

# Agro-Morphological Variability Assessment of Common Bean (*Phaseolus vulgaris* L.) Genotypes in High Hill Jumla, Nepal

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**Abstract**— Common bean (*Phaseolus vulgaris* L.) is the most important leguminous crop widely grown from Terai to high hills of Nepal covering 10,529 hectare land producing 15550 mt with the productivity of 1477 kgha<sup>-1</sup> and Jumla occupies almost 21% of the total bean cultivated area of the country. For the experiment, twelve genotypes of common bean were collected from different locations of Nepal. The experiment was conducted at Agricultural Research Station Vijayanagar, Jumla Nepal from July, 2016 to October, 2016 in Randomized Complete Block Design with three replications and twelve treatments. Different agro-morphological characters were observed and wide variability was recorded in growth habit, flower color, seed color, seed shape, seed length (0.76-1.7cm), pod color, pod length(9.1-14.3 cm), plant height (57.1-116.5 cm), days to flowering (38-52 days) and maturity (74-90 days), number of pods plant<sup>-1</sup> (9-22 seeds), number of seeds pod<sup>-1</sup> (4-8 pods), hundred grain weight (18.3-54.7gm) and yield (2339-4164KgHa<sup>-1</sup>). Significant differences were found among genotypes for days to flowering, pod length, no of seeds pod<sup>-1</sup> and yield hectare<sup>-1</sup>. The coefficients of determination illustrate the positive and significant association of grain yield hectare<sup>-1</sup> with number of seeds pods<sup>-1</sup>, therefore these traits should be considered for genetic improvement through breeding.

**Keywords**— Common bean, agro-morphological, genotypes, variability, breeding.

## I. INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is the most important leguminous crop widely grown from Terai to high hills of Nepal. It is important cash crop of mid-western development region grown during summer in upland under rain fed condition. It is annual crop, tolerant to drought. The performance of bean is well in drier areas where the climatic condition to cultivate maize is suitable (Alghamdi, 2007). Since, bean is a warm season grain legume, it cannot

be grown well under temperature below 20°C. The optimum mean temperature for common bean is 20-25°C. High temperature hindrances with seed setting while low temperature has adverse effects on growth (Alghamdi & Ali, 2004). In Nepal, it covers 10,529 ha land producing 15550 mt with the productivity of 1477 kgha<sup>-1</sup> (ABPSD, 2015). Only at Jumla, a district of high hill, it occupies almost 21% of the total cultivated area of the country (DADO Jumla). The crop has more importance in subsistence agro-farming system where it is grown without or with little external input in marginal land. However, farmers today, consider bean as a cash crop and grow a number of landraces with varying morphology (Neupane and Vaidya, 2002).

The primary center of origin and diversity for common beans is considered to be the Americas, where various researches have suggested that most groups are derived from the Andean common bean gene pool (Gepts et al. 1986). However, common beans are widely distributed and very diverse all around the world, whole in Europe and Asia (Blair et al. 2010).

Common bean is consumed in various ways: as split and whole dal, as a dry bean, as green pod vegetable. Bean flour is used for making *roti* (bread) and *dhindo* (thick porridge), *khichdi* (rice and beans cooked together). It is used as a folk medicine for diarrhoea, dropsy, dysentery, diabetes and kidney problems (Duke, 1991). Bean seed is rich in protein contents, fibre, polyphenols, flavonoids, carotenoids, saponins, oligosaccharides, condensed tannins, lectins, trypsin inhibitors and phytic acid which are considered to be the most important phytochemical responsible for antioxidant biological activities and preventive against cardiovascular or chronic degenerative (Camacho et al. 2006). Also it is source of essential vitamins (A, B<sub>12</sub> and C), minerals and dietary fiber, which make it an excellent component of the human nutrition (Filgueira 2013).

Various studies of common bean in high hills of Nepal particularly in Jumla district have indicated that it contains the greatest genetic diversity of *Phaseolus vulgaris*. Jumla, which is famous as a potential area of bean production is deprived of most of the activities regarding the characterization of the beans. The maintenance of this diversity is fundamental to develop and support breeding programs and enhance productivity. Morphological and agronomic traits of the plant are preferred for the primary characterization of the genotypes as it is being cheaper and easier to assess. Several characters are used to characterize genetic resources, particularly morphological and agronomic (Singh 2001). The present work is aimed to assess the genetic divergence among the bean genotypes evaluated and the extent of phenotypic and genetic variability with respect to agro-morphological traits.

## II. MATERIALS AND METHODS

The experiment was conducted in the field, at the Agricultural Research Station Vijayanagar, Jumla Nepal, geographically located at 29° 17'N latitude and 82° 1'E longitude with an elevation of 2290 m amsl. Climatic condition in Jumla ranges from cool summer to freezing winter with low humidity and low rainfall.

Twelve genotypes of common bean were collected for the experiment from different locations of Nepal. PB lines were introduced in Jumla from National Grain Legume Research Program Khajura, Nepalgunj which have been cultivated by farmers of Jumla and KBL lines were collected from the

Jumla which have been cultivated in Karnali region since very long time.

The experiment was conducted from July, 2016 to October, 2016 in Randomized Complete Block Design with three replications and twelve treatments. The plot size for each treatment was six square meter with row to row distance 50 cm and plant to plant distance of 10 cm adjusting four rows each measuring 3m length. The seed was sown on 9 July, 2016. The seed rate and fertilizer dose used was 120 kg/ha and 100:60:40 NPK kg/ha respectively. Nitrogen was provided in two splits, half as basal dose and next half was top dressed at vegetative growth stage just after first weeding (one month after sowing). Data were recorded for agro-morphic characters like days to 50% flowering (DF), Days to 75% maturity (DM), Plant height (PH), pod length (PL), number of pods plant<sup>-1</sup> (NOPP), number of seeds pod<sup>-1</sup> (NOSP), seed size, 100 seed weight and grain yield. The morphological characters were flower color, growth habit, pod color, seed shape and seed color (IBPGR, 1982).

## Statistical Analysis

The data recorded were entered in microsoft excel 2016 and analysis was done in R Studio 3.1.1. Duncan Multiple Range Test (DMRT) was done in 5% level of significance for mean comparison. Correlation and regression analysis were done using microsoft excel. T test and cluster analysis was performed using agricolae package and h-clust respectively. Data was normalized before calculation of Euclidean distance (Wiley, 2014).

## III. RESULTS AND DISCUSSIONS

Table.1: Agro-morphological traits of 12 genotypes of common bean evaluated at Jumla, Nepal.

Genotype	Growth Habit	Flower Color	Seed color	Pod Color	Seed Shape	Seed Length(cm)
PB0001	Bushy	Light pink to white	Dark red with white streaks	Green	Kidney	1.45
PB0002	Trailing	Dark Pink	Creamy white with purple streaks	Green with dark purple streaks	Elongated	1.39
PB0048	Trailing	Very light pink to white	Dark red	Green	Elongated	1.70
KBL-1	Trailing	Dark Pink	Black	Green	Elongated	1.09
KBL-2	Trailing	White	Dark Red	Reddish Green	Elongated	1.09
KBL-3	Trailing	Very dark pink	Dark purple with white streaks	Green	Elongated	1.25
KBL-4	Trailing	Dark Pink	Creamy to very light brown	Green	Flattened elongated	1.08
KBL-5	Bushy	Pink	Light brown	Green	Elongated	1.36
KBL-6	Trailing	White	White	Green	Elongated	0.76
KBL-7	Trailing	Whitish Pink to dark	Creamy to very light	Green	Oval	1.06

		pink	brown			
<b>KBL-8</b>	Bushy	Very Light Pink to white	White with dark red streaks	Green	Kidney	1.52
<b>KBL-9</b>	Trailing	Dark Pink	Light to dark grey	Green	Elongated	1.04

Three genotypes PB0001, KBL-5 and KBL-8 are bushy in nature whereas all others are trailing type. The flower color shows variations from white, light pink to very dark pink and the seed color varies widely among genotypes. The color of pods at maturity ranges from yellow, purple stripe on white to carmine red. The seed shape of two genotypes

PB0001 and KBL-8 were kidney shaped, KBL-7 was oval shaped, KBL-4 was flattened elongated and all other genotypes possessed elongated seed. The seed length ranges from 0.76 to 1.7 cm in which PB0048 possessed highest seed length 1.70 cm and KBL-6 showed lowest seed length, 0.76cm (Table 1).

Table.2: Mean value of agro-morphological characteristics of 12 genotypes of common bean evaluated at Jumla, Nepal.

S.N	Genotypes	FD	MD	PH	NOPP	PL	NOSP	HGW	YLD
1	PB0001	47	87	57.7	13	9.5	4	43.3	3691 <sup>ABC</sup>
2	PB0002	51	84	109.1	16	10.7	6	36	3610 <sup>ABC</sup>
3	PB0048	45	84	110.6	18	10.7	4	47.3	3222 <sup>ABCD</sup>
4	KBL-1	49	85	116.5	20	9.9	7	23	3683 <sup>ABC</sup>
5	KBL-2	46	84	103.1	16	9.7	8	24.3	4164 <sup>A</sup>
6	KBL-3	52	90	100.5	15	10.4	6	29	3538 <sup>ABC</sup>
7	KBL-4	50	90	82.7	17	10.5	6	26.3	3796 <sup>AB</sup>
8	KBL-5	38	74	62.5	15	14.3	6	31	2620 <sup>BCD</sup>
9	KBL-6	47	84	78.6	22	9.1	6	18.3	3779 <sup>AB</sup>
10	KBL-7	45	88	97.5	12	10.8	7	39	2339 <sup>D</sup>
11	KBL-8	38	79	57.1	9	12.3	5	54.7	2517 <sup>CD</sup>
12	KBL-9	45	87	90.3	17	11.3	7	24.3	3278 <sup>ABCD</sup>
CV		9.03	5.45	30.4	25.89	13.04	16.14	34.59	21.14
LSD		6.92	-	-	-	2.33	1.58	-	1177.85
F-test		**	NS	NS	NS	*	*	NS	*

Note: SN-serial number, FD-days to 50% flowering, MD-days to 75% maturity, PH-plant height in cm, NOPP-number of pods plant<sup>-1</sup>, PL-pods length in cm, NOSP-number of seeds pod<sup>-1</sup>, HGW-hundred grain weight in gram, YLD-Yield kgha<sup>-1</sup>, CV- coefficient of variation,

LSD-least significant difference. Means followed by the same letters in a column are not significantly different by DMRT at 5% level of significance, NS-non significant.

#### Regression Analysis

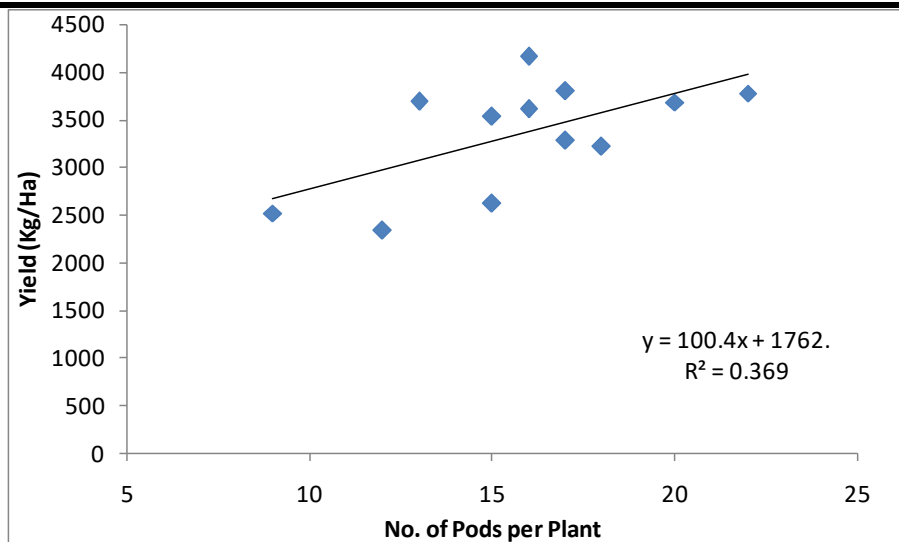


Fig.1: Linear Relationship Between No. of Pods Plant<sup>-1</sup> and Yield(KgHa<sup>-1</sup>) of Bean Genotypes at Jumla, Nepal.

There is a positive linear relationship between No. of Pods Plant<sup>-1</sup> and Yield (KgHa<sup>-1</sup>). According to linear regression equation, with unit increased in No. of Pods Plant<sup>-1</sup>, Yield would have been increased by 100.4 times. According to

coefficient of determination, about 36.90% variation in yield was due to No. of Pods Plant<sup>-1</sup> and remaining portion due to other variables as shown in Figure 1.

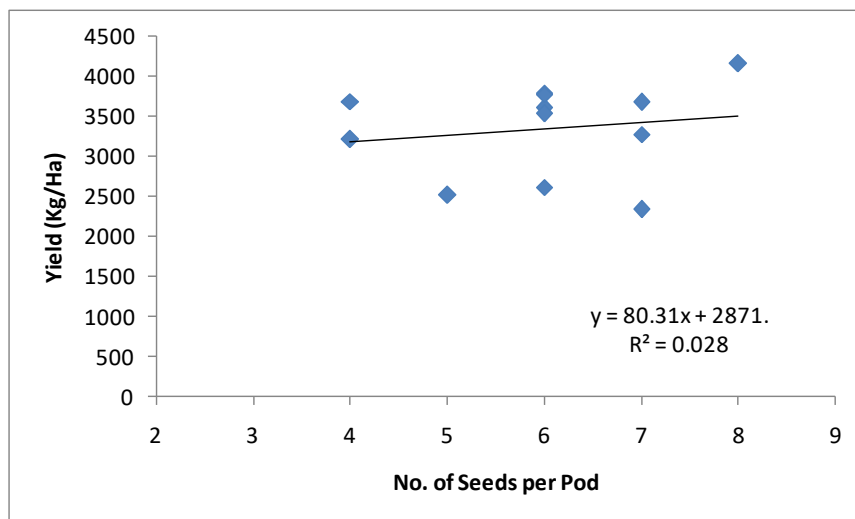


Fig.2: Linear Relationship between No. of Seeds pod<sup>-1</sup> and Yield (KgHa<sup>-1</sup>) of Bean Genotypes at Jumla, Nepal.

The positive and significant (P<0.05) linear relationship between No. of Seeds pod<sup>-1</sup> and Yield (KgHa<sup>-1</sup>) as shown in Figure 2, showed that with unit increased in No. of Seeds pod<sup>-1</sup> increased in yield by 80.31 times. According to the

coefficient of determination about 2.80% (R<sup>2</sup>=0.028) variation in yield was due to No. of Seeds pod<sup>-1</sup> and remaining portion due to other variables.

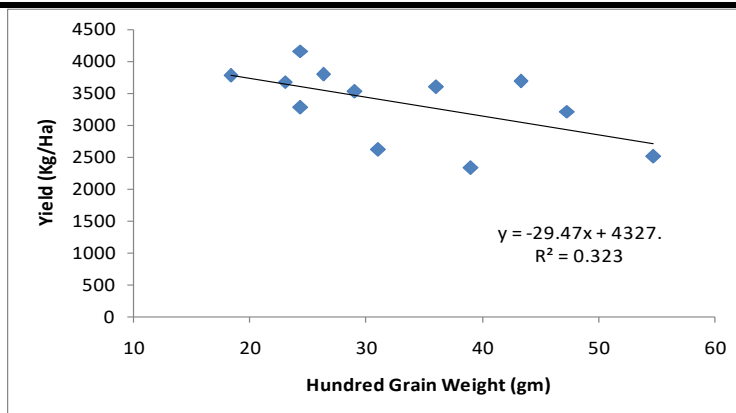


Fig.3: Linear Relationship between Hundred Grain Weight (gm) and Yield(KgHa<sup>-1</sup>) of Bean Genotypes at Jumla, Nepal.

There is a negative linear relationship between hundred grain weight (gm) and Yield (KgHa<sup>-1</sup>). The contribution of hundred grain weight to the yield was approximately

32.30% (R<sup>2</sup>=0.323) and remaining portion might be due to other variables as shown in Figure 3.

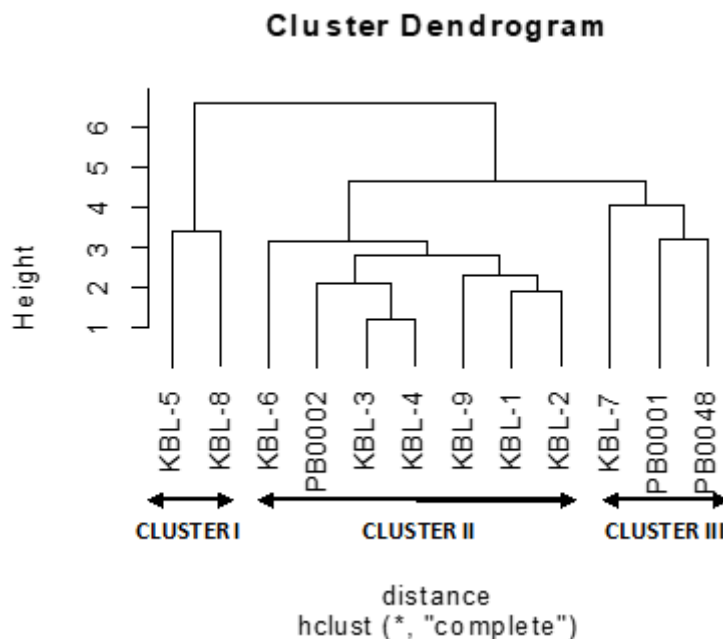


Fig.4: Dendrogram showing clustering pattern of 12 common bean genotypes based on Euclidean distance values obtained from agro-morphological data.

The germplasm used in this experiment were grouped in cluster I, II and III in (Figure 4) which holds 2, 7 and 3 genotypes respectively. The mean value of various traits for each character showed that genotypes with minimum days to flowering, minimum days to maturity, maximum pod length and minimum yield hectare<sup>-1</sup> were found in cluster I. Likewise, genotypes of cluster II constitute maximum days to maturity, maximum plant height, maximum no. of pods plant<sup>-1</sup>, minimum hundred grain weight and maximum yield

hectare<sup>-1</sup>. Genotypes with similar pod length and similar days to flowering and days to maturity were kept in cluster III.

#### IV. CONCLUSION

Genotypes on intra cluster showed similar agro-morphological traits whereas inter clusters' genotypes showed higher agro-morphic diversity, mainly for days to flowering, pod length, no of seeds pod<sup>-1</sup> and yield hectare<sup>-1</sup>.

Therefore, for further improvement, effective phenotypic selection can be done from these diversified genotypes however, it is now essential to undertake more research work on characterization of common bean from Jumla, Nepal.

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