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Control of Fungal Wheat Diseases Under Field Conditions

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ABSTRACT

Field studies were performed in Ashmon district, Menofia Governorate, to evaluate the efficacy of four chemical fungicides and one bioagent against wheat diseases in wheat (C.V. Gemiza 9) fields during the two successive seasons (2013-2014 and 2014-2015) incompasion with untreated control. The chemical fungicides were (Vitavax 200 75% WP (carboxin +thiram), Sumi eight 2% WP (diniconazole), Rovral 50% WP(iprodione) and Rizolex – T 50% WP (tolclofos- methyl +thiram), whereas the bioagent was Plant- guard (*Trichoderma harzianum*) 30 million spores cm^{-3}. All the tested compounds were used as seed treatments at the rate of 1, 2 and 3 g kg^{-1} of seeds. Generally, all the tested compounds increased the number of plants m^{-2} compared with untreated control. Diniconazole and iprodione fungicides were the most effective fungicides, Plant- guard was the least effective while the other compounds showed intermediate effects. Diniconazole and iprodione also significantly reduced the number of rotted roots at 21 days after sowing (DAS), and increased the number of tillers $plants^{-1}$ compared with untreated control. The fungicides diniconazole and tolclofos- methyl +thiram reduced the number of white head m^{-2}, also diniconazole and carboxin +thiram reduced the number of scabby heads m^{-2}. Generally, increasing the rate of application significantly increased the efficacy of the tested compounds, and the chemical treatments were more effective than the bioagent in all cases. Results also showed that seed treatments with these compounds particularly diniconazole, tolclofos- methyl +thiram and iprodione increased the grain and straw yield.

Keywords: Wheat diseases, chemical control, biological control.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the world's most important cereal being the chief source of staple food for about one third of the global population after rice and maize (Pathak and Zaidi, 2013). In Egypt, wheat is considered the main crop used as source for human food but the straw is also used for industrial products and as feed for livestock (Moubarak and Abdel-Monaim, 2011). Most economically significant wheat diseases are caused by fungi, which may attack the seed, root, crown and foliage, and cause the death of seedlings before or soon after emergence. Seed-borne diseases caused by fungi are important from the economic point of view as they render losses in a number of ways. (Agarwal and Sinclair ,1996 and Rekanović, *et al*. 2010). Several fungi were recorded as causal pathogens of root-rot diseases such as *Fusarium graminearum, Rhizoctonia solani*, *Pyrenophora tritici-repentis* (Fouly *et al.* 1996; Shabana, Parveen and Kumar, 2001 and Asran and Eraky, Amal 2011). Therefore, seed treatments with fungicides and bioagents (BCA_s) were used to control these pathogens and increased grain yield. (Matthews *et al.* 1985; Innocenti *et al*. 1990; Gupta *et al*. 1990; El-Kholy,1993; Ismail *et al*. 1994; Meisner *et al*. 1994; Ilyas *et al*. 1998; El-Kholy,1999; Kelley 2001; Kabir *et al*. 2007; Moubarak and Abdel-Monaim, 2011; Marcia *et al.* 2011; Kadege 2013 and Bhoyar *et al*. 2014).

Therefore, the present study was carried out to evaluate the effect of four chemical fungicides and one bioagent on fungal pathogens in wheat crop.

MATERIALS AND METHODS

The field trials were carried out during the two consecutive seasons (2013-2014 and 2014-2015) in a private farm at Ashmon district, Menofia Governorate. Gemiza 9 wheat cultivar was used in this study. Four commercial chemical fungicides, and one biological agent were used in this study, and shown in Table (1**).**

Table 1. List of the tested fungicides.

Trade name and formulations	Common name	Chemical name (IUPAC)
Vitavax 200 75% W.P.	37.5% Carboxin+ 37.5% Thiram	5,6-dihydro-2-methyl-1,4-oxathi-ine-3-carboxanilide. Tetramethylthiuram disulfide; bis(dimethylthiocarbamoyl) disulfide
Sumi eight 2% WP	Diniconazole	(*E*)-(*RS*)-1-(2,4-dichlorophenyl)-4,4-dimethyl-2-(1*H*-1,2,4-triazol-1-yl)pent-1-en-3-ol
Rovral 50% WP	Iprodione	3-(3,5-dichlorophenyl)-*N*-isopropyl-2,4dioxoimidazolidine-1-carboxamide
Rizolex-T 50%W.P.	20% Tolclofos-methyl + 30% Thiram	*O*-2,6-dichloro-*p*-tolyl *O,O*-dimethyl phosphorothioate. Tetramethylthiuram disulfide; bis(dimethylthiocarbamoyl) disulfide
Plant guard 30 million spores/cm^3	*Trichoderma harzianum*	Egyptian strains of fungus *Trichoderma harzianum* each one cm^3 of the liquid contains 30 million organisms.

*** All the tested fungicides were applied at 1, 2 and 3gkg^{-1} seeds**

The experiments were designed in a complete randomized block design with three replicates for each treatment. The plot size was 21 m^2 (1 / 200 feddan, 3 × 7m.). Wheat seeds were treated one day before planting with the tested fungicides at 1, 2 and 3g product Kg^{-1} seeds. Seeds were treated with fungicides according to Warhman *et al*. (1989) with some modifications. The appropriate amounts of the tested fungicides were placed in plastic bags, seeds were added, then, a few drops of 5 % animal glue solution were added and shaken by the hand until the seeds were uniformly covered by the chemical. Treated and untrated seeds

were planted and repeated in 7 – 11- 2013 and 14 - 11 - 2014, respectively.

The following measurements were recorded during the growing seasons:

- Plant stand counts in one m^{-2} area of each plot (by square wood frame), and rooted-rot symptoms / 15 plants randomly collected from each plot were determined after 21 days from planting {(at the end of GS2) seedling stage}
- Number of tillers plant $^{-1}$ (15 plants randomly collected from each plot) was determined after 42 days from planting (at GS10), (stem elongation)
- Number of white head m^{-2} was calculated after110 days from planting.
- Number of scabbed spikes m^{-2} was recorded after 120 days from planting (grain development stage)(GS11).
- Grain yield and straw yield as Kg plot $^{-1}$ were calculated at harvesting, (at 180 days from planting).

Statistical analysis:

The obtained results were statisticaly analyzed according to Snedecor and Cochran (1969), and L.S.D values were obtained at 0.01 and 0.05.

RESULTS AND DISCUSSION

Effect of fungicides on the emergence and plant growth:

In the two seasons, results in table (2) show that, all the tested compounds significantly increased the number of plants m^{-2} compared with untreated control. Generally, diniconazole and iprodione were the most effective fungicides, and the Plant- guard (*Trichoderma harzianum*) was the least one, while the two other fungicides showed an intermediate effect. Diniconazole and Plant-guard, for example, gave 394.66 and 350.00 plants m^{-2}, respectively, while iprodione, carboxin + thiram and tolclofos methyl+thiram gave 384.00, 380.66 and 378.66 plants m^{-2}, respectively, all at 3 g Kg^{-1} seeds during the 1st season. This indicated that diniconazole and iprodione are much more active against soil and seed borne fungi of wheat.

The obtained data indicate that increasing the rate of application significantly increased the wheat stands. For instance, increasing the application rates of diniconazole during the 1st season from 1 to 2 and to 3 g Kg^{-1} resulted in increasing the number of plants m^{-2} from 313.66 to 359.66 and to 394.66, respectively (Table 2).

Obesrvations made in the present study on the effect of the tested fungicides on emergence of wheat plants are consistent with those described by several authors. Pikushova (1995) indicated that Raxil (tebuconazole) used as wheat seed treatment controlled *Alternaria* and *Fusarium* on the seeds and increased seed germination. El-Kholy (1999) indicated that fungicide seed treatment of wheat increased the number of plants m^{-2}, shoot length 21 days after sowing. Tebuconazole was the most effective followed by triticonazole, iprodione and carboxin-thiram, but thiabendazole and tolclofos-methyl were the least effective. Khanzada *et al*. (2002) evaluated the efficacy of some fungicides in controlling seed borne fungi associated with wheat and recorded that Baytan, Vitavax, Benlate and Captan were highly effective and significantly increased the seedling emergence over control. Sharma-Poudyal *et al*. (2005) found that Vitavax 200B increased germination of wheat seeds and reduced seedling infection by *Cochliobolus sativus*. Srinivas *et al.* (2005) reported that seed germination and seedling vigour index were increased following seed treatment with bioagents and fungicides. Malaker and Mian (2009) showed that seed treatment with either Vitavax-200 or Homai-80WP significantly increased plant population and grain yield of wheat. Chen *et al.* (2010) reported that in China, used triazole fungicides as seed treatment to control sharp eyespot in wheat in order to protect the seedlings in the beginning of growing season. They mentioned that difenoconazole was effective against the pathogenic fungi such as *Gaeumannomyces graminis* in the field and led to a significant increase in wheat yield.

Table 2. Effect of fungicide seed treatments on mean number of wheat plants m^{-2} (C.V.Gemiza 9), 21 days after sowing under field conditions during the two growing seasons.

Treatments	Season 2014 Rate of application (gm $Kg^{-1}$of seeds)			Season 2015 Rate of application (gm $Kg^{-1}$of seeds)		
	1	2	3	1	2	3
Carboxin+Thiram	277.66	336.66	380.66	267.00	325.00	340.00
Diniconazole	313.66	359.66	394.66	295.00	356.00	407.00
Iprodione	290.00	340.00	384.00	292.00	337.00	395.00
Plant-guard	260.66	310.00	350.00	257.00	293.00	327.00
Tolclofos methyl +Thiram	289.33	340.00	378.66	270.00	327.00	390.00
Untreated (check)		210.00			235.00	
L.S.D.at =	1 %		5 %	1 %		5 %
Treatments (T.)	41.28		30.75	21.99		16.39
Rates (R.)	29.19		21.74	15.54		11.59
T .R.	N. S		N. S	37.80		28.39

All values shown in the table are averages of three replicates.

Effect of fungicides on root-rot disease:

The effect of fungicide seed treatments on root-rot disease was evaluated after 21 days from sowing as a number of rotted-roots in 15 plants randomly collected from each plot (Tables 3). The results indicated that, all the tested compounds significantly reduced the number of rotted-roots compared with the untreated control, with the exception of Plant-guard at the rate 1 and 2g kg^{-1} seed. Generally, diniconazole and iprodione were the most effective fungicides, while the Plant- guard

was the least effective. The remaining fungicides showed an intermediate effect, and this result was true in the two tested seasons. For example, diniconazole and iprodione at 3 g kg^{-1} seed completely controlled root-rot. Results indicated that increasing the rate of application from 1 to 2 and to 3 g Kg^{-1} seed resulted in an insignificant reduction in rotted-roots. For example, iprodione insignificantly reduced the number of rotted-roots from 1.66 to 1.33 and to 1.00, respectively.

These results are in agreement with those obtained by several authors. Siddiqui and Zaman (2004) reported that seed-borne fungi can be controlled by the treatment with fungicides. Stack and McMullen (1991) cited that triadimenol and difenoconazole were the most promising materials against common root-rot on both spring wheat and barley. They reported that triadimenol increased wheat and barley yield by 7.0 and 8.0 %, respectively. El-Kholy (1999) found that tebuconazole and triticonazole exhibited high fungicidal effects against the pathogens causing root rot disease, the same fungicides reduced number of white head m^{-2} 110 days after planting. Increasing the rate of application up to 3 g kg^{-1} resulted in increasing the efficiency of fungicides. Bhoyar *et al*, (2014) evaluated of bioagents and fungicides on the incidence of seed mycoflora, The results showed that the treatments of thiram+ carbendazim (2:1) and carboxin(0.2%) were most effective in reducing the incidence of seed borne mycoflora (100 %) followed by *T. harzianum* (70.58 %). On the other hand Bending *et al.* (2007) reported that Mancozeb, Captan, Carbamate, Metalaxyl plus, Thiabendazole, and Triadimenol have the potential to be harmful to the soil and non-soil environment as well as carry the potential to be phytotoxic to the seed and the emerging seedling. The systemic fungicides. Dithane and metalaxyl plus mancozeb, difenoconazole, tebuconazole, thiabendazole, triadimenol and triticonazole effectively used in controlling seed-borne diseases, however, under conditions of high disease pressure, they may often fail Marcia *et al*. (2011).

Table 3. Effect of fungicide seed treatments on mean number of a rotted roots 15 plants^{-1} of wheat (C.V.Gemiza 9),21 days after sowing under field conditions during the two growing seasons.

Treatments	Season 2014 Rate of application (gm Kg^{-1} of seeds)			Season 2015 Rate of application (gm Kg^{-1} of seeds)		
	1	2	3	1	2	3
Carboxin+Thiram	1.66	1.33	1.66	2.00	1.00	0.66
Diniconazole	1.66	1.00	0.66	1.66	0.66	0.00
Iprodione	1.66	1.33	1.00	1.66	1.00	0.00
Plant-guard	2.33	2.00	1.66	2.00	1.66	0.66
Tolclofos methyl +Thiram	1.66	1.33	1.00	2.00	1.00	0.66
Untreated (check)		2.66			2.00	
L.S.D.at =	1 %		5 %	1 %		5 %
Treatments (T.)	0.97		0.72	N. S		N. S
Rates (R.)	N . S		N . S	0.57		0.75
T.R.	N . S		N . S	N . S		N . S

***All values shown in the table are averages of three replicates.**

Effect of fungicides on number of tillers:

The results in Table (4) showed that all the tested compounds at all application rates during both seasons increased the number of tillers of wheat plant^{-1} compared with the untreated control. Diniconazole and iprodione were the most effective fungicides in increasing the number of tillers of wheat plant $^{-1}$, while the Plant- guard was the least effective. The remaining fungicides showed an intermediate effect. These results were true in both tested seasons. For example, diniconazole at 3 g Kg^{-1} during the 1st season gave 3.2 tillers plant^{-1}, Plant- guard gave 2.6 tillers plant^{-1}, tolclofos methyl + thiram gave 2.8 tillers plant^{-1}. Such findings may be due to the control of seed and soil borne fungi.

These results are in agreement with those obtained by other authors. Sharma-Poudyal *et al*. (2005) studied the effect of seed treatment with different fungicides including Vitavax 200B on disease and performance of wheat .Results showed that seed treatment significantly affected germination and effective number of tillers, treating seed with these chemicals could contribute to improved early plant establishment.

Effect of fungicides on number of white head symptom m^{-2}:

The results in (Tables 5) indicated that, all the tested compounds significantly reduced the number of white head m^{-2} compared with the untreated control, and diniconazole and tolclofos methyl+thiram were the most effective fungicides, while Plant- guard was the least effective. The remaining fungicides showed an intermediate effect. For example, diniconazole and tolclofos methyl+thiram at 3 g Kg^{-1} seed during the 1st season reduced the mean number of white head m^{-2} of wheat plants to 0.00 and 3.00, respectively, while that of Plant guard was 9.33. Results indicated that increasing the rate of application from 1 to 2 and to 3 g Kg^{-1} seed significantly reduced the numbers of white head m^{-2} of wheat. Diniconazole, for example, reduced the number of white head m^{-2} from 6.66 to 3.33 and to 0.00, respectively. In this respect El-Kholy (1999) found that tebuconazole and triticonazole have highly fungicidal effects against the pathogens causing root rot disease, the same fungicides reduced number of white head m^{-2} 110 days after planting. Increasing the rate of application up to 3 g kg^{-1} resulted in increasing the efficiency of fungicides.

Table 4. Effect of fungicide seed treatments on mean number of tillers of wheat plants^{-1} 42 days after sowing under field conditions during the two growing seasons.

Treatments	Season 2014 Rate of application (gm Kg^{-1}of seeds)			Season 2015 Rate of application (gm Kg^{-1}of seeds)		
	1	2	3	1	2	3
Carboxin+Thiram	2.4	2.6	2.8	2.3	2.4	2.7
Diniconazole	2.6	2.8	3.2	2.3	2.8	3.0
Iprodione	2.4	2.8	3.2	2.5	2.8	3.0
Plant-guard	2.4	2.4	2.6	2.2	2.5	2.6
Tolclofos methyl +Thiram	2.4	2.6	2.8	2.3	2.6	2.9
Untreated (check)		2.2			2.2	
L.S.D.at =	1 %		5 %	1 %		5 %
Treatments (T.)	N. S		0.37	0.22		0.17
Rates (R.)	N. S		0.26	0.16		0.12
T .R.	N. S		N. S	N. S		N. S

*All values shown in the table are averages of three replicates.

Table 5. Effect of fungicide seed treatments on mean number of white head m^{-2} of wheat plants (C.V. Gemiza 9) under field conditions during the two growing seasons.

Treatments	Season 2014 Rate of application (gm Kg^{-1}of seeds)			Season 2015 Rate of application (gm Kg^{-1}of seeds)		
	1	2	3	1	2	3
Carboxin+Thiram	09.33	06.66	05.00	10.11	07.66	05.66
Diniconazole	06.66	03.33	00.00	05.33	02.33	00.00
Iprodione	11.00	09.00	08.66	12.00	10.00	08.66
Plant-guard	13.00	11.00	09.33	14.00	12.00	08.66
Tolclofos methyl +Thiram	07.00	06.00	03.00	08.00	07.00	04.00
Untreated (check)		16.00			19.00	
L.S.D.at =	1 %		5 %	1 %		5 %
Treatments (T.)	2.11		1.61	2.10		1.52
Rates (R.)	1.55		1.15	1.43		1.11
T .R.	3.77		2.77	2.77		2.83

*All values shown in the table are averages of three replicates.

Effect of fungicides on scab disease:

The results present in (table 6) indicate that, seed treatments with the tested compounds at their application rates significantly reduced the mean number of scabby heads m^{-2} compared with the untreated control. Diniconazole and carboxin+thiram were the most effective fungicides, but the Plant- guard was the least effective. The other fungicides showed an intermediate effect .The results also indicated that as the rate of application increased, the number of scabby heads m^{-2} reduced. For example increasing the rate of application from 1 to 2 and to 3 g Kg^{-1} seeds for diniconazole resulted in significant reduction in number of scabby heads m^{-2} from 7.66 to 4.66 and to 1.66, respectively.

This finding is in agreement with those obtained by other outhors. Mesterhazy *et al*. (2003) reported that fungicides containing triazoles as active ingredients are the most effective plant protection agents against *Fusarium* species which are the plant pathogenic fungi causing scabby heads diseases. Suty-Heinze and Dutzmann (2004) reported that difenoconazole, like the other members of DMI fungicides has a wide spectrum of activity for the control of plant pathogenic fungi, including different species of *Fusarium* Leslie and Summerell (2006) reported that scab (Head Blight) caused by *Fusarium graminearum* and *Fusarium moniliforme* occurs in all regions of the world where humid conditions exist during the flowering and grain filling. stages. Yagouda (2010) found that the seed treatment with iprodione, baytan and Metalaxy plus each at the rate of 2g/kg of seeds were effective in the control of *Fusarium graminearum* and *Fusarium moniliforme* on wheat.

Table 6. Effect of fungicide seed treatments on mean number of scabby heads m^{-2} of wheat plants (C.V.Gemiza 9) under field conditions during the two growing seasons.

Treatments	Season 2014 Rate of application (gm Kg^{-1}of seeds)			Season 2015 Rate of application (gm Kg^{-1}of seeds)		
	1	2	3	1	2	3
Carboxin+Thiram	13.00	09.33	06.33	14.33	10.00	07.66
Diniconazole	7. 66	04.66	01.66	08.66	05.00	02.66
Iprodione	15.33	09.66	07.66	16.00	11.33	08.77
Plant-guard	19.00	15.33	11.00	20.00	16.00	12.00
Tolclofos methyl +Thiram	16.00	12.00	09.00	17.00	12.66	10.00
Untreated (check)		25.66			27.66	
L.S.D.at =	1 %		5 %	1 %		5 %
Treatments (T.)	3.41		2.61	1.83		2.71
Rates (R.)	2.41		1.82	1.42		1.96
T .R	4.71		3.41	4.32		3.55

*All values shown in the table are averages of three replicates.

Effect of fungicides on yield:

The results in Tables (7 and 8) showed that seed treatment with the all tested compounds at any rate of application, significantly increased the grain and straw yield (Kg plot^{-1}) compared with the untreated control. All the tested fungicides at the three application rates significantly decreased the straw yield compared with control during both seasons. For grain yield, diniconazole, tolclofos methyl+thiram and iprodione were the most effective fungicide, while the Plant-guard was the least effective and carboxin+thiram gave an intermediate effect. Generally, increasing the rate of application from 1 to 2 and to 3 g Kg^{-1} seed significantly in increased the yield.

Table 7. Effect of fungicide seed treatments on grain yield (Kg Plot^{-1}) of wheat plants (C.V.Gemiza 9) under field conditions during the two growing seasons.

Treatments	Season 2014 Rate of application (gm Kg^{-1} of seeds)			Season 2015 Rate of application (gm Kg^{-1} of seeds)		
	1	2	3	1	2	3
Carboxin+Thiram	13.95	14.82	16.79	14.18	15.31	16.89
Diniconazole	14.42	15.95	19.18	15.06	16.84	18.31
Iprodione	14.43	15.21	16.73	14.94	16.00	17.25
Plant-guard	12.79	13.65	15.98	13.81	14.90	15.89
Tolclofos methyl +Thiram	13.63	15.29	17.43	14.51	16.36	17.61
Untreated (check)		11.68			12.22	
L.S.D.at =	1 %		5 %	1 %		5 %
Treatments (T.)	1.12		0.83	0.78		0.58
Rates (R.)	0.79		0.59	0.55		0.41
T .R	N . S		1.45	1.35		1.01

[$] **All values shown in the table are averages of three replicates.**

Table 8. Effect of fungicide seed treatments on straw yield (Kg Plot^{-1}) of wheat plants (C.V. Gemiza 9) under field conditions during the two growing seasons.

Treatments	Season 2014 Rate of application (gm Kg^{-1} of seeds)			Season 2015 Rate of application (gm Kg^{-1} of seeds)		
	1	2	3	1	2	3
Carboxin+Thiram	13.00	09.33	06.33	14.33	10.00	07.66
Diniconazole	7.066	04.66	01.66	08.66	05.00	02.66
Iprodione	15.33	09.66	07.66	16.00	11.33	08.77
Plant-guard	19.00	15.33	11.00	20.00	16.00	12.00
Tolclofos methyl +Thiram	16.00	12.00	09.00	17.00	12.66	10.00
Untreated (check)		25.66			27.66	
L.S.D.at =	1 %		5 %	1 %		5 %
Treatments (T.)	3.41		2.61	1.83		2.71
Rates (R.)	2.41		1.82	1.42		1.96
T .R	4.71		3.41	4.32		3.55

[*] **All values shown in the table are averages of three replicates.**

Several authors recorded that fungicide seed treatments against fungal pathogens resulted in increasing the wheat growth and subsequently increased yield components. For example, Meisner and Ahmed (1996) found that Metalaxyl plus 200 has broad spectrum fungicidal activity as wheat seed treatment against both externally and internally seed-borne diseases was found to increase plant stand by 23% and grain yield by 18% under farmer's field condition. Rahman *et al.* (1999) found that seed treatment with Vitavax 200 WP combined with Tilt – 250 EC spraying resulted in 27.3 % increase of 1000- grain weight and 55.7% increase of grain weight over the control. Khanzada *et al.* (2002) studied the efficacy of different fungicides evaluated for the control of seed borne fungi associated with wheat. Baytan, Vitavax, Benlate and Captan were found to be highly effective. All fungicides significantly increased the seedling emergence, number of grains per spike,1000- grain weight, grain yield per plot and per hectare over control. Carmona, *et al* (2008) reported an increase of 100 grain yield by 11% when seed treatment fungicide was used as compared to untreated control. Kadege (2013) reported that seed treatment with metalaxyl plus, mancozeb and Baytan resulted in increasing number of grain per spike, 100 grain weight and total grain yield on both three locations and varieties. The increased yield in treated seeds was probably due to reduced intensity of the diseases observed compared to untreated controls.

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مكافحة أمراض القمح الفطرية تحت الظروف الحقلية

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تم إجراء التجارب الحقلية في منطقة أشمون محافظة المنوفية بهدف تقييم فاعلية أربعة من مبيدات الفطريات الكيماوية وواحد من المواد الحيوية في مكافحة أمراض القمح خلال موسمي (٢٠١٣-٢٠١٤ و ٢٠١٤- ٢٠١٥) بالمقارنة مع الغير معامل (الكنترول). وكانت المبيدات المستخدمة هي فيتافاكس ٢٠٠ ٧٥% مسحوق قابل للبلل (كاربوكسين – ثيرام) , روفرال ٥٠ % مسحوق قابل للبلل (إبروديون) ,سومي ايت ٢ %مسحوق قابل للبلل (داينيكونازول)وريزولكس تي ٥٠ % مسحوق قابل للبلل (تولكلوفوس ميثيل + ثيرام) وذلك بالإضافة إلي المركب الحيوي بلانت جارد(تريكودرما هارزيانم) . تم معاملة البذور بالمركبات السابقة بمعدل ١ , ٢, ٣ جرام من التجهيزة / كيلو جرام بذرة. بصفه عامة فإن كل المركبات المختبرة قد زادت من عدد النباتات / م^{٢} بالمقارنة بالغير معامل وكان مبيدي داينيكونازول و إبروديون من أكفأ المبيدات المستخدمة وكان المركب الحيوي أقل فاعلية وقد أعطت المركبات الأخري تأثيرات متوسطة. وقد أسفر استخدام هذه المعاملات عن نقص عدد الجذور المصابة بعفن الجذور بعد ٢١ يوم من الزراعة وأيضا زادت من عدد التفريعات / نبات مقارنة بالكنترول . كما أوضحت النتائج أن المعاملة بمبيدات داينيكونازول و تولكلوفوس ميثيل + ثيرام ادت الي انخفاض عدد السنابل البيضاء (المتسببة عن عفن الجذور) وأيضا أدت المعاملة بمبيدات داينيكونازول و كاربوكسين + ثيرام إلي انخفاض السنابل المصابة بجرب السنابل (فطر الفيوزاريوم) . عموما يمكن القول أن زيادة المعدلات من ١ إلي ٢ ومن ٢ إلي ٣ جرام/ كيلو جرام بذرة أحدثت تأثيرا معنويا للصفة الحيوية المراد دراستها وزاد التأثير بزيادة التركيز (علاقة طردية) وكانت مبيدات الفطريات الكيماوية أكثر فاعلية من المركب الحيوي بلانت جارد وقد زاد محصول الحبوب والتبن الناتج نتيجة لهذة المعاملات وكانت مبيدات داينيكونازول- و إبروديون- وتولكلوفوس ميثيل + ثيرام من أحسن المبيدات المستخدمة فعالية في هذة التجارب.