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EFFECT OF CERTAIN AGROCHEMICALS ON THE EFFICACY OF FUNGICIDES AGAINST DAMPING-OFF OF COTTON

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Abstract

This study was carried out to investigate the interaction between the cotton seed dresser fungicides monceren, monceren-combi, monceren-euparen, rizolex-T and vitavax-300, the fertilizer superphosphate and herbicides cotoran, goal and stomp in a soil infested with *Rhizoctonia solani* Kuhn under suitable conditions for infection in the greenhouse. All fungicides significantly reduced the infection. Monceren-euparen was the most effective compound, while monceren alone was the least effective. The efficacy of monceren in mixtures (monceren-combi and monceren-euparen) was better than monceren alone. Superphosphate had no significant effect on the efficacy of the fungicides. Herbicides alone or in combination with superphosphate had no effect on cotton damping-off. The interaction between fungicides and herbicides improved monceren efficacy when goal was applied, while stomp decreased the effect of monceren-euparen.

In the presence of superphosphate, the interaction between fungicides and herbicides indicated that the effect of monceren was reduced with cotoran, while a little improvement in efficacy occurred with goal and stomp. Monceren-combi lost its effect gradually with goal, but improved with cotoran through four weeks, then a slight reduction in efficacy was observed. No marked change was noticed in the efficacy of monceren-euparen when the tested herbicides were applied, except in case of stomp which reduced fungicides effect after 3 weeks. Rizolex-T and its combination with the herbicides started with nearly equal efficacies, but in the case of goal, the efficacy was reduced between the 2nd and the 3rd week. Application of stomp reduced the efficacy of vitavax-300 at the beginning of the experiment. In spite of vitavax-300 and its combinations with cotoran and goal started with approximately equal efficacies, vitavax-300 alone and with cotoran lost their effects gradually to become similar to vitavax + stomp. Generally, in the presence of superphosphate, the most effective treatments were monceren-euparen + goal, monceren-combi + cotoran, monceren-euparen alone, monceren + goal and monceren + stomp, respectively. Without superphosphate, there is no change in efficacies of fungicides except the reduction of efficacy in case of monceren + stomp and monceren-combi + cotoran.

INTRODUCTION

Cotton is the most important economic crop in Egypt. It is subject to attack by some various seeds- and soilborne fungi during the first part of the growing season, especially those causing damping-off diseases. *Rhizoctonia solani* Kuhn is the most frequent fungus causing damping-off disease of cotton. This fungus exists in nearly all agricultural soils, and lives saprophytically on dead plant remains, but it can become vigorously parasitic when root or other parts of susceptible hosts are found in infested soils. Breeding for resistance to cotton seedling diseases seems remote because of the variation in susceptibility to various *Rhizoctonia* sp. (Sinclair, 1957 and Shatla, 1964), and the lack of high type of resistance to all races of *Rhizoctonia* sp. (Shatla, 1964). The pathogen attacks cotton seeds and seedlings in the pre- or post- emergence stages. Heavy infection obligates growers to replant their fields with additional seeds delaying maturation and exposing the bolls to severe bollworms attack.

Cotton seeds and seedlings must be protected from infection. Seed treatment is the most important and most economical method of controlling seed and soil- borne disease (Sinclair *et al.*, 1959).

Usually, cotton seeds are planted in soil fertilized with superphosphate. Sometimes, soil is also treated with herbicides to control weeds. The interaction between the different types of chemicals (fungicides, fertilizers and herbicides) might occur (Frisina and Benson, 1988; Carling *et al.*, 1990).

The objective of the present study was to investigate the effect of some agrochemicals, usually used in cotton fields, on the efficacy of cotton seeds treated with fungicides. This would indicate the most compatible compounds against seedling diseases.

MATERIALS AND METHODS

Isolation of *R. solani* : Infected seedling samples were collected from a naturally infested cotton field in Behera Governorate. Roots and hypocotyl segments showing typical soreshin lesions were washed in running tap water, surface disinfested (5 min. in 0.255 % sodium hypochlorite), washed in sterilized water for 4 times, plated on potato-dextrose agar (PDA) and incubated for 48 hr at 23±2°C. Mycelial agar parts were transferred from the margin of the advancing colonies to the center of PDA plates and then incubated for one week at 23±2°C.

Inoculum preparation for soil infestation: Erlenmeyer flasks (250 ml) each containing 100 ml of broth potato dextrose (PD) medium were autoclaved, inoculated with 3 fungal discs (6 mm) of *R. solani* taken from the previous cultures and then incubated for 2 weeks at 23±2°C. The mycelial mates of each flask were collected through filter paper, washed 3 times with sterilized water and then blended with 200 ml sterilized water for 30 seconds.

Pathogenicity tests: Equal amounts (1 kg/pot) of sterilized soil were filled in sterilized clay pots (15 cm in diameter) and infected with *R.solani* by adding 30 ml of the fungal suspension on the soil surface, covered with a thin layer of soil (Sinclair, 1957), watered and kept in a greenhouse for one week. Each treatment was replicated 6 times. Six pots containing sterilized soil were used as a control. Each pot was planted with 10 cotton seeds variety Giza 70, kept at 17-22°C (Arndt, 1957) and irrigated when necessary. Stand plants free from disease symptoms were recorded after 4 weeks.

Compounds used

Fungicides		**a.i.%**	**Common name**	**Rate of application**
- Monceren	WP	25	Pencycuron	3 g/kg
- Monceren-combi	WP	70	Pencycuron + Captan	3 g/kg
- Monceren-euparen	WP	60	Pencycuron + Dichlofluanid	3 g/kg
- Rizolex-T	WP	50	Tolclofos methyl + Thiram	3 g/kg
- Vitavax-300	WP	75	Carboxin + Captan	3 g/kg

Fertilizer

- Superphosphate 15 %	100 kg/feddan

Herbicides		**a.i. %**	**Common name**	**Rate of application**
- Cotoran	WP	80	Fluometuron	1250 g/feddan
- Goal	EC	24	Oxyfluorfen	750 ml/feddan
- Stomp	EC	50	Pendimethalin	1700ml/feddan

Application of fungicides to seed: Mather's *et al.* (1986) method was modified by adding suitable amount of sticker to the water before mixing with fungicides. Wettable powder formulations were mixed with the correct amount of water in a beaker and agitated to prevent settling. A clear glass jar, its volume about four times of the

seeds was used. The jar was held at a 45° angle, the correct amount of suspension [2 % by weight of the seeds (Minton *et al.*, 1986)] was added by pipette to one side of the jar, the jar was rotated at a 180°, the seeds were added while the jar was held at 45 angle and the jar was capped immediately. With hands on the bottom and the top of the jar, the jar was rotated rapidly at 45° angle first clockwise and then counter clockwise, the jar was inverted and rotation was continued until the glass was relatively clear. The treated seeds were poured into paper sack. Untreated seeds also were rotated and used as a control.

Fertilizer application: After 3 days of infestation, a fertilizer superphosphate (15 %) was added in equal amounts (0.5 g) to each pot and incorporated in the soil.

Herbicide application: Solutions of the herbicides cotoran, goal and stomp at the rate 1250 g, 750 ml and 1700 ml/feddan, respectively were prepared by adding a correct amount of tap water to certain volume or weight from each herbicide to obtain the recommended rate. Each herbicide was sprayed on the pots soil surface after planting and then the pots were irrigated immediately.

Effect of fungicides: Infested soil in pots, was planted with the treated seeds. Six replicates were used for each fungicide treatment, while untreated seeds were planted as a control.

Effect of fertilizer on the efficacy of fungicides: Pots containing infested soil were divided into two sections. The first was divided into six groups. Each group was planted with seeds treated with one fungicide, while one group was served as a control. The second section was fertilized with equal amounts (0.5 g/pot) of superphosphate 15 %, and planted as previously indicated.

Effect of fertilizer and herbicides on the efficacy of fungicides: Pots containing infested soil were divided into two sections. The first was divided into four subsections, three for herbicides and the fourth was left untreated. Each subsection was divided into six groups, five for planting with seeds treated with fungicides and the sixth was served as a control. Pots of the second section were fertilized as mentioned before and were also divided as in the first section. All pots were planted with untreated or treated seeds, then applied or not applied with herbicides.

Untreated seeds were planted in pots containing sterilized soil to determine the germination and viability of seeds. Six replicates were used for each treatment in all experiments. Each pot was planted with 10 cotton seeds, watered, kept in a greenhouse

at 17-22°C for six weeks, irrigated when necessary and examined weekly after two weeks from sowing. Stand plants were recorded and the percentages of absent seedlings (A.S.) were calculated and adjusted according to the following equation (Abbott, 1925):

$$\% \text{ of absent seedlings} = \frac{a - b}{(100 - b)} \times 100$$

where:

a: Percentage of absent plants in infested soil
b: Percentage of absent plants in sterilized soil

Data were statistically analysed as factorial experiment in a completely randomized design including three factors: fungicides, fertilizers and herbicides.

RESULTS AND DISCUSSION

Pathogenicity test : Results of pathogenicity test indicated that the mean percentages of stand plants in sterilized soil was 90 %, while the mean of the percentages of stand plants free from infection in infested soil was 16.68 %. According to Abbott formula, the percentage of absent seedlings was 81.48 %. It means that the viability of the cotton seeds was high (90 %) and the fungus was a severe virulent.

Effect of fungicides : The effect of cotton seeds treatment with certain fungicides to control damping-off disease caused by *R. solani* is indicated in Table 1. Data showed significant reduction in the percentages of damping-off of seedlings when cotton seeds were treated with any of the tested fungicides and planted in infested soil with *R. solani.* The same results were found by Owen and Gay (1964), Borum and Sinclair (1968), Hupptaz *et al.* (1983) and Zedan *et al.* (1998). Monceren-euparen was the most effective compound against the disease, followed by rizolex-T, monceren-combi and then vitavax 300, while monceren alone was the least effective. It is of interest to note that when monceren was applied in mixtures with other fungicides (monceren-combi or monceren-euparen) the efficacy was significantly increased compared with monceren alone.

Effect of the fertilizer superphosphate on the efficacy of fungicides : Results in Table 2 indicated that application of the infested soil with superphosphate had no significant effect on the efficacy of the fungicides.

Table 1. Effect of certain fungicides against cotton damping-off disease caused by *Rhizoctonia solani*.

Fungicide treatment	% of absent seedlings (A.S.)
Control	75.37
Monceren	46.85
Monceren-combi	39.07
Monceren-euparen	31.48
Rizolex-T	36.48
Vitavax 300	39.07

L.S.D. at 0.05 = 6.76

Table 2. Effect of superphosphate on the efficacy of fungicides.

	% of absent seedlings	
Fungicide treatment	With fertilizer	Without fertilizer
Control	74.08	76.67
Monceren	42.59	51.11
Monceren-combi	37.41	40.74
Monceren-euparen	31.11	31.85
Rizolex-T	34.07	38.89
Vitavax 300	39.63	38.50

Not significant. (N.S.)

The percentages of damping-off in each treatment were the same either in fertilized or unfertilized soil. This is in agreement with Ramses (1997) who found that superphosphate showed no apparent effect on the growth of *R. solani* when combined with rizolex-T at the concentrations 1, 2 and 4 ppm and with monceren-euparen *in vitro* at the concentrations 8 ppm or more.

Effect of herbicides : Data in Table 3 present the effect of herbicides and their combination with superphosphate on cotton damping-off disease.

Table 3. effect of herbicides and their interaction with superphosphate on cotton damping-off disease.

Herbicide treatment	% of absent seedlings (A.S.)	
	With superphosphate	Without superphosphate
Control	74.08	81.48
Cotoran	66.67	68.58
Goal	77.78	90.74
Stomp	74.08	70.37

The results revealed that there was no significant interaction between superphosphate and the tested herbicides. The tested herbicides showed no positive or negative effect when applied to infected soil with *R. solani* after seed planting. The data agree with those of Gilbertson *et al.* (1987) who stated that under low and moderate disease severity in the field, the herbicides EPTC and EPTC with Trifluralin did not significantly increase or decrease Pinto bean root disease caused by *Fusarium solani* f.sp. *phaseoli* and *R. solani*.

Effect of herbicides on the efficacy of fungicides : From the results shown in Table 4 some variations in the efficacy of fungicides when combined with any of the herbicide were indicated. Soil application with the herbicide goal increased the efficacy of monceren as the absent seedlings were 30.55 %, compared with 51.85 % in untreated soil. On the other hand, the application of the three herbicides with monceren-combi, rizolex-T and vitavax 300 had no significant effect on their efficacies. In case of monceren-euparen, the herbicide stomp significantly decreased its efficacy from 29.63 % to 45.37 % absent seedlings. It is interesting to note that the best combinations were goal with monceren-euparen (24.99 %), monceren (30.55 %) and vitavax 300 (31.48 %), stomp with rizolex-T (27.63 %) and monceren-combi (29.63 %) and cotoran with monceren-euparen (32.40 %).

Table 4. effect of treatment with herbicides on the efficacy of fungicides.

Herbicide	% of absent seedlings (A.S.)					
	Untreated	Monceren (M)	M-combi	M-euparen	Rizolex-T	Vitavax 300
Control	77.78	51.80	37.96	29.63	40.74	43.52
Cotoran	67.59	53.70	39.81	32.40	45.37	50.96
Goal	84.26	30.55	48.15	24.99	44.44	31.48
Stomp	72.22	50.00	29.63	45.37	27.63	40.74

L.S.D. of the interaction between fungicides and herbicides at 0.05 = 15.12

Effect of fertilizer and herbicides on the efficacy of fungicides : The interaction between seed treatment with fungicides, fertilizer (Superphosphate) and herbicides (cotoran, goal and stomp) in infested soil with *R. solani* is indicated in Figs. 1, 2, 3, 4 & 5. The effect of such interaction was evaluated starting from the second week after sowing until the six. Table 5 summarizes such results.

Although the performance of fungicides was not affected significantly by superphosphate, application with herbicides changed the activity of some of them. Grover and Kataria (1985) attributed the reasons for the diversity of efficacy of fungicides in some instances to variations in soil characteristic or to interaction with other materials including fertilizers, herbicides and insecticides.

It is shown from Fig. 1 that monceren and its combinations with goal and stomp started with approximately equal efficacies (22.2 %, 14.8 % and 16.6 % S.A., respectively). Monceren alone lost its efficacy slowly between the 2nd and the 3rd week (22.2 % to 27.75 % A.S.), then rapidly (38.85 % and 53.65 % A.S.) after 4 and 5 weeks, respectively. On the other hand, application with goal or stomp prolonged the initial efficacy of the fungicide nearly to the same level until the end of the experiment. It is obvious that application of cotoran reduced monceren efficacy (53.65 % A.S.) in the beginning and this reduction increased gradually until the end of the experimental period. With time progress, the results showed the improvement of the fungicide effect by the application of the herbicides goal and stomp, as the absent seedlings were 22.22 % and 24.07 %, respectively; but with cotoran, the efficacy was reduced (70.37 % A.S.). Efficacy of monceren-combi and its combination with stomp and goal started with nearly equal efficacies (25.9 %, 22.2 % and 20.35 % A.S., respectively); however, the latter combination lost its effect against the disease infection, while the fungicide alone and its combination with stomp remained without a marked change till the end of the experiment, Fig. 2. On the other hand, the fungicide efficacy was improved when it was combined with cotoran for 4 weeks (9.3 % A.S.), then a slight drop appeared between the fourth and fifth week (20.4 % A.S.). After 6 weeks, the fungicide efficacy was reduced by goal (57.4 A.S.), while it was improved by cotoran application (20.4 % A.S.).

The pattern of combination of monceren-euparen with the herbicides cotoran, goal and stomp is illustrated in Fig. 3. It is clear that monceren-euparen and its combinations with goal and cotoran started with similar efficacies at the beginning of the experiment and remained without a marked change during 6 weeks. Stomp application reduced the efficacy of the fungicide at the beginning from 18.5 % to 31.45 % A.S. and

this reduction increased rapidly to reach 55.5 % A.S. after 4 weeks from sowing. At the end of the experiment, the efficacy of monceren-euparen did not change when used in combination with the tested herbicides except in case of stomp, where the seedlings absent reached 61.11 %.

Figure 4 represents the effect of rizolex-T and its combination with herbicides. It is obvious that all treatments started with nearly low or moderate rate of infection (11.1 % - 25.9 % A.S.). The effect of all treatments was reduced gradually during the experimental periods except in case of rizolex-T/goal combination, in which the reduction ranged from 25.9 % to 38.85 % after 3 weeks from sowing. Results after 6 weeks showed no significant differences between the effect of rizolex-T alone or in combination with the tested herbicides.

In Fig. 5, the interaction between vitavax-300 and its combinations with herbicides is illustrated. It is interesting to note that vitavax-300 alone started with high efficacy (14.8 % A.S.), however, this efficacy was markedly reduced (42.55 % A.S.) after 5 weeks from sowing. When the fungicide was combined with the herbicides, the application of stomp reduced the fungicide efficacy to reach 38.85 % A.S. after 2 weeks from sowing, thereafter, the reduction was slight, but in case of cotoran a marked decrease appeared after 4 weeks from sowing (35.2 % A.S.). Application of goal however produced slight gradual reduction in the efficacy of the fungicide. At week sixth, the efficacy of vitavax-300 had not been affected significantly with the application of herbicides.

Table 5. interaction effect of fungicides, herbicides and Superphosphate on the percentage of seedling absence in soil infested with *R. solani*.

Fertilizer treatment	Herbicide treatment	% of absent seedlings					
		Fungicide treatment					
		Untreated	Monceren	M-combi	M-euparen	Rizolex-T	Vitavax
With super-phosphate	No herbicide	74.05	53.10	33.33	22.22	37.04	50.00
	Cotoran	66.67	70.37	20.37	31.48	33.33	48.15
	Goal	77.78	22.22	57.40	16.67	46.29	33.28
	Stomp	74.07	24.07	33.33	61.11	29.63	44.44
Without super-phosphate	No herbicide	81.48	50.00	42.59	37.03	44.44	37.04
	Cotoran	68.52	37.03	59.26	33.33	57.41	53.70
	Goal	90.74	30.89	38.89	33.33	42.59	27.78
	Stomp	70.37	75.92	25.92	29.62	29.61	37.04

L.S.D. at 0.05 % of the interaction of fungicides x fertilizer x herbicides = 21.38

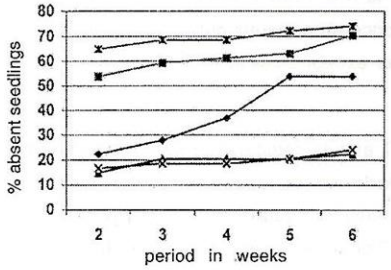


Fig. 1. Efficacy of Monceren in combination with superphosphate and herbicides.

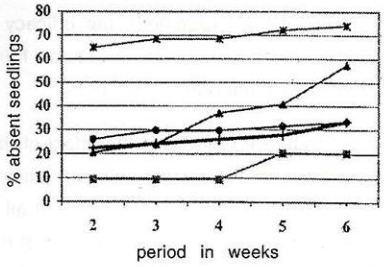


Fig. 2. Efficacy of Monceren-combi in combination with superphosphate and herbicides.

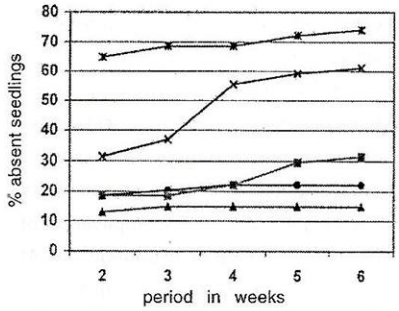


Fig. 3. Efficacy of Monceren-euparen in combination with superphosphate and herbicides.

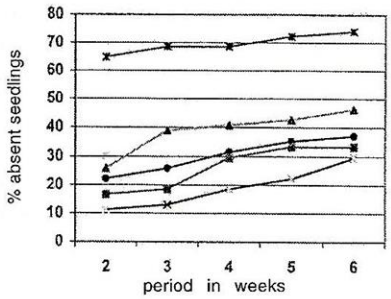


Fig. 4. Efficacy of Rizolex in combination with superphosphate and herbicides.

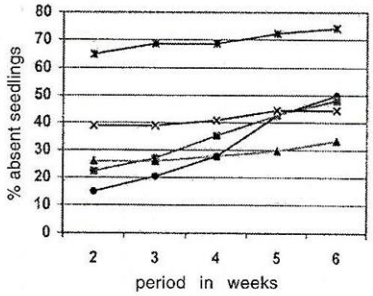
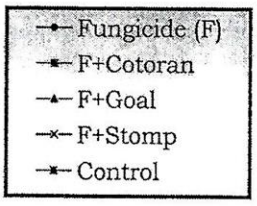


Fig. 5. Efficacy of Vitavax-300 in combination with superphosphate and herbicides.



Data in Table 5 indicated that the efficacies of fungicides varied by the application of herbicides, in the presence of superphosphate or without it.

It was noticed that the addition of superphosphate improved the fungicide efficacy and reduced significantly seedlings absence in the combinations monceren/ stomp, monceren-combi/cotoran and rizolex-T/cotoran to 24.07 %, 20.37 % and 33.33 %, while they were 75.92 %, 59.26 % and 57.4 %, respectively in the unfertilized soil. On the other hand, when superphosphate was applied, the seedlings absence increased in case of monceren/cotoran, monceren-combi/goal and monceren-euparen/stomp to reach 70.37 %, 57.4 % and 61.11 %, corresponding to 37.03 %, 38.89 % and 29.62 %, respectively in the unfertilized soil.

It is of interest to note that all combinations of fungicides/herbicides was not badly affected by the application of superphosphate except the three cases previously mentioned, while the rest of the combinations gave satisfactory results and seedlings absence did not rise over 48.15 %.

In general, the results indicated the possibility of obtaining satisfactory control against cotton damping-off disease, by using the suitable fungicide for seed treatment in conjunction with soil application of suitable herbicides to control weeds in the presence of the fertilizer superphosphate to get enough healthy cotton plants from less amount of seeds. These results would certainly lead to the decrease of cotton seeds needed for planting.

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تأثير بعض الكيماويات الزراعية على كفاءة المبيدات الفطرية المستخدمة فى مقاومة مرض سقوط البادرات فى القطن

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المعمل المركزى للمبيدات - مركز البحوث الزراعية - الدقى - الجيزة.

اجرى هذا البحث لدراسة التداخل بين المبيدات الفطرية (مونسرين، مونسرين-كومبى، مونسرين ايوبارين، ريزولكس-ت وفيتافاكس ٢٠٠) المستخدمة فى معاملة بذور القطن وبين سماد (سوبر فوسفات)، ومبيدات الحشائش (كوتوران، جول وستومب) وتأثير ذلك على كفاءة المبيدات الفطرية، فى تربة أجريت لها ظروف العدوى الصناعية بفطر ريزوكتونيا سولانى تحت ظروف مناسبة لنجاح العدوى فى الصوبة.

وجد أن مركب مونسرين-ايوبارين اكثرها كفاءة بينما كان اقلها مركب مونسرين. يجدر الإشارة أن خلائط مركب مونسرين (مونسرين-كومبى ومونسرين - ايوبارين) كان اكثر كفاءة من مونسرين بمفرده. وبإضافة سماد سوبر فوسفات للتربة لم يلاحظ أى تأثير معنوى على كفاءة المبيدات الفطرية. وبمعاملة التربة بمبيدات الحشائش لوحظ كفاءة مركب مونسرين باستخدام جول، بينما انخفضت كفاءة مونسرين - ايوبارين باستخدام ستومب. رغم أن مبيدات الحشائش بمفردها - بدون مبيدات فطرية - لم يكن لها أى تأثير على مقاومة الإصابة، سواء فى وجود أو غياب السماد.

اظهر استخدام المبيدات الفطرية مع مبيدات الحشائش فى وجود سماد السوبر فوسفات النتائج الآتية :- انخفضت كفاءة مونسرين مع كوتوران من البداية، بينما كان هناك انخفاض طفيف مع جول وستومب. وبالنسبة لمركب مونسرين - كومبى فقد انخفضت كفاءته تدريجياً باستخدام جول، بينما حدث تحسن باستخدام كوتوران حتى الاسبوع الرابع ثم ظهر انخفاض طفيف بعد ذلك. وفى حالة مركب مونسرين - ايوبارين، فإن كفاءته لم يظهر عليها تغير ملحوظ باستخدام مبيدات الحشائش باستثناء مع ستومب حيث انخفض تأثيره بعد الأسبوع الثالث.

أما كفاءة ريزولكس - ت مع مبيدات الحشائش فقد بدأت متقاربة الا أن هذه الكفاءة انخفضت مع مركب جول بين الأسبوع الثانى والثالث. وقد لوحظ أن كفاءة فيتافاكس ٢٠٠ انخفضت مع مبيد الحشائش ستومب من بداية التجربة. ورغم أن كفاءة هذا المبيد الفطرى كانت فى البداية متساوية مع كفاءته بمصاحبة كوتوران أو جول، نجد أن فيتافاكس ٢٠٠ بمفرده أو مع كوتوران فقدا تأثيرهما تدريجياً حتى اصبحا فى مثل كفاءته مع ستومب.

عموماً فى وجود سماد سوبر فوسفات كانت اكثر المعاملات كفاءة على التوالى:
مونسرين - ايوبارين + جول، مونسرين - كومبى + كوتوران، مونسرين - ايوبارين منفرداً، مونسرين + جول ومونسرين + ستومب. وبدون سوبر فوسفات لم يحدث تغير فى كفاءة المبيدات الفطرية، باستثناء انخفاض كفاءة مونسرين + ستومب، مونسرين - كومبى + كوتوران.