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Evaluation of Faba Bean Varieties Intercropped with Maize at South Achefer and Jabitenan Districts

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Abstract: The maize pulse intercropping participatory experiment was conducted using randomised complete block design with three replications on three selected farmers' fields for two years for the two districts of South Achefer and Jabitenan in 2014 and 2015 cropping seasons. The faba bean treatements were improved varieties i.e Wolki, Moti, Tumsa, Dosha, Gebelcho, Degaga, Holetta-2, and Obse. The maize variety was QPM 545. The tested intercrops were planted on a pot size of 19.125m^2 (5.1m *3.75m) with five rows of maize which are 75cm apart from each other and four rows of pulse in the middle of the maize rows, the spacing between the two adjacent bocks was 1m. For maize, recommended seed rate of 25kg/ha and fertilizer rate of 138/180kg/ha N P_2O_5 were used in the experiment. 100 kg DAP was used for the pulse crops. The performance of the tested intercrops on earliness, pod number, disease reaction, pod length and seed size were evaluated by farmers' research groups at flowering and maturity stage using pair wise ranking method. Grain yield was collected from three central rows of each plot for maize and two central rows for pulses. ANOVA and LSD were analyzed using SAS version 9.0. Based on their rank disease tolerance was the first followed by pod number and pod length respectively. Whereas, earliness was the least followed by seed size. Welki from faba bean varieties was their first choices for both Jabitenan and Achefer districts. There was a significance difference in mean grain yield for both crops maize and faba bean. Variety Welki scored the highest mean grain yield 1202kg/ha besides, the intercropped maize scored the highest mean grain yield 7587 kg/ha. Variety Welki from faba bean is recommended.

Keywords: Maize, Faba Bean, Intercropping, Participatory

1. Introduction

Intercropping as a method of sustainable agriculture is the simultaneous growing of two or more crops during the same season on the same area, which utilize common limiting resources better than the species grown separately as an efficient resource use method [5, 12]. Intercropping of cereals with legumes has been popular in humid tropical environments [13] and rain-fed areas of the world [4] due to its advantages for yield increment, weed control [11], insurance against crop failure, low cost of production and high monetary returns to the farmers [10], improvement of soil fertility through the addition of nitrogen by fixation and transferring from the legume to the cereal [5], improving yield stability, socio-economic and some other advantages [14]. Intercropping is the practice of growing more than one crop simultaneously in alternating rows of the same field [3]. Intercropping is therefore a type of mixed cropping. Many studies have confirmed the advantages of intercropping compared with mono cropping, which include higher total yield per unit land area, resulting in a land equivalent ratio (LER) > 1 [7-9]. Systems that intercrop maize with a legume are able to reduce the amount of nutrients taken from the soil as compared to a maize monocropped [1]. Increased diversity of the physical structure of plants in an intercropping system produces many benefits. Increased leaf cover in intercropping systems helps to reduce weed populations once the crops are established [3]. Having a variety of root systems in the soil reduces water loss, increases water uptake and increases transpiration. The increased transpiration may make the microclimate cooler, which, along with increased leaf cover, helps to cool the soil and reduce evaporation [6]. This is important during times of water stress, as intercropped plants use a larger percentage of available water from the field than

monocropped plants. Creating windbreaks may also modify the microclimate. Rows of maize in a field with a shorter crop will reduce the wind speed above the shorter crops and thus reduce desiccation [3]. Increased plant diversity in intercropped fields may reduce the impact of pest and disease outbreaks by providing more habitat for predatory insects and increasing the distance between plants of the same crop. Other ecological benefits of intercropping include less land needed for crop production, reduction of pesticide and herbicide use, and a reduction in soil erosion. Intercropping has several benefits to the farmer including a reduction in farm inputs, diversification of diet, addition of cash crops, increased labor utilization efficiency, and reduced risk of crop failure [2].

Therefore, the objective of the study was to select best performing faba bean variety which can best fit with the maize crop for intercropping for the areas of South Achefer and Jabitehnan.

2. Materials and Methods

In 2014 cropping season, both Jabitenan and South Achefer districts were selected among areas which commonly experience maize mono cropping agricultural systems. Then the experiment was conducted using randomised complete block design with three replications on three selected farmers' fields for two years for the two districts of South Achefer and Jabitenan in 2014 and 2015 cropping seasons. The faba bean treatements were improved varieties i.e Wolki, Moti, Tumsa, Dosha, Gebelcho, Degaga, Holetta-2, and Obse. All the pulse varieties were intercropped with improved variety of maize i.e. QPM 545. The tested intercrops were planted on a pot size of 19.125m^2 (5.1m*3.75m) with five rows of maize which are 75cm apart from each other and four rows of pulse in the middle of the maize rows, the spacing between the two adjacent bocks was 1m. For maize, recommended seed rate of 25kg/ha and fertilizer rate of 138/180kg/ha N P_2O_5 were used in the experiment. 100 kg DAP was used for the pulse crops. The whole amount of DAP was applied at planting while urea was split in to half at planting and the remaining half at the knee high stage. The performance of the tested intercrops on earliness, pod number, disease reaction, pod length and seed size were evaluated by farmers' research groups at flowering and maturity stage using pair wise ranking method. Grain yield was collected from three central rows of each plot for maize and two central rows for pulses. The data were subjected to analysis of variance (ANOVA) using SAS version 9.0 and the least significance differences among means were calculated to identify differences among treatments.

3. Results and Discussion

Participatory variety selection was done at maturity using participatory tool of pair wise ranking methods. A total of fifty farmers (male = 30 and female = 20) participated to evaluate and select improved faba bean varieties using participatory tool at both locations. Both male and female key informant farmers were randomly selected and participated regardless of their religion and wealth to determine the performance of the faba bean varieties. Male and female informants were assembled and they prioritized their selection criteria and jointly agreed on five characters (pod number, pod length, disease reaction, earliness and seed size) during the maturity stage (Table 1).

Table 1. *Pair-wise ranking of the criteria by farmers.*

Criteria	Earliness	Pod number	Disease tolerance	Pod length	Seed size	Total	Rank
Earliness	X	Pod number	Disease tolerance	Pod length	Seed size	0	5
Pod number		x	Disease tolerance	Pod number	Pod number	3	2
Disease tolerance			X	Disease tolerance	Disease tolerance	4	1
Pod length				x	Pod length	2	3
Seed size					x	1	4

Farmers identified their best selection criteria and carefully observed the entire experimental plots to select their fitness to the specific criteria. The assignments of ranks to each variety and traits were determined from the number of times each selection criterion was preferred by the group (Table 2). The ranking procedure was explained for farmer participants and then each selection criterion was ranked and scored on a scale of 1-5 (5 = Excellent, 4 = Very good, 3 = Good, 2 = Poor and 1 = Very poor) (Table 1). During the evaluation, all farmers have selected varieties with their trait of interest. All the selected characters were tabulated in a matrix scoring method and pair wise fashion was used to compare each selection criteria. The farmers' own selection criteria were analyzed using the pair-wise ranking matrix. The best adapting and performing faba bean Welki variety was identified based on a simple ranking score method (Tables 3).

Table 2. *Rank of total acceptance from farmers for faba bean.*

Criteria	Varieties							
	Holeta-2	Degaga	Gebelicho	Moti	Welki	Dosha	Tumsa	Obsie
Earliness	24 (7)	70 (2)	48 (4)	58 (3)	12 (8)	75 (1)	35 (5)	38 (6)
Pod number	25 (7)	80 (1)	75 (2)	58 (3)	37 (5)	32 (6)	42 (4)	913 (8)
Disease tolerance	16 (7)	73 (1)	65 (2)	57 (3)	14 (8)	35 (6)	45 (5)	55 (4)
Pod length	80 (1)	20 (7)	70 (2)	60 (3)	10 (8)	30 (6)	40 (5)	50 (4)
Seed size	58 (3)	68 (2)	30 (6)	20 (7)	10 (8)	40 (5)	54 (4)	80 (1)

Table 3. *Products of weights given to the criteria and ranks of the faba bean varieties.*

Variety	Criteria with their weights					Total	Rank
	Earliness (1)	Pod number (4)	Disease tolerance (5)	Pod length (3)	Seed size (2)		
Holeta-2	7	28	35	3	6	79	3
Degaga	2	4	5	21	4	36	8
Gebelcho	4	8	10	6	12	40	7
Moti	3	12	15	9	14	53	6
Wolkie	8	20	40	24	16	108	1
Dosha	1	24	30	18	10	83	2
Tumsa	5	16	25	15	8	69	5
Obse	6	32	20	12	2	72	4

The combined analysis of variance for grain yield in the maize faba been intercropping showed that there was a significance difference in mean grain yield for both crops maize and faba bean. Variety Welki scored the highest mean grain yield 1202kg/ha besides, the intercropped maize scored the highest mean grain yield 7587 kg/ha (Table 4).

Table 4. *Mean seed yield (kg/ha) and other agronomic characters of eight Faba bean varieties under intercropping with Maize var. BH QPY-545 in PVS trial combined over location and years.*

No	Variety	DFfb	Dmfb	PHfb	PPPfb	SPPfb	100SW fb	Yldm (kg/ha)	Yldfb (kg/ha)	Checo. Spt
1	Holeta-2	50	125	199	8.55	4	66	6858	1082	5.0
2	Degaga	47	125	207	8.25	4	50	6839	999	4.5
3	Gebelcho	52	125	190	8.25	3	62	6544	940	5.0
4	Moti	47	125	182	7.5	3	65	6507	865	4.25
5	Wolkie	49	128	168	8.92	4	65	7587	1202	4.5
6	Dosha	48	126	178	8.25	4	62	6539	1050	5.0
7	Tumsa	53	125	199	8.02	3	59	6972	735	5.0
8	Obse	46	128	196	6.65	4	64	7043	461	5.15
	Mean	49.0	125.9	189.9	8.0	3.6	61.6	6861.12	916.8	
	CV (%)	3.1	1.6	9.5	3.5	4.98	5.34	12	13.5	
	LSD 0.05	2.7**	-	-	0.35*	-	1.4*	250*	101**	

Note: DFfb = Days to flowering faba bean, Dmfb = Days to maturity faba bean, PHfb = Plant Height faba bean, PPPfb = pod per plant faba bean, SPPfb = seed per pod faba bean, 100SWfb = Hundred seed weight faba bean, Yldm = Yield of maize, Yldfb = Yield of faba bean, Checo. Spt = Checolate spot, CV = Coefficient of variation, LSD = Least Significant difference.

4. Conclusion and Recommendation

In the maize legume inter cropping Variety Welki from faba bean is recommended for South Achefer and Jabitenan areas for their significance difference in yield as well as for being the first choice in the farmers' preference.

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