetic advance as percent mean was recorded for days to 50% flowering (2.86) and days to maturity (1.43). Similar results in lentil have been reported by Pandey *et al.* (2017) [11], Netra *et al.* (2019) [10], Reena *et al.* (2018) [13.

**Table 1:** Analysis of variance for seed yield and its component traits in Lentil

| Characters Source of variation | Mean sum of square | | |
|---|---|---|---|
| | **Replications** | **Treatments** | **Error** |
| **D. F.** | **2** | **19** | **38** |
| Days to 50% flowering | 14.23 | 17.119312** | 6.23 |
| Days to maturity | 8.95 | 9.954738** | 4.12 |
| Plant height (cm) | 5.97 | 50.033995** | 10.20 |
| Number of Primary Branches per Pod | 0.04 | 0.383649** | 0.04 |
| Number of Secondary Branches Per Pod | 0.59 | 2.745893** | 0.25 |
| Total number of pods per plant | 253.97 | 3338.093442** | 126.30 |
| Number of effective pods per plant (gm) | 134.90 | 3291.815298** | 85.54 |
| Biological Yeild Per Plant (gm) | 1.42 | 31.633298** | 2.41 |
| Harvest Index | 5.11 | 201.744385** | 11.52 |
| Seed Index | 0.12 | 1.068626** | 0.04 |
| Seed Yield Per Plant (gm) | 0.07 | 3.37717** | 0.13 |

* &** Significant at 5% & 1% respectively

**Table 2:** Per se performance of 20 genotypes for seed yield and its component traits in Lentil

| Genotypes | Days of 50% Flowering | Days of maturity | Plant height | Total No. of primary branches | Total No. of secondary branches | Total No. of pods per plant | No. of Effective pods per plant | Biological Yield per plant | Harvest Index | Seed Index | Seed Yield Per Plant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IPL-316 | 82.33 | 112.67 | 37.80 | 3.00 | 7.27 | 166.60 | 155.67 | 17.47 | 29.47 | 3.20 | 4.67 |
| IPL-534 | 80.67 | 111.33 | 44.29 | 3.33 | 6.73 | 166.47 | 155.33 | 12.87 | 45.05 | 2.80 | 4.29 |
| IPL-321 | 80.33 | 115.67 | 36.14 | 2.47 | 5.23 | 123.80 | 113.80 | 12.33 | 31.11 | 2.93 | 2.87 |
| IPL-220 | 81.67 | 112.67 | 33.63 | 2.73 | 5.47 | 139.07 | 132.67 | 8.67 | 37.97 | 2.54 | 2.87 |
| LH-7-26 | 84.67 | 116.66 | 42.27 | 2.67 | 5.53 | 154.66 | 142.73 | 13.80 | 42.30 | 3.23 | 4.53 |
| EL-78933 | 84.33 | 115.67 | 37.33 | 3.20 | 7.20 | 143.14 | 129.27 | 12.33 | 31.37 | 2.07 | 3.33 |
| L-4603 | 85.00 | 114.67 | 40.98 | 3.47 | 6.87 | 175.93 | 167.47 | 18.07 | 30.23 | 2.87 | 4.40 |
| IG-2507 | 87.00 | 116.34 | 30.75 | 2.73 | 5.60 | 65.34 | 56.94 | 7.80 | 14.01 | 1.00 | 1.00 |
| IPL-98/193 | 86.67 | 114.67 | 36.70 | 2.80 | 7.00 | 114.93 | 105.80 | 14.27 | 24.80 | 2.27 | 3.00 |
| P-2016 | 86.00 | 114.67 | 34.79 | 3.93 | 6.87 | 78.13 | 63.00 | 10.27 | 23.02 | 2.73 | 1.31 |
| IPLS-09-19 | 83.00 | 115.67 | 31.23 | 2.67 | 4.40 | 78.03 | 72.93 | 14.73 | 29.83 | 3.67 | 3.53 |
| FLIP-2009-55-L | 85.67 | 114.34 | 37.38 | 2.60 | 6.53 | 117.54 | 108.23 | 17.53 | 16.31 | 2.67 | 2.13 |
| BHICHA | 80.33 | 112.00 | 40.43 | 2.53 | 5.50 | 147.37 | 135.54 | 12.83 | 38.09 | 2.20 | 3.41 |
| BRLS-2 | 79.33 | 112.00 | 38.00 | 2.87 | 6.13 | 99.53 | 87.13 | 10.60 | 32.13 | 3.00 | 2.13 |
| TALL-17 | 80.34 | 112.67 | 31.57 | 2.80 | 5.43 | 96.33 | 87.47 | 11.57 | 27.91 | 2.20 | 2.13 |
| IG-69573 | 83.67 | 115.00 | 35.34 | 2.93 | 6.17 | 90.07 | 85.34 | 13.57 | 20.63 | 2.47 | 2.10 |
| IG-69513 | 84.00 | 115.33 | 42.83 | 2.83 | 5.67 | 117.73 | 114.70 | 16.50 | 20.78 | 2.60 | 2.60 |
| LL-864 | 86.33 | 114.33 | 37.97 | 3.27 | 8.63 | 147.83 | 145.63 | 18.47 | 29.94 | 2.50 | 4.00 |
| IG-3546 | 82.00 | 110.33 | 29.93 | 3.13 | 6.67 | 111.87 | 102.80 | 8.57 | 37.67 | 1.60 | 2.13 |
| Tall-10 | 84.00 | 112.00 | 36.00 | 2.97 | 6.87 | 165.40 | 155.57 | 15.83 | 32.94 | 2.10 | 3.47 |
| Mean | 83.37 | 113.93 | 36.77 | 2.95 | 6.29 | 124.99 | 115.90 | 13.40 | 29.78 | 2.53 | 3.00 |
| C.V. | 2.99 | 1.78 | 8.69 | 6.42 | 7.99 | 8.99 | 7.98 | 11.58 | 11.40 | 7.79 | 12.22 |
| S.E. | 1.44 | 1.17 | 1.84 | 0.11 | 0.29 | 6.49 | 5.34 | 0.90 | 1.96 | 0.11 | 0.21 |
| C.D. 5% | 4.13 | 3.36 | 5.28 | 0.31 | 0.83 | 18.58 | 15.29 | 2.57 | 5.61 | 0.33 | 0.61 |

**Table 3:** Estimates of variability, heritability and genetic advance as percentage of mean

| Characters | GCV | PCV | H2 (Broad Since) | GA | GAM |
|---|---|---|---|---|---|
| Days of 50% Flowering | 2.29 | 3.77 | 36.80 | 2.38 | 2.86 |
| Days of maturity | 1.22 | 2.16 | 32.00 | 1.63 | 1.43 |
| Plant height | 9.91 | 13.18 | 56.50 | 5.65 | 15.35 |
| Total No. of primary branches | 11.56 | 13.22 | 76.40 | 0.61 | 20.81 |
| Total No. of secondary branches | 14.50 | 16.55 | 76.70 | 1.65 | 26.16 |
| Total No. of pods per plant | 26.18 | 27.68 | 89.40 | 63.75 | 51.00 |
| No. of Effective pods per plant | 28.21 | 29.31 | 92.60 | 64.80 | 55.91 |
| Biological Yield per plant | 23.29 | 26.01 | 80.20 | 5.76 | 42.95 |
| Harvest Index | 26.74 | 29.07 | 84.60 | 15.09 | 50.67 |
| Seed Index | 23.14 | 24.42 | 89.80 | 1.14 | 45.18 |
| Seed Yield Per Plant | 34.71 | 36.80 | 89.00 | 2.02 | 67.46 |

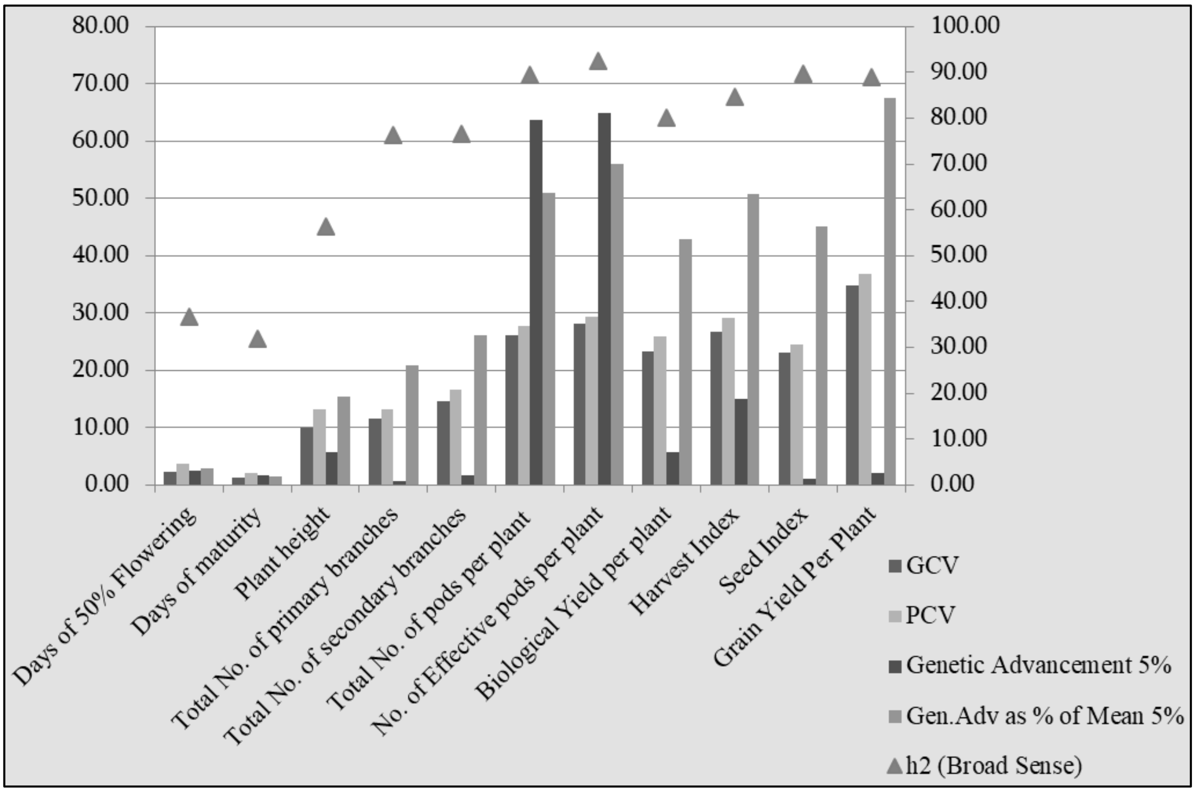


**Fig 1:** Bar chat representation of relationship among the GCV, PCV, Heritability, Genetic advance, Genetic advance as percent Mean

## Conclusion

Therefore, it is concluded that the characters which showed high heritability coupled with genetic advance should be considered for direct selection. Here grain yield per plant, number of effective pods per plant, total number of pods per plant, harvest index, seed index and biological yield per plant the character under study showed high heritability and genetic advance. Thus one should select these characters for direct selection.

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