Effect of Water Extracts of some Aromatic and Medicinal Plants on Mortality and Egg Hatching of Root- knot Nematode, *Meloidogyne Incognita* in Vitro studies

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Abstract

Water extracts of the ten aromatic and medicinal plant namely, Camphor (*Eucalyptus globulus*), Camphor Lemon (*E. citriodora*), Demssisa (*Ambrosia maritime*), Lemon grass (*Cymbopgon citratus*), Marjoram (*Origamum majorana*), Neem (*Azadrachta indica*), Rosemary (*Rosmarimus officinallis*) and Thyme (*Thymus vulgaris*) as leaves, Chamomile (*Matricaria chamomilla*) and Daisy (*Calendula officinalis*) as leaves and flowers with different concentrations (5, 10 & 15%) of different plants were assessed in vitro against egg hatching and juveniles (J_{2s}) mortality of root- knot nematodes *Meloidogyne incognita* in different durations. Results indicated that eggs inhibition and J2s mortality increased with an increase in the concentration of all the extracts. Similarly, with an increase in exposure time, J_{2s} mortality was also increased. Water extracts of all plants showed nematicidal effect against *M. incognita* at varying degree. Based on these finding, these plant extracts at the highest concentration (15%) were divided into 4 main groups i.e. highly toxic (> 85% mortality or inhibition), consisting of Demssisa, Camphor Lemon and Thyme, toxic (70 - < 85%) consisting of Daisy and Marjoram, moderately and lowly toxic groups, consisting of the test plant extracts tested. This finding is important from the point of view of controlling root- knot nematodes without the use of chemical nematicides in view of environmental pollution likely to cause. The use of these plant extracts may be one of the efficient alternatives and cheep methods of nematode control, that are sale to farmers and inurnment. These may be replacement to the synthetic dangerous and expensive chemical nematicides in future.

Keywords: Aromatic plant, medicinal plant, in vitro test, *Meloidogyne incognita*, water extract, eggs hatching, sugarbeet.

Introduction

Root- knot nematode, *Meloidogyne* species, are generally known to be the most harmful phytoparasites, because of their worldwide occurrence and the heavy yield losses caused to a large range of agriculture crops (**Wesemael *et al.,* 2010**).

The population of plant parasitic nematodes in the field can be minimized through several approaches such as using natural enemies (**Maareg *et al.,* 2005a and Khan & Kim, 2007**), enhancing cultural practices (**Maareg *et al*., 2005b & 2007** and **Okada & Harada, 2007**), cultivating resistant cultivars (**Williamson & Kumar, 2006**) and applying chemical nematicides. Application of these pesticides have been found as an effective measure for the control of nematodes, but due to its high toxic residual effect and toxicity of these chemicals to beneficial flora and fauna in the soil there is therefore need to develop an alternative nematode control strategies. One of the outstanding alternative control measures against nematode pests is the application of plant extracts. Numerous plant extracts have been reported to suppress root- knot nematode population (**Ibrahim *et al*., 2006; El-badri *et al*., 2008; Mousa *et al*., 2011; Salim *et al*., 2016 and Youssef *et al*., 2015)**. Analysis of these plants showed that capability of non- toxic metabolites is the best alternative strategy for controlling nematodes but use of compounds and secondary metabolites of plants was limited (**Khayyat *et al*., 2014**).

Use of plant and their products is one of the safe methods to control root-knot nematodes. These methods are low cost, easy to apply and also have the ability to improve soil texture and fertility.

The objectives of this work, to evaluate the nematicidal effect of the water extracts of ten aromatic and medicinal plants on mortality and eggs hatching of second stage juveniles (J_{2s}) of root- knot nematode, *M. incognita* in vitro studies.

Materials and Methods

Plant materials:

The ten aromatic and medicinal plant species, and their scientific, family, common, arabic names and part of the plant used for extraction are presented in Table, 1.

Preparation of extract:

The aqueous plant extracts were prepared as follows, the test plant leaves and flowers (Table, 1) were collected, washed and dried in laboratory condition. After drying, plants were separately powdered using an electric grinder and 5, 10 and 15 g powder of each plant powder were mixed separately in 100 ml of distilled water in aluminum foil covered 500 ml flasks. These flasks were then placed into shaker with the idle speed for 24 hours at laboratory temperature. After 24 hrs, the contents of the flasks were passed from muslin cloth, and then it was filtered through 15 mm diam. Whatman No. 1 filter paper to get the clear extract. Obtained filtrained filtrates were used as 5, 10 and 15% concentrations for each plant extract.

Effect of water plant extracts on juveniles mortality:

The tested root- knot nematode species, *M. incognita*, was harvested according to the method as described by **Barker, (1985)**.

Table (1): The scientific, family, common arabic names and plant parts that were extracted for ten aromatic and medicinal plants tested

Scientific name	Family name	Common name	Arabic name	Part used
Ambrosia maritime L.	Asteraceae (Compositae)	Demssisa	دمسيسة	Leaves
Calendula officinalis L.		Daisy	بردقوش	Leaves flowers
Cymbopgon citratus L.		Lemon grass	حشيشة ليمون	Leaves
Azadrachta indica L.	Meliaceae	Neem	نيم	Leaves
Eucalyptus citriodora L.	Myrtaceae	Camphor Lemon	كافور ليمون	Leaves
Eucalyptus globulus L.		Camphor	كافور بلدى	Leaves
Matricaria chamomilla L.	Poaceae (Gramineae)	Chamomile	شيح بابونج	Leaves flowers
Origamum majorana L.	Lamiaceae	Marjoram	أقحوان	Leaves
Rosmarimus officinallis L.		Rosemary	حصا لبان (روز مارى)	Leaves
Thymus vulgaris L.		Thyme	زعتر	Leaves

To detect the effect of plant extracts against the mortality% of the second stage juveniles (J_{2s}) of *M. incognita*. The J_{2s} suspension was adjusted to 100 J_{2s} per ml. Nine ml of each concentration of plant extract of each plant were added to 1 ml of J_{2s} suspension in Petri dish. Also, nine ml of distilled water were added to 1 ml of J_{2s} suspension in the Petri dish for the control treatment. The numbers of live and dead nematodes were counted under light microscope after 24, 48 and 72 hrs of exposure periods to tested plant materials at 25ºc. From these counts, the percentage of nematode mortality was calculated for each treatment. The corrected nematode mortality percentages were calculated according to **Abbott (1925).**

Effect of water plant extracts on egg hatching:

This study was carried out to determine the effect of different concentrations of water plant extracts on hatching of *M. incognita* eggmasses under in vitro conditions. Root- knot nematode infected tomato plants from pure culture pots were up- rooted and washed gently under running tap water. Eggmasses of *M. incognita* were picked up from tomato roots using dissecting needle and forceps. Uniformly sized eggmasses used and transferred to Petri dishes (one eggmass/ Petri dish). Ten ml of each concentration of water plant extract of each plant were added to one eggmass in Petri dish. Eggmass in ten of distilled water was only served as control treatment. The number of juveniles hatched after three days exposure to different concentrations and distilled water were caunted under light microscope, and mean juveniles hatched was calculated.

All tested Petri dishes containing the suspension and the eggmasses kept at room temperature on laboratory bench in completely randomized design with four

replications for each treatment. Data were subjected to analyses of variance and means were compared using LSD at 0.05 according to **Gomez and Gomez, (1984),** followed by Duncan's multiple range tests to compare means **(Duncan, 1955).**

Results and Discussion

The nematicidal activity of water extracts of ten aromatic and medicinal plants (Table, 1) were evaluated with different concentrations against *M. incognita* J_{2s} mortality and eggmass hatching in vitro studies, and the obtained data tabulated in Tables 2 and 3.

Against juveniles mortality:

The results of nematicideal activity of water extracts of tested aromatic and medicinal plants with 5, 10 and 15% concentrations after 24, 48 and 72 hours of exposure periods on mortality of *M. incognita* J_{2s} are given in Table (2). It was obvious that there a significant ($P \leq 0.05$) differences among tested treatments. The least mortality percentage (1.3%) of J_{2s} of *M. incognita* was observed with control (distilled water) 24 hours after treatment application, while, the highest mortality percentage (94.1%) of J_{2s} was seen at highest concentration (15%) with Demssisa leaves extract 72 hours after treatment, compared to all the other treatments. The percentage of viability or mortality of the second stage juveniles (J_{2s}) was affected by plant species (type) and their concentrations as well as exposure time. In general, the mortality percentage increased with the progressive increase in concentration and/ or in time of exposure in each plant extract.

After 24 hours of exposure, all water extracts of test plants were effective in causing larval mortality. The mortality rate was found to differ significantly ($P \leq 0.05$) among different concentrations of water extracts of tested plants. The highest concentration i.e. 15% of extracts being more efficacious and show high significant ($P \leq 0.05$) differences than the other concentrations (10 and 5%) and there was a significant difference between them in all plant extracts tested. The rate of mortality was directly proportionate to concentrations of each extract. The highest mortality rate of J_{2s} was observed at highest concentration (15%) and the lowest one was observed at lowest concentration (5%) within all water plant extracts under study. The different concentrations i.e., 5, 10 and 15% of Damssisa leaves extract were more effective in causing J_{2s} mortality, when compared to the same concentrations of all the other plant extracts within 24 hours of exposure treatment. At 15% concentration of plant extract application, the highest J_{2s} mortality% (65.1%) was shown in Demssisa leaves extract, followed by Camphor lemon leaves extract (64.3%, Daisy leaves and flowers extract (48.9%) and Thyme leaves extract (45.8%), respectively, however, the lowest J_{2s} mortality% at the same concentration was shown in both chamomile leaves & flowers and Rosemary leaves extracts with an average 17.0 and 16.25% of J_{2s} mortality, respectively.

Table (2): Effect of water extracts of some and medicinal plants with three concentrations on second stage juveniles of root- knot nematode, *Meloidogyne incognita* after 24, 48 and 72 hours of exposure period in vitro tests.

Aromatic and medicinal plants	24 hours			48 hours			72 hours		
	Concentrations %								
	5	10	15	5	10	15	5	10	15
Camphor *(Eucalyptus globules)*	10.6	19.5	38.7	15.3	23.7	43.4	22.0	34.4	56.1
Camphor lemon *(Eucalyptus citriodora)*	41.0	56.5	64.3	55.9	67.1	79.3	62.8	74.9	89.7
Chamomile *(Matricaria chamomilla)*	7.1	12.9	15.9	10.7	15.8	33.7	29.2	35.9	39.0
Daisy *(Calendula officinalis)*	36.2	44.8	48.9	49.7	55.1	63.3	47.8	61.2	73.4
Demssisa *(Ambrosia maritime)*	44.3	58.5	65.1	63.8	69.9	82.9	68.0	87.6	94.1
Lemon grass *(Cymbopogon citrates)*	29.1	32.2	39.2	31.6	36.0	40.1	45.0	52.5	61.5
Marjoram *(Origanum majorana)*	13.7	26.3	41.0	14.5	28.6	43.1	33.3	45.5	63.8
Neem *(Azadrachta indica)*	18.7	24.1	34.9	30.1	32.9	38.5	55.3	46.0	61.0
Rosemary *(Rosmarinus officinalis)*	5.8	11.4	15.2	30.4	38.5	38.3	32.0	39.3	36.7
Thyme *(Thymus vulgaris)*	27.8	33.4	45.8	30.4	37.0	46.9	45.5	50.9	69.3

$LSD_{0.05}$ Intervals (A) 1.14

$LSD_{0.05}$ Plants (B) 1.78

$LSD_{0.05}$ Concentration(C) 0.83

Table (3): Effect of water extracts of some aromatic and medicinal water plants with three concentrations on egg hatching and hatching inhibition of root- knot nematode, *Meloidogyne incognita* after 72 hours of exposure period in vitro tests.

Aromatic and medicinal plants	Concentration%							
	5		10		15		Mean	
	No. eggs hatching	Inhibition %	No. eggs hatching	Inhibition %	No. eggs hatching	Inhibition %	No. eggs hatching	Inhibition %
Camphor (*Eucalyptus globulus* L.)	30	54.89	25.5	61.65	20.75	68.80	25.42	61.78
Camphor lemon (*Eucalyptus citriodora* L.)	13.75	79.32	11.5	82.71	9	86.47	11.42	82.83
Chamomile (*Matricaria chamomilla* L.)	34.25	48.50	29	56.39	24	63.91	29.08	56.27
Daisy (*Calendula officinalis* L.)	16.25	75.56	13.5	79.70	11.5	82.71	13.75	79.32
Demssisa (*Ambrosia maritime* L.)	14.5	78.20	10.75	83.83	8.75	86.84	11.33	82.96
Lemon grass (*Cymbopgon citratus* L.)	22	66.92	19.25	71.05	15	77.44	18.75	71.80
Marjoram (*Origamum majorana* L.)	15	77.44	13.5	79.70	13	80.45	13.83	79.20
Neem (*Azadrachta indica* L.)	21.25	68.05	17.25	74.06	14	78.95	17.50	73.68
Rosemary (*Rosmarimus officinallis* L.)	45.75	31.20	36.50	45.11	28.5	57.14	36.92	44.49
Thyme (*Thymus vulgaris* L.)	15	77.44	12.75	80.83	9.5	85.71	12.42	81.33
Control	66.5							

$LSD_{0.05}$ Pants (A) 3.50
$LSD_{0.05}$ Concentrations (B) 1.99
$LSD_{0.05}$ AB 5.15

Similar results were obtained for the mortality% at 48 and 72 hours of exposure periods for the same trend at 24 hours of exposure. At 48 hours of exposure treatment with application of 15% concentration, the highest mortality% of J_{2s} was obtained in Demssisa leaves extract and the lowest extract showed in Chamomile leaves and flowers extract. Also, at 72 hours of exposure application treatment, the highest and lowest J2s mortality% was found in Demssisa and Chamomile extracts, respectively. The mortality rate of J_{2s} significantly increased ($P \leq 0.05$) with increasing in exposure time within the all plant extracts tested. Demssisa leaves extract at 15% concentration immobilized (inhibited) J_{2s} by 65.1, 82.9 and 94.1%, and Camphor lemon leaves extract by 64.3, 79.3 and 89.7% after 24, 48 and 72 hours of exposure, respectively. On the other hand, Chamomile leaves & flowers and Rosemary leaves extracts at the same concentration showed less mortality of J_{2s} than the other plant extracts within 24, 48 and 72 hours treatments.

Among water plant extracts tested after 72 hours of exposure treatment, the extract from Demssisa leaves showed the maximum J_{2s} mortality% (83.2%), followed by Camphor lemon leaves extract (75.8%) and Daisy leaves and flowers extract (60.8%). On the other hand, Chamomile leaves and flowers Rosemary leaves and Camphor leaves extracts showed the minimum J_{2s} mortality% with an average of 34.7, 36.0 and 37.5%, respectively, without significant differences among them.

In short, after 72 hours treatment application, both at 10 and 15% concentrations, the Demssisa and Camphor lemon leaves extracts recorded (87.6 & 94.1%) and (74.9 & 89.7%) J_{2s} mortality%, respectively. However, the Daisy, Thyme, Marjoram, Neem, Lemon grass and Camphor extracts application at the 15% concentration observed 73.4, 69.3, 63.8, 61.0, 61.5 and 56.1%, J_{2s} mortality, respectively. Also, at the same concentration (15%), the Chamomile and Rosemary extracts were recorded 39.0 and 39.3% only J_{2s} mortality, respectively, when compared to the control treatment (about 3.3% mortality).

From the average mortality of J_{2s} of *M. incognita* after 72 hours of exposure period in the all tested water plant extracts in Table (2), the results revealed that Demssisa and Camphor lemon leaves extracts were highly toxic to the J_{2s} of *M. incognita*, killing more than 85% of the J_{2s}, while the others gave quite low mortalities as shown in Table (2). Based on these findings, these water plant extracts were divided into four main groups i.e., 1- highly toxic (> 85% J_{2s} mortality) consisting of Demssisa leaves water extract at the 10 & 15% concentrations (87.6 & 94.1% J_{2s} mortality, respectivelty) and Camphor lemon leaves water extract at 15% concentration (89.7% J2s mortality), 2-toxic (70 - < 85% J_{2s} mortality) consisting of Camphor lemon leaves water extract at 10% concentration (74.9%) and Daisy leaveas & flowers water extract at 15% concentration (73.4% J_{2s} mortality), 3-

moderately toxic (50 - < 70% J_{2s} mortality) consisting of Demssisa and Camphor lemon leaves water extracts at 5% concentration, lemon grass and Thyme leaves water extracts at both the 10 and 15% concentrations, Daisy leaves & flowers at 10% concentration and Camphor, Neem and Marjoram leaves water extracts at 15% concentration, 4 – lowly toxic (20 - < 50% J2s mortality) consisting of the rest water plant extracts treatments tested.

Against egg hatching:

Effect of water extracts of different aromatic and medicinal plants with different concentrations against eggs hatching of root- knot nematode, *M. incognita* larvae at 3rd days exposure period are presented in Table (3).

The results revealed that all water plant extract treatments showed nematicidal activity by affecting the hatching of eggs of *M. incognita* root- knot nematode after 72 hours of exposure. The hatching of nematode eggs was observed to be varying in different concentrations in different plant extracts. The impact of plant extracts is concentration and plant species or type. The egg hatching rate was inversely proportional to concentration of plant extract, as concentration was decreased, toxicity was decreased resulting in correspondent decrease in inhibition %, and minimum egg hatching inhibition rate (maximum egg hatching rate) was observed in distilled water (0% concentration) as control treatment. There were significant differences ($P \leq 0.05$) among different concentrations and among different plants (plant extracts) applied in number of infective juveniles per eggmass. Different water extracts of plants applied at different concentrations were inhibited ($P \leq 0.05$) egg hatching to juveniles compared to distilled water (control treatment).

Among water plant extracts, extract obtained from Demssisa leaves showed minimum egg hatching rate (11.33 larvea/ eggmass), followed by Camphor lemon leaves extract (11.42), thyme leaves extract (12.42), Daisy leaves & flowers extract (13.75) and Marjoram leaves extract (13.85 larvae/ eggmass), respectively, without significant differences among them. However, the maximum hatching rate of eggs (36.92 larvae/ eggmass) was recorded with Rosemary leaves extract, followed by chamomile leaves & flowers extract (29.08) and Camphor leaves extract (25.42 larvae/ eggmass), respectively. The moderate egg hatching rate was obtained with leaves extract of both lemon grass and Neem plants with an average of 18.75 and 17.50 larvae/ eggmass, respectively, compared to distilled water (66.5 larvae/ eggmass). There were no significant difference between Lemon grass and Neem leaves water extracts. In general, the greatest inhibition percentage of egg hatching of *M. incognita* was recorded with Demssisa, Camphor lemon and Thyme leaves water extracts with an average of 82.96, 82.83 and 81.33%, respectively, however, the lowest inhibition (44.49%) was obtained by Rosemary leaves extract.

Among different concentration, all concentrations within all water plant

extracts were inhibited significantly ($P \leq 0.05$) egg hatching rate. The rate of egg hatching was decreased significantly with increasing concentration for each plant extract except, there were no significant differences among tested concentration (5, 10 and 15%) in leaves extract of Marjoram plant only. The maximum hatching rate of eggs was observed in 5% concentration treatment, while, the minimum rate was at 15% concentration treatment in all water plant extracts tested. In general, water plant extracts applied at concentration of 15% was more effective than water extracts applied at both 10 and 5% concentrations on egg hatching. The least inhibition % of egg hatching was obtained by Rosemary leaves water extract with an average of 31.20, 45.11 and 57.14% at 5, 10 and 15% concentrations, respectively. Demssisa leaves, Daisy leaves & flowers, Marjoram leaves, Thyme leaves and Camphor lemon leaves water extracts at 15% concentration reduce the egg hatching maximum (>80%) over than control treatment (0% concentration). Both at 10 and 15% concentrations, the greatest percentage of egg hatching inhibition (83.83 and 86.84%) was achieved by Demssisa leaves extract, followed by Camphor lemon (82.71 and 86.47%) and Thyme (80.83 and 85.71%) leaves water extracts, respectively. On the other hand, Neem, Lemon grass, Camphor and chamomile leaves extracts were inhibited egg hatching by 78.95, 77.44, 68.80 and 63.91%, respectively, at the 15% concentration.

The application of 15% concentration of water plant extracts revealed that Demssisa, Camphor lemon and Thyme leaves extracts were highly toxic against eggs hatching of *M. incognita* root- knot nematode, inhibiting more than 85% of the eggmass hatching, while, the others gave quite low egg inhibition (Table, 3). Based on these finding, these water plant extracts were divided into four main groups i.e. 1- highly toxic (> 85 egg inhibition) consisting of Demssisa (86.84%), Camphor lemon (86.47%) and Thyme (85.71% egg inhibition) leaves water extracts, at 15% concentration, 2 – toxic (70 - < 85% egg inhibition) consisting of Camphor lemon, Demssisa and Thyme leaves water extracts at 5 and 10% concentrations, Daisy leaves & flowers and Marjoram leaves water extracts at all concentrations and lemon grass and Neem leaves water extracts at 10 and 15% concentrations, 3 – moderately toxic (50 - < 70% egg inhibition) consisting of Camphor leaves water extract at all concentrations, lemon grass and Neem leaves water extracts at 5% concentration, Rosemary leaves water extract at 15% concentration and Chamomile leaves & flowers water extract at 10 & 15% concentrations, 4 – lowly toxic (30 - < 50% eggs inhibition) consisting of the rest of the water plant extract treatments tested.

Our results showed that all the water extracts of aromatic and medicinal plants tested significantly increased ($P \leq 0.05$) the J_{2s} mortality and eggmass hatching of *M. incognita* root- knot nematode after 72 hours of exposure. Eggmass hatching and J_{2s} mortality increased with increase concentration of all the extracts. J_{2s} mortality increased corresponding to an increased time of exposure. A similar

results were reported by **Elbadri *et al*. (2008); Kumari & Devi, (2013); Feyisa *et al*. (2015); Patikar *et al*. (2016) and Singh *et al*. (2017)**. The Demssisa (*A. maritime*), Camphor lemon (*E. citroidora*) and Thyme (*T. vulgaris*) extracts were more suppressive at level (concentration) of 15%. Some investigators indicated that the toxic of plants may be due to toxic effects of certain compounds. Demssisa plant includes thogene, flanders, glicocin, lambrosen, arthimin (**Gad- El- Rab, 2000**). The application terpene aldehyde citronallal was the major component found in Camphor Lemon. Relatively small amounts of other monoterpenoids such as isopulegal, citronellal and citronellyl format were also detected in this plant (**Laqual *et al*., 2015**). The Thyme plant was found to contain thymal is monoterpenoid phenol as the dominat comound, together with very small amounts of other monoterpenoid constituents as carvacrol eugenol, linalool (**Ibrahim *et al*., 2006 and Kong *et al*., 2007**).

The impact of water extracts of aromatic and medicinal plants against root-knot nematodes, *Meloidogyne* species has been reported by several investigations. **Ibrahim *et al.* (2006)** reported that the extracts of pure components carvacrol, thynol and linallol at 1, 2 and 4 mg/ L concentrations were the most toxic against M. incognita J_{2s} followed by terpinal and menthone. Hatching eggs was completely inhibited at high concentrations (2, 4 mg/ L.) of carvacrol, thynol and linalool compounds. **Khalil and Shawky *et al*. (2008)** found that water leaf extracts of Demssisa (*A. anaritima*) was obviously redction *M. javanica* final population and build up, **Nimbal Kar and Rojurkar (2009)** reported that 100% concentration of root extracts of Neem and Lemon grass at 100% concentration exhibited 100 & 95% inhibition of eggs hatching 7 days after treatment and 100 & 75% larval mortality after 48 hours of exposure, respectively of *Meloidogyne* species.

One the other hand, **Wiratno *et al*. (2009)** found that Neem and Lemon grass extracts were not toxic on J_{2s} of *M. incognita* after 24 hours of exposure period. In among treatments of Rape seed & leaf, Africana marigold leaf Neem leaf and Nemm seed water extracts **Feyisa *et al*. (2015)** found that the Neem seed extract more significantly inhibited eggs hatching (after 7 days of exposure) and J_{2s} mortality (after 72 hours of exposure) of *M. incognita* at the 10% concentration, followed by Lantana, Africana marigold, Rape and Neem Leaf extracts, respectively. Also, the aqueous extracts of Camphor and Neem when applied at 10% concentration suppressed J_{2s} of *Meloidogyne* species by 100 & 91%, respectively (**Salim *et al*., 2016**). On the other side, **Shawky *et al*. (2016)** found that the Demssisa and Camphor as aqueous extracts had a significant effect in reducing final population and build up of *M. incognita*, and Camphor extract was the least effective treatment. Maximum mortality in J_{2s} of *M. incognita* was observed in lemon grass water extract at 5000 ppm concertration after 24 hours of exposure while, the minimum cumulative eggs hatching was found at 1000 ppm concentration after 16 days of exposure **Patidar *et al*. (2016)**. **Bajestani *et al*. (2017)** reported that in

among treatments of medicinal plant extracts (Marigold, Resomary and nigella), Resomary extract has the greatest impact on the reduction of *M. incognita* at 40% concentration.

Conclusion:

It has been concluded from present study that certain water plant extracts showed nematicidal potential in the management of *M. incognita* among the tested extracts, the leaf powder extracts of Demssisa, Camphor Lemon and Thyme at the rate of 15% were highly toxic to the nematodes, killing and inhibiting more than 85% of the J_{2s} and eggs hatching. The use of these plant extracts may be one of the efficient alternatives and cheep methods of nematode control that are need of the hour and safe to farmers as well as environment. These may be replacement to the synthetic dangerous and expensive chemical in future.

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كفاءة المستخلصات المائية لبعض النباتات العطرية والطبية ضد يرقات وفقس البيض لنيماتودا تعقد الجذور النوع *ميلويدوجين انكوجنيتا* تحت ظروف المعمل.

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الملخص العربي

تم دراسة تأثير المستخلصات النباتية لعشرة من النباتات العطرية والطبية (الأقحوان، الكافور البلدي، الكافور الليمون، البردقوش، الدمسيسة، حشيشة الليمون، النيم، شيح البابونج، حصالبان، الزعتر) باستخدام (٣) تركيزات لكل مستخلص نباتي، وهى ٥، ١٠، ١٥% ضد معدل موت يرقات الطور المعدي، ومعدل فقس البيض لنيماتودا تعقد الجذور المختبرة تحت ظروف المعمل، وأخذت النتائج بعد ثلاث فترات زمنية (٢٤، ٤٨، ٧٢ ساعة) على التوالي من المعاملة بالنسبة لليرقات، وبعد فترة زمنية واحدة (ثلاثة أيام) بالنسبة لمعاملة أكياس البيض.

وأوضحت النتائج التالي:

- جميع المستخلصات بتركيزاتها المختلفة لها تأثير جوهري على معدل موت اليرقات ومعدل فقس البيض مقارنة بمعاملة المقارنة (الماء المقطر). كما وجد أن هناك اختلافات جوهرية بين مستخلصات هذه النباتات وبين التركيزات لكل مستخلص نباتي وبين الفترات الزمنية المختلفة للتعرض.
- كان التأثير لهذه المستخلصات مختلفًا باختلاف نوع النبات، والتركيز المستخدم، وكذلك الفترة الزمنية لمعاملة النيماتودا بالمستخلص.
- وجد بزيادة معدل التركيز المستخدم تزيد نسبة موت اليرقات، ويقل معدل الفقس للبيض. كما وجد أن نسبة موت اليرقات تزيد مع زيادة فترة تعرضها لكل تركيز.
- أعطت مستخلصات هذه النباتات نسب مختلفة ومتباينة في معدل موت اليرقات ومعدل الفقس للبيض. وبناء على هذه النتائج في نهاية مدة الدراسة تم تقسيم مستخلصات هذه النباتات (عند التركيز ١٥%) إلى أربع مجاميع رئيسية من حيث درجة سميتها للنيماتودا (مجموعة شديدة السمية، مجموعة سامة، مجموعة متوسطة السمية، مجموعة منخفضة السمية).
- مجموعة شديدة السمية (أعلى من ٨٥% نسبة موت لليرقات أو تثبيط فقس البيض) وتشمل مستخلصات نباتات الدمسيسة، كافور الليمون، الزعتر.
- المجموعة السامة (٧٠ – أقل من ٨٥% نسبة موت لليرقات أو تثبيط فقس البيض)، وتشمل مستخلصي نباتات البردقوش والأقحوان.
- أما مجموعتي المستخلصات متوسطة السمية ومنخفضة السمية تضم باقي المستخلصات النباتية الأخرى تحت الدراسة.

ومن هذه النتائج يمكن استخدام المستخلصات النباتية شديدة السمية والسامة في مكافحة نيماتودا تعقد الجذور دون استخدام المبيدات الكيماوية. وتعتبر هذه المستخلصات طرق بديلة لمكافحة نيماتودا تعقد الجذور، رخيصة الثمن، سهلة التجهيز، أمنة للمزارعين والبيئ، ويمكن لهذه المستخلصات أن تحل

محل المبيدات الكيماوية شديدة الخطورة وعالية الثمن مستقبلاً كما يمكن إدخالها في برامج المكافحة المتكاملة للنيماتودا.