AGRICULTURAL PRACTICES IN RELATION TO THE MAJOR DISEASE PROBLEMS MANAGEMENT OF CANOLA IN EGYPT

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ABSTRACT

Isolation trails from infected seedlings and canola plants showed symptoms of root rot, charcoal rot and wilt diseases yielded three soil born fungi. However, they were identified as Rhizoctonia solani (Kűhn), Macrophomina phaseolina (Tassi) Goid. and Fusarium oxysporum (Schlecht). R. solani was the most frequently isolated fungus (45.4%) followed by F. oxysporum (29.7%) and M. phaseolina (24.9%).

The impact of various cultural practices on economically important foliar diseases of canola (Brassica napus L.) in Ismailia Governorate was discussed during 2000-2001 and 2001-2002 seasons. The diseases considered were white rust (Albugo candida), Alternaria leaf, stem and fruit spots (Alternaria spp.), downy mildew (Peronospora parasitica), charcoal rot (Macrophomina phaseolina), wilt (Fusarium oxysporum) and root rot (Rhizoctonia solani).

Studying the effect of inoculum density of the fungal propagules in the infested soil and crop amendments to soil, on soilborne diseases showed positive reaction against incidence of root rot, wilt and charcoal rot. Infection percentage increased by increasing the fungal propagules density of R. solani (the cause of root rot), F. oxysporum (the cause of wilt) and M. phaseolina (the cause of charcoal rot). Regarding the effects of soil amendments on charcoal rot, root rots and wilts diseases, adding soybean, sesame, maize, sunflower and peanut straw to soil one weak before planting greatly reduced infection by these diseases. The least disease incidences were observed with maize, soybean or sunflower straw.

Planting on ridges decreased the severity of these diseases incidence and increased the seed yield. The 60-cm apart was better than 30-cm apart in this respect. Also, the 20-cm hill spacing decreased the diseases incidence as compared to 10 and 15-cm hill spacing. On the other hand, planting canola on Oct. 15 gave generally the least infection by diseases and increased the seed yield as compared with planting on Sept. 15 or Nov. 15 in two tested seasons. In contrast, the highest severity of the diseases incidence was recorded in sprinkler irrigation than surface one, since 15 min. irrigation every 48 hrs gave the less severity of the diseases incidence than 30 and 45min.

Downy mildew, Alternaria spots, white rust and damping off were increased with increasing the level of nitrogen (N) fertilizers, while it decreased by increasing the level of phosphorus (P) and potassium (K) fertilizers. The seed yield was always increased by increasing K level. Generally, the best level of NPK fertilizer in minimizing these diseases and maximizing seed yield was (25-60-48) unit NPK. On the other hand, percentage of pre-emergence damping-off was decreased in depth 2-cm than 3 or 4-cm.

Keywords: Canola (*Brassica napus* L.), cultural practices, white rust, downy mildew, Alternaria spots, charcoal rot, wilt, root rot, damping-off

INTRODUCTION

Canola (*Brassica napus* L.) is an important oil seed crop allover the world. Canola can be grown on most soil types (Bassel *et al.*, 1998). Egypt, as a developing country, is suffering from an acute shortage of edible oils, so this crop was recently introduced in order to increase edible oils sources. Therefore, a big effort should be done to improve agronomic practices, adapt new cultivars and search for effective and economical control measures against the diseases of canola.

Economically important diseases of canola such as damping-off, white rust, downy and powdery mildews and Alternaria spots attack seeds germination, seedlings and plants during their growth causing serious losses in plant stand and seed yield (Thompson, 1982; Tewari, 1985; Hilal *et al.*, 1989 and Draz, 1995).

Several attempts were done upon fungicides as the main strategy for control in order to manage these diseases and increase quantity and quality of canola seed yield in Egypt and other countries (Kolte *et al.*, 1989 and Draz, 1995). Harmful side effects of the fungicides on human and environment as well as the possibility of increase in incidence and severity of non-target diseases lead to use the agricultural practices as safe and environment-friendly diseases control mean (Palti, 1981; Bruehl,

1987; Kharbanda, 1987; Kadian & Saharan, 1988; Teo *et al.*, 1988; Saharan, 1992; Kharbanda & Tewari, 1996 and Bassal *et al.*, 1998). Through suitable adjustments in cultural practices, it is possible to modify the environment or the host so that conditions become unfavorable for one or more pathogens and subsequent diseases development.

The present investigation was planned mainly to study the effects of some agricultural practices such as crop amendments to soil, planting methods, time of seeding, hill spacing, depth of seeding, management of irrigation and NPK on incidence and severity of root and foliar fungal diseases of canola. The effectiveness of these agricultural practices on plant height and seed yield was also investigated.

MATERIALS AND METHODS

This investigation was conducted at Ismailia Agric. Res. Sta. during 2000-2001 and 2001-2002 growing seasons. Pactol cultivar of canola was usually planting in all greenhouse and field experiments during the planting seasons tested. The purpose was to study the effect of soil amendments, two planting methods, time of seeding, two irrigation methods and different rates of NPK on severity of downy mildew, white rust, Alternaria spots diseases and seed yield. Also, the effects of depth seeding on pre-emergence damping-off infection were investigated.

The infection percentages of root rot, wilt and charcoal rot plant and severity of foliar diseases were always recorded 3 months after planting except that of Alternaria spots which was estimated at harvest. On the other hand, severity of downy mildew, white rust and Alternaria spots estimated according to (Townsend & Heuberger, 1943 and Horsfall & Barratt, 1945).

I. Isolation and identification of the causal organisms:

Canola seedlings and plants showing symptoms of rot, wilt and spot diseases were collected from Ismailia Governorate (Ismailia Agric. Res. Sta., El-Tall El-Keber & East Qantara). Isolation was carried on PDA medium and the fungal isolates were purified using single spore and hyphal tip techniques according to Dhingra and Sinclar, 1985 and maintained on PDA slants. The Staff of Mycol. Res. and Pl. Dis. Dept., Pl. Pathhol kindly confirmed identification. Res. Inst., ARC, Giza, Egypt.

II. Greenhouse experiments:

Studying the effect of inoculums density and soil amendments on the incidence of damping-off, charcoal rot, roots rot and wilt diseases:

1- Inoculums density:

Five inoculum's densities, i.e 0, 5, 15, 25 and 35 ml fungal containing 10^{10} fungal propagules/ml water was used in this study. The rate was used to infest four pots (25-cm diam.) and mixed with soil before planting. *R. solani*, *M. phaseolina* and *F. oxysporum* were grown in 500 ml conical flasks containing 200 ml Potato Dextrose Borth at 28°C for 20 days. The medium was decanted and each fungal mat was washed thoroughly with sterilized distilled water for 2 minutes. The concentration of each fungal propagules was adjusted to 10^{10} /ml by using Haemocytometer. Soil infestation was carried out seven days before planting, with six sterilized seeds/pot. Four pots containing soil free from fungal propagules were used as control. Percentages of infection were recorded after 1 and 3 months of planting.

2- Effect of soil amendments on infection by charcoal rot, root rot and wilt diseases:

Dry and ground sesame, peanut, soybean, sunflower and maize plants (as summer crops precede canola) were added, 7 days before planting, to 4 kgs of each pot soil at the rate of 1% (w/w). Inocula as fungal growth suspension from of *R. solani*, *M. phaseolina* and *F. oxysporum* were added to each pot at 25 ml (10^{10} fungal propagules/ml) before planting. Each treatment was, however, replicated five times. Six sterilized seeds with 1% sodium hypochlorite for 2 minutes were sown/pot. Percentages of the diseases incidence were recorded after 3 months of planting.

III. Field experiments:

1- Effect of two planting methods on canola disease incidence and seed yield:

Two planting methods were carried out as follows:

A- Planting on ridges, 30 & 60-cm apart and the hill spacing were 10-cm (one plant/hill).

B- Planting on rows, 30 & 60-cm apart and the hill spacing were 10-cm (one plant/hill).

The experimental design was factorial experiment in randomized complete blocks. The size of each plot was 10.5 m^2. Seeds of canola were sown on Nov.5 in both seasons, respectively, using the previously mentioned planting methods. The usual agricultural practices were followed. The severities of white rust, downy mildew, and

Alternaria spots were estimated. Plant height and seed yield were also estimated.

2- Effects of hill spacing on infection severity of downy mildew, white rust, Alternaria spots, plant height and seed yield:

The design of this experiment was completely randomized blocks. The spacing between plants was 10, 15 and 20 cm in both seasons on ridges 60 cm apart. The infection severity of white rust, downy mildew, Alternaria spots, plant height and seed yield were estimated.

3- Effects of different time of seeding on infection severity of Alternaria spots, downy mildew, white rust diseases, plant height and seed yield:

The experimental design was the same as the aforementioned experiments. The times of seeding were Sep. 15, Oct. 15 and Nov. 15. The infection severity of the foliar diseases tested was recorded as well as plant height and seed yield.

4- Effects of surface and sprinkler irrigation methods on infection severity of downy mildew, white rust, Alternaria spots and seed yield:

Each irrigation method was performed in a separate experiment. The experimental design was randomized complete blocks. The plot was 10.5 m^2 and the surface and sprinkler irrigation were used in the first and second experiments, respectively. Irrigation frequency per season varied according to soil needs. The severity of downy mildew, white rust, and Alternaria spots and seed yield were estimated.

5- Effects of time and amount of sprinkler irrigation on infection severity of downy mildew, white rust, Alternaria spots and seed yield:

The experimental design was the same as the aforementioned experiment. Plants were irrigated with 10 overhead sprinklers when conditions called for irrigation; all replicates of the treatment given were irrigated simultaneously. Time and amount of irrigation are listed in Table (1). The irrigation was every 2 days. These experiment were conducted during 2000-2001 and 2001-2002 seasons. The severity of downy mildew, white rust and Alternaria spots and seed yield were calculated.

Table (1): Time (minutes) and amount (m^3/hr./fed.) of irrigation

Time of irrigation	Total water (m^3) hour/feddan
15 min.	12 m^3
30 min.	24 m^3
45 min.	36 m^3

6- Effects of different amount of NPK fertilizers on infection by damping-off and severity of downy mildew, white rust, Alternaria spots and seed yield:

This experiment was carried out during two seasons using complete randomized block design with four replicates was used. Each plot was always 1/100 of feddan. Different levels and combinations of three types of fertilizers, namely ammonium nitrate (0, 25 and 50 unit/fed.), calcium superphosphate (0, 30 and 60 unit/fed.) and potassium sulphate (0, 24, and 48 units/fed.) were tested. Infection by damping-off, severity of downy mildew, white rust, Alternaria spots and seed yield were estimated.

7- Effects of depth of seeding on infection by damping-off disease:

The experiment was conducted during two seasons. A complete randomized block design with four replicates. Effects of different depths of seeding (2, 3 and 4-cm) on pre-emergence damping-off were recorded one month from planting.

RESULTS AND DISCUSSION

I- Isolation and identification of the causal organisms:

Three fungi were isolated from roots of the diseased seedling and plants (Table. 2). They were identified as *Rhizoctonia solani* (Khün), *Fusarium oxysporum* (Schlecht) and *Macrophomina phaseolina* (Tassi) Goid. The frequently of these fungi were 45.4%, 29.7% and 24.9%, respectively. *R. solani,* was, however, the most frequent isolated fungus and *Alternaria brassica* (Berk.) Sacc., *A. raphani* Groves & Skolko and *A. alternata* (Fr.) Keissler were isolated from leaf, stem and fruit spots. These results are in agreement with those obtained by Gugel *et al.* (1987), Hilal *et al.* (1989), Draz, (1995) and Kharband and Tewari, (1996).

Table (2): Occurrence percentage of fungi isolated from diseased canola plants.

Root fungi	% frequency
Rhizoctonia solani	45.4
Fusarium oxysporum	29.7
Macrophomina phaseolina	24.9
Total	100
Alternaria spot fungi	
Alternaria brassica	100
Alternaria raphani	100
Alternaria alternate	100

II. Greenhouse experiments:

Studying the effect of inoculum density and soil amendments on the incidence of damping-off, charcoal rot, root rot and wilt diseases.

1. Inoculum density

Data in (Table, 3) show that the percentages of damping-off increased from 15.77 to 29.16% by increasing the rate of fungal suspension from 5 ml to 35 ml of 10^{10} fungal propagules/ml of *M. pheaseolina*, also, percentages of infected plants with damping-off caused by *F. oxysporum* from 21.13 to 39.15 % as the rate of fungal suspension increased from 5 ml to 35 ml, and the percentages of infected plants with damping-off caused by *R. solani* from 26.12 to 47.73% by increasing the rate of fungal suspension from 5 ml to 35 ml. The percentages of charcoal rot, root rot and wilt were higher than damping-off with each one of the three tested pathogen. The increase in inoculum density gave the chance to more spores or productive parts to invade canola plants resulting in more infection. This agrees with results of (French, 1965, Abdel-Kader, 1983 and El-Deeb *et al.*, 1998).

2- Effects of soil amendments on infection by charcoal rot, root rot and wilt diseases:

Results in (Table, 4) show that the percentages of infection by *M. phaseolina*, *R. solani* and *F. oxysporum* were significantly reduced when canola was sown after maize than the control and the other treatments. In this respect, soybean and sunflower, however, came the second in position. In contrast sesame and peanut were less effective against the disease incidence. These results could be attributed to the effects of these crop components on the population of soil microflora, including the causal fungal pathogens. The effect of crop amendments to soil on severity of soil borne diseases was found by Williams and Schmitthenner, (1960). Crookston *et al.* (1991) reported that soybean-amended soil increased grain yield in corn. Also, Neil *et al.* (1978) found that potatoes grown in plots with wheat straw amendments produced less sever Rhizoctonia disease. Baird *et al.* (1995) observed that corn (zea mays) in soil reduced *R. solani* in peanut plants. El-Deeb *et al.* (1998) found that percentages of infection by *M. phaseolina* (charcoal rot) and *F. oxysporum* f. sp. *sesami* (wilt) diseases were highly reduced when sesame was sown after adding onion, wheat or clover straw.

Table (3): Effect of inoculum density on incidence of damping-off, charcoal rot, root rot and wilt diseases under greenhouse conditions

Inoculum density (10^{10} propagules/ml)	*M. phaseolina*		*F. oxysporum*		*R. solani*	
	% damping-off	% charcoal rot	% damping-off	% wilt	% damping-off	% root rot
0.0	0.00	0.00	0.00	0.00	0.00	0.00
5	15.77	19.17	21.13	19.23	26.12	24.13
15	22.12	25.16	30.76	29.26	36.83	38.16
25	26.26	28.29	34.16	35.12	43.12	44.12
35	29.16	31.61	39.15	36.17	47.73	48.61
L.S.D at 5%	6.57	6.81	7.21	7.34	8.37	8.41

III. Field experiments:

1. Effect of two planting methods on canola fungal diseases incidence and seed yield:

Data presented in (Table, 5) indicate that there were significant differences between the effects of the two planting methods on diseases incidence, plant height and seed yield in both seasons tested.

Table (4): Effect of five crop amendments to soil on incidence of charcoal rot, root rot and wilt diseases, 1 and 3 month after planting, under greenhouse conditions

Crop amendments to soil	*M. phaseolina*		*R. solani*		*F. oxysporum*	
	% damping-off	% charcoal rot	% damping-off	% root rot	% damping-off	% wilt
Soybean	17.17	19.14	23.14	25.79	18.76	20.78
Maize	12.14	14.35	16.31	19.16	13.14	15.10
Sunflower	21.34	23.17	29.41	31.42	22.71	24.10
Sesame	27.18	26.75	36.41	37.16	28.19	29.60
Peanut	28.16	29.76	38.16	39.76	29.33	30.10
Control	33.16	35.2	45.16	47.71	35.16	36.10
LSD at 5%	4.20	4.41	5.10	5.21	4.16	4.31

Table (5): The effects of two planting methods (ridges and rows) on the severity of the diseases incidence, plant height and seed yield on canola "cv. Pactol"

Treatments	(%) Diseases severity						Plant height (cm)		Yield per 10 plants (g)	
	White rust		Downy mildew		Alternaria spots					
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
Planting on ridges (30 cm apart)	10.0	11.5	8.5	9.5	18.5	21.0	158.2	157.4	46.5	44.3
Planting on ridges (60 cm apart)	6.5	7.5	5.5	6.0	14.0	17.0	163.5	162.1	49.1	48.3
Planting on rows (30 cm apart)	13.0	15.5	11.0	13.0	21.0	23.5	152.3	152.0	42.4	40.3
Planting on rows (60 cm apart)	8.5	11.0	7.5	9.5	17.0	19.5	159.1	158.2	44.5	42.6
L.S.D at 5%										
Ridges	2.1	2.3	1.6	1.8	2.4	2.7	2.7	2.6	1.9	2.0
Rows	2.4	2.5	2.1	2.2	2.8	2.8	2.9	2.7	1.8	1.6
Ri. X Ro	1.9	1.6	1.1	1.0	2.5	2.2	2.9	2.8	1.7	1.5

The incidence of white rust, downy mildew and Alternaria spots diseases, were less in canola planted on ridges, 30-cm apart (10.0 & 11.5, 8.5 & 9.5 and 18.5 & 21% in 2001 and 2002, respectively) than rows, 30-cm apart (13.0 & 15.5 , 11.0 & 13.0 and 21.0 & 23.5% in 2001 and 2002, respectively). In addition, the plants heights were taller on ridges (158.2 & 157.4 cm in 2001 and 2002, respectively) than those (152.3 & 152.0 cm in 2001 and 2002, respectively) on rows. Also, the seed yield was increased when canola planted on ridges than in rows. The planting in 60-cm apart on ridges or in rows were the best distances than 30-cm apart in decreasing the diseases incidence and in increasing the plant height and seed yield. The planting on ridges was found to be better than rows may be because planting on ridges achieves the following advantages: (1) More controlled irrigation, weeds, hoeing, fertilization, (2) The moisture in ridges are less in rows, (3) The plants are firmly fixed by roots and can better utilize water and nutrients, resulting in good plants and yield, (4) Uniform planting, and better root distribution which insures an appropriate plant population. Similar results on the superiority of planting on ridges than that on rows in decreasing diseases incidence and in improving plant growth and seed yield were reported by Clarke *et al.* (1978); Morrison and Rashid (1988) and Bassal *et al.* (1998).

2- Effect of hill spacing on white rust, downy mildew, Alternaria spots, plant height and seed yield:

Data in (Table, 6) indicate that the hill spacing had significant effects on diseases incidence, plant height and seed yield in both seasons tested. The severity of white rust, downy mildew and Alternaria spots were less in 20-cm spacing between the hills in both trial seasons and the plants were taller and produced more seed yield than the other treatments (15 and 10-cm). The increases in diseases incidence and the decreases in plant height and seed yield in 10-cm spacing between the hill may be due to the high competition between plants with the denser plant population for nutrients and

light and the increases in moisture around the plants which favored the diseases infection and development. Similar results were, however, reported by Patil and Rajat (1978), Mendham *et al* (1981) and Bassal *et al.* (1998).

Table (6): The effect of hill spacing on the severity of disease incidence, plant height and seed yield of canola, 2001 and 2002 seasons

Treatments*	% Diseases severity						Plant height (cm)		Yield per 10 plants (g)	
	White rust		Downy mildew		Alternaria spots					
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
10-cm between hills	6.5	7.5	7.5	9.0	14.0	17.0	163.5	162.1	49.1	48.3
15-cm between hills	5.0	6.5	6.0	8.5	11.0	13.0	166.1	165.6	51.5	50.8
20-cm between hills	4.0	5.0	5.0	6.5	7.0	10.0	168.6	167.4	53.0	52.6
L.S.D at 5%	0.81	0.83	0.81	0.84	2.1	2.3	1.4	1.2	1.2	1.1

* The treatments performed on ridgs of (60-cm apart).

3- Effects of different time of seeding on infection severity of downy mildew, white rust, Alternaria spots, plant height and seed yield.

Data in (Table, 7) show no significant effects between the time of seeding in Sep. 15 and Oct. 15 on the severity of downy mildew, white rust and Alternaria spots, while there are significant differences in between these two dates and other (Nov. 15) in both seasons. The severities of these diseases were always higher in the time seeding in Nov. 15 than the other because the downy mildew, white rust stage header and Alternaria spots were greatly influenced by environmental factors. Adjusting the time of seeding to avoid high levels of inoculum or conditions conductive for development of a particular disease may result in reduced severity of several diseases. In this respect Kolte (1985) and Saharan & Verma (1992) reported that in certain parts of India, mustard seeded before mid. October escapes staghead formation and suffers minimal damage due to leaf infection. On the other hand, the plant height and seed yield were increased when the crop was sown in Oct. 15 than in Nov. 15 and Sep. 15. This may be attributed to decrease in the disease losses, since low level of the diseases severity was recorded.

Table (7): The effects of different time of seeding on the diseases severity, plant height and yield of canola, 2001 and 2002 seasons

Time of seeding	(%) Diseases severity						Plant height (cm)		Yield per 10 plants (g)	
	Downy mildew		White rust		Alternaria spots					
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
Sep. 15	8.5	9.0	9.5	11.0	3.4	4.1	145.2	147.1	40.1	41.3
Oct. 15	9.0	10.0	9.0	10.5	5.3	6.2	163.2	164.2	53.1	53.6
Nov. 15	10.5	11.5	11.5	12.5	21.6	23.5	156.2	158.2	46.2	46.6
L.S.D at 5%	1.2	1.3	1.1	1.2	3.1	3.3	2.3	2.2	2.4	2.5

4- Effect of surface and sprinkler irrigation methods on infection severity of downy mildew, white rust, Alternaria spots and seed yield, the effect of time and amount of sprinkler irrigation on the aforementioned diseases.

Data in (Table, 8) indicate that the sprinkler irrigation increased the severity of diseases tested than that of surface irrigation, since they were (10.5 & 13.0%), (15.0 & 17.0%) and (19.5 & 21.0%) in case of downy mildew, white rust and Alternaria spots during in 2001 and 2002, respectively. Also, the produced seed yields were significantly decreased using sprinkler irrigation than surface irrigation in both seasons. This may be due to the increases in moisture level in soil and relative humidity around the plants, which favoured the infection occurrence and also accelerated the diseases development.

Table (8): Effects of different irrigation methods on the diseases severity and seed yield of canola, 2001 and 2002 seasons.

Type of irrigation	(%) Disease severity						Yield per 10 plants (g)	
	Downy mildew		White rust		Alternaria spots			
	2001	2002	2001	2002	2001	2002	2001	2002
Surface irrigation	5.5	6.5	6.5	8.5	12.0	15.5	54.2	53.2
Sprinkler irrigation	10.5	13.0	15.0	17.0	19.5	21.0	46.2	45.1
L.S.D at 5%	2.2	3.1	3.2	4.0	4.1	4.2	4.8	4.7

5- Effects of time and amount of sprinkler irrigation on infection severity of downy mildew, white rust, Alternaria spot diseases and seed yield:

Data presented in (Table, 9) show that the increasing in time of irrigation or water amount/feddan was always correlated with significantly increases in the severity of white rust, downy mildew and Alternaria spot diseases. Also, the same reaction was found to give significant decreases in seed yield. However, 15 minutes as time of irrigation (12 m^2 water/hour/fed.) was the best treatment in decreasing diseases severity and in increasing seed yield in both seasons, while the 45 minutes was the worst treatment in this respect.

The occurrence of high severity in the fungal diseases infection when sprinkler irrigation (45 minutes) was used may be due to the availability of suitable environmental conditions, i.e. high relative humidity around the grown plants and high level of soil moisture, for diseases infection and development. In this respect, Teo *et al.* (1988) found that increased soil moisture resulted in higher disease rating in mature plants of canola. Similar results were observed by Porter *et al.* (1987) and Barnes and Csinos (1990) on peanut diseases. On the other hand, frequent irrigation may increased Alternaria black spot and root rot (Teo *et al.*, 1988 and Saharan, 1992). The fungal infection is favored in high moisture and rainfall on sunflower, therefore the Alternaria disease (leaf spots & stem lesion), is favored by humid conditions that promote extended periods of plant surface leaf wetness (Kadir, 1999).

Table (9): Effects of time and quantity of sprinkler irrigation on the diseases severity and seed yield of canola, 2001 and 2002 seasons

Time of irrigation sprinkler	Total water (m^3) hour/fed	(%) Diseases severity						Yield per 10 plants (g)	
		White rust		Downy mildew		Alternaria spots			
		2001	2002	2001	2002	2001	2002	2001	2002
15 min.	12	4.5	6.0	5.5	7.5	10.5	13.0	48.1	47.4
30 min.	24	8.0	10.0	9.0	11.5	13.0	16.0	46.7	46.1
45 min.	36	12.0	14.0	14.0	17.0	18.5	22.0	45.2	44.1
L.S.D at 5%		2.3	2.5	2.7	2.6	2.1	2.4	1.2	1.1

6- Effect of different amount of NPK fertilizers on damping-off and severity of white rust, downy mildew, Alternaria spot and seed yield:

Results obtained in (Table, 10) indicate that percentage of damping-off, white rust, downy mildew and Alternaria spots increased with increasing the rate of nitrogen fertilizer. While, P and K fertilizers resulted in reducing percentages of these diseases infection and severity and increasing the seed yield. The (25-60-48) unit of NPK treatment gave the lowest infection percentages of both diseases phases followed by (0-60-48) unit NPK. In contrast, the highest percentages of infection were recorded with (0-0-0) and (50-0-0) NPK. The highest yields were, however, obtained with (25-60-48) unit NPK fertilizers. These results were in agreement with those reported by Kadian & Saharan (1988) and Saharan (1992), who indicated that high levels of nitrogen increase the development of Alternaria blight in canola. The application of organic manure, avoidance of excess nitrogen and the addition of phosphorus and potassium decrease white rust in canola (Saharan & Verma, 1992). Also, excessive amounts of nitrogen, which promotes leaf crop canopies, should be avoided to discourage Sclerotinia stem rot development in canola (Kharbanda & Tewari, 1996) and soil-borne diseases of peanut (Hilal *et al.*, 1994).

The cultural practices including fertilization are very important means in integrated

disease control (Rotem and Palti, 1980). Moreover, nutrients can affect host and pathogen parameters and the relations between crop and pathogen in many different ways (Palti, 1981). Therefore, each fertilizer type and rate and their tested combinations of NPK affect incidence of the diseases. On the other hand, our findings on the efficiency of fertilizers were supported with those of Bruehl (1987), who reported that fertilizer is very important mean in controlling plant diseases.

7- Effects of depth of seeding on infection pre-emergence damping-off:

Data in (Table, 11) show that the percentages of pre-emergence damping-off decreased when seeds were planted in 2-cm depth followed by 3-cm and 4-cm. Rapid emergence of seedlings reduces pre-emergence damping-off because the period of contact between the emerging seedlings and soil-borne fungi in the soil reduced. Nuttall (1982) reported significantly higher seedling emergence for several *Brassica rapa* cultivars seeded at 1.5 cm than at 3.0 cm. Similar results were obtained in greenhouse study where significantly higher emergence was recorded when canola was planted at 2 cm than at 4 cm depth in soil infested with *R. solani* (Kharbanda, 1987).

Table (10): Effect of NPK fertilization on pre-and post-emergence damping-off, white rust, downy mildew, Alternaria spots and seed yield of canola, 2001 and 2002 seasons.

NPK			Pre-emergence (%)		Post-emergence (%)		(%) Disease severity						Yield per 10 plant (g)	
							White rust		Downy mildew		Alternaria spots			
			2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	**2001**	**2002**
0	0	0	15.5	17.5	20.6	20.7	11.0	11.4	12.0	13.0	18.3	20.5	35.1	33.6
0	0	24	14.6	15.7	18.1	19.2	8.5	9.0	9.0	9.5	18.2	19.0	35.7	34.2
0	0	48	14.3	15.1	16.2	17.8	8.4	8.5	8.5	9.0	17.8	18.0	36.3	35.6
0	30	0	13.7	14.2	16.0	16.4	10.0	10.1	11.2	11.5	18.0	18.3	35.5	35.9
0	30	24	13.6	14.2	10.7	11.4	8.3	8.5	9.5	9.8	15.1	16.1	39.2	37.2
0	30	48	13.1	13.8	8.5	10.5	8.0	8.0	9.0	9.3	13.5	14.7	42.8	41.3
0	60	0	12.7	13.6	12.0	13.6	10.0	10.5	10.5	11.0	14.7	14.8	41.3	41.0
0	60	24	12.3	13.0	10.2	9.5	8.3	8.6	8.5	9.0	10.5	10.8	47.7	47.2
0	60	48	9.4	9.8	7.7	8.2	7.9	8.2	8.3	8.5	9.3	9.5	52.8	52.1
25	0	0	15.7	18.9	20.2	20.3	11.5	11.7	12.0	12.4	18.7	21.0	35.3	33.0
25	0	24	15.1	15.8	16.1	16.8	9.3	9.5	10.0	10.7	17.7	17.8	36.2	36.1
25	0	48	14.6	15.3	15.2	15.3	9.2	9.4	9.5	9.8	15.2	17.0	39.0	35.7
25	30	0	13.0	13.5	15.7	15.4	9.9	10.1	10.3	10.5	14.7	16.8	41.4	36.6
25	30	24	10.3	10.8	8.5	8.8	9.1	9.5	9.5	9.8	11.0	13.5	45.2	43.2
25	30	48	9.8	10.0	7.9	8.9	8.4	8.5	8.5	9.0	9.8	12.2	52.2	49.7
25	60	0	12.8	12.9	11.4	12.0	11.3	11.3	11.5	12.0	12.5	13.7	44.8	42.6
25	60	24	12.6	12.6	8.3	9.0	8.0	8.1	8.5	8.8	9.5	10.0	52.0	49.8
25	60	48	8.1	8.2	7.3	8.2	7.6	7.8	8.2	8.5	9.0	9.2	53.7	53.6
50	0	0	18.7	19.1	20.6	21.0	12.5	13.0	13.0	14.0	19.5	22.0	34.1	33.6
50	0	24	15.4	15.6	18.1	18.7	12.2	12.5	12.6	13.0	16.2	18.7	37.1	35.3
50	0	48	14.7	15.5	16.1	17.4	11.9	12.1	12.2	12.6	15.8	18.0	38.2	35.2
50	30	0	14.2	15.1	14.1	16.0	11.9	12.0	12.4	12.8	14.7	17.5	41.4	36.8
50	30	24	10.5	10.9	12.6	14.2	10.1	10.4	10.5	10.8	12.7	14.5	44.6	42.2
50	30	48	10.3	10.7	11.3	13.1	9.8	10.1	10.0	10.5	10.5	12.0	47.8	44.0
50	60	0	13.2	12.3	12.6	14.4	10.7	11.0	11.0	11.5	14.0	14.5	42.6	42.1
50	60	24	12.9	13.1	10.6	11.4	10.2	10.5	10.5	11.0	11.0	12.0	45.1	44.8
50	60	48	12.8	12.9	9.1	10.0	9.4	9.5	9.8	10.5	10.5	10.8	47.9	47.8
L.S.D at 5%			1.2	1.3	1.3	1.4	1.1	1.2	1.3	1.4	1.6	1.5	1.3	1.1

Table (11): Effects of seeding depth on incidence percentages of pre-emergence damping-off of canola under field condition

Depth of seeding	% pre-emergence damping-off	
	2001	2002
2 cm	6.8	7.1
3 cm	16.7	18.8
4 cm	24.3	25.4
L.S.D at 5%	3.2	3.4

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الملخص العربي

العمليات الزراعية وعلاقتها بمكافحة المشاكل المرضية الرئيسية على محصول الكانولا فى مصر

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تـم عزل ثلاث مسببات مرضية من بادرات ونباتات الكانولا المصابة باعفان الجذور والذبول والعفن الفحمى وكانت هذه الفطريات هى *Rhizoctonia solani* و *Fusarium oxysporum* و *Macrophomina phaseolina* وكـان فطـر *R. solani* اكـثر تكرار للعزل (٤٥,٤%) عن *F. oxysporum* (٢٩,٧%) أو *M. Phaseolina* (٢٤,٩ %).

كما تم دراسة دور العمليات الزراعية المختلفة على الأمراض ذات التأثير الاقتصادى على نباتات الكانولا فى محافظة الإسماعيلية.

اشـتملت الدراسـة الأمراض التالية: الصدأ الأبيض المتسبب عن فطر *Albugo candida* وفطريات تبقع الاوراق والسـيقان والثمار Alternaria spp والبياض الزغبى *Peronospora parastica* التى تصيب المجموع الخضرى والعفن الفحمى *Macrophomina phaseolina* ، والذبول *Fusarium oxysporum* ، واعفان الجذور *Rhizoctonia solani*.

وجـدت تأثيرات ايجابية عند دراسة كثافة اللقاح الفطرى واضافة قش المحاصيل للتربة على حدوث الاصابة بامراض اعفان الجذور والذبول وعفن الساق الفحمى فى الكانولا ووجد ان بزيادة تركيز وحدات العدوى تزداد الاصابة بالفطـريات. وأمـا بالنسبة لتأثير إضافة المخلفات النباتية للتربة من محاصيل (فول الصويا – السمسم – الذرة – عباد الشـمس – الفـول السـودانى) قـبل الزراعة بأسبوع ، فقد بينت الدراسة أن إضافة تلك المخلفات تقلل من الإصابة بالفطريات المذكورة مقارنة بالكنترول وكان اقل حدوث الإصابة عند استخدام الذرة يليه فول الصويا ثم عباد الشمس.

أوضحت النتائج أيضا أن الزراعة على خطوط أدت إلى خفض شدة الإصابة المرضية وزيادة المحصول كما كانـت الزراعة على خطوط بعرض ٦٠ سم افضل من ٣٠ سم. وكانت مسافة الزراعة ٢٠ سم افضل من ١٠ أو ١٥ سم على الصفات المختبرة. ومن ناحية اخرى وجد أن ميعاد زراعة الكانولا فى ١٥ أكتوبر كان افضل من الزراعة فى ميعاد ١٥ سبتمبر او ١٥ نوفمبر فى خفض معدل الإصابة وزيادة المحصول.كما أن أعلى معدل للإصابة المرضية عند اسـتخدام الـرى بالرش مقارنة بالرى بالغمر وكانت شدة الإصابة المرضية اقل باستخدام معدل الرى بالرش لمدة ١٥ دقيقة كل ٤٨ ساعة مقارنة بالرش كل ٣٠ او ٤٥ دقيقة / ٤٨ ساعة.

كمـا أوضحت النتائج أن شدة الإصابة بأمراض الكانولا تحت الدراسة تزداد بزيادة التسميد النتروجينى بينما تقـل بزيادة معدل التسميد الفوسفورى والبوتاسى. وقد زاد المحصول بزيادة معدل التسميد البوتاسى وكان افضل معدل للتسميد (ن – فو – بو) هو ٢٥-٦٠-٤٨ وحدة/للفدان فى خفض الإصابة. كما وجد ان افضل عمق لزراعة البذور هو الـزراعة على عمق ٢ سم فى التربة مقارنة بالزراعة على عمق ٣ او ٤ سم حيث أدى ذلك إلى خفض نسبة الإصابة بموت البادرات قبل الإنبات.