Adaptation of Mungbean Genotypes under Irrigation Production at Kobo District, North Wollo

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Abstract

Mungbean (Vigna radiata) has been grown in India since ancient times. It is still widely grown in Southeast Asia, Africa, South America and Australia. Mungbean is a warm season annual crop requiring 90-120 days of frost-free conditions from planting to maturity. It does best on fertile sandy loam soils with good internal drainage. In spite of its importance and merits mentioned above, Mungbean is not well-studied and known in Ethiopia especially in eastern Amhara under irrigation. Kobo woreda lies in warm temperature zone, it has hot to warm sub-moist agro-ecology. The objective of this study was to evaluate the adaptability and yield potential of different cultivated varieties and introduced mungbean genotypes under irrigation. The trial was conducted in RCB design with three replications in 2010 and 2011 irrigation seasons. The tested varieties/genotypes were N-26, VC6173-B-33, Kenya, Shewarobit local 1 and Shewarobit local 2. The result indicated that variety N-26 and Shewarobit local 2 had produced significantly higher yield of 1600 kg ha^{-1} and 1534 kg ha^{-1}, respectively. Moreover, they require short maturity period,65-70 days, than the others. In addition N-26 had shiny and bold seed which is an important quality criterion for export. It was slightly determinant in nature than the others which is suitable for mechanization and efficient utilization of labor. The overall performance of N-26 and Shewarobit local 2 was better than the other varieties. Therefore, these two varieties were recommended to be demonstrated and popularized under irrigation condition of Kobo and similar agro ecologies.

Key words: Mungbean, Vigna radiata, Kobo

Introduction

Endowed with varied agro ecological zones and diversified natural resources, Ethiopia has been known as the home land and domestication of several crop plants. Pulses have been cultivated and consumed in large quantities in Ethiopia for many years. As an jnqpsubou dpnqpofou pg dspq! qspevdujpo! jo! Fuijpqjb(t! tnbmmipmefst! bhsjdvmuvsf! pvmft! are providing an economic advantage to small farm holdings as an alternative source of protein, cash income, and food security. The crops have been used for many years in crop rotation practices. Some of them have also played an important role in the export sector generating foreign currency for the country. Although the availability of pulses have never been in surplus in the subsistence farming community, recently it is observed that the production and supply of some pulses is increasing due to increase in demand both in local and international markets (MOA, 2004). Mungbean is early maturing crop, which is also drought resistant. It has great potential for the semi-arid areas; due to its short growing cycle. Special features include high yield, good nutritive value, the earliness and drought resilient features, the reasonable cost of production and the ability to withstand striga without being parasitized.

Mung bean is widely adapted from 1000 1650 m a.s.l under low to medium rainfall conditions (350 750 mm). It is adapted to many areas of short length of growing period such as the Rift Valley, Kobo, Showarobit and other similar areas (Kidane *et al*, 2010). Since the crop is a recent introduction to Ethiopia, unlike other pulses, its consumption is not widespread. Moreover, despite a growing demand in the international market, there is also chronic supply gap in Ethiopia. However, although the production is low and recent, the export market have been grown slightly from 822 tons in 2001 to 1363 tons in 2002 (MOA, 2004)

Mungbean seeds are sprouted for fresh use or canned for shipment to restaurants. It constitutes a substantial portion of easily digestible protein (20-23%) of low flatulence in the cereal-based diet of a majority of people. Its sprouts are consumed as a common vegetable in many countries. Its composition includes 23.86-27% protein, 1.15% fat, 3.32% ash, 62.62% carbohydrates, 16.3% fiber, 6.60% total sugars, 9.05% water (Heather Maskus *et al*, 2010). In addition, mungbean is rich in vitamins A, B1, B2, and C, and niacin as well as minerals such as potassium and calcium, which are necessary for the human body. Because of their major use as sprouts, a high quality seed with excellent germination is required. Larger seed with a glassy, green color seems to be preferred.

Mungbean is a warm season annual crop requiring 90-120 days of frost-free conditions from planting to maturity. Adequate moisture is required from flowering to late pod fill in order to ensure good yield. If proper varieties are used Mungbean are adapted to the same climatic areas as soybean, dry bean and cowpea. Mungbean do best on fertile sandy, loam soils with good internal drainage. They do poorly on heavy clay soils with poor drainage. Performance is best on soils with a pH between 6.7 and 7.2 and plants (Oplinger *et al*, 1990). Mung bean productivity can range from 340 to over 2267.5 kg ha^{-1} (Oplinger *et al*, 1990). In spite of its importance and merits mentioned above, mungbean production was not well-studied and known in Ethiopia especially in eastern Amhara both under rainfed and irrigation conditions.

The low land areas of eastern Amhara fall in rift valley. These areas are characterized by moisture stress having high population pressure. These areas have high potential of pulse production in general and mung bean in particular. However, in the face of unreliable and inconsistent nature of rainfall, production of export or high value commodities like mung bean under irrigation provide multiple benefits. Farmers in Kobo produced three times in a year using rainfall and irrigation, from July to October, October to end of January and February to May, respectively. Hence, irrigation based mungbean production in this area can play vital roles to maintain soil fertility and crop rotation practices. However, given irrigation production potential and market access to the nearby regions, it had never reaped the opportunities of mungbean production, as it would suppose to be. Therefore, the objective of this study was to evaluate different Mungbean varieties or genotypes under irrigation to make mungbean familiar for the area and to increase crop diversity so as to increase the income of farmers.

Materials and Methods

Study area

The experiment was conducted at Kobo which is located 54 km from Woldia in the direction of north. Its altitude ranges from 1000 - 2800 m a.s.l and mean annual rainfall amount of 668 mm. It has an agro-ecology of hot to warm sub-moist valley and escarpment. Its mean daily temperature is usually greater than 21^{o}C. The agro-climatic feature of the woreda is inclined to be tropical with 7.9%, 37.2%, and 54.9% of it is *Dega*, *Woina Dega*, and *Kolla*, respectively (Girma and Samuael *et al*, 2000). Soil type is Euritic Fluvisol lying on low plain on valley floor enclosed by low but steep side hills and drains to rift valley river basin. The soils are deep to very deep, mostly alluvial origin, moderately well to imperfectly drained. The infiltration rate and permeability are low with high runoff generation potential. But due to flat topography it is less susceptible to erosion. The pH of the soil ranges from 6 to 7. The major crops grown in the area are Sorghum, *Teff*, and Maize (Getachew, 1993). The livelihood of the population is depending on mixed farming and crop production, with about 96% of its population engaged in agriculture. Due to various constraints, Kobo woreda is one of the food insecure woredas of the Amhara National Regional State.

Experimental Set up

The trial was conducted for two years during 2010 and 2011 irrigation seasons. Five Mungbean varieties/genotypes were evaluated in randomized complete block design with three replications for their adaptability and yield performance under irrigation. The materials were N-26, VC 6173-B-33, KENYA, Shewarobit local 1 and Shewarobit local 2. Shewarobit local 1 has deep green seed color, 65-75 days length of growing period and 55-65 cm plant length; and Shewarobit local 2 has light green seed color and 60- 70 days length of growing period. In addition, it has smaller seed size than Shewarobit local 1. The varieties/genotypes were planted with 40cm and 5cm between rows and plants, respectively on a plot size of 20m^2 (4m X5m). Data were collected for number of pods per plant, number of seeds per pod, biomass, 100 seed weight, seed yield, harvest index, days to flowering, days to maturity and plant height. The data were analyzed using GenStat 13th Edition (SP2) statistical software.

Results and Discussion

As it is presented in Table 1, results obtained during first year (2010) showed that there was significant difference in days to flower, number of pods per plant, number of seeds per pod, plant height and 100 seed weight. But there was no significant difference in biomass, seed yield and harvest index among the tested varieties. Even if there was no statistically significant difference in seed yield, N-26 and Shewarobit local 2 showed better performance than the other varieites. The varieties N-26 and Kenya produced the highest

(1332 kg ha^{-1}) and lowest yield (718 kg ha^{-1}) respectively. The respective days to maturity was 62 days and 69 days for variety N-26 and Shewarobit local 1. Nevertheless, the overall performance of N-26 and Shewarobit local 2 was better as compared to other varieties (Table 1). However, due to water scarcity and irrigation water management, the first year yield of all the tested varieties was low as compared to second year (Table 2).

Table 1: Means of Days to Flowering, Days to Maturity, Number of Pods Per Plant, Number of seeds Per pod, plant height, 100 Seed Weight, Biomass, Grain Yield and Harvest index of mungbean, 2010.

	Genotypes	DF (days)	DM (days)	NPP	NSP	PH (cm)	Ds	100 SW(g)	BM (g/plot)	GY (kg/ha)	HI
1	**N-26**	**44a**	**62**	**11a**	**9a**	**33.7c**	**1**	**6.1a**	**7814a**	**1332**	**27.3**
2	VC6173-B-33	44a	64	14b	7ab	27.0ab	1	6.4a	7980a	1197	23.9
3	Kenya	46a	66	8a	8ab	24.8a	1	6.7a	5251b	718	17.7
4	Shewarobit local 1	24a	69	20c	5ab	30.3bc	1	4.4b	7584ab	1011	20.9
5	Shewarobit local 2	**37b**	**67**	**15b**	**7a**	**24.8a**	**1**	**4.3b**	**7921a**	**1232**	**24.8**
	GM	39	66	14	7	28.1	1	5.6	7310	1098	22.9
	CV (%0	12.5	3.4	10.7	9.1	6.6	0	6.7	17.6	23.9	18.5
	DMRT(0.05)	*	NS	*	**	*	NS	**	NS	NS	NS

*** Significant at 0.01%, *significant at 0.05%, *** significance at < 0.001, DF=days to flowering, DM=days to maturity, NPP=number of pod per plant NSP=number of seed per pod, Ph= plant height (cm), Ds= disease score, SW=seed weight, BM= biomass, GY=Grain yield, GM=grand mean, DMRT= Duncan multiple range test, CV% =coefficient of variations*

In 2011, maximum yield was produced from variety N-26 (1867 kg ha^{-1}) and Shewarobit local 2 (1530 kg ha^{-1}), respectively. The lowest yield was recorded in variety Shewarobit local 1 (1167 kg ha^{-1}). There was significant difference among the varieties in seed yield, days to flower, days to maturity, plant height, 100 seed weight and harvest index. But there was no statistically significant difference in biomass yield and number of pod per plant among the varieties. The maximum and minimum days to flower was recorded in variety Shewarobit local 1 and Kenya, 57 days and 42 days, respectively. Variety Shewarobit local 1 showed maximum days to mature (97 days) and N-26 showed lowest days (65 days) to mature (Table 2).

The combined analysis showed that significant variation in seed yield was observed due to the main effects of year and genotype and the interaction effect of year by genotypes. The year by variety interaction in seed yield, days to flower, days to mature and plant height were significant (P<0.01). All the varieties performance in seed yield, plant height and other parameters increased during the second year (Table 3). The crop has indeterminate nature that is why the year by Genotype interaction for days to flower and maturity showed significant difference. Higher and lower yields were recorded in variety N-26 and Shewarobit local 2, 1600 and 1534 kg ha-1, respectively. N-26 and Kenya showed better performance in number of seed per plant (i.e., 9.5 and 8, respectively). Shewarobit local 1 was taller than the other varieties with a height of 51.6 cm. In two years period, there was no economical disease infection although halo blight was observed at the seedling stage. Frequent irrigation, hoeing, fertilization and other cultural practices were used to control insect pests. After the implementation of the above cultural practices the plant recovers from insect damages.

Table 2: Means of Days to Flowering, Days to Maturity, Number of Pods per Plant, Number of seeds Per pod, plant height, 100 Seed Weight, Biomass, Grain Yield and Harvest index of Mungbean, 2011.

Genotypes	**DF (days)**	**DM (days)**	**NPP**	**NSP**	**PH (cm)**	**Ds**	**100 SW(g)**	**BM (g/plot)**	**GY (kg/ha)**	**HI**
N-26	**48b**	**65c**	**19**	**9.7**	**44.b**	**1a**	**6.1bc**	**5722**	**1867a**	**31a**
VC6173-B-33	44d	70b	22	8.7	47.3b	2a	6.5ab	4777	1335bc	30.9a
Kenya	42e	71b	16	8.7	49b	1a	6.8a	6754	1366bc	22.7ab
Shewarobit local 1	57a	97a	24	10	73a	1a	5.5c	7507	1167c	16.5b
Shewarobit local 2	**46c**	**70b**	**26**	**7.7**	**45.6b**	**2.6a**	**3.9d**	**6957**	**1530b**	**26.8a**
GM	47.5	74.5	21.6	8.9	51.8	1.6	5.7	6343	1453	25.6
CV (%)	1.6	2.0	19.1	15.9	10.5	61.4	5.1	30.1	9.8	18.4
DMRT(0.05)	***	***	NS		***	NS	***	NS	*	*

*** Significant at 0.01%, *significant at 0.05%, *** significance at < 0.001, DF=days to flowering, DM=days to maturity, NPP=number of pod per plant NSP=number of seed per pod, Ph= plant height, Ds= disease score, SW=100 seed weight, BM= biomass, GY = grain yield in kilo gram per ha GM=grand mean, DMRT= Duncan multiple range test, CV% =coefficient of variations*

Table 3: Combined Means of Days to Flowering, Days to Maturity, Number of Pods Per Plant, Number of seeds Per pod, plant height, 100 Seed Weight, Biomass, Grain Yield and Harvest index of Mungbean, 2010 and 2011

Genotypes	DF	DM	NPP	NSP	PH (cm)	Ds	100 SW (g)	BM (g/plot)	GY (kg/ha)	HI
N-26	46a	63c	15bc	9.5a	39.0b	1	6.1b	5303	1600a	29.1a
VC6173-B-33	44ab	67b	18ab	7.8b	37.1b	1.5	6.5ab	4882	1383bc	28.3a
Kenya	44ab	68b	12c	8ab	36.9b	1	6.7 a	5018	1042d	26a
Shewarobit local 1	40b	83a	22a	7.7b	51.6a	1	5c	6124	1296c	23a
Shewarobit local 2	41ab	69b	20a	7b	35.2b	2	4d	5954	1534ab	28.9a
GM	43.13	70	17.5	8	40.0	1	5.680	5456	1371.	27.2
G	NS	***	*	*	***	NS	***	NS	***	NS
Y	*	**	*	*	**	NS	NS	*	*	NS
G XY	***	***	Ns	*	***	NS	*	NS	***	NS
CV (%)	8.1	2.7	19.8	13.7	10.4	53.3	5.9	26.9	10.5	30.5

*** Significant at 0.01%, *significant at 0.05%, *** significance at < 0.001, DF=days to flowering, DM=days to maturity, NPP=number of pod per plant NSP=number of seed per pod, Ph= plant height, Ds= disease score, SW=seed weight, BM= Biomass, GY = Grain yield in kilo gram per ha GM=grand mean, DMRT= Duncan multiple range test, CV% =coefficient of variations*

Conclusion and Recommendations

Five varieties were tested during irrigation season with the objective of evaluation and adaptation of different varieties/genotypes and introduced mungbean genotypes and to make the area productive in different crops and increase the income of the farmers. High yield, early maturity and disease tolerance were important criteria to select the varieties. N-26 and Shewarobit local 2 were found high yielder and early maturing. Moreover, N-26 was slightly determinant in nature than the others and it had shiny and bold seed which is important quality parameter for export. The determinant nature made it suitable for mechanization and efficient utilization of labor. Therefore, these two varieties were recommended to be demonstrated and popularized under irrigation condition of Kobo and similar agro ecologies. Further agronomic studies on mung bean under irrigation condition should be future focus towards the achievement of maximum yield potential of the varieties.

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