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# INFLUENCE OF SOME ORGANIC SOIL AMENDMENTS AS *MELOIDOGYNE INCOGNITA* SUPPRESSANTS ON CUCUMBER

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**ABSTRACT: Dried powdered fruit peels of *Citrus paradisi, C. aurantum, C. sinesis, C. aurantifolia* and *C. reticulata* were examined as organic soil amendments at 0.50 and 0.75 g doses for controlling *Meloidogyne incognita* infecting cucumber plants, *Cucumis sativus,* cv. Alpha Beit PS. under greenhouse conditions. Results indicated that certain dried fruit peels of citrus with the two rates tested obviously improved growth of cucumber plants when compared with that of the nematode alone. The application of *C. aurantum* at 0.75 g revealed gave the highest increase of the whole plant fresh weight which was amounted to 100.93 % followed by the same treatment at 0.50 g (94.88 %), *C. aurntifolia* at 0.75 g, 0.50 g (88.84 %, 82.79 %), *C. paradisi* at 0.75 g (80.93 %) and then *C. sinesis* at 0.75 g (80.00 %), respectively. All treatments tested showed significant reduction in number of the root-knot nematode in soil as well as number of developmental stages, females, galls and egg-masses in cucumber roots. However, a significant reduction in nematode population was recorded with *C. aurantum* at 0.75 g (94.13 %) followed by the same treatment at 0.50 g (93.41 %) then *C. aurntifolia* at 0.75 g (93.35 %).**

**Key words: cucumber, *Cucumis sativus, Meloidogyne incognita,* oxamyl, plant products (dried powdered fruit peels of citrus).**

## INTRODUCTION

Cucumber, *Cucumis sativus* cv. Alpha Beit PS. is one of the most important vegetable crops cultivated in Egypt. Root-knot nematodes (*Meloidogyne* spp.) are the most widespread and destructive of all plant parasitic nematodes, causing certain loss in

major crops, mainly, cucumber plants in Egypt (Oteifa & El-Gindi, 1956; Oteifa *et al.*, 1964; Ibrahim *et al.*, 1986 and Mostafa, 1995).

Chemical management of *Meloidogyne* spp. has successfully limited the impact of this nematode below damaging level, (El-Sherif, 1984 and Mohamed *et al.*, 1990). However, great interest has given among nematologists, in order to use alternative nematode management practices because of environmental and health problems associated with nematicide use. The nematicidal activity of certain plant products applied in soil as organic amendments e.g. powders, chopped leaves or shoots or fruit peels against plant parasitic nematodes have been widely studied (Goswami & Vijayalakshmi, 1986; Jain & Bhatti, 1988; Pathak *et al.*, 1988; Akhtar & Alam, 1989; Siddiqui & Alam, 1989; Zaki & Bhatti, 1989; Akhtar & Alam, 1990; Akhtar *et al.*, 1990; Alam, 1991; Gaur & Dhingra, 1991; Khalil, 1996; Amin & Youssef, 1997 and Abou-Eid *et al.*, 1998). Recently, Khalil (2000) reported that *Vinca rosea* powder singly or integrated with oxamyl caused significant and better increment in sunflower growth, i.e. head diameter, seed weight, seed yield/plant and seed oil percentage as well as significant reduction in number of the reniform nematode in soil and roots under greenhouse and field conditions.

The present research was conducted to assess the influence of citrus fruit peels powder of five fruit trees in reducing *Meloidogyne incognita* infecting cucumber plant and the resulting impact on plant growth under greenhouse conditions.

## MATERIALS AND METHODS

Fresh fruit peels of grapefruit, *Citrus paradisi;* sour orange, *Citrus aurantum;* common oranges, *Citrus sinesis;* lime tree, *Citrus aurantifolia* and mandarin, *Citrus reticulata* were sun-dried and powdered. Plastic pots 10 cm-diameter were filled with 250 g steam sterilized sandy loamy soil (1:1, v:v) and were supplied with 0.50 and 0.75 g of powder of the previously mentioned plants.

Seeds of cucumber (*Cucumis sativus*) cv. Alpha Beit PS. were planted in pots following the addition of the five components separately (*C. paradisi, C. aurantum, C. sinesis, C. aurantifolia* and *C. reticulata*). After germination plants were

thinned to one plant per pot and inoculated with 1000 of the newly-hatched second stage juveniles of *Meloidogyne incognita*. Oxamyl as a nematicide was used at the recommended dose (0.03 g) for comparison. Inoculated plants free of powders were served as control. Pots neither treated with nematodes nor powders were also included.

Treatments were as follows:

1- N (Nematode) + grapefruit (0.50 g),
2- N + grapefruit (0.75 g),
2- N + sour orange (0.50 g),
4- N + sour orange (0.75 g),
5- N + common orange (0.50 g),
6- N + common orange (0.75 g),
7- N + lime tree (0.50 g),
8- N + lime tree (0.75 g),
9- N + mandarin (0.50 g),
10- N + mandarin (0.75 g),
11- N + oxamyl,
12- N alone (control), and
13- Plant free of N or any treatment.

Each treatment was replicated four times.

Pots were randomly arranged on a greenhouse bench at 28 ± 5 °C. Plants were received water as needed. Fifty days after inoculation, plants were removed. Data dealing with length and weight of fresh shoots and roots were recorded. Shoot dry weight was also measured. Juveniles of *Meloidogyne incognita* were extracted from soil by sieving and modified Baerman techniques (Goodey, 1957). Roots were stained by acid fuchsin in acetic acid according to Byrd *et al.* (1983), and examined for counting nematode stages and egg-masses. Root galls were also recorded using the root gall index scale for 0-5 with 0= no galls, 1= 1-2, 2= 3-10, 3= 11-30, 4= 31-100 and 5= > 100 per root system (Taylor and Sasser, 1978). Data were also subjected to analysis of variance (ANOVA) (Gomez and Gomez, 1984) and means were compared by Duncan's multiple-range test (Duncan, 1955). This work was undertaken in the greenhouse of Tag El-ez, Research Station, Tag El-ez, Temai El-Amdeed, Dakahlia Governorate, Egypt.

## RESULTS AND DISCUSSION

Data concerning the effect of preplant application with dried powdered fruit peels of *C. paradisi, C. aurantum, C. sinesis, C. aurantifolia* and *C. reticulata* at the rate 0.50 and 0.75 g per pot on growth of cucumber plants

infected with *M. incognita* were presented in Table (1). It was found that certain dried fruit peels with the two tested rates obviously improved growth of cucumber plants. Dried powders of *C. aurantum* or *C. aurntifolia* with the two tested rates and *C. paradisi* or *C. sinesis* at the rate 0.75 g significantly increased fresh weight of cucumber shoots and roots when compared with that of the nematode alone (Table 1). Among the five powders tested *C. aurantum* at 0.75 g, gave the best plant growth response of shoot weights followed by the same treatment at 0.50 g, *C. aurntifolia* at 0.75 g., *C. paradisi* at 0.75 g and *C. aurntifolia* at 0.50 g, since their values were 3.06, 3.02, 2.90, 2.89 and 2.82 g, respectively. Also, results revealed that, the percentage of fresh weight of the whole plant was increased according to the increase in rate of all tested organic amendments, whereas the application of *C. aurantum* at 0.75 g revealed the highest value of percentage increase of the whole plant fresh weight which was 100.93 % followed by the same treatment at 0.50 g (94.88 %), *C. aurntifolia* at 0.75 g, 0.50 g (88.84 %, 82.79 %), *C. paradisi* at 0.75 g (80.93 %) and *C. sinesis* at 0.75 g (80.00 %), respectively. Moreover, *C. aurantum* and *C. aurntifolia* with the two rates caused (93.55 %, 83.87 %) and (87.10 %, 80.65 %) increase in plant shoot dry weight as compared with nematode alone (Table 1).

Data presented in Table (2) indicated that all treatments tested showed significant reduction in number of the root-knot nematode in soil as well as number of developmental stages, females, galls and egg-masses in cucumber roots. However, a significant reduction in nematode population was recorded with *C. aurantum* at 0.75 g (94.13 %) followed by the same treatment at 0.50 g (93.41 %) then *C. aurntifolia* at 0.75 g (93.35 %). Also, results revealed that, the percent reduction in number of the root-knot nematode in soil as well as number of developmental stages, females, galls and egg-masses in cucumber root was increased according to the increase in rate of all tested organic amendments. Similar trend was obtained with number of egg-masses (Table 2).

Results also showed that root galls were highly suppressed in all treatments with root gall index ranged from 2.00 to 3.00 as

**Table (1): Impact of some organic soil amendments on the growth of cucumber, cv. Alpha Beit PS. infected with *M. incognita* under greenhouse conditions.**

| Treatments | Rate (g) | Plant growth response* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Length (cm) | | Fresh weight (g) | | Fresh Wt. of the whole plant (g) | Increase % | Shoot dry* weight (g) | Increase % |
| | | Shoot | Root | Shoot | Root | | | | |
| *C. Paradisi* | 0.50 | 16.38 d | 7.85 bcd | 2.54 bcd | 0.92 fg | 3.46 | 60.93 | 0.53 gh | 70.97 |
| | 0.75 | 16.63 cd | 7.80 bcde | 2.89 ab | 1.0 def | 3.89 | 80.93 | 0.53 gh | 70.97 |
| *C. aurantum* | 0.50 | 17.35 b | 8.13 ab | 3.02 a | 1.17 b | 4.19 | 94.88 | 0.57 c | 83.87 |
| | 0.75 | 17.98 a | 8.30 a | 3.06 a | 1.26 a | 4.32 | 100.93 | 0.60 a | 93.55 |
| *C. sinesis* | 0.50 | 16.70 cd | 7.88 bc | 2.69 abc | 1.05 cde | 3.74 | 73.95 | 0.55 f | 77.42 |
| | 0.75 | 16.83 cd | 8.10 ab | 2.78 abc | 1.09 bcd | 3.87 | 80.00 | 0.56 d | 80.65 |
| *C. aurntifolia* | 0.50 | 16.90 c | 8.00 ab | 2.82 abc | 1.11 bc | 3.93 | 82.79 | 0.56 d | 80.65 |
| | 0.75 | 17.60 ab | 8.13 ab | 2.90 ab | 1.16 b | 4.06 | 88.84 | 0.58 b | 87.10 |
| *C. reticulata* | 0.50 | 15.80 e | 7.55 cde | 2.46 cd | 0.84 g | 3.30 | 53.49 | 0.51 k | 64.52 |
| | 0.75 | 15.93 e | 7.48 e | 2.68 abcd | 0.87 g | 3.55 | 65.12 | 0.52 j | 67.74 |
| Oxamyl | 0.03 | 15.55 e | 7.53 de | 2.29 d | 0.88 g | 3.17 | 47.44 | 0.53 gh | 70.97 |
| Nematode alone | | 12.63 f | 5.98 f | 1.49 e | 0.66 h | 2.15 | | 0.31 i | |
| Plant free of nematode | | 16.42 cd | 7.93 b | 2.70 abc | 0.98 ef | 3.68 | 71.16 | 0.54 g | 74.19 |

*** Each value presented the mean of four replicates.**

**Means in each column followed by the same letter(s) did not differ at < 0.50 according to Duncan's multiple-range test.**

**Table (2): Rate of build-up, egg-masses and galls numbers of *M. incognita* infecting cucumber plant, cv. Alpha Beit PS. as affected with some organic soil amendments under greenhouse conditions.**

| Treatments | Rate (g) | Nematode population in * | | | Total | Rate of build-up | Reduction % | Number of egg-masses* | Number of galls* | Root gall index |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Soil | Root | | | | | | | |
| | | | Immature stages | Females | | | | | | |
| *C. Paradisi* | 0.50 | 128.80 c | 20.00 bc | 6.50 c | 155.30 c | 0.155 | 88.53 | 5.00 cd | 14.00 c | 3.00 b |
| | 0.75 | 122.00 cd | 16.25 c | 6.25 c | 144.50 cd | 0.145 | 89.33 | 5.50 c | 13.50 c | 3.00 b |
| *C. aurantum* | 0.50 | 82.00 cde | 3.00 d | 4.25 de | 89.25 de | 0.089 | 93.41 | 3.25 efg | 8.00 e | 2.00 c |
| | 0.75 | 72.50 de | 3.75 d | 3.25 ef | 79.50 e | 0.080 | 94.13 | 2.25 g | 7.00 ef | 2.00 c |
| *C. sinesis* | 0.50 | 100.3 cde | 5.50 d | 5.25 cd | 111.00 cde | 0.111 | 91.80 | 4.25 de | 12.25 c | 2.75 b |
| | 0.75 | 97.00 cde | 5.75 d | 4.25 de | 106.80 cde | 0.107 | 92.15 | 3.25 efg | 11.50 cd | 2.75 b |
| *C. aurntifolia* | 0.50 | 95.75 cde | 4.50 d | 5.00 cd | 105.30 cde | 0.105 | 92.22 | 3.75 ef | 9.25 de | 2.25 c |
| | 0.75 | 82.50 cde | 3.50 d | 4.00 def | 90.00 de | 0.090 | 93.35 | 2.75 fg | 9.00 de | 2.25 c |
| *C. reticulata* | 0.50 | 181.30 b | 30.00 b | 10.00 b | 221.30 b | 0.221 | 83.66 | 8.50 b | 19.50 b | 3.00 b |
| | 0.75 | 179.50 b | 21.00 bc | 9.50 b | 210.00 b | 0.210 | 84.49 | 8.25 b | 18.25 b | 3.00 b |
| Oxamyl | 0.03 | 49.75 e | 2.00 d | 2.50 f | 54.25 e | 0.054 | 95.99 | 1.00 h | 4.75 f | 2.00 c |
| Nematode alone | | 1084.0 a | 248.80 a | 21.75 a | 1354.00 a | 1.354 | 0.00 | 18.50 a | 43.00 a | 4.00 a |

*** Each value presented the mean of four replicates.**

**Means in each column followed by the same letter(s) did not differ at < 0.50 according to Duncan's multiple-range test.**

compared with nematode alone (R.G.I. = 4.00). *C. aurantum* with the two rates tested and oxamyl were found to be more effective in decreasing root galls (R.G.I. = 2.00) followed by *C. aurantifolia* at 0.50 or 0.75 g (R.G.I. = 2.25), *C. sinesis* at 0.50 or 0.75 g (R.G.I. = 2.75) and *C. reticulata* at 0.50 or 0.75 g (R.G.I. = 3.00).

From the previous results it can be concluded that most tested organic soil amendments improved cucumber growth as well as suppressed nematode population. *C. aurantum* at the high rate (0.75 g) gave the best plant growth response as well as the lowest rate of nematode build-up followed by the same treatment but at the low rate (0.50 g) and then *C. aurantifolia* at rate 0.75 g. These results agree with the findings reported by Amin and Youssef (1997). The potential of powders in suppressing *M. incognita* can be attributed to toxicity of the decomposing products (Habicht, 1975; Alam *et al.*, 1979 and Khalil, 1996, 2000). Further changes in physical or chemical properties to soil may be inimical to nematodes (Ahmed *et al.*, 1972), or they may be increasing host resistance (Alam *et al.*, 1977, 1980 and McSorley and Gallaher, 1996). This nematode suppressive action may be attributed to the release of some compounds having nematicidal potential against plant-parasitic nematodes (Venkata Rao *et al.*, 1986; Perwez *et al.*, 1988; Siddiqi and Alam, 1988; Abadir *et al.*, 1996 and Ameen, 1996).

In conclusion, the potential of organic soil amendments as biocontrol agents against *M. incognita* could be attributed to its decomposition, particularly those high in nitrogen and formation of toxic ammonia which affect nematode reproduction. Finally, this approach of nematode control has an advantage over the use of nematicidal chemicals, since it is less expensive, safer and easy to apply with no pollution risks and can improve soil structure and fertility.

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## تأثير بعض محسنات التربة العضوية على نيماتودا تعقد الجذور ميلودوجينى إنكوجنيتا التى تصيب نباتات الخيار

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تم دراسة تأثير إضافة معدلين ٠,٥٠ ، ٠,٧٥ جرام من مطحون قشر ثمار الجريب فروت والنارنج والبرتقال البلدى والليمون البلدى واليوسفى على تعداد نيماتودا تعقد الجذور ميلودوجينى إنكوجنيتا ونمو نباتات الخيار تحت ظروف الصوبة.

يتفاوت تأثير معظم المواد النباتية المختبرة بمعدلاتها المختلفة فى تحسين نمو نباتات الخيار بدرجات مختلفة مقارنة بالمعاملة الضابطة (النيماتودا فقط).

كذلك حققت معاملة النارنج بالمعدل المرتفع (٠,٧٥ جرام) أعلى نسبة زيادة فى الوزن الكلى للنباتات مقارنة بالكنترول يليها نفس المعاملة ولكن عند المعدل المنخفض (٠,٥٠ جرام) والليمون البلدى ٠,٧٥ جرام ، ٠,٥٠ جرام والجريب فروت والبرتقال البلدى عند المعدل ٠,٧٥ جرام وذلك بنسبة زيادة تصل إلى ١٠٠,٩٣ % ، ٩٤,٨٨ %، ٨٨,٨٤ % ، ٨٢,٧٩ % ، ٨٠,٩٣ % ، ٨٠,٠٠ % على التوالى.

سجلت جميع المعاملات إنخفاضا معنويا فى تعداد النيماتودا. لقد سجلت معاملة النارنج ٠,٧٥ جرام أعلى نسبة إنخفاض فى تعداد النيماتودا (٩٤,١٣ %) يليها نفس المعاملة ولكن عند المعدل المنخفض (٩٣,٤١ %) ثم معاملة الليمون البلدى ٠,٧٥ جرام (٩٣,٣٥ %).

كما حققت جميع المعاملات المختبرة إنخفاضا معنويا فى كتل البيض والعقد الجذرية لنيماتودا التعقد الجذرى "ميلودوجينى إنكوجنيتا" مقارنة بالكنترول.