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Variability and Interrelations of Grain Yield and Its Components in Lablab Beans (Lablab purpureus L.)

A.E.S. IBRAHIM (1), R.S. MODAWI (2), AND A.A. AHMED (2)

1. Faculty of Agric. Sciences, United Arab Emirates University, Al-Ain,UAE.
2. Faculty of Agric. Sciences, Gezira University, Medani, Sudan.

ABSTRACT

The present investigation was undertaken to study the phenotypic variability of grain yield and its components as well as the interrelationships among these components in six cultivars of lablab beans (Lablab purpureus L.) . The cultivars took a longer time period (99-137 days) to flower when sown in July compared to September sowing (59-85 days) . In both seasons the early and late flowering cultivars were Highworth and Brazilian, respectively. The grain yield components displayed a wide range of phenotypic variability and showed significant variation among the cultivars. The grain yield range of the cultivars was 0.61-1.45 t/ha in 1983 and 1.20-2.40 t/ha in 1984 with Highworth and Local III as highest and lowest yielding cultivars, respectively. Cultivars crude protein content range was 19.1-29.7 % and their range for oil content was 1.00-1.45%. Grain yield, weight of pods, number of pods, number of fruiting branches, 100-seed weight, plant height, plant fresh and dry weights were significantly affected by season, cultivar and cultivar x season interaction. Grain yield was positively and significantly correlated with weight of pods, number of pods, number of fruiting branches, plant height and fresh and dry weights of the plant. Such traits could be used as selection criteria for increased grain and / or forage yield.

Key Words: Cultivars, Grain yield, Interrelations, Lablab purpureus L., Variability .

INTRODUCTION

Lablab purpureus (L.) Sweet, known as Egyptian bean , lablab bean,bonavist bean or hyacinth bean (Hendricksen and Minson, 1985) is a useful grain legume (Purseglove, 1968), a rotational crop (Ishag, 1965), a forage crop (Schaaffhausen, 1963) and a cover crop (Buckley, 1959). In the Sudan this crop is grown as a pulse and a forage crop and considered as an important rotational crop in the large irrigated agricultrural schemes because it increases the amount of soil nitorgen (Rai, 1969) .

Few experiments were carried out in the Sudan dealing with the crop husbandry of lablab beans as a forage crop (Ageeb, 1981; Osman and Osman, 1982) but practically no information is available regarding the phenotypic variation in some of its important grain yield contributing agronomic characters. Recently a research program has been initiated in the University of Gezira for quantification and identification of variability and interrelationships among characters determining grain yield in lablab beans. Such information will be useful to breeders planning for the improvement of this crop. This study was, therefore, undertaken to obtain information on (a) phenotypic variability of grain yield and its components (b) the interrelationships among these components and (c) cultivar x season interaction for these characteristics .

MATERIALS AND METHODS

Six cultivars of lablab beans were grown on the

University of Gezira farm, Wad Medani, Sudan (latitude 14 5`N and longitude 33 38`E) in an alkaline, heavy, cracking, clay soil. The cultivars were Highworth and Rongai from Australia, Brazilian from Brazil and three local cultivars arbitrarily named Local I, Local II and Local III. The cultivars were morphologically described in Table 1. The sowing dates were the first of September and 21st of July 1983 and 1984, respectively. The experiments were laid out in a completely randomized block design with four replicates. Each cultivar in a replicate was planted in a plot consisting of 8 ridges, each 7m long. The interrow and interplant spacings were 75 and 50 cm , respectively. Three seeds per hole were sown and two weeks after seeding the plants were thinned to one plant per hole. The crop was hand weeded and surface irrigated according to crop water requirements. No fertilizer was applied.

At the respective maturities of each cultivar, 10 plants from the inner 6 rows of each plot were randomly sampled and used for recording the measurements and their mean values were utilized for statistical analysis. Measurements were recorded on the following characteristics: days to flowering, grain yield/ha(t), grain yield/plant (g), weight of pods/plant (g), number of pods/plant, number of fruiting branches/plant, 100-seed weight (g), pod length (cm), pod width (cm), number of seeds/pod, 100-pod weight (g), oil content (%), protein content (%), plant height (cm), fresh weight/plant (g) and dry weight/plant (g).

confirmed the results of Ahmed (1978) who reported that lablab beans failed to flower at 12,13 and 14 daily length hours but gave the highest number of flowers at 10 hours daily length .

Phenotypic variability

The variability displayed by the different characters under study is shown in form of cultivar means, coefficient of variation and `F` ratios in the two seasons (Table 2). In general the means for the different characters were higher in the 1984 than in 1983 season. The per plant increase in grain yield, fresh and dry weights of the 1984 data over that of 1983 were 55, 175 and 146% respectively. This is in accordance with the findings of Fadda and Ahmed (1963) who reported that July sowing of Lablab beans outyielded that of September and October sowings. The present findings could perhaps be explained by the fact that July sowing gave the plant the full chance of completing its normal vegetative stage of growth while in September sowing the vegetative stage of growth was shortened by the early occurrence of the flowering stage due to photoperiod sensitivity of this crop to short days.

The cultivars selected for this study varied in many seed characteristics. Such phenotypic variability was shown by the size of the CV where weight of pods, number of pods, number of fruiting branches, plant fresh and dry weights exhibited high CVs relative to the other traits. The least variation was shown by 100-seed weight, 100-pod weight and protein content. The cultivars were significantly

Table (2) Phenotypic variation in 14 characters of six lablab bean cultivars for two seasons.

Character	Mean		S.E.(±)		CV (%)		F Value for cultivar	
	1983	1984	83	84	83	84	83	84
Grain yield/plant(G)	96.54	149.44	14.39	9.84	30	13	3.62*	21.07**
Weight of pods/plant (G)	140.44	217.93	19.28	15.73	27	14	3.48*	18.15**
Number of pods/plant	144.75	234.63	20.43	19.73	28	17	5.88**	25.28**
Number of fruiting branches/ plant	23.25	47.58	3.64	2.77	31	12	2.87	23.17**
100 - seed weight (G)	26.17	24.72	0.21	0.33	2	3	438.01**	219.31**
Pod length (cm)	4.82	4.62	0.15	0.17	6	7	20.50**	11.89**
Pod width (cm)	1.48	1.50	0.05	0.05	7	6	7.45**	11.59*
Number of seeds/pod	3.21	3.17	0.22	0.14	14	9	7.21**	9.86*
100 - pod weight (G)	110.51	112.18	1.82	3.20	3	5	302.41**	124.82**
Oil content (%)	1.60	1.67	0.11	0.07	18	12	1.95	3.46
Protein content (%)	20.26	26.48	0.51	0.92	5	7	7.59**	9.04**
Plant height (cm)	100.54	136.37	5.38	5.13	11	8	14.24**	16.41**
Fresh weight/plant (G)	424.43	1168.33	45.53	73.23	21	13	5.36*	5.75**
Dry weight/plant (G)	146.21	360.20	18.27	21.63	25	12	4.99*	9.47**

*, ** Significant at 0.05 and 0.01, respectively.

different in most characters with the exception of number of fruiting branches and oil content in 1983 and oil content in 1984. The significant variation for these traits indicated the genetic diversity among these cultivars and suggested that selection for these characters may be effective.

The range for the grain yield of the different cultivars was 0.61-1.45 t/ha in 1983 and 1.20-2.40 t/ha in 1984 (Table 3) indicating the superiority of July sowing. Grain yields of 0.2-1.2 t/ha for field sowings were reported in India (Veeraswamy et al., 1973) and of 1.1-2.6 t/ha for experimental sowings were reported in Australia (Wildin, 1974; Wood, 1983). Averaged over the two seasons the highest yielding cultivar was Highworth and the lowest yielder was Local III. Highworth gave the lowest and the highest grain yield, weight of pods, number of pods, number of fruiting branches in 1983 and 1984, respectively. The current data showed that the high yielding cultivars displayed also high values of weight of pods, number of pods and number of fruiting branches. In general the performance of Local I, Local II and Rongai in most measured grain yield parameters was similar suggesting that these cultivars may have somewhat similar genetic makeup because they originated from the same geographic area. Rongai was introduced to Australia from East Africa (Barnard, 1972) while Highworth seeds were collected from India and then introduced to Australia (Wildin, 1974).

The crude protein content of the cultivars were higher in 1984 than in 1983 while their oil content

Table (3) Grain yield and its major components of six lablab bean cultivars in two different seasons.

Characters	Grain yield t/ha		Grain yield / plant (G)		Weight of pods/ plant (G)		Number of pods/ plant		Number of fruiting branches/ plant	
	1983	1984	1983	1984	1983	1984	1983	1984	1983	1984
Local 1	1.02 ab*	1.64 b	100 ab	156 b	159 ab	227 ab	210 a	301 ab	30 a	47 b
Local 11	0.90 b	1.50 bc	81 b	144 bc	132 abc	222 bc	173 ab	283 b	25 a	47 b
Local 111	1.04 ab	1.21 d	103 ab	111 d	137 abc	146 c	88 c	86 d	18 b	31 c
Highworth	0.61 b	2.40 a	58 b	235 a	81 c	339 a	91 c	361 a	14 b	72 a
Brazilian	0.98 ab	1.36 bod	95 ab	132 bcd	140 abc	192 bc	130 bc	195 c	23 a	45 b
Rongai	1.45 a	1.20 od	140 a	116 cd	191 a	178 bc	170 ab	180 c	30 a	43 b

* Means followed by the same letter (s) within a column do not differ significantly at probability 0.05 level according to Duncan's Multiple Range Test.

showed a reversed trend with a slightly higher oil content in 1983 (Table 4). The cultivars crude protein content varied from 19.1 to 22.7 % in 1983 and from 22.8 to 29.7 % in 1984 which is quite comparable to the crude protein range of 22.9 to 28.7 % reviewed by Hendricksen and Minson,(1985). Local II gave the highest crude protein content and the lowest oil content in both seasons which is expected because these two quality characteristics are known to be negatively associated with each other in most oil crops and they vary with cultivar, environment and management.

Table (4) Crude protein and oil content of six lablab bean cultivars in two different seasons

Cultivar	Protein content (%)		Oil content (%)	
	1983	1984	1983	1984
Local 1	20.0 bc	29.4 ab	1.03 a	1.10 bc
Local 11	22.7 a	29.7 a	1.03 a	1.00 c
Local 111	19.3 c	22.8 d	1.20 a	1.08 bc
Highworth	19.1 c	26.3 c	1.25 a	1.35 a
Brazilian	19.4 c	26.6 bc	1.45 a	1.20 abc
Rongai	21.1 ab	24.1 cd	1.33 a	1.28 ab

* Means followed by the same letter within a column do not differ dignificantly at probability 0.05 level according to Duncan's Multiple Range Test.

Cultivar x season interactions

In the combined analysis of variance for the two seasons, grain yield, weight of pods, number of pods, number of fruiting branches, 100-seed weight, plant height, plant fresh and dry weights were significantly affected by season, cultivar and cultivar x season interaction (Table 5). For pod length, pod width, number of seeds/ pod and oil content the effect of season and cultivar x season interaction were not significant suggesting that these characteristics were fairly stable over years and not greatly affected by the variation in the environment.

Simple correlations

Grain yield, weight of pods, number of pods, number of fruiting branches, plant height, fresh and dry weight of the plant were positively and significantly correlated with each other (Table 6), indicating that grain yield is largely a function of these characters. Low nonsignificant correlations with grain yield were shown by 100-seed weight, pod length, pod width, number of seeds, 100-pod weight and oil content.

The strong positive associations of grain yield with weight of pods, number of pods and number of fruiting branches was a confirmation to the previous findings that in the present study high yielding cultivars exhibited also the highest mean values for these traits (Table 3). On the other hand the high positive correlations of plant height, dry and fresh

Table (5) Mean squares for season, cultivar and season x cultivar for 14 characters in lablab beans.

Character	Season	Cultivar	Season x Cultivar
Grain yield/plant(G)	33517.47**	1685.62*	9480.28**
Weight of pods/plant (G)	72059.50**	4470.69*	18533.23**
Number of pods/plant	96930.19**	29608.64**	19556.16**
Number of fruiting branches/ plant	7105.33**	301.73**	560.53**
100 - seed weight (G)	2.43**	168.08**	7.89**
Pod length (cm)	0.48	3.03**	0.05
Pod width (cm)	0.00	0.11	0.02
Number of seeds/pod	0.02	2.04**	0.07
100 - pod weight (G)	33.50	8432.37**	108.77*
Oil content (%)	0.21	0.91*	0.21
Protein content (%)	211.51**	11.63	5.26*
Plant height (cm)	15401.17**	3037.61**	374.27*
Fresh weight/plant (G)	6640720.91**	61730.69*	106063.35**
Dry weight/plant (G)	549487.81**	12190.02**	12242.20**

*, ** Significant at the 0.05 and 0.01probability levels, respectively.

Table (6) Simple correlation coefficients among 14 characters over two seasons in lablab beans.

	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.97**	0.83**	0.90**	-0.04	-0.11	0.20	0.02	-0.09	0.15	0.56**	0.40**	0.69**	0.70**
2		0.91**	0.93**	-0.15	-0.20	0.26	-0.10	-0.19	0.10	0.62**	0.34*	0.70**	0.70**
3			0.88**	-0.47**	-0.50**	0.35*	-0.37	-0.52**	0.02	0.70**	0.69**	0.55**	0.51**
4				-0.23	-0.30*	0.24	-0.20	-0.26	0.03	0.72**	0.36*	0.81**	0.81**
5					0.83**	0.83**	0.76**	0.94**	0.01	-0.35*	0.58**	0.05	0.06
6						-0.44**	0.80**	0.86**	0.04	-0.41**	0.48**	0.01	0.04
7							-0.35*	-0.58**	0.29	0.22	-0.38**	0.10	0.13
8								0.78**	0.03	-0.25	0.47**	0.02	0.04
9									0.03	-0.30*	0.62**	0.12	0.14
10										-0.19	-0.15	-0.00	0.04
11											0.36*	0.68**	0.60**
12												0.67**	0.64**
13													0.95**

1. Grain yield/ plant (G)
2. Weight of pods/ plant (G)
3. Number of pods/ plant
4. Number of fruiting branches/ plant
5. 100 - seed weight (G)
6. Pod length (cm)
7. Pod width (cm)
8. Number of seeds/ pod
9. 100 - pod weight (G)
10. Oil content (%)
11. Protein content (%)
12. Plant height (cm)
13. Fresh weight/ plant (G)
14. Dry weight/ plant (G)

Number of observations (n) = 48

*,** Significant at 0.05 and 0.01 probability level, respectively.

weight of the plant with grain yield suggest that cultivars that are high in grain yield may also prove to be of reasonable value in forage production. Wood (1983) suggested that some lablab bean cultivars could be used for dual purposes.

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التباين الظاهرى والعلاقات المتداخلة لناتج البذور ومكوناته فى محصول اللابلاب(Lablab purpureus L.)

أبو الحسن صالح ابراهيم (١) و الرشيد سليمان مضوى (٢) و أحمد عبدالله أحمد (٢)

(١) كلية العلوم الزراعيه ، جامعة الامارات ، العين ، دولة الامارات

(٢) كلية العلوم الزراعيه، جامعة الجزيره ، مدني ، السودان .

ملخص

أجريت هذه التجارب لدراسة التباين الظاهرى والعلاقات المتداخلة لغلة البذور ومكوناته لستة أصناف من محصول اللابلاب (Lablab purpureus L.) كانت الفترة ما بين الزراعة وبداية الازهار أطول (٩٩ – ١٣٧ يوما) عندما زرعت الأصناف فى يوليو مقارنة بالزراعه فى سبتمبر (٥٩ – ٨٥ يوما). كان الصنف هايورث (HIGHWORTH) مبكرا فى ازهاره عن الأصناف الاخرى فى حين كان أكثر الاصناف تأخرا فى ازهاره هو الصنف البرازيلي . أظهرت صفات غلة البذور تباينا ظاهريا معنويا. تراوح مدى انتاجية البذور للاصناف بين ٦١ر٠ – ٤٥ر١ ط/هـ عام ١٩٨٣ و ٢٠ر١ – ٤٠ر٢ ط/هـ عام ١٩٨٤ وكان أعلى انتاج بذور للصنف هايورث وادناه للصنف محلي ٣ . تراوح مدى نسبة البروتين الخام للاصناف بين ١٩ر١ – ٧ر٢٩٪ ونسبة الزيت بين ٠٠ر١ – ٤٥ر١٪ . تأثرت صفات ناتج البذور ووزن القرون وعدد الافرع المثمره ووزن ١٠٠ بذره وطول النبات ووزن النبات الرطب والجاف تأثرا معنويا باختلاف الموسم والصنف وتفاعل الموسم x الصنف . ظهر أن صفات ناتج البذور ووزن القرون وعدد القرون وعدد الافرع المثمره وطول النبات والوزن الرطب والجاف للنبات ترتبط ببعضها ارتباطا معنويا موجبا وعليه يقترح استعمالها بواسطة مربى هذا المحصول كمؤشرات انتخاب لزيادة الانتاج من البذور والعلف .

كلمات مفتاحية : أصناف ، علاقات متداخلة ، محصول اللابلاب ، غلة البذور ، التباين الظاهرى .