SEED YIELD AND QUALITY OF FABA BEAN GENOTYPES AS AFFECTED BY WATER REGIMES

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ABSTRACT

Two field experiments were carried out in the Research and Experimental Center of Faculty of Agriculture at Moshtohor, Benha University, Egypt, during 2013/14 and 2014/15 winter seasons to study the performance of five faba bean genotypes (Moshtohor 5, Moshtohor 8, Moshtohor 1084, Misr 3 and Nobaria 3) under four water regimes were, one irrigation (300 m^3 fed^{-1}) at flowering stage {90 day after planting (DAP)}, two irrigations (250 m^3 fed^{-1} for each irrigation) at vegetative growth and pod formation stages (60 and 120 DAP, respectively), three irrigations (200 m^3 fed^{-1} for each irrigation) at vegetative growth, flowering and pod formation stages (45, 90 and 135 DAP, respectively) and traditional irrigation.

The results could be summarized as follows:

No. of pods and seeds $plant^{-1}$, weight of pods and seeds $plant^{-1}$, weight of 100 seeds, seed yield fed^{-1}, protein yield fed^{-1}, moisture%, carbohydrate% and calcium% in faba bean seeds were significantly increased by the increase in number of irrigations compared with one irrigation treatment. Whereas, protein% and potassium% in faba bean seeds were significantly decreased by the increase in number of irrigations in the first and second seasons. Faba bean genotypes were significantly different in all traits studied except No. of pods and seeds $plant^{-1}$ and moisture% in faba bean seeds in the first season. Significant interaction effect was noticed between water regimes and broad bean genotypes for all the studied characters except weight of 100 seeds and moisture% in faba bean seeds in the first season. Generally, it can be concluded that planting Moshtohor 1084 genotype or Nobaria 3 and Misr 3 varieties at normal irrigation or at three irrigations.

Key Words: *Faba bean, Genotypes, Water regimes, Seed quality, yield and its components.*

INTRODUCTION

Faba bean (*Vicia faba L.*) is considered the most important seed legume in Egypt. Many attempts had been carried out to increase the total production of faba

bean to meet increasing human consumption demand. Two of the most important factors that may influence yield ability are; irrigation treatments and new pure lines.

Many investigators had reported the effect of irrigation number or water regimes on faba bean for yield and yield components as well as seeds quality **(Ebaid, 1990, Ainer *et al*, 1994, Plies-Balzer *et al*, 1995, Mehasen, 1998, Ouda *et al*, 2010, Ibrahim, 2011, Tayel and Sabreen, 2011b, El-Hadidi *et al*, 2012, El-Hadidi *et al*, 2014, Mekkei, 2014 and Abdel-Ghany *et al*, 2016).**

To compare faba bean genotypes, Many investigators have reported high variability among faba bean genotypes and varieties for yield, yield components and seeds chemical contents **(El-Hosary and Mehasen, 1998, Mehasen, 1998, Tageldin and Mehasen, 2004, Al-Fageh and Mehasen, 2006, Al Ghamdi, 2007, Osman *et al*, 2010, Bakry *et al*, 2011, Abdellatif *et al*, 2012, Hendawey and Younes, 2013, Mekkei, 2014, Siddiqui *et al*, 2015 and Abdel-Ghany *et al*, 2016).**

Thus, the objective of this study is to investigate yield and yield components as well as seeds quality response to irrigation numbers at growth stages using some new promising pure lines and commercial varieties at Moshtohor, Kalubia Governorate, S. Delta.

MATERIALS AND METHODS

This investigation was conducted at the Agricultural Research and Experimental Center of the Faculty of Agriculture, Moshtohor, Kalubia Governorate, Benha University, Egypt, in winter 2013/14 and 2014/15 seasons, to study the effect of number of irrigations at different growth stages {one irrigation (300 m^3 fed^{-1}) at flowering stage {90 day after planting (DAP)}, two irrigations (250 m^3 fed^{-1} for each irrigation) at vegetative growth and pod formation stages (60 and 120 DAP, respectively), three irrigations (200 m^3 fed^{-1} for each irrigation) at vegetative growth, flowering and pod formation stages (45, 90 and 135 DAP, respectively) and traditional irrigation, four irrigations (200 m^3 fed^{-1} for each irrigation). on yield and yield components as well as seed quality of five faba bean genotypes (Moshtohor 5, 8 and Moshtohor 1084) as well as two local variety (Misr 3 and Nobaria 3). Split plot design with three replications was used in the two seasons. The irrigation treatments were randomly assigned to the main plots, and five faba bean genotypes represented in the sub-plots. Each sub-plot was 5 ridges 3.5 m long and 60 cm wide, the sub-plot area 10.5 m^2 (1/400 fed). Planting was carried out on 8th Nov. in 2013/14 season, and on 4th Nov. in 2014/15 season. The preceding crop was corn in both seasons. Nitrogen

fertilizer at a rate of 20 kg N fed^{-1} was spitted into two equal doses applied at planting and before the first irrigation in the two seasons. The used N carrier was urea (46.5% N). Other agricultural practices were done as recommended in region and outlined.

Irrigation discharge was adjusted by using triangular weirs (V notch). The height of flowing water was fixed at 30 cm. Water discharge was counted according to the equation of **Hansen *et al*, (1980)** as follows:

$Q = 0.0138 \times h^{2.5} \times 3.6$ where:

Q = Water discharge, $m^3\ hr^{-1}$.

0.0138 and 3.6 = constant values, where 3.6 was added for obtaining Q in $m^3\ hr^{-1}$.

h= Water height or pressure head (cm).

Water use efficiency (WUE) was determined according to **Hansen *et al*, (1980)** as follows:

WUE = Seed yield kg/total water input m^3.

Water saved $m^3\ fed^{-1}$ and seed yield reduction percentage were calculated for each irrigation treatment compared with traditional irrigation for two seasons.

At harvest, ten guarded plants were taken at random from the central ridge to estimate: number of pods $plant^{-1}$, number of seeds $plant^{-1}$, weight of pods $plant^{-1}$ (g), weight of seeds $plant^{-1}$(g) and 100-seed weight (g). Moreover, the whole plot was harvested to determine seed yield (kg fed^{-1}) was determined from the three central ridges of each experimental plot. Moisture%, protein%, carbohydrate%, calcium%, and potassium% were determined according to the methods recommended by **A.O.A.C. (2000)**. Protein yield (Kg fed^{-1}) was calculated by multiplying Protein percentage by the seed yield fed^{-1}.

Analysis of variance was done for the data of each season separately according to **Snedecor and Cochran (1990)** treatment means were compared using least significant difference test at 0.05 level of significance.

RESULTS AND DISCUSSION

- Effect of water regime.

The mean values of the traits studied as affected by water regime are presented in **Table (1)**. Traditional irrigation and three irrigations treatments showed significant differences in all traits studied in the first and second seasons. Adding one irrigation at flowering stage or two irrigations at vegetative growth and pod formation stages decreased all traits studied in both seasons. Adding one irrigation at flowering stage treatment decreased number of pods $plant^{-1}$, number of seeds $plant^{-1}$, weight of pods

plant^{-1}, weight of seeds plant^{-1}, 100-seed weight and seed yield fed^{-1} by 37.42, 79.88, 121.72, 127.35, 26.03 and 47.71% respectively, in the first season and by 25.04, 70.62, 119.83, 125.88, 32.59 and 36.86% respectively, in the second season compared with adding three irrigations treatment. Also, Adding two irrigations at vegetative growth and pod formation stages treatment decreased number of pods plant^{-1}, number of seeds plant^{-1}, weight of pods plant^{-1}, weight of seeds plant^{-1}, 100-seed weight and seed yield fed^{-1} by 20.29, 21.79, 37.54, 37.88, 13.32 and 20.44% respectively, in the first season and by 26.01, 29.74, 39.84, 41.44, 9.91 and 16.23% respectively, in the second season compared with traditional irrigation treatment. The negative effect of yield and its components caused by skipping irrigation could be explained on the basis of the loss of turgor which affects the rate of cell expansion and ultimate cell size. Loss of turgor is probably the most sensitive process to water stress, thus, decrement in growth rate, stem elongation and leaf expansion. In this connection, Ebaid (1990), Ainer *et al*, (199, Mehasen (1998), Ouda *et al*, (2010), Ibrahim (20110, Tayel and Sabreen (2011a &b), El-Hadidi *et al*, (2012), El-Hadidi *et al*, (2014), Mekkei (2014) and Abdel-Ghany *et al*, (2016), reached the same conclusion.

Table 1. Effect of water regimes on yield and yield components of faba bean during 2013/14 and 2014/15 seasons

Water regime	No. of pods plant^{-1}	No. of seeds plant^{-1}	Wt. of pods plant^{-1} (g)	Wt. of seeds plant^{-1} (g)	Wt. of 100-seed (g)	Seed yield (kg fed^{-1})
2013/14 season						
One	10.93	32.80	20.21	16.16	49.24	1245
Two	13.06	52.00	35.64	29.17	56.00	1512
Three	15.02	59.00	44.81	36.74	62.06	1839
Control	15.71	63.33	49.02	40.22	63.46	1821
L.S.D at 5%	**1.01**	**4.60**	**5.04**	**4.15**	**4.26**	**32.12**
2014/15 season						
One	11.46	33.60	19.87	15.88	47.16	1359
Two	12.80	49.33	35.87	29.08	58.80	1639
Three	14.33	57.33	43.68	35.87	62.53	1860
Control	16.13	64.00	50.16	41.13	64.63	1905
L.S.D at 5%	**0.37**	**2.17**	**2.94**	**2.43**	**4.34**	**38.2**

One =One irrigation at flowering stage Two =Two irrigation at vegetative and pod formation stages
Three =Three irrigation at vegetative, flowering and pod formation stages Control =Normal irrigation

Results in **Table (2)** show the effects of water regime on moisture%, protein%, protein yield fed^{-1}, carbohydrate%, calcium% and potassium% in seeds of faba bean in 2013/14 and 2014/15 seasons. Application of one irrigation treatment significantly decreased moisture%, protein yield fed^{-1}, carbohydrate% and calcium%, whereas, the same treatment gave the highest values of protein% and potassium% in faba bean seeds compared with other irrigation treatments in the first and second

seasons. Similar results were also obtained by **Plies-Balzer et al, (1995) and Mekkei (2014).**

Table 2. Effect of water regimes on chemical contents of faba bean seed during 2013/14 and 2014/15 seasons

Water regime	Moisture %	Protein %	Protein yield (kg fed^{-1})	Carbohydrates %	Calcium %	Potassium %
2013/14 season						
One	7.68	32.28	401.88	61.23	2.29	2.297
Two	8.83	29.88	451.78	63.62	2.40	1.814
Three	9.63	27.44	504.62	66.06	2.64	1.693
Control	10.28	25.63	466.72	67.88	2.78	1.533
L.S.D at 5%	**0.49**	**0.02**	**13.31**	**0.038**	**0.10**	**0.13**
2014/15 season						
One	7.34	33.80	459.34	59.70	2.27	2.289
Two	8.75	29.70	486.78	63.78	2.41	1.957
Three	9.66	27.98	520.43	65.59	2.56	1.507
Control	11.01	25.95	494.34	67.58	2.66	1.478
L.S.D at 5%	**0.02**	**0.03**	**28.81**	**0.166**	**0.05**	**0.25**

One =One irrigation at flowering stage Two =Two irrigation at vegetative and pod formation stages
Three =Three irrigation at vegetative, flowering and pod formation stages Control =Normal irrigation

- Effect of genotypes.

The results reported in **Table (3)** indicate clearly that, there were significant differences between the different among the 5 faba bean genotypes in all traits studied except No. of pods plant^{-1} and No. of seeds plant^{-1} in the first season only. Moreover; it is clear from **Table (3)** that Moshtohor 1084 genotype gave the highest values of weight of seeds plant^{-1} (33.35 and 32.08 g), weight of 100-seed (61.25 and 61.53 g) and seed yield (1689 and 1759 kg fed^{-1}) in the first and second seasons, respectively. Also Moshtohor 1084 genotype gave the highest values of No. of seeds plant^{-1} and weight of pods plant^{-1} in the first and second seasons, respectively compared with other faba bean genotypes except Nobaria 3 variety was the same values in No. and weight of seeds plant^{-1} and seed yield (kg fed^{-1}) in the first season. On the other hand, Moshtohor 5 genotype gave the lowest values of No. of pods and seeds plant^{-1}, weight of pods and seeds plant^{-1}, weight of 100-seed and seed yield (kg fed^{-1}) in the first and second seasons, respectively except No. of seeds plant^{-1} in the first season. It could be concluded that varietal differences among faba bean genotypes may be due to genetical make up. The superiority of Moshtohor 1084 genotype or Nobaria 3 variety in grain yield (kg fed^{-1}) over other faba bean genotypes might be due to the increase in yield components, namely, No. of pods and seeds plant^{-1}, weight of pods and seeds plant^{-1}, weight of 100-seed. The results obtained by El-Hosary and Mehasen (1998), Mehasen (1998), Tageldin and Mehasen (2004), Al-Fageh and Mehasen (2006), Al Ghamdi (2007), Osman *et al,* (2010), Bakry *et al,* (2011), Abdellatif *et al,*

(2012), Hendawey and Younes (2013), Mekkei (2014), Siddiqui *et al,* (2015) and Abdel-Ghany *et al,* (2016) indicated marked differences among faba bean genotypes in yield and yield components.

Table 3. Effect of faba bean genotypes on yield and yield components in 2013/14 and 2014/15 seasons

Water regime	No. of pods plant^{-1}	No. of seeds plant^{-1}	Wt. of pods plant^{-1} (g)	Wt. of seeds plant^{-1} (g)	Wt. of 100-seed (g)	Seed yield kg fed^{-1}
2013/14 season						
Mosht. 5	13.25	50.16	34.22	27.25	54.12	1468
Mosht. 8	13.45	50.08	34.46	29.12	55.87	1526
Misr 3	13.60	52.08	38.68	31.46	57.29	1650
Nobaria 3	14.16	53.41	40.88	33.35	59.92	1689
Mosht. 1084	13.95	53.41	38.86	33.35	61.25	1689
L.S.D at 5%	**N.S**	**N.S**	**2.53**	**2.02**	**2.17**	**64.6**
2014/15 season						
Mosht. 5	13.33	49.00	34.44	28.31	55.33	1601
Mosht. 8	13.35	49.66	35.18	29.75	56.54	1637
Misr 3	13.75	51.25	38.40	30.46	57.45	1704
Nobaria 3	14.10	52.75	38.55	31.21	60.55	1753
Mosht. 1084	13.88	52.66	40.40	32.08	61.53	1759
L.S.D at 5%	**0.44**	**2.13**	**2.35**	**1.91**	**2.30**	**38.2**

The 5 faba bean genotypes under study significantly varied in moisture%, protein%, protein yield fed^{-1}, carbohydrate%, calcium% and potassium% in seeds in both seasons except moisture% in the first season only **(Table, 4)**. Moshtohor 1084 genotype was significantly highest in moisture% in seeds (9.59%) compared with the four other genotypes in the second season. The greatest protein% was 29.25 and 29.62% recorded by Nobaria 3 and Misr 3 varieties in the first and second seasons, respectively. Nobaria 3 variety, Moshtohor 1084 genotype and Misr 3 variety were the leading genotypes and surpassed significantly the two other genotypes in protein yield fed^{-1} in the first season, moreover, Moshtohor 1084 genotype and Nobaria 3 variety in the second one. The greatest carbohydrates% and potassium % were recorded by Moshtohor 5 genotype compared with other genotypes in the first and second seasons. While, The highest value of calcium% in faba bean seeds was obtained by Misr 3 variety in the first season, moreover, in the second one, The 5 faba bean genotypes could be arranged in a descending order in their calcium% content in seeds as follows: Moshtohor 8 and 1084 genotypes, Misr 3 and Nobaria 3 varieties without significant between them.

It could be concluded that Moshtohor 5, 8 and 1084 genotypes, Misr 3 and Nobaria 3 varieties were superior in assimilating moisture%, protein%, protein yield

fed^{-1}, carbohydrate%, calcium% and potassium% in seeds which may be due to the genetical differences between faba bean genotypes. These results agree with those obtained by Bakry *et al*, (2011), Abdellatif *et al*, (2012), Hendawey and Younes (2013) and Abdel-Ghany *et al*, (2016).

Table 4. Effect of faba bean genotypes on chemical contents for seeds in 2013/14 and 2014/15 seasons

Water regime	Moisture %	Protein %	Protein yield kg fed^{-1}	Carbohydrates %	Calcium %	Potassium %
2013/14 season						
Mosht. 5	8.87	28.16	413.38	65.34	2.50	1.927
Mosht. 8	9.08	28.96	441.92	64.55	2.50	1.859
Misr 3	9.17	28.99	478.33	64.49	2.64	1.844
Nobaria 3	9.29	29.25	494.03	64.25	2.47	1.768
Mosht. 1084	9.12	28.67	484.23	64.88	2.52	1.772
L.S.D at 5%	**N.S**	**0.02**	**20.92**	**0.057**	**0.10**	**0.09**
2014/15 season						
Mosht. 5	8.86	28.94	463.33	64.54	2.44	1.970
Mosht. 8	8.80	29.24	478.66	64.25	2.50	1.958
Misr 3	9.30	29.62	504.72	63.89	2.50	1.770
Nobaria 3	9.39	29.46	516.43	64.10	2.45	1.679
Mosht. 1084	9.59	29.52	519.35	64.02	2.50	1.681
L.S.D at 5%	**0.02**	**0.02**	**13.22**	**0.245**	**0.05**	**0.07**

-Interaction effect:

Significant effect of interaction between water regime and faba bean genotypes was obtained for yield and yield components except weight of 100-seed in the first season only **(Table 5)**. Traditional irrigation or three irrigations treatments for Moshtohor 5 and 1084 genotypes, Misr 3 and Nobaria 3 varieties gave the highest values of No. of pods and seeds plant^{-1} in the first season and without significant between them, while, in the second one was Traditional irrigation treatment for Moshtohor 1084 genotype, Misr 3 and Nobaria 3 varieties gave the highest values of No. of pods and seeds plant^{-1} and without significant between them. The highest values of weight of pods and seeds plant^{-1} (54.23 and 44.46, 53.86 and 43.96 g) were obtained by traditional irrigation treatment with Moshtohor 1084 genotype and Nobaria 3 variety in the first and second seasons respectively. Also, the highest value of 100-seed weight of 67.50 and 70.49 g was obtained by normal irrigation treatment with Nobaria 3 variety in the first and second seasons respectively. The heaviest seed yield fed^{-1} of 1974 and 2015 kg in the first and second seasons respectively were obtained by application of four irrigations treatment with Moshtohor 1084 genotype and Nobaria 3 variety, respectively and without significant between three irrigation treatment with Moshtohor 1084 genotype, Misr 3 and Nobaria 3 varieties in the first

season and without significant between three irrigation treatment with Misr 3 variety in the second season. On the other hand, the lowest values of number of pods plant^{-1} (10.00 and 10.66 pod), number of seeds plant^{-1} (30.00 and 31.00 seed), weight of pods plant^{-1} (17.05 and 15.86 g), weight of seeds plant^{-1} (12.63 and 12.86 g), 100-seed weight (44.50 and 41.16 g) and seed yield fed^{-1} (1072 and 1140 kg) obtained by application of one irrigation at flowering stage treatment with Moshtohor 5 genotype in the first and second seasons, respectively. These results agree with those obtained by Mehasen (1998), Al-Suhaibani (2009), Mekkei (2014) and Abdel-Ghany *et al*, (2016).

Table 5. Effect of the interaction between water regime and faba bean genotypes on yield and yield components in 2013/14 and 2014/15 seasons

	2013/2014 season (First season)					2014/2015 season (Second season)				
Treatments	**Mosht 5**	**Mosht 8**	**Misr 3**	**Nobar 3**	**Mosht 1084**	**Mosht 5**	**Mosht 8**	**Misr 3**	**Nobar 3**	**Mosht 1084**
water regime	**No. of pods plant^{-1}**									
One	10.00	11.36	11.10	11.66	10.53	10.66	11.60	10.80	13.60	10.67
Two	13.66	13.03	11.76	13.66	13.20	11.66	13.60	12.80	12.60	13.33
Three	13.00	14.36	15.76	16.66	15.30	15.00	13.60	14.80	13.60	14.66
Control	16.33	15.03	15.76	14.66	16.76	16.00	14.60	16.60	16.60	16.86
L.S.D at 5%	**1.76**					**0.87**				
water regime	**No. of seeds plant^{-1}**									
One	30.00	33.00	34.00	35.00	32.00	31.00	36.00	31.00	38.00	32.00
Two	53.00	51.00	47.66	54.66	53.00	45.66	46.66	50.00	51.00	53.33
Three	52.00	56.66	63.66	62.66	61.00	59.00	56.00	58.00	55.00	58.66
Control	65.33	59.33	63.00	61.33	67.66	60.33	60.00	66.00	67.00	66.66
L.S.D at 5%	**6.2**					**4.27**				
water regime	**Wt. of pods plant^{-1} (g)**									
One	17.05	18.93	22.70	22.90	19.50	15.86	19.60	18.50	23.14	22.26
Two	32.83	34.50	32.76	40.00	38.30	30.70	23.23	38.03	35.96	41.43
Three	39.83	40.90	49.03	50.86	43.43	42.86	44.53	44.90	41.23	44.86
Control	47.16	43.73	50.23	49.76	54.23	48.33	43.36	52.16	53.86	53.06
L.S.D at 5%	**5.06**					**4.71**				
water regime	**Wt. of seeds plant^{-1} (g)**									
One	12.63	16.13	18.14	18.33	15.60	12.86	16.46	13.93	18.33	17.80
Two	27.00	28.83	26.50	32.50	31.03	25.10	27.73	30.00	28.96	33.60
Three	31.66	34.60	40.06	41.73	35.63	35.43	37.33	36.00	33.60	37.00
Control	37.70	36.93	41.16	40.83	44.46	39.86	36.36	41.93	43.96	43.53
L.S.D at 5%	**4.04**					**3.83**				
water regime	**Wt. of 100-seed (g)**									
One	44.50	48.00	50.01	51.18	52.50	41.16	44.00	45.50	49.46	55.70
Two	51.50	55.01	53.50	60.50	59.50	55.00	58.00	59.50	58.80	62.70
Three	62.00	59.66	61.66	60.50	66.50	59.66	65.00	61.83	63.46	62.70
Control	58.50	60.83	64.00	67.50	66.50	65.50	59.16	63.00	70.49	65.03
L.S.D at 5%	N.S					**4.60**				
water regime	**Seed yield (kg fed^{-1})**									
One	1072	1212	1390	1361	1190	1140	1284	1371	1475	1525
Two	1278	1422	1530	1620	1710	1605	1578	1602	1700	1710
Three	1760	1735	1932	1886	1882	1808	1882	1985	1822	1803
Control	1760	1735	1748	1889	1974	1851	1802	1858	2015	1999
L.S.D at 5%	**129.3**					**76.3**				

One =One irrigation at flowering stage **Two =Two irrigation at vegetative and pod formation stages**
Three =Three irrigation at vegetative, flowering and pod formation stages **Control =Normal irrigation**

Moisture%, protein%, protein yield fed^{-1}, carbohydrate%, calcium% and potassium% in faba bean seeds were significantly affected by the interaction between water regimes and genotypes in both seasons (Table, 6). The lowest moisture% (7.46 and 6.60%) was recorded by one irrigation treatment under Moshtohor 5 and Moshtohor 8 genotypes in the first and second seasons respectively**,** while the highest moisture% (10.70 and 10.72%) were recorded by normal irrigation treatment under Misr 3 variety and Moshtohor 1084 genotype in the first and second seasons respectively. Moreover, The highest protein contents (33.35 and 34.65%) were obtained by application of one irrigation at flowering stage treatment with Moshtohor 8 genotype and Moshtohor 1084 genotype in the first and second seasons, respectively, whereas, the lowest values of protein content of 24.32 and 25.25% were recorded by application of four irrigations (control) treatment under Moshtohor 5 genotype in the first and second seasons, respectively. The highest values of protein yield fed^{-1} of 532.23 and 560.76 kg were produced from application of three irrigation treatment under Moshtohor 1084 genotype and Misr 3 variety in the first and second seasons, respectively. On the other hand, application of one irrigation treatment under Moshtohor 5 genotype gave the lowest protein yield fed^{-1} of 347.86 and 374.26 kg in the first and second seasons, respectively. The highest carbohydrates% (69.20 and 68.23%) were obtained by application of four irrigations treatment with Moshtohor 5 genotype in the first and second seasons, respectively, whereas, the lowest values of carbohydrates% (60.13 and 58.90%) were recorded by application of one irrigation treatment under Moshtohor 8 and Moshtohor 1084 genotypes in the first and second seasons, respectively. The highest calcium contents of 3.16 and 2.70% were obtained by application of control treatment with Misr 3 variety in the first season and Moshtohor 5, 8 and Moshtohor 1084 genotypes with the same value in the second season, whereas, the lowest value of calcium content of 2.20% was recorded by one irrigation treatment under Misr 3 variety in the first season and Moshtohor 5 and Nobaria 3 in the second season. The highest potassium% of 2.347 and 2.500% were obtained by one irrigation treatment with Misr 3 variety and Moshtohor 5 genotype in the first and second seasons, respectively, whereas, the lowest values of potassium% (1.430 and 1.340%) were recorded by application of control treatment under Misr 3 variety in the first and second seasons, respectively. This finding is in the same trend with this reported by Alghamdi (2009), Suhaibani (2009) and Abdel-Ghany et al, (2016).

Table 6. Effect of the interaction between water regime and faba bean genotypes on chemical contents for seeds in 2013/14 and 2014/15 seasons

Treatments	2013/2014 season (First season)					2014/2015 season (Second season)				
	Mosht 5	Mosht 8	Misr 3	Nobar 3	Mosht 1084	Mosht 5	Mosht 8	Misr 3	Nobar 3	Mosht 1084
water regime	**Moisture %**									
One	7.46	7.59	7.54	7.81	8.01	7.38	6.60	7.73	7.18	7.81
Two	8.25	8.47	8.90	9.20	9.33	8.17	8.27	8.67	9.34	9.32
Three	9.75	9.72	9.55	9.57	9.59	9.70	9.74	9.62	9.72	9.52
Control	10.01	10.56	10.70	10.56	9.57	10.22	10.62	10.17	10.32	10.72
L.S.D at 5%	**N.S**					**0.05**				
water regime	**Protein %**									
One	32.45	33.35	32.55	32.45	30.62	32.83	33.55	34.42	33.55	34.65
Two	29.42	29.72	30.36	30.46	29.45	30.45	30.60	29.42	29.62	28.45
Three	24.47	27.35	27.45	27.65	28.28	27.25	27.50	28.25	28.35	28.55
Control	24.32	25.42	25.62	26.45	26.36	25.25	25.32	26.42	26.32	26.44
L.S.D at 5%	**0.03**					**0.04**				
water regime	**Protein yield (kg fed^{-1})**									
One	347.8	404.2	452.4	441.6	364.3	374.2	430.7	471.9	494.8	528.4
Two	375.9	422.6	464.5	493.4	503.5	488.7	482.8	471.3	503.5	486.4
Three	430.6	474.5	530.3	521.4	532.2	492.7	517.5	560.7	516.5	514.7
Control	428.0	441.0	447.8	499.6	520.3	467.3	456.2	490.9	530.3	528.5
L.S.D at 5%	**41.85**					**26.45**				
water regime	**Carbohydrates %**									
One	61.03	60.13	60.93	61.06	63.00	60.66	59.93	59.10	59.93	58.90
Two	64.10	63.80	63.10	63.03	64.10	63.03	62.90	64.10	63.80	65.06
Three	67.03	66.16	66.03	65.83	65.26	66.23	66.00	65.26	65.50	64.96
Control	69.20	68.10	67.90	67.06	67.16	68.23	68.20	67.10	67.20	67.16
L.S.D at 5%	**0.057**					**0.245**				
water regime	**Calcium%**									
One	2.30	2.40	2.20	2.30	2.26	2.20	2.30	2.36	2.20	2.30
Two	2.40	2.20	2.50	2.40	2.50	2.40	2.40	2.36	2.50	2.40
Three	2.60	2.70	2.70	2.60	2.60	2.46	2.60	2.66	2.50	2.60
Control	2.73	2.70	3.16	2.60	2.73	2.70	2.70	2.63	2.60	2.70
L.S.D at 5%	**0.21**					**0.09**				
water regime	**Potassium %**									
One	2.290	2.340	2.347	2.157	2.353	2.500	2.400	2.303	2.040	2.200
Two	1.970	1.940	1.890	1.707	1.563	2.300	2.300	1.877	1.733	1.573
Three	1.887	1.597	1.710	1.687	1.583	1.570	1.470	1.560	1.523	1.410
Control	1.563	1.560	1.430	1.523	1.590	1.510	1.580	1.340	1.420	1.540
L.S.D at 5%	**0.18**					**0.01**				

One =One irrigation at flowering stage **Two =Two irrigation at vegetative and pod formation stages**
Three =Three irrigation at vegetative, flowering and pod formation stages **Control =Normal irrigation**

-Water relationship:

The amount of irrigation water used m^3 fed^{-1} throughout the season, water saved percentage and seed yield reduction as well as water use efficiency is presented in **Table (7)**. Results showed that one irrigation at flowering stage (One), two irrigation at vegetative and pod formation stages (Two), three irrigation at vegetative, flowering and pod formation stages (Three) and normal irrigation (Control) tended to increase the amount of water used from 300, 500 to 600 and 800 m^3 fed^{-1}, respectively. Under one irrigation treatment decreased the water used from 300 m^3 fed^{-1} for faba bean genotypes, consequently water was saved by 62.5%. Water saved two and three treatments compared to control treatment was 37.5 and 25.0% with corresponding seed yield reduction of 15.42 and 0.52% for two and three treatments,

respectively. The amounts of water saved due to irrigation regimes ranged from 62.5% recorded by one irrigation treatment under faba bean genotypes, to 37.5% recorded by two irrigation treatment under faba bean genotypes, to 25.0% recorded by two irrigation treatment under faba bean genotypes. Concerning water use efficiency (WUE) values for different aspects. Obviously, WUE was the highest by one irrigation treatment (4.34 kg m^{-3}). Regarding the effect of faba bean genotypes on water use efficiency, data observed that increased WUE from 2.95 to 3.39 kg m^{-3} by Moshtohor 5 genotype and Nobaria 3 variety, respectively.

Table 7. Water relations and seed yield reduction (%) as affected by water regimes and faba bean genotypes. (Average of two seasons)

Water relations	water regimes	Faba bean genotypes					Mean
		Mosht. 5	Mosht. 8	Misr 3	Nobar 3	Mosht. 1084	
Water applied m^3 fed^{-1}	One	300	300	300	300	300	300
	Two	500	500	500	500	500	500
	Three	600	600	600	600	600	600
	Control	800	800	800	800	800	800
Mean		550	550	550	550	550	550
Water saved (%)	One	62.5	62.5	62.5	62.5	62.5	62.5
	Two	37.5	37.5	37.5	37.5	37.5	37.5
	Three	25.0	25.0	25.0	25.0	25.0	25.0
	Control	--	--	--	--	--	--
Mean		41.16	41.16	41.16	41.16	41.16	41.16
Seed yield reduction (%)	One	38.74	29.43	23.43	27.36	31.66	30.12
	Two	19.88	15.18	13.14	14.96	13.92	15.42
	Three	1.19	+2.26	+8.62	5.02	7.25	0.52
	Control	--	--	--	--	--	--
Mean		8.62	9.25	8.65	6.85	9.39	8.55
Water use efficiency (WUE) kg m^{-3}	One	3.69	4.16	4.60	4.73	4.53	4.34
	Two	2.88	3.00	3.13	3.32	3.42	3.15
	Three	2.97	3.01	3.26	3.09	3.07	3.08
	Control	2.26	2.21	2.25	2.44	2.48	2.33
Mean		2.95	3.09	3.31	3.39	3.37	3.22

One =One irrigation at flowering stage Two =Two irrigation at vegetative and pod formation stages
Three =Three irrigation at vegetative, flowering and pod formation stages Control =Normal irrigation

REFERENCES

Abdellatif, K. F.; E. A. El Absawy and Asmaa M. Zakaria, 2012. Drought stress tolerance of faba bean as studied by morphological traits and seed storage protein pattern. Journal of Plant Studies; Vol. 1(2):47-54.

Ainer, N.G.; W.I. Miseha and H.H. Abdel-Maksoud, 1994. Water management for faba bean in the Delta. Zagazig J. Agric. Res . 20(6): 2045-2053.

Al Ghamdi, S., 2007. Genetic behavior of some selected faba bean genotypes. African Crop Science Proceedings, 8: 709-714.

Al-Fageh, Fatma, M. and S.A.S. Mehasen, 2006. Response of two new genotypes of faba bean to nitrogen and phosphorus fertilization. Annals of Agric. Sci., Moshtohor. 44 (3): 877-886.

A.O.A.C. 2000. Official Methods of Analysis Association of official analysis chemists, 14th Ed., Washington, D.C., USA.

Bakry, B.A., T.A. Elewa, M.F. El karamany, M.S. Zeidan and M.M. Tawfik, 2011. Effect of row spacing on yield and its components of some faba bean varieties under newly reclaimed sandy soil condition. World J. Agric. Sci., 7 (1): 68-72.

Ebaid, M.A. 1990. Effect of weed control method and irrigations number on growth and yield of field bean (*Vcia faba L*.) Annals of Agric. Sc., Moshtohor 28(3): 1429-1439.

El-Hadidi, E. M.; M. M. Kassab and Sara M. El-Tobgy,2012. Effective management of faba been watering under different irrigation levels. J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 3 (8): 807 – 814.

El-Hadidi, M.E.; Samia M.EL-Marsafawy and I.M. Abdel- Fattah, 2014. The amount of water should be applied for faba bean crop under drip and deficit irrigation.J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol.5 (4): 557 -567.

El-Hosary, A.A. and S.A.S. Mehasen, 1998. Effect of foliar application of zinc on some new genotypes of faba bean. Annals of Agric. Sc., Moshtohor, 36 (4): 2075-2086.

Hansen, V.E., O.W. Israelsen and G.E. Stringham, 1980. Irrigation principles and practices. 4th ed. John Willey & Sons Inc. USA.Hare.

Hendawey, M.H. and A.M.A. Younes, 2013. Biochemical evaluation of some faba bean cultivars under rainfed conditions at El-Sheikh Zuwayid. Annals of Agricultural Science., 58(2), 183–193.

Ibrahim, E. M. 2011. Effect of preceding summer crops and irrigation systems on faba bean planted at different ridges width.J.Plant Production, Mansoura Univ., 2 (11): 1579 – 1592.

Mehasen, S.A.S., 1998. Response of some new pure lines of faba bean to irrigation treatments. Annals of Agric. Sci., Moshtohor, 36 (4): 2063-2073.

Mekkei, M. El. R. 2014. Effect of skipping irrigation at various growth stages on yield and quality of some faba bean cultivars (*vicia faba* L.). J. Plant Production, Mansoura Univ., Vol. 5 (7): 1303-1315.

Osman, A.A.M., S.O. Yagoub and O.A. Tut, 2010. Performance of faba beans (*Vicia faba* L.) cultivars grown in new agro-ecological regions of Sudan (South Sudan). Australian J. Basic and Appl. Sci., 4(11): 5516-5521.

Ouda, Samiha A.; M. A. Shreif and R. Abou Elenin, 2010. Increasing water productivity of faba bean grown under deficit irrigation at middle Egypt. Fourteenth International Water Technology Conference, IWTC 14 2010, Cairo, Egypt.

Siddiqui, M. H.; M. Y. Al-Khaishany; M. A. Al-Qutami ; M.H. Al-Whaibi ; Anil Grover ; H. M. Ali ; Mona S. Al-Wahibi andNajat A. Bukhari, 2015. Response of different genotypes of faba bean plant to drought stress.International Journal ofMolecular Sciences.16: 10214-10227.

Snedecor, G.W. and W.G. Cochran, 1990. Statistical Methods 8th Ed. Iowa State press, Iowa, USA.

Tageldin, M.H.A. and S.A.S. Mehasen, 2004. Faba bean cultivars fertilized with phosphorus assessed for precision and bias of yield estimation techniques, and for yield component power and sample size. Annals of Agric. Sc., Moshtohor, 42 (3): 975-988.

Tayel, M.Y. and Kh.P. Sabreen, 2011-b. Effect of irrigation regimes, phosphorous level and two Vicia faba varities on II-yield, water and phosphorous use efficiency. Journal of Applied Sciences Research, 7(11): 1518-1526.

تأثرجودة ومحصول البذور لتراكيب وراثية من الفول البلدى بكميات مياه الرى

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أقيمت تجربتان حقليتان بمركزالتجارب و البحوث الزراعية بكلية الزراعة بمشتهر – جامعة بنها- محافظة القليوبية- مصر خلال موسمى الزراعة 2014/13 و 2015/14 م لدراسة تأثير اربع معاملات رى فى مراحل نمو مختلفة من حياة النبات وهي { رية واحدة بعد 90 يوم من الزراعة (300م3/ فدان) ، ريتان بعد 60 و 120 يوم من الزراعة (250م3/ فدان في الرية) ، ثلاث ريات بعد 45 و90 و135 يوم من الزراعة (200م3/ فدان في الرية)، رى عادي أربع ريات (200م3/ فدان في الرية)} على المحصول ومكوناتة وجودة البذور لخمس تراكيب وراثية من الفول البلدى وهى (مشتهر 5 ، مشتهر 8 , مصر 3 , نوبارية 3 ومشتهر1084) و استخدم تصميم قطع منشقة حيث وضع الرى فى القطع الرئيسية والتراكيب الوراثية فى القطع الشقية فى ثلاث مكررات. وكانت أهم النتائج المتحصل عليها كما يلى:

-أدت زيادة عدد الريات الى زيادة معنوية فى جميع الصفات المدروسة بإستثناء البروتين % و البوتاسيوم % تناقصت بزيادة عدد الريات / ف بالمقارنة بمعاملة الرية الواحدة فى كلا الموسمين.

-أظهرت التراكيب الوراثية من الفول البلدى اختلافاً معنوياً فى جميع الصفات المدروسة ما عدا عدد القرون والبذور/ نبات.

- تأثير التفاعل كان معنوياً بين عدد الريات/ ف والتراكيب الوراثية من الفول البلدى فى جميع الصفات المدروسة ما عدا وزن 100 بذرة و % للرطوبة فى البذور فى الموسم الاول.

لذا توصى الدراسة بزراعة مشتهر 1084 ، نوبارية 3 ومصر 3 بإستخدام ثلاث أو أربع ريات / ف بدون فروق معنوية.