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EVALUATION OF COMMON BEAN GERMPLASM COLLECTED FROM THE NEGLECTED POCKETS OF NORTHWEST PAKISTAN AT KALAM (SWAT)

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Abstract

An experiment consisted of 33 germplasm of common bean (*Phaseolus vulgaris* L.) collected from FATA (Federally Administered Tribal Areas) and neglected pockets of Khyber Pakhtunkhwa were evaluated at the sub-Research Station, Kalam (Swat) during summer 1999-2000. Based on the grain yield potential, these germplasm were divided into three groups. Germplasm CB-9 ranked first by producing maximum grain yield of 3310 kg ha^{-1}, while germplasm CB-6 with 3188 kg ha^{-1} ranked second, while the lowest grain yield (333 kg ha^{-1}) was produced by germplasm CB-23. Average grain yield in groups decreased in descending order from 2701 kg ha^{-1} in group I to 1553 kg ha^{-1} in group II and then further decreased to 750 kg ha^{-1} in group III. Maturity period varied from 76 to 96 days, plant height 39 to 96 cm, branches per plant 4 to 7, pod length 5.7 to 14.3 cm, seeds per pod 4.9 to 7.6, pods per plant 9 to 39, dry matter yield 1334 to 6666 kg ha^{-1}, 100-seeds weight 19.0 to 72.1 g, and harvest index varied from 14.3 to 66.2% among different germplasm. Average values of grain yield in the three groups showed positive relationship with plant height, dry matter yield, and harvest index; but showed negative relationship with days to maturity.

Introduction

Malnutrition is one of the major problems in the whole Khyber Pakhtunkhwa (KP) province of Pakistan in general and in the northern parts of KP in particular is mainly due to the protein deficiency in the diet. Food legumes have an important role to play not only in increasing the quantity of food but in improving the quality of their cereal based diets (Amanullah, 2010). Common bean (*Phaseolus vulgaris* L.) has a promising future in Pakistan and therefore attempt should be made to improve its yield through development of the high yielding varieties and better agronomic practices. As the consumption of common bean in Pakistan is more than its production, therefore large amount is imported every year. Nutritionists characterize the common bean as a nearly perfect food because of its high protein content and generous amounts of fiber, complex carbohydrates, and other dietary necessities. Identification of higher yielding germplasm will lead to its self sufficiency and will also improve the living standard of the farmers of Kalam, Parachinar & Tirah valley of Khyber Pakhtunkhwa where common bean is the major summer crop. But despite its potential and importance no research has been reported in Pakistan so for. Research work on different pulses germplasm collection and evaluation was reported earlier by Amanullah & Hatam (2000, 2001). Ahmad *et al*., (2000) reported that grain yield in cowpea germplasm increased with increase in branches and pods per plant, plant height, dry matter, seeds per pod, 100-seed weight and harvest index. Hakim *et al*., (2005) worked on the evaluation of mid and full season soybean varieties at Mansehra. Amanullah & Hatam (2001) worked on the yield performance and nodulation efficiency of soybean cultivars and evaluation of vegetable soybean germplasm at Peshawar.

Amanullah *et al*., (2006) reported significant variation in the grain yield of 25 common bean germplasm. They reported positive relationship of grain yield with 100-seed weight, pods per plant and harvest index while, plant height and branches per plant showed positive association with dry matter yield.

Materials and Methods

An experiment consisting of 33 germplasm of common bean was carried out at the Agriculture Sub-station Kalam (Swat) during summer 1999-2000. Each germplasm was considered as treatment and planted in randomized complete block design with three replications by assigning each germplasm to a plot of 3 m². Each plot consisted of 3 rows, 2 m long and 50 cm apart. A basal dose of 25 kg N and 64 kg P_2O_5 per hectare was applied as DAP and incorporated into the soil during seedbed preparation. Weeds were controlled manually at the early vegetative stage and irrigations were applied when required.

Data were collected on days to maturity, plant height (cm), branches per plant, pods per plant, seeds per pod, pod length (cm), 100-seed weight (g), grain yield (kg ha^{-1}), dry matter yield (kg ha^{-1}), and harvest index (%). Data were subjected to analysis of variance (ANOVA) according to the methods described by Steel *et al*., (1996), and means between germplasm were compared by least significant difference (LSD) at $p \leq 0.05$.

Results and Discussion

It was very difficult to correlate the performance of individual germplasm in grain yield with other agronomic characters, therefore, the germplasm were first arranged in descending order and then divided into three groups on the basis of grain yield (kg ha^{-1}) to interpret meaningful results. Group I consisted of 10, group II consisted of 12 and group III consisted of 11 germplasm.

Days to maturity: Days to maturity varied significantly from 76-96 days (Table 1). Average values of days to maturity delayed in descending order i.e. 83 in group I, 85 in group II and then further delayed to 87 days in group III. The difference in days to maturity could be due to photoperiod, because different germplasm respond differently to a particular photoperiod. These results are in close conformity with those of Amanullah *et al*., (2006) who reported significant variation in days to maturity among common bean germplasm. This variation in days to maturity of different germplasm might be due to the difference in the genetic make-up of different germplasm.

Plant height: Perusal of the data in Table 1 showed that plant height varied significantly from 39 (CB-7) to 96 cm (CB-26) in different germplasm. Average values in groups decreased also decreased in descending order from 74 cm in group I to 71 cm in group I and then further decreased to 66 cm in group III. This variation in plant height of different germplasm might be due to the difference in the genetic make-up of different germplasm. In contrast to our previous results (Amanullah *et al*., 2006) average values of plant height in groups showed positive relationship with maturity. The discrepancy in plant height of common bean germplasm in our previous results and results obtained in this experiment might be due to the variation in the rainfall data in different years. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of these germplasm might be considered the possible cause of this variation.

Table 1. Days to maturity, plant height (cm), branches per plant, pod length (cm) and dry matter yield (kg ha^{-1}) of common bean germplasm during summer 1999-2000 planted at Kalam (Swat).

Acc. No.	Group	Days to maturity	Plant height	Branches per plant	Pod length	Dry matter yield
CB-9		76i	85abc	5	8.5mn	5777a-e
CB-6		83g	85abc	5	7.0pg	6221abc
CB-3		86ef	94a	6	6.3rst	6444ab
CB-13		96a	77b-g	6	12.9bc	5221a-g
CB-12	I	81h	88ab	5	11.9de	6666a
CB-7		76i	39k	5	11.7ef	5888a-d
CB-15		87e	73b-h	5	14.3a	5000a-g
CB-19		93b	86abc	7	8.4mn	4000a-j
CB-1		61h	63f-j	4	5.7t	4444a-i
CB-10		76i	75b-h	5	11.1fgh	4666a-h
Mean group I		**83**	**74**	**5.3**	**9.8**	**5433**
CB-4		86ef	79a-f	4	9.7jk	4000a-j
CB-20		94b	68d-j	5	10.6hi	4777a-g
CB-2		86ef	73b-h	5	8.2mno	3333c-j
CB-5		76i	65e-j	4	6.6qrs	3666b-j
CB-39		94b	70b-j	5	8.4mn	4000a-j
CB-33	II	76i	65e-j	4	10.9gh	2333g-j
CB-17		83g	71b-i	5	8.8lm	3000d-j
CB-37		87e	68d-j	4	12.6bcd	3000d-j
CB-32		83g	84a-d	5	11.9de	2166f-j
CB-18		86ef	72b-i	4	8.2mn	2333g-j
CB-8		81h	55ijk	4	7.8no	2333g-j
CB-14		91c	81e-e	6	8.3mn	5333a-f
Mean group II		**85**	**71**	**4.6**	**9.3**	**3356**
CB-11		86ef	59hij	6	10.0ij	2555f-j
CB-26		83g	56a	6	12.3cde	1666ij
CB-16		91c	69c-j	6	9.4jkl	3000d-j
CB-31		83g	84a-d	4	13.3b	1666ij
CB-27		91c	53jk	4	11.6efg	1333j
CB-25	III	86ef	60g-j	6	9.3kl	3666b-j
CB-29		85f	81e-e	5	7.0pqr	1666ij
CB-21		91c	41k	4	7.5op	1833hij
CB-22		89d	41k	5	13.0bc	1333j
CB-24		87e	61g-j	5	6.0st	1333j
CB-23		91c	80a-f	5	10.6hi	2333g-j
Mean group III		**87**	**66**	**5.1**	**10.0**	**2035**
LSD at 5%		**1.67**	**17.09**	**ns**	**0.72**	**2900**

Mean values carrying similar letters in the same column do not differ significantly at 5% level of probability

Branches per plant: Differences in the branches per plant of common bean germplasm were no significant (Table 1). However, it varied from 4 to 7 in different germplasm. Variation in branches per plant of different germplasm might be due to the genetic variability of different germplasm. These results are in contrast to those of Amanullah *et*

al., (2006) who reported significant variation in branches per plant. The discrepancy in our previous results and results obtained in this experiment might be due to the variation in the rainfall data in different years. As these germplasm were collected from different climatic conditions, so the rate of acclimatization of these germplasm might be considered the possible cause of this variation.

Pod length: Pod length varied significantly from 5.7 (CB-1) to 14.3 cm (CB-15) as shown in Table 1. Average values in groups decreased from 10.0 in group III to 9.8 in group I and then further decreased to 9.3 in group II. Overall, 8 germplasm ranged between 5.7 and 7.5, 10 from 8.2 and 9.7 while 15 germplasm between 10 and 14.3 branches per plant. These results are in close confirmation of our previous results (Amanullah *et al*., 2006) where significant variation was observed in pod length among different common bean germplasm. Differences in pod length of different germplasm might be due to the difference in the genetic make up of these germplasm.

Dry matter yield: Dry matter yield varied significantly from 1334 to 6666 kg ha^{-1} among different germplasm (Table 1). Average values in groups decreased in descending order from 5433 kg ha^{-1} in group I to 3356 kg ha^{-1} in group II and then further decreased to 2035 kg ha^{-1} in group III. Dry matter yield showed positive association with plant height and grin yield but negative relationship with days to maturity. On the other hand, in our previous results (Amanullah *et al*., 2006) found positive association of dry matter yield with maturity, plant height and harvest index but its relationship with grin yield was not very well established. The discrepancy in our previous results and results obtained in this experiment might be due to the variation in the rainfall data in different years. Variation in dry matter yield of different germplasm might be due to the genetic variability of different germplasm. Moreover, as these germplasm were collected from different climatic conditions, so the rate of acclimatization of these germplasm might be considered the possible cause of this variation.

Seeds per pod: Seeds per pod varied significantly from 4.9 (CB-5) to 7.6 (CB-26) as shown in Table 2. Average values in groups decreased from 6.0 in group II to 5.9 each in group I and II. It ranged from 5.2-7.3 in group I, 4.9-7.6 in group II and 5.1-7.1 in group III. In the overall situation, 20 germplasm ranged from 4.9 to 5.9 seeds per pod while 13 from 6.0 to 7.6 seeds per pod. Genetic variability of germplasm might be responsible for variation in seeds per pod among different germplasm. These results are in close conformity with those of Amanullah *et al*., (2006) who reported that common bean germplasm had significant variation in seeds per pod.

100-seed weight: 100-seed weight varied significantly from 19.0 (CB-8) to 72.1 g (CB-15) as shown in Table 2. Average values in groups decreased in descending order from 40.9 g in group III to 38.1 g in group I and then further decreased to 34.4 g in group II. In the overall situation, 8 germplasm ranged from 19.0 26.9 g, 14 from 27.1 to 37.46 g, 9 from 40.0 to 55.0 g and 2 from 61.9 to 72.1 g. These results are in close conformity with those of Amanullah *et al*., (2006) who reported that common bean germplasm had significant variation in seed weight. This variation in seed weight of common bean germplasm probably may be due to the genetic variability among different germplasm.

Table 2.. Seeds per pod, 100-seed weight (g), pods per plant, grain yield (kg ha^{-1}) and harvest index (%) of common bean germplasm during summer 1999-2000 planted at Kalam (Swat).

Acc. No.	Group	Seeds per pod	100-seed weight	Pods per plant	Grain yield	Harvest index
CB-9		6.7d	32.1i-l	21cd	3310a	57.3e
CB-6		5.2lm	24.0no	18cg	3188a	51.2i
CB-3		5.9fg	24.6mn	18cg	3000ab	46.5n
CB-13		5.7g-j	58.3bc	17dg	2977ab	57.0e
CB-12	I	6.9cd	42.1ef	17dg	2622abc	39.3r
CB-7		5.7g-j	42.7e	14e-h	2555abc	43.4p
CB-15		5.8ghi	72.1a	16d-h	2499abc	50.0j
CB-19		5.4jkl	26.8lmn	21cde	2388a-d	59.7d
CB-1		4.6n	24.4mn	16dh	2311a-e	52.0h
CB-10		7.3abc	33.6n-k	16dh	2166a-f	46.4n
Mean group I		**5.9**	**38.1**	**17**	**2701**	**50.3**
CB-4		5.0lm	28.2lmn	17cg	1977a-g	49.4k
CB-20		5.8ghi	24.2no	20cf	1955a-g	41.0q
CB-2		5.6h-k	30.7i-l	12gh	1877a-g	56.3f
CB-5		4.9mn	29.2k-n	18cg	1866a-g	51.0i
CB-39		5.8ghi	34.8g-j	17dg	1533b-h	38.3s
CB-33	II	5.6ijk	35.3ghi	18cg	1483b-h	63.5b
CB-17		6.1fg	26.9lmn	18cg	1477c-h	49.2k
CB-37		7.4ab	40.0efg	18cg	1466c-h	48.8l
CB-32		6.9cd	34.1h-k	22cd	1433c-h	66.2a
CB-18		7.6a	27.1lmn	16dh	1288c-h	55.2g
CB-8		6.1fg	19.0o	12fgh	1155c-h	49.5k
CB-14		5.3klm	30.1i-l	20cg	1133c-h	21.2v
Mean group II		**6.0**	**34.4**	**17**	**1553**	**49.1**
CB-11		5.9f-i	29.7j-m	17dg	944d-h	37.0t
CB-26		6.6de	37.4fgh	39a	933d-h	56.0f
CB-16		5.4jkl	55.0cd	16dh	910e-h	30.3u
CB-31		5.8ghi	42.5ef	16dh	866e-h	52.0h
CB-27		6.6de	43.1e	17dg	800fgh	60.0c
CB-25	III	5.3klm	31.6i-l	17dg	733fgh	19.9w
CB-29		6.0fgh	41.6ef	22cd	733fgh	44.0o
CB-21		7.1bc	30.6i-l	9h	690fgh	38.1s
CB-22		5.3klm	61.9b	14e-h	666gh	50.0j
CB-24		5.1lm	52.7d	25bc	633gh	47.5m
CB-23		6.3ef	24.3n	30b	333h	14.3x
Mean group III		**5.9**	**40.9**	**20**	**750**	**40.8**
LSD at 5%		**0.39**	**5.28**	**7.34**	**1497**	**0.24**

Mean values carrying similar letters in the same column do not differ significantly at 5% level of probability

Pods per plant: Pods per plant varied significantly from 9 (CB-21) to 39 (CB-26). It ranged from 12-21 in group I, 12-22 in group II and 9-39 in group III. Average values in groups increased 17 each in group I and II to 20 in group III. In the overall situation, 5 germplasm ranged from 9-14, 19 from 16-18 and 9 from 20-39 pods per plant. These

results are in close conformity with those of Amanullah *et al*., (2006) who reported that common bean germplasm had significant variation in their number of pods per plant Differences in pods per plant might be attributed to variation in the genetic makeup among different germplasm.

Grain yield: Grain yield varied significantly from 333 (CB-23) to 3310 kg ha^{-1} (CB-9) among different germplasm (Table 2). It ranged from 2166 to 3310 kg ha^{-1} in group I, 1133 to 1977 kg ha^{-1} in group II and 333 to 944 kg ha^{-1} in group III. Average values in groups decreased in descending order from 2701 kg ha^{-1} in group I to 1553 kg ha^{-1} in group II and then further decreased to 750 kg ha^{-1} in group III. Grain yield showed positive association with plant height, dry matter yield and harvest index but negative association with days to maturity which is clear from the average values of groups. Our previous results suggested that grain yield of common bean had positive relationship with 100-seed weight; pods per plant and harvest index but had negative relationship with days to maturity (Amanullah *et al*., 2006). Ahmad *et al*., (2000) reported that grain yield in cowpea germplasm increased with increase in branches and pods per plant, plant height, dry matter yield, seeds per pod, 100-seed weight and harvest index.

Harvest index: Harvest index varied significantly from 14.3 to 66.2% (Table 2). Maximum harvest index of 66.2% was calculated for germplasm CB-32, followed by CB-33 with 63.5%, while minimum harvest index of 14.3 % was recorded for germplasm CB-23. Average values of harvest index in groups decreased in descending order from 50.3% in group I to 49.1% in group II and then further decreased to 40.8% in group III. In the overall situation, harvest index of 3 germplasm ranged between 14.3 and 21.2%, 5 between 30.3 and 39.3%, 10 between 41.0 and 49.5% and 15 between 50.0 and 66.2%. Harvest index showed positive relationship with both grain and dry matter yields. Amanullah *et al*., (2006) reported positive relationship between harvest index and grain yield but negative relationship between harvest index and dry matter yield.

Conclusions

The 10 high yielding (2166 to 3310 kg ha^{-1}) common bean germplasm in group I (CB-09, 06, 03, 13, 12, 07, 15, 19, 01, and 10) were recommended for further studies especially for development of best agronomic practices for higher productivity and profitability in different potential areas in the Khyber Pakhtunkhwa, Pakistan. The development of modern cultivation technology for these high yielding common bean germplasm will not only add to the income of small farmers but would also increase soil fertility on sustainable basis. Emphasis should be given for further screening and classifying the common germplasm, especially for grain yield, quality and resistant to biotic and abiotic stresses.

References

Ahmad, N., M. Hatam and Amanullah. 2000. Yield potential of cowpea germplasm collected from FATA and neglected pockets of NWFP. *Sarhad J. Agric*., 16: 7-11.

Amanullah. 2010. Common bean (*Phaseolus vulgaris* L.): The unexploited but the potential food legume crop in the Northern Khyber Pakhtunkhwa-Pakistan. CreateSpace, NY.

Amanullah and M. Hatam. 2000. Correlation between grain yield and agronomic parameters in mung bean. *Pak. J. of Bio. Sci.,* 3: 1242-1244.

Amanullah and M. Hatam. 2000. Forage potential of three promising cowpea germplasm at different cutting stages. *Sarhad J. of Agric*., 16: 131-134.

Amanullah and M. Hatam. 2000. Grain yield potential of lentils germplasm. *Pak. J. of Bio. Sci*., 3: 1553-1555.

Amanullah and M. Hatam. 2000. Performance and distinguishing characters of promising cowpea germplasm. *Sarhad J. of Agric*., 16: 365-375.

Amanullah and M. Hatam. 2000. Performance and distinguishing characters of promising mung bean germplasm. *Sarhad J. of Agric*., 16: 259-268.

Amanullah and M. Hatam. 2000. Performance and distinguishing characters of promising black bean germplasm. *Sarhad J. of Agric*., 16: 467-476.

Amanullah and M. Hatam. 2000. Performance and nodulation efficiency of soybean cultivars. *Pak. J. of Bio. Sciences*, 3(10): 1822-1823.

Amanullah and M. Hatam. 2000. Yield potential of black bean germplasm. *Pak. J. of Bio. Sci*., 3: 1571-1573.

Amanullah and M. Hatam. 2000. Yield potential of cowpea germplasm. *Pak. J. of Bio. Sci.,* 3: 858-861.

Amanullah and M. Hatam. 2001. Correlation between grain yield and agronomic parameters in black bean. *Sarhad J. of Agric*., 17: 317-320.

Amanullah and M. Hatam. 2001. Evaluation of chickpea germplasm under Peshawar Valley conditions. *Sarhad J. of Agric*., 17: 311-315.

Amanullah and M. Hatam. 2001. Grain yield potential of garden pea germplasm. *On Line. J. of Bio. Sci.,* 1: 242-244.

Amanullah and M. Hatam. 2001. Performance of vegetable soybean germplasm under Peshawar Valley conditions. *Sarhad J. of Agric*., 17(1): 27-31.

Amanullah and M. Hatam. 2001. Performance of vegetable soybean germplasm under Peshawar Valley conditions. *Sarhad J. of Agric*., 17: 27-31.

Amanullah, A.A. Khan, K. Nawab and Q. Suhail. 2006. Performance of common bean germplasm at Kalam-Swat. *Pak. J. of Bio. Sci*., 9: 2642-2646.

Hakim K., M. Bashir and Amanullah. 2005. Evaluation of mid-season soybean varieties at Mansehra. *Sarhad J. of Agric*., 21(4): 531-533.

Hakim K., M. Bashir and Amanullah. 2005. Performance of full-season soybean varieties at Mansehra. *Sarhad J. of Agric*., 21(3): 327-329.

Hatam M and Amanullah. 2002. Grain yield potential of field pea germplasm. *Asian J. of Agric. Plant Sci.,* 1: 180-181.

Steel, R.G.D, J.H. Torrie and D. Dickey. 1996. *Principles and procedures of Statistics*, McGraw-Hill, USA.

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