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Seed Yielding of Faba Beans *(Vicia faba L)* Cultivars Grown in Southern Sudan Environment (Malakal Locality)

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Abstract: Field experiments were conducted in (2004\05 and 2005\06) growing seasons in the Main Campus Farm of Upper Nile University (Malakal), to investigate seed yielding ability of faba bean (*Vicia faba L*) cultivars, H-93, BB-7 and Sm-L, under the environment of Southern Sudan (Malakal condition). The layout followed was the randomized complete block design with three replications. The 90 plants from these faba bean cultivars were characterized for yield and yield –related components on replicated single plant basis. Significant simple correlations were obtained between seed yield and number of podded nodes, number of pods and number of seeds per plant. Data analysis indicated that total dry matter production, seed weight and number of pods per plant were important in determining yield structure in Malakal. Statistical interpretation showed that number of pods and total dry matter production adequately described yield potential of Malakal grown faba beans. H-93 and BB-7 cultivars had high correlations between primary yield traits and yield reflecting good prospect for substantial yield. Sm-L cultivar was not suitable since its large seed size required longer cooler growing season. Yield and yield related components values were very low because of short winter seasons of Southern Sudan.

Key words: Sees yielding, Faba bean, Cultivars, Environment

INTRODUCTION

Faba bean (*Vicia faba L*) are the most favorable food legume in Sudan [7,15] the crop occupies 60% of the total pulse crops acreage, followed by haricot beans, chickpeas and lentils[16] and 25% of the total legume production[5] in the Sudan.

Faba bean requires a cool season for best development. it is grown in a winter annual in wormer temperate and sup tropical areas; hardier cultivars in the Mediterranean regions tolerate winter temperatures of 10 C without serious injury, whereas the hardiest European cultivars can tolerate up to -15C[12]. It can be grown anywhere and does not winterkill. Suitable temperature requirement for growth ranges from 10 to 30C (Saxena,1982).Faba bean tolerates nearly any soil type, grows best on rich loams; requires adequate and sustained water supply[4,11].

In the Sudan, faba bean is grown in the Northern and Nile States, where temperature are relatively cooler and winter longer; winters are shorter and worm southwards[16]. Moderate moisture supply is essential, with highest requirement at about 9-12 weeks after establishment[4].

Among the yield components tested by Abu Salih [1] and Ageeb[2], yield was significantly correlated with the number of pods per plant. Seed weight and plant height were also important yield components for the realization of high yield[6,3]. Number of effective branches, podding nodes and strew weight were also important attributes of seed yield potential in faba bean [2,8].

Yield components studies in faba bean (*Vicia faba* L.) are quite recent, and share in common with the earlier studies in small grain cereals the contradictions and confusion regarding the use of yield components as selection criteria[10].

Yielding ability of a crop is a key element in crop productivity for an area, whereby agronomic performance of a variety can be as important as yield to a farmer. Factors limiting the use of available arable land such as length of growing season make it desirable to test cultivars as area checks for agro-ecological suitability. The importance of crop dictates the need to make the land useable through local research or through introduction of varieties developed elsewhere. This study investigates the seed yielding ability of faba bean varieties under Malakal environmental conditions to identify the seed yield related components that determine the yield structure.

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MATERIALS AND METHODS

Field experiments were carried out two consecutive seasons (2004\05 and 2005/06) in the Main Campus Farm of the Upper Nile University "Malakal". Malakal is located on Latitude 09 º 33" N and Longitude 32 º 39" E at altitude 390m. The climate is described as Savanna, with six months rainy season, from May to October. The cool Weather begins in November and ends in January, with average maximum temperature of 36.8oc and the mean minimum of 20 º c during the winter months and relative humidity of around 30 % (Table 1). The soil was sandy clay, with quite high permeability, apparent density 1.8g/cm2, pH 6.84.

Treatment consisted of three faba bean cultivars, namely, H-93, BB-7 and Sm-L. The seed material was obtained from Hudeiba Agricultural Research Station, El Damer. The layout followed was randomized complete block design with three replications. The land was ploughed, harrowed, leveled and ridged. Divided into nine plots each measuring 320x320cm. Ridge spacing of 80 cm apart.

First season (2004/05) sowing was on first day of November, irrigation interval was 7 days, and the second season (2005/06) planting was on 15 October with watering intervals of 3 days. Two seeds were sown per hole spacing of 15cm on a ridge. No insect pests control applied or fertilization during the first season. Top dressing with urea was applied 43 days after emergence when the crop showed leaves yellowing and bean aphids control with Malathion was done during the same period.

The following were measured for two consecutive seasons; plant high (cm), ten plants were randomly selected from each replicate and their high were measured from the tip to the ground level. Number of branches per plant, number of nodes per main stem, number of podded nodes per stem. After full maturity was attained, yield and yield components were recorded by harvesting the selected plants, and then number of pods per plant, number of seeds per pod, number of seed per plant were calculated. Total weight of the whole plant cut from the ground to determine the total dry matter. Threshing and weighting the seeds produced by a plant obtained seed yield per plant. 1000 seeds weight was recorded from the weight of 1000-seeds of bulked seeds cultivars plants sampled. Yield per hectare was obtained by threshing and weighting the seed of plot and get the mean of three.

Data generated was subjected to Statistical Package for Social Science (SPSS). Means were tested using two factors randomized complete block design, where factor A represents plants (10) and factor B represents varieties (3) and then mean separated using Dunkann s Multiple Range Test(DMRT) according to Steel and Torrie[18].

RESULTS AND DISCUSSION

Simple correlations among all yield related traits were calculated for 2004/05 and 2005/06 seasons data as presented in tables 2, 3 and 4.

Total dry matter production and seed yield For H-93 cultivar (Table 2)showed , the highest correlations (r=0.986) in 2004/05 season, but in 2005/06 response between total dry matter production and seed yield was negative (r= -0.440). In BB-7 cultivar (Table 3) total dry matter had strong relationship with yield (r=0.965 in season 2004/05and weak response(r=0.490) in 2005/06. while in Sm-L cultivar association between total dry matter production and yield was negative (r= -0.215) and (r= -0.084) in 2004/05 and 2005/06 respectively.

In H-93 cultivars, negative correlation between total dry matter production and seed yield in second might have been caused by excessive heat inhibition of flowering and the subsequent pod setting, while vegetative matter growth tolerated high temperature. Sm-L cultivar negative response between total dry matter production and yield in both seasons reflecting the failure of the cultivar to exploit the environment. This variety suits the long cool winter of Northern State[13].

1000- seed weight had the highest association with yield for H-93 cultivar, (Table2) in 2005/06 season (r =0.897), following positive relationship (r= 0.467) for the previous season (2004/05).in BB-7 cultivar (Table 3) and Sm-L cultivar (Table 4) 1000-seed weight and yield showed the highest association (r =1.000)in 2005/06 for both cultivars. But in the first season for the Sm-L cultivar it indicated negative trend (r = -0.644)

High responsiveness noticed between 1000-seed weight and yield in season 2005/06 season might resulted from longer growing season, might have allowed adequate time for manufacture and translocation of photoseynthate portioned to the seeds, while short growing period of the previous season (2004/05) might have deprived the seeds of assimilates deposition as the crop went into senescence early. Sm-L cultivar showed negative trend because its large seed could not attain its size.

Number of pods per plant and yield reviled high association in two seasons for the three cultivars, H-93, BB-7 and Sm-L, (r=0.881 and r=0.595, r=0.822 and r=0.579, r=0.629 and r=0.863) respectively (Table, 2, 3 and 4). Pods number per plant and seed yield had high and consistent correlation in both season, the trait would therefore, be valued as selection criterion for genotypes. Many workers[6,8] reported the primary role of the number of pods per plant in yield determination.

Number of seeds per pod was highly correlated with seed yield in both seasons for, BB-7, (r=0.666 and r=0. 649) respectively (Table2), while in two cultivars H-93 and Sm-L showed weak correlation (r=0.018 and 0.053) and (r= 0.306 and 0.215) in 2004/05 and 2005/06(Table 1 and 3). The positive correlation of number of seeds per pod with yield in both seasons indicated that the environment did not significantly affect the trait. It is relatively a stable character;[8].

For the three cultivars the podded nodes showed positive correlation with yield. It is high (r=0.881) in H-93, (r= 0.822) in BB-7 and (r=0.694) in Sm-L in 2004/06 .but the correlation is decline in the second season which is (r=0.454, r=0.439 and r=0.442 accordingly to the above cultivars. podded nodes per plant and yield were highly responsive in the first season, while in the second season association between the traits went low, possibly, due to increased stem length, while flower induction diminished following temperature rise.

Plant high and seed weight was weak in (r=0.303) in 2004/05 and (r=0.224) in 2005/06, for H-39 cultivar. Also similar relation was showed (r=0.519) in the first season, and (r=0.291) in the second season for Sm-L cultivar. Moreover for BB-7 cultivar plant height indicated positive response with yield (r=0.589) in 2004/05 and showed negative trend (r=-0.037) in 2005/06. Plant height association with yield was important. Stem length low value with seed yield reflected unfavorable growth condition at some stages of the growing period; where plants produce short internodes, and some plants may have failed to develop nodes capable of producing flowers. Effect of plant height on yield potential is indirect[6,9].

Number of branches per plant had positive response with yield (r=0.365) in 2004/05 and negative association (r=-0.080) in 2005/06 for H-93 cultivar. When in BB-7 cultivar this trait showed weak correlation with yield (r=0.119 and r=0.230) respectively in two seasons. But for Sm-L cultivar relationship was negative (r=-0.253 and r=-0.374) in the two seasons. As a general correlations between branches number and yield were very low for both H-93 and BB-7 and Sm-L showed negative response in both seasons, all the indication was that the number of branches did not contribute to yield.

Table 1: Metrological data for Malakal for two experimenting seasons(SMA2004/05-2005/06).

Month	Temperature (°C) Mean max		Main min		Mean daily		Relative humidity (%)		Rainfall (mm)	
	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06
October	34.9	34.4	23.0	22.4	28.95	28.4	73	75	45.6	85.1
November	37.0	36.2	21.7	19.4	29.95	27.8	51	49	TR	0
December	36.3	38.1	20.2	19.3	28.25	28.7	30	36	0	0
January	35.7	38.0	19.1	20.5	27.4	29.25	21	30	0	0
February	41.1	39.8	23.2	19.6	32.15	29.7	21	22	0	0
Mean	37.0	37.3	21.44	20.24	29.22	28.77				

Table 2: Simple correlations among yield – related trait season 2004/05(above), 2005/06 (down) (H-93 variety)

Parameters	Seed yield	Seed/ plant	Seeds/ pots	Pods/ plant	Podded nodes/ Plant	nodes/ plant	Plant high (cm)	Stalks/ Plant	Total dry matter	1000-seeds wt (gm)
Seed yield (gm)/plant		0.958 0.816	0.018 0.053	0.881 0.595	0.881 0.454	0.239 0.330	0.303 0.224	0.365 -0.030	0.986 -0.440	0.467 0.897
Seeds/plant			0.019 0.471	0.951 0.593	0.915 0.656	0.430 0.694	0.489 0.443	0.299 0.006	0.931 -0.128	0.345 0.894
Seeds/plots				-0.359 -0.032	-0.359 0.352	-0.135 0.460	0.207 0.370	-0.401 -0.203	-0.087 0.164	-0.621 0.843
Pods/plant					1.000 0.638	0.410 0.512	0.365 0.490	0.456 0.487	0.900 -0.247	0.577 0.802

Table 2: Continue

Podded nodes/plant	0.416	0.363	0.456	0.900	0.517
	0.634	0.784	0.557	-0.398	0.527
nodes/plant		0.857	-0.273	0.153	0.617
		0.599	0.454	-0.054	-0.098
Plant high (cm)			-0.487	0.178	-0.299
			0.411	-0.329	0.673
Stalks/plant				0.498	0.419
				-0.246	-.0.201
Total dry matter					0.161
					0.970

Table 3: Simple correlations among yield – related trait season 2004/05(above), 2005/06 (down) (BB-7 variety)

parameters	Seed yield	Seed/ Plant	Seeds/ pots	Pods/ Plant	Podded nodes/ Plant	nodes/ plant	Plant high (cm)	Stalks/ plant	Total dry matter	1000-seeds wt (gm)
Seed yield		0.980	0.666	0.822	0.822	0.519	0.589	0.119	0.965	0.249
(gm)/plant		-0.034	0.649	0.579	0.439	-0.794	-0.387	0.230	0.490	1.000
Seeds/plant			0.898	0.898	0.898	0.589	0.630	0.194	0.954	0.670
			0.433	0.433	0.126	0.007	-0.433	0.211	0.132	1.000
Seeds/plots				0.272	0.272	0.298	0.457	-0.113	0.712	-0.869
				-0.221	-0.226	-0.786	-0.048	-0.206	0.582	0.921
Pods/plant					1.000	0.542	0.577	0.166	0.795	0.340
					0.808	-0.221	-0.484	0.483	0.052	0.685
Podded nodes/plant						0.542	0.577	0.166	0.795	0.340
						-0.013	-0.167	0.445	0.072	0.985
nodes/plant							0.571	0.392	0.462	0.000
							-0.439	0.017	-0.413	-0.999
Plant high (cm)								0.723	0.521	0.832
								0.136	0.023	0.024
Stalks/plant									0.001	0.000
									-0.041	-.0.276
Total dry matter										-0.646
										0.851

Table 4: Simple correlations among yield – related trait season 2004/05(above), 2005/06 (down) (Sm-L variety)

parameters	Seed yield	Seed/ plant	Seeds/ pots	Pods/ plant	Podded nodes/ Plant	nodes/ plant	Plant high (cm)	Stalks/ plant	Total dry matter	1000-seeds wt (gm)
Seed yield (gm)/plant		0.698	0.306	0.629	0.694	0.317	0.519	-0.253	-0.215	-0.644
		1.000	0.434	0.863	0.442	0.663	0.291	-0.374	-0.084	1.000
Seeds/plant			0.774	0.727	0.783	0.534	0.763	-0.300	-0.607	0.000
			0.434	0.862	0.442	0.663	0.292	-0.373	-0.083	1.000
Seeds/plots				0.246	0.302	0.503	0.561	-0.059	-0.550	1.000
				-0.046	-0.493	0.053	0.254	-0.327	-0.002	0.824
Pods/plant					0.965	0.191	0.460	-0.296	-0.554	0.102
					0.791	0.748	0.059	-0.171	-0.175	0.974
Podded nodes/plant						0.294	0.536	-0.221	-0.661	-0.636
						0.484	-0.187	-0.186	-0.511	0.989
nodes/plant							0.858	0.283	-0.145	0.878
							-0.011	0.000	-0.035	0.954

Table 4: Continue

Plant high (cm)	-0.025	-0.254	0.431
	-0.567	0.237	-0.090
Stalks/plant		0.186	-0.853
		0.517	-.0.689
Total dry matter			0.540
			0.832

Number of seeds per plant had high correlation with yield in the first season for the three cultivars; H-93, BB-7 and Sm-L, (r= 0.958, r= 0.980 and r=0.629) respectively (Tables, 2,3and 4). However in the second season the correlation was high in H-93(r =0.816) and negative for BB-7(r= - 0.034).the number of seeds per plant and yield strong relation expressed in all the cultivars may have resulted from high correlation between number of pods per plant and yield; and association between number seeds per pod and yield and may be varietals behavior.

Conclusion:

Under dry weather cropping as in Malakal, high levels of total dry matter production and number of pods per plant are the two characters required to achieve stable yield.

Commercial faba bean production may not feasible in Malakal area in the near future, given the short growing season and lack of suitable cultivars for the environment.

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