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# NON CHEMICAL CONTROL OF ROOT- KNOT NEMATODE *Meloidogyne javanica* ON PEANUT IN EGYPT

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**ABSTRACT: Three experiments were conducted to control the root-knot nematode; *Meloidogyne javanica* infecting peanut by using non chemical control viz certain bioagents, plant extracts and algae under laboratory, greenhouse and field conditions in Egypt. Seven treatments including suspension of orange oil, *Bacillus thuringiensis, Trichoderma harzianum, Spirulina platensis, Gomphrena globosa, Origanum majorana* and Mocap were used.**

**Laboratory experiment revealed that high percentage of juvenile mortality occurred during all the exposure periods of all treatments especially after 72 hrs Data also showed that the treatments of both orange oil and *Spirulina platensis* had a significant effect on juvenile mortality especially at the highest concentration (86.6% and 78.4%) respectively. While, *Origanum majorana* showed the lowest effect at the highest concentration (64.8%).**

**Under greenhouse conditions all treatments led to increase the total fresh weight of shoots and roots of peanut plants especially at the highest concentration. The treatment of orange oil revealed the highest value of percentage increase of the whole plant fresh weight at the highest concentration (78.5%) but lower than Mocap treatment (86.3%), while the treatment of *Origanum majorana* gave the lowest value of percentage increase of the whole plant fresh weight at the lowest concentration (56.5%).**

**Under field conditions all treatments increased the crop weight of peanut. The treatment of orange oil showed the highest increase in the weight of 100 seeds of peanut (81.93 g) but lower than Mocap treatment (82.56 g). While the treatment of *O. majorana* showed the**

**lowest effect (73.23 g) compared to control (55.23 g). *T. harzianum*, *B. thuringiensis* and *G. globosa* occupied an intermediate position. On the other hand, other parameters including plant height, numbers of branches and pods as well as pods weight/plant gave the same trend. Orange oil and *Spirulina platensis* were the most effective treatments in reducing numbers of developmental stages, egg laying females, number of eggs/egg-mass and number of second stage juveniles but lower than Mocap treatment, whereas treatment of *O. majorana* was the least effective one under both greenhouse and field conditions.**

**Key words: Peanut, *Meloidogyne javanica*, bioagents, plant extracts, algae and Mocap.**

## INTRODUCTION

In Egypt, peanut *(Arachis hypogaea)* is one of the most important legume and oil crops for local consumption and exporting. It is usually grown in the newly reclaimed sandy localities. In recent years, plant parasitic nematodes are considered one of the major obstacles to the production of peanut crop. Root-knot nematodes (*Meloidogyne* spp.) are among the most damaging nematodes in agriculture, causing an estimated US$100 billion loss/year worldwide (Oka *et al.*, 2000). They are found wherever plants are grown and any agricultural crop may be a host to one or more root-knot-nematode species (Sasser and Freckman, 1987). *Meloidogyne javanica* (Neal) Chitwood and other root-knot nematodes cause galls in roots of many crops impeding normal uptake of water and nutrients. Use of chemical nematicides is one of the primary means of controlling plant-parasitic nematodes.

However, their potential negative impact on the environment and human health has led to a total ban or restricted use of most nematicides. In addition, use of chemical nematicides are prohibited in organic farming. Therefore, there is a need to develop alternative, environmentally friendly management tactics for plant-parasitic nematodes (Noling and Becker, 1994). Application of microorganisms antagonistic to *Meloidogyne* spp., or compounds produced by the microbes, could provide additional opportunity for managing the damage caused by

root-knot nematodes to such crops. Recently, one of the biological control practices attempted is the study of cyanobacteria that parasitize plant-parasitic nematodes. The nematicidal potential of culture filtrates of the blue- green algae, *Microcoleus vaginatus* (cyanobacterium) was tested against *M. incognita*. Results showed a hatching inhibition of eggs and killed second stage juveniles (Khan and Saxena, 1997).The beneficial effect of root-dip treatment on tomato increased with the increase in the concentration of culture filtrate. Root galling and final nematode population were reduced by 65.9% and 97.5%, respectively when treated at the highest concentration (Khan *et al.,* 2005). Microalgal metabolites have attracted attention, because they are a resource for toxins, and potential new drugs (Shimizu, 2003). *Bacillus subtilis* is reported as a biocontrol agent against root-knot nematodes. Nematode mortality was observed after 8 hours incubation and a concentration of at least $10^{8}$ colony forming unite (cfu)/ml were necessary to cause nematode mortality higher than 30%. *Bacillus subtilis* act through production of number of antibiotic as bacterocin and subitisin antibiotics (Ferreiro *et al.*, 1991; Farahat, 1998; Khan *et al.*, 2002 and Shawky and Abd El-Moneim, 2005). *Trichoderm harzianum* act through different mechanisms including mycoparasitism, also through production of antibiotic substances (Hayes, 1992). *Trichoderm harzianum* also act through production of destructive enzymes i.e., chitenase (Paderes *et al.*, 1992; Abd El –Moity *et al.*, 1998; Bolar *et al.*, 2000 ; Sharon *et al.*, 2001; Faruk *et al.*, 2002; Shawky and Abd El- Moneim ,2005 and Sahebani & Hadavi ,2008). Plant extracts of *Gomphrena globosa* could provide abundant sources of secondary metabolites possessing biological activities against target nematode (El-Deriny, 2009). The nematicide, Mocap has nematicidal contact effect (Stephan *et al.*, 1998; Cheol *et al.*, 1999 and D'-Errico *et al.*, 2000).The present work was carried out to study the control of root-knot nematode infecting peanut by using some non chemical control methods namely certain bioagents, plant extracts and algae in comparison with

Mocap as a nematicide under both greenhouse and field as well as laboratory conditions.

## MATERIALS AND METHODS

### Preparation of Fungal Inocula, Aqueous Leaf Extracts, Orange Oil and Algae Inocula

The isolates of *Bacillus thuringiensis* and *Trichoderma harzianum* were obtained from Central Laboratory of Organic Agriculture, Agricultural Research Center, Giza, Egypt. The concentrations of *Bacillus thuringiensis were* $1x10^6$, $3 x10^6$ and $5x 10^6$cells and *Trichoderma harzianum* $1x10^6$, $3 x10^6$ and $5x 10^6$cfu.

Fresh leaves of two plants were collected and transferred to Nematology Laboratory of Plant Pathology Res. Inst., A.R.C., for extraction. The tested plants were marjoram; *Origanum majorana* and globe amaranth; *Gomphrena globosa*. Standard leaf extracts were prepared by crushing and dissolving 20 g of leaves in 100 ml distilled water separately using mortar and pestle. The result solution was then centrifuged at 5000 rpm for five minutes. The supernatant was filtered through a layer of muslin cloth, and dilution of 5, 10 and 20% were prepared from each standard.

The treatment of orange oil was the commercial product obtained from Florida Chemical Company, USA.The concentrations of orange oil were 0.5, 1 and 2 ml/100ml water.

The isolate of *Spirulina platensis* was obtained from Algae Department, Soils & Water and Environment Research Instiute, A.R.C., Giza, Egypt. The concentrations of *S. platensis* were 1, 2 and 3% from the filtrate.

### Efficacy of Certain Bioagents, Plant Extracts and Algae at Different Concentrations on *M. javanica* Juveniles under Laboratory Conditions

To estimate the efficacy of some bioagents, plant extracts and algae at different concentrations on the activity of *M. javanica* juveniles, 1ml/concentration from all the tested treatments was added separately to 1ml of nematode suspension containing 100 juveniles in glass vials. The numbers of active and non-active juveniles were examined and counted microscopically after 24, 48 and 72 hours and then recorded.

**Efficacy of Certain Bioagents, Plant Extracts and Algae at Different Concentrations in Comparison with Mocap on Peanut Infected by *M. javanica* Under Greenhouse Conditions**

Clay pots (25 cm-diam.) were filled with steam sterilized sandy loam soil, then seedlings of peanut cv. Giza 5 were grown in each pot. Each seedling was inoculated with 3000 newly hatched second stage juveniles of *M. javanica* after seven days from germination under greenhouse conditions. Seedlings were drenched separately with 20 ml of the tested treatments with three concentrations as soil drench around peanut seedlings. Ethoprop (Mocap) 10% G as nematicide was used for comparison at the recommended dose (0.09g / pot). Inoculated seedlings without any treatment were served as control. Pots neither treated with nematodes nor any treatment were also served as control. Each treatment was replicated four times.

Sixty days after inoculation, all plants were carefully uprooted and fresh root and shoot systems were weighted. Nematode populations in soil /pot were determined according to Goodey, (1957). Roots were stained by acid fuchsin in acetic acid according to Byrd *et al.* (1983), and examined for counting number of developmental stages and females/ root. Egg-masses, eggs/egg-mass of *M. javanica* were extracted by using sodium hypochoride (NaOCl) method as described by Hussey and Barker (1973).

**Efficacy of Certain Bioagents, Plant Extracts and Algae in Comparison with Mocap on Peanut Infected by *M. javanica* Under Field Conditions**

This experiment was conducted in naturally infested sandy soil to determine the efficacy of certain bioagents, plant extracts and algae in comparison with Mocap to control *M. javanica* under field conditions at the highest concentration ($5\times10^6$ cfu) for the *Trichoderma harzianum* and ($5\times10^6$ cells) for the *Bacillus thuringiensis*. *Origanum majorana* and *Gomphrena globosa* were used at concentration 20%, oil orange was used at 2 ml/100ml water, the isolate of *Spirulina platensis* was used at concentration 3% of the filtrate. All previous treatments were added as soil drenching by using 150 ml. Also ethoprop (Mocap) 10% (30 kg /Feddan) was used as the recommended rate. All treatments were replicated three times every replicate was ten $m^2$.

Every month, nematode populations in both soil and root

including number of second stage juveniles/250g in soil, developmental stages, females, egg-masses and eggs/egg-mass/g root were determined after treatments up to the harvesting time during the growing season as previously mentioned. Roots were stained by acid fuchsin in acetic acid according to Byrd *et al.*, (1983) and examined for number of developmental stages and females/1g root. Egg-masses, eggs /egg-mass of *M. javanica* were extracted by using sodium hypochoride (NaOCl) method as previously done. At harvest the plant height, number of branches, pods and pods wt. /plant, the weight of 100 seed and puds yield of peanut were determined.

### Statistical Analysis

Data were subjected to analysis of variance (ANOVA) (Gomez and Gomez, 1984) and means were compared by using L.S.D. at 5 % level of significance.

## RESULTS AND DISCUSSION

### Estimation the Efficacy of Certain Bioagents, Plant Extracts and Algae on *M. javanica* Juvenile Mortality in the Laboratory

Data in Table 1 show that all tested bioagents, plant extracts and algae had various degrees of effectiveness toward the mortality % of nematode juveniles.

Moreover, the percentage of mortality increased with increase of the concentration and exposure period. The highest concentration of orange oil (2 ml/100ml water) achieved the highest percentage of nematode juvenile mortality during all exposure periods reached to 80.6, 83.2 and 86.6%, respectively. After 24 hours, the nematode mortality % caused by all tested bioagents, plant extracts and algae at the highest concentrations were between 54.8-80.6 % compared with control (0.8%). Also, after 24 hours at the concentration (2 ml/100ml water) of orange oil the highest percentage of mortality was 80.6 % while the lowest percentage of mortality caused by *O. majorana* was 54.8 %. *S. platensis*, *T. harzianum*, *B. thuringiensis* and *G. globosa* ranked in the second level in the percentage of nematode juvenile mortality %during all exposure periods. The highest value was obtained after exposure period (72 hours) was 86.6 % for the treatments of orange oil. The percentage of nematode mortality differed according to such treatments and concentrations.

**Table 1. Estimation the efficacy of certain bioagents, plant extracts and algae on *M. javanica* juveniles after different exposure periods under laboratory conditions**

| Treatments | Concentrations | Mortality% Exposure periods (in hours) | | |
|---|---|---|---|---|
| | | 24 | 48 | 72 |
| *T. harzianum* | $1\times10^6$ cfu | 57.5 | 61.5 | 65.7 |
| | $3\times10^6$ cfu | 60.8 | 64.8 | 68.4 |
| | $5\times10^6$ cfu | 67.1 | 70.4 | 73.8 |
| *B. thuringiensis* | $1\times10^6$ cells | 46.7 | 49.2 | 60.5 |
| | $3\times10^6$ cells | 55.8 | 60.4 | 67.9 |
| | $5\times10^6$ cells | 60.2 | 65.8 | 70.3 |
| *S. platensis* | 1% | 54.4 | 66.7 | 69.2 |
| | 2% | 65.9 | 70.9 | 73.5 |
| | 3% | 72.3 | 76.6 | 78.4 |
| *O. majorana* | 5% | 46.8 | 50.8 | 51.9 |
| | 10% | 50.3 | 57.3 | 60.5 |
| | 20% | 54.8 | 60.1 | 64.8 |
| *G. globosa* | 5% | 42.8 | 46.5 | 57.1 |
| | 10% | 45.7 | 57.9 | 62.7 |
| | 20% | 57.3 | 62.8 | 66.1 |
| Orange oil | 0.5 ml/100 ml water | 74.8 | 76.4 | 80.1 |
| | 1 ml/100 ml water | 77.9 | 80.3 | 85.7 |
| | 2 ml /100 ml water | 80.6 | 83.2 | 86.6 |
| Nematode in distilled water | | 0.8 | 1.4 | 2.1 |

## Impact of Certain Bioagents, Plant Extracts and Algae in Comparison with Mocap on Peanut Infected with *M. javanica* Under Greenhouse Conditions

### The effect on *M. javanica* population

Data in Table 2 illustrate that all tested bioagents, plant extracts and algae treatments were effective in controlling *M. javanica* under greenhouse conditions at the high concentration. Orange oil and *S. platensis* were the most effective treatments in reducing numbers of developmental stages , females, number of eggs/ egg- mass and number of second stage juveniles than the other treatments while the least effective treatment was *O. majorana*. Also, data showed positive correlation between efficacy of the treatments and concentrations. Using orange oil and *S. platensis* treatments performed the highest decrease in both soil and roots (development stages, females, number of eggs/ egg-mass) comparing to the other treatments. *B. thuringiensis*, *T. harzianum* and *G. globosa* occupied the second rank in reducing the nematode populations, while *O. majorana* showed the lowest number of nematode populations in both soil and roots. Also, it was evident that *M. javanica* population density in soil and roots was significantly suppressed in all treatments with a rate of nematode build-up ranged from 0.66 for orange oil to 5.33 for *O. majorana* at the highest concentrations when compared to nematode alone (12.04), Table 2 .

### The effect on number of *M. javanica* galls

All bioagents, plant extracts and algae showed remarkable decrease in number of root galls caused by *M. javanica* on peanut compared to the control Fig. 1. Orange oil and *S. platensis* resulted in the lowest number of root galls at the highest concentration (15 and 23, respectively). While, *O. majorana* alone showed the highest number of root galls (64) compared to other treatments.

### The effect on reduction % of *M. javanica*

Fig. 2 show high reduction in the *M. javanica* population density that was obviously achieved by the application of orange oil (90.20%) followed by *S. platensis* (84.88 %), *T. harzianum* (75.74%) at the highest concentration.

Data in Fig. 3. Show the effect of some bioagents, plant extracts and algae on percent increase in fresh weight of the whole peanut plants infected by the fourth month since *M. javanica*

**Table 2. Efficacy of certain bioagents, plant extracts and algae on peanut (cv. Giza5) infecting with *M.* javanica under greenhouse conditions**

| Treatments | Concentrations | *Nematode population in | | | | | **Final nematode population (PF) | Rate of build- up (PF/PI) |
|---|---|---|---|---|---|---|---|---|
| | | Soil/pot | Root | | | | | |
| | | | developmental stages females | Egg-mass | Eggs/ egg-mass | | | |
| | $1\times10^6$ cfu | 890 | 58 | 46 | 40 | 246 | 10834 | 3.61 |
| *T. harzianum* | $3\times10^6$ cfu | 820 | 55 | 41 | 37 | 232 | 9500 | 3.17 |
| | $5\times10^6$ cfu | 800 | 52 | 37 | 35 | 225 | 8764 | 2.92 |
| | $1\times10^6$ cells | 1010 | 69 | 58 | 49 | 270 | 14367 | 4.79 |
| *B. thuringiensis* | $3\times10^6$ cells | 950 | 66 | 53 | 45 | 260 | 12769 | 4.26 |
| | $5\times10^6$ cells | 930 | 62 | 49 | 41 | 252 | 11373 | 3.79 |
| | 1% | 750 | 48 | 34 | 33 | 220 | 8092 | 2.70 |
| *S. platensis* | 2% | 700 | 42 | 30 | 28 | 215 | 6792 | 2.26 |
| | 3% | 680 | 39 | 28 | 23 | 205 | 5462 | 1.82 |
| | 5% | 1180 | 90 | 72 | 55 | 282 | 16852 | 5.62 |
| *O. majorana* | 10% | 1130 | 87 | 67 | 54 | 280 | 16404 | 5.47 |
| | 20% | 1110 | 83 | 64 | 53 | 278 | 15991 | 5.33 |
| | 5% | 1100 | 80 | 65 | 52 | 276 | 15597 | 5.20 |
| *G. globosa* | 10% | 1050 | 77 | 63 | 51 | 273 | 15113 | 5.04 |
| | 20% | 1030 | 73 | 60 | 48 | 270 | 14123 | 4.71 |
| | 0.5ml./100 ml. water | 650 | 37 | 25 | 20 | 200 | 4712 | 1.57 |
| Orange oil | 1 ml. /100 ml. water | 620 | 32 | 23 | 17 | 195 | 3990 | 1.33 |
| | 2 ml. /100 ml. water | 610 | 25 | 22 | 15 | 192 | 3537 | 1.18 |
| Mocap | (0.09 g)/ pot | 300 | 22 | 16 | 13 | 170 | 2548 | 0.85 |
| Nematode (check) | | 2300 | 112 | 96 | 82 | 410 | 36128 | 12.04 |
| L.S.D. (5%) | | 9.7 | 2.4 | 1.3 | 1.1 | 4.9 | 312.4 | 0.1 |

*Each value presented the mean of four replicates.

**Final nematode population (PF) = (No. of egg-masses x No. of eggs/egg-mass) + No. of females + No. of developmental stages+ No. of juveniles in soil/pot.

$$\text{Rate of build - up} = \frac{\text{Final nematode population (PF)}}{\text{Initial nematode population(PI)}}$$

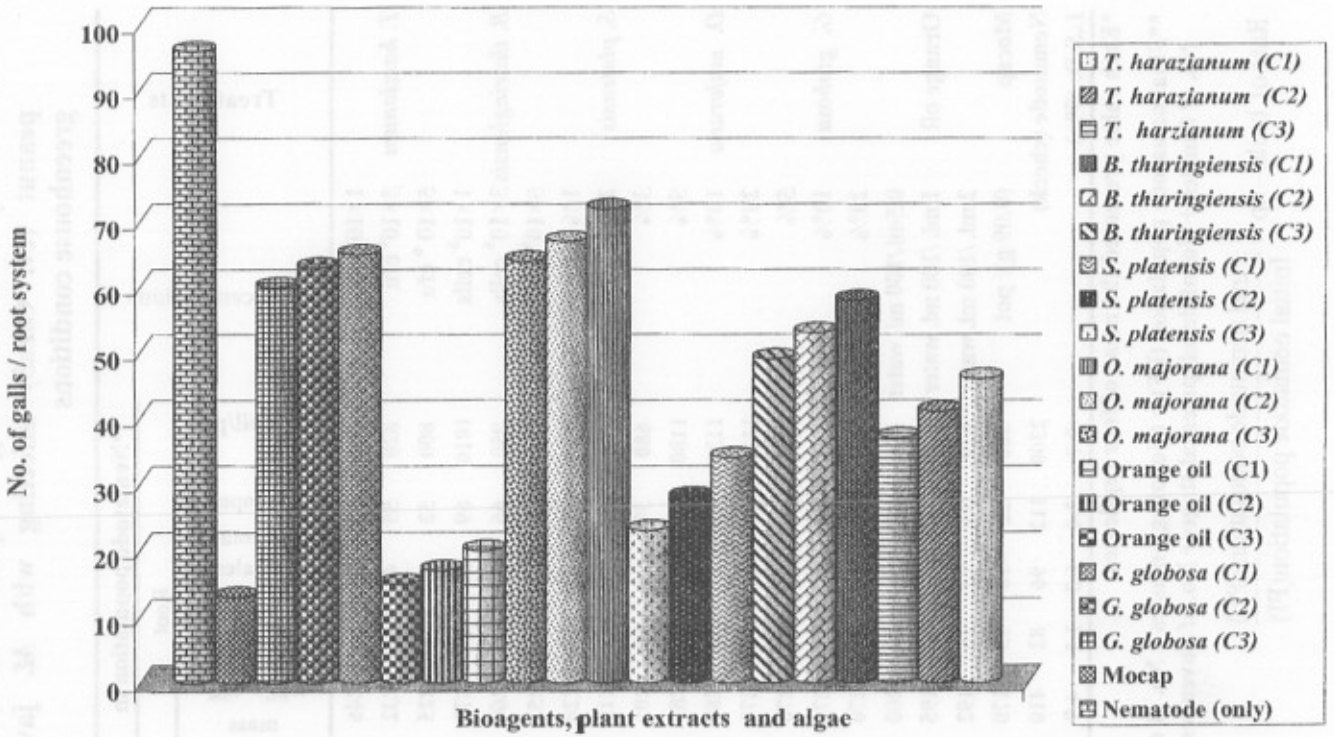


**Fig. 1. Effect of certain bioagents, plant extracts and algae on number of galls /root of peanut plants infected by *M. javanica* under greenhouse conditions**

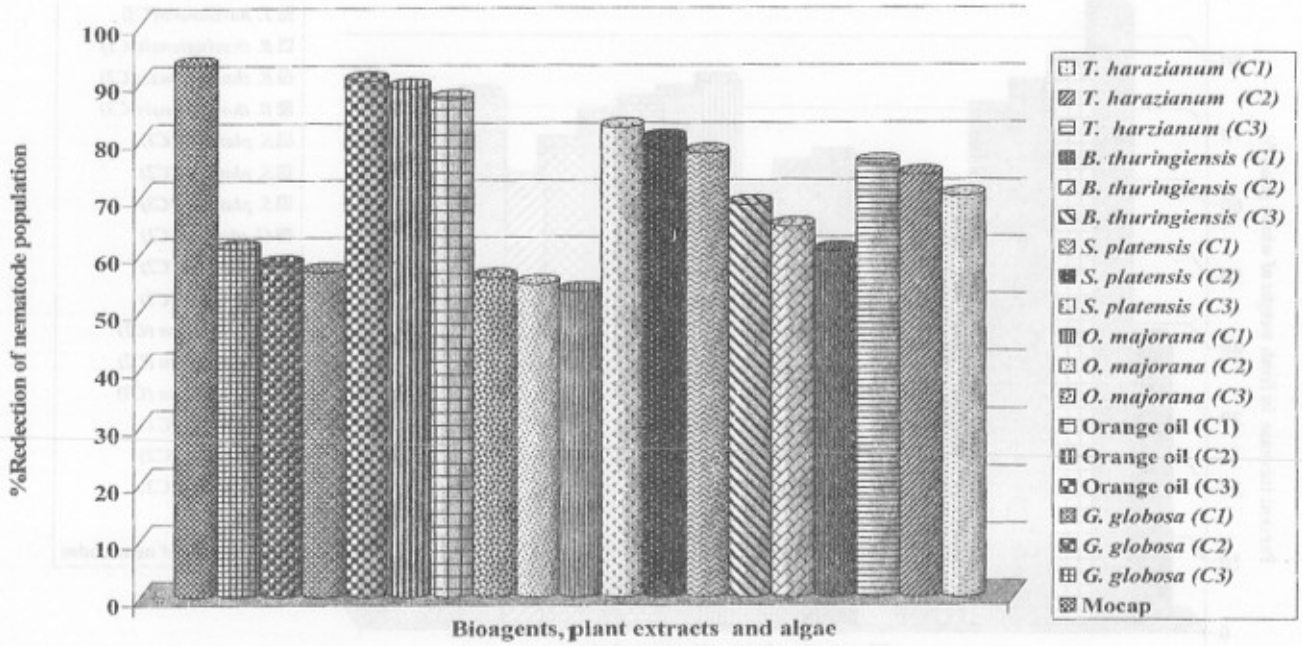


**Fig. 2. Effect of certain bioagents, plant extracts and algae on reduction of nematode% of peanut plants infected by *M. javanica* under greenhouse conditions**

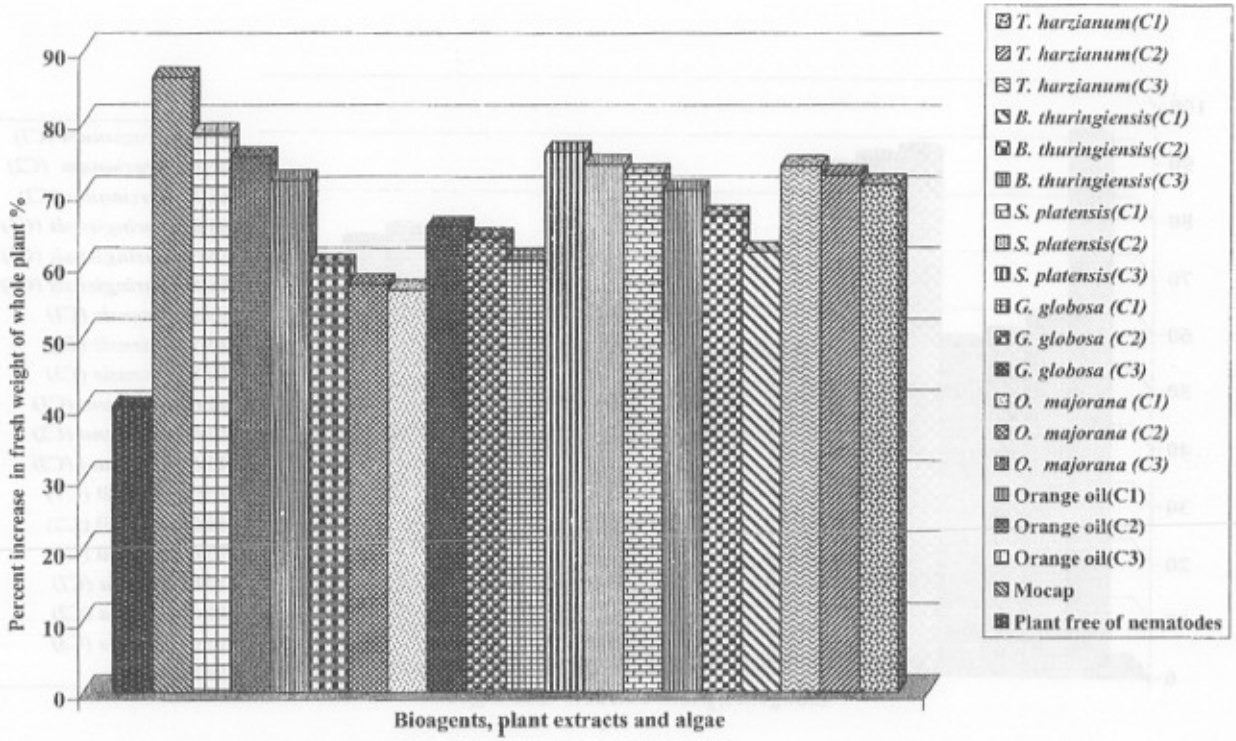


**Fig. 3. Effect of certain bioagents, plant extracts and algae on percent increase in fresh weight of the whole peanut plants infected by *M. javanica* under greenhouse conditions**

under greenhouse conditions. The results were expressed as increasing % over control. Fresh weight of the whole plant was greatly improved in treatment of orange oil where the percentage of increase reached 78.5% at the highest concentration (2 litre/ fed.), while, in the treatment of *O. majorana* it was 56.5% at the lowest concentration (5%).

## Efficacy of Certain Bioagents, Plant Extracts and Algae on *M. javanica* Under Field Conditions

The efficacy of certain bioagents, plant extracts and algae treatments were tested under field conditions in an experiment lasted four months. Samples were monthly collected from soil and roots in field of peanut (cv. Giza 5), naturally infested with *M. javanica.* The nematode populations were counted throughout the experimental period and documented in Table 3. Total nematode population in both soil and root samples revealed the suppressive effect of all materials on the nematode counts. In general, the nematode counts decreased gradually in both soil and root of the treated plants. All treatments performed the total nematode population ranging between 780-1180 one month after treatment. Then, remarkable suppression in nematode counts obtained after two months or more except in the total nematode counts in both soil and root samples were increased. At the end of experiment all the treatments gave satisfactory decrease in the nematode counts.

Data in Table 3 reveal that both suspensions of orange oil at 2 litre/ fed. and *S. platensis* at 3% performed the highest decrease in the total number of nematodes in both soil and root samples in comparison with the other treatments. Suspension of *B. thuringiensis* occupied the second rank in reducing the number of total nematodes, while *O. majorana* (20%) resulted in the lowest reduction in the total number of nematodes. *G. globosa* (20%) and *T. harzianum* ($5\times10^6$cfu) occupied an intermediate position in reducing the total number of nematodes in both soil and root samples.

Data in Table 4 reveal different response in the plant height, number of branches and pods, pods weight/ plant and weight of 100 seeds of peanut. The treatment of orange oil showed the highest

increase in the weight of 100 seeds of peanut reached to 81.93g, while, the treatment of *O. majorana* showed the lowest effect reached to 73.23g compared with control (55.23g). *T. harzianum*, *B. thuringiensis* and *G. globosa* occupied an intermediate value in the weight of 100 seed of peanut. Other parameters including plant height, numbers of branches, pods and pods weight/plant revealed the same trend.

Results in Fig. 4 reveal different response in the weight of peanut yield (ardab)/fed. The treatment of orange oil at 2 litre/ fed. showed the highest increase in yield weight of peanut reached to 13.5 ardab/fed., while, the treatment of *O. majorana* (20%) showed the lowest increase reached to10.8 ardab/fed. compared with control.

*B. subtilis* act through production of number of antibiotics (Farahat *et al.*, 1998). *B. thuringiensis* can grow and multiplicate very fast under this circumstance (Chen *et al.*, 2000 and Xiang *et al.*, 2007). *T. harzianum* act through different mechanisms including mycoparasitism (Benhamoud and Chet,1993)also through production of antibiotic substances (Turner, 1971 and Hayes 1992). *T. harzianum* also act through production of the destructive enzyme chitenase (Paderes *et al.*, 1992 and Bolar *et al.*, 2000). *Trichoderma* spp. can produce various toxin metabolites and different enzymes that improve photolytic activity of the antagonist and control of nematodes. In addition *T. harzianum* has ability to conolization (Tronsmo *et al.*, 1993; Devi *et al.*, 2000; Sharon *et al.*, 2001; Faruk *et al.*, 2002). The blue green algae (cyanonbacteria) such as: *Microcystis, Anabaen, Nostoc* and *Oscillatoria* produce a great variety of secondary metabolites like nitrogen containing compounds, polyketides, lipopeptides, cyclic peptides and many others (Gervick *et al.*, 2001). Culture filtrates showed significant increase in plant growth and inhibit root galling and population of *M. incongnita* (Khan *et al.*, 1998).

Plant extracts of *G. globosa* could provide abundant sources of secondary metabolites possessing biological activities against target nematode (El-Deriny, 2009). The active ingredients of *O. majarana* containing active substances i.e. thimol, alcavacrol, alorzamanik acid. Also it contains pilot oil: major components, hydrates

**Table 3.The efficacy of certain bioagents, plant extracts and algae on peanut (cv. Giza5) infected with *M. javanica* under field conditions**

| Treatments | Concentrations | Initial | After one month | | After two months | | After three months | | After four months | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total population in soil/250 g | Total population in soil/250 g + in root/g | PF/PI | Total population in soil/250 g+ in root/g | PF/PI | Total population in soil/250 g+ in root/g | PF/PI | Total population in soil/250 g + in root/g | PF/PI |
| *T. harzianum* | $5\times10^{6}$ cfu | 1720 | 1150 *(45%) | 0.67 | 950 *(71%) | 0.55 | 790 *(79%) | 0.46 | 950 *(75%) | 0.55 |
| *B. thuringiensis* | $5\times10^{6}$ cells | 1600 | 1100 *(44%) | 0.69 | 920 *(70%) | 0.58 | 760 *(79%) | 0.47 | 920 *(75%) | 0.58 |
| *S. platensi* | 3% | 1580 | 920 *(52%) | 0.58 | 840 *(72%) | 0.53 | 700 *(79%) | 0.44 | 860 *(77%) | 0.54 |
| *O. majorana* | 20% | 1740 | 1240 *(41%) | 0.71 | 1160 *(65%) | 0.66 | 940 *(76%) | 0.54 | 1200 *(68%) | 0.69 |
| *G. globosa* | 20% | 1700 | 1180 *(43%) | 0.69 | 1000 *(69%) | 0.59 | 830 *(78%) | 0.49 | 1000 *(73%) | 0.59 |
| Orange oil | 2 ml/100 ml water | 1600 | 880 *(55%) | 0.55 | 780 *(74%) | 0.48 | 640 *(82%) | 0.40 | 820 *(78%) | 0.51 |
| Mocap | 40 kg./fed. | 1540 | 740 *(61%) | 0.48 | 620 *(79%) | 0.40 | 400 *(88%) | 0.25 | 620 *(83%) | 0.40 |
| Nematode (check) | | 1840 | 2240 | 1.21 | 3500 | 1.90 | 4100 | 2.22 | 4300 | 2.34 |
| L.S.D. ( 5%) | | 17.6 | 20.9 | 0.02 | 25.3 | 0.1 | 27.6 | 0.01 | 28.9 | 0.02 |

Figures in parentheses indicate percentage of nematode reduction in soil according to Henderson & Tillton, (1955).

* Efficacy %= 100 x [1- (Total nematode population of treated plots after application x Total nematode population of check plots before application) / (Total nematode population of treated plots before application x Total nematode population of check plots after application)

**Table 4. Efficacy of certain bioagents, plant extracts and algae on yield components of groundnut (cv. Giza 5) infected with *M. javanica* under field conditions**

| Treatments | Concentrations | Plant height (cm) | No. of branches /plant | No. of pods/plant | Pods wt./ plant(g) | Weight of 100 seeds (g) |
|---|---|---|---|---|---|---|
| *B. thuringiensis* | $5\times10^{6}$ cells | 59.66 | 10 | 38 | 65.78 | 77.15 |
| *T. harzianum* | $5\times10^{6}$ cfu | 62.96 | 8 | 40 | 58.21 | 79.58 |
| *S. platensis* | 3% | 65.36 | 9 | 42 | 60.42 | 80.89 |
| *O. majorana* | 20% | 54.36 | 6 | 32 | 55.31 | 73.23 |
| *G. globosa* | 20% | 56.39 | 7 | 35 | 56.82 | 75.23 |
| Orange oil | 2 ml. /100 ml. water | 70.85 | 11 | 45 | 70.58 | 81.93 |
| Mocap | 40 kg./ fed. | 75.37 | 12 | 48 | 75.24 | 82.56 |
| Nematode (check) | | 50.19 | 6 | 29 | 50.13 | 55.23 |
| L.S.D. (5%) | | 2.6 | 1.3 | 1.2 | 1.5 | 1.8 |

alsabinin, alcarvakrwol, inalol, flavonyat, alcaviien acid, alagoesarniek acid and triturbines (Saravanapriya *et al.*, 2004). Chemical analysis of *G. globosa* reveal the presence of β-D-glucoside, β-sitosterd, stigmiasterrol, campesterol, stigmasterol- β-D-glucoside, friedelin, 3-epi-friedelinol, allantion, flavonid and chrysoeriol-7-O-β-D-glucoside in the aerial parts of plant (Dinda *et. al.*, 2006). D-Limonene is the major component of the oil extracted from the citrus rind during the citrus juicing process. When the fruit is juiced, the oil is pressed out of the rind, then separated from the juice and distilled to recover certain flavor and fragrance compounds.

In conclusion, it can be said that drenching application with plant extracts (orange oil) retained their nematicidal effects in soil and there is a possibility of using this trend for controlling nematodes that clearly needs further investigation on a large scale.

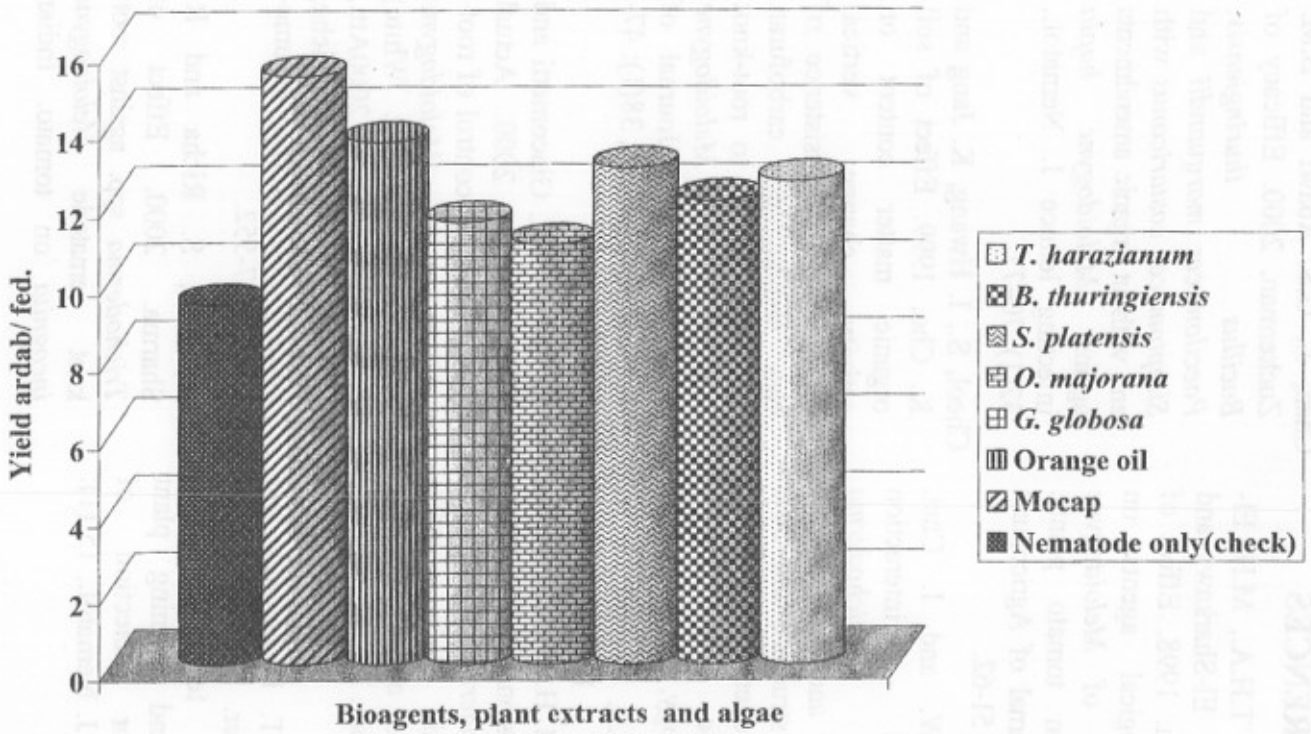


**Fig. 4. Effect of certain bioagents, plant extracts and algae on yield weight of peanut plants infected by *M. javanica* under field conditions**

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# المكافحة الغير كيماوية لنيماتودا تعقد الجذور (ميلودوجين جافانيكا) على الفول السوداني في مصر

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تم دراسة تأثير استخدام زيت البرتقال- بكتريا باسيلس سيرنجينزس – الفطر تريكودرما هارزيانم – طحلب سبريولينا بلاتنسيس – مستخلص نبات المدنة ومستخلص نبات البردقوش بالمقارنة بمبيد الموكاب على تعداد نيماتودا تعقد الجذور (ميلودوجين جافانيكا) ونمو نباتات الفول السوداني صنف "جيزة ٥" تحت ظروف المعمل والصوبة والحقل وأوضحت النتائج مايلى:

أثبتت التجارب المعملية أن جميع المعاملات المختبرة أدت إلى موت اليرقات خاصة بعد تعرضها لفترة ٧٢ ساعة حيث أعطت معاملة زيت البرتقال وطحلب الاسبيرولينا بلاتينسيس أعلى تأثير معنوي في موت اليرقات خاصة عند التركيز الأعلى (٨٦,٦% و ٧٨,٤%) بينما معاملة البردقوش كانت الأقل تأثيرا (٦٤,٨%).

أدت جميع المعاملات إلى زيادة في الوزن الكلى للمجموع الخضري و الجذري تحت ظروف الصوبة خاصة عند التركيز الأعلى. حيث أعطت معاملة زيت البرتقال أعلى نسبة في الوزن الكلى للنبات (٧٨,٥%) حيث احتلت المرتبة الثانية بعد المعاملة بالمبيد(٨٦,٣%) بينما معاملة البردقوش كانت الأقل تأثيرا(٥٦,٥%).

حقليا جميع المعاملات أدت إلى زيادة في وزن محصول الفول السودانى حيث أعطت المعاملة بزيت البرتقال أعلى زيادة في وزن ال١٠٠ حبة(٨١,٩٣ جرام)بعد المعاملة بالمبيد (٨٢,٥٦ جرام) بينما كانت المعاملة بالبردقوش هي الأقل (٧٣,٢٣جرام) مقارنة بالمعاملة الضابطة (٥٥,٢٣ جرام). ومن ناحية أخرى حققت معاملات (بكتريا باسيلس سيرنجينزس – الفطر تريكودرما هارزيانم – مستخلص نبات المدنة) نتائج متقاربة في وزن ال١٠٠حبة وطول النباتات وعدد الأفرع وعدد القرون وعدد ووزن الحبوب) في حين حققت معاملة زيت البرتقال و طحلب الاسبيرولينا بلاتينسيس أعلى تأثير في خفض أعداد النيماتودا (الأطوار اليرقية الغير كاملة–الإناث الكاملة النضج –أكياس البيض– الطور اليرقى الثاني) بعد المعاملة بالمبيد بينما كانت المعاملة بالبردقوش هي الأقل تأثيرا تحت ظروف الصوبة والحقل.