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PRODUCTIVITY AND CHOCOLATE SPOT AND RUST DISEASES OF SOME FABA BEAN CULTIVARS UNDER DIFFERENT SOWING DATES AND SALICYLIC ACID CONCENTRATES

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ABSTRACT

Two experiments were conducted at the experimental Farm at Tag El-Ezz, Dakahlia, Egypt, during 2008/2009 and 2009/2010 to evaluate the productivity, chocolate spot and rust diseases for five faba bean cultivars under two sowing dates and three salicylic acid concentrations. Sowing date November 15th gave the highest values of morphological and yield characters while, gave the lowest values of chocolate spot and rust compared with October 15th sowing date in both seasons. Seed yield/fed. recorded 8.17 and 7.49 ardab** /fed*. for sowing date November 15th and 6.17 and 6.15 ardab/fed. for the sowing date October 15th in both seasons, respectively. Giza 716 produced the highest seed yield/fed. in the second season, but no significant differences were observed between faba bean cultivars in the first season. The maximum reduction in severity of chocolate spot and rust diseases accrued under the application of salicylic acid (SA) at 150 mg/L. at the two sowing dates in both seasons. Whereas, led to marked improvement in morphological characteristics and yield. The interaction between sowing date and faba bean cultivars led to significant increase in plant height, straw yield, seed weight/plant and seed yield in both seasons. The maximum reduction of chocolate spot and rust disease severity was recorded with Giza 716 in November 15th planted under application of SA at 150 mg/L.

The correlation coefficient cleared significant positive correlation between seed yield and each of individual studied characters. Multiple regression analysis indicated that the relative contribution for all characters gave 93.06% from the total variations of yield. Stepwise regression revealed that three out of six variables significantly affected seed yield/plant, these variables were seed weight, number of branches and number of pods per plant.

The present investigation recommends to planting Giza 716 cultivar in November 15th with spraying of SA (150mg/l.) after 50 and 70 days from sowing to decrease the severity of chocolate spot and rust diseases and improve faba bean productivity.

Keywords: Sowing date, Cultivars, faba bean, salicylic acid, chocolate spot and rust disease.

*Feddan =4200m^2, **ardab=155kg.

INTRODUCTION

Faba bean *(vicia faba L.)* is one of the major field crops grown in Egypt, it is an important source of protein for human and animal consumption and it plays a role in crop rotation. However, the total production of this crop is still insufficient to cover the local consumption. So, there is a great need to overcome this gap between local production and consumption by expansion through reclaimed area which represent the most hope of cultivated land in increasing our agricultural production and subsequently in overcoming the

deficiency in food requirements, as well as increasing the vertical production through sowing dates and production of new varieties with high yield potential.

Sowing date is one of the most important agronomic factors relating to crop growth and yield. It affects greatly on the time duration of vegetative and reproductive growth as well as the degree of infection with plant diseases. The recommended plant date of faba bean is considered important to allow and adequate length of growing season before the onset of hot weather in late spring to gave high seed yield (Adisarwanto and Knight, 1997; Refay, 2001; Confalone and Ssu, 2006; Hashemabadi and Sedaghathoor, 2006 and Mahmoud and Gamalat, 2008).

Cultivars are important production component where yield is determined by the genetic makeup of the cultivar and interaction with the environmental conditions. In this respect, Rahman (2002) reported that growth characteristics and yield components of tested cultivars are affected with different sowing dates.

Chocolate spot caused by *Botrytis Faba* surd. (Rahman et al., 2002), and rust *(Uromyces vicia faba* pers, Schroet.) diseases are the most important limiting factors which cause great annual losses and sometimes complete crop failures (Mohamed, 1982; Hebblethwait, 1983 and Hanounik and Bisri, 1991) . Chocolate spot occurs mainly on leaves , but stems and flowers may also be infected under favorable conditions. Under optimum conditions of temperature (18 -20^{o}c) and relative humidity (90 to100 %), the infection becomes aggressive. Also, under prolonged wet conditions, the disease may reach epidemic with heavy crop losses (Harrison, 1988 and Bernier *et al*, 1993). The infection by *Uromyces vicia faba* first appears as minute, slightly raised, white to cream coloured spots on leaves and to a lesser extent on stems. As spots enlarge the epidermis ruptures, releasing masses of dark brown spores (urediospores) to form characteristic pustules (uredia). The pustules are often surrounded by a range of yellow tissue. On highly susceptible cultivars, rust can build up rapidly until most of l eaves are covered with pustules. Severely infected leaves rapidly dry up and premature defoliation may occur (Bernier *et al,* 1993).

Application of fungicides leads to the risk of developing new resistant strains of pathogens (Smith and Littredl, 1980). The current trend in crop protection against diseases is to apply different chemical inducers. Various chemical inducers have been considered for their potential to induce systemic resistance in the host plant project from different pathogens. Salicylic acid has been extensively studied for its role in disease resistance and has been demonstrated as a resistance inducer in several plant species, including in barely against *Erysiphe graminis* (Walters *et al.,* 1993) and rice against *Pyricularia oryzae* (Manandhar et al. 1998) . Ryals and Ward (1994) mentioned that all plants have the ability to defend themselves against pathogenic infection through a wide variety of mechanisms that can be local or systemic, constitutive or inducible.

This investigation is an attempt to study the effects of sowing dates and salicylic acid in increasing the productivity and decreasing chocolate spot

and rust infections in faba bean cultivars in newly reclaimed soil at Dakahlia Governorate.

MATERIALS AND METHODS

Two field experiments were carried out during 2008/2009 and 2009/2010 seasons in the Experimental Farm, Tag El- Ezz Station, Dakhalia Governorate, Egypt, to evaluate the growth, chocolate spot and rust infection, yield and yield components of five faba bean cultivars under two sowing dates with using two salicylic acid concentrations in newly reclaimed soils .

Soil analysis:-

Samples of soil were taken from the soil depth of 30 cm from all sites of experiments. This was done after harvesting of the preceding summer crop, nitrates at soil samples were determined according to Kieldahl method as described by Jackson (1958) . The field soil was clay loam in texture with medium salinity according to united state salinity laboratory (1954) as presented in Table(1).

Table 1: Mechanical and chemical analysis of experimental soil of Tag EL-Ezz .

a) Soil physical analysis (average two seasons)

Soil sample	Course sand%	Fine sand %	Silt %	Clay %	Soil texture
Average	3.00	10.60	33.20	53.20	Clayey loam

b) Chemical analysis of soil (average two seasons)

Soil sample	Na*	. K*	Ca**	Mg**	Hco3-	Cl-	So4-	Ec ppm-moh	E.C m.moh	PH
Average	14.0	0.24	14.30	7.61	0.49	15.14	17.61	2624	4.1	8.2

Sowing dates:

Two sowing dates, i. e. October 15th and November 15th were using in these experiments.

Varieties:

Giza 716, Sakha 1, Giza 40, Giza 3 and Sakha 2 were obtained from Field Crops Research Institute, A.R.C. Giza, Egypt.

Elicitors:

SA obtained from Sigma Chemicals Co (St- Louis, Mo, USA), was used at two concentrations, i.e (100 and 150 mg/L.) as foliar treatments. Developed plants from each assigned treatment were sprayed with individual elicitors three times with 30 day intervals beginning from 20 days after sowing, plants sprayed with tap water only served as check

Disease assessment:

The disease severity (DS) of chocolate spot disease was estimated at 45 and 65 days from sowing under natural infection conditions by using scale of Bernier *et al.* (1993) as follows :

1=No disease symptoms or very small specks (highly resistance).
3= Few small discrete lesions (resistant).
5= Some coalesced lesions with some defoliation (moderate resistant).
7= Large coalesced sporulating lesions, 50% defoliation and some dead plant (susceptible).
9= Extensive lesions on leaves, stems and pods, severe defoliation , heavy sporulation stem girdling, blackening and death of more than 80% of plants (highly susceptible).

The disease severity of rust was recorded at 100 days frome sowing according to the standard scale suggested by Bernier *et al.*, (1993) as follows :

1=No pustules or very small non sporulating flecks (highly resistant).
3= Few scattered pustules covering less than 1% of leaf area, and few or no pustules on stem (resistant) .
5= Pustules common on leaves covering 1 -4 % of leaf area, little defoliation and some pustules on stem (moderately resistant).
7=Pustules very common on leaves covering 4 -8% of leaf area, some defoliation and many pustules on stem (Susceptible).
9=Extensive pustules on leaves, petioles and stems covering 8 -10% of leaf area, many dead leaves and severe defoliation (highly susceptible).

Percentages of chocolate and rust diseases severity were calculated using the formula adopted by (Hanounik, 1986):

$$\text{Disease severity \%} = \frac{(\text{NPC} \times \text{CR}) \times 100}{(\text{NIP} \times \text{MSC})}$$

Where:

NPC = No. of plants in each class rate
CR = Class rate
NIP = No. of infected plants
MSC= Maximum severity class rate

The experiment included 90 experimental units, which were combinations two sowing dates x five faba bean cultivars x three foliar application of SA x three replicates. The experimental unit included five ridges with 60 cm width apart, and 3.5 meters length occupying an aria of 10.5 m2 i.e 1/400 fed. Treatments were arranged on split-split plot design with three replicates. Sowing dates were arranged in the main plots, cultivars were the sub plots and salicylic acid concentrations were in the sub-sub plots. Calcium super phosphate (15.5% P2O5) was added during soil preparation at the rate of 200 kg/fed. Potassium sulfate (48 % K2O) was added at the rate of 50 kg/fed. with the first irrigation .

5 – Studied characters:

At harvesting, plant samples were taken at random from each plot to determine the following characters:

1- Plant height (cm).
2- Number of branches/ plant.
3- Number of pods /plant.
4- Seeds weight (g) /plant.
5- 100- seed weight (g.).

6- Seed yield /fed. Weight of seeds harvested from each plot and converted to ardab /fed. (ardab = 155kg).
7- Straw yield (Ton/fed.), it was calculated by sub – starting seed yield the total yield for each plot and converted to Ton /fed.
6- Statistical analysis:-

The collected data were statistically analyzed according to the technique of analysis of variance of split–split plot design by means of "MSTAT-C" computer software package, the least significant difference (LSD) method was used to test the differences between treatment means at 5% probability, as published by Gomez and Gomez (1984). The relationships among dependent and independent variable through calculating simple correlation coefficient by Sendecor and Cochran (1989) was estimated by means of the correlation coefficient (r) between each of dependent and independent variable, multiple regression analysis according to Draper and Smith (1987) to calculate the coefficient of determination (R2) and to estimate relative contribution of independent variables for each dependent variable and to get the prediction equations and stepwise multiple regression analysis to determine the variables accounting for the majority of total variability independent character as described by Draper and Smith (1987).

RESULTS AND DISCUSSION

A – Morphological characters:

Results in Table (2) markedly indicated that November 15th sowing date gave the highest increase in plant height and number of branches/plant compared with October 15th sowing. The increases were (22 and 27%) for plant height and (30 and 31%) for number of branches /plant for November 15th over October 15th in both seasons, respectively. This effect may be due to the high temperature through October which leads to early flowering and consequently decreased plant height and number of branches/plant compared with the low temperature through November. These findings were in agreement with those reported by Hassan, *et al.* (1997), Pascale and Barbieri (1997), Refay (2001) and Confalone and Sau (2006).

The results in Table (2) Shows that there is a highly significant differences among faba bean cultivars for plant height and number of branches/plant in both seasons. Giza 3 cultivar was surpassed for plant height than other cultivars in both seasons. The percentage increase for plant height was (30, 31, 12 and 30%) in the first season and (34, 43, 14 and 39%) in the second season over Giza 716, Sakha 1, Giza 40 and sakha 2, respectively . On the other hand, Sakha 1 cultivar gave the highest value of number of branches/plant compared with the other cultivars. Similar results were reported by Al- Koddousi (1996), Hussein, *et al.* (1999), Refay (2001) and saad and El-Kholy (2001)

Data in Table (2) indicated that both morphological characters were significantly affected by sprayingwith salicylic acid in both seasons. SA at 150 mg/ L. was more effective. Similar results with Pascale and Barbieri (1997), El- Hakem (2008) and Khafaga, *et al.* (2009).

B – Yield and yield components:

Means of pods number and seed weight, 100-seed weight, seed yield (ardab /fed,) and straw yield (Ton /fed.) are presented in Table 3. Data show that November 15th sowing date gave the highest increases in all yield characters compared with October 15th sowing date. The percentage increases were (51 and 52%) for number of pods/plant, (27 and 22 %) for seeds weight (gm plant), (20 and 20 %) for 100-seed weight, (33 and 18 %) for seed yield /fed. and (27 and 19 %) for straw yield with November 15th sowing date over October 15th sowing date in both seasons respectively. These findings were in agreement with those reported by Stuztel, *et al.* (1995), Alkoddousi (1996), Rafey (2001) and Hashemabadi and Sedaghathoor (2006) they stated that the high temperature in early sowing dates lead to decrease in the yield and it's components.

Table (2): Plant height and number of branches/plant of Faba bean cultivars as influenced by sowing dates and salicylic acid during 2008/2009 and 2009/2010 seasons

Characters / Seasons	Plant height (cm)		Number of branches/plant	
	2008/2009	2009/2010	2008/2009	2009/2010
A. Sowing dates				
a1- October 15th	90.64	89.96	2.88	2.73
a2- November 15th	110.67	111.58	3.65	3.57
F – test	**	**	**	**
B-Cultivars :-				
b1- G. 716	93.33	92.11	3.35	3.16
b2- Sakha 1	91.28	86.44	3.45	3.50
b3- G. 40	107.00	108.33	3.35	3.06
b4- G. 3	119.44	123.28	2.96	2.93
b5- Sakha 2	92.22	88.69	3.22	3.02
F- test	**	**	**	**
LSD	7.18	3.68	0.20	0.20
C- Salicylic acid				
c1- Control	96.60	96.97	2.96	2.82
c2- 100 mg/L.	97.73	99.35	3.40	3.25
c3- 150 mg/L.	107.63	105.97	3.47	3.38
F-test	**	**	**	**
LSD	5.28	4.10	0.08	0.06
D-Interactions				
d1- A xB	**	**	**	ns
d2- A x C	**	**	ns	ns
d3- B x C	ns	ns	ns	ns

Data inTable (3) show that, G. 716 cv. gave the highest values of number of pods and seed weight /plant and seed yield/fed. The percentage increases for seed yield/fed. were (1, 3, 11 and 11%) over Sakha 1, G. 40, G. 3 and Sakha 2 cultivars, respectively in the second season only . On the other hand, Giza 3 cultivar recorded the highest values of 100-seed weight and straw yield /fed. in both seasons. These results are in line with those

reported by Hassan, *et al.* (1997), Hussein, *et al.* (1999), Refay (2001), Saad and El-Kholy (2001), El-Murshedy *et al.* (2002) and El- Hindi *et al.* (2008).

Data in Table (3) show that yield and yield components significantly affected with spraying by salicylic acid at both concentrations. SA at 150 mg/L. gave the highest values of all characters under this study compared with 100 mg/L. concentration and untreated treatment. Seed yield/ fed. recorded (12%) for 150 mgr/ L. over untreated treatment in the first season and (14 and 2%) in the second season for 150 mg/L over 100 mg/L. and control treatments, respectively and the straw yield (17 and 16%) and (15 and 13%) for 150 mg/L. over 100 mg/L. and the control in the two seasons, respectively . Similar results recorded by Harrison (1981), McEwen, *et al.* (1988) Bouhassan, *et al.* (2004) and Torres, *et al.* (2004).

Table 3: Number of pods and seed weight (gm/plant), 100-seed weight, seed yield (ardab/ fed.) and straw yield (Ton/fed.) of faba bean cultivars as influenced by sowing dates and salicylic acid concentrations in 2008/2009 and 2009/2010

Characters / Seasons	No. of pods/plant		Seed weight (g)/plant		100-seed weight (g)		Seed yield ardab./fed.		Straw yield ton/fed.	
	2008/9	2009/10	2008/9	2009/10	2008/9	2009/10	2008/9	2009/10	2008/9	2009/10
A-Sowing dates										
a1-October 15th	9.92	8.95	9.93	10.28	55.48	55.20	6.17	6.15	1.24	1.35
a2- November 15th	14.96	13.64	12.62	12.58	66.69	66.02	8.22	7.49	1.580	1.60
F- test	**	**	**	**	**	**	**	**	**	**
B-Cultivars										
b1-G. 716	13.25	12.03	11.72	11.98	68.83	64.90	7.39	7.16	1.40	1.49
b2- Sakha 1	13.03	11.56	11.35	11.94	51.70.	56.28	7.28	7.10	1.26	1.41
b3- G. 40	12.74	11.48	10.87	10.88	54.22	55.83	7.12	6.93	1.38	1.33
b4- G. 3	12.10	11.03	11.53	11.64	71.50	68.76	7.10	6.47	1.58	1.65
b5- Sakha 2	11.08	10.39	10.91	10.72	59.17	57.28	7.05	6.42	1.44	1.50
F- test	**	*	*	**	**	**	Ns	**	**	**
LSD	1.14	0.71	0.51	0.47	3.65	1.23	--	0.26	0.03	0.07
C-Salicylic acid										
c1- control	11.18	10.37	10.60	10.53	58.43	57.43	6.66	6.29	1.33	1.39
c2-100 mg/L.	12.88	11.70	11.61	11.80	60.83	58.75	7.44	7.02	1.34	1.42
c3- 150 mg/L.	13.26	11.79	11.62	11.96	63.97	65.65	7.46	7.15	1.56	1.61
F-test	**	**	**	**	**	**	**	**	**	**
LSD	0.48	0.28	0.27	0.41	1.30	1.41	0.14	0.25	0.03	0.05
D- Interactions										
A x B	**	Ns	*	Ns	Ns	**	**	**	**	**
A x C	Ns	**	Ns	Ns	Ns	**	**	**	**	**
B x C	**	*	**	Ns	Ns	**	Ns	Ns	**	ns

The interactions among studied factors had significant effects on studied characters as shown in Table (4). Planting Giza 3 cultivar at mid November recorded the highest values of plant height (120.44 and 129.11 cm) and straw yield (1.746 and 1.834 t/fed.) in both seasons, respectively.

On the other hand, data in Table (5) indicated that the planting Giza 716 cultivar at mid November recorded the highest values of seed weight/plant (13.45 and 13.56 g.) and seed yield (ardab/fed.) (8.59 and 8.01ardab/fed.) whereas sowing Sakha2 at mid October recorded the lowest seed yield values (5.89 and 5.65 ardab) at both seasons, respectively .

Table 4: Plant height (cm) and straw yield Ton/fed. as affected by the interaction between sowing dates of faba bean cultivars in 2008/2009 and 2009/2010 seasons

Characters	Plant height (cm)				Straw yield (Ton/fed.)			
Seasons	2008/2009		2009/2010		2008/2009		2009/2010	
Sowing dates	October 15th	Novem. 15th	October 15th	Novem. 15th	October 15th	Novem. 15th	October 15th	Novem. 15th
Cultivars								
Giza 716	72.89	113.78	70.89	111.33	1.153	1.643	1.382	1.592
Sakha 1	76.56	106.00	70.00	102.89	1.096	1.422	1.286	1.527
Giza 40	99.67	114.33	98.44	118.22	1.189	1.572	1.244	1.416
Giza 3	118.44	120.44	117.44	129.11	1.414	1.746	1.438	1.834
Sakha 2	85.67	98.78	83.00	94.33	1.354	1.528	1.373	1.628
F-test	**		**		**		**	
LSD	13.20		6.81		0.11		0.12	

Table 5: Seed weight (g)/plants and seed yield (ardab /fed.) as affected by the interaction between sowing dates of faba bean cultivars during the two growing seasons 2008/2009 and 2009/2010

Characters	Seed weight (g) /plant				Seed yield (ardab /fed.)			
Seasons	2008/2009		2009/2010		2008/2009		2009/2010	
Sowing dates	October 15th	Novem- 15th	October 15th	Novem- 15th	October 15th	Novem. 15th	October 15th	Novem. 15th
Cultivars								
Giza 716	9.61	13.45	10.41	13.56	6.05	8.59	6.25	8.01
Sakha 1	9.82	12.88	10.63	13.25	6.18	8.14	6.31	7.99
Giza 40	9.74	12.01	9.62	12.14	6.18	8.06	5.75	7.20
Giza 3	11.09	12.34	11.29	11.98	6.56	8.01	6.81	7.04
Sakha 2	9.40	12.43	9.49	11.96	5.89	8.20	5.65	7.20
F- test	*		**		*		**	
LSD	0.95		0.87		0.55		0.48	

C-Disease assessment:-

1-Chocolate spot disease

Data presented in Table (6) showed that disease severity (DS) with chocolate spot disease caused by *Botrytis faba* was decreased significantly under November 15th sowing date from 15.01 to 9.81 in 45 days after sowing and 12.46 to 7.69 in 65 days after sowing in the first season also, from 14.7% to7.69% in 45 days and 11.45 to 6.42 in 65 days in the second season was delayed from October to November 15th. The results are in line with those obtained by Mc Ewen *et al.* (1988) in UK, who found that early sowing in late

of September increased the risk of chocolate spot disease. The present results showed that the DS were higher in the first season than those of the second one, this may be attributed to lower temperature and higher relative humidity (RH) in the first season as two climatic factors affecting this disease (Harrison, 1981).

Results in Table (6) showed that Giza 716 cultivar followed by Sakha 2 were highly resistance for infection of chocolate spot and rust disease. In contrast, Giza 40 followed by Giza 3 were highly sensitive. The relative tolerance of these evenly due to their genotypic factors which may be delayed the infection or enabled the plants to prevent its spreading. Harrison (1981), suggested caused cell death and thereby during of the tissue, thus preventing further fungal growth and lesion development.

Table 6: Effect of sowing dates, faba bean cultivars and salicylic acid on chocolate spot disease severity in faba bean at 45 and 65 days after sowing during 2008/2009 and 2009/2010 seasons

Seasons	2008/2009		2009/2010	
Sowing dates	45 day	65 day	45 day	65 day
A-Sowing dates				
a1-October 15th	15.01	12.46	14.70	11.45
a2-November 15th	9.81	7.69	7.69	6.42
F-test	**	**	**	**
B-Cultivars				
b1-Giza 716	8.74	6.16	7.90	5.74
b2-Sakha 1	11.94	9.00	10.31	7.89
b3-Giza 40	16.32	14.91	15.51	12.45
b4-Giza 3	14.28	12.36	13.74	11.16
b5-Sakha 2	10.77	7.96	10.16	7.75
F-test	**	**	**	**
LSD	1.34	0.77	1.34	0.40
C-Salicylic acid				
c1-Control	14.36	11.07	12.52	11.78
c2-100 mg/L.	12.73	10.06	11.52	8.70
c3-150 mg/L.	10.51	9.10	10.13	6.43
F-test	**	**	**	**
LSD	2.03	0.11	1.85	0.31
D-Interactions:				
d1- A x B	**	**	**	**
d2- A x C	ns	**	**	**
d3- B x C	ns	**	ns	**
d4- A x B x C	*	**	ns	Ns

Data presented in Table (6).showed that the application of both levels of SA on faba bean plants significantly reduced chocolate spot and rut disease DS compared with check treatment. However, at 45 and 65 days after sowing, SA 150 mg/L. was superiority in reducing chocolate spot disease severity in both seasons. The mode of action of chemical inducers for controlling plant diseases may include : (1) acting as second messengers in enhancing the host defense mechanism (Geetha and Shetty 2002); (2)

activating resistance by increasing the activity of peroxides (POD) , the synthesis of new POD iso forms, or the accumulation of the phenol compound (Hassan et al. 2007 and Sarma *et al.* 2007), (3) activating resistance through inhibition of some antioxidant enzymes and catalase thereby leading to production of elevated amounts of H2O2 accumulation (Radwan *et al.* 2008) and (4) enhancing resistance by direct effects on multiplication, development, and survival of pathogens or indirect effects on plant metabolism, with subsequent effects on the pathogen food supply . As evident from the differential mode of action of the chemical inducers, the varying efficiencies among there chemicals in protecting faba bean against chocolate spot and rust disease have been observed under field conditions.

The interaction between cultivars and sowing dates substances on disease severity in the two seasons was shown in Table (7). November 15th sowing date at all cultivars showed the best and most effective in reducing DS on all tested cultivars.

Interaction between faba bean cultivars and SA treatments on chocolate spot disease severity in 2008/2009 and 2009/2010 seasons are shown in Table (8) .The lowest values of chocolate spot disease severity occurred under the application of SA at 150mg /L. in all tested cultivars.

Table 7: Effect of faba bean cultivars and sowing dates on chocolate spot disease after 45 and 65 days sowing during 2008/2009 and 2009/2010 seasons

characters	45 day from sowing				65 day from sowing			
seasons	2008/2009		2009/2010		2008/2009		2009/2010	
Sowing dates	Oct. 15th	Nove. 15th	Oct. 15th	Nove. 15th	Oct. 15th	Nove. 15th	Oct. 15th	Nove. 15th
Giza 716	12.64	11.70	11.10	4.70	9.89	2.42	7.89	3.59
Sakha 1	14.61	8.89	14.79	6.76	12.55	5.53	11.70	4.33
Giza 40	18.00	14.63	18.12	12.91	16.49	13.32	14.29	10.40
Giza 3	17.22	14.15	14.80	12.68	12.79	11.74	12.63	9.70
Sakha 2	12.77	6.64	13.55	5.83	10.40	5.46	11.10	4.07
F- test	**		**		**		**	
LSD	1.66		2.21		0.82		0.77	

Table 8: Effect of faba bean cultivars and salicylic acid on chocolate spot disease severity in faba bean at 45 and 65 days after sowing

Characters	65 days from sowing			65 days from sowing		
(SA) concentration	Control	100 mg/L.	150 mg/L.	Control	100 mg/L.	150 mg/L.
Cultivars:						
Giza 716	9.45	5.35	3.90	8.17	4.50	3.60
Sakha 1	12.08	8.10	7.16	11.22	7.78	6.89
Giza 40	22.37	13.13	10.23	18.61	12.00	8.11
Giza 3	18.40	10.40	8.86	12.61	9.82	7.94
Sakha 2	10.63	7.17	6.10	8.33	6.61	5.83
F- test	**			**		
LSD	0.68			3.82		

2- Rust disease:-

The data presented in Table (9) showed that disease severity with rust disease was decreased under November 15th sowing date compared with October 15th. Rust pustules rupture the epidermis and cuticle, so the plant can longer control its transpiration and desiccates rapidly in a water deficit (Tissera and Ayres, 1986). Early sowing can rust in high biomass production, restricting air flow through the canopy and favoring disease development, while early sown crops are also more prone to attack by broom rape (Saxena *et al.*, 1981). Management practices. Such as early sowing to minimize the impact of terminal drought, may thus subject the crop to greater risk of disease (Stoddard et al., 2010.

The interaction between sowing dates and salicylic acid substances on disease severity in the two seasons on rust disease these was shown in Table (10). November 15th sowing date with 150 mg/l. concentration SA was the best and most effective in reducing DS

Table 9: Effect of sowing dates, faba bean cultivars and salicylic acid on rust disease severity in faba bean during 2008/2009 and 2009/2010 seasons

Seasons / Characters	2008 /2009	2009 /2010
	100 days	100 days
A- Sowing dates :		
A1- October 15th	12.12	10.51
A2- November 15th	10.25	8.50
F-test	**	**
B- Cultivars :		
B1- Giza 716	7.21	5.26
B2- Sakha 1	9.02	7.68
B3- Giza 40	17.41	15.46
B4- Giza 3	14.70	13.18
B5- Sakha 2	7.55	5.97
F- test	**	**
LSD	0.07	0.17
C-Salicylica :		
C1- Control	15.96	14.42
C2- 100mg/l	10.37	8.24
C3- 150 mg/l	7.22	5.78
F-test	**	**
LSD	0.03	0.12
D- Interactions ;		
D1- AxB	**	**
D2- A xC	**	**
D3- B xC	**	**
D4- A xB x C	**	**

Table 10: Effect of interaction between sowing date and salicylic acid levels on rust disease severity during 2008/2009 and 2009/2010

Seasons	2008 /2009			2009 /2010		
SA	Control	100 mg/l	150 mg/l	control	100 mg/l	150 mg/l
Sowing dates :						
A1- October 15th	17.09	11.30	7.96	15.44	9.79	6.29
A2- November15	14.84	9.44	6.98	13.19	7.69	4.88
F-test	**			**		
LSD	0.04			0.06		

Table 11: Effect of interaction between faba bean cultivars, sowing dates and SA concentrations on rust bean disease during 2008/2009 and 2009/2010

Seasons	2008/2009						2009/2010					
Sowing date	October 15th			November 15th			October 15th			November 15th		
SA	Co-	100	150	Co-	100	150	Co-	100	150	Co-	100	150
Cultivars												
1- Giza 716	10.33	8.28	5.49	7	6.27	5.00	8.23	6.28	5.29	7.42	6.00	3.31
2- Sakha 1	18.17	11.05	8.88	10.94	7.83	6.66	13.61	10.55	7.00	8.16	6.38	6.00
3- Giza 40	27.33	16.11	12.55	26.11	14.00	9.55	24.26	13.23	10.00	23.00	12.08	8.00
4- Giza3	23.83	13.61	9.33	21.36	12.42	8.60	14.79	11.87	8.00	19.41	10.45	7.13
5-Sakha 2	10.78	9.44	6.55	8.39	6.66	5.55	10.00	8.42	5.55	8.00	6.11	5.29
F Test	**			**			*			**		
LSD	1.12			0.78			3.04			2.18		

The interaction between faba bean cultivars , sowing dates and SA on rust disease severity through 100 days from sowing in the two seasons was shown in Table (12). November 15th sowing date and spraying 150 mg/l. SA at all faba bean cultivars gave the best effect in reducing DS compared with sowing date October 15th and 100 mg from SA and the control .

Table 12: Effect of interaction between faba bean cultivars and salicylic acid levels on rust disease severity

Seasons	2008/2009			2009/2010		
	100 days from sowing			100 days from sowing		
SA levels	Con-	100 mg/l	150 mg/l	Con-	100 mg/l	150 mg/l.
Cultivars						
1- G. 716	8.89	7.28	4.40	7.39	5.06	2.72
2- Sakha 1	12.06	8.94	6.09	10.73	7.61	4.72
3- G. 40	26.72	15.06	11.05	24.89	13.56	9.44
4- G. 3	22.80	13.01	8.97	20.78	11.39	7.39
5-Sakha 2	9.36	7.55	5.61	7.83	6.11	3.66
F-test	**			**		
LSD	0.68			3.82		

Interaction between faba bean cultivars and SA concentrations on rust disease severity are shown in Table (12).T he lowest values of rust disease severity occurred under the application of SA at 150 mg/l. on all cultivars under study.

Correlation coefficient:-

The correlation coefficient in Table (13) showed the interrelationships among yield and yield attributes. It is clear that that positive and significant correlation coefficient were obtained between seed yield /fed. and each of branches/plant (r = 0.899**), number of pods/plant (r = 0.849**), 100-seed weight (f = 0.724**) and seed weight/plant (r = 0.955**) . Seed weight /plant was positive and significantly correlated with plant height (r = 0.73**), number of branches/plant (r = 0.825**), number of pods/plant (r = 0.831**) and 100-seed weight (r = 0.707**). 100-Seed weight was positive and significantly correlated with number of branches/plant (r = 0.777**) and number of pods/plant (0.674**). Also positive correlation was found between 100 –seed weight and plant height (r = 0.188) but the correlation coefficients did not reach the significance level. Number of pods/plant was positive and significantly correlated with plant height (r = 0.626**) and number of branches/plant (r = 0.833**). Number of branches/plant was positive and significantly correlated with plant height (r = 0.516**). These results are in agreement with those obtained by Nigem *et al.* (1983).

Table 13: Simple correlation coefficient among faba bean characters average of combined analysis for two seasons 2008/2009 and 2009/2010

Characters	1	2	3	4	5	6
1-Plant height	1					
2-No. of branches/plant	0.516**	1				
3-No. of pods/plant	0.626**	0.833**	1			
4-100-seed weight	0.188	0.777**	0.674**	1		
5-Seed weight/plant	0.730**	0.825**	0.831**	0.707**	1	
6-Seed yield/fed.	0.682**	0.859**	0.849**	0.724**	0.955**	1
7-Straw yield/fed.	0.767**	0.646**	0.691**	0.459	0.780**	0.742**

Multiple regression:-

Results of multiple regression analysis recorded in Table (14) cleared that the relative contribution R2 for all variables in the total variation of seed yield 93.06%; On the other hand, the residual value was 6.02% which indicated that the most characters were included in this analysis.

Data in Table (14) showed that three variables out of the six were accepted as significantly contributing variables to variation in faba bean seed yield. These variables were seed weight, number of branches and number of pods/plant. With R2 being 91.27,1.26 and 0.23% according stepwise analysis respectively. The results indicated that stepwise analysis develop a sequence of multiple regression by removing R2 from the full model equation with relative contribution of 0.02%.In conclusion, it can be stated that seed weight , number of branches and number of pods/plant to the most important characters , since they have not only relative contributing towards seed yield/fed. in the prediction equation. There for, maximum effort should be given to these characters for the improvement of faba bean seed yield by selection through breeding programs.

Table 14: Multiple regression and stepwise regressions analysis for seed yield ardab/fed. (Y) as affected by all studied characters in faba bean

Prediction equation according to multiple regression	
Y = a + b1X1 + b2X2 +b3X3 +b4X4 + b5X5 + b6X6 Y = 0.199X1 + 0.307X2 + 0.034X3 + 0.003X4 + 0.455X5 + 0.127X6	
Relative contribution (R2) for all variables according to full modle regression	93.06%
Prediction equation according to stepwise	
Y = a + b5X5 + b2X2 + b3X3	
Y = 0.216 + 0.470X5 + 0.324X2 + 0.034X3	
X5 – Seed weight/plant	91.27%
X2 – Number of branches/plant	1.26%
X3 – Number of pods/plant	0.23%
The total relative contribution (R2) for all accepted variables according to stepwise regression	93.06%
The relative contribution (R2) for all removed variables according to stepwise regression	0.02%
The relative contribution (R2) for residual variables according to stepwise regression	6.02%
Total effect (accepted, removal and residual)	100%

Stepwise regression analysis:

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تقييم انتاجية بعض أصناف الفول البلدى والاصابة بمرض التبقع البنى و الصدأ تحت مواعيد زراعة مختلفة والرش بحامض السلسلك

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بتاج العز محافظة الدقهلية خلال موسمى الزراعة ٢٠٠٨/٢٠٠٩ و٢٠٠٩/٢٠١٠ لدراسة انتاجية بعض أصناف من الفول البلدى والاصابة بالتبقع البنى و الصدا

تحت مواعيد زراعة مختلفة والرش بحامض السلسيلك وقد استخدم فى هذة الدراسة خمسة أصناف من الفول البلدى وهى جيزة ٧١٦ ، سخا١، جيزة ٤٠، جيزة ٣ و سخا ٢ تحت ميعادان للزراعة هما ١٥ أكتوبر و١٥ نوفمبر وقد استخدم فى هذة التجربة التصميم الاحصائى القطع المنشقة مرتين فى ثلاث مكررات وتم تنفيذ باقى العمليات الزراعية الموصى بها للفول البلدى

وكانت أهم النتائج هى .

١ – كان لميعاد الزراعة تأثير معنوى عالى على جميع الصفات المدروسة خلال موسمى الزراعة ،حيث تفوقت الزراعة فى منتصف نوفمبر بمقدار ٢ أردب للفدان (٢٦.٧%) ، ١.٣٤ أردب للفدان (٢١.٨ %) وذلك مقارنة بالزراعة فى منتصف أكتوبر فى الموسمين على التوالى . وذلك لأن الزراعة المبكرة خلال شهر أكتوبر فى الأراضى حديثة الاستصلاح بسبب ارتفاع

درجة الحرارة تسببت فى تقزم النباتات ومن ناحية أخرى تدفع النباتات الى التزهير المبكر الذى يصحبة قلة العقد فى النباتات وبالتالى ينخفض المحصول .

٢ – دلت الدراسة على أنة توجد فروق معنوية بين الأصناف فى جميع الصفات التى وضعت تحت الدراسة وكان التفوق لصالح الصنف ٧١٦ فيما عدا صفة طول النبات التى تفوق فيها الصنف جيزة ٣ على باقى الأصناف بما فيها الصنف ٧١٦ . من ناحية أخرى لاتوجد فروق معنوية بين الأصناف فى محصول الفدان من البذور خلال السنة الأولى بينما وجدت فروق معنوية فى السنة الثانية لهذة الصفة .

٣ – أدى استخدام حامض السلسلك بتركيز ١٥٠جرام/ملليجرام رشا على النباتات الى تقليل نسبة الاصابة بالتبقع البنى والصدأ على جميع الأصناف وكان التأثير أكبر على الصنف جيزة ٧١٦ مما أدى الىتحسين الانتاجية فى جميع ألأ صناف بعيدا عن استخدام المبيدات الضارة للانسان والملوثة للبيئة .

٤ – أظهرت النتائج المتحصل عليها الى وجود ارتباط موجب وعالى المعنوية بين المحصول وجميع الصفات المدروسة و أيضا جميع الصفات فيما بينها . كما أظهرت نتيجة تحليل الانحدار المتعدد أن المساهمة النسبية لكل الصفات كمتغيرات مستقلة مجتمعة هو ٩٣.٠٦% فى تباين المحصول (أردب/ فدان) . كما أظهرت نتيجة تحليل الانحدار التعدد المرحلى أن ٣ مكونات من ٦ مكونات تساهم بنسبة ٩٣.٠٦% فى التباين الكلى للمحصول (أردب/ فدان) وهذة المكونات هى وزن بذور النبات بالجرام ٩١.٢٧% ، عدد أفرع النبات ١.٢٦% و عدد قرون النبات ٠.٢٣% على الترتيب مما يوضح أن هذةالصفات الثلاثة لها علاقة بالمحصول وساهمت بنسبة عالية فى التباين الكلى للمحصول ٩٣.٠٦% مما يجعل هذة الصفات تساهم مساهمة مباشرة وعالية فى برامج التربية لزيادة انتاجية الفول البلدى .

قام بتحكيم البحث

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