Control of root rot diseases in faba bean crop under field condition

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ABSTRACT

Field experiments were conducted in a private farm at Abia El-Hamra Village, El-Delengat district, El-Beherah Governorate to evaluate the efficacy of five chemical fungicides and three bioagents on root rot diseases caused by *Fusarium solani* and *Rhizoctonia solani* in faba bean (*vicia faba*) (cv. Sakha 716) under field conditions during the two consecutive growing seasons (2018-2019 and 2019-2020). The tested fungicides were carbendazim (Nasr Zim 50% W.P), thiram (No-Blight 50% WP), carboxin+ thiram (Tendro ٤0% FS), tolclofos-methyl + thiram (Rizolex-T 50% WP) and fludioxonil +mefenoxam (Maxim XL 3.5%). The used bioagents were: *Bacillus megaterium* (Bio- Arc 6% WP), *Trichoderma album* (Bio-Zeid 2.5% WP) and *Trichoderma harzianum* {(Plant guard), (30 million spores cm^{-3},}. All treatments were applied at three rates of applications 1, 2 and 3gm or ml formulated material Kg^{-1} of seeds. The results clearly indicated that chemical fungicides were more effective than biofungicides. The higher rates were the most effective particularly, tolclofos-methyl + thiram, carboxin+ thiram and fludioxonil +mefenoxam. Theyignificantly (*P= 0.05*) reduced the pre- and post-emergence rotted roots, increased the survival plants and subsequently increased yield and some agronomic traits in comparison with the untreated control.

Keywords: faba bean, root-rot, fungicides, biofungicides.

INTRODUCTION

Faba bean (*Vicia faba* L.), which is also known as broad bean, is one of the world's oldest legume crops primarily grown as a valuable protein-rich food for both human and animal consumption (Vasić *et al*., 2019). It plays a vital role in the diet of developing countries as it is a major source of vegetable protein (Alghamdi, 2009). China, Europe, Ethiopia, Egypt and Australia are the major faba bean-producing countries in the world (Duc *et al*., 2010 and Jensen *et al*.,2010). In Egypt, faba bean is the most important grain legume and it is a very common food in the Egyptian diet (Hegab *et al*.,2014). The economic importance of faba bean crop is due to the fact that it contains vitamins such as B 1, B 2 and C as well as minerals (iron, zinc and calcium), protein (26%), carbohydrates (56%) and other compounds (Alghamdi, 2009). It also increases the nitrogen content in the soil (Köpke and Nemecek, 2010).

Egypt ranks third in the production of cultivated faba bean grown in Africa after Ethiopia and Sudan (Merga *et al*., 2019). In Egypt, 89.815 thousand feddans of faba beans were cultivated with a productivity of about 410 thousand tons in 2018. About 274.173 thousand tons were imported though (Anonymous, 201٩). The production of faba bean in Egypt is still limited and is not sufficient for the increasing local consumption. Therefore, there is an urgent need to improve the productivity of the bean crop and control the pests and diseases, so that thecrop is quite adequate for the increasing local consumption.

Many fungal plant diseases caused considerable damage of faba bean crop and caused significant yield losses (Mahmoud, Nagwa, 1996, Sillero *et al*., 2010 and Habtegebriel and Boydom, 2016). Root rot and damping off diseases are caused by several soil pathogenic fungi such as *Rhizoctonia solani*, *Fusarium solani* f. sp. *fabae, F. moniliforme, F. oxysporum, Verticillium dahliae* and *Macrophomina phaseolina* (Wang and Chai, 2000 and Hugar, 2004). The fungi such as *R. solani* and *F. solani* caused serious root rot diseases which decreases crop productivity and lower quality of seeds (Abdel-Hafez, 1988; Abou-Zeid *et al*., 1997; Mazen *et al*., 2008; Elwakil *et al*., 2009 and Akrami *et al*., 2009). The losses are due to the infection by the pathogenic fungi that could reach up to 12% (Anonymous, 2006 and Chang *et al*., 2014).

Several fungicides have been used to control root rot diseases caused by *R. solani* and *F. solani* on legumens. For example, carbendazim and thiram were evaluated by Khalequzzaman (2019) on fenugreek. (Hassuba *et al*. (2016) and on peanut crop. The fungicidal activity of carboxin + thiram and tolclofos-methyl + thiram on faba bean was studied by Eisa, Nawal *et al.* (2006). In addition, the fungicidal action of fludioxonil + mefenoxam was evaluated by El-Kholy *et al*. (2021). They reported that this compound has a wide range of activity against fungal pathogens belonging

to different fungal classes on common bean crop.

Also, biological control agents (BCAs) have been widely used for controlling faba bean plant diseases. For example, *Bacillus megaterium* had a good biological control against *R. solani* and *F. solani* on faba bean (Mahmoud *et al*., 2018). Additionally, *Trichoderma harzianum* was found to exhibit significant action on diseases caused by *R. solani* on faba bean (El-Shennawy, 2011) or *F. solani* on faba bean (Habtegebriel and Boydom, 2016).

Therefore, the present study was conducted to evaluate the efficiency of five commercial fungicides and three bioagents as seed treatments at three rates against root rot diseases of faba bean under field conditions during 2018-2019 and 2019-2020 seasons.

MATERIALS AND METHODS

This trial was conducted to evaluate the efficiency of fungicides and bioagents as seed treatment for controlling the incidence of naturally infected root-rot diseases on faba bean grown during two consecutive seasons of 2018-2019 and 2019-2020. It was conducted under field conditions in Abia El-Hamra Village, El-Delengat district, El-Beherah Governorate. It also covers the effect of these treatments on the faba bean yield and some agronomic traits.

Five commercial fungicides and three bioagents were evaluated on faba bean root-rot diseases. Some information on these treatments is listed in Table (1).

These treatments were distributed in a randomized complete block design (RCBD) with three replicates each of 21 m^2 (3×7). Sowing dates were on the 1st and the 5th of November for the first and second seasons respectively. Seeds of faba bean (cv. Sakha 716) were supplied by the Central Administration of Seeds (CAS) and Agricultural Research Center (ARC). Ministry of Agriculture and Land Reclamation were treated with the tested fungicides and bioagents at the rates of 1, 2 and 3gm or ml product Kg^{-1} of seeds according to the method described by Metwally *et al*. (2006). Two seeds were planted in each hole on two rows each row has two bridges and the distance between the two holes is 20 cm.

The following measurements were calculated during the two growing seasons as follows: -

Disease assessment.

Disease assessment was recorded as the mean numbers of pre- and post-emergence damping-off after 14 and 42 days after sowing (DAS) respectively during 2018-2019 and 2019-2020 seasons. Also, the survival plants were recorded at 42 DAS.

Yield and some agronomic traits.

After physiological maturity {(160 days after sowing (DAS)}, in both seasons), the plants were harvested by hand and left to dry for 7 days under natural conditions under the field condition, and the following parameters were estimated:

Biological yield (B.Y.) = {(weight of all plants) Kg $plot^{-1}$}.

Grain yield (G.Y.) = weight of all grains (Kg $plot^{-1}$).

Straw yield (S.Y.) = weight of all straw [Kg $plot^{-1}$].

Weight of 100 grains (H.G.W.) (gm).

Also, the yield over control (YOC%) in all parameters was calculated by the following formula =

YOC = T-C / T x 100.

Where:

T = the value of each parameter in the treatment.

C = the value of each parameter in the control.

Statistical analysis:

The obtained results were statistically analyzed using the method described by Gomez and Gomez (1984). Means were compared at the 5% and 1% level of significance by the least significant difference (L.S.D.) test.

RESULTS AND DISCUSSION

Effect of the tested compounds on root-rot diseases.

The data presented in Table (2 and 3) showed that all fungicides and bioagents (as seed treatment) significantly (*P= 0.05*) reduced disease incidence and increased emergence and faba bean plant compared to the untreated control. Decrease of pre-emergence damping off with the treated seeds may be attributed to the effect of these compounds on the fungal pathogens attacking the seeds causing seed decay. In addition, data indicated that the tested compounds were effective in reducing

post-emergence damping off when compared with untreated seeds. Results in the same table also indicated that the tested mixtures of fungicides were more efficient in controlling damping off disease than using fungicide alone. For example, tolclofos-methyl + thiram, carboxin + thiram and fludioxonil + mefenoxam, when applied at the higher rates, reduced the incidence of damping off disease to 3.00, 5.67 and to 6.67 plants plot^{-1} and to 5.33, 8.67 and 9.67 plants plot^{-1} in the first and second season respectively for pre-emergence damping-off and reduced the incidence of post-emergence damping-off to 2.00, 3.67 and 4.67 and 5.67, 7.67 and 8.67 plants plot^{-1} in the two seasons respectively while carbendazim and thiram reduced the incidence of pre-emergence damping-off to 7.00 and 8.00 and to 10.00 and 11.00 plants plot^{-1} in first and second season respectively and reduced the incidence of post-emergence damping-off to 6.67 and 10.33 and to 10.67 and 14.33 plants plot^{-1} in first and second season respectively. Regarding the plant survivals, fungicides showed higher significantly fungicidal activity than bioagents.

The same trend of results was observed in both seasons. It was noticed that increasing the rate of the tested compounds resulted in enhancing their efficiencies against the pathogenic fungi with increasing the growing plants. However, the difference between the two rates (2 and 3 gm kg^{-1} seeds) for carbendazim was not significant for pre-emergence damping off in both seasons. Also, there were no significant differences (*P= 0.05*) between all rates of fludioxonil + mefenoxam in case of pre-emergence damping off during both seasons.

Such results are in agreement with those obtained by many investigators. Vatchev and Maneva (2012) found that fungicide mixtures of Topsin-M 70% WP (thiophanate-methyl) plus Previcur 607 SL (propamocarb hydrochloride), or Benlate 50% WP (benomyl) plus Previcur 60.7 SL provided more consistent control of the entire disease complex as compared to the control by the application of each individual product alone for controlling root rot complex and stem rot of cucumber. Hassuba *et al*. (2016) reported that treatment of peanut seeds with tolclofos-methyl + thiram, carboxin + thiram and thiram fungicides at 1,2 and 3 gm kg^{-1} of peanut seeds decreased pre- and post-emergence damping-off, also raised in survival plants and increased emergence and plant stands. Mahmoud *et al.* (2018) found that Rizolex-T (tolclofos-methyl + thiram), Vitavax-200 (carboxin + thiram) and Moncut (flutolanil) were the most effective fungicides in reducing the percentages of pre- and post-emergence damping-off caused by *F. solani* and *R. solani* in faba bean at the rate of 3 gm Kg^{-1} of seeds. Khalequzzaman (2019) indicated that seed treatment and soil drenching with Provax 200 WP (carboxin + thiram) and Autostin 50 % WDG (carbendazim) is useful to reduce foot and root rot diseases of fenugreek. El-Kholy *et al*. (2021) concluded that tolclofos-methyl + thiram (Rizolex-T 50% WP), carboxin+ thiram (Tendro ٤0% FS) and fludioxonil +mefenoxam (Maxim XL 3.5%) were the most effective in reducing the number of pre- and post-emergence damping-off, rotted roots and consequently increasing survival (healthy) plants in common bean.

On bioagents, several researchers found that the seed treatment of faba bean seeds with *Bacillus megaterium* (Bio Arc) and *Trichoderma harzianum* (Plant guard) at 3 cm^3 kg^{-1} reduced the incidence of pre- and post-emergence damping off and root-rot and increased crop parameters (Abd-El-Khair *et al*., 2018). Matloob (2019) tested the ability of *T. harzianum* and *T. viride* to control broad bean root-rot diseases. He found that *T. harzianum* and *T. viride* had biocontrol ability and they reduced the disease incidence and severity and increased plant growth promoting. Moreover, several mechanisms were suggested to explain the role of biocontrol agents as antagonistic organisms in suppression soil-borne pathogens and controlling diseases. The suppression may be due to antagonistic fungi include antibiosis, competition for space and nutrient, mycoparasitism and degradation of the toxins produced by the pathogens (Arras, 1996 and Elad, 1996).

Effect of seed treatments on some agronomic traits.

The data in Tables (4, 5, 6 and 7) indicated the effect of chemical and biological seed treatments on yield and some agronomic traits during the first and second seasons (2018-2019 and 2019-2020), respectively. It seemed that seed yield was 7.11 and 5.95 kg plot^{-1} when the plants were naturally infected with fungi causing root-rot disease in the two tested seasons respectively. This indicated that infection of faba bean with root-rot greatly reduced faba bean yield, Tables (4 and 5). These results indicated that all fungicides and bioagents as seed treatments significantly (*P= 0.05*) increased biological seed and straw yield and weight of 100 seeds at the end of both seasons compared with untreated check. The

best parameters were obtained through the use of tolclofos-methyl + thiram, carboxin + thiram and fludioxonil + mefenoxam at the high rates (3 ml kg^{-1} of seeds) which highly controlled the root-rot disease. *T. harzianum* (which had the lower fungicidal activity) also gave the lowest yields. Tolclofos-methyl + thiram, carboxin + thiram and fludioxonil + mefenoxam were the most effective fungicides for increasing the yield parameters followed by carbendazim and thiram, and later bioagents. Also, the tested mixtures of fungicides significantly (*P= 0.05*) increased the yield of faba bean more than fungicides alone. Also, *B. megaterium* seemed to be the most effective bioagents followed by *T. album* and *T. harzianum.* It was found that tolclofos-methyl + thiram, carboxin + thiram, fludioxonil + mefenoxam, carbendazim and thiram at the higher (gm or ml kg^{-1} of seeds) rates gave seed yield of 9.13,9.11, 9.07, 8.96 and 8.13 kg $plot^{-1}$, and 7.97, 7.95, 7.87, 7.81 and 6.97 kg $plot^{-1}$ in the first season and second seasons respectively. Meanwhile *B. megaterium, T. album* and *T. harzianum* at the same rate (3gm or ml kg^{-1} of seeds) gave seed yield of 7.67, 7.59 and 7.60 kg $plot^{-1}$ and 6.51, 6.42 and 6.52 kg $plot^{-1}$ in the first and second season. respectively. These parameters in the control treatments were 7.11 and 5.95 in the first and second season respectively.

Data in Tables (**4, 5, 6** and **7**) showed that the treatment of faba bean seeds at sowing with fungicides and bioagents increased the biological seed and straw yield and weight of 100 seeds (H.G.W.) of faba bean from 1.38 to 14.54%, from 0.33 to 22.10%, from 1.79 to 11.08% and from 0.51 to 12.00% and from 1.45 to 16.63%, from 0.89 to 25.36% from 1.65 to 12.55 and from 0.56 to 12.45%, in the first and second season respectively.

The observations made in this study are in agreement with those obtained by many researchers. Shehata (2015) found that treatment of common bean seeds with tolclofos-methyl + thiram (Rizolex-T 50% WP) by 3 gm Kg^{-1} seeds reduced percentage of pre- and post-emergence damping-off, increased the percentage of healthy survival plants and significantly increased number of pods $plant^{-1}$ and seed yield compared with untreated control. El-Kholy *et al*. (2021) reported that treatment of common bean seeds with Rhizolex-T 50% WP (tolclofos-methyl + thiram), Tendro 40% FS (carboxin + thiram) and Maxim XL 3.5% FS (fludioxonil + mefenoxam) at two rates (1.50 and 3.00 gm). reduced percentage of pre- and post-emergence damping-off and hence increased emergence and plant stands and significantly increased yield parameters.

Generally, all the used treatments were sighted a good control of root rot diseases in faba bean. Also, the higher rates were more effective than the other rates in treatments with tolclofos-methyl + thiram, carboxin + thiram and fludioxonil +mefenoxam, respectively. Chemical fungicides were more effective than bioagents in reducing and increasing the yield and some agronomic traits. The fungicides tolclofos-methyl + thiram followed by carboxin + thiram followed by fludioxonil +mefenoxam were the best while *Trichoderma harzianum* and *Trichoderma album* were the lowest effect. The compound carbendazim and thiram gave an intermediate effect.

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Table (1): The tested compounds

Trade name and Formulations	Active ingredients	Chemical name (IUPAC)	Source	Rate of application (gm or ml kg^{-1} of seeds)
Nasr zim 50% WP	carbendazim	methyl benzimidazol-2-ylcarbamate	El-Nasr Co. for intermediated chemicals	1,2 and 3 gm kg-1 of seeds
No-blight, 50% WP	thiram	Tetramethylthiuram disulfide; bis (dimethylthiocarbamoyl) disulfide.	Kafr El-Zayat (K Z.) for Pesticides and Chemicals Co.	1,2 and 3 gm kg-1 of seeds
Tendro ٤0% FS	٢٠% carboxin + ٢٠% Thiram	5,6-dihydro-2-methyl-1,4-oxathi-ine-3-carboxanilide. Tetramethylthiuram disulfide; bis(dimethylthiocarbamoyl) disulfide	Biotech Company for Fertilizers and Biocides.	1,2- and 3-ml kg-1 of seeds
Rizolex-T 50% WP	20% tolclofos-methyl + 30% thiram	O-2,6-dichloro-p-tolyl O, O-dimethyl phosphorothioate. Tetramethylthiuram disulfide; bis(dimethylthiocarbamoyl) disulfide	K Z. for Pesticides and Chemicals Co	1,2 and 3 gm kg-1 of seeds
Maxim XL 3.5% FS	2.5% fludioxonil + 1% mefenoxam	4-(2,2-difluoro-1,3-benzodioxol-4-yl) pyrrole-3-carbonitrile methyl N-(methoxyacetyl)-N-(2,6-xylyl)-D-alaninate; methyl (R)-2-{[(2,6-dimethylphenyl)methoxyacetyl]amino}propionate	Syngeta Co.	1,2- and 3-ml kg-1 of seeds
Bio- Arc 6% WP	*Bacillus megaterium*	25 million cells $gram^{-1}$	Kafr El-Zayat (K Z.) for Pesticides and Chemicals Co	1,2 and 3 gm kg-1 of seeds
Bio-Zeid 2.5% WP	*Trichoderma album*	10 million cells $gram^{-1}$	Kafr El-Zayat (K Z.) for Pesticides and Chemicals Co	1,2 and 3 gm kg-1 of seeds
Plant guard 30 million spores/cm3 liquid	*Trichoderma harzianum*	Egyptian strains of fungus Trichoderma harzianum each one cm^3 of the liquid contains 30 million organisms	Biotech Company for Fertilizers and Biocides	1,2- and 3-ml kg-1 of seeds

Table 2: Effect of fungicide seed treatments on pre and post- emergence damping-off and survival plants of faba bean (cv. Sakha 716) under field conditions during two growing seasons of 2018-2019.

Treatments	Mean number of			
	Rate of application (gm or ml kg^{-1} of seeds)	Pre-emergence damping-off*	Post- emergence damping-off**	Survival plants***
Carbendazim Nasr zim 50% WP	١	11.33	13.00	285.67
	٢	8.33	10.67	291.00
	٣	7.00	6.67	296.33
Thiram No-blight, 50% WP	١	12.00	14.00	284.00
	٢	10.33	11.67	288.00
	٣	8.00	10.33	291.67
Carboxin + thiram Tendro 40% FS	١	9.67	11.33	289.00
	٢	8.67	11.00	290.33
	٣	5.67	3.67	300.67
Tolclofos-methyl + thiram Rizolex-T 50% WP	١	10.33	12.00	287.67
	٢	8.00	10.00	292.00
	٣	3.00	2.00	305.00
Fludioxonil + Mefenoxam Maxim XL 3.5% FS	١	7.67	7.33	295.00
	٢	7.00	5.33	297.67
	٣	6.67	4.67	298.67
Bacillus megaterium Bio- Arc 6% WP	١	14.33	16.33	279.33
	٢	12.33	14.33	283.33
	٣	11.00	12.67	286.33
Trichoderma album Bio-Zeid 2.5% WP	١	13.67	16.00	280.33
	٢	12.67	14.67	282.67
	٣	11.33	13.33	285.33
Trichoderma harzianum Plant guard	١	14.67	16.67	278.67
	٢	13.67	15.33	281.00
	٣	12.00	13.67	284.33
Untreated control	--	22.33	17.00	270.67

*Pre emergence was calculated after 14 DAS as number of non-emerged seedlings / number of planted seeds ×100.

** post emergence was calculated after 42 DAS as number of dead seedlings / numbers of planted seeds ×100.

*** survival plants were calculated after 42 DAS as number of survived healthy plants / Number of sown seeds ×100.

		Pre		Post		Survival	
L.S.D. at	=	1%	5%	1%	1%	5%	1%
Treatments (T.)	=	4.14	3.11	1.87	1.40	4.32	3.25
Rates (R.)	=	2.39	1.80	1.08	0.81	2.50	1.87
T. × R.	=	7.17	5.39	3.24	2.43	7.49	5.62

Table 3: Effect of fungicide seed treatments on pre and post- emergence damping-off and survival plants of faba bean (cv. Sakha 716) under field conditions during two growing seasons of 2019-2020.

Treatments	Rate of application (gm or ml kg^{-1} of seeds)	Mean number of Pre-emergence damping-off*	Post- emergence damping-off**	Survival plants***
Carbendazim Nasr zim 50% WP	١	14.33	17.00	278.67
	٢	11.00	14.67	284.33
	٣	10.00	10.67	289.33
Thiram No-blight, 50% WP	١	15.00	18.00	277.00
	٢	13.33	15.67	281.00
	٣	11.00	14.33	284.67
Carboxin + thiram Tendro 40% FS	١	12.67	15.33	282.00
	٢	12.33	15.00	282.67
	٣	8.67	7.67	293.67
Tolclofos-methyl + thiram Rizolex-T 50% WP	١	13.33	16.00	280.67
	٢	11.00	14.00	285.00
	٣	5.33	5.67	299.00
Fludioxonil + Mefenoxam Maxim XL 3.5% FS	١	10.67	11.33	280.00
	٢	9.67	10.00	290.33
	٣	9.67	8.67	291.67
Bacillus megaterium Bio- Arc 6% WP	١	17.33	20.67	272.00
	٢	15.33	18.33	276.33
	٣	14.00	16.67	279.33
Trichoderma album Bio-Zeid 2.5% WP	١	16.33	20.00	273.67
	٢	15.33	18.67	276.00
	٣	14.33	17.33	278.33
Trichoderma harzianum Plant guard	١	17.67	20.67	271.67
	٢	16.67	19.33	274.00
	٣	14.67	17.67	277.67
Untreated control	--	25.00	21.67	263.33

*Pre emergence was calculated after 14 DAS as number of non-emerged seedlings / number of planted seeds ×100.

** Post emergence was calculated after 42 DAS as number of dead seedlings / numbers of planted seeds ×100.

*** Survival plants were calculated after 42 DAS as number of survived healthy plants / Number of sown seeds ×100.

		Pre		Post		Survival	
L.S.D. at	=	1%	5%	1%	1%	5%	1%
Treatments (T.)	=	2.53	1.90	1.87	1.40	3.37	2.53
Rates (R.)	=	1.46	1.10	1.08	0.81	1.95	1.46
T. × R.	=	4.38	3.29	3.24	2.43	5.84	4.39

Table 4: Effect of treatments on yield, and some agronomic traits of faba bean (cv. Sakha 716) under field conditions during season 2018-2019.

Treatments	Rate of application (gm or ml kg^{-1} of seeds)	biological yield*	Straw yield**	Grain yield***	weight of 100 seed (gm)****
Carbendazim Nasr zim 50% WP	١	26.65	19.18	7.47	90.51
	٢	27.63	19.23	8.40	91.88
	٣	28.72	19.76	8.96	95.20
Thiram No-blight, 50% WP	١	26.30	18.71	7.58	90.37
	٢	26.90	19.21	7.69	91.08
	٣	27.46	19.32	8.13	92.86
Carboxin + thiram Tendro 40% FS	١	27.03	19.09	7.93	91.24
	٢	27.29	19.26	8.03	91.58
	٣	29.00	19.89	9.11	99.64
Tolclofos-methyl + thiram Rizolex-T 50% WP	١	26.78	19.41	7.38	99.66
	٢	27.79	19.47	8.33	93.44
	٣	29.07	19.94	9.13	101.02
Fludioxonil + Mefenoxam Maxim XL 3.5% FS	١	27.83	19.13	8.70	94.06
	٢	28.71	19.80	8.90	96.77
	٣	28.88	19.82	9.07	98.05
Bacillus megaterium Bio- Arc 6% WP	١	25.49	18.27	7.22	89.37
	٢	26.05	18.75	7.30	90.17
	٣	26.59	18.91	7.67	90.65
Trichoderma album Bio-Zeid 2.5% WP	١	25.67	18.49	7.18	89.85
	٢	25.83	18.63	7.20	90.07
	٣	26.47	18.88	7.59	90.45
Trichoderma harzianum Plant guard	١	25.19	18.06	7.13	89.35
	٢	25.74	18.14	7.17	89.97
	٣	26.37	19.20	7.60	90.37
Untreated control	--	24.84	17.73	7.11	88.89

	biological yield		straw yield		seed yield		weight of 100 seed (gm)	
L.S.D. at =	1%	5%	1%	5%	1%	5%	1%	5%
Treatments (T.) =	0.09	0.06	0.27	0.20	0.23	0.17	0.17	0.12
Rates (R.) =	0.05	0.04	0.16	0.12	0.13	0.10	0.10	0.07
T. × R. =	0.15	0.11	0.47	0.35	0.39	0.30	0.29	0.21

*B.Y.= {(weight of all plants) Kg plot $^{-1}$}.

* S.Y.= Straw yield (Kg plot^{-1}).

*** G.Y.= weight of all grains (Kg plot^{-1}).

****H.G.W. = Weight of 100 grains (gm).

Table 5: Effect of treatments on yield, and some agronomic traits of faba bean (cv. Sakha 716) under field conditions during season 2019-2020.

Treatments	Rate of application (gm or ml kg-1 of seeds)	biological yield*	Straw yield**	Grain yield***	weight of 100 seed (gm)****
Carbendazim Nasr zim 50% WP	١	22.67	16.34	6.32	87.05
	٢	23.65	16.43	7.23	88.45
	٣	24.74	16.93	7.81	91.78
Thiram No-blight, 50% WP	١	22.32	15.90	6.42	86.92
	٢	22.92	16.39	6.53	87.63
	٣	23.48	16.52	6.97	89.44
Carboxin + thiram Tendro 40% FS	١	23.05	16.27	6.78	87.82
	٢	23.31	16.43	6.87	88.14
	٣	25.01	17.06	7.95	96.19
Tolclofos-methyl + thiram Rizolex-T 50% WP	١	22.80	16.59	6.22	90.00
	٢	23.82	16.64	7.18	96.22
	٣	25.01	17.05	7.97	97.58
Fludioxonil + Mefenoxam Maxim XL 3.5% FS	١	23.86	16.31	7.52	90.61
	٢	24.85	16.33	7.54	93.34
	٣	24.90	16.36	7.87	94.62
Bacillus megaterium Bio- Arc 6% WP	١	21.52	14.97	6.55	85.94
	٢	22.08	15.93	6.16	86.73
	٣	22.66	16.15	6.51	87.22
Trichoderma album Bio-Zeid 2.5% WP	١	21.69	15.69	6.00	86.38
	٢	21.86	15.84	6.02	86.61
	٣	22.49	16.07	6.42	87.01
Trichoderma harzianum Plant guard	١	21.16	15.16	6.00	85.91
	٢	21.70	15.18	6.44	86.57
	٣	22.40	15.95	6.52	86.93
Untreated control	--	20.85	14.91	5.95	85.43

	biological yield		straw yield		seed yield		weight of 100 seed (gm)	
L.S.D. at =	1%	5%	1%	5%	1%	5%	1%	5%
Treatments (T.) =	0.08	0.06	0.17	0.08	0.07	0.17	0.29	0.22
Rates (R.) =	0.04	0.03	0.10	0.05	0.09	0.10	0.17	0.13
T. × R. =	0.13	0.10	0.29	0.15	0.12	0.29	0.51	0.38

*B.Y.= {(weight of all plants) Kg plot –1}

** S.Y.= Straw yield [Kg plot–1].

*** G.Y.= weight of all grains (Kg plot–1).

****H.G.W. = Weight of 100 grains (gm).

Table 6: Effect of treatments on yield over control (YOC%) of faba bean (cv. Sakha 716) under field conditions during season 2018-2019.

Treatments	Rate of application (gm or ml kg^{-1} of seeds)	YOC% of biological yield	YOC% of Straw yield	YOC% of Grain yield	YOC% of weight of 100 seed (gm)
Carbendazim Nasr zim 50% WP	١	6.78	7.56	4.78	1.79
	٢	10.07	7.78	15.32	3.26
	٣	13.50	10.26	20.65	6.63
Thiram No-blight, 50% WP	١	5.53	5.24	6.24	1.63
	٢	7.66	7.69	7.58	2.40
	٣	9.52	8.23	12.58	4.28
Carboxin + thiram Tendro 40% FS	١	8.08	7.12	10.38	2.58
	٢	8.98	7.94	11.46	2.93
	٣	14.34	10.84	21.98	10.79
Tolclofos-methyl + thiram Rizolex-T 50% WP	١	7.24	8.62	3.62	10.81
	٢	10.61	8.90	14.61	4.87
	٣	14.54	11.08	22.10	12.00
Fludioxonil + Mefenoxam Maxim XL 3.5% FS	١	10.74	7.30	18.31	5.50
	٢	13.46	10.45	20.14	8.14
	٣	13.99	10.51	21.58	9.34
Bacillus megaterium Bio- Arc 6% WP	١	2.55	2.94	1.57	0.54
	٢	4.64	5.44	2.60	1.42
	٣	6.56	6.24	7.34	1.95
Trichoderma album Bio-Zeid 2.5% WP	١	3.21	4.08	0.97	1.07
	٢	3.83	4.81	1.30	1.31
	٣	6.16	6.07	6.37	1.72
Trichoderma harzianum Plant guard	١	1.38	1.79	0.33	0.51
	٢	3.47	2.22	0.88	1.20
	٣	5.80	7.64	6.45	1.64

Yield Over Control (YOC%) = Treatment -Control / Treatment x 100.

Table 7: Effect of treatments on yield over control (YOC%) of faba bean (cv. Sakha 716) under field conditions during season 2019-2020.

Treatments	Rate of application (gm or ml kg^{-1} of seeds)	YOC% of biological yield	YOC% of Straw yield	YOC% of Grain yield	YOC% of weight of 100 seed (gm)
Carbendazim Nasr zim 50% WP	١	8.00	8.79	5.96	1.87
	٢	11.84	9.25	17.71	3.42
	٣	15.72	11.95	23.89	6.92
Thiram No-blight, 50% WP	١	6.59	6.27	7.37	1.71
	٢	9.02	9.05	8.93	2.51
	٣	11.20	9.75	14.64	4.48
Carboxin + thiram Tendro 40% FS	١	9.52	8.38	12.25	2.73
	٢	10.53	9.29	13.48	3.08
	٣	16.62	12.61	25.23	11.19
Tolclofos-methyl + thiram Rizolex-T 50% WP	١	8.55	10.13	4.34	5.08
	٢	12.44	10.40	17.18	11.22
	٣	16.63	12.55	25.36	12.45
Fludioxonil + Mefenoxam Maxim XL 3.5% FS	١	12.59	8.62	20.96	5.72
	٢	16.08	8.70	21.17	8.48
	٣	16.24	8.88	24.41	9.71
Bacillus megaterium Bio- Arc 6% WP	١	3.08	0.40	9.21	0.60
	٢	5.57	6.40	3.41	1.50
	٣	7.96	7.70	8.61	2.06
Trichoderma album Bio-Zeid 2.5% WP	١	3.84	4.97	0.89	1.10
	٢	4.59	5.87	1.22	1.37
	٣	7.28	7.26	7.32	1.82
Trichoderma harzianum Plant guard	١	1.45	1.65	0.94	0.56
	٢	3.92	1.82	7.71	1.32
	٣	6.89	6.56	8.79	1.73

Yield Over Control (YOC%) = Treatment -Control / Treatment x 100.

مكافحة أمراض أعفان الجذور فى الفول البلدي تحت الظروف الحقلية.

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الملخص العربي

أجريت التجارب الحقلية فى مزرعة خاصة فى قرية إبياء الحمراء مركز الدلنجات بمحافظة البحيرة وذلك بهدف تقييم فاعلية خمسة من مبيدات الفطريات وثلاثة من المركبات الحيوية على أمراض أعفان الجذور فى الفول البلدى (صنف سخا ٧١٦) التى تسببها فطريات فيوزاريوم سولانى وريزوكتونيا سولانى، وكان ذلك فى موسمي الدراسة ٢٠١٨-٢٠١٩ و٢٠١٩-٢٠٢٠، على الترتيب. كانت مبيدات الفطريات المستخدمة هي نصرزيم ٥٠٪ WP (كربندازيم)، ونوبلايت ٥٠٪ WP (الثيرام)، وتندرو ٤٠% FS (كربوكسين + ثيرام) وريزولكس تى ٥٠٪ WP وماكسيم اكس ال٣،٥ % FS (فلودكسونيل + ميفينوكسام)، بينما كانت المركبات الحيوية هى بيو أرك ٦٪ WP (باسيلس ميجاتيريم) وبلانت جارد ٣٠ مليون جرثومة لكل مل (تريكودرما هارزيانم) وبيوزيد ٢,٥٪ WP (تريكودرما ألبيوم) وتم ذلك لكل المعاملات على ثلاثة معدلات هى١، ٢ و ٣ جرام أو مل لكل كيلوجرام بذرة. بينت النتائج أن المركبات الكيماوية أعطت نتائج أفضل من المركبات الحيوية فى مكافحة الأمراض وكانت المعدلات الأعلى هى أكثر تاثيراً وخصوصا مركب ريزولكس تى وقد أنقصت موت البادرات قبل الإنبثاق وبعد الإنبثاق وزادت من معدلات النباتات السليمة مما أدى إلي زيادة المحصول النهائي الناتج.

الكلمات الاسترشادية: الفول البلدي، أعفان الجذور، مبيدات فطرية، المبيدات الحيوية.