Evaluation of Pole-type French bean (*Phaseolus vulgaris* L.) Genotypes for Agro-Morphological Variability and Yield in the Mid Hills of Nepal

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Abstract

Knowledge of genetic diversity is crucial to assess the variability of genotypes and their potential use in crop improvement program. The present experiment was conducted at Horticultur Research Station (HRS), Dailekh (1300 masl) for three years during 2016-2018 to study the agro-morphological variability and performance of six genotypes of French bean (Phaseolus vulgaris L.) for pod and seed yield.The genotypes viz; Bhatte, Chaumase, Dhankute Chirrke, WP Con Bean, White OP and Trishuli were experimented in Randomized Completely Block (RCB) design with four replications. Observations were recorded on 14 qualitative and 12 quantitative traits. Among the qualitative traits, French bean genotypes observed variability w.r.t. stem pigmentation, leaf color, leaflet shape, stem hairyness, flower color, pod color, pod shape, pod cross section, pod beak position, pod appearance, seed size, seed shape and seed color. Analysis of variance for quantitative traits showed significant differences among all the genotypes for all the characters studied. Three year mean results showed the genotype Chaumase (35.0 t/ha) followed by Trishuli (28.0 t/ha), WP Con Bean (24.6 t/ha) and White OP (22.9 t/ha) recorded the maximum green pod yield. Similarly, genotypes Chaumase (2.1 t/ha), Trishuli (2.1 t/ha), Dhankute Chirrke (1.44 t/ha) and White OP (1.09 t/ha) were found promising for seed production purpose. The agro-morphological variation observed in growth and pod characters could be utilized in variety improvement programs. Future research work needed to be focused on the further evaluation of these genotypes under different production system for yield and seed producion and to identify traits useful for crop improvement.

Key words: Crop improvement, genotypes, green pod yield, seed yield

1. Introduction

French bean (*Phaseolus vulgaris* L.), the oldest domesticated plant species is a native crop of Central and South America (Swaider et al. 1992). It is also known as a common bean, snap bean, kidney bean, and haricot bean. The common bean is predominantly self-pollinated diploid annual species (2n=x=22). The green pods are nutritionally rich containing on an average of 1.7 % protein, 4.5 % carbohydrate, 1.8 % fiber, calcium 50 mg, magnesium 28 mg and iron 1.7 mg per 100 gm of pod (Shanmugavelu, 1989). Apart from protein, French bean also contains vitamins and minerals which can help to partial alleviation of the malnutrition problem. It is majorly cultivated for its tender pods as vegetable, dried seeds used as pulse and the foliage is used as fodder for animals (Pandey et al., 2012). In Nepal, it is cultivated in a wide range of agro-climatic conditions and different season from 300 m to 2,500 masl (Neupane et al. 2008). Both pole and bush-type French beans are cultivated in the hilly region (500–1600 masl) for green pods during summer to autumn. These beans are grown as a mono-crop in the commercialized peri-urban areas using staking for pole beans or intercropped with maize as a rain-fed crop in the hills. Farmers regard beans as a cash-generating crop in the hills and grow several landraces with varying morphologies (Neupane and Vaidya, 2002). The current research was initiated with the objectives of evaluation of pole type French bean genotypes for agro-morphological variability and their yield potential.

2. Materials and Method

Field experiment was conducted at Horticulture Research Station, Dailekh during winter season (Aug-Dec) for three years 2016/17, 2017/18 and 2018/19 to evaluate the agro-morphological, yield and yield attributing characters of popular and potential genotypes of French bean. The station located at a latitude of 28^{o}13’6.18” N and a longitude of 83^{o} 58’27.72” E is characterized

by subtropical climate with an elevation of 1300 masl. The climatic data of the location viz. precipitation, relative humidity, maximum and minimum temperature for three years period are presented in figures 1a, 1b, and 1c. The experiment was arranged in a Randomized Complete Block (RCB) design with four replications; each replication was presented in a four-row plot. Seeds were sown with 75cm row to row and 25 cm plant to plant distance. Manure and fertilizer were applied as compost (20 t/ha) and 40:60:50 kg ha^{-1} N, P, and K respectively. Gap filling was carried out after 8th day of sowing and 32 plants were maintained in each plot. Within the plot, six plants were randomly taken and tagged for recording observations. Pods were harvested at the time of marketable maturity for recording the observations. Scoring of agro-morphological characters viz. stem pigmentation, leaf color, leaflet shape, stem hairiness, flower color, pod color, pod shape, pod cross-section, pod beak position, pod pubescence, pod appearance, seed size, seed shape and seed color was done according to the procedures given in the IBPGR (International Board for Plant Genetic Resources) descriptors for *Phaseolus vulgaris* [6]. The quantitative observations recorded for the experiment were namely germination percentage, pod length (cm), pod diameter (mm), individual pod weight (g), seeds pod^{-1}, green pods $plant^{-1}$, green pod yield $plant^{-1}$ (kg), green pod yield per hectare (t), dry pods $plant^{-1}$, dry pod yield $plant^{-1}$ (g), seed yield (t/ha) and 100 seeds weight (g). The qualitative characters/traits were measured by a team of 10^{-1}5 experts and consumers. The pod length and pod diameter were measured with the help of meter-scale and vernier caliper respectively. Germination percentage is calculated by Pooled mean values of the parameters in each replication were statistically analyzed through R programming (R Core Team, 2014). Statistical testing was carried out using Duncan's new multiple range test at the $P < 0.05$ level. Microsoft Excel was used for plotting figures, and graphs.

3. Result and Discussions

3.1 Agro-morphological Attributes

3.1.1 Stem pigmentation

Stem pigmentation is a useful DUS trait for classifying and differentiating genotypes. The data on stem pigmentation of six genotypes are presented in Table 1. Among the genotypes, Bhatte, Dhankute Chirrke, White OP and Trishuli had green pigmentation on stem, Chaumase had green with red streaks and WP Con Bean had green with purple stem pigmentation. Among the 15 genotypes of Dolichos bean studied for stem pigmentation, four genotypes were light green stem color, four genotypes purple stem and seven genotypes dark purple stem (Golani et al. 2015). Fifteen Jack bean genotypes were categorized based on stem color into three group viz., light green, purple and dark purple (Lenkala et al. 2015).

3.1.2 Leaf Color

Leaf colors in beans are categorized as pale green, green, and dark green. Among the six, three genotypes namely Bhatte, Dhankute Chirrke, and WP Con Bean had pale green leaf color. Chaumase and Trishuli produced the dark green whereas White OP had green leaf color (Table 1). Similar findings have been reported by other researchers. Leaf color intensity of hyacinth bean varied from pale green to green to dark green (Islam et al. 2010). Studying the leaf color, only green and purple vein colors among 107 hyacinth bean genotypes were observed and leaf color intensity varied from pale green to green to dark green (Sultana, 2011).

3.1.3 Leaflet shape

Leaflet shape is a certifying DUS characteristic for distinguishing genotypes. The data on the leaflet shape of six genotypes observed are presented in Table 1. The leaflet shape of five genotypes namely Bhatte, Chaumase, WP Con Bean, White OP, and Trishuli was round while

Dhankute Chirrke had ovate form of leaflet shape. Similar classification of soybean varieties and hyacinth bean genotypes was observed based on leaflet shape (Islam et al. 2010; Agarwal and Pawar, 1990). Fifteen genotypes of Jack bean based on leaf density was categorized as sparse, intermediate and dense (Lenkala et al. 2015).

3.1.4 Hairiness on the stem

Data on hairiness on the stem of French bean genotypes are presented in Table 1. Out of the six, three genotypes namely Bhatte, WP Con Bean and White OP had glabrous (without hairs) whereas the genotypes Chaumase, Dhankute Chirrke, and Trishuli had sparse hairiness. Seven French bean genotypes based on seedling pubescence was categorized as glabrous and dense (Prashanth, 2003).

3.1.5 Flower Color

Flower color is an important DUS characteristic that offers a quick and easy identification module for characterizing genotypes. The petal color of four genotypes namely, Bhatte, WP Con Bean, White OP, and Trishuli had white color whereas Chaumase had lilac and Dhankute Chirrke had violet-purple petal color. Similarly, 284 bean accessions were studied and categorized them into three group viz., white, plain red to dark lilac and purple colored flowers (Okii et al. 2014).

3.1.6 Pod Shape

Pod shape influences the consumer preference in the market and also qualifies as distinguishing DUS trait. The data on the pod shape of French bean genotypes are presented in Table 1. Among six French bean genotypes studied for pod shape, Bhatte and Dhankute Chirrke had straight pods; Chaumase, WP Con Bean and White OP produced slightly curved and Trishuli produced

recurring pods. The study of French bean genotypes found most of the genotypes had straight pods and a few had slightly curved pods (Muchui et al. 2008). Among the eighty accessions of local and exotic bean germplasm for pod curvature on fully expanded immature pods, 43 accessions were slightly curved, 29 were straight and 7 accessions were curved (Neupane et al. 2008).

3.1.7 Pod Color

Pod color is an important NBPGR crop descriptor for classifying and distinguishing genotypes. The data on pod color at an immature stage of French bean genotypes are presented in Table 1. Among the six genotypes, normal green pods were observed in Bhatte, Chaumase, and Trishuli, light green were recorded in WP Con Bean and White OP and green with red stripes were obtained in Dhankute Chirrke. A similar way of classification was done based on pod color (Islam et al. 2010; Okii et al. 2014).

3.1.8 Pod Cross Section

Data on pod cross-section of French bean genotype are presented in Table. Among six genotypes studied for pod cross-section, Bhatte and Dhankute Chirrke were very flat and Chaumase, WP Con Bean, White OP, and Trishuli had round elliptic pod cross-section.

3.1.9 Pod Beak Position

The data on pod beak position of French bean genotype are presented in Table. Among six genotypes studied for pod beak position, Bhatte, Chaumase, WP Con Bean, White OP, and Trishuli had marginal beak and Dhankute Chirrke had non-marginal beak position.

3.1.10 Pod Pubescence

Data on hairiness on pod of French bean genotype are presented in Table 1. Among six French bean genotypes studied for hairiness on pod, all genotypes were glabrous (without hairs) type. Pod surface in 15 French bean genotypes was observed and reported as smooth pod surface in eight genotypes and pubescent pod surface in the remaining seven genotypes (Kar et al. 2006).

3.1.11 Seed Size

Classifying genotypes on the basis of seed size is important for designing future breeding strategy for fulfilling the selective market needs of concerned community. The data on seed size of six French bean genotypes are presented in Table 1. The genotype Bhatte, and White OP had large seed size; Trishuli had medium and Chaumase, Dhankute Chirrke and WP Con Bean had small size seed. Thirty two French bean cultivars and classified them on the basis of 100 seed weight ranging from 18.4 to 50.6g (Anonymous, 2000). Similarly, eighteen different germplasm accessions of hyacinth bean (*Lablab purpureus*) and reported the seed sizes ranged from 5.7 to 14.3 mm in length and 4.0–8.6 mm in width (Maass, 2006).

3.1.12 Seed Shape

Seed shape influences the consumer preference in the market. Therefore, to meet out the aspirations of the market it becomes essential to screen out and classify the genetic stock as per the market orientation. Among the six genotypes, Bhatte and Dhankute Chirkke had circular to elliptic seed shape; Chaumase, WP Con bean, and White OP had kidney shape and Trishuli had elliptic seed shape (Table 1). Eighteen French bean varieties collected from ICAR institutes and SAUs were reported circular to elliptic, kidney and elliptic and seed shape (Singh et al. 2014). Similarly, twenty-two common bean genotypes were observed as round, oval, kidney and cuboid shape (Boros, 2014).

3.1.13 Seed coat color

Seed coat color is an identification indicator and useful trait to the distinctness of a genotype. The genotypes under study produce different color as light brown, black, orange white and purple, white and brown. In the present study, different French bean genotypes observed varied seed coat color. Chaumase produced black seed color. White OP and WP Con Bean white color seed coat whereas Trishuli alone produced brown seed coat. Bhatte and Dhankute Chirrke produced light brown and orange white with purple respectively (Table 1). Seed coat color was used to distinguish 80 accessions of bean germplasm (Neupane et al. 2008). Examination identified different color patterns viz., pink, purple, ash, cream, yellow, maroon, black, violet, shining purple and red among different seed samples. Similarly, the diversity of common bean landraces classified based on seed color (Bode et al. 2013; Pandey et al. 2011).

4. Yield and Yield Attributes

3.1 Germination Percentage

Pooled data of three years revealed that germination percentage differs significantly among the French bean genotypes (Table 2). The genotypes which showed relatively higher germination percentage were Bhatte (93.8%) and Chaumase (93.2%). However, the lowest values of these attributes were associated with White OP (84.0%) and WP Con Bean (84.2%). Relatively higher germination percentage in some genotypes may be due to the bold seed character of the genotype.

3.2 Pod Length, Pod Width and Individual Pod Weight

The pooled analysis of three-year data revealed that pod length, pod width, and individual pod weight differed considerably among the genotypes (Table 2 and Table 3). Significantly highest pod length was observed for the genotype Trishuli (19.3 cm) and lowest for Dhankute Chirrke (11.3 cm). In general consideration, it can be concluded from the result that genotypes Trishuli, Chaumase, White OP and WP Con Bean produced relatively longer pods whereas the genotypes like Bhatte and Dhankute Chirrke have relatively smaller pod length. Highest pod diameter was measured as 11.9 mm from the genotype Bhatte and lowest from WP Con Bean (9.5 mm) and White OP (9.5 mm), statistically identical to each other. Genotypes like Chaumase, Trishuli and Dhankute Chirrke having intermediate pod diameter ranging from 9.6 mm to 11.7 mm. The genotypes included in the study obtained an average variation of individual pod weight from 8.7 g to 14.7 g. Among the genotypes, Trishuli measured the highest individual pod weight (14.7 g) followed by Chaumase (13.3 g). The lowest value was recorded for Dhankute Chirrke (8.7 g).

The variation in pod length, pod width and individual pod weight of French bean genotypes observed in the present study may be due to their inherited traits and to some extent by environmental factors. Similarly, variability in different varieties of French bean was observed for pod length and pod width (Nepane et al. 2008; Pandey et al. 2011). Similarly, variation for pod length and pod width was observed in varieties of hyacinth bean (Islam et al. 2010) and lablab bean (Pengelly and Maass, 2001).

3.3 Green Pods Plant^{-1}, Green Pod Yield Plant^{-1} and Green Pod Yield

The pooled analysis of three-year data revealed that green pods plant^{-1}, green pod yield plant^{-1} and green pod yield in a considerable manner among the genotypes (Table 3 and Figure 2). Green pods plant^{-1} ranged from 39.9 to 70.5 (Table 3). The maximum green pods plant^{-1} was

observed for the genotype Chaumase (70.5) and the minimum number of pods plant^{-1} was recorded for Dhankute Chirrke (39.9). The variation in green pods plant^{-1} might be due to differences in the number of inflorescences, pods per raceme, flower dropping tendency of the genotypes (Khan, 2003). The highest green pod yield plant^{-1} was observed for the genotype Chaumase (0.57 kg). The lowest green pod yield plant^{-1} was obtained from Bhatte (0.35 kg), Dhankute Chirrke (0.36 kg), WP Con Bean (0.38 kg), White OP (0.40 kg) and Trishuli (0.41 kg) which were statistically identical. Similarly, the maximum green pod yield was obtained for genotype Chaumase (35.0 t/ha) and minimum yield for Bhatte (20.2 t/ha) and Dhankute Chirrke (20.5 t/ha), which were statistically identical. This higher green pod yield plant^{-1} and per hectare for Chaumase is attributed due to a higher number of green pods plant^{-1} and individual pod weight. Similar, results were reported by Pandey et al. (2012) with the genotype Chaumase (Four Season) obtaining the greatest fresh pod yield (25.75 t/ha) at different sowing times. Similarly, the pod yield in bean was influenced by the genotype (Neupane et al. 2008). They found that the genotypes sown on the same date produced green pod plant^{-1} ranging from 5 to 32.

3.4 Dry Pods Plant^{-1} and Dry Pod Yield Plant^{-1}

The pooled analysis of three-year data revealed that dry pods plant^{-1} and dry pod yield plant^{-1} differ significantly among the genotypes (Table 4). Chaumase recorded the highest dry pods plant^{-1} (53.9) which was statistically identical with White OP (47.9); whereas, the lowest number was observed in Trishuli (31.7), statistically at par with Dhankute Chirrke (317) and Bhatte (35.7). The highest dry pod yield plant^{-1} was recorded for Chaumase (152.2 g) and the lowest in Bhatte (80.2 g) showed the least dry pod yield plant^{-1}.

3.5 Seeds Pod^{-1}, 100 Seed Weight and Seed Yield

The pooled analysis of three-year data revealed that seeds pod^{-1}, 100 seed weight and seed yield differed significantly among the genotypes (Table 5 and Figure 3). Chaumase (8.2) recorded the maximum seeds pod^{-1} statistically identical with Trishuli (7.9) followed by White OP (7.1) and WP Con Bean (7.1). The minimum seeds pod^{-1} was found for Dhankute Chirrke (5.3) statistically identical with Bhatte (5.5). 100 seed weight was maximum for Dhankute Chirrke (60.0 g) followed by Trishuli (42.3 g), Bhatte (39.2 g) and Chaumase (29.9 g) whereas least was recorded for WP Con Bean (23.9 g) statistically identical with White OP (24.4 g). The maximum seed yield was recorded in Chaumase (2.1 kg/ha) statistically at par with Trishuli (2.10 kg/ha) whereas, least was recorded in WP Con Bean (1.09 kg/ha). Similarly, pod and dry seed yield in bean was influenced by the genotype (Neupane et al. 2008). They found that the genotypes sown on the same date produced seed yield (g/m^2) ranging from 5.9 to 306.5.

5. Conclusion

The agro-morphological variation observed in the genotypes could be utilized in the selection of genotypes for varietal improvement program. Among the qualitative traits, French bean genotypes observed variability concerning stem pigmentation, leaf color, leaflet shape, stem hairiness, flower color, pod color, pod shape, pod cross-section, pod beak position, pod appearance, seed size, seed shape, and seed color. Three year mean results showed the genotype Chaumase (35.0 t/ha) followed by Trishuli (28.0 t/ha), WP Con Bean (24.6 t/ha) and White OP (22.9 t/ha) recorded the maximum green pod yield. Similarly, genotypes Chaumase (2.1 t/ha), Trishuli (2.1 t/ha), Dhankute Chirrke (1.44 t/ha) and White OP (1.09 t/ha) were found promising for seed production purpose. Future research work needed to be focused on the further evaluation of these genotypes under different production systems for yield and seed production and to identify traits useful for crop improvement.

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Table 1. Plant, leaf, flower and pod characteristics of different genotypes of French bean at HRS, Dailekh in 2016-2018

Genotype	Stem pigmentation	Leaf color	Leaflet shape	Hairiness	Flower color	Pod shape	Pod color	Pod cross - section	Pod beak position	Pod pubescence	Pod appearance	Seed size	Seed shape	Seed color
Bhattte	Green	Pale green	Round	Glabrous	White	Straight	Normal green	Very flat	Marginal	Glabor ous	Attractive	Large	Ciruclar to elliptic	Light brown
Chaumase	Green with red streaks	Dark green	Round	Sparse	Lilac	Slightly curved	Normal green	Round elliptic	Marginal	Glabor ous	Very attractive	Small	Kidney shape	Black
Dhankute Chirrke	Green	Pale green	Ovate	Sparse	Violet purple	Straight	Green with red stripes	Very flat	Non-marginal	Glabor ous	Attractive	Small	Ciruclar to elliptic	Orange white with purple
WP Con bean	Green with purple streaks	Pale green	Round	Glabrous	White	Slightly curved	Light green	Round elliptic	Marginal	Glabor ous	Very attractive	Small	Kidney shape	White
White OP	Green	Green	Round	Glabrous	White	Slightly curved	Light green	Round elliptic	Marginal	Glabor ous	Medium	Large	Kidney shape	White
Trishuli	Green	Dark green	Round	Sparse	White	Recurving	Normal green	Round elliptic	Marginal	Glabor ous	Attractive	Medium	Elliptic	Brown

Table 2. Performance of different genotypes of French bean for germination percentage, pod length and pod width at HRS, Dailekh during 2016-2018

Geotypes	Germination Percentage (%)				Pod length (cm)				Pod width (mm)			
	2015/16	2016/17	2017/18	Mean	2015/16	2016/17	2017/18	Mean	2015/16	2016/17	2017/18	Mean
Bhattte	92.2	91.4	97.9	93.8a	12.9	13.8	12.0	12.9d	10.5	14.8	10.3	11.9a
Chaumase	97.7	85.1	96.9	93.2a	16.7	17.7	15.9	16.7b	10.1	9.7	9.1	9.6c
Dhankute Chirrke	94.5	75.7	94.8	88.4ab	10.9	12.3	10.5	11.3e	10.5	14.2	10.4	11.7a
WP Con Bean	92.2	68.7	91.7	84.2b	15.7	18.8	13.4	15.9c	10.2	9.2	9.1	9.5c
White OP	91.4	77.3	8.3	84.0b	16.3	17.4	13.9	15.9c	10.0	9.2	9.2	9.5c
Trishuli	99.4	78.9	97.9	92.1a	18.6	21.3	18.1	19.3a	10.3	11.2	10.6	10.7b
Mean	90.5	78.4	93.2	89.3	15.2	16.9	14.0	15.4	10.3	11.4	9.7	10.5
F-value				0.001*				<0.001**				<0.001**
LSD (0.05)				5.3				1.03				0.36
CV (%)				7.2				4.8				4.1

Note: NS, * and ** indicate non-significant, significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

Table 3. Performance of different genotypes of French bean for individual pod weight, green pos plant^{-1} and green pod yield plant^{-1} at HRS, Dailekh during 2016-2018

Genotypes	Individual pod weight (g)				Green pods plant^{-1} (nos.)				Green pod yield plant^{-1} (Kg)			
	2015/16	2016/17	2017/18	Mean	2015/16	2016/17	2017/18	Mean	2015/16	2016/17	2017/18	Mean
Bhattte	9.2	12.9	9.3	10.4c	41.6	53.0	49.3	47.9bc	0.35	0.37	0.34	0.35b
Chaumase	11.5	18.6	9.6	13.3b	66.9	60.9	83.6	70.5a	0.71	0.37	0.64	0.57a
Dhankute Chirrke	7.9	10.2	7.9	8.7d	31.3	39.1	49.3	39.9c	0.37	0.39	0.31	0.36b
WP Con Bean	9.5	13.5	8.5	10.5c	54.5	50.6	51.0	52.0b	0.33	0.34	0.47	0.38b
White OP	9.2	12.7	9.8	10.6c	60.7	48.2	56.9	55.2b	0.31	0.33	0.55	0.40b
Trishuli	11.0	18.1	15.5	14.7a	35.3	36.9	68.5	46.9bc	0.42	0.34	0.48	0.41b
Mean	9.7	14.4	9.9	11.4	48.4	48.1	59.8	52.1	0.42	0.36	0.47	0.41
F-value				<0.001**				<0.001**				<0.001**
LSD (0.05)				1.13				9.43				0.08
CV (%)				12.1				22.1				24.0

Note: NS, * and ** indicate non-significant, significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

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Table 4. Performance of different genotypes of French bean for dry pod yield plant^{-1} and dry pod yield plant^{-1} at HRS, Dailekh during 2016-2018

Genotypes	Dry pod plant^{-1} (nos.)				Dry pod yield plant^{-1} (g)			
	2015/16	2016/17	2017/18	Mean	2015/16	2016/17	2017/18	Mean
Bhattte	20.3	22.1	18.1	20.2c	88.3	86.8	65.4	80.2c
Chaumase	38.8	32.3	33.9	35.0a	193.8	182.6	80.1	152.2a
Dhankute Chirrke	21.3	23.7	16.5	20.5c	136.5	150.4	85.0	124.0b
WP Con Bean	19.4	29.3	25.3	24.6bc	145.9	145.1	36.7	109.3bc
White OP	17.9	21.3	29.6	22.9bc	168.2	160.1	42.9	123.7ab
Trishuli	29.9	28.4	25.7	28.0b	119.3	120.3	82.6	107.4bc
Mean	45.6	45.4	32.2	41.1	142.0	140.9	65.5	116.1
F-value				<0.001**				<0.001**
LSD (0.05)				6.8				28.36
CV (%)				20.3				29.6

Note: NS, * and ** indicate non-significant, significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

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Table 5. Performance of different genotypes of French bean for Seeds pod^{-1} and 100 seeds weight at HRS, Dailekh during 2016-2018

Genotypes	Seeds pod^{-1} (nos.)				100 seeds weight (g)			
	2015/16	2016/17	2017/18	Mean	2015/16	2016/17	2017/18	Mean
Bhattte	6.4	6.4	3.7	5.5c	44.3	40.7	32.5	39.2c
Chaumase	8.4	8.8	7.3	8.2a	34.7	31.3	23.7	29.9d
Dhankute Chirrke	5.3	5.6	4.8	5.3c	65.7	60.6	53.7	60.0a
WP Con Bean	7.6	8.4	5.2	7.1b	26.0	24.0	19.2	23.9e
White OP	7.2	8.4	5.6	7.1b	26.0	25.0	19.1	24.4e
Trishuli	7.5	8.7	7.6	7.9a	45.7	43.2	37.8	42.3b
Mean	7.1	7.7	5.7	6.8	40.8	37.8	31.0	36.4
F-value				<0.001**				<0.001**
LSD (0.05)				0.46				2.2
CV (%)				8.2				7.3

Note: NS, * and ** indicate non-significant, significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

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Figure Legends

Figure 1a: Precipitation (mm), relative humidity, minimum and maximum temperature (^{0}C) pattern in HRS, Dailekh of Nepal, during 2016/17

Figure 1b: Precipitation (mm), relative humidity, minimum and maximum temperature (^{0}C) pattern in HRS, Dailekh of Nepal, during 2017/18

Figure 1c: Precipitation (mm), relative humidity, minimum and maximum temperature (^{0}C) pattern in HRS, Dailekh of Nepal, during 2018/19

Figure 2: Performance of different genotypes of French bean for green pod yield (t/ha) at HRS, Dailekh during 2016-18

Figure 3: Performance of different genotypes of French bean for seed yield (t/ha) at HRS, Dailekh during 2016-18

Figure 1a

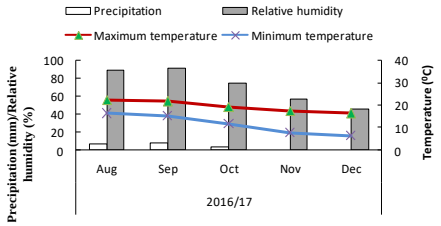


Figure 1b

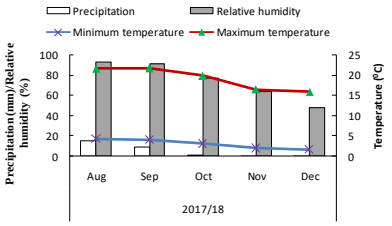


Figure 1c

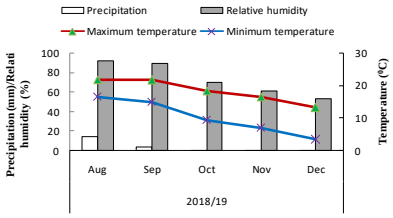
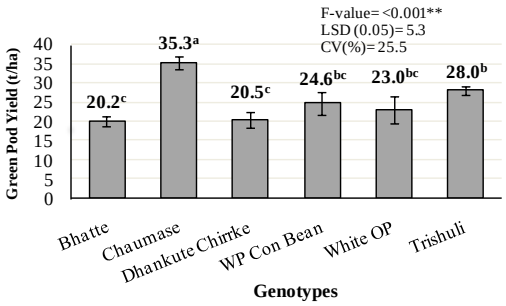
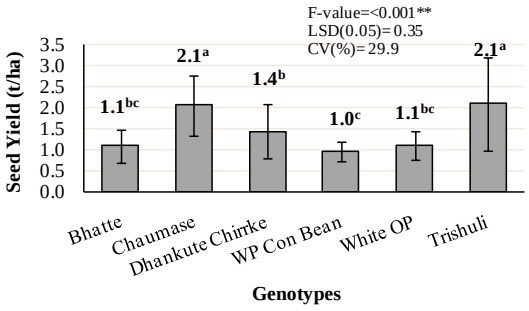


Figure 2


F-value= <0.001**
LSD (0.05)= 5.3
CV(%)= 25.5
Green Pod Yield (t/ha)
40
35
30
25
20
15
10
5
0
20.2c
35.3a
20.5c
24.6bc
23.0bc
28.0b
Bhatte
Chaumase
Dhankute Chirke
WP Con Bean
White OP
Trishuli
Genotypes

492 Figure 3



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