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Integrated Mycobiocides and Certain Herbicide Against *Orobanche crenata* Infestation in Faba Bean Field

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Integration between mycobiocides and herbicide for controlling broomrape was carried out during winter season 2001-2002 in faba bean field naturally infested with *Orobanche crenata* at Giza governorate, Egypt. Mycobiocides, *i.e. Trichoderma harzianum* (T1&T3) and *T. viride* (T2) were used in this study. Mycobiocides - inoculated compost substrate was used as soil drench before faba bean sowing. The herbicide glyphosate [N-(phosphonomethyl) glycine] was used as a single or double foliar spray at a low determined rate of 50 µl one or two times during the growing season. It was found that the fungal growth was affected at 70 ppm, gradually decreased by increasing glyphosate concentrations and failed to grow at 130-140ppm. Under field conditions, significant reduction in the incidence and intensity of broomrape infection was observed in mycobiocidal and herbicidal treatments. The mycobiocides drenched as inoculated compost to the soil followed by foliar spraying for two times with glyphosate was the most appropriate treatment that resulted in the highest reduction in the parasitic parameters of *O. crenata* along with the highest records of yield increase. The integrated mycobiocidal and herbicidal control being acceptable for controlling *O. crenata* in faba bean fields. Adaptation of the method for greater efficiency in broomrape control is suggested.

Key words: Broomrape, glyphosate, mycobiocides, *Orobanche crenata*, *Trichoderma harzianum* and *T. viride*.

The holoparasite broomrape attacks and severely damages many food and ornamental crops, causes considerable yield losses (Parker and Wilson, 1986). The obligate parasitic weeds (*Orobanche* spp.) are wide spread in the Mediterranean area, south east Europe and the Middle East (Parker, 1986). In Egypt *Orobanche crenata* Forsk. presents a serious problem for crop production especially faba bean (*Vicia faba* L.).

The actual area infested with the broomrape in Behera governorate, Egypt, was reported to be 65% of the total cultivated area, causing about 19 000 tons yield loss (Zaitoun, 1990). In another determination (s) the infested area covered 18–86% of the total along with 7–80% yield reduction (Korashi *et al.*, 1996). The intensity of broomrape parasitic on faba bean plants in Minofia, however, was recorded to be 1–4 spike/plant that caused 15–53% yield reduction (ARC, 1998). The endemic spread of the parasite in the Nile of the Delta, the exceptionally long survival of seeds in soil along with the high susceptibility of different host cultivars rendering the issue of control of a paramount importance.

Recently, several measures is being tried for Orobanche control. In this regard, few investigators have reported effective control using systemic herbicides and even fewer reported effective and selective applications of soil residual herbicides (Foy *et al.*, 1989; Parker and Riches, 1993). Glyphosate application was recommended by several researchers, for large scale in faba bean fields, under heavy infestation with Orobanche. The application of glyphosate at the rate of 0.07 kg *a.i.* / ha during the attachment stage was efficient for controlling *Orobanche foatida* on faba bean (Kharrat and Halila, 1994). Periodical application of glyphosate at different doses to tobacco fields reduced Orobanche emergence by 50% (Raju, 1996). In Egypt, results over three years indicated that periodical glyphosate sprays at the beginning of flowering (three sprays, three weeks intervals) reduced Orobanche incidence by 97-100% and increased faba bean seed yield from 34-124% (ICARDA / IFAD Nile Valley projects, 1983). The use of herbicides, however, must be tested against different crops and *Orobanche* species, because of the systemic action in principal that may probably affect the host plant.

The biological control has been tried for the control of different species of *Orobanche*. In this regard, many investigators used *Fusarium oxysporum* f.sp. *orthoceras* as a potential agent for biological control of root parasitic weed (*Orobanche* spp.) in sunflower, tobacco and other crops. The fungus attacks the under ground stages, such as juveniles, tubercles and seed germ tubes (Bedi *et al.*, 1994; Bozoukov and Kouzmanova, 1994 and Tomas *et al.*, 1999). In Egypt, the parasitism of some soilborne fungi, isolated from the rhizosphere of different hosts on *Orobanche crenata* under greenhouse conditions was evaluated (Abdel-Kader *et al.*, 1998). They found that isolates of *Trichoderma* spp. and *Fusarium* spp. had shown aggression in parasitizing *O. crenata* either before or after emergence without causing noticeable damage to faba bean the host plant. In further studies three isolates of *Trichoderma* as mycoherbicides in pea fields were used by Abdel-Kader (1999) and Abdel-Kader and EL-Mougy (2001). They found that drench application of *Trichoderma* isolates was more effective in controlling Orobanche infestation and minimized significantly number of spikes per pea plant as well as an increase in the total yield.

The present investigation was undertaken to evaluate the integrated mycobiocidal and herbicidal treatments controlling *Orobanche crenata* infestation in faba bean fields.

Materials and Methods

Laboratory studies:

Source of mycobiocides:

Trichoderma harzianum (T1 & T3) and *T. viride* (T2), obtained from the Plant Pathol. Dept., National Res. Centre, were cultured on SM medium (Oken *et al.*, 1973) and served as mycobiocidal agents during this study.

Effect of the herbicide on the mycobiocidal mycelial growth:

The inhibitory effect of the herbicide glyphosate [N-(phosphonomethyl) glycine] on the mycelial radial growth of the used *Trichoderma* spp. was *in vitro* evaluated.

Glyphosate (36%) at 15 consequent concentrations started from 0 up to 140ppm with a constant increase of 10ppm were tested. Different volumes of glyphosate stock solution were added to the SM medium, before solidification, to give the desired concentration, then poured at approximately equal volumes of 20ml / plate. A set of Petri-dishes containing glyphosate-free medium was kept as check. Disks (5mm in diameter) from 7 days old cultures were placed in the middle of each dish and five as replicates for each particular treatment as well as check were used. Incubation was made for 7 days at 25±1°C, and then examined. The percentage of growth reduction of the fungi tested in different treatments relatively to check ones was calculated.

Spores produced were counted just after the latest determination of the radial growth on solid medium. Fungal spores of each particular treatment were suspended in 100 ml distilled water and counting was made by a Haemocytometer slide. The average number of spores was calculated per mm^2 of fungal growth in each particular treatment.

Field experiment:

The experiment was carried out in the winter season 2001/2002 in a faba bean field naturally contaminated with *Orobanche crenata* seed bank at Al-Aiat territory, Giza governorate. The plants in this field were heavily infected by broomrape parasitism during the last six previous seasons (>50%) due to the continuous cultivation of the host plants that increased *Orobanche crenata* seed bank in the soil.

Mycobiocides inoculum preparation:

The fungal inocula were grown on compost plant materials and were used as a soil drench application, according to the following:

(a) Compost substrate preparation:

Plant debris and farm wastes were used for preparing the composted matrix according to the following procedure:

Squash waste materials (500 kg) and clover plants (500 kg) were chopped in small pieces and mixed together. Calcium supper phosphate (15 kg), ammonium sulphate (25 kg), calcium carbonate (25 kg) and air dried clay soil (100 kg) were mixed. A pyramid shape heap with rectangle base (2 x 3m) consisting 10 layers of the above mentioned mixtures in a consecutive order was prepared.

The preparing compost was turned over , up side down keeping the shape and reversing the sequence of arranged layers, every 10 days for a 6 weeks during July – August, 2001. The moisture content of the prepared compost was kept constant at 50-60% during the composting period.

(b) Compost inoculation with mycobiocides:

On the first of September, 2001, the prepared compost was divided into four pyramid shape heaps, each separately inoculated with the mycobiocides in concern. Inocula of *Trichoderma* spp. (T1, T2 and T3) were grown for 15 days on sand barely medium (1 : 1, w:w and 40% water) then used for compost inoculation at the rate of 10% (w:w) and thoroughly mixed. Regular mixing every 10 days was made for 30 days with adjustment of the moisture content to *c.* 40%, before use for soil drench.

The fungal population in the prepared compost was estimated by the plate count technique (Allen, 1961).

(c) Experimental field design:

The inoculated compost substrate was separately introduced into the soil and mixed with the 20 cm top soil, then lined, irrigated and left for one week. The plots (7.5 x 10.5m) each comprised 12 rows with 30 seed bed / row, in a Randomized Completely Block Design. Three replicates (plots) for each particular treatment as well as the check were considered.

Integration between mycobiocides and glyphosate was evaluated for efficacy controlling broomrape incidence. The following treatments were applied for this purpose:

- Soil drench separately inoculated with mycobiocide containing compost (*T. harzianum* T1 & T3 and *T. viride* T2)
- Foliar spray with glyphosate only
- Soil drench plus foliar spray with glyphosate

Faba bean seeds cv. Giza 3 were sown in all plots at the rate of 3 seeds / bed, and received the usual agricultural practices. Developed plants were sprayed with glyphosate herbicide (50 ppm) once 30 days after sowing or twice 30 and 40 days after sowing. The percentage of plants infected by *O. crenata* as well as the intensity of attack was estimated at the end of the growing season. The percentage of attack with *O. crenata* was calculated as the number of the infected faba bean plants compared to the total number of plants in the experimental plot. To calculate the intensity of attack (I.A.), infected faba bean plants were classified into five categories according to the number of attached *O. crenata* juveniles, *i.e.* one, two, three, four and more than four juveniles per host plant. The formula suggested by Chastanger and Ogawa (1979) modified and was used as follows:

$$\text{I.A.} = \frac{\sum (n \times c)}{N}$$

Whereas: I.A.= Intensity of attack.
n = Number of infected plants per category.
c = Category number.
N = Total examined plants.

At harvest time the obtained yield was determined for each particular treatment as kg per plot as well as 100 dry seeds weight.

Statistical analysis:

Obtained were data statistically analyzed according to Steel and Torrie (1980).

Results and Discussion

Laboratory studies:

Different concentrations of the glyphosate herbicide (36 %) were tested for their inhibitory effect on the mycelial growth of *Trichoderma* spp. Reduction in mycelial linear growth in response to different glyphosate concentrations added to the growth medium was presented in Table (1). The results show that glyphosate at concentrations ranged from 10 up to 60ppm had no effect on the mycelial growth of all *Trichoderma* spp. in all treatments as well as the check. The inhibitory effect of glyphosate was shown at 70ppm causing 4.4, 6.7 and 5.6% growth reduction for *T. harzianum* (T1 & T3) and *T. viride* (T2), respectively. The inhibitory effect of glyphosate on the mycobiocide growth increased as the increase of its concentrations, and total inhibition was achieved at concentrations ranged between 130 and 140ppm.

Spore production by the fungi tested was more sensitive to glyphosate increase than the mycelial growth (Table 1). Spore production decreased by increasing glyphosate concentration in the growth medium. Complete inhibition of spore production was observed at concentration of 120ppm for *T. viride* (T2), while *T. harzianum* (T1 & T3) failed to produce spores at concentration of 130ppm. There is no available literature on the antimicrobial effect of glyphosate on the growth of microorganisms, though the observed inhibitory effect on the fungi tested that may be attributed to the biochemical activity of glyphosate that may inhibit 5-enolphyruvylshi-Kimate-3-phosphate synthetase (EPSPS), an enzyme of the aromatic acid biosynthetic pathway. This prevents synthesis of essential aromatic amino acids needed for protein biosynthesis in plants and fungal cells to growth propagation and spore formation (Worthing, 1991; Parker and Riches, 1993 and Lolas, 1994).

Table 1. Linear growth and spore production of mycobiocides in response to glyphosate at different concentrations *in vitro*

Glyphosate concentration (ppm)	Reduction (%) in mycobiocides linear growth and spore production					
	T. harzianum (T1)		*T. harzianum* (T3)		*T. viride* (T2)	
	G *	S	G	S	G	S
60 or less	0.0	0.0	0.0	0.0	0.0	0.0
70	4.4	7.2	6.7	8.3	5.6	6.4
80	53.4	61.3	64.5	69.2	55.6	63.2
90	66.6	72.4	70.3	78.6	60.2	69.7
100	74.5	86.2	76.7	86.4	71.2	78.6
110	80.0	91.3	87.8	92.3	85.6	93.2
120	89.9	96.2	96.7	95.2	95.6	100.0
130	97.6	100.0	98.2	100.0	100.0	100.0
140	100.0	100.0	100.0	100.0	100.0	100.0
check	0.0	0.0	0.0	0.0	0.0	0.0

* G: linear growth & S: spore production.

Field experiment:

Mycobiocide population:

Inoculation of the prepared compost substate with the *Trichoderma* spp. (T1, T2 and T3) in concern was separately made at the rate of 10% (w:w) and thoroughly mixed. The obtained results revealed an increase in mycobiocide population as much as twenty folds during 30 days (the period between the compost inoculation and soil infestation). The mycobiocidal inoculum increased from 10^5 to $2x10^6$ cfu/g dry weight of compost substrate.

Assessment of broomrape incidence and yield production:

Represented data in Table (2) and Fig. (1) show that all treatments either mycobiocidal or herbicidal resulted in significant decrease in *O. crenata* incidence parasitic on faba bean. Moreover, integration between mycobiocidal and chemical treatments gave more protection to faba bean plants against broomrape invasion comparing with each treatment alone. On the other hand, a significant decrease in broomrape incidence in plots treated with mycobiocides and sprayed twice with glyphosate than those sprayed once. The two species of Trichoderma significantly differed in their action on broomrape incidence either when applied alone or combined with glyphosate spraying, while no significant differences was observed between T1 and T3 isolates of *T. harzianum*.

It is important to note that a significant reduction in broomrape incidence was observed when the mycobiocide inoculated compost was applied before sowing as a drench infestation in addition to single foliar spraying with glyphosate. This approach caused reduction in *O. crenata* incidence recorded as 67.5, 64.4 and 83.0% in Trichoderma treatments T1, T3 and T2, respectively. These records increased to 72.0, 70.5 and 86.8%, respectively, for the corresponding treatments with application glyphosate.

Soil infestation alone with the mycobiocide, on the other hand, showed lesser reduction in broomrape incidence (Table 2). Faba bean plots drenched with the mycobiocides only showed 47.7, 45.5 and 56.0% reduction in broomrape incidence in T1, T3 and T2 treatments, respectively, over the untreated check.

The lowest effect, however, was observed in faba bean treatments sprayed with glyphosate only. These treatments showed reduction in *O. crenata* incidence by 8.6 and 25.8% when glyphosate was sprayed either once or twice, respectively. This low effect may be attributed to the use of glyphosate at 50ppm concentration which is lower than the recommended dose of application being 135ppm (Anonymous, 2000). The used dose was suggested to avoid the harmful effect of greater glyphosate concentration on the growth of the mycobiocide fungi (Table 1).

It is interesting to recognize the combined effect of mycobiocide and chemical treatments (Table 2). Drenching the soil with *T. viride* (T3) combined with two foliar glyphosate sprays resulted in high reduction in broomrape incidence estimated as 86.8%, compared to 56.0 and 25.8% for the single treatments, respectively. The same trend could be observed with *Trichoderma* isolates (T1 & T2).

Table 2. Incidence and intensity of broomrape in response to mycobiocides and herbicide treatments

Treatment		Broomrape incidence			
Mycobiocide	Glyphosate	Incidence (%)	Reduction (%)	Intensity (%)	Reduction (%)
T. harzianum T1	-	32.8	47.7	35.6	60.2
T. viride T3	-	27.6	56.0	28.7	67.9
T. harzianum T2	-	34.2	45.5	36.3	59.4
-	Once	57.3	8.6	53.5	40.2
-	Twice	46.5	25.8	40.6	54.6
T. harzianum T1	Once	20.4	67.5	24.4	72.8
T. harzianum T1	Twice	17.6	72.0	21.2	76.3
T. viride T3	Once	10.7	83.0	8.3	90.8
T. viride T3	Twice	8.3	86.8	4.6	94.9
T. harzianum T2	Once	22.6	64.0	26.2	70.7
T. harzianum T2	Twice	18.5	70.5	22.3	75.1
Untreated (check)		62.7	-	89.4	-
L.S.D. at 5% for Myco. (M)		4.2	–	3.8	–
Gly. (G)		6.1	–	2.4	–
Between (M x G)		14.7	–	11.6	–

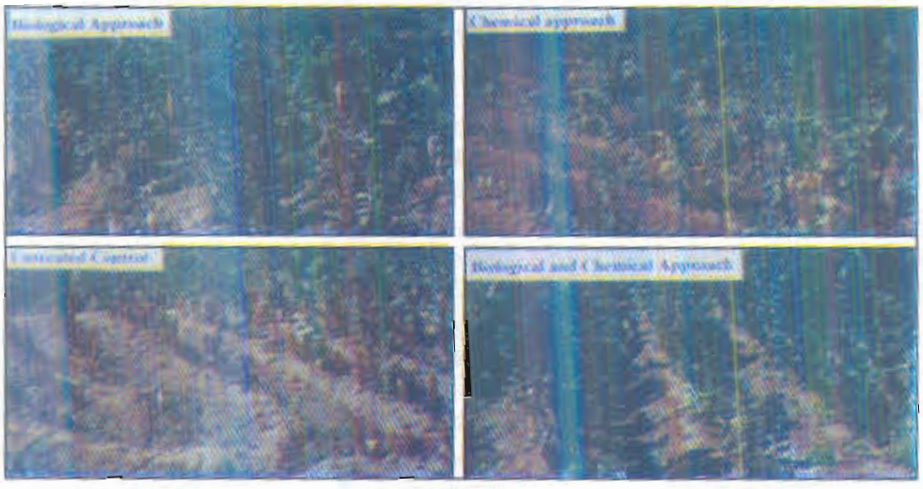

Fig. 1. Integrated mycobiocides and herbicide against *Orobanche crenata* infestation in faba bean field during cultivation season 2001 / 2002.

Application of the mycobiocides as inoculated compost for soil drench followed by double foliar spraying with glyphosate at the growing season had proven to be the most effective treatment for control of broomrape incidence. The recorded intensity was 21.2, 22.3 and 4.6% for T1, T2 and T3, respectively, compared to 89.4% in the untreated check. Moreover, the highest reduction in intensity in the same above mentioned treatments was recorded as 76.3, 75.1 and 94.9%, respectively. Similar trend could be observed in the combined treatments with a single glyphosate spray.

The obtained results revealed that different treatments of *T. harzianum* and *T. viride* either single or in combination with glyphosate as a foliar spray of plants grown in fields heavily infested with the broomrape had successfully reduced both incidence and intensity of attack with *O. crenata* on faba bean. These findings are in accordance with those previously reported by other investigators, who concluded that *Trichoderma* spp. could attack juveniles before and after emergence above soil surface resulting in high reduction in their numbers and infection severities (Abdel-Kader *et al.*, 1998; Abdel-Kader, 1999 and Abdel-Kader and El-Mougy, 2001). They added that the fungi tested did not infect the faba bean and pea plants under greenhouse and field conditions.

Similar results were reported with *Fusarium oxysporum* f.sp. *orthoceras* for controlling broomrape (*Orobanche* spp.) in different crops (Bedi *et al.*, 1991 and 1994; Bozoukov and Kouzmanova, 1994 and Thomas *et al.*, 1999).

In this regard, Murasheva (1995) and Murasheva and Sizova (1995) reported that the use of *Fusarium oxysporum* var. *orthoceras* as a mycobiocide being not recommended due to certain pathological and toxicological aspects of some strains on sunflower, tomato and wheat crops.

In the present study, the observed reduction in faba bean invasion with *O. crenata* may be attributed to the high use and the exponential increase of *Trichoderma* spp. (T1, T2 and T3) established in the vicinity of the seed bed prior to planting and the root region thereafter.

Regarding the herbicide use, on the other hand, glyphosate [N-(phosphonomethyl) glycine] was recommended by several researchers for controlling broomrape in different crops (Kharat and Halila, 1994; Raju, 1996). The latter was tried in Egypt in 1980-1983 through ICARDA / IFAD project.

Glyphosate (64 g *a.i.*/ha) as three foliar sprays at weekly intervals resulted in 97-100% reduction in broomrape incidence and increased faba bean seed by 34 to 124%. These reports are in accordance with results reported herein.

Table (2) shows that foliar spray with glyphosate (50 ppm) for two times, at 10 days interval, in a field artificially infested with mycobiocides gave similar effect on broomrape incidence that was reduced by 86.8%. The same treatment increased faba bean seed yield from 8.9 to 14.2 kg / plot as about 59.5% (Table 3).

The systemic action of glyphosate was considered in this work, thus the application 30 and 40 days after sowing was tried. The latter periods were assumed suitable for the attachment and establishment of broomrape tubercles to the host plant (Worthing, 1991).

Table 3. Yield of faba bean plants following application of mycobiocides and herbicide treatments in field naturally infested with *O. crenata*

Treatment		Yield characters			
Mycobiocide	Glyphosate	Yield * (kg/plot)	Increase (%)	100 dry seeds weight (g)	Increase (%)
T. harzianum T1	-	12.2	47.1	43.6	18.9
T. viride T3	-	12.8	43.8	44.4	20.9
T. harzianum T2	-	12.1	35.9	41.6	13.3
-	Once	10.4	16.8	38.1	3.8
-	Twice	10.8	21.3	39.2	6.8
T1	Once	13.1	47.1	49.7	35.4
T1	Twice	13.9	46.0	54.2	47.6
T3	Once	13.6	58.7	53.1	44.6
T3	Twice	14.2	59.5	58.4	59.1
T2	Once	12.8	43.8	48.8	32.9
T2	Twice	13.5	51.6	52.5	43.0
Untreated (check)		8.9	-	36.7	-
LSD at 5% for Myco. (M)		0.5	-	1.6	-
Gly. (G)		N.S.	-	2.1	-
Between (M x G)		1.2	-	4.3	-

* Average yield in ARE is 750 kg/feddan and average weight of 100 dry seeds for cv. Giza 3 is (50-55g) [after Anonymous, 1998].

The results reported herein (Tables 2 and 3), provided further evidence on the value of using mycobiocides and glyphosate, either single or in combination, in *O. crenata* control. The wide range of effect, however, indicates the need of further studies for application of control measures for broomrape control. These results are in harmony with those reported by Abdel-Kader (1999) and Abdel-Kader and El-Mougy (2001).

Moreover, the used treatments (Table 3) showed significant increase of the produced faba bean yield ranged between 10.8 up to 14.2 kg/plot compared with 8.9 kg/plot recorded in untreated check. The highest seed yield recorded was 13.9, 14.2 and 13.5 kg/plot in faba bean plots drenched before sowing with T1, T3 and T2 inoculated-compost, respectively, and two times glyphosate foliar spraying. The corresponding yield of the same treatment with a single glyphosate spray was 13.1, 13.6 and 12.8 kg/plot. Faba bean plots drenched with mycobiocides also showed a significant increase in recorded yield being 47.1, 43.8 and 35.9% for T1, T3 and T2, respectively. Faba bean yield in plots sprayed only with glyphosate either one or two times showed a significant increase over the check treatments, but to a lesser extent compared with the other mentioned treatments. The same trend was observed for the dry faba bean seeds weight.

The influence of Orobanche on yield production decrease was also reported by many investigators. Kharat *et al.* (1994) found that non-emergent *Orobanche juveniles* affect the growth and the seed yield of faba bean regardless of the number

and biomass of emergent broomrapes. Also, Ibrahim (1997) reported that faba bean infection by *O. crenata* caused significant reduction in quantity and quality of produced yield. He attributed this reduction to the nutrition transfer from host plant to the parasite especially during the pod formation period. On the other hand, Abdel-Kader (1999) attributed the reduction in *O. crenata* to mycobiocidal application that resulted in high quantity of produced yield.

The results obtained in the present work indicate that *Trichoderma viride* (T-3) plus double glyphosate spraying gave reasonable level of protection against *O. crenata* as expressed by high yield production. The present field study demonstrates that the method of application of *T. harzianum* and *T. viride* as soil drench and plant spray with glyphosate may be acceptable against broomrape infection. It could be concluded that the amount of introduced mycobiocides might be decreased by adapting a method of application for each crop and agricultural practices considering the contamination level of the soil with broomrape seeds. Studying the ecology and survival of Trichoderma in the field may lead to the development of more efficient procedures against Orobanche and/or to develop the present ones. The time of application also must be looked upon with great concern.

It is interesting to note here that, the present study indicate that glyphosate concentration more than 60ppm had a harmful effect on the growth and spore production of the present mycobiocides. Therefore the recommended dose of glyphosate, *i.e.* 75cm *a.i.*/100 l. (135ppm) must be revised in light to its harmful effect on the beneficial soil microflora following its application.

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المكافحة المتكاملة باستخدام مبيدات الحشائش الحيوية الفطرية والكيماوية ضد حشيشة الهالوك من النوع كريناتا فى حقول الفول البلدى

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اجريت تجربة حقلية على نطاق تطبيقى لدراسة المكافحة المتكاملة باستخدام مبيدات الحشائش الميكروبية و الكيماوية وذلك فى حقول الفول البلدى الملوثة طبيعيا بحشيشة الهالوك من النوع كريناتا وذلك فى مركز العياط بمحافظة الجيزة خلال موسم الزراعة الشتوى ٢٠٠١-٢٠٠٢ م .

استخدم فى هذه الدراسة الفطريات ترايكودرما هارزيانم (تى - ١) & (تى - ٣) و ترايكودرما فيردى (تى - ٢) كممرضات لحشيشة الهالوك فى زراعات الفول البلدى.

و تم دراسة تاثير تركيزات مختلفة من الجلايفوسيت على نمو وانتاج الجراثيم لفطريات الترايكودرما المستخدمة فى المكافحة و ذلك تحت ظروف المعمل . وجد أن نمو و انتاج جراثيم الفطريات المختبرة يتاثر بتركيزات الجليفوسيت بداية من ٧٠ جزء فى المليون وتوقف تماما عند ١٣٠-١٤٠ جزء فى المليون .

تم اضافة مبيدات الحشائش الميكروبية الى التربة قبل الزراعة وذلك فى صورة كومبوست من المخلفات الزراعية تم تلقيحة صناعيا بالفطريات السابق ذكرها .

تحت ظروف الحقل تم استخدام مبيد الحشائش جلايفوسيت (٣٦ %) بتركيز ٥٠ جزء فى المليون مرة او مرتان رشا على نباتات الفول البلدى .

اظهرت نتائج الحقل أن كل المعاملات التى استخدم فيها المبيدات الميكروبية و الكيماوية كان لها تاثير معنوى على خفض نسبة اصابة نباتات الفول البلدى بالهالوك مقارنة بالنباتات غير المعاملة ، كما لوحظ ايضا انخفاض فى شدة الاصابة مع زيادة فى كمية و جودة المحصول الناتج .

لوحظ أن استخدام الرش بالجليفوسيت (٥٠ جزء فى المليون) مرتان بعد ٣٠ ٤٠ يوم من الزراعة لنباتات الفول البلدى النامية فى تربة سبق معاملتها بالمبيدات الميكروبية فى صورة كومبوست نباتى اعطت افضل النتائج فى مكافحة حدوث الاصابة بحشيشة الهالوك و كذلك شدة الاصابة بها بالاضافة الى زيادة المحصول مقارنة بباقى المعاملات.

تشير النتائج الى انه لابد وان يؤخذ فى الاعتبار فى الدراسات القادمة البحث عن طرق تطبيقية اكثر كفاءة او تطوير الطرق الحالية للوصول الى افضل الوسائل لتقليل الاضرار الناتجة عن الاصابة بحشيشة الهالوك.