Impact of fish waters, composted chicken manure water on Galling and Reproduction of *Meloidogyne incognita* Infecting tomato plants under greenhouse conditions

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Abstract: A laboratory tests carried out to evaluate nematicidal activities of three fish waters (adult tilapia, fry tilapia and fry mullet) on IJs and egg masses of root-knot nematodes *Meloidogyne incognita* under laboratory conditions. After two weeks of exposure, fry tilapia water significantly ($P \leq 0.05$) more effect one with egg hatching inhibition 24.30% followed by big tilapia water with 19.28% while, fry mullet was less toxic to egg masses of *M. incognita*. On the other hand, mortality percentages reached to 84.67, 66.00 and 62.67 with fry tilapia fish, big tilapia fish and fry mullet, respectively after two weeks. Two greenhouse experiments were conducted to evaluate the nematicidal activity of fry tilapia fish water alone or combined with composted chicken manure water on galling and reproduction of *M. incognita* infecting tomato plants (*Solanum lycopersicum* L. c.v. Super strain B) under greenhouse conditions. Pots irrigated with fry tilapia fish water significantly ($P \leq 0.05$) minimized the root-gall numbers (125.67) with percentages of reduction (24.44%) as compared to positive control treatment irrigated with tap water and increased of shoot fresh weight of tomato plants (34.80%). Whereas, galls diameter ($\geq$ 4 mm) decreased to reach 6.00 as compared with 20.00 in pots irrigated with tab water. Pots treated with fry tilapia fish water combined with soaked local chicken manure (local chicken manure water) showed least gall numbers and reproduction of root knot- nematode, *M. incognita*. Also, statistical analysis showed that fish water + composted local chicken manure water and fish water decreased galls diameter. Since number of galls ($\geq$ 4 mm) decreased to reach 6.00 and 0.00 with fish water and fish water + composted local chicken manure water, respectively as compared with 20.00 in pots irrigated with tab water. Regarding the efficiency of the treated materials on egg masses, results clearly showed that fish water + composted local chicken manure water achieved the highest percentage of reduction in egg masses (68.64%). On the other hand, use fish water alone or fish water + local chicken manure water significantly increase root weight of tomato plants. Percentages of increase in root weight for treated waters were 50.37 and 35.00 % with fish water + local chicken manure water and fish water only, respectively. Also, percentage increase in shoot fresh weight in treatment of fish water + composted local chicken manure water was 77.46% as compared with 34.80% in fish water.

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1. Introduction

The tomato crop (*Solanum lycopersicum* L.) belongs to family Solanaceae is becoming one of the most vegetable crops grown for both local consumption and export in Egypt; it is an important source of vitamins. Tomatoes can make people healthier and also can decrease the risk of condition such as cancer, osteoporosis and cardiovascular disease (Debjit *et al*.,2012). The crop is infested with many pests during the different stages of plant growth (Singh *et al.*, 2014). Most cultivated plant species are susceptible to nematodes, especially root-knot nematodes, *Meloidogyne* spp. (Goeldi) which attack and cause remarkable damage to vegetables, with certain predilection for tomato plants (Bertrand, 2001).

Between various obstacles including fungi, bacteria and viruses in cultivating tomato plants, root knot nematodes (RKNs), *Meloildogyne* spp. are recognized as a major pathogen of tomato (Kamran *et al*., 2010) especially in tropical, subtropical and Mediterranean climates. In Egypt, Ibrahim (1985) showed to the main problems arise from the contamination of newly reclaimed sandy areas by RKNs *M. incognita* (Kofoid and White). Although, Nematicides have been used to control nematode pests with remarkable results, they have great problems to our micro and /or macro- environment (Hassan *et al*., 2010). Vegetables production depends on the correct management of these pathogens (Sikora & Fernandez, 2005).

Nowadays, in poor countries or particularly to rural poor farmers, researchers turned their view to look for alternative measures those are cheaper, readily available and sustainable with minimal negative effects on the environment. Therefore,

finding safer alternatives to chemical nematicides is one of the top priorities for future nematology.

Many of the soil amendments (chicken litter manure) and manipulated fish water used as nutrient sources for crop production have been found to control plant parasitic nematodes with an increase in crop yield and growth (Al-Sayed *et al*., 2007; Mahfoud, 2011).

The objective of the present study was to determine the effect of fry tilapia fish, big tilapia fish and fry mullet on infectivity, development and reproduction of *M.incognita* infesting tomato plants under laboratory condition.

2. Materials and Methods

1- Source of root – knot nematode:

In the greenhouse of Faculty of Agriculture (Zagazig University), Pure culture of *M. incognita*, was maintained on the eggplant seedling *Solanum melongena* cv. Beauty planted in the greenhouse for using as source of inoculum. Species identification was based on juvenile measurements and examination of perineal pattern system of adult females according to Eisenback *et al.,* (1981) and Jepson, (1987). Infected eggplant roots were cut into small pieces (2-cm long) placed in a 600 – ml flask with 200 ml of 0.5% sodium hypochlorite (180 ml water + 20 ml Clorox). The tightly capped flack was shaken for 3 minutes. The shaking partially dissolved the gelatinous matrix thus freeing eggs from egg masses (Hussey & Barker 1973). By using a 200- mesh and a 500-mesh sieve, liquid suspension of eggs was poured and immediately washed the collected eggs on 500-mesh sieve many times to be free from sodium hypochlorite solution. Eggs of *M. incognita* were incubated in Petri dishes at 25±1°C until hatching. Newly hatched of second stage juveniles (J2) were collected by using a micropipette.

2- Plants culture:

The tomato plants were chosen in the present study because of severely attacked by *M.incognita* besides regional economic importance.

Seeds of tomato plants (*Solanum lycopersicum* L.) cv. Super strain B were soaked in sterile distilled water in Petri dishes and kept in an incubator at 25±1°C.

3- Analysis of fish water and local chicken manure water:

Table (1). Analysis of different sources of fish water.

Fish species	Total Ammonia NH4	pH	Total Alkalinity	Total Hardness
Fry Tilapia	0.199	7.8	300	800
Fry Mullet	0.52202	8.2	275	900

Table (2). Chemical analysis of chicken manure.

Analysis	Ph (H_2O)	DM	P_2O_5	K_2O	Total N	N-SoI.H_2O	NH4-N	Org-C	C:N
Mean	7.8	64	3.0	29	2.2	32.3	9.6	28.3	11.2
Median	8.0	66	3.0	2.8	2.0	29.2	7.5	29.0	11.7
Maximum	8.9	85	4.9	4.6	4.4	60.9	20.3	43.3	18.1
Minimum	6.0	34	1.0	0.7	1.1	11.8	1.2	21.3	9.2
CV%	7.4	17	2.6	33	2.9	42	106	20	13

4- Experimental designs:

4.1- Viability of IJs of RKN in fish waters:

Ten milliliters of the three-fish water (fry tilapia fish, big tilapia fish and fry mullet) were poured in Petri dishes (9-cm diameter). The IJs were added to the dilution at the rate of 100 nematodes per dish (0.1 ml of the stock nematode suspension). The control treatment consisted of the 100 IJs maintained in 10 ml tab water alone. Each treatment was replicated five times and the dishes were kept at (24±2°C); IJs survive more at this temperature (Dunphy and Webster, 1986). All dishes were sealed tightly with parafilm to avoid vaporization of the solution. Each of 0.5 ml, were pipetted into a Hawksely counting slide and examined by the aid of a research microscope at 100x. IJs showing inactive straight posture or inactive (S) posture were considered as dead; any other types of movement were scored as alive (Ishibashi and Takii,1993) or did not show any movement after prodding were considered dead (Elizabeth *et al.*, 2003).

Number of alive and dead IJs was counted after one, two and four, one week and two weeks. Percent of dead nematodes was calculated by the following equation:

$$\text{Mortality (\%)} = \frac{\text{Dead larvae}}{\text{Totall number of larvae}} \times 100$$

4.2 -Effect of the fish waters on eggs hatching:

Five egg masses of uniform size were added to ten ml of each fish water in 5 cm diam. Petri dishes.

The control treatment was prepared using distilled water only. Each treatment was replicated three times. All treatments were left under room temperature 26±3˚C. Numbers of hatched juveniles were counted using a research microscope (100X magnification) after one day, two days, three days, four days, one week and two weeks of exposure. Percentage of hatching inhibition was calculated in comparison with the control treatment, according to the following equation:

$$\text{Egg hatching inhibition (\%)} = \frac{\text{Control - treatment}}{\text{Control}} \times 100$$

4.3- Greenhouse experiment:

A sterilized sandy soil of Khattara project (faculty of agriculture, Zagazig University) was chosen to plant tomato after germination. Tomato plants were planted in plastic pots of 25-cm diameter containing steam sterilized sandy soil (95.7% sand; 1.2% silt and 3.1% clay) and two weeks later, plants were thinned to one per pot. When seedlings were approximately 10 cm in height (time of inoculation), they were inoculated with 1000 newly hatched infective juveniles (IJs) of *M.incognita* per plant. 2 ml of the inoculum suspension of IJs were pipetted around tomatoes root system into four holes. Immediately, after inoculation the holes were covered with moist soil. The solution of local chicken manure was prepared by adding 0.25 Kg of litter chicken manure to a beaker and soaked with a small amount of distilled water to about 12 hours in the room temperature and then completed the volume for 1000 ml with the distilled water.

The treatments were done according to the following scheme:

1- Control-1 (healthy plants): irrigated only by tap water for two months as well as without nematode inocula. Each treatment was replicated three times.

2- Control-2: positive control treatments included inoculation of *M. incognita* 1000/ IJs per plant as well as irrigated only by tap water for two months.

3- Plants were applied with 1000/IJs of *M. incognita* per plant and irrigated only by fish water for two months.

4- Plants were applied with 1000/IJs of *M. incognita* per plant and irrigated by combining fish water and soaked composted chicken manure water (1:1,v/v) for two months. Each treatment was replicated three times.

All treatments were arranged in a randomized complete block design in the greenhouse at 25 ± 4°C., and all received similar horticultural treatments. Two months after inoculation, plants were removed carefully from pots and data on plant growth (fresh weight of shoots and roots) were recorded. Roots and surrounding soil in the pots were soaked in clean water for half an hour to facilitate removing adhering soil and keep egg masses on root surface.

Roots were wrapped in tissue paper to prevent drying out during the steps of evaluation. Moreover, Root weight, shoot weight, numbers of galls were counted per root system under a stereomicroscope. Root-knot index was assessed using Taylor and Sasser (1978) scale of 0 = No galling; 1 = 1-2 galls; 2 = 3 - 10 galls; 3 = 11 - 30 galls; 4 = 31-100 galls and 5 = more than 100 galls. Gall diameter was also measured according to El-Deeb *et al*. (2018) measurement. Means were compared by Duncan's multiple range test at $P \leq 0.05$ level (Duncan, 1955).

Results and Discussion

1-Impact of three fish water on root knot nematode, *Meloidogyne incognita* eggs hatching.

The impact of big tilapia fish, fry tilapia fish and fry mullet water on egg hatching of *M. incognita* after one day, two days, three days, four days, one week and two weeks of exposure were investigated in Table (3).

Data showed that after one, two, three and four days percent of egg hatching inhibition increased gradually with the tested fish water with insignificant variance ($P \leq 0.05$) between the tested fish waters. Fry tilapia fish was the superior one over all treatments, the inhibition percentages were 3.81, 3.30, 5.02 and 7.16% after one, two, three and four days big tilapia fish followed by with percentages of inhibition valued as much as 1.91,2.69, 3.07 and 5.55% at the mentioned days. Whereas, fry mullet water was the lowest one in egg hatching inhibition with percentages of inhibition valued as 0.92, 2.28, 2.23 and 4.65% after one, two, three and four days of exposure.

After one and two weeks of *M. incognita* egg masses, exposure to the tested fish waters, fry tilapia fish gave the highest effect followed by adult tilapia fish while fry mullet was the lowest effective one in egg hatching inhibition. Significant differences were existed in the percent of hatching inhibition between the three –fish waters against *M. incognita* egg masses.

One and two weeks after exposure, the percent egg hatching inhibition of fry tilapia water and big tilapia water were 19.28 (24.30) and 15.07 (19.28), respectively. With fry mullet decreased to reach 11.36 and 17.57 % after one and two weeks, respectively.

Generally, it could be concluded that water of fry tilapia fish was more effective one followed by adult tilapia fish and fry mullet was less toxic to egg masses of *M. incognita*.

Table 3. Percentage inhibition of the tested fish waters on *M. incognita* egg hatching after one, two, three, four, one week and two weeks of exposure

Fish waters	Exposure time					
	one day	Two days	Three days	Four days	One week	Two weeks
	(Egg hatching inhibition %)					
Control	226.67 a	433.33 a	596.67 a	930.00 a	1346.3 a	1462.0 a
adult tilapia fish	222.33 a (1.91)	421.67 a (2.69)	578.33 a (3.07)	878.33 b (5.55)	1143.3 ab (15.07)	1180.0 b (19.28)
Fry tilapia fish	218.33 a (3.81)	419.00 a (3.30)	566.67 a (5.02)	863.33 b (7.16)	1086.7 b (19.28)	1106.7 b (24.30)
Fry mullet	222.67 a (0.92)	423.67 a (2.28)	583.33 a (2.23)	886.67 ab (4.65)	1193.3 ab (11.36)	1205.0 ab (17.57)

* Means followed by the same letter in rows are not significantly different at P ≤0.05 according to Duncan's multiple range test.

$$\text{Egg hatching inhibition } (\%) = \frac{\text{Control - treatment}}{\text{Control}} \times 100$$

2- Effect of fish waters (adult tilapia fish, fry tilapia fish and fry mullet) on juveniles viability of *M. incognita*.

Results in Table 4 show that one, two, three and four days after exposure IJs of *M.incognita*, mortality percentages in fry tilapia fish treatment were 12.33,19.00 25.33 and 39.33, respectively. Whereas, the parallel values in big tilapia fish and fry mullet at the same periods were 10.33 (9.33); 14.00 (11.67); 14.00 (15.33) and 25.67 (23.00), respectively. After one and two weeks, percent mortality increased significantly (P ≤ 0.05) with three fish water.

Mortality percentages in fry tilapia fish and big tilapia fish and fry mullet after one and two weeks of the treatment were significantly different for all the tested waters. It means that the effect of this compound significantly varied with fish species. One week after treatment, percent mortality were 45.00, 68.33 and 42.67 with adult tilapia fish, fry tilapia fish and fry mullet, respectively. After two weeks, percent mortality increased to reach 84.67, 66.00 and 62.67 with fry tilapia fish, big tilapia fish and fry mullet, respectively.

It means that the effect of fish waters significantly varied with fish species species. Generally, results showed that fry tilapia fish was the highest effective water against infective stage of root knot nematode *M. incognita* and increased by the time of exposure increase.

Table (4). Mortality percent of IJs of *M. incognita* 1, 2, 3, 4, 7 and 14 days of exposuring to fish waters.

Fish waters	Exposure time					
	one day	Two days	Three days	Four days	One week	Two weeks
Control	3.33 b	7.6667 b	11.33 b	13.67 c	16.00 c	18.33 c
adult tilapia fish	10.33 a	14.00 ab	17.00 b	25.67 b	45.00 b	66.00 b
Fry tilapia fish	12.33 a	19.00 a	25.33 a	39.33 a	68.33 a	84.67 a
Fry mullet	9.33 a	11.67 b	15.33 b	23.00 b	42.67 b	62.67 b

*Means followed by the same letter in rows are not significantly different at P≤0.05 according to Duncan's multiple range test.

$$\text{Mortality } (\%) = \frac{\text{Dead juveniles}}{\text{Total number of juveniles}} \times 100$$

3- Impact of fry tilapia fish waters on galling and growth of plant tomato infected with *M. incognita*.

Data in Table (5) show the fry tilapia fish water on galling and reproduction of *M. incognita* infecting tomato plants (*Solanum lycopersicum* L. c.v. Super strain B) under greenhouse conditions.

The obtained results revealed that treatments of fry tilapia fish water significantly (P ≤ 0.05) reduced the galls numbers as compared to positive control treatment. Pots treated with the mentioned fish water minimized numbers of root-galls (125.67) with percentages of reduction (24.44%).

For plant growth, effect of fish water treatments on growth of tomato plants was indicated by shoot fresh weight (Table 5). It is clear that, fish water improved of shoot fresh weight of tomato plants to a certain extent. Percentage increase in shoot fresh weight in treatment of fish water was 34.80%. On the other hand, use fish water minimized the numbers of galls and egg masses with insignificantly effect compared to pots irrigated with tap water only. The number of galls were 166.33 and 185.67 with tab water treatments and fish water treatments, respectively. Whereas, treatments of fish water

decreased significantly number of egg masses (185.33) as compared to tap water treatments (250.67) with percent reduction 19.65%. Also, statistical analysis showed that fish water decreased galls diameter. Since number of galls (≥ 4 mm) decreased to reach 6.00 as compared with 20.00 in pots irrigated with tap water.

Table (5): Effect of fry tilapia fish application of *M. incognita* on suppressing galling and reproduction of tomato plants in sandy soil under greenhouse conditions.

Treatments	Shoot weight (Increase %)	Root weight (Increase %)	Root long (Increase %)	Root galls (Reduction %)	Gall diameter ≥ 4 mm	Gall diameter < 4-2 mm	Gall diameter < 2 mm	Egg masses /Root (Reduction %)
Control-1 (healthy plants)	6.89 a	5.58 a	14.73 a	0.0000 b	0.00	0.00	0.00	0.00 c
Control -2 Super strain B treated with tab water only	3.24 c	2.70 b	11.67 b	166.33 a	20.00 a	49.67 a	99.00 a	230.67 a
Super strain B treated with fry tilapia fish	4.97 b (34.80)	2.00 b (35.00)	11.73 b (5.14)	125.67 a (24.44)	6.00 b	47.00 a	70.00 a	185.33 b 19.65

Same letter (s) in each column indicate no significant difference (P ≤ 0.05) between treatments according to Duncan's multiple range test.

$$\text{Reduction} \quad (\%) = \frac{\text{Control} \quad - \text{Treated}}{\text{Control}} \times 100 \qquad \text{Increase} \quad (\%) = \frac{\text{Treated} \quad - \text{Control}}{\text{Control}} \times 100$$

Table (6): Effect of simultaneously application of fry tilapia water combined with composted chicken manure water on suppressing galling and reproduction of *M. incognita* of tomato plants in sandy soil under greenhouse conditions.

Treatments	Shoot weight (Increase %)	Root weight (Increase %)	Root long (Increase %)	Root galls (Reduction %)	Gall diameter ≥ 4 mm	Gall diameter < 4-2 mm	Gall diameter < 2 mm	Egg masses /Root (Reduction %)
Control-1 (healthy plants)	6.89 a	5.58 a	14.73 a	0.00 a	0.00	0.00	0.00	0.00 d
Control -2 Super strain B treated with tab water only.	3.24 c	2.00 c	11.67 b	166.33 b	20.00 a	47.00 a	99.00a	230.67 a
Super strain B treated with fish water	4.97 b	2.70 c	11.73 b	125.67 c	6.00 b	49.67 a	70.00 b	185.33 b
	(34.80)	(35.00)	(5.14)	(24.44)				19.65
Super strain B treated with fish water + composted local chicken manure water	5.75 b	4.06 b	12.93 b	27.67 d	0.00 b	7. 67 b	20.00 c	72.33 c
	77.46	50.37	10.23	83.36				68.64

Same letter (s) in each column indicate no significant difference (P ≤ 0.05) between treatments according to Duncan's multiple range test.

$$\text{Reduction} \quad (\%) = \frac{\text{Control} \quad - \text{Treated}}{\text{Control}} \times 100 \qquad \text{Increase} \quad (\%) = \frac{\text{Treated} \quad - \text{Control}}{\text{Control}} \times 100$$

Data in Table (6) show the comparison between effect of fry tilapia fish water and soaked local chicken manure (local chicken manure water) on galling and reproduction of root knot- nematode, *M. incognita* under greenhouse conditions. After two months of application, susceptibility of tomato plants varied greatly according to water types used in plants irrigation.

Results indicated that combination between fish water and local chicken manure water significantly (P ≤ 0.05) reduced gall numbers as compared to pots treated with fry fish water only. Since maximum percentages of reduction were recorded (83.36) when plants treated with fry fish water + composted local chicken manure water overwhelmed those treated with fish water only (27.67) with high significantly differences were detected between fish water and local chicken manure water treatments compared with check treatment.

Also, statistical analysis showed that fry fish water+ composted local chicken manure water and fry fish water decreased galls diameter. Since number of galls (≥ 4 mm) decreased to reach 6.00 and 0.00 with fry fish water and fish water + composted local chicken manure water, respectively as compared with 20.00 in pots irrigated with tap water.

Regarding the efficiency of the treated materials on egg masses, results clearly showed that fry fish water + composted local chicken manure water achieved the highest significantly effect in minifying numbers of egg masses compared to other treatments. Whereas, fry fish water gained the lowest significantly affect compared to untreated plants. Percentages of reduction in egg masses for treated pots were 19.65 and 68.64 % with fish water and fry fish water + composted chicken manure water, consequently.

For plant growth, effect of fry fish water and local ckicken manure water treatments on growth of tomato plants were mainly indicated by shoot fresh weight (Table 6). It is clear that, fry fish water + composted local chicken manure water improved greatly shoot fresh weight of tomato plants. Percentage increase in shoot fresh weight in treatment of fry fish water + composted local chicken manure

water was 77.46% followed by fry fish water 34.80%.

On the other hand, use fish water alone or fry fish water + local chicken manure water significantly increase root weight of tomato plants. Percentages of increase in root weight for treated waters were 50.37 and 35.00 % with fry fish water + local chicken manure water and fry fish water only, respectively.

4. Discussion

The present results indicated that three studied fish (big tilapia, fry tilapia and fry mullet) effluents varied in reduce the root-knot nematode criteria on the infected tomato plant roots. Application of fish waters combined with well composted chicken manure to the soil have many known benefits on soil nutrients, soil physical conditions, soil biological activity and crop performance (Abubakar *et al.*, 2004; Al-Sayed *et al*., 2007 and Mahfoud, 2011). Furthermore, the microbial breakdown of nitrogen containing substances in soil via processes of mineralization might have acted as operative tools against nematodes by increasing predacious nematodes, nematode-trapping fungi and their toxins (Walker, 1992) in addition influence of pH, Ca+ ions, and moisture could adversely affect nematode activity (Dubey, 1968).

Applications of livestock manures to soil can recycle nutrients, increase soil organic matter, and improve soil physical conditions, as well as increase crop yields and reduce nematode populations (Johnson, 1962; Mankau and Minteer, 1962; Lear, 1959). Different management strategies for plant-parasitic nematodes have been developed, some of which involve the use of botanicals, crop rotation, solarization, use of synthetic nematicides and biological control (Mankau and Mibtteer,1962) besides use organic manures (Oka *et al*., 2000). Also, the organic acids produced by the breakdown organic material (chicken manure) have contact nematicidal action on free stages of parasitic nematodes (Browning *et al.*, 2004 and El-Ashry *et al.,* 2018).

Ammonia, dimethylamine (DMA), trimethylamine (TMA), indole, phenol, and butyric acid are the most common compounds present in poultry manure. McGahan, 2002 & Gutarowska *et al.*, 2014). Changes in physicochemical characteristics such as C/N, pH, mineral nitrogen, water-soluble organic C, and temperature have been studied during composting. The C/N in the solid phase (Bernal *et al*., 1998 & Brito *et al.,* 2012), water extract (Hue and Liu,1995), and water-soluble organic C (Hsu and Lo, 1999 & Bernal *et al.*,1998, Hue and Liu,1995) have been found to decrease as composting proceeded. However, Tiquia and Tam (2002) reported increased C/N in poultry litter composts. The pH usually increased with composting (Albrecht *et al*., 2008) & Wang *et al*., 2015 & Brito *et al.,* 2012), but Tiquia *et al.*, 1999 found a decline pH trend during 91-day composting of pig litter. The decreased $NH4^{+}$-N and increased $NO3^{-}$-N often led to low $NH4^{+}$-N/$NO3^{-}$-N ratios at the end of composting (Bernal *et al.*, 1998 & Brito *et al.,* 2012 & Zucconi and Bertoldi,1987).

Also, Oka *et al*., 2000 and Orisajo *et al*.,2008 showed that adding poultry manure as soil amendment produced beneficial effects on soil nutrients, soil physical conditions, and soil biological activities thereby improving the health of plants and reducing populations of plant-parasitic nematodes. On the other hand, Aktar and Malik (2000) revealed that the addition of organic matters increased rapidly population of free-living nematodes. Due to significant quantities of N, P, K, Ca, Mg and micronutrients also, nitrogen content of poultry manure particularly contains significant amounts of uric acid, which is readily decomposable and available to plants (Hue and Silvia 2000) for enhanced plant growth and yield.

Suppression of nematode population may rely on nematoxic compounds released from the composted material. For example, ammonia produced in the dry chicken manure might be involved in nematode suppression since the C:N ratio of chicken manure less than 20 are sufficient for nematode management due to enhancement of the indigenous soil micoflora (Rodr!ıguez-Kabana *et al*.,1987).

Results confirm the potential of well composted chicken manure wastes as a management option for suppression of plant-parasitic nematodes (Akhtar and Alam, 1993; Akhtar and Malik, 2000). The exact mechanism (s) of action of the released compounds that increase proteins and fatty acids in the root tissues as well inhibit viability or pre-penetration activities of the egg and J2 stages of root knot- nematode *M. incognita*, because once juveniles penetrate roots to complete their life cycle they are protected from chemical compounds unless those compounds are systemic.

Conclusions

Composted chicken manure alone or mixed with fish water can be used in place of chemical nematicides to manage *M. incognita* on vegetables considering its little cost, unknown hazard to plant, man and his environment. Also, mention to uncomposted chicken manure is harmful according to Nowak *et al.,* 2017 who revealed that odorous compounds from poultry manure induce DNA damage, nuclear changes, and decrease cell membrane integrity in chicken liver hepatocellular carcinoma cells. So, for excellent fertilizing and nematicidal effects of chicken manure, might be use composted chicken manure as soil amendment and management of plant parasitic nematodes.

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