

Assessment of Adaptation and Cultivation Methods of Three Local Varieties of Bean in Kabul Climatic Conditions

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Abstract: Pulses are essential for fulfilling basic human and animal needs, such as food, fodder, fiber, and energy. The main challenges of agriculture in Afghanistan are improper management, institutional policies and strategies problems, lack of researches activities, lack of funding and continuous war. Cereals and pulses are widely recognized the important elements in national economy, gross domestic product (GDP) as well as food security. The main objectives of this research were to compare the yield, yield components, morphological and agronomical characters of three types of local beans under Kabul climatic conditions. In this research three local beans with different cultivation methods (using fence and maize as stand and without stand) were studied. Based on the results, all varieties were adapted in Kabul climatic conditions but *Watany Beyara Dar* and *Capsuly 45 Roza* showed well adaptation and performed high yield than the others. *Capsuly 45 Roza* is a good choice for farmers with short growth period and high yield capacity. The farmers can cultivate it twice a year. Using stick or iron bars as stand for bean plants plays a useful role in increasing of the yield, which has been used in this research and the results were significant.

Keywords: Agriculture, Pluses, Sustainable Development, Bean, Stand

1. Introduction

Phaseolus vulgaris, the common bean (also known as the string bean, field bean, flageolet bean, French bean, garden bean, green bean, haricot bean, pop bean, or snap bean), is a herbaceous annual plant grown worldwide for its edible dry seed. The major producers in the world are: Brazil, India, China, Mexico, Myanmar, and United States (6). Its leaf is also occasionally used as a vegetable and the straw as fodder. Its botanical classification, along with other *Phaseolus* species, is as a member of the legume family Fabaceae, most of its members acquire the nitrogen they require through an association with rhizobia, a species of nitrogen-fixing bacteria (13).

In terms of its nutrition components, dry edible beans are nutrient-rich foods; they contain a variety of vitamins, minerals and other nutrients while providing a moderate amount of calories. Beans provide protein, fiber, folate, iron, potassium and magnesium while containing little or no total fat, trans-fat, sodium and cholesterol. Because of their high concentration of health-promoting nutrients, consuming more beans in the American diet could improve overall health and also decrease the risk of developing certain diseases, including heart disease, obesity and many types of cancers. The 2010 Dietary Guidelines for Americans recommend consuming 1.5 cups of beans per week to take advantage of these potential health benefits (1, 3).

Statistics for dry bean production are vague. Figures for the biggest producers and consumers in developing countries are underestimated because beans are often intercropped and/ or grown in remote areas (8). As a result, data are often imprecise. Political disturbances or war sometimes makes statistical analysis difficult or impossible to perform as in the case of Kenya, Rwanda, and Eastern Europe. Illegal

trading also occurs across various borders (7).

The major problems of this country are food in-security, poverty, malnutrition and low yield. As bean is a major crop in Afghanistan's agriculture and plays a vital role in its economy, that's why the research about bean was conducted to make clear the adaptation and yield comparison of certain varieties and then recommend to farmers (10). Maize – Legume intercropping system are one of the best organic practices that insure high production per unit area while averting the monoculture problem (12).

It should be mentioned that there is a great effort in Egypt to extend the cultivation of common bean by increasing the biological yield and the cultivated area by approximately 20% every year. Common bean is the second most important commercial legume crop after soybean (11).

The highest significant maize yield (9 t ha⁻¹) was obtained when common bean was planted with BH661 simultaneously followed by 20 days after BH546 planting (2, 8, 9).

The objectives of this research were to study the overall yield of these three local varieties of bean in climatic conditions of Kabul, to study morphological characteristics, to study agronomic characteristics and effect of cultivation methods on Beans yield

Based on background study the expectable result will be higher yield and the adaptation of 45 Roza bean than other varieties.

2. Materials and Methods

The research was conducted in the research form of faculty

of Agriculture Kabul University Afghanistan in areas of 612m² on 10-May-2016. In this research we used three Afghan local bean cultivars, namely {Capsuly 45 Roza, Watany Beyara Dar (Dawendah), Nejrabi Kapisa} and one Afghan local corn variety of (Zard Kohistan Kapisa) this corn variety is not part of our research, it's only to fill the blank spaces in the field.

The experiment design was a Randomized Complete Block Design (RCBD) with three replications. Four treatments [NS (planting without fence), P&S (Planting using fence), Bean & Bean (Planting together) and Bean & Corn (Planting along with Corn)] were applied. Each replication was consisted of 16 plots, totally were 48 plots and area of each sub-plot was arranged 3x4= 12m².

The amount of 375 kg ha⁻¹ of DAP and 250 kg⁻¹ of urea fertilizer were applied in bean field by using a basic fertilizing machine. The amount of all DAP was applied at the time of cultivation and urea was applied during at 4 leaf stag of bean and for corn it was applied in 2 stages (8 and 12 leaf) stages. The fertilizer was applied 7cm away from seed and 5cm in deep than the seed level.

Bean and corn seed were treatment of Vitawax Thiram a wetttable powder fungicide. Research field was irrigated two days before planting and the seeds were planted in 5cm depth and 20cm of space in ~60% of soil moisture on 10-May-2016.

Among 16 plots in each replication, each cultivar was planted in four plots [using fence, without fence, with another bean and along with corn randomly]. Based on necessity, irrigation was applied once a week and weeds were controlled by mechanical way with hoe, knife and other metal equipment in to 3 times. After harvesting of 45 Roza bean variety in a proper time, than the mentioned verity was cultivated again. The measurement parameters included plant height, number of leaf, length of leaf, leaf width, number of pod per plant, length of pods, number of grains per pod and 100 grain weight. SPSS was used for statistical analysis of the data (5).

3. Results and Discussions

Agronomic and morphological analysis

After 6 days of planting the seeds were germinated and the data were recorded (Figure 1). According to the first sampling, the plant's height minimum, average and maximum, Number of leaves, Leaves width and leaves length were measured. Based on the results the height of

beans cultivars was ranged from 21.7cm – 25 cm, which Nejrabi Kapisa cultivar exhibited the tallest height and Watani Beyara Dar performed the shortest plant height (Tab 1). Capsuly 45 Roza was produced the largest number of leaves then the others. The widest and longest leaves were performed in Existing of high number of leaf in 45 Roza bean variety in this stage representative a good plant growth as well as the length and width of leaf is one of distinguish characteristics in Beyara Dar variety.



Figure 1: Germinated seed plot

Table 1: Measurement of agronomic traits

L. length (cm)	L. width (cm)		P. height (cm)		Varieties
8	11	56	30	Max	Capsuly 45 Roza
5	6	33	23.6	Ave	
2	1	11	9	Min	
10	7.5	41	28	Max	Watany Beyara Dar
8.2	6.2	32	21.7	Ave	
6.5	5	24	15.5	Min	
11	8	38	33	Max	Nejrabi Kapisa
6.5	4.5	31	25	Ave	
2	1	24	17	Min	
62	8	10	58	Max	Zard Kohistan
33.5	4.45	8	45.25	Ave	
5	0.9	7	28	Min	

Three parameters were considered in Capsuly 45 Roza that was including Number of pods per plant, length of each pod in cm and Number of seeds per pod (Fig. 2). The lengthiest and furthest pod was observed at NS treatment in above variety then others but, number of grains per pod was higher in P&S tenements. Based on calculated data, there were no significant differences among treatments in the mentioned variety. The reason depend on shortage of plant height after flowering, rather generate strong pod. Therefore, cultivation methods were not effects on yield production.

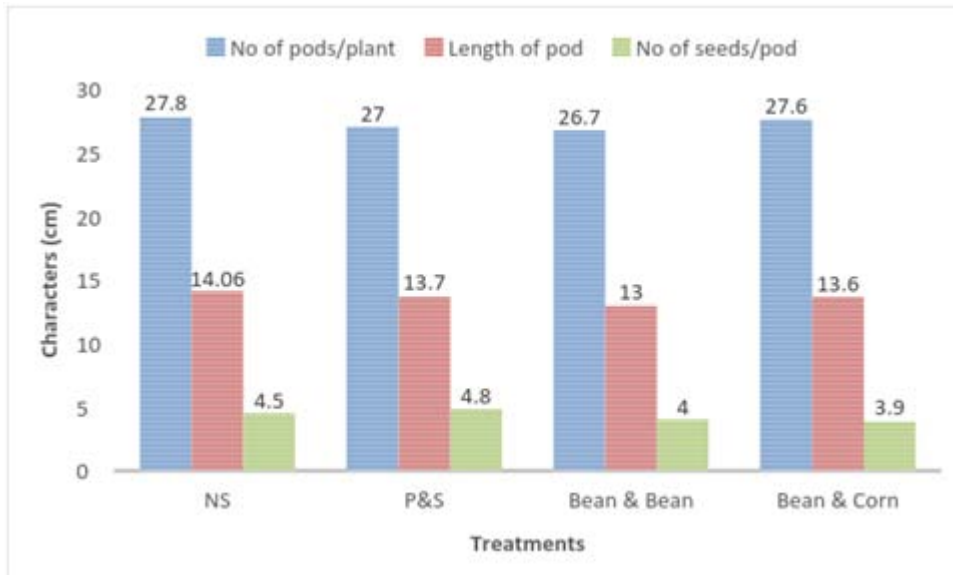


Figure 2: Comparison of three characters in four treatments of Beyara Dar cultivar with different planting methods

According to the results, Beyara Dar cultivar in Bean and Corn treatments exhibited much more number of pods per plant than the other two varieties. Because of agronomical characteristics of the mentioned variety that assisted with a stick for a better growth resulted in a longer pod, less number of seeds per pod due to large number of pods per plant. The NS treatment was produced less pods per plant, large number of seeds per pod. Therefore there is no correlation among pods per plant, seeds per pod and yield as well.

length of pod was shorter than Capsuly 45 Roza (Fig.3). There was no significant difference in grains number per plant.

In Beyara Dar cultivar result has shown large number of pods per plant and shorter pod length than the others, number of pods per plant was ranged from 46.7 to 64.6 but

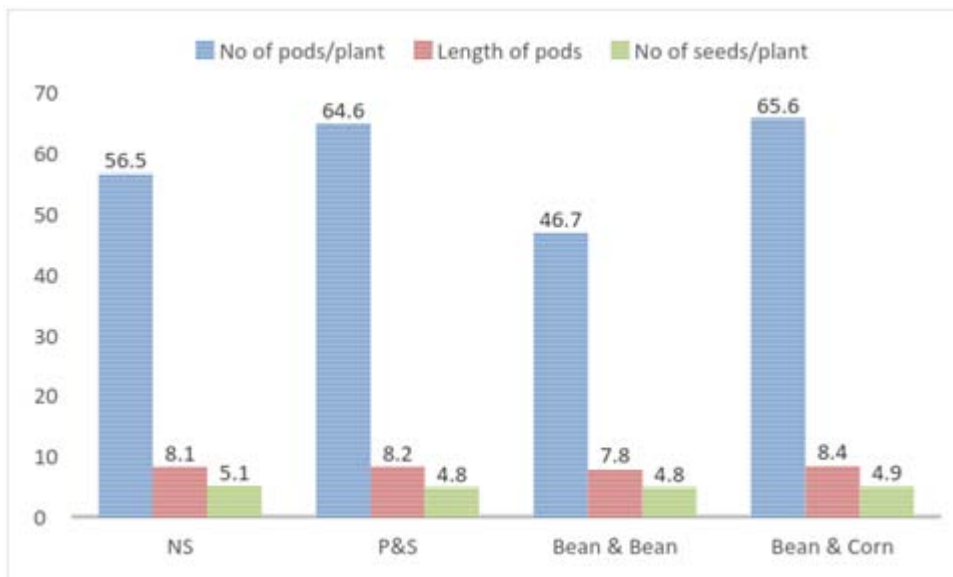


Figure 3: Comparison of three characters in four treatments of Beyara Dar cultivar with different planting methods

After analyzing data, there was no significant difference among treatments in Nejrabi Kapisa cultivar but the number of pods per plant in Bean & Corn treatments were exceed

than the others as well as number of seeds per pod in Bean & Corn was rather. Generally the planting methods were not affected on planting methods in Nejrabi cultivar (Fig. 4).

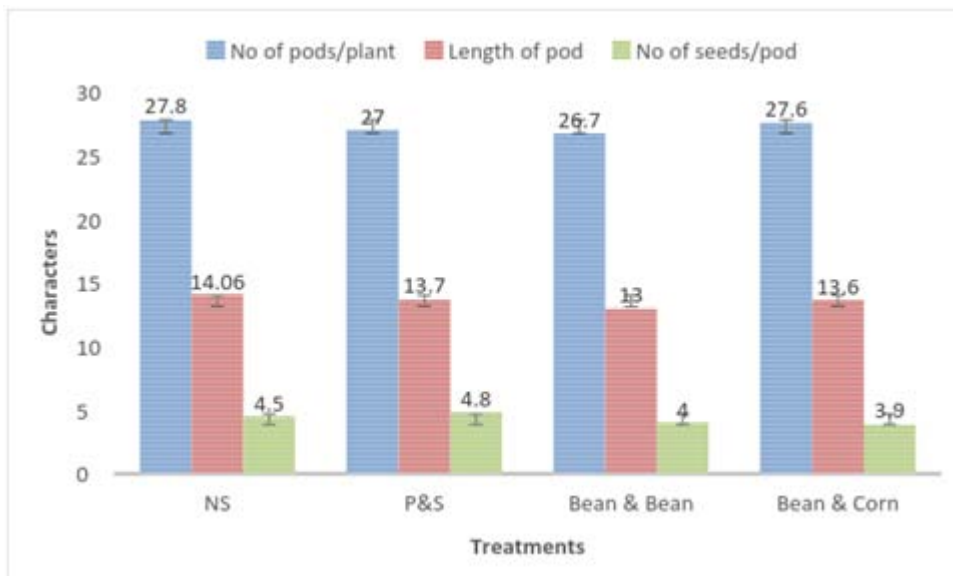


Figure 4: Comparison of three characters in four treatments of Beyara Dar cultivar with different planting methods

According to 100 grain weight of these varieties, Nejrabi Kapisa cultivar exhibited the heavy 100 grain amongst the other varieties and Watany Beyara Dar variety performed light (-weight) 100 grain among varieties (Fig. 5). Likewise the number and length of pod was rather in Negrabi Kapisa cultivar but it is mentionable that yield of 45 Roza cultivar must be higher than others because of short time growth period of 45 Roza cultivar. In other words, lead farmers of Kapisa province indicate that the suitable temperature (18-22°C) during planting date of the foregoing cultivar, but in this experiment during planting time, the temperature was over than 22°C. therefore, the second chance for completing growing season become less, the yield of next cultivation was not significant (Fig.4). Afghan local varieties of bean have bright color, smooth grains, high protein, tasty and short period of cooking. Morphological structures of Afghan local beans along with their agronomic features are shown in figure 6.



Figure 6: Grain, pod and leaf structures of local bean varieties of Afghanistan

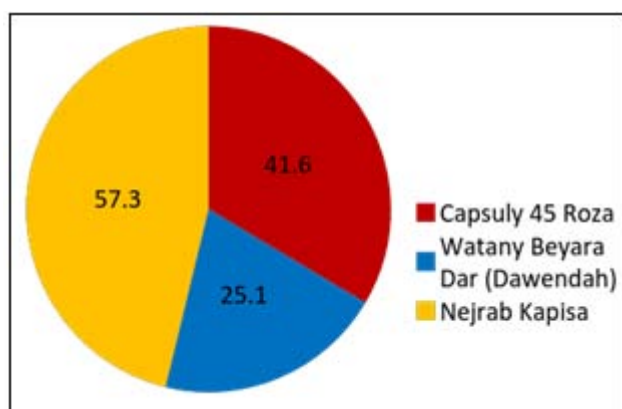


Figure 5: 100 grains weight of Afghan local bean varieties.

Based on analysis of variances, there was no significant differences of yield among blocks at 5 and 1 percent levels, but there was significant differences among treatments at 5 and 1 % levels (Tab 2). According to results, we can conclude that application of different methods of cultivation affected on yield of local varieties of bean using corn as a stand for bean is useful for increasing of yield and it can see that this treatment performed the highest yield among all treatments and lowest yield obtained from cultivation without stand or fence. Therefore standing method is fruitful to increase the yield of bean in Afghanistan. Coefficient of Variance (CV) has also been calculated, the results showed the smallest CV, which indicate the preciseness of this research. Low CV shows that this research has been performed accurately and there was no big error.

Table 2: Analysis of variance (ANOVA) of yield

S.V	df	S.S	M.S	F.Calculate	F. table	
					5%	1%
Total	(n-1)= 47	1024				
Block	(r-1)=2	0.18	0.090	1.2	3.32	5.39
Treatment	(t-1)=15	7.94	0.530	7.57**	1.89	2.47
Error	30	2.12	0.070			

S.V: Source of variation, df: Degree of freedom, S.S: Sum of squares, M.S: Mean of Squares

$$CV = \frac{\sqrt{\text{Error MS}}}{\text{Grand Mean}} \times 100 = \frac{\sqrt{0.07}}{13.67} \times 100 = 1.93.$$

Treatments comparison using Least Significance Difference Test (L.S.D)

The results of LSD test were indicated that there were differences among varieties in yield capacity using different cultivation methods (Tab 3).

df error=30 R=3 MS error=0.07

$$LSD = t_{\infty 5\%} \times sd = 2.04 = 2.04 \times \frac{\sqrt{2(0.07)}}{3} = 2.04 \times 0.21 = 0.44kg.$$

$$LSD = t_{\infty 1\%} \times sd = 2.75 \times 0.21 = 0.59kg$$

Table 3: Least Significant Test (LSD) for variety comparison

P&S	Bean & Bean	NS	Bean & Corn	Treatments:
2.34 ^d	2.96 ^c	2.99 ^b	3.63 ^a	Mean:

4. Conclusion

Among the three bean varieties that were used in this research, all of them were adapted to Kabul climatic conditions, but Watany Beyara Dar and Capsuly 45 roza were well adapted to Kabul climatic conditions and their yield was considerably different. Capsuly 45 roza for its short maturity, high yield and twice yielding a year is recognized a desirable variety and is recommended for farmers. This variety can be planted twice in a growing season under Kabul agro-ecological conditions. It is worth mentioning sticks support to the bean varieties is useful during the growing season, because it helps the bean varieties not to lodge.

Considering this, we can conclude that the results of the research carried out in Kabul climatic conditions was quite similar to the research conducted in Michigan.

In summary, the results show that varieties without a stand support produced lower yield in comparison to those cultivated with stands. Therefore, we recommend that beans being planted in the field should be provided with a stand support for expecting higher yield.

5. Acknowledgment

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Author Profile

Farid Ahmad Sherzai received Diploma in 1979 from Charqala High School, Kabul, Afghanistan. He did B.S and M.S. in year 1982 and 1985 respectively from Tashkend Agriculture University, Uzbekistan with specialization in Genetics and Plant Breeding. In 1986 he serves as Assistant Professor in Department of Biotechnology Kabul University, Afghanistan. In 1996 served as English Instructor, Care International, Kabul, Afghanistan. He has been serving as English Instructor in ICRC, UNDP, ZOA, ATVI, Kabul, Afghanistan in 2005, 1994, 2003 and 2007 respectively. Farid Ahmad Sherzai is proficient in speaking, reading and writing Persian(Dari), Pashto and English

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Prof. Dr. Wakil Ahmad Sarhadi s/o Hi Mohammad was born in Andarab district of Baghlan province in 1347. He completed Qasan-e- Andarab elementary school and received his baccalaureate from Agriculture High School in Baghlan province. After passing the entrance exam, and due to high interest and enthusiasm in agriculture field, he got admission to agriculture faculty of Kabul University. After the completion of four-year study and receiving BSc degree in excellent grade, he has been accepted as an assistant professor in the Department of Agronomy of Agriculture Faculty at Kabul University. In addition, he was farm research manager in the research farm of Agriculture Faculty from 1372 to 1376. He was selected as the head of agronomy department in an open selection in 1382. For further education up to Master and PhD degrees, he went to Japan and successfully completed the mentioned programs in 1387. He returned to his home country after obtaining of Master and PhD degrees and continued the sacred profession of being a professor at Kabul University. Prof. Dr. Sarhadi has membership of Society of Plant Breeding Science, Society of Agronomists, and Crop Science Society. Prof. Dr. Sarhadi has more than 50 scientific publications in national and international languages in national and international journals. He has been appointed as the dean of Agriculture Faculty in 1392. Currently, he is the dean of the faculty and an active professor of agronomy department in Agriculture Faculty of Kabul University. Prof. Dr. Sarhadi speaks in five different languages Dari, Pashto, English, Japanese, and Arabic