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EFFECT OF CERTAIN MODERN METHODS ON ROOT-KNOT NEMATODE CONTROL ON CUCUMBER PLANTS

By

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6- SUMMARY

Cucumber (*Cucumis sativus*) is an economically important crop grown in open as well as protected cultivation. Root -knot nematodes have been reported to be associated with cucumber cultivation worldwide. Cucumbers considered one of the major vegetables summer crops in commercial fields in Egypt. However, during the last few decades efforts were concentrates to grow the crop in protected system in greenhouses during autumn and winter seasons.

Plant-parasitic nematodes cause significant reduction in yield and quality of many crops. Root-knot nematode, *Meloidogyne* spp., are the major plant-parasitic nematodes attacking many crops. Significant reduce the yield of many crops grown in infested soils. *M. incognita*, one of the most economically important species of root-knot nematodes, adversely affects plant growth and yield. The nematode pests are the most important pests affecting the cucumber plants, especially the root-knot nematode, due to their widespread and the destruction of many field crops. The hazardous effect of chemical nematicides or their degradation products on the environment and human health strongly necessitate the search for new, harmless means of disease control.

Therefore, this study was conducted to apply different alternative methods of control to eliminate the disease of the root-knot nematodes on cucumber plants compared to the nematicide Rugby 20%CS, under greenhouse and field conditions, this study included the following basic points:

1- Greenhouse experiments:

a- Use of some soil organic amendments as follows: Diatoms, brown algae (*Ascophyllium nodosum*) and moringa leaves powder were

added at the rate of 2,4 or 6 g. /plant, while humic acid at the rate of 0.5,1.0 or 2.0 ml/plant at transplanting.

b- Use of some plant oils (black seed, pumpkin and garlic) at the rate of 7.5, 15µl/ml of solvent mixture (3% acetone and 10% ethanol).

c- Use of some chemical and bio inducers: Bion® commercially product that belongs to the benzothiadiazole (BTH) 50 WG. and H_2O_2 as chemical resistance inducers were used. Trianum-P, commercially product of *Trichoderma harazainum* T-22 as bio-inducer was used. Bion at the rate of 0.08, 0.17 or 0.25g/plant and H_2o_2 at the different concentrations 50,100 or 200 ppm/ plant were used as foliar spraying or soil drench. Plants were treated with 20 ml of each concentration of treatments. Trianum-P was used as soil drench at three concentrations at the rate of (0.05, 0.1or 0.2 g/plant). Activity of Polyphenol oxidase (PPO) and Peroxidase (POX) enzymes were determined.

d- Use of Biofertal contains bacteria (*Bacillus megatrium* 1×10^9 cfu/g) was added at the rate of 0.1, 0.2 or 0.4 gm./plant.

e- Use of powder of some brassica plants was added at the rate of 1.5, 3.0 or 6.0 gm. /plant.

f- Use of grafting onto some resistance rootstocks: Cucumber, cv. Prince was used as a scion onto three commercial rootstocks (interspecific hybrid of *Cucrbita maxima* x C. *moschata*), Obkatosa, Flexifort and Star.

2- Field experiments:

Two field experiments were conducted, the first experiment was for studying the effect of some soil organic amendments and the second experiment for studying the effect of magnetized irrigation water and or potassium humate on control root-knot nematode *Meloidogyne* spp. on cucumber plants compared to the nematicide Rugby 20%CS

a- Effect of some soil organic amendments:

At transplanting, diatoms, moringa leaves powder and *Ascophyllum nodosum* were added at the rate of 6g/plant and Humic acid at the rate of 2 ml/plant. Humic acid was added three times at 14 day intervals.

b- Effect of magnetized irrigation water and or humate potassium:

Humat potassium, Rugby 20%CS (4.5 L./fed.) and control without any treatment were irrigated with normal water or with water after magnetization. The humate potassium was added at the rate of 0.2 g/plant with 14 days intervals. Mineral elements (N, P, K) of shoots and activity of Polyphenol oxidase (PPO), Peroxidase (POX) and Catalase(CA) enzymes were determined. Also electrolyte leakage% (E.L. %) and ROS (Reactive Oxygen Species) on cucumber plants were determined.

The results of the study resulted in the following points.

1- Greenhouse experiments:

a- Effect of some soil organic amendments:

All the treatments significant reduced the root-galling, egg-masses and the root system and nematode final population (J_2) in soil compared with the control (nematode only). Generally, the reduction of these parameters increased as the concentrations to treatments increased and the highest effects was observed at the highest concentration. Humic acid was the best treatment especially, the highest concentration (2ml/plant) was suppressed the number of galls and egg-masses/root system on the root of cucumber and number of (J_2) in soil by (83.0, 77.4 and 84.5 % reduction, respectively). The effect of these treatments were not significant different from that achieved by the nematicide Rugby 20% CS. Also all treatments significantly increased the fresh and dry weights of shoots and length of cucumber plants compare with control 1(nematode only.

b- Effect of some chemical and bio inducers:

All the treatments significant reduce the root-galling, egg-masses and the nematode final population (J_2) in soil compared with the control (nematode only). Generally, the reduction of these parameters increased as the concentrations to treatments increased and the highest effects was observed at the higher concentration. The highest reductions of number of galls on root galling and final nematode population (J2 in soil) were recorded by using Trianum-P and H_2O_2 as drench soil or spray treatments at high concentration in number of galls on root (70.6 , 69.1 and 68.8% reduction), respectively and in nematode population (73.9, 72.4 and 71.1% reduction), respectively without any significant differences. Results also, indicated that the high concentration of bio-inducer was the most effective against development of egg-masses as it inhibited number of egg-masses by (72.8%)**.** All treatments significant increase fresh and dry weights of shoots and increased as the concentrations to treatments increased and the highest effects was observed at the higher concentration.

c- Effect of some plant oils:

All the treatments significant reduce the root-galling, egg-masses and the nematode final population (J_2) in soil compared with the control (nematode only). The more effective treatment was the garlic oil at two concentrations in reducing root galling with reduction by (70 and 78.9%) respectively, which didn't significantly different from the nematicide treatment. The two concentration of garlic oil were the more effective treatments, in reduce egg-masses (61.6 and 68.2%, respectively) and development of nematode population with reduction (76.1 and 79.6%, respectively). Also, all treatments significant increase fresh and dry weights of shoots and length of cucumber plants compare with control 1(nematode only).

d- Effect of bio fumigation using brassica plants:

All concentrations of brassica plants powder were significant reduced the root-galling, egg-masses and the nematode final population (J_2) in soil compared with the control (nematode only). Generally, the reduction of these parameters increased as the concentrations to treatments increased and the highest effect was observed at the higher concentration. Treating the soil with high concentration of bio-fumigation using brassica plants was achieved the highest reduction on root galling (69.2%), egg-masses (67.5%) and in nematode final population by (69.0%). Also the treatments were improved growth parameters of cucumber plants.

e- Effect of bio-control agent *Bacillus megatrium*:

All treatments significant reduced the number of galls on root, egg-masses/ root system and final nematode population (J_2) in soil before and at planting compared with control. The high concentration at before planting was the best, (66.3, 68.7 and 70.8% reduction) respectively.

f- Effect of grafting cucumber onto some rootstocks:

The nematode disease parameters were significantly reduced when the cucumber grafted onto the tested rootstocks at different concentrations of nematode compere with the control (prince cv.ungrafting). Generally, the effect was increased as the inocula of nematode decreased. Grafted seedlings of prince onto flixefort was gave the best results in reduction of number of galls/root system at the different inocula levels of nematode by (88.7, 84.2 and 85. %, respectively), egg-masses (88.2, 82.1 and 83.5%, respectively) and nematode final population (88.8, 85.7 and 81.4%, respectively).

2- Field experiments:

a- Effect of some soil organic amendments on cucumber plants under naturally infested field conditions with *Meloidogyne* spp.

All treatments significant reduce root galling, egg-masses and nematode final population on soil (J_2) compared to the control (untreated). Highest reduction of root-galling (87.70 and 84.04%) and nematode final population in soil (85.30 and 78.67%) was achieved, when soil treated with humic acid, then moringa powder. On the contrary, moringa treatment was achieved the highest reduction in number of egg-masses (82.06%) then humic acid treatment (80.6%). Also all treatments significant increase fresh and dry weights of shoots, length of plant and fruit yield of cucumber, except treating soil with algae, whereas, the increasing in fresh and dry weights of shoots don't significant increasing. The treatments significant increase the fruit yield of cucumber by 40.39-63.05%. The highest increase in fruit yield (63.05%) was achieved when soil was treated with moringa leaves powder, then humic acid treatment (58.55%).

The treatments significantly increased the leaves content of total mineral including N, P, K (%) compared with control 1 except, *Ascophyllum nodosum* treatment which decreased P and K (%) of leaves and diatoms treatment which decreased only K (%) of leaves.

b- Effect of using magnetized irrigation water and potassium humate on cucumber plants under naturally infested field conditions with *Meloidogyne* spp.

The treatments with the magnetized water irrigation were achieved the best effects in reducing the disease nematode parameters. The potassium humate with water magnetized had the best results in reduction of number of galls/root system by(85.58%), while the

nematicide (Rugby 20% CS) treatment was the best results in reduction of egg-masses (94.44%) and nematode final population (88.0%) compared with control (nematode only). Humate treatment with water magnetized treatment was achieved reduction in egg-masses and nematode population by(87.22 and 79.54% respectively).

All treatments caused significantl increased in fresh weight of shoots compared with normal water treatment (control), except magnetized water irrigation only treatment. Also all treatments caused significantly increased in dry weight of shoots compared with normal water treatment (control). On the other hand, all treatments were enhanced the plant length and significant increased the yield of cucumber plants compared with normal water treatment (control). The highest increase in yield was achieved when soil treated with humate combined with magnetized water irrigation (66.9 %).

The treatments significantly increased the leaves content of total mineral including N, P, K (%) compared with control (nematode only) with normal water. The highest increase in N,P and K% of the leaf was achieved when the soil was treated humate with water magnetized.

The using magnetized irrigation water increased activity of the enzymes poly phenol oxidase, peroxidase (POX) and catalase (CAT) in leaves. Treatments with magnetized irrigation water were significantly decreased electrolyte leakage % (EL %) on shoots of cucumber plants compare with treatments with normal water**.** All treatments were able to increase the levels of endogenous ROS mainly superoxide ($O_2^{\cdot -}$) and hydrogen peroxide (H_2O_2) in cucumber plants.

Results of the present study provide evidence that can be used efficient non-chemical methods against root-knot nematode *M. incognita* on cucumber plants to avoid the drawbacks of traditional chemical control.