EVALUATION OF POLE TYPE FRENCH BEAN GENOTYPES FOR WESTERN MID HILLS OF NEPAL

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ABSTRACT

Eleven exotic and indigenous pole type French bean (Phaseolus vulgaris L.) genotypes were evaluated at Agriculture Research Station, Malepatan, Pokhara (848 masl) during summer and autumn seasons 2009/10 and 2010/11 with an objective to identify and recommend the suitable varieties. The experiment was conducted in randomized complete block design (RCBD) with three replications for pod yield and yield attributes. The results of the study showed that the highest number of flower buds per inflorescence was produced by Madhav (5.70 and 5.57) whereas the lowest by Tarbare (3.43 and 3.33) during summer and autumn season respectively. The longest pods were produced by Chinese Long (20.47 and 20.67 cm) whereas the shortest by Syangja (7.67 and 7.60 cm) during summer and autumn season respectively. The highest pod width was found in Tarbare (33.53 and 33.43 mm) whereas the lowest width in Makwanpur (8.37 and 8.47 mm) during summer and autumn season respectively. The highest fresh pod yield was produced by Makwanpur (23.91 t/ha) and the lowest by Tarbare (8.63 t/ha) during summer. During autumn season, Four Season produced the highest pod yield (28.43 t/ha) and the lowest by Tarbare (7.70 t/ha). The result revealed that the fresh pod yield was not influenced by other floral and pod characteristics. Most genotypes produced fresher pod yield during autumn than summer season. Four Season produced 28.5% more yield during autumn than in summer whereas Trishuli and Makwanpur produced 32.7 and 13.2% more yield respectively. It could be concluded that Four Season followed by Makwanpur and Trishuli could successfully be grown during autumn season and Makwanpur followed by Four Season and Trishuli during summer season for western mid hills of Nepal.

INTRODUCTION

French bean (*Phaseolus vulgaris* L.) is an important vegetable crop and cultivated in a wide range of agro-climatic conditions from terai (300 masl) to high hills (2500 masl) in different seasons. Beans, the "meat of the poor", contribute essential protein to the undernourished people living in the hills. In Nepal, beans are grown for their green pods as fresh vegetable and dried seeds as pulse and seed purpose and foliage as fodder and restoring the soil fertility. It is a native of central and South America (Swaider *et al.*, 1992) and one of the longest cultivated plants. It is widely cultivated in the temperate and subtropical regions and in many parts of the tropics. It is the most important legume worldwide for direct human consumption and diversity (Singh, 1999). Nepal is one of the world's richest centers of crop genetic diversity because of diverse agro-climatic conditions, socioeconomic and cultural variations. About 400 species of food and horticultural crops have been reported in Nepal and of them, including 200 species in the vegetable category (Pandey *et al*,. 2000). Fifty species of vegetables are domesticated in Nepal and French bean is one of them.

Different ethnic groups have their own way of preparing beans and there are special occasions and festivals when the products are relished. Red kidney beans are cultivated during winter season in the plains (below 500 masl) and are an integral part of the cuisine as a socio-cultural identity in the plains (terai) of Nepal. Different Indian rajma genotypes are introduced in the production areas and the predominant cropping pattern is mono crop. In the mid hills, fresh green pods are important and widely consumed vegetable. Both pole and bush type French beans are cultivated for green pods in the hills (500-1600 masl) during summer to autumn season. Most of the growing genotypes in the hills were introduced from India and China. Green stringless French bean (snap bean) is a very popular vegetable crop among the hill people. These beans are grown as mono crop in the commercialized peri-urban areas using staking for pole beans. Pole beans are also cultivated as mixed cropped with maize as a rain fed crop in the hills. Dried shelling beans are usually produced from summer to autumn season in the high hills and mountains (1600-2500 masl). These beans are long duration vegetables, which are grown either with maize or in apple orchards. In the high hills, it is the major source of protein to the households and cash generating enterprise. Dried beans produced in the high hills are considered as high quality beans and find their ways to distance markets and cities. Farmers regard beans as a cash generating crop in the hills and grow a number of landraces with varying morphology. This research was initiated with an objective of collection and evaluation of available exotic and indigenous germplasms so that they can be utilized for varietal improvement and commercial cultivation.

MATERIALS AND METHODS

French bean germplasms were collected from government farms, markets and farm households during February-March 2010. A total of 11 landraces were collected and of them, 2 were from India, one from China and remaining 8 from Nepal. Special attention was given to collect the genotypes which were generally grown for fresh vegetable (string less). The collected genotypes were Samjhana, Madhav, Chinese Long, Four Season, Trishuli, Syangja, LB-39, Tarbare, LB-31, Myagdi and Makwanpur. The genotypes were evaluated at Agriculture Research Station (Horticulture), Malepatan, Pokhara (848 masl). The experiment was arranged in randomized complete block design (RCBD) with 3 replications. Spacing was maintained 75 x 45 cm; plot size: 3.6 x 1.5 m. The crop was planted on 27 April 2010 and 29 August 2010. Manures and fertilizers were applied as compost 20 t/ha and NPK 40:60:50 kg/ha. Scoring of agro-morphological characters was done as per the procedures given in the IBPGR descriptors for *Phaseolus vulgaris* (IBPGR, 1982). The data were analyzed using Genstat and M-stat software.

Node number was recorded after flower set from base to first axillary inflorescence. The number was averaged from 10 randomly selected plants. Number of flower buds per inflorescence was recorded from lateral inflorescence (3rd from apex). The number was averaged from 10 randomly selected plants. Number of branches was recorded from base to first inflorescence and averaged from 5 randomly selected plants. Plant height was recorded in centimeters and averaged from randomly selected 5 plants. Pod length was measured at largest fully expanded immature green pods in centimeters (cm) and averaged from 10 randomly selected plants. Pod width was measured at largest fully expanded immature green pods in millimeters (mm) and averaged from 10 randomly selected plants. Fresh pod yield was recorded immediately after harvesting when the pods were largest fully expanded immature green pods suitable for the market.

RESULTS AND DISCUSSION

Branches

The number of branches per plant in different genotypes differed significantly (Table 1 and 2). The highest number of branches was produced by Myagdi with an average of 8.93 and 9.00 in the bothseasons, summer and autumn respectively. The lowest number of branches was produced by LB-39 with an average of 3.5 and 3.57 in the both seasons, summer and autumn respectively. Plant growth including number of branches is the result of variety's genetic potential interacting with climate and farming practices. The result showed that the number of branches of different genotypes was affected by genotypes and growing environment. As in number of nodes, genotypes Myagdi, Syangja and Tarbare did not enter into reproductive phase as early as other genotypes, produce more branches and vegetative growth. Alghamdi (2007) also reported that the studied genotypes of faba bean significantly differed for all traits. He found that the number of branches/plant were significantly different.

Flower buds

The number of flower buds per inflorescence was found significantly different among the genotypes (Table 1 and 2). The highest number of flower buds was produced by Madhav with an average of 5.70 during summer and with an average of 5.73 by Makwanpur during autumn season. The lowest number of flower buds with an average of 3.43 and 3.33 during summer and autumn respectively was produced by Tarbare. The number of flower buds production was influenced by genotypes. Neupane *et al.* (2008) reported that the number of flower buds per inflorescence in bean was influenced by genotypes; all the genotypes were planted at the same date and found varied number of flower buds from 1.8 to 18 depending on the bean genotypes.

Node Number

The number of nodes per plant produced by different genotypes was found significantly different (Table 1 and 2). The highest number of nodes with an average of 45.70 and 43.67 was produced by Tarbare during summer and autumn season respectively. The lowest number of nodes with an average of 24.67and 24.3 was produced by LB-39. Growth, development and yield of vegetable crops are the result of variety's genetic potential interacting with environment and farming practices. The result showed that the node number of different varieties was affected by genotypes and growing environment. Genotypes Tarbare, Myagdi and Syangja did not enter into reproductive phase as early as other genotypes, produce more nodes and vegetative growth. Similar result has been reported by Luitel *et al.* (2009) that the ground coverage and stem number were directly influenced by the genotypes in potato crop. Islam *et al.* (2010) reported that the genotypes of hyacinth bean showed considerable variations for most of the morpho-physical traits. They found that the number of nodes per raceme ranged from 2.33 to 14.1 in different genotypes.

Table 1 Yield and yield attributes of pole type French bean genotypes 2009/10 (summer season)

SN	Genotypes	Number of branches	No. of flower buds	Number of nodes	Plant height (cm)	Pod length (cm)	Pod width (mm)	Pod yield (t/ha)
1	Four Season	3.60	4.70	27.00	247.20	18.17	09.13	22.12
2	LB-39	3.50	4.90	24.67	239.60	18.47	10.10	15.69
3	Madhav	4.37	5.70	26.33	229.30	18.97	09.83	20.16
4	Trishuli	3.83	5.17	25.67	240.70	16.23	09.60	20.15
5	Chinese Long	5.27	5.43	34.00	275.40	20.47	08.97	13.08
6	Makwanpur	4.60	5.53	27.67	247.40	18.13	08.37	23.91
7	Samjhana	5.27	5.40	29.00	256.70	20.13	09.57	20.75
8	LB-31	5.07	5.07	32.00	214.20	17.17	09.07	16.32
9	Syangja	8.40	4.67	44.00	255.47	07.67	32.83	10.18
10	Myagdi	8.93	4.70	45.33	245.40	13.27	27.60	10.15
11	Tarbare	6.33	3.43	45.70	266.73	11.57	33.53	08.63
	Mean	5.38	4.97	32.85	247.10	16.38	15.33	16.47
	P-value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	LSD (0.05)	0.31	0.21	1.54	9.30	0.26	0.45	1.93
	CV (%)	3.4	2.5	2.8	2.2	0.9	1.7	6.9

Plant height

The plant height differed significantly among the genotypes (Table 1 and 2). The tallest plants were found in Chinese Long with an average of 275.40 and 277.40 cm during summer and autumn respectively. The shortest plants were produced by LB-31 with an average of 214.20 and 212.30 cm respectively. Neupane *et al.* (2008) reported that the plant height in beans was influenced by genotypes. They recorded that the plant height ranged from 28 to 144 cm in different bean genotypes that were planted at the same date. Similar results were also reported by other researchers. Alghamdi (2007) reported that faba bean genotypes significantly differed in flowering date and plant height.

Table 2 Yield and yield attributes of pole type French bean genotypes 2010/011 (autumn season)

SN	Varieties	No. of branches	No. of flower buds	No. of nodes	Plant height (cm)	Pod length (cm)	Pod width (cm)	Pod yield (t/ha)
1	Four Season	3.63	5.07	28.00	245.80	19.53	9.57	28.43
2	LB-39	3.57	4.93	24.33	237.70	18.63	10.23	24.45
3	Madhav	4.40	5.57	27.00	228.30	18.90	9.90	21.36
4	Trishuli	3.80	5.30	26.33	239.10	16.50	9.77	26.74
5	Chinese Long	5.17	5.50	33.33	277.40	20.67	9.07	21.99
6	Makwanpur	4.70	5.73	28.67	249.40	18.23	8.47	27.06
7	Samjhana	5.30	5.50	28.33	255.30	20.07	9.47	18.89
8	LB-31	5.07	5.17	31.33	212.30	17.23	9.23	20.34
9	Syangja	8.53	4.43	42.67	253.80	7.60	32.70	8.48
10	Myagdi	9.00	4.47	44.00	243.70	13.30	27.50	8.69
11	Tarbare	6.40	3.33	43.67	267.70	11.53	33.43	7.70
	Mean	5.41	5.00	32.51	246.41	16.56	15.39	19.47
	P-value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	LSD (0.05)	0.23	0.96	1.49	6.9	0.17	0.24	0.55
	CV (%)	2.5	2.5	2.7	1.7	0.6	0.9	1.7

Pod length

The pod length among the genotypes was found significantly different (Table 1 and 2). Chinese Long produced the longest pods with an average of 20.47 and 20.67 cm during summer and autumn season respectively. The shortest pods with an average of 7.67 and 7.60 cm were produced by Syangja. The result revealed that the pod length was influenced by genotypes. Snap bean genotypes have produced longer pods and shelling beans (Tarbare, Syangja and Myagdi) produced shorter pods. Similar results were also reported by other researchers. Neupane *et al.* (2008) reported that the pod length in beans was influenced by genotypes. They found that all the genotypes planted at the same date produced varied pod length ranging from 6.7 to 17.4 cm. Islam *et al.* (2010) reported that the genotypes of hyacinth bean showed considerable variations in pod length that varied from 3.96 cm to 18.20 cm. Pengelly and Maass (2001) also reported that the pod length in lablab bean ranged from 2.5 cm to 14 cm among 249 genotypes.

Pod width

The pod width among the genotypes differed significantly (Table 1 and 2). Tarbare produced the pods with highest width with an average of 33.53 and 33.43 mm during summer and autumn season respectively. The pods with lowest width were produced by by Makwanpur with an average of 8.37 and 8.47 mm during summer and autumn respectively. Shelling beans (Tarbare, Syangja and Myagdi) which are indigenous and are cultivated in mid to high hills have produced wider pods with more width while snap bean genotypes have produced narrower pods with less width. These shelling beans have shorter but wider pods which produce bigger dry beans. Neupane *et al.* (2008) reported that the pod width in beans was influenced by genotypes. They recorded pods width ranging from 10 to 30 mm in different genotypes which were planted at the same date. Islam *et al.* (2010) also reported that the genotypes of hyacinth bean showed considerable variations in pod width that ranged from 1.5 cm to 4.46 cm.

Pod yield

The pod yield among the genotypes differed significantly (Table 1 and 2). Makwanpur produced the highest fresh pod yield with an average of 23.91 t/ha during summer season and Four Season produced the highest fresh pod yield with an average of 28.43 t/ha. The lowest fresh pod yield was produced by Tarbare with an average of 8.63 and 7.70 t/ha during summer and autumn season respectively. All snap bean genotypes produced higher fresh pod yield during autumn than in summer season. Shelling beans Syangja, Myagdi and Tarbare produced lower yield during autumn than in summer season. These beans were planted in April but flowered and bear pods in October-November.

CONCLUSIONS

The agro-morphological variation observed in the genotypes shows that there is enough scope for selection of suitable genotypes for various production systems. The result revealed that the fresh pod yield was not influenced by other floral and pod characteristics. Most genotypes produced more fresh pod yield during autumn than summer season. Four Season produced 28.5% more yield during autumn than in summer whereas Trishuli and Makwanpur produced 32.7 and 13.2% more yield respectively. It could be concluded that Four Season followed by Makwanpur and Trishuli could successfully be grown during autumn season and Makwanpur followed by Four Season and Trishuli during summer season for western mid hills of Nepal. Four Season, Trishuli and Makwanpur which are already in farmer's fields, could be profitably used for scaling up in the target area. Future research work should focus on the agronomic management and their evaluation across a range of environments to identify and select location specific and wide adaptive genotypes.

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