# EFFECT OF MAGNETIZED WATER WITH SOME NANO-PREPARATIONS ON TOMATO PLANTS INFECTION WITH THE ROOT KNOT NEMATODE *MELOIDOGYNE JAVANICA*

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***ABSTRACT***

*The irrigation with not-stored magnetized water gave more effect on M. javanica reproduction on tomato than the use of other magnetized water stored at different periods before the application. Where the treatment with non-stored magnetized water, gave a 75% reduction in the final nematode count compared to the control treatment (by using nonmagnetic water) and 61%, 56%, 47% and 21 % reduction when using magnetized water stored for 24 , 48, 72, 96 hours, respectively. Growth of tomato plants infected by M. javanica , improved when irrigated by magnetized water than the control that irrigated with nonmagnetic water. The increase rate % in the weight of tomato shoot over control were 142.9, 100.0, 78.6, 57.1 and 14.3 % by the irrigation with stored magnetized water for 0, 24, 48, 72 and 96 hours stored magnetized water, respectively.*

*AgNPs prepared with jojoba by magnetized water surpassed other prepared by distilled water in reducing the final population of M. javanica, by 91.8 % but when using distilled water in preparing silver nanoparticles by jojoba, the final nematode count was reduced by 77 % compared to the control. The percentage of increase in tomato shoot weight as a result of using magnetized water to prepare silver nanoparticles with jojoba was 175.0%. As for the silver nanoparticles synthesized with jojoba extract that prepared with distilled water, it gave an increase of 137.5% over the control treatment which was not treated with silver nanoparticles.*

***Keywords: Magnetized water, AgNPs, Jojoba, Meloidogyne javanica.***

## INTRODUCTION

Nematodes are considered one of the most dangerous pests that infect different plant families. The most important species of nematodes are root-knot nematodes. For controlling these nematodes the chemical nematicides are repeatedly used. In general nematicides cause environment pollution that negatively affect the climate, so the thought was to use the safe unconventional methods such as magnetized water that disrupt nematode to find these hosts and improve the plant growth. Many studies have done on these topics (Caveness and Panzer, 1960; Hozayn *et al*., 2013; Hozayn *et al*., 2014; Sadeghipour and Aghaei, 2013; Teixeira da Silva and Dobránszki, 2014; Hozayn *et al*., 2017 and Saadoon *et al.*, 2019). This work aims to study the effect of magnetized water at different periods of storage as well as the effect of silver nanoparticles prepared with the magnetized water extract of jojoba on tomato infection with root knot nematodes and the extent to which their growth is affected.

## MATERIALS AND METHODS

### *Effect of magnetized water on the infectivity of root knot nematode Meloidogyne javanica to tomato seedlings under greenhouse conditions:*

In this experiment pots 15 cm in diameter filled by sterilized loam soil (40% sand, 40 % silt and 20% clay) were planted with seedlings of tomato Super Jackal cv. and inoculated with 1000 newly hatched larvae (J2) of the root knot nematode after 15 days of seedling these pots were arranged in complete random design with sixth groups in green house each group were four pots each pot represented a replicate

First group were irrigated when they needed with fresh magnetic water (zero time age),

Second group were irrigated with stored magnetic water (24 hrs. age),

Third group were irrigated with stored magnetic water (48 hrs. age),

Fourth group were irrigated with stored magnetic water (72 hrs. age),

Fifth group were irrigated with stored magnetic water (96 hrs. age),

Sixth group were irrigated with nonmagnetic water.

Irrigation was performed in regular times. After four weeks from inoculation plants and soil were gently removed from pots and the roots were carefully washed in running tap water. Data on fresh weight of shoots, roots as well as number of galls formed in each plant were recorded.

### *Effect of magnetic water on the control potential of AgNPs prepared by jojoba extract against this nematode under greenhouse conditions:*

In this experiment three groups of pots, each group was four pots (20 cm in diameter) filled by sterilized loam soil (40% sand, 40 % silt and 20% clay) planted with seedlings of tomato Super Jackal cv. and inoculated with 1000 newly hatched larvae

(J2) of the root knot nematode after 15 days of seedling. These pots were arranged in complete randomized design in the greenhouse.

**The first group** was treated in the second day of inoculation with AgNP synthetized with jojoba extract prepared with fresh magnetic water (not stored). These pots were watered by tap water when are needed.

***The preparation of AgNPs –Jojoba was as follows:***

Jojoba leaves were washed with distilled water to remove debris and soils. Dried in a vacuum oven for 3 h.. A portion of 250g was crushed in electric blender with adding during crushing 200 ml of distilled water or fresh magnetic water (no more than one hr. age) for treatments, during crushing. The extract was soaked for a half hour in water bath at 70°C. This extract was centrifuged at 1000 rpm for ten minute. The supernatant was taken then 30 ml of the supernatant of the extract was added to 100 ml of 3 mM AgNO3. The solution was mixed well and kept in a shaker incubator for overnight at 37 °C. Once dark brown color was formed that indicating the formation of silver nanoparticle **(Krishnaraj *et al*., 2010).**

**The second group** was inoculated with 1000 freshly hatched juveniles of M. *javanica*. These pots were treated with AgNPs formulated by Jojoba extract in distilled water. Pots were watered by tap water when they are needed.

**The third group** was infected with root-knot nematodes and untreated with AgNPs- Jojoba formulations.

***Estimation of infestation and growth parameters:***

After one month from inoculation Plants were removed carefully. Average Shoot length, Shoot weights, root weights, number of galls/ plant were measured. Gall indices were assessed using Taylor and Sassar (1978) scale of 0=No galling; 1= 1-2 galls; 2= 3-10 galls, 3=11-100 galls and 5= more than 100 galls. Extraction of root- knot nematode 2nd juveniles was conducted by using the combination of Baermann funnels with elutriation and sieving technique. A modified method from the method of **(Thorne, 1961)**.

In this procedure pot soil were mixed with water and added to the elutriator "Ostenbrink apparatus" which run with a current of water in a rate of 1000 $cm^3$ per minute against gravity. After the elutriator is full, current of water was stopped and the suspension of soil and nematodes sieved by using a 400 mesh sieve. Then the sieve contents were transported to Baermann funnels, each unit consist of 2 wet strength facial tissues of filter supported on a screen of 8 cm. in diameter, that screen superimposed on a glass funnel 10 cm.in diameter. A plastic hose ended with a clamp was fixed in funnel stem. Amount of water was added till the level of water become 1 cm. upstairs the sample level. The nematodes were collected after an incubation period of 3 days at 21-24 C. Nematodes were calculated using count slide1 ml. capacity and examined using a light microscope **(Hassan, 1990).**

Final population in the infested pots including the sieved juveniles and the juveniles hatched from the eggs extracted from roots by shaking the roots in a 0.5% sodium hypochlorite solution for three minutes **(Hussey and Barker, 1973)**.

Egg-masses were kept in a Petri dish containing distilled water and placed in an incubator at 28 °C in the dark the hatched J2s were collected on the third day.

## RESULTS AND DISCUSSION

***Effect of the irrigation with magnetized water on the infectivity of root knot nematode Meloidogyne javanica to tomato seedlings under greenhouse conditions:***

The obtained data of the nematode infestation criteria appeared on the plants indicate that the irrigation with fresh magnetic water gave more effect on *M. javanica* reproduction on tomato under greenhouse conditions than the use of other magnetic water stored at different periods before the application. Where the treatment with fresh, non-stored magnetized water, gave a 75% reduction in the final nematode count after one month of infection with nematodes compared to the control treatment (by using nonmagnetic water) and 61% reduction when using magnetized water stored for 24 hours, while the magnetized water stored for 48 hours gave a reduction 56% in the final nematode count after one month from nematode inoculation. As for the magnetized water stored for 72 hours, it caused a reduction of nematode final population by 47%. Less reduction (21%) in nematode reproduction was achieved with the irrigation with 96 hours stored magnetized water (Table 1). These results may be attributed to galvanotaxis of root -knot nematodes when exposed to a magnetic field that cause disruption of nematode for finding their host root and make them far from plant roots and thus the infection of plant roots with nematodes will decrease. **(Jean-Claude Prot, 1980).** mentioned that nematode attraction to plant roots affected by Electro –chemical potential of roots.

On the other hand **Caveness and Panzer (1960)** found that in an electric field, *Panagrellus redivivus* and nematodes of the genera *Tylenchus* and *Pratylenchus* migrated towards the cathode. Most authors who have studied this phenomenon have concluded that the redox potential or an electric field can orient nematode migrations and it seems possible that the gradient of electrical potential created by the roots could contribute to their attraction for nematodes. (**Bird, 1959).** reported that the accumulation of *Meloidogyne* juveniIes in the region of cell elongation may be due to a potential difference of 10/20/mV between this part and the contiguous areas of the root.

Data in Table (1) also illustrate that the growth parameters of tomato plants infected by *M.javanica* nematode, improved when irrigated by magnetized

water than the control that irrigated with nonmagnetic water. The rate % of increase in the weight of tomato shoots over control were 142.9, 100.0, 78.6, 57.1 and 14.3 % by the irrigation with fresh , 24 hours, 48 hours, 72 hours and 96 hours stored magnetized water, respectively. **(Saadoon *et al.*, 2019).** reported that magnetized irrigation water achieved the high values in the improvement plant criteria as well as reduction nematode population in soil and root with reproduction factor 2.6 in comparison with 12.4 for control. (**Hozayn *et al.*, 2017)**. explained that magnetic treatment is considered one of uncommon factor which has positive effects on yield of many crops.

**Table (1): Impact of magnetized waters at different periods of storage on infested tomato plants with initial inoculum 1000 newly hatched larvae of *Meloidogyne javanica* per pot in greenhouse**

| Treatments with AgNP Jojoba preparation | Fresh shoot weight (g.) | The rate % of Increase in the weight of shoot over control | Weight root (g.) | Number of galls/ plant | Final population/ pot | Reduction percentages of final population over control |
|---|---|---|---|---|---|---|
| **Fresh magnetic water (one hr. age)** | 17.0 | 142.9 | 6.0 | 9 | 570 | 75[a] |
| **Stored magnetic water (24 hrs. age )** | 14.0 | 100.0 | 4.0 | 15 | 900 | 61[ab] |
| **Stored magnetic water (48 hrs. age)** | 12.5 | 78.6 | 3.5 | 19 | 1000 | 56[bc] |
| **Stored magnetic water (72 hrs. age)** | 11.0 | 57.1 | 3.0 | 25 | 1200 | 47[c] |
| **Stored magnetic water (96 hrs. age)** | 8.0 | 14.3 | 2.5 | 35 | 1800 | 21[d] |
| **Nonmagnetic water (control)** | 7.0 | - | 2 | 50 | 2280 | 0[e] |

Each value is average of four replicates, Reduction percentages sharing the same letter don't differ according to Chi square test at P=0.05

***Effect of AgNPs synthesized with jojoba extracts formulated with fresh magnetized water in comparison with other prepared by distilled water on M. javanica infected tomato seedlings:***

Table (2) shows the effect of AgNPs synthesized with jojoba extracts formulated by fresh magnetized water in comparison with other prepared by distilled water on *M. javanica* infected tomato seedlings. AgNPs prepared with jojoba by magnetized water surpassed other prepared by distilled water in reducing the reproduction of *M. javanica* and the final population of nematodes, recording reduction of 91.8 % but when using distilled water in preparing silver nanoparticles by jojoba, the final nematode count was reduced by 77 % compared to the comparison treatment. The percentage of increase in vegetative growth (fresh shoot weight) of tomatoes as a result of using magnetized water to prepare silver nanoparticles with jojoba was 175.0%. As for the silver nanoparticles synthesized with jojoba extract and prepared with distilled water, it gave an increase of 137.5% over the control treatment which was not treated with silver nanoparticles (Table 2). **(Saadoon *et al.*, 2019).** indicated that magnetized irrigation water in raised the efficiency of the use of plant extract of *Aloe vera* at three concentrations (ml/ml: in ratio 10, 20 and 40%) in the control of *M. incognita.*

**Table (2) Effect of AgNPs synthesized with jojoba extracts formulated with fresh magnetized water in comparison with other prepared by distilled water on *M. javanica* infected tomato seedlings**

| Treatment | Fresh shoot weight (g.) | % of Increase in the weight of shoot over control | Number of galls/plant | Final population/ pot (Pf.) | Reduction percentages of Pf. over control |
|---|---|---|---|---|---|
| **AgNPs synthetized by jojoba prepared by magnetic water** | 22.0 | 175.0 | 9 | 225 | 91.8[a] |
| **AgNPs synthetized by jojoba prepared by distilled water** | 19.0 | 137.5 | 15 | 628 | 77.0[b] |
| **Control Untreated infected plants,** | 8.0 | - | 53 | 2730 | 0[c] |

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## تأثير الماء الممغنط مع بعض المستحضرات النانوية على إصابة نباتات الطماطم بنيماتودا تعقد الجذور *Meloidogyne javanica*

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١-تأثير الري بالمياه الممغنطة على إصابة نيماتودا تعقد الجذر *Meloidogyne javanica* لشتلات الطماطم تحت ظروف البيوت المحمية:
تشير البيانات التي تم الحصول عليها لمعايير الإصابة بنيماتودا تعقد الجذور على نباتات الطماطم إلى أن الري بالمياه الممغنطة أعطى تأثيرًا فى خفض تكاثر *M. javanica* على الطماطم تحت ظروف الصوبة مقارنة باستخدام المياه الممغنطة الأخرى المخزنة في فترات مختلفة قبل التطبيق. حيث أعطت المعاملة بمياه ممغنطة غير مخزنة انخفاضًا بنسبة ٧٥٪ في العدد النهائي للديدان النيماتودية بعد شهر واحد من الإصابة بهذه النيماتودا مقارنةً بمعاملة التحكم (باستخدام المياه غير الممغنطة) ولوحظ انخفاض فى تعداد النيماتودا النهائى بنسبة ٦١٪ عند استخدام المياه الممغنطة المخزنة لفترة ٢٤ ساعة ، بينما المياه الممغنطة المخزنة لمدة ٤٨ ساعة أعطت انخفاضًا بنسبة ٥٦٪ في العدد النهائي للديدان النيماتودية بعد شهر واحد من العدوى بالنيماتودا. أما بالنسبة للمياه الممغنطة المخزنة لمدة ٧٢ ساعة ، فقد تسبب في انخفاض عدد النيماتودا النهائي بنسبة ٤٧٪. تم تسجيل انخفاض أقل (٢١٪) في تكاثر النيماتودا مع الري باستخدام ماء ممغنط مخزن لمدة ٩٦ ساعة. تحسنت معاملات نمو نباتات الطماطم المصابة بالديدان النيماتودية *M. javanica* عند ريها بالمياه الممغنطة عن مجموعة المقارنة التي تروى بمياه غير ممغنطة. بلغ معدل الزيادة في وزن المجموع الخضرى للطماطم عن معاملة المقارنة ب % ١٤٢,٩ عند الري بالمياه الممغنطة الغير مخزنة ونسب خفض ١٠٠,٠ ، ٧٨,٦ ، ٥٧,١ و ١٤,٣٪ بإستخدام المياه الممغنطة المخزنة لمدة ٢٤ ساعة ، ٤٨ ساعة ، ٧٢ ساعة و ٩٦ ساعة على التوالي.

٢-تأثير جسيمات الفضة النانوية المحضرة مع مستخلص الجوجوبا بمياه عذبة ممغنطة مقارنة بغيرها المحضرة بالماء المقطر الغير ممغنط على شتلات طماطم المصابة بالنيماتودا *M. javanica*

تفوقت المعاملة ب بجسيمات الفضة النانوية المحضرة مع الجوجوبا بواسطة الماء الممغنط عن تلك المحضرة بالماء المقطر الغير ممغنط في الحد من تكاثر *M. javanica* والتعداد النهائي للديدان النيماتودية ، مسجلة انخفاضًا بنسبة ٩١,٨٪ ولكن عند استخدام الماء المقطر في تحضير جزيئات الفضة النانوية بواسطة الجوجوبا انخفض العدد النهائي للديدان النيماتودية بنسبة ٧٧٪ مقارنة بمعاملة المقارنة. بلغت نسبة الزيادة في النمو الخضري (الوزن الطازج) للطماطم نتيجة استخدام الماء الممغنط لتحضير جزيئات الفضة مع الجوجوبا ١٧٥,٠٪. أما بالنسبة لجسيمات الفضة النانوية المُصنَّعة بمستخلص الجوجوبا والمُحضرة بالماء المقطر ، فقد أعطت زيادة قدرها ١٣٧,٥٪ عن معاملة المقارنة المصابة بالنيماتودا والتي لم يتم معالجتها بجسيمات الفضة النانوية.