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Evaluation of Common Bean [*Phaseolus Vulgaris (*L.)] Varieties, for Yield and Yield Components

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Abstract
A field experiment was conducted on research field of Jinka Agricultural Center in South Omo Zone of Southern Ethiopia using thirteen improved common bean (Phaseolus vulgaris (L.)) varieties and one local check were used under rain fed condition in 2008. The objective of the study was to select the best performing common bean varieties that will increase productivity and production of common in the target areas. The treatments involved were thirteen improved varieties of common bean (Dark Red Kidney (DRK) Bean, Omo-95, Awash-1, Granscope, Roba, Argene, Chore, Ebaya, Awash Melka, Dinkinesh, SNNPR-1-20, Melka Dima and Nasir) and local check. The experiment was carried out using a randomized complete block design /RCBD/ with three replications at Jinka in 2008. The result of analysis of variance showed that both of the phenological parameters studied were significantly affected by varieties. In this study, there were significant variations observed among the common bean varieties for all the yield and yield components except number of seeds per pod. Grain yield advantages of 66.11%, 60.53%, and 55.55%, were obtained from the improved varieties Dinkinesh, SNNPR-1-20, Ebaya and Awash-1, respectively over the local check in this study. The effect of varieties on grain yield was significant and the best performing varieties of common bean namely Dinkinesh (2.1478 t ha^{-1}) and SNNPR-1-20 (1.9511 t ha^{-1}) would be recommended for the specific community and its vicinity even though further study should be carried out including a number of recently released varieties for improved common bean production.
Keywords: Common Bean, Phenological Parameters, Yield Components, Varieties, Yield

1. Introduction

The common bean (*Phaseolus vulgaris* L.) is the most important food legume in the world [1]. It is the most important food legume in Latin America and East and Southern Africa. Common bean is a traditional crop of the neotropics, where it was domesticated several thousand years ago [2]. Though the total world production of the common bean could not be calculated with certainty due to confusion with other legumes in some of the data, but estimated between 11 and 12 million tons [3]. The total common bean production in sub-Saharan Africa is around 3.5 metric tons with 62% of production in East African countries of Burundi, DR Congo, Ethiopia, Kenya, Rwanda, Tanzania and Uganda, making this the most important region for the crop within the African continent [4]. The East African highlands are a region of important common bean production and high varietal diversity for the crop [5].

Common bean is the most important grain legume for human consumption [6]. Given that most protein consumed by the poor is from plant sources, being protein-rich, beans play an especially significant role in the human diet. Although far less important than cereals as a source of calories, beans of supply a significant proportion of carbohydrates [7]. Like other legumes, they are also a key source of minerals; especially iron [8]. Common bean is an important income source; its straw serves as feed for livestock, and also improves soil fertility by its virtue of nitrogen fixation in the cropping system. Although the potential yield of beans is as high as 5 tons ha^{-1} [9].

In Ethiopia, generally legumes are the major sources of protein where common bean accounts for the largest proportion next to faba bean and field pea [10, 11]. It is one of the major grain legumes widely cultivated and grown as source of protein and cash by smallholder farmers by the smallholder farmers in the Southern Ethiopia [12]. Even if its production is concentrated at low land areas; but the extent of production of common bean in the target area especially in South Omo Zone is with the use of farmers' variety rather than the improved varieties so far. The lack of the improved varieties of common bean is the bottle neck problem that aggravates for the lower yield of the common bean in the study area. The lack of improved varieties is one of the top problems for low yield of common bean [13]. Therefore, there is need to introduce the improved common bean varieties to the target area is paramount important to come up with improved productivity and production of common bean in the study area. To this end, this research is initiated with the objective of selecting the best performing common bean varieties in the study area.

2. Materials and Methods

2.1. The Treatments, the Study Area and Experimental Design

The experiment was conducted at research farm of Jinka Agricultural Research Center located 729 kms South West of the capital Addis Ababa at E 36^0 33' 02.7" Longitude and N 05^0 46' 52.0" Latitude and at an altitude of 1383 meters above sea level. The long term weather data for the center revealed that the maximum and minimum

monthly average temperature of the main center is 27.55 ^{0}C and 16.55^{0}C, respectively; whereas, the maximum and minimum monthly average temperature of the growing period was 26.61^{0}C and 16.94^{0}C, respectively. The long term rainfall data for the area revealed that the mean annual rainfall of the area is 1274.67 mm; while the mean monthly rainfall of the area for the growing season was 130.38 mm. The experiment was conducted during (April to July, 2008) under rain fed condition.

2.2. Treatments and Experimental Design

The treatments involved were thirteen improved varieties of common bean (Dark Red Kidney (DRK) Bean, Omo-95, Awash-1, Granscope, Roba, Argene, Chore, Ebaya, Awash Melka, Dinkinesh, SNNPR-1-20, Melka Dima and Nasir) and the local check. The experiment consisted of 14 treatments with a total of 42 plots. The field experiment was laid out in a randomized complete block design (RCBD) with three replications. Common bean was sown on April 8, 2008 in twelve rows per plot with spacing of 40 cm between rows and 10 cm between plants within a row with gross plot area of 24 m^2.

2.3. Data collection

Phenological Parameters

Phenological parameters such as days to flowering and days to maturity were recorded. Days to flowering was recorded by counting the number of days after emergence when 50% of the plants per plot had the first open flower. Days to maturity was recorded when 90% of pods matured per plot.

Grain Yield and Yield Components

Six central rows were harvested for determination of grain yield. Grain yield was adjusted to 12.5% moisture content. Five plants were randomly selected from the six central rows to determine yield and yield components, which consisted of number of pods per plant and number of seeds per pod. Pod number per plant was determined by counting pods of the five randomly selected plants while number of seeds per pod was recorded by counting the total number of seeds in a pod from ten randomly sampled pods taken from the five randomly selected plants. Seed weight was determined by taking a random sample of 1000 seeds and adjusted them to 12.5% moisture content.

2.4. Statistical Analysis

All the agronomic data were recorded and being subjected to analysis using the SAS statistical software [14]. The analysis of variance was also performed using the GLM procedure of SAS Statistical Software [14]. Effects were considered significant in all statistical calculations if the P-values were $\leq$ 0.05. Means were separated using Fisher's Least Significant Difference (LSD) test.

3. Results and Discussion

The result of analysis of variance depicted that, days to flowering and days to maturity were significantly ($P < 0.001$) affected due to varieties (Table 1). This indicates that there exists a linear response of the studied phenological parameters to varieties.

The result of analysis of variance for mean squares revealed that, number of pods per plant was significantly ($P < 0.05$) affected by varieties (Table 1). The maximum and minimum number of pods plant^{-1} of (24.00) and (8.333) were noted for the varieties Dinkinesh and Melka Dima, respectively (Table 2). In this study, number of seeds pod^{-1} was not significantly affected due to varieties (Table 1). The maximum and minimum number of seeds pod^{-1} of (6.4) and (4.6) were noted for the varieties Dinkinesh and Dark Red Kidney /DRK/ bean, respectively (Table 2). From the above findings, it could be concluded that the maximum number of pods per plant and the highest number of seeds per pod resulted in the maximum grain yield of (2.1478 t ha^{-1}) for the common bean variety Dinkinesh.

In this experiment, grain yield of common bean was significantly ($P < 0.01$) affected by varieties (Table 1). This finding agrees with the previous findings reported [12].

The highest grain yield of (2.1478 t ha^{-1}) was recorded for the variety Dinkinesh and the least grain yield of (0.7278 t ha^{-1}) was noted for the local check (Table 2). The grain yield advantages of 66.11%, 60.53%, and 56.55% were obtained from the improved varieties Dinkinesh, SNNPR-1-20, Ebaya and Awash-1, respectively over the local check in this study.

Table 1: Mean Square Values for Crop Phenology, Yield and Yield Components of Common Bean as Influenced by Variety at Jinka, in 2008.

Source	DF	Days to Flowering	Days to Maturity	Pods (Plant^{-1})	Seeds (Pod^{-1})	Grain Yield (t ha^{-1})
Replication (R)	2	5.167ns	22.167^{ns}	136.580**	9.060**	0.053^{ns}
Variety (Var.)	13	79.634***	161.569***	49.165*	0.569^{ns}	0.3930**
Error a	26	6.397	8.679	17.183	1.0579	0.1469

*, ** and *** indicate significance at P< 0.05, P< 0.01 and P< 0.001, respectively and 'ns' indicate non significant

Table 2: Crop Phenology, Yield and Yield Components of Common Bean as Affected by Variety at Jinka, in 2008.

Treatments	Days Flowering	toDays to Maturity	Pods (Plant^{-1})	Seeds (Pod^{-1})	Grain Yield (t ha^{-1})
Variety (Var.)					
DARK RED KIDNEY BEAN (DRK)	54.333b	92.00bcde	11.40bc	4.6000a	1.3716d
OMO-95	48.00cd	97.00b	11.067bc	5.0667a	1.2736bcd
AWASH-1	50.00bc	94.00bcde	14.933bc	5.2667a	1.6753abc
GRANSCOPE	50.00bc	95.333bcd	14.600bc	5.5333a	1.0638cd
ROBA	50.00bc	95.333bcd	11.867bc	5.6000a	1.4104abcd
ARGENE	45.00de	92.333bcde	16.800ab	5.5333a	1.4744abc
CHORE	44.00de	90.333cde	13.133bc	5.5333a	1.5536abc
EBAYA	46.00cde	94.000bcde	17.133ab	5.3333a	1.8440ab
AWASH MELKA	50.00bc	96.000bc	14.267bc	5.2667a	1.2444bcd
DINKINESH	43.00e	91.667bcde	24.000a	6.4000a	2.1478a
SNNPR-1-20	44.00de	92.333bcde	10.400bc	5.9333a	1.9511ab
MELKA DIMA	43.00e	90.000de	8.333c	5.0667a	1.4042abcd
NASIR	43.00e	89.000e	10.133bc	5.6000a	1.4931abc
LOCAL CHECK	61.00a	119.000a	9.733bc	5.8667a	0.7278d
LSD 0.05	**4.25**	**4.94**	**6.95**	**NS**	**0.64**
CV%	**5.27**	**3.11**	**30.90**	**18.79**	**26.01**

Note: Means with the same letters within the columns are not significantly different at P <0.05.

4. Summary and Conclusion

Production of common bean by introducing the improved and high yielding varieties could make an important contribution to increase agricultural production and productivity in areas like Jinka where there is low practice of using improved varieties of common bean. To this end, using the improved common varieties could be one of the alternatives to improve productivity by small farmers. However, production of common bean using the improved varieties is not yet introduced and studied in the target area. Thus, this research work is initiated to investigate the impact of improved varieties on the performance of common bean.

Study on variety was conducted at Jinka under rain fed condition in 2008. The objective of the study was to select the best performing varieties that will improve common production. The experiment was carried out using the randomized complete block design (RCBD) with three replications at Jinka in 2008. Treatments involved in this experiment were thirteen improved common bean varieties and one local check.

The result of analysis of variance showed that both of the phenological parameters studied were significantly affected by varieties. In this study, there were significant variations observed among the common bean varieties for all the yield and yield components except number of seeds per pod. The effect of varieties on grain yield was significant and the best performing varieties of common bean namely Dinkinesh (2.1478 t ha^{-1}) or SNNPR-1-20 (1.9511 t ha^{-1}) would be recommended for the specific community and its vicinity even though further study should be carried out including a number of recently released varieties for improved common bean production in the target area and also to put the recommendation on strong basis.

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