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# Influence of two species of water ferns, *Azolla caroliniana* and *A. pinnata* as soil amendments against *Meloidogyne javanica* infecting tomato in Egypt.

Ahmed El-Sayed Ismail*, Abbas Mohamed Kheir.

Department of Plant Pathology, National Research Center, Dokki,12622 Giza, Egypt.

Research Article

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***For Correspondence**
Fish Reproduction Division, National Institute of Oceanography and Fisheries, Suez and Aqaba Gulfs Branch P. O. box 40, Shoubra, Cairo, Egypt.

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**ABSTRACT**

The effect of dry materials of *Azolla caroliniana* and *A. pinnata* on controlling *Meloidogyne javanica* on tomato cv. Super Strain-B was carried out under greenhouse conditions 25±5°C. The treatments were applied at the rates 25 and 50 gm of dry materials of each species / pot. Application of *A. caroliniana* and *A. pinnata* succeeded in reducing the development and reproduction of *M. javanica* and improved the plant growth when compared with those of the check. *A. pinnata* was more efficient in reducing number of nematode stages based on galls, egg-masses, females, developmental stages in roots, as well as, number of juveniles in soil per plant at both rates as compared with *A. caroliniana* did. Also, the growth of tomato plants was affected due to the application of azolla. Addition of azolla to the plant soil caused remarkable increase in all plant growth parameters.The higher dose was more effective than the lower one. However, *A. pinnata* resulted in increasing the plant growth much more than *A. caroliniana*.

## INTRODUCTION

In Egypt, the root-knot nematodes, Meloidogyne spp. attack tomato (*Solanum lycopercicum* L.) roots and severly reduce plant growth. Therefore, the control of nematode has received attention to minimize damage to plants. Synthetic nematicides have efficiently been used for a long time; however, hazards resulting from such chemicals have encouraged scientists to search for alternatives. Several studies showed significant reduction in the nematode infestation and avoidance of environmental pollution by using organic nitrogen fertilizers which is one of the mostly effective methods used in eliminating different nematode species populations infecting several economic crops (Nakhla et al., 1998, Ismail et al., 2007, 2009 and Usman and Siddiqui, 2013). Azolla, a free floating water fern or mosquito fern or duckweed fern or fairy moss as common names (Yanni et al., 1994) grows heavily on water surface and fixes atmospheric nitrogen. There were three Azolla species namely: *Azolla pinnata* R. Br., *A. caroliniana* Willd. and *A. filiculoides* Lam. (Azollaceae) introduced by soil microbiologists of the Agriculture Research Center (ARC), Egypt for green manuring of rice in Egypt (Yanni et al., 1994). Some attempts have been devoted to utilize Azolla plants as a bio-fertilizers in management different plant-parasitic nematodes i.e. *Pratylenchus penetrans*, *Heterodera glycines*, *Meloidogyne incognita*, *Tylenchorhynchus vulgaris* and *M. incognita* in soil, due to the highly nitrogenous component in these plants (Walker, 1969, Barker et al., 1971, Thaker et al., 1988, Patel et al., 1989 and 1994 , Abadir and El-Hamawi, 1995 and Ramakrishnan et al,1996; respectively) .So, the aim of the present work is to compare the role of two dry species of water ferns, *A. caroliniana* and *A. pinnata* as soil amendments in suppressing root knot nematode, *M. javanica* infecting tomato under greenhouse conditions 30 ± 5°C in Egypt.

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## MATERIALS AND METHODS

Two species of Azolla plants namely, *A.carolinaria* and *A. pinnata* were dried and used as soil amendments under greenhouse conditions 25±5°C. The pure culture of Azolla plants were originally obtained from Plant Nutrition Department, Institute of Soil and water Research, Agriculture Research Center (ARC), Giza, Egypt. Twenty three-day old of tomato, *Solanum lycopercicum* L. seedlings cv. Super Strain-B were transplanted in 15- cm diameter clay pots filled with 1 kg solarized sandy loam soil (1:1 w/w) and incorporated with dry Azolla plants at the rates of 25 or 50 gm / pot of each species. The dry Azzola rates of each species were added two weeks before transplanting to allow their decomposing in the soil. All treatments were replicated five times, besides a set of five pots were left without adding Azolla to serve as a check. All pots were arranged in a greenhouse bench in a randomized block design, and all normal cultural practices were conducted as needed. Seven days later, all the pots were inoculated with 1000 freshly hatched juveniles of *M. javanica* / pot. The experiment was terminated after seventy days of the inoculation time. The nematodes in the soil were extracted by sieving and decanting methods (Barker, 1985). Also, the number of galls, egg-masses, females and the developmental stages in tomato roots were determined. All shoots and roots parameters were recorded. Percentage of plant growth increase based on shoot and root fresh weights and percentages of nematode reproduction criteria reduction were determined.

### *Statistical analysis*

Data were subjected to analysis of variance by the least significant differences (LSD) according to Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

The data in Table 1 revealed that, generally, that when dry azolla plants of both species were incorporated into soil of tomato plants cv. Super Strain B fourteen days before transplanting, it markedly affected on development and reproduction of *M. javanica* . It is clearly to notice that *Azolla pinnata* was more effective in reducing all the nematode stages as compared with *A. caroliniana* did. However, both azzola species succeeded in decreasing gall formation, egg-masses number, females number, developmental stages number and number of juveniles per plant when compared with those of the control. Such effect increased with increasing the rates of azolla. So, galls number was highly affected by using the higher rate (50 gm / pot) of each species than the lower one (25 gm /pot), as was reduced by 35.9 and 18.8% , or by 69.5 and 27.0% when the soil was amended with *A. caroliniana* or *A. pinnata*; respectively (Table 1). Also, the reproductive potential of the nematode was affected when soil was amended with either *A. caroliniana* or *A. pinnata*. Noticeable decrease in number of egg-masses, females, developmental stages / root as well as number of juveniles / soil was obtained by using either higher or lower rate of azzola plants as compared to the control. Although, *A. pinnata* treatment was more effective than *A. caroliniana*, no remarkable difference in number of egg-masses / root was noticed between *A. pinnata* rates, a pronounced difference was observed between treatments of *A. caroliniana*. Comparatively, percentages of reduction in number of egg-masses / root of *A. caroliniana* treatments were 19.9 and 50.7 for the lower and higher rates; respectively; while they were 58.8 and 66.9% for the lower and higher rates of *A. pinnata*; respectively (Table 1).

**Table 1. Effect of two azolla species plants as soil amendments on development of *M. javanica* infecting tomato.**

| Treatments & rates | No. of galls / root | R. % | No. of egg-masses / root | R. % | No. of females / root | R. % | No. of D.S./ root | R. % | No. of juveniles in soil | R. % |
|---|---|---|---|---|---|---|---|---|---|---|
| *Azolla caroliniana* | | | | | | | | | | |
| 25 g / pot | 208 | 18.8 | 109 | 19.9 | 189 | 18.5 | 173 | 14.8 | 1320 | 29.8 |
| 50 g / pot | 164 | 35.9 | 67 | 50.7 | 107 | 53.9 | 145 | 28.6 | 980 | 47.9 |
| *Azolla pinnata* | | | | | | | | | | |
| 25 g / pot | 187 | 27.0 | 56 | 58.8 | 87 | 62.5 | 92 | 54.7 | 1134 | 39.7 |
| 50 g / pot | 78 | 69.5 | 45 | 66.9 | 51 | 78.0 | 52 | 74.4 | 675 | 64.1 |
| Control | 256 | | 136 | | 232 | | 203 | | 1880 | |
| LSD 0.05 | 16 | | 18 | | 32 | | 55 | | 203 | |
| LSD 0.01 | 23 | | 32 | | 40 | | 63 | | 245 | |

R. = Reduction %. D.S. = Developmental stages.

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Table 2: Effect of two azolla species plants as soil amendments on growth parameters of tomato plants infected with *Meloidogyne javanica*.

| Treatments & rates | Lengths (cm) | | | | Fresh weights (g) | | | | Dry weights (g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | root | Inc.% | shoot | Inc.% | root | Inc.% | shoot | Inc.% | root | Inc.% | shoot | Inc.% |
| *Azolla caroliniana* 25 g / pot | 24.9 | 4.6 | 73.2 | 4.6 | 6.3 | 28.6 | 27.3 | 10.1 | 1.4 | 16.7 | 4.3 | 16.2 |
| 50 g / pot | 30.1 | 26.5 | 75.6 | 8.0 | 6.9 | 40.8 | 30.5 | 23.0 | 1.9 | 58.3 | 5.6 | 51.4 |
| *Azolla pinnata* 25 g / pot | 31.3 | 31.5 | 77.3 | 10.4 | 8.7 | 77.6 | 36.2 | 46.0 | 2.1 | 75.0 | 5.8 | 56.8 |
| 50 g / pot | 35.7 | 50.0 | 80.1 | 14.4 | 9.3 | 89.8 | 38.7 | 56.1 | 2.6 | 116.7 | 6.4 | 73.0 |
| Control | 23.8 | | 70.0 | | 4.9 | | 24.8 | | 1.2 | | 3.7 | |
| LSD 0.05 | 3.2 | | 2.8 | | 2.1 | | 2.6 | | 0.6 | | 1.7 | |
| LSD 0.01 | 5.7 | | 3.4 | | 3.7 | | 4.2 | | 0.9 | | 2.4 | |

Inc. = Increase %.

Growth of tomato plants was also affected due to soil amending with dry azolla plants. Generally, all azolla treatments increased all plant growth parameters (Table 2). A positive correlation was detected between the plant growth increase and rates of both azolla species. However, *A. pinnata* was more effective than *A. caroliniana*, and the higher rates were, also, more effective than the lower ones. The obtained results proved the activity of azolla plants in eliminating population of *M. javanica* when used as soil amendments. The highly nutritive components of such plants from minerals (Calcium, Phosphorus, Potassium, Sodium, Magnesium, Manganese, Zinc, Copper and Iron) and amino acids (Alanine, Arginine, Aspartic acid, Cystine, Glutamic acid, Glycine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Proline, Serine, Threonine, Tryptophan, Tyrosine and Valine) could adversely interfere on the development and reproduction of the nematode (Thomas et al.,1980 and Francisco et al.,2000). Also, the decomposing dry azolla plants could help in improving the plant growth. Similar results has been obtained by Patel et al.(1989 & 1994) as they found that dry *A. pinnata* reduced the stunt nematode, *Tylenchorhynchus vulgaris* and improved the plant growth , as well as, Abadir and El-Hamawi (1995) who found that fresh materials of both *A. filiculoides* and *A. pinnata* decreased the root-knot nematode, *M. incognita* and improved the plant growth. In addition, Thaker et al.(1988) reported that extracts of fresh and dry azolla i.e. *A. pinnata* inhibited hatching of *M. javanica* and *M. incognita*. However, further studies are needed to elucidate proper effect against plant-parasitic nematodes.

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