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Effect of Leftover Certain Crops and some Bioagents on Controlling Onion White Rot Disease

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Alfalfa, broccoli, carrot and Sudan grass were used as preceding crops residues to evaluate their effect on onion white rot caused by *Sclerotium cepivorum* Berk. either alone or in combined treatments with *Trichoderma harzianum* and with the bio-product Plant guard. The fungicide Folicure was used as check treatment. All treatments decreased percentage of infection, soil scleroial number and increased onion bulb yield. Combined treatments were effective more than single ones in most cases. Under greenhouse conditions, broccoli residues as single or combined with Plant guard strongly reduced disease incidence (20.0% infection with 71.0% efficacy) in comparison with the other tested treatments. Under open field conditions, however, all treatments decreased the percentage of infection during 2015-2016 and 2016-2017 growing seasons. According to the mean values of the two seasons, broccoli residues combined with *T. harzianum* recorded the lowest percentage of infection by *S. cepivorum* (16.56%) with 70.06% efficacy. Sclerotial number was counted under greenhouse and open field conditions before onion transplantation and at the end of each season. Before transplantation, under greenhouse conditions all treatments significantly decreased sclerotial number with an efficacy that ranged between 25.89% with alfalfa and 45.5% with broccoli. Under open field conditions treatments decreased sclerotial number between 15.0% with alfalfa and 40.0% with broccoli. At the end of seasons, broccoli resides gave 3.0 sclerotia/g soil (72.73% efficacy) under greenhouse. Wherever, under open filed conditions broccoli residues combined with *T. harzianum* gave efficacy reached 73.13% and whereas it gave 70.15 % efficacy with Plant guard. All tested treatments under investigation significantly increased bulb yield compared to non-treated plants.

Keywords: Alfalfa, Broccoli, Carrot, Green manure, Onion, Plant guard, Plant residues, *Sclerotium cepivorum*, Soil amendment, Sudan grass, *Trichoderma harzianum*.

Onion (*Allium cepa* L.) is one of the most popular and essential spice plants as well as vegetables all over the world. It is also used as medicinal plant in controlling human and plant diseases (Vohora *et al.*, 1974). In Egypt, it is considered one of the oldest known and important crops, not only for local consumption but also for exportation.

Sclerotium cepivorum Berk., the causal organism of white rot, exclusively affects *Allium* spp., and is found in practically all regions where species of Allium are grown (Crowe *et al*., 1993). The first record of white rot in Egypt was in 1931 by Nattrass at Maghagha district, Menia governorate.

Chemical, biological, agricultural practices, soil solarization, plant extracts and induced resistance were all tried to control onion white rot (Abd El-Moity *et al*., 1982, El-Shehaby, *et al*., 1992, Amin, 2003 and Amin *et al.*, 2016).

Organic soil amendments such as green manures have been studied as a potential control strategy for soil-borne pathogens of several host plants. It offers substantial benefits to the soil including increase nutrients and organic matter, improve soil structure and control plant diseases (Larkin, 2013). In addition, green manures have been showed a significant reduction of common scab of potato (Rouatt and Atkinson, 1950), Verticillium wilt of potato (Davis *et al*., 1996), Aphanomyces root rot of pea (Williams-Woodward *et al*., 1997) and Rhizoctonia stem canker of potato (Scholte and lootsma, 1998).

Therefore, the objective of this study was to evaluate the effect of onion, alfalfa, broccoli, carrot and Sudan grass alone or mixed with *T. harzianum* or the bio-fungicide Plant guard on percentage of onion white rot infection, sclerotial number of *S. cepivorum* in soil, and onion bulb yield under greenhouse and open field conditions.

Materials and Methods

Sclerotium cepivorum:

S. cepivorum was previously isolated from naturally infected onion plants collected from Menia governorate (Amin *et al.*, 2016). The isolate was used to inoculate bottles of sterilized barley seeds medium (100 g barley seeds and 120 ml tape water) according to Van der Meer *et al.* (1983) for 3 weeks at 20±2^{o} C and was used as inoculum.

Trichoderma harzianum:

An isolate of *T. harzianum* was kindly obtained from Onion, Garlic and Oil Crops Dept., Plant Pathol. Res. Inst., ARC and grown for 10 days at 25±2^{o} C in a liquid Gliotoxin fermentation medium, then blended in an electrical blender for 2 min. and adjusted for 30x0^{6} spores/ ml using a hemocytometer slide. Bulb and roots of onion transplants (cv. Giza 6, 60 days old) were dipped in the spore suspension with 1% Arabic gum for 5 min. and left to air dry for one hour before transplanting.

Plant guard:

The bio-fungicide (Plant guard), consists of *Trichoderma* spp., 30x0^{6} spores, was used in this investigation for comparison with the tested treatments. Bulb and roots of onion transplants were dipped in Plant guard with 1% Arabic gum for 5 min. and left to air dry for one hour before transplantation.

Folicure:

The fungicide Folicure 25% EC (tebuconazole 25%) was used in the present investigation for comparison with the tested treatments. Bulb and roots of onion transplants were dipped for 5 min. in the Folicure 25% (25ml/L water) just before transplanting. Later, after transplantation the grown plants were sprayed with fungicide at 6 and 12 weeks (187.5 ml/100L water).

Greenhouse experiments:

Pot experiment was carried out under greenhouse conditions during 2015-2016 growing season. Plastic pots (30 cm diam.) were filled with sterilized sand-clay soil infested with *S. cepivorum* inoculum at the rate of 2% w/w. On the 1st of August tested plants, *i.e.* alfalfa (*Medicago sativa*), broccoli (*Brassica oleracea* var. *capitata*), carrot (*Daucus carota* subsp. s*ativus*) and Sudan grass (*Sorghum sudanese*) were seeded in pots and irrigated when needed. After two months, the whole plants were turned up into the soil and left for one month before onion transplanting on 1st of November. Different treatments were applied as follow: *T. harzianum,* plant guard, leftover crops residues, *T. harzianum* + leftover crop residues, plant guard + leftover crop residues and the fungicide Folicure as check (Table, 1). Five replicate pots were used for each treatment. Check treatments were pots filled with infested soil. Five onion transplants cv. Giza 6, 60 days old were transplanted in each pot. All pots received the same normal agricultural practices. Percentage of infection at the end of each season, in 15th of April, was calculated according to the following formula:

$$\% \text{ infection} = \frac{\text{No. of infected plants in treatment}}{\text{No. of cultivated plants in treatment}} \text{ X100}$$

Field experiments:

Experiments were carried out during 2015-2016 and 2016-2017 growing seasons under naturally infested soil with *S. cepivorum* at Mallawy Agriculture Research Station, Menia governorate. Experiments were designed as complete randomized blocks. The same treatments carried out under greenhouse were applied under open field after crop plough in the soil. Plots were 10.5 m^2 (3*3.5 m) contained 5 rows (50 cm apart). Each plot was planted with 300 onion transplants cv. Giza 6 (60 days old). Three replicate plots were used for each treatment and control (plots without treatment). All plots received the same normal agricultural practices. At the end of each season in 15th of April, percentage of infection and onion bulb yield (Kg/plot) were calculated.

Sclerotial number:

Number of sclerotia was determined/g soil samples within 15 cm from soil surface just before onion transplanting and at the end of the season under greenhouse and field conditions according to Abd-El-Rehim (1984).

Statistical analysis:

Data were statistically analyzed and significance was assessed by the least significant difference (LSD) at 5 % probability using SAS ANOVA program V.9 (Anonymous, 2014).

Results

Greenhouse experiments:

Leftover residues of four different plant species were used to evaluate their effect in controlling onion white rot as single or in combined treatments with *T. harzianum* or the bio-fungicide Plant guard compared to Folicure fungicide.

Under greenhouse conditions, data presented in Table 1 show that all the tested treatments significantly decreased the percentage of infection compared to control. However, in most cases, the differences among the treatments were not significant (Table 1). Transplanting onion transplants in pots containing broccoli residues as single or in combined treatments gave the lowest percentage of infection. Broccoli combined with Plant guard was the highest effective treatment compared to all other treatments including Folicure which gave 25.0% infection. Booth of broccoli, *T. harzianum* as single or combined with each other and alfalfa combined with *T. harzianum* were approximately similar with no significant differences.

Table 1. Effect of preceding crop residues, bio-treatments and fungicide Folicure on onion white rot incidence under greenhouse conditions during 2015-2016 growing season

Treatment	Infection (%)	Efficacy (%)
Alfalfa	35	50.0
Broccoli	25	64.3
Carrot	30	57.1
Sudan grass	30	57.1
Alfalfa + *T.harzianum*	25	64.3
Broccoli + *T.harzianum*	25	64.3
Carrot + *T.harzianum*	30	57.1
Sudan grass+ *T.harzianum*	30	57.1
Alfalfa+ Plant gurad	30	57.1
Broccoli + Plant gurad	20	71.4
Carrot + Plant gurad	30	57.1
Sudan grass + Plant gurad	30	57.1
T.harzianum	25	64.3
Plant gurad	30	57.1
Folicure	25	64.3
Control *	70	0.0
L.S.D. at 0.05 %	13.18	-

* Only infested pots with *S. cepivorum* without treatment.

Field experiments:

Under open field conditions, all treatments significantly decreased the percentage of infection during 2015-2016 and 2016-2017 growing seasons. The combined treatments gave better results than single ones. The effectiveness was slightly increased in the presence of *T. harzianum* more than with Plant guard. Plots previously treated with broccoli and transplanted with onion in the presence of

T. harzianum recorded the lowest mean of infection (16.56%) with 70.06% efficacy during the two seasons tested. In this respect, Folicure treatment gave the lowest percentage of infection with the highest efficacy reached, 79.89% (Table 2).

Table 2. Effect of preceding crop residues, bio-treatments and fungicide Folicure on onion white rot incidence under naturally infested field with *S. cepivorum* at Mallawi Agric. Res. Sta., Menia governorate, during 2015-2016 and 2016-20117 growing seasons

Treatment	Infection (%)			Efficacy (%)
	2015-16	2016-17	Mean	
Alfalfa	27.50	28.25	27.88	49.60
Broccoli	23.50	24.50	24.00	56.61
Carrot	27.50	27.75	27.63	50.06
Sudan grass	26.75	26.50	26.63	51.86
Alfalfa + *T.harzianum*	17.50	18.00	17.75	67.91
Broccoli + *T.harzianum*	16.50	16.63	16.56	70.06
Carrot + *T.harzianum*	17.00	17.75	17.38	68.59
Sudan grass+ *T.harzianum*	16.25	17.50	16.88	69.49
Alfalfa+ Plant gurad	18.38	20.63	19.50	64.75
Broccoli + Plant gurad	19.50	16.75	18.13	67.23
Carrot + Plant gurad	16.25	20.75	18.50	66.55
Sudan grass + Plant gurad	15.75	21.00	18.38	66.78
T.harzianum	17.25	20.75	19.00	65.65
Plant gurad	18.25	20.00	19.13	65.42
Folicure	10.50	11.75	11.13	79.89
Control *	53.38	57.25	55.31	0.00
L.S.D. at 0.05 %	3.10	1.50	-	-

* Only infested soil with *S. cepivorum* without treatment.

Effect of preceding crop residues on sclerotial number of S. cepivorum:

Sclerotial number was counted under greenhouse and open field conditions on two phases, before onion transplanting and at the end of the growing season. Before onion transplanting, under greenhouse conditions all treatments decreased sclerotial number significantly. Efficacy ranged between 25.89% with alfalfa and 45.5% with broccoli (Table 3). While, under open field conditions the efficacy ranged between 15.0% with alfalfa and 40.0% with broccoli (Table 4).

Table 3. Effect of preceding crop residues on sclerotial number* of *S. cepivorum* under greenhouse conditions during 2015-2016 growing season

Treatment	Number of sclerotia/g soil	Efficacy (%)
Alfalfa	6.80	25.89
Broccoli	5.00	45.50
Carrot	5.90	35.69
Sudan grass	5.13	44.14
Control**	9.18	-
L.S.D.at 0.05%	0.42	-

*Sclerotial numbers were calculated as sclerotium/g soil just before onion transplanting.
**only infested pots with *S. cepivorum* without treatment.

Table 4. Effect of preceding crop residues on sclerotial number* of *S. cepivorum* in naturally infested field soil at Mallawi Agric. Res. Sta., Menia governorate, during 2015-2016 and 2016-2017 growing seasons

Treatment	Number of sclerotia/g soil			Efficacy (%)
	2015-16	2016-17	Mean	
Alfalfa	4.50	4.00	4.25	15.00
Broccoli	3.17	2.83	3.00	40.00
Carrot	4.00	3.00	3.50	30.00
Sudan grass	3.67	2.67	3.17	36.60
Control**	4.67	5.33	5.00	-
L.S.D.at 0.05%	1.74	1.20	-	-

*Sclerotial numbers were calculated as sclerotium /g soil just before onion transplanting.
**only infested soil with *S. cepivorum* without treatment.

Concerning sclerotial number at the end of the season, under greenhouse, data in Table 5 show that all treatments decreased sclerotial number in comparison with control. Broccoli leftover treatment as a single treatment or combined with Plant guard gave the highest reduction (3.0 sclerotia/g soil with 72.73% efficacy), while Folicure gave 4.67 sclerotia/g soil with 57.58% efficacy. The effect of alfalfa and carrot residues was increased when excited in soil transplanted with onion transplants treated with *T. harzianum* and Plant guard, respectively.

In the same trend, all plant residues as single or combined treatments during the two successive growing seasons decreased sclerotial number under open field conditions (Table 6). Broccoli residues as a single or in combined treatments were the most effective in this respect. The combination with *T. harzianum* or Plant guard gave the highest reduction in sclerotial number, respectively at the two tested growing seasons without significant differences between them. In most cases, addition of either *T. harzianum* or Plant guard increased the suppression effect of all plant residues towards the sclerotial number determined.

Data about sclerotial number clearly showed that the number of sclerotia was decreased in soil because of leftover of tested plants in soil compared with control. Also, the number was decreased continuously up to the end of the season and this was reflected on the percentage of infection.

Table 5. Effect of some preceding crop residues, bio-treatments and fungicide Folicure on sclerotial number* of *S. cepivorum* under greenhouse conditions during 2015-2016 growing season

Treatment	Number of sclerotia/g soil	Efficacy (%)
Alfalfa	6.33	42.42
Broccoli	3.00	72.73
Carrot	5.00	54.55
Sudan grass	3.33	69.70
Alfalfa + *T.harzianum*	5.33	51.52
Broccoli + *T.harzianum*	3.33	69.70
Carrot + *T.harzianum*	4.00	63.64
Sudan grass+ *T.harzianum*	3.67	66.67
Alfalfa+ Plant gurad	4.00	63.64
Broccoli + Plant gurad	3.00	72.73
Carrot + Plant gurad	4.33	60.61
Sudan grass + Plant gurad	6.57	40.30
T.harzianum	3.33	69.70
Plant gurad	4.00	63.64
Folicure	4.67	57.58
Control**	11.00	0.00
L.S.D. at 0.05 %	1.85	-

*Sclerotial numbers were calculated as sclerotium/g soil just before onion transplanting.
**only infested pots with *S. cepivorum* without treatment.

Regarding to the effect of treatments tested on bulb yield, data in Table 7 clearly indicate that all the tested treatments significantly increased bulb yield in comparison with the control. Combined treatments increased bulb yield more than any single ones. The best treatment was after broccoli combined with *T. harzianum* which gave 12.34 kg/plot on the average with increase in yield reached 143.83% in comparison with the control. While Folicure treatment gave 7.41 kg/plot on the average with 46.30% increase in yield compared to control.

Table 6. Effect of preceding crop residues, bio-treatments and fungicide Folicure on sclerotial number* of *S. cepivorum* under naturally infested soil at Mallawi Agric. Res. Sta. Menia governorate, during 2015-2016 and 2016-2017 growing seasons

Treatment	Number of sclerotia/g soil			Efficacy (%)
	2015-16	2016-17	Mean	
Alfalfa	2.33	4.33	3.33	40.30
Broccoli	2.00	3.00	2.50	55.22
Carrot	2.67	4.00	3.33	40.30
Sudan grass	2.33	3.67	3.00	46.27
Alfalfa + *T.harzianum*	2.00	3.00	2.50	55.22
Broccoli + *T.harzianum*	1.50	1.50	1.50	73.13
Carrot + *T.harzianum*	1.50	2.17	1.83	67.16
Sudan grass+ *T.harzianum*	1.33	2.33	1.83	67.16
Alfalfa+ Plant gurad	2.83	2.33	2.58	53.73
Broccoli + Plant gurad	1.67	1.67	1.67	70.15
Carrot + Plant gurad	2.00	4.33	3.17	43.28
Sudan grass + Plant gurad	2.00	4.00	3.00	46.27
T.harzianum	1.67	2.33	2.00	64.18
Plant gurad	1.50	4.67	3.08	44.78
Folicure	1.00	1.67	1.33	76.12
Control**	5.00	6.17	5.58	0.00
L.S.D. at 0.05 %	0.76	1.16	-	-

* and ** as described under Table 4.

Table 7. Effect of preceding crop residues, bio-treatments and fungicide Folicure on onion bulb yield under naturally infested field soil with *S. cepivorum* at Mallawi Agric. Res. Sta., Menia governorate during 2015-2016 and 2016-2017 growing seasons

Treatment	Bulb yield (Kg/plot)			Efficacy (%)
	2015-16	2016-17	Mean	
Alfalfa	10.81	8.50	9.66	90.74
Broccoli	11.00	9.50	10.25	102.47
Carrot	10.38	8.75	9.56	88.89
Sudan grass	10.63	9.00	9.81	93.83
Alfalfa + *T.harzianum*	11.19	9.63	10.41	105.56
Broccoli + *T.harzianum*	13.19	11.50	12.34	143.83
Carrot + *T.harzianum*	12.63	8.63	10.63	109.88
Sudan grass+ *T.harzianum*	12.25	10.75	11.50	127.16
Alfalfa+ Plant gurad	11.56	9.88	10.72	111.73
Broccoli + Plant gurad	12.50	11.13	11.81	133.33
Carrot + Plant gurad	11.38	10.25	10.81	113.58
Sudan grass + Plant gurad	13.25	10.00	11.63	129.63
T.harzianum	12.75	8.38	10.56	108.64
Plant gurad	10.75	9.38	10.06	98.77
Folicure	8.06	6.75	7.41	46.30
Control*	5.75	4.38	5.06	0.00
L.S.D. at 0.05 %	0.80	0.87	-	-

* Only infested soil with *S. cepivorum* without treatment.

Discussion

Crops leftover residues have the ability to change soil biology through many changes include physical, chemical and biological properties, and may also result in suppression of specific plant pathogens. Leftover organic components increase microbial biomass and cause distinct changes in soil microbial populations that may be partially responsible for suppression of diseases. The mechanisms of suppression on plant diseases are varied and often unknown. It may influence pathogens directly through the breakdown of organic matter or by releasing fungitoxic compounds. Green manures may also affect soil-borne pathogens indirectly by influencing indigenous microbial activity and microbial diversity (Lupwayi *et al*., 1998), as well as densities of bacteria, fluorescent *Pseudomonas* spp. (Mazzola *et al*., 2001), non-pathogenic *Fusarium* spp. (Davis *et al*., 1994), mycophagous organisms (Scholte and Lootsma, 1998) and streptomycetes as well as other actinomycetes (Mazzola *et al*., 2001) in soil. These changes in the microbial community may affect pathogen populations through competition, parasitism, predation or antagonism (Scholte and Lootsma, 1998).

Residues of the four different plant species tested were effectively decreased the incidence of onion white rot, sclerotial number under greenhouse and open field conditions, also increased onion bulb yield. Robert (2013) stated that, brassica residues and related crops had emerged as most effective for management of multiple plant diseases due to their bio-fumigation potential, expressed in suppression of pathogens through the release of volatile toxic breakdown products, as well as other unique effects on soil microbial ecology. So, it had been used to control a variety of fungal pathogens, including species of *Rhizoctonia, Verticillium, Sclerotinia, Phythophthora, Pythium, Aphanomyces* and *Macrophomina*, in various crops production systems. Villar *et al*. (1990) stated that incorporation of cabbage and broccoli residues at 5% w/v into soil infested with *S. cepivorum* (4 sclerotia/g soil) significantly reduced the number of dead onion plants and disease index (40% and 25-65%, respectively).

Alfalfa shoots are a rich source of antioxidant flavonoids, mainly apigenin, tricin, luteolin, chrysoeriol glycosides and of phenolic compounds (Choi *et al*., 2013). Saponins of alfalfa showed fungitoxic effect on six pathogenic fungi (*Fusarium oxysporum* f.sp. *callistephi*, *Botrytis cinerea*, *Botrytis tulipae*, *Phoma narcissi*, *Fusarium oxysporum* f.sp. *narcissi* and *Fusarium oxysporum*) at all the tested concentrations but their potency were differed in case of the individual fungi. The highest saponin concentration (0.1%) was the most effective and the inhibition of *Fusarium oxysporum* f.sp. *callistephi*, *Botrytis cinerea*, *Botrytis tulipae*, *Phoma narcissi*, *Fusarium oxysporum* f.sp. *narcissi* were 84.4, 69.9, 68.6, 57.2 and 55.0%, respectively. While *Fusarium oxysporum* Schlecht., a pathogen of *Muscari armeniacum* was inhibited only by 9.5% (Alicja *et al*., 2006).

Sorghum, Sudan grass (*Sorghum sudanese*) tended to have greater proportions of antagonists than fallow-treated soils. Furthermore, consistent with previous studies, treated soils had greater streptomycetes and bacterial densities than fallow-treated soils (Mazzola *et al*., 2001). *Verticillium dahlia* was suppressed by Sudan grass as green manure crop (Davis *et al*., 1996). Sometimes Sudan grass gave a negative impact on subsequently planted crops, but it has a positive effect on control weeds and plant pathogens, for example weed populations have been decreased in wheat following sorghum (Cheema and Khaliq, 2000), and root exudates of *Sorghum bicolor* reduced growth of different weeds (Einhelling and Souza, 1992).

The severity of pepper Phytophthora blight was markedly reduced by cabbage, garlic, and alfalfa residues by 15.3, 39.8 and 46.9%, respectively in pot trials and by 89.5, 40, and 10.7%, respectively under field conditions (Fikret and Sara, 2006).

The incorporation of raw or composted vegetable waste mixtures to sandy loam, silt and peat soils reduced the viability of *S. cepivorum* sclerotia under glasshouse pot bioassays. The reduction in viability was dependent on waste type, rate of incorporation, duration of exposure and soil type (Coventry *et al*., 2005). Planting and incorporation of broccoli significantly reduced sclerotia density and viability (53 and 14%, respectively). Pinto *et al*. (1998) stated that, water extracts of *Brassica oleracea* var. *capitata* leaves had little effect on mycelial growth or sclerotial germination, although acetone-water leaves extract reduced mycelial growth more than sclerotial germination of *S. cepivorum*. Somlinska (2000) found that air dried and crushed mustard (*Brassica juncea*) added to the soil effectively reduced the viability of fungal propagules. The addition of rapeseed (*Brassica napus* Bolko cv. and *B. napus* Gorczanski cv.) residues to soil also resulted in a significant decrease of number of *S. cepivorum* sclerotia. Volatile emanating from decomposing cabbage and broccoli residues at low rates significantly stimulates sclerotial germination, whereas high rates inhibit sclerotial germination (Zavaleta *et al*., 1991). Fikret and Sara (2006) found that ethanol extracts of alfalfa, garlic, cabbage, and peppermint reduced diameter of *Phytophthora capsica* on corn meal agar between 3.46 and 13.73%, whereas it was increased by onion, radish, garden cress, and lentil extracts. There is significant onion response to the different soil organic amendments. Onion plant height, number of leaves, root length, dry and fresh weight and bulb weight are high in farmyard manure, followed by compost manure and lastly green manure compared to the control (Bosco Bua *et al*., 2017). Organic materials, such as farmyard manure, not only improve soil physical and chemical properties but also have positive effect on root growth and improve root rhizosphere conditions (Funda *et al*., 2011). Ulacio-Osorio *et al*., 2006 mentioned that broccoli residues increased the yield of garlic 18% compared to control.

Conclusion

It is concluded from this study that the tested residues of broccoli, Sudan grass, alfalfa and carrot plants and bio-treatments (*T. harazinum* and Plant guard) decreased disease incidence, number of sclerotia in soil under both greenhouse and open field conditions, as well as increased onion bulb yield. Broccoli residues alone or combined with bio-treatments were the most effective one.

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تأثير مخلفات المحصول السابق و بعض عناصر المقاومة الحيوية فى مكافحة العفن الأبيض على البصل

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تم استخدام أربعة أنواع نباتية هم البرسيم، البروكلي، الجزر و حشيشة السودان لتقييم تأثير مخلفاتهم على مرض العفن الأبيض فى البصل سواء فى صورة معاملة فردية أو معاملة مشتركة مع *T. harzianum* أو المبيد الحيوى بلانت جارد فى وجود المبيد الفطرى فوليكور للمقارنة. جميع المعاملات أدت إلى خفض نسبة الإصابة وعدد الأجسام الحجرية بالتربة وزادت من محصول الأبصال مقارنةً بغير المعامل. كانت المعاملات المشتركة أفضل من المعاملات الفردية فى معظم المعاملات. تحت ظروف الصوبة كانت مخلفات البروكلى كمعاملة فردية أو مشتركة مع المبيد الحيوى بلانت جارد أهم المعاملات تأثيراً بما فيها مبيد الفوليكور حيث أعطت ٢٠% إصابة و ٧١% كفاءة مقارنةً بالمعاملات الأخرى المختبرة. خفضت جميع المعاملات نسبة الإصابة تحت ظروف الحقل خلال موسمى النمو تحت الإختبار (٢٠١٥ - ٢٠١٦ و ٢٠١٦ - ٢٠١٧). حيث سجل متوسط الموسمين لمعاملة البروكلى مع *T. harzianum* أقل نسبة إصابة ١٦.٥٦% و ٧٠.٠٦% كفاءة. تم عد الأجسام الحجرية للفطر *Sclerotium cepivorum* بالتربة سواء بالصوبة أو الحقل قبل زراعة الشتلات و عند نهاية الموسم. أدت كل المعاملات إلى خفض عدد الأجسام الحجرية معنوياً قبل زراعة شتلات البصل و قد تراوحت كفاءة المعاملات بين ٢٥.٨٩% مع مخلفات البرسيم و ٤٥.٥% مع مخلفات البروكلى. فيما تراوحت كفاءة المعاملات بين ١٥% مع مخلفات البرسيم و ٤٠% مع مخلفات البروكلى تحت ظروف الحقل. عند نهاية الموسم كانت أعداد الأجسام الحجرية ٣ جسم حجرى/جم تربة بكفاءة ٧٢.٧٣% مقارنةً بغير المعامل مع معاملة البروكلى بالصوبة، بينما تحت ظروف الحقل أعطت معاملة البروكلى كفاءة ٧٣.١٣% عندما استخدمت مع *T. harzianum* و ٧٠.١٥% عندما استخدمت مع معاملة بلانت جارد. أدت جميع المعاملات إلى زيادة وزن محصول الأبصال مقارنةً بالنباتات غير المعاملة.