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EFFECT OF HARVESTING DATE AND STORAGE PERIODS ON SEED QUALITY OF FABA BEAN (*Vicia faba,* L.).

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ABSTRACT: Two field experiments were conducted in loam soils at Tag El-Eiz, Agricultural Research Station, Dakahlia Governorate, during two successive winter growing seasons of 2000-2001 and 2001-2002. The objective of the study was evaluate the effect of harvesting date and storage period on seed quality of faba bean variety (Giza 843). The results indicated that seed moisture content at 120 days from sowing was more than at 140 days. However, harvesting after 140 day from sowing increased 100-seed wet weight, protein, carbohydrate and oil percentages in both seasons. Total phenols, tannins, trypsin and vicine were decreased. The differences in seed protein patterns were obviously out findings due to differences in harvesting dates. Germination percentage increased gradually with later harvesting date. On the other hand, germination percentage of the seeds decreased gradually with the longevity of storage periods. The interaction between harvesting dates and storage periods indicated that harvesting at 140 day and storage period for six months is the best treatment to obtain the highest values of germination and quality of the seeds.

INTRODUCTION

Availability of viable and vigorous seeds at planting time is very important for increasing agricultural production, because high quality seeds act as catalyst for relizing the potential of other inputs. The loss of seed viability during harvesting time and storage cannot be stopped, or can viability be increased during seed harvest

harvested seeds from each harvesting date. Nevertheless, effect of seed storage under ambient conditions and harvesting date were determined by testing the germination capacity percentage.

Hundred seed weight (g) was estimated according to ISTA (1993); seed moisture content was calculated according to ISTA (1976); crude protein percentage was digested using a micro Kjeldahl Apparatus . The crude protein was calculated by multiplying the total nitrogen by 6.25 according to A.O.A.C. methods (1990); carbohydrate percentage: was estimated according to Dubious and Gilles methods (1956); oil percentage: was determined after extraction with Soxholets Apparatus using hexan According to A. O. A. C. methods (1975); total Phenols: was determined by using Folin-Denis reagent according to the method of Swain and Hillis (1959); determination of tannins: were determined using vanilling hydro-chloric acid (V.HCl) method as described by Burns (1971). trypsin inhibitor content: was estimated according to Roy and Bhat method (1974). vicin content: Total vicine content, i.e., vicine and convicine were extracted from 1g sample using 4%m-phosphoric acid according to Collier (1976); the standard laboratory germina-tion test as described in the rules of testing seeds (A. O. S. A (1976) and protein extracts of seeds of faba bean at six harvesting dates were identified by SDS-PAGE according to the method of Laemmli (1970). All chemical and technological tests were conducted at Seed Technology Unit at Mansoura and Seed Technology Department at Giza, Field Crops Research Institution., Agriculture Research Center, Giza, Egypt.

Freshly harvested seeds were placed in cloth bags. These bags were stored under room temperature for 18 month. A sample was withdrawn every two months to carry out standard germination test according to A. O. S. A. (1976) regulations.

All data were statically analyzed according to Gomez and Gomez (1984)

varieties were the condensed tannins. Saxena and Stewart (1983) found that concentration of vicine and convicine on a percent dry basis, were approximately 0.70 and 0.28 percent in Egyptian varieties. Filippetti and Azadegan (1994) elucidated the variability in protein and trypsin inhibitior content in 113 lines/varieties of faba bean (*Vicia faba,* L.) There was no correlation between trypsin inhibitor level and protein content (r = 0.19). Horbowicz and Obendorf (1994) found that the vigour of the seeds stored was lower, as compared with freshly harvested seeds. The biggest slump in vigour (manifested by a decreased seedling length and increased membrane permeability) was noticed in the seed stored over the longest period and harvested at the lowest level of maturity.

The present work was designed to investigate the effect of harvesting date and storage period on seed quality of faba bean.

MATERIALS AND METHODS

Two field experiments were conducted at Tag El-Eiz Agricultural Research Station, Dakahlia Governorate during the two successive growing seasons. Of 2000-2001 and 2001-2002.. A randomized complete block design with four replicates was adopted. Each replicate includes six plots. The plot size was 7.2 m^2 (three meters long and 60 cm wide). Each plot consists of four ridges. The field was ploughed and calcium super phosphate (15.5% P_2O_5) was incorporated in the soil during tillage operation at the rate of 30 kg P_2O_5/fad. Nitrogen fertilizer in the form of ammonium nitrate (33.5%N) was applied before the first irrigation at the rate of 35 kg N/fad. The experiments were carried out using Giza 843 variety of faba bean in both seasons at the rate of 60 kg seeds/fad. Seeds were treated with specific rhizobia of this crop, seeds and rhizobia were supplied from Agricultural Research Center, Giza. Faba bean seeds were sown on 13th November in both seasons. Six harvest dates at four days intervals beginning 120 days after sowing to 140 days. Seeds were harvested from the main stem.

All the quality determination were carried out on freshly

and storage periods. Labuda (1991) found that protein and total sugars percentages were 4.90% and 2.62% at 16.08% seed moisture. Anisa *et al.* (1996) reported that 100-seed weight and germination percentage gradually decreased with later sowing. Elias *et al.* (1979) found that tannin concentration was high in coloured seed coats and low in white-coated beans. Moreover, there is a correlation between tannin concentration in the seed coat and trypsin inhibitor activity, the hulls have much greater amounts of trypsin inhibtor than the cotyledon. Probably most of the trypsin inhibitor activity of the hulls is attributed to tannins. Chin (1981) found that long bean (*Vigna sesquipedalis*) seeds of three different maturity stages i.e. harvested at 15, 20, 25 days after anthesis were compared at harvest and subsequently after one year storage. Immediately after harvesting, they differ significantly in moisture content. The moisture content of immature seeds i.e. (15 days after anthesis) is 76.3 percent as compared to mature seeds (i.e.25 days after anthesis) which it was only 26.3 percent. On drying the immature seeds were lower in 1000-seed weight than the mature seeds. The percentage of germination however did not differ significantly, but it was lower for the immature seeds. After one year storage, the germination% is significantly lower for immature seeds and higher for the mature seeds. The seeds after storage and when they were sown differ in their performance. The immature seeds produce less vigorous seedlings and plants. Immature seeds are low in seed quality, poor in germination and do not store well. Wilson *et al.* (1972) reported that considerable variation was found in the vicine and convicine content of field bean varieties and locations. Martin *et al* (1977) found that there appears to be little doubt that the growth depression caused by faba bean tannins is due to an adverse effect on protein and dry matter digestibility. Pitz *et al.* (1981) reported that the concentrations of vicine and convicine, on a percent dry basis, were approximately 1.94 and 0.83 percent in Canadian varieties .Also they found that vicine and convicine content in faba beans were high in young seeds and decreased rapidly with maturity. Griffiths (1982) concluded that the active constituents in the seed coats of coloured, flowered

RESULTS AND DISCUSSION

Data presented in Tables (1) and (2) show that seed moisture content at 120 day from sowing was higher than the last harvest i.e. 140 day by approximately 89.09% and 20.60% in the first and second seasons, respectively. The last harvesting date has increasing 100-seed wet weight, protein, carbohydrate and oil percentages by approximately 18.13, 13.87, 5.43 and 60.33% in the first season and by 26.64, 7.84, 5.97 and 70.56% in the second season, respectively. On the other hand, harvesting at 140 day decreased phenols, tannins, trypsin and vicine by 3.03, 6.78, 3.50 and 1.67 mg % dry weight in the first season and 4.00, 3.65, 6.89 and 2.88 mg % dry weight in the second season respectively. These results may be due to increase transfer levels of protein, carbohydrate and oil from leaves to seeds with final harvesting date and some physiological changing in phases of phenols, tannins, trypsin and vicin at the final harvesting date. Similar results were obtained by Chin (1981) and Pitz *et al.* (1981).

Total seed protein content of faba bean seeds variety Giza 843 at six harvesting dates were analyzed for their electrophoretic banding patterns using SDS-PAGE. Molecular weights and percentages (% total proteins) of these protein bands are showed in Table (3) and Fig (1). It is clear that the banding battern were 120 , 124, 128, 132, 136 and 140 days, bands of major protein of six harvesting date respectively. The results indicated that distinct differences in seed protein banding patterns between the different dates of harvest, seeds of 120 days is characterized by protein with molecular weights of (144.049 KD). The concentrations in seed proteins were (0.46%). Seeds harvested after 136 days had protein with molecular weights of (25.157 KD). The percentage of total proteins were (31.15%). Seeds of 140 days had protein with molecular weights of (48.371 and 16.946 KD). The percentages of total protein were (15.79 and 37.56%).

Table (1) : Effect of harvesting dates on 100 – seed weight, seed moisture, protein, carbohydrate and oil contents of Faba bean in 2000/2001 and 2001/2002 seasons.

Treatments	100-seed wet weight (g)		Moisture percentage		Protein percentage		Carbohydrate percentage		Oil percentage	
	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002
Harvesting date :-										
1- 120 days from sowing	144.25	130.60	68.83	79.20	22.99	24.35	60.70	61.26	3.00	2.48
2- 124 days from sowing	152.20	130.63	63.87	79.06	24.24	24.83	61.26	61.83	3.18	2.91
3- 128 days from sowing	170.96	134.91	62.13	76.78	25.51	25.20	61.34	62.07	3.27	3.26
4- 132 days from sowing	168.91	151.02	63.90	71.94	25.95	25.41	60.94	62.44	4.14	4.18
5- 136 days from sowing	163.17	161.91	57.31	69.46	26.07	25.73	62.58	62.99	4.38	4.23
6- 140 days from sowing	170.41	165.39	36.40	65.67	26.18	26.26	64.00	64.92	4.81	4.23
F. test	**	**	**	**	**	**	**	**	**	**
L. S. D at 5 %	8.34	8.02	5.25	0.86	0.24	0.17	0.65	1.37	0.61	0.13
L. S. D at 1 %	13.08	12.57	8.24	1.35	0.84	0.26	1.02	2.15	0.96	0.21

Table (2): Effect of harvesting dates on phenolic, tannins, trypsin and vicine contents of faba bean in 200/2001 and 2001/2002 seasons.

Treatments	Phenole (mg% dry weight)		Tannins (mg% dry weight)		Trypsin (TIμ/mg)		Vicine (mg/g dry weight)	
	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002
Harvesting date :-								
1- 120 days from sowing	62.00	63.18	139.67	137.99	69.30	70.54	7.48	8.72
2- 124 days from sowing	61.36	61.79	139.66	136.89	69.18	69.23	7.13	7.25
3- 128 days from sowing	60.73	61.43	136.87	135.81	67.77	67.11	6.00	7.43
4- 132 days from sowing	59.60	59.17	134.31	134.66	66.50	66.62	5.83	6.91
5- 136 days from sowing	59.59	60.10	134.31	134.37	66.50	64.61	5.81	5.89
6- 140 days from sowing	58.97	59.18	132.89	134.34	65.80	63.65	5.97	5.84
F. test	*	**	*	**	*	**	*	**
L. S. D at 5 %	2.39	1.30	5.20	1.91	2.54	1.03	1.31	0.20
L. S. D at 1 %	-	2.04	-	3.00	-	1.61	-	0.31

Table (3): Molecular weight and protein pattern % of soluble protein bands extracted from faba bean by polyacrylamide gel electrophoresis (SDS-PAGE) for the second season.

Protein M.W K D	Sample of harvesting dates					
	120	124	128	132	136	140
311.515	-	6.00	5.34	5.49	-	-
300.742	-	-	-	-	3.95	4.64
278.000	4.93	5.42	4.71	4.97	5.87	7.12
246.879	1.62	2.38	2.03	2.03	2.30	-
224.136	-	-	2.03	2.12	2.03	3.26
222.939	2.35	2.53	-	-	-	-
183.338	1.75	2.39	0.74	0.73	0.98	-
146.395	-	2.12	1.76	1.90	2.14	1.71
144.049	0.46	-	-	-	-	-
122.285	11.98	9.16	8.44	7.53	8.71	8.26
97.747	1.24	0.36	0.95	1.04	1.17	2.44
88.124	3.69	21.26	1.25	4.46	2.62	-
85.700	2.94	-	3.69	3.98	2.44	2.89
83.900	-	-	12.08	9.23	-	-
81.547	-	-	-	-	10.76	14.16
60.714	-	-	-	6.56	8.31	-
52.568	-	2.43	3.01	-	-	-
49.912	38.17	19.70	13.21	13.55	16.91	0.96
48.371	-	-	-	-	-	15.79
43.252	-	-	3.86	4.02	-	-
36.988	1.06	7.64	0.35	0.57	0.65	0.90
28.226	-	18.61	5.47	31.81	-	-
25.157	-	-	-	-	31.15	-
19.582	29.83	-	31.09	-	-	-
16.946	-	-	-	-	-	37.56
Total of bands	12	13	17	16	15	12

Data presented in Table (4) show that germination percentages of faba bean seeds in both seasons were significantly affected by harvesting dates and Germination percentages were increased from (80.94 % and 83.89 %) with harvesting date of 120 day from sowing to (93.78 % and 93.94 %) with harvesting date of 140 day from sowing in the first and second seasons, respectively. These findings may be due to increase size of seeds and embryo with increasing of imbricated the nutrition through seeds maturation. These results are in general agreement with those obtained by Chin (1981), Labuda (1991) and Mansour (1995).

Data seen in Table (4) show that germination percentages of seeds which stored for two months were (92.37 % and 92.00%) and it was increased to (94.67% and 98%) after four months in the first and second seasons, respectively. Then, germination percentage were decreased gradually to (68.58% and 72.08%) after 18 months in the first and second seasons, respectively. These results may be due to increasing the respiration of embryo and increasing the destroy of consumption nutrients in the seed cells through different periods of storage and different changes in density of some seed nutrients with longevity of storage periods. Similar results were obtained by Horbowicz and Obendorf (1994) and Anisa *et al.* (1996).

Data presented in Table (5) show that the interaction between harvesting dates and storage periods which were significantly affected germination percentage in the second season, that seeds harvested at 140 day from sowing and stored four to six months gave the highest value of germination (99.50 % and 99%) but it was decreased gradually to (82.50 %) after 18 months. On the other hand seeds were harvested at 120 days from sowing had the lowest values of germination percentage (96.50%) after four months and it was decreased to (58.50%) after18 months. These results may be due to less of nutrients in these seeds and lowest size and weight of seeds and embryos. Similar results were obtained by Chin (1981).

From the abovementioned results. it can be concluded that 140 days from sowing and six months storage period of faba bean seeds have the highest values of germination percentages and seed quality.

Table (4): Effect of harvesting date and storage periods on germination percentage in the two seasons 2000/2001 and 2001/2002

Treatments	Seasons	
	2000/2001	2001/2002
A-Harvesting date :		
1- 120 days from sowing	80.94	83.89
2- 124 days from sowing	84.06	87.67
3- 128 days from sowing	90.22	91.28
4- 132 days from sowing	90.64	91.44
5- 136 days from sowing	90.78	91.89
6- 140 days from sowing	93.78	93.94
F. test	* *	* *
L. S. D at 5 %	2.70	3.62
B- Storage periods:		
1- 2 months	92.37	92.00
2- 4 months	94.67	98.00
3- 6 months	94.25	96.83
4- 8 months	93.50	94.33
5- 10 months	92.92	93.17
6- 12 months	91.08	91.50
7- 14 months	89.58	90.08
8- 16 months	78.67	82.17
9- 18 months	68.58	72.08
F. test	* *	* *
L. S. D at 5 %	3.60	3.00

Table (5): The interaction effect between harvesting date and storage periods on germination percentage in 2001/2002 season.

Treatments	Harvesting date (days from sowing)					
	120	124	128	132	136	140
Storage period:						
1- 2 months	82.00	88.50	93.00	94.50	96.50	97.50
2- 4 months	96.50	97.00	98.00	98.00	99.00	99.50
3- 6 months	92.50	95.50	98.00	98.00	98.00	99.50
4- 8 months	87.50	94.00	97.00	94.00	95.50	98.00
5- 10 months	87.50	94.00	95.00	93.50	92.00	97.00
6- 12 months	87.00	93.00	94.00	92.00	90.00	93.00
7- 14 months	87.00	86.50	92.50	92.00	89.50	93.00
8- 16 months	76.50	80.00	84.00	82.00	84.50	86.00
9- 18 months	58.50	60.50	75.50	77.50	78.00	82.50
F. test	**					
L. S. D at 5%	6.44					

1 2 3 4 5 6

Figure (1): Electrophoretic patterns of salt-soluble proteins obtained from seeds of six harvesting date of faba bean variety Giza 843 for the second season.

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تأثير ميعاد الحصاد وفترات التخزين على جودة بذور الفول البلدى

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أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بتاج العز - محافظه الدقهلية خلال موسمى الزراعه٢٠٠٠/٢٠٠١ و٢٠٠١/٢٠٠٢ وذلك لدراسة تأثير ميعاد الحصاد (١٢٠-١٢٤-١٢٨-١٣٢-١٣٦-١٤٠ يوم) وفترات التخزين(تسعه معاملات - كل شهرين) على جوده بذور الفول البلدى (جيزه ٨٤٣) وكانت أهم النتائج المتحصل عليها كما يلى:

١- نسبة الرطوبة فى البذور التى تم حصادها بعد ١٢٠ يوم من الزراعة أعلى منها فى البذور التى تم حصادها بعد ١٤٠ يوم من الزراعه ولكن البذور التى تم حصادها بعد١٤٠ يوم زادت بها نسبة كلا من البروتين والكربوهيدرات والزيوت فى كلا الموسمين.

٢- حدوث تناقص تدريجى فى نسبة كلا من الفينولات والتانينات والتربسين والفايسين مع التاخير فى ميعاد الحصاد حيث تصل إلى أقل نسبه مع الحصاد عند ١٤٠ يوم.

٣- وجود إختلاف فيما بين ميعاد الحصاد بعد ١٢٠ و الحصاد بعد ١٣٦ و١٤٠ يوم.

٤- تزايد نسبه إنبات البذور تدريجيا مع زيادة فترة نضج البذور حتى ١٤٠ يوم من الزراعة.

٥- البذور تحتفظ بأعلى نسبه للانبات عند تخزينها حتى مده ستة أشهر وبعد ذلك تبدأ نسبة إنبات البذور فى الانخفاض تدريجيا وتصل إلى أقل معدل لها عند التخزين لمدة ١٨ شهر بعد الحصاد.

توصى هذه الدراسة بأن الحصاد على ١٤٠ يوم من الزراعة والتخزين لمدة ستة أشهر هى أفضل المعاملات للحصول على أعلى نسبة للإنبات و بذور عالية الجودة.