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Comparative on Yield and its Components Performance and Correlation in Some Broad Bean (*Vicia faba* L.) Genotypes at Bakrajo, Sulaimani

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Abstract: During 2013/4 and 2014/5 winter seasons at the research field of Agricultural Technical Institute of Bakrajo, affiliate to the Sulaimania Polytechnic University. Field experiments were carried out to select the most successful Broad bean genotypes which are most common in the Kurdistan region. The investigation was done with aim of searching the relationships between morphological characters and yield of broad bean plant. Randomized complete block design (RCBD), in split-split plot arrangement, with three replications was applied. Results of this study summarized of the two seasons as follow; the analysis of variance showed significant differences for majority of the studied characters and the results of mean comparing of traits are shown in between majority genotypes significant difference exists. The Australi genotypes presented maximum values for the seed yield than other genotype. Correlation analysis for traits in 2013/4 showed that statistically significant and positive correlations were obtained between seed yield, number of branches per plant (r = 0.573), the number of pods per plant (r = 0.561*) and 100 seed weight (r = 0.62**). However, in 2014/5 showed that statistically significant and positive correlations were obtained between seed yield, 100 seeds weight (r = 0.56*) and the number of branches per plant (r = 0.558*).

Key words: Broad bean · Yield components · Genotypes · Correlation

INTRODUCTION

Broad bean (*Vicia faba* L.) is the most important annual pulse crops grown in the Middle East Mediterranean areas for many years under the name of 'broad bean'. Like peas, faba beans have become an important protein crop known as 'field bean' Modern cultivars are grown in Australia, Canada and European countries, while landraces are still grown in many countries [1] and they are cultivated mainly in England, China provides half of the 4.3 million tons produced worldwide [2, 3]. Wide variation of protein content (20-41%) has been reported. When spring and winter Broad beans are compared, winter beans have slightly higher concentrations of protein than the latter [3]. The nutritional value of Broad bean is high and in some areas is considered to be superior to peas or other grain legumes. Broad bean is a considerable source of energy: 344 Kcal/100 g and can efficiently replace animal protein in poor countries. It is a significant source of protein rich food in developing countries and is used both as a human food and a feed for pigs, horses, poultry and pigeons in industrialized countries [4] and for available nitrogen in the biosphere. Its critical role in crop rotation, reducing energy cost, improving soil physical conditions and decreasing the amount of diseases and weed populations has long been recognized [5, 6, 7]. It has been clearly established that time of planting, is a major factor affecting Broad bean yield and its components [8]. Planting broad bean genotypes earlier on October gave higher number of pods/plant, seed yield than November [3, 9 and 10]. Rabie (1991) recommended the end of October as the best date for producing the highest seed yield and quality average compared with the latest dates [11]. Broad bean (*Vicia faba* L.) is grown in a variety of environments in latitudes ranging from 50° N to 40° S and

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altitudes from 0 to 3000 m a.s.l [12]. Broad bean requires 20-25°C average daily temperatures for a proper growth and higher temperatures leads to fall of flowers and fruits [13]. Broad bean is a cool-season grain legume and can resist to certain levels of low temperatures. Low temperature tolerance levels are between -6°C and -12°C. Several local landraces from North of Kurdistan Region in Iraq, Syria and Lebanon survived repeated sub-zero temperatures, including exposure to one night at -11°C [14]. Rainfall of 650-1000 mm per annum evenly distributed is ideal. The maturity period ranges from 90 -220 days depending upon the cultivars and climatic conditions [15]. They are many problems facing broad bean productions in Kurdistan Region (North of Iraq), to solve all those problems, alternative plant types have been selected and developed, for example, plants with determinate growth habit [16]. The present study was conducted to evaluate and select Broad bean varieties for high yield and other agronomic traits in two successive seasons.

MATERIALS AND METHODS

Four imported and one local varieties of Broad bean were obtained from Sulaimani Agriculture Research Center (SARC) and were grown in a varietal trail at the Field Crops Experiment Station, Bakrajo Technical Agriculture Institute, affiliate to the Sulaimani Polytechnic University (SPU). Experiment was conducted during the two seasons (2013-2014) and (2014-2015) under the rainfall region. The study site is located at an altitude of 731 meter above of mean sea level [17], about 7 Km North West of Sulaimani City. The soil of Bakrajo Agricultural Technical Institute belongs to (Clay Loam). Soil physical and chemical analyses are shown in Table 1. The distance between lines was 0.4 m, the plot area was 2*3 m (6 m^2) and the seeds were sown in the autumn season in booth growing seasons. The purpose of the experiment is a comparison of four genotypes of Broad bean (Australi, Saher, Sivihia and Zaina).The experiment was laid out according to randomize complete block design with three replications, each plot consist of 4 rows of 3 meter length by 0.4 m spacing between rows. Sowing was done by hand drilling, the experiment was carried out under the same conditions in the two seasons such as the soil preparation, plowing, hoeing, weeds control by herbicides and the proportion of rainfall fairly close in two seasons 635.8 mm in 2013-2014 and 659.8 in 2014-2015 [18]. Agronomic characteristics were including plant height, number of branches per plant, number of pods per plant, number of seeds per plant, days to 50% flowering, days to maturity, 100 seeds weight and seed yield [19]. Data were recorded on 10 competitive plants of each plot and seed yield (kg /h) was calculated for the entire plot. Data analysis was done by using SPSS for analysis of variance & compare means by Duncan and correlation coefficient analysis [20].

Table 1: Soil Physical and Chemical Analysis

Properties	2013/4	2014/5
EC dsm^{-1}	0.33	0.36
pH	7.13	7.09
%N	0.30	0.28
Available P(ppm)	26.9	28.1
Soluble K+ Meq/L	0.224	0.229
Soluble K+ Meq/L	0.360	0.387
%Sand	12.07	14.23
%Silt	44.17	42.09
%Clay	41.17	43.16

RESULTS AND DISCUSSION

Analysis of Variance: Result of analysis of variance Tables 2, 3 showed that there was significant difference among different genotypes in broad bean in the majority of traits. This indicated effect these genotypes for improved morphological traits. The data showed that all growth parameters increased gradually by using these genotypes.

Compare Means

Plant Height: The results of mean comparing of traits are shown in Tables 4, 5 between majority genotypes significant differences exist. The data recorded in Tables 4, 6 showed that plant height increased across the broad bean genotypes; there were some significant differences in the plant heights. The minimum plant height was recorded in the Saher genotype 60.6 cm (Table 4). The minimum plant height was recorded in the Zaina genotype 58.7 cm (Table 5). The maximum plant height was recorded in Australi genotype. The mean difference is statistically significant in the case of genotypes broad bean treatment, compared to in all other genotypes Tables 4, 5, 6.

Number of Branches per Plant: Mean comparing of the number of branches Tables 4, 5 showed that between majority genotypes significant difference were exists. In the Table 5 minimum numbers of branches per plant was recorded in the Saher genotype and maximum number of branches per plant was recorded in Australli genotype. The mean difference is statistically significant in the case of genotypes broad bean treatment, compared to in all other genotypes Tables 4, 5, 6.

Table 2: Analysis of variance (RCBD) for studied traits (2013-2014)

		MS							
S.O.V	df	Plant height / cm	Number of branches / plant	Number of pods / plant	Number of seeds / pod	Days to 50% flowering	Maturity (day)	100 Seeds weight (g)	Seed yield (kg/ha)
Replication	2	4.968	.180	.701	.555	3.009	5.137	21.880	2790.333
Treatment	3	46.274*	4.171**	4.379*	1.868*	6.967*	21.052	123.63**	37645.317**
Error	6	11.587	0.017	.980	.302	1.886	7.177	11.59	2824.667

Table 3: Analysis of variance (RCBD) for studied traits (2014-2015)

		MS							
S.O.V	df	Plant height / cm	Number of branches / plant	Number of pods / plant	Number of seeds / pod	Days to 50% flowering	Maturity (day)	100 Seeds weight (g)	Seed yield (kg/ha)
Replication	2	12.948	.524	.173	.164	.164	50.067	23.64	37064
Treatment	4	58.872*	3.873*	5.027*	2.352**	2.352	80.767*	372.796*	75606.109**
Error	8	9.372	.577	.510	.229	.229	21.067	80.111	2034.159

Table 4: Mean comparing in broad bean genotypes (2013-2014)

	Traits							
Genotypes	Plant height / cm	Number of branches / plant	Number of pods / plant	Number of seeds / pod	Days to 50% flowering	Maturity (day)	100 Seeds weight (g)	Seed yield (kg/ha)
Australli	70.96b	7.83c	10.76b	5.30b	108.33b	172.66ab	156.33b	2018.43b
Saher	60.60a	5.16a	7.70a	4.76ab	106.33ab	174.66ab	142.00a	1833.33a
Sivihia	64.03a	6.31b	9.36ab	3.90a	107.00ab	176.0a	143.00a	1787.66a
Zaina	64.13a	5.03a	10.06b	3.76a	105.00a	170.00b	148.2a	1992.00b

Table 5: Mean comparing in broad bean genotypes in (2014-2015)

	Traits							
Genotypes	Plant height / cm	Number of branches / plant	Number of pods / plant	Number of seeds / pod	Days to 50% flowering	Maturity (day)	100 Seeds weight (g)	Seed yield (kg/ha)
Australli	70.70c	7.40c	10.26c	5.56c	103.33a	170.00a	154.00c	2104.33b
Saher	61.43ab	4.66a	6.93a	4.50b	106.33a	173.33ab	142.66a	1776.66a
Sivihia	65.2bc	6.28b	8.93b	3.26a	106.36a	175.66b	146.00b	1782.66a
Zaina	58.70a	5.20ab	8.73b	4.46b	105.00a	183.00c	146.7.0b	2011.66b

Table 6: Mean comparing in broad bean genotypes in (2013-2014) & (2014-2015)

	Traits							
Genotypes	Plant height / cm	Number of branches / plant	Number of pods / plant	Number of seeds / pod	Days to 50% flowering	Maturity (day)	100 Seeds weight (g)	Seed yield (kg/ha)
Australli	70.83c	7.61b	10.51b	5.43c	105.83a	171.33a	155.16c	2059.33c
Saher	60.68a	.4.60a	7.31a	4.63bc	105.00a	174.00b	142.33b	1805.00a
Sivihia	64.61ab	6.90b	9.15b	3.58a	106.83a	175.83b	144.50bc	1785.166a
Zaina	61.41a	5.10a	9.40b	4.11ab	105.00a	176.50b	147.45a	2001.83b

Number of Pods per Plant: The results of mean comparing of traits are shown in Tables 4, 5. Between different genotype significant difference were exist. The data recorded in Tablse 4, 5 showed that number of pods per plant was increased at all genotypes. There were significant differences in the number of pod per plant. The minimum number of pods per plant was recorded in the Saher genotype while the maximum was recorded in the Australi genotype. The mean difference is statistically significant in the case of genotypes broad bean treatment, compared to in all other genotypes Tables 4, 5, 6.

Number of Seeds per Plant: Mean comparing of the number of seeds per plant Tables 4, 5 showed that between all genotypes significant differences were exists. The minimum number of seeds per plant was recorded in the Zaina genotype, while the maximum was recorded in Australi genotype. From T able 5, the minimum number of seeds per plant was recorded in the Sivihia genotype and maximum number of seeds per plant was recorded in Australli genotype. The mean difference is statistically significant in the case of genotypes broad bean treatment, compared to in all other genotypes Tables 4, 5, 6.

Days to 50% Flowering: Mean comparing of the Days to 50% flowering (Table 4) showed between some genotypes significant difference were exists. The minimum days to 50% flowering was recorded in the Zaina genotype while the maximum was recorded in Australi genotype. In Tables 5, 6 showed between some genotypes no significant differences were exists.

Table 7: Mean comparing in broad bean genotypes in 2013-2014

	Traits							
Genotypes	Plant height / cm	Number of branches / plant	Number of pods / plant	Number of seeds / pod	Days to 50% flowering	Maturity (day)	100 Seeds weight (g)	Seed yield (kg/ha)
Plant height / cm	1							
Number of branches / plant	.67**	1						
Number of pods / plant	.73**	.46	1					
Number of seed s/ pod	.22	.52*	-.93	1				
Days to 50% flowering	.637**	.63**	.060	.35	1			
Maturity (day)	-.28	-.081	-.34	.046	.021	1		
100 seeds weight (g)	.788**	.694**	.429	.661**	.412	.079	1	
Seed yield (kg/ha)	.375	.573*	.561*	.49	-..06	-.472	.62**	1

Table 8: Mean comparing in broad bean genotypes in 2014-2015

	Traits							
Genotypes	Plant height / cm	Number of branches / plant	Number of pods / plant	Number of seeds / pod	Days to 50% flowering	Maturity (day)	100 Seeds weight (g)	Seed yield (kg/ha)
Plant height / cm	1							
Number of branches / plant	.713* *	1						
Number of pods / plant	.62*	.631	1					
Number of seed s/ pod	.26	.33	.274	1				
Days to 50% flowering	-.25	-.54	-.161	-.502	1			
Maturity (day)	-.611	-.388	-.169	-.30	-.06	1		
100 seeds weight (g)	.80**	.59*	.165	.076	-.12	.80**	1	
Seed yield (kg/ha)	.357	.558*	.663**	.650**	.003	.031	.56*	1

Days to Maturity: The results of mean comparing of traits are shown in Tables 4, 5 showed that between genotypes significant difference were exists. The data presented in Table 4 showed that days to maturity increased across the broad bean genotypes. The minimum days to maturity was recorded in the Zaina genotype while the maximum days to maturity was recorded in Sivihia genotype. In the time as showed in the Table 5, minimum days to maturity were recorded in the Australli genotype while the maximum days to maturity was recorded in Zaina genotype. The mean difference is statistically significant in the case of genotypes broad bean treatment, compared to in all other genotypes Tables 4, 5, 6.

100 Seeds Weight: Mean comparing of the 100 seed weight Tables 4, 5 showed that between genotypes significant difference were exists. The data presented in Table 4 showed that 100 seeds weight increased across the broad bean genotypes. There were significant differences in the 100 seeds weight. The minimum 100 seed weight was recorded in the Saher genotype while the maximum was recorded in Australi genotype. The mean difference is statistically significant in the case of genotypes broad bean treatment, compared to in all other genotypes Tables 4, 5, 6.

Seed Yield: Mean comparing of the seed yield Tables 4, 5 showed that between genotypes significant difference were exists. The data presented in Tables 4, 5 showed that seed yield increased across the broad bean genotypes. There were significant differences in the seed yield. The minimum seed yield was recorded in the Saher genotype while the maximum was recorded in Australli genotype. The mean difference is statistically significant in the case of genotypes broad bean treatment, compared to in all other genotypes Tables 4, 5, 6.

Correlation Analysis: To determine association between studied traits we calculated coefficient of correlation. Studied in 2013-2014 years showed Table 7 that seed yield was in the strongest relation with number of branches per plant (r = 0.573*). After this traits the number of pods per plant (r = 0.561*) and 100 seed weight (r = 0.62*) showed the most correlation with seed yield. Increasing number of branches per plant and number of pods per plant caused increase majority traits according highest correlation this trait with other traits. The highest positive correlation were observed between plant height and number of branches per plant (r = 0.67**) and the number of pods per plant (r = 0.73**). Significantly positive correlations were also observed for plant height, number of pods per plant, number of seeds per pod and days to 50% flowering; however, negative correlation was also found among certain characters in the present study. Studied in 2014-2015 years showed Table 8 that seed yield was in the strongest relation with 100 seeds weight (r = 0.563*). After this traits the number of branches per plant (r = 0.558*), number of pods per plant, number of seeds per pod showed the most correlation with seed yield Table 8. Increasing number of branches per plant and number of

pods per plant caused increase majority traits according highest correlation this trait with other traits. The highest positive correlation were observed between number of pods per plant and number of branches per plant (r = 0.713**) as well as number of seeds per pod (0. 650**) significantly positive correlations were also observed for plant height, number of pods per plant and 100 seeds weight. The plant height was positively correlated with seed yield. Plant height positively correlated with total plant yield. The heights values of genotypic and phenotypic variation suggestd that there is good scope for yield improvement through selection for pods per plant, seeds per pod and yield per plant [21, 22].

CONCLUSION

According to this study the traits 100 seeds weight, number of branches per plant and pod per plant were positively correlated.

From present results it can be concluded that the compare means showed between genotypes minimum seed yield was recorded in the Saher genotype while the maximum was presented in Australli genotype. Depending on this conclusion it can be recommended that Australli genotype the most suitable verities for cultivation in Bakrajo. In addition, these correlations should be considered in breeding program. It could be concluded that the high yielding genotypes, such as Australli could be used to improve faba bean genotypes [22]. Moreover, the traits that exhibited strong and positive association with seed yield could be used as selection criteria for improving faba bean. These correlations should be further studied and should be considered for an improvement program [23, 24 and 25].

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