

Identification, Distribution and Density Determination of Plant Parasitic Nematodes in Ornamental Plants of Mazandaran

Seyed Esmaeil Mahdavian , Farahnaz Jahanshahi

Abstract— 170 samples of soil, root and standing parts of ornamental greenhouses plant collected from different city of Mazandaran province which included AmolTonekaboon, Ramsar, Salmanshahr, KelarAbad, AbasAbad, Nashtarood, Nowshahr, Hachirood. These samples collected from 74 flowers and ornamental plants that belong to the 50 different groups of plant and collected between the years of 2012-2015 and then investigated. There wasn't any nematode contamination in aboveground organs of plant. Totally nine genera and 10 species (*M. javanica* ,Aphelenchoides ,*D. dipsaci* ,*Helicotylenchus* ,*Scutellonemabrachyurus* ,*M.brevidens* ,*P. thornei* ,*P. vulnus* ,*Paratylenchus* and *Tylenchulussemipenetrans*) Belonging to eight families and Tylenchidae family (from this family of the following genera *Filenchus* ,*Boleodorus* ,*Psilenchus* ,*Basiria* and *Neopsilenchus*) extracted and identified. *M. javanica*, *Aphelenchoides* and *D. dipsaci* were the host of three important nematodes of ornamental plant parasites; these hosts investigated according to the number of nematodes per 250 Cm³ of soil, average of population that exist on each host and the number of contaminated samples for each city. Tylenchidae with 64 contaminated has the most frequency percentage. The most population of nematode related to the Pothos plant that was located in Abas-abad region. *Paratylenchus* nematode with one contaminated sample has the lows frequency percentage and the most population of nematode related to the *Asparagus* plant in Amol city. *M. javanica* with 43 contaminated samples and 2520 nematode was collected from Pothos plant that is located in Nowshahr. 32 out of 74 collected ornamental plants was host of *M. javanica*, 21 plants was host of *Aphelenchoides* and 12 plants was the host of *D. dipsaci*; therefore 43, 25, 14 samples reported that contaminated to these three nematodes. 15 contaminated samples was the most amounts that located in Nowshahr, the most population of 2520 identified from the Pothos plant of Nowshahr city and Nashtarood and tonekaboon has zero contaminated samples. The most contaminated samples to the *Aphelenchoides* identified from Nowshahrthah has six samples and the most population of this nematode with 320 population identified from camellia plant in Hachirooda and Tonekaboon with one sample has the lowest contaminated sample. There are six contaminated samples to the *D. dipsaci* that located in Nowshahr and the most contamination of this nematode was 190 that identified from *Begonia* plant in Abas-Abad.

Tonekaboon, Amol, Ramsar, Kelar-Abad and Nashtarood have not any contaminated samples. 52% was the most population for *M. javanica* that was in Ramsar, *Aphelenchoides* had the most frequency of 29% that was in Amol, *D. dipsaci* had the frequency of 22% that was in Salmanshahr and the total

frequency percentage of these three nematode was 25, 15 and 8 respectively.

Index Terms— nematode, ornamental plants.

I. INTRODUCTION

Extent of ornamental plants under the cultivation in Mazandaran province was 615 hectares which included 232 hectares of greenhouse plants and 383 hectares of Outdoor plant. Amol city with the extent of 1587458, Ramsar and Tonekaboon with the extent of 1116121 and 1105800 square meters, respectively have the largest area under cultivation [1]. Like other production, Ornamental plants that grow in greenhouses have large range of nematodes that cause damage. Sasser and Ferkman stated in 1987[43] that in all of the world, 11.1 percentage of damage caused by nematodes on ornamental plants [22]. In different areas of the world, ornamental plants as well as other agricultural products are under the attack of nematodes and large numbers of researchers reported the existence of nematodes on the ornamental plants[39, 37, 38, 34, 46, 12, 14, 5, 9, 33, 2, 23, 24, 40, 44, 48, 29, 4, 7, 17, 25-27, 21, 18, 47, 20, 30-31, 15, 16, 32, 3, 41]. The flowering ornamental plant parasitic nematodes, research has been done in Iran [22, 45, 35],[9-11].

Plant Protection Research Department, Mazandaran Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Sari, Iran

Iranian Research Institute of Plant Protection, Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran

II. MATERIAL AND METHODS

Greenhouse and outdoor ornamental plants in the province was investigated, soil and root samples collected from a depth of 10 to 30 Cm of soil of different region. Ornamental plants and external greenhouse randomly selected; sampling was done by 3 sub-samples per each 1000 meter greenhouse. So sub-sample of each plant mix with each other and one sample gained. Totally 171 samples of soil and root were collected. Nematodes of each soil sample separated with Jenkins method [28] after transferring to the Laboratory. 5 grams root of each sample was used, so the nematodes which existed inside of root extracted by Blonder and Centrifugal methods[6]. After extraction of nematodes in the soil and roots, counting the number of nematodes per sample were determined by using a counting slide in the suspension obtained from a certain volume of soil. Vermiform nematodes fixed and then transferred into the pure glycerin

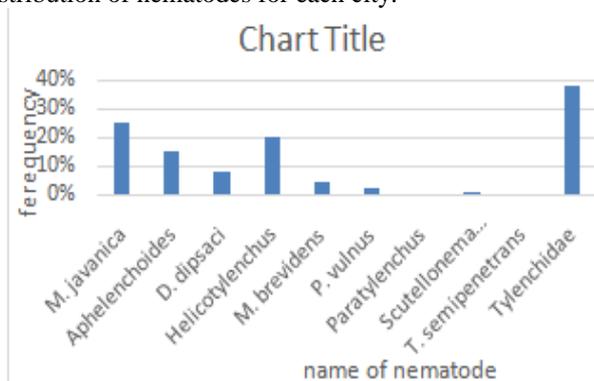
Seyed Esmaeil Mahdavian, Assistance professor, Natural Resources and Education, Agricultural Research center of Mazandaran, Farahnaz Jahanshahi,

and different slides and morphological characteristics were identified. Infested areas of nematodes identified and their frequency percentages determined according to the numbers of samples ratio which has desired species to the total samples.

III. RESULTS

170 samples of soil, root and standing parts of ornamental greenhouses plant collected from different city of Mazandaran province which included Amol (7 samples), Tonekaboon (23 samples), Ramsar (21 samples), Salmanshahr (9 samples), KelarAbad (24 samples), AbasAbad (34 samples), Nashtarood (9 samples), Nowshahr (34 samples), Hachirood (9 samples). These samples collected from 74 flowers and ornamental plants that belong to the 50 different groups of plant and collected between the years of 2012-2015 and then investigated. There wasn't any nematode contamination in aboveground organs of plant. Totally nine genera and 10 species (*M. javanica*, *Aphelenchoides*, *D. dipsaci*, *Helicotylenchus*, *Scutellonemabrachyurus*, *M. brevidens*, *P. thornei*, *P. vulnus*, *Paratylenchus* and *Tylenchulus semipenetrans*)

Belonging to eight families and Tylenchidae and Tylenchidae family (from this family of the following genera *Filenchus*, *Boleodorus*, *Psilenchus*, *Basiria* and *Neopsilenchus*) extracted and identified .The amount of nematodes that extracted from 250Cm³ of soil identified and then showed the distribution of nematodes for each city.



Figure(1) Frequency percentage of each nematode that was in total samples.

The frequency percentage of each nematode **Figure(1)** calculated according to the most population, plant name and the name of the region .*M. javanica*, *Aphelenchoides* and *D. dipsaci* were the host of three important nematodes of ornamental plant parasites; these hosts investigated according to the number of nematodes per 250 Cm³ of soil, average of population that exist on each host and the number of contaminated samples for each city . Also, frequency percentages of these three nematodes for each region calculated separately **Figure (2)**.

Amol

The investigation results of collected samples from Amol city (7samples) shows five genera and three species and one family of nematodes that existed in the soil of greenhouse, strelitzia flower with the 1170 nematodes has the largest amount of population. Tylenchidae with 57 frequency

percentage has the most distribution. *Scutellonemabrachyurus* nematodes have the largest amount of frequency of 1270 and 28 frequency percentage of Plant asparagus that extracted from 250 cm³.

Tonekaboon

One species, three genera and one family identified from collected samples of Tonekabon city. *Helicotylenchus* nematode with 13% frequency has the most distribution and its most nematode population of was 250 that existed 250 Cm³. *Aphelenchoides* nematode had the frequency of 9% and maximum population of 100. Tylenchidae nematode with the frequency of 9% and maximum population of 30 nematodes separated from 250 cm³ of soil. *Ramsar*

Four species, six genera and one family of nematodes identified between the collected samples of Ramsar city (21 samples). *Helicotylenchus* nematode with the frequency of 62 has the most distribution. The most population of this nematode existed in the greenhouse that located in Shosta village, so 2760 nematodes existed in 250 cm³ of soil. *M. javanica* had the frequency of 52/4% and the most population of it separated from 250 cm³ which existed just on the Hortensia plant. Tylenchidae nematode with the frequency of 33/4% and the most nematode population of 300 existed in third place.

Salmanshahr

Four species, six genera and one family of nematode identified among the collected sample from Salmanshahr (9 samples) city. *M. javanica* has 33% distribution; the most population of this nematode was 1140 in 250 cm³. *Aphelenchoides* nematode has 25 frequency percent and maximum population of 20. *P. thornei* identified from population of 10 nematodes per 250 cm³ of soil.

KelarAbad

Two species, six genera and one family of nematode identified among the collected sample from KelarAbad (24sample) city . *D. dipsaci* species has 14 frequency percentage and the most population of 20 nematode, *Helicotylenchus* nematode has 14 frequency percent and the most population of it existed on Linda flowers with the number of 920 nematode. Tylenchidae with the 230 nematode collected from two species. Contamination to *M. javanica* nematode was low and 4 frequency percent with 40 nematodes collected from Red Fotonia.

Abas-Abad

Two species, four genera and one family of nematode collected from Abas-Abad (34 sample) city. *M. javanica* with 24 frequency percentage and 670 nematodes was collected from 250 cm³ soil that was around of pilea root. *D. dipsaci* nematode with 23 frequency percent and 190 was in the second place of distribution. Tylenchidae with 50 frequency percentage has the most distribution and the most population of it existed on the Pothos plant that is located on Karkas region with the 3600 nematodes in 250 cm³. *Aphelenchoides* nematode has the 14 frequency percent and *Helicotylenchus* has 18 frequency percentages.

Nashtarood

Three species, five genera of nematodes was identified from collected samples of Nashtarood city. *Helicotylenchus* nematode with 45 frequency percent has the most distribution, so the most population of this nematode with 1800 number existed on Fern plant that identified from 250

cm³. Tylenchulussemipenetrans identified from 250 cm³ of soil and has the frequency percentage of 33 and most population of 540. P. thornei nematode with the frequency percent of 33 located in the soil of Hortensia, Aglaonema and Fern plant.

Nowshahr

Four species, six genera and one family of nematode identified from collected sample of Nowshahr (34 samples) city. M. javanica with frequency percent of 57 and nematode population of 2520, Tylenchidae with the frequency percentage of 44 and nematode population of 1010 have the most distribution. D. dipsaci nematode has 33 frequency percentage and 30 nematode that extracted from 250 cm³. Aphelenchoides genera Nematode was saw in two samples. Merliniusbrevidens nematode with the frequency of 24 and population of 720 extracted from 250 cm³. Hachirood One species, 4 genera and one family of nematode was identified from collected sample of Hachirood (9 samples) city. Tylenchidae with the frequency of 44 percent and population of 720 has the most distribution. M. javanica nematode has 33 frequency percentage and 170 nematode population that collected from 250 cm³ of soil. D. dipsaci nematode saw just in one sample. Aphelenchoides and Helicotylenchus nematode with 22 frequency percentage has the similar distribution.

Generally 74 ornamental plants that belong to the 50 family was collected during 2012-2016 and investigated. Totally nine genera and 10 species (M. javanica, Aphelenchoides, D. dipsaci, Helicotylenchus, Scutellonemabrachyurus, M. brevidens, P. thornei, P. vulnus, Paratylenchus, Tylenchulussemipenetrans) belonged to the 8 families and Tylenchidae family (Boleodorus, Psilenchus, Basiria, Neopsilenchus, Filenchus belong to this family) extracted and identified.

Tylenchidae with 64 contaminated has the most frequency percentage. The most population of nematode related to the Pothos plant that was located in Abas-abad region. Paratylenchus nematode with one contaminated sample has the lows frequency percentage and the most population of nematode related to the Asparagus plant in Amol city. M. javanica with 43 contaminated samples and 2520 nematode was collected from Pothos plant that is located in Nowshahr. Figure (1).

32 out of 74 collected ornamental plants was host of M. javanica, 21 plants was host of Aphelenchoides and 12 plants was the host of D. dipsaci; therefore 43, 25, 14 samples reported that contaminated to these three nematodes. 15 contaminated samples was the most amounts that located in Nowshahr, the most population of 2520 identified from the Pothos plant of Nowshahr city and Nashtarood and tonekaboon has zero contaminated samples. The most contaminated samples to the Aphelenchoides identified from Nowshahrthah has six samples and the most population of this nematode with 320 population identified from camellia plant in Hachirooda and Tonekaboon with one sample has the lowest contaminated sample. There are six contaminated samples to the D. dipsaci that located in Nowshahr and the most contamination of this nematode was 190 that identified from Begonia plant in Abas-Abad. Tonekaboon, Amol, Ramsar, Kelar-Abad and Nashtarood have not any

contaminated samples 52% was the most population for M. javanica that was in Ramsar, Aphelenchoides had the most frequency of 29% that was in Amol, D. dipsaci had the frequency of 22% that was in Salmanshahr and the total frequency percentage of these three nematode was 25, 15 and 8 respectively Figure(2).

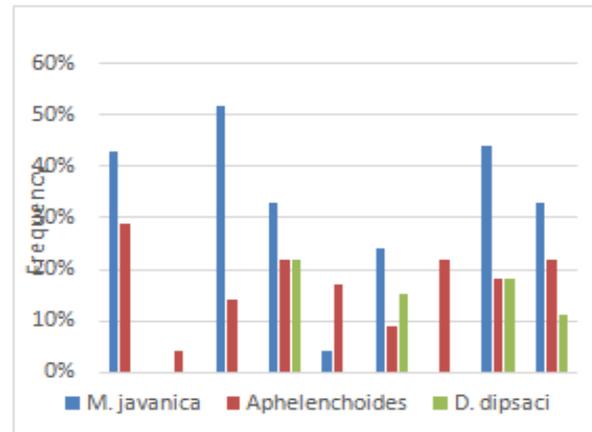


Figure (2) Percentage of population abundance of three nematode parasites of important ornamental plants for each region

IV. DISCUSSION

Two families of Liliaceae (Aloe, Mondo grass, Dragon tree, Grass, Hvsna, Snsvrya, wheat and horse's mane plant) and Araceae (Fig leaf plant, Spathiphyllum, Aglaonema, claws Ghazi, Potosi, dieffenbachia and syngonium) with 7 plant have the most collected sample out of 74 ornamental plants that belong to the 50 families. M. javanica, Helicotylenchus, Aphelenchoides, D. dipsaci and Tylenchidae are the most nematode in greenhouse of Mazandaran province with 25, 20, 15, 8, 38.5 frequency percentage. M. brevidens, P. thornei, P. vulnus, Scutellonemabrachyurus and Paratylenchus had frequency percentage of 4, 3.5, 2, 1 and 0.6. Generally, Tylenchidae with 64 contaminated samples had the frequency percentage of 35.5, and the population of 3600 identified from Pohtos plant in Abas-Abad. The lowest frequency percentage of 0.6 related to the Paratylenchus nematode and 10 nematode saw on the Asparagus plant in Amol. Plant parasites were some of the identified nematodes in this research and it seems that cause damage to ornamental plant. 32 out of 74 ornamental plants were the hosts of M. javanica, 21 plants were the host of Aphelenchoides and 12 plants were the host of D. dipsaci that 43, 25, 14 contaminated samples to these nematodes reported. Nowshahr had the most contaminated samples of 15 and the most population of these nematodes was 2520 and identified on Pothos plant with. Nashtarood and Tonekabonn have not any contaminated samples. Most of the samples in Nowshahr were contaminated to the Aphelenchoides and the most population of it was on camellia plant with 320 nematodes that located in Hachirood. Also, the lowest contaminated samples were in tonekabon that was just one sample. D. dipsaci with six contaminated samples was located in Nowshahr and the population 190 nematode identified from Begonia plant that located in Abas- Abad and Amol, Tonekaboon, Ramsar, Kelar-Abad, Nashtarood hadn't any contaminated samples.

M. javanica in Ramsar had 52 frequency percentages, *Aphelenchoides* had 29 frequency percentages in Amol and *D. dipsaci* had 22 frequency percentages in Salmanshahr and the total frequency for these three nematodes were 25, 15 and 8 percentage respectively. *M. javanica* extracted from Ramsar, Nowshahr, Amol, Salmanshahr, Hachirood, Abas-Abad, Kellar-Abad, and had frequency percentage of 52, 44, 43, 33, 33, 24, 4 respectively and just the samples of Tonekabon were without any contamination. *P. vulnus* nematode has frequency of 2% and 840 nematodes per 250 cm³ and *P. thornei* nematode with the frequency of 3.5% and 150 maximum nematodes per 250 cm³ of soil was collected from boxwood, canna, Hortensia, Aglaonema, Fern and Rose and identified. *Scutellonemabrachyurus* nematode has frequency of 1% and identified from in one greenhouse of Amol city and extracted from lily and Asparagus plant with 150 nematode per 250 cm³. For the nematodes of citrus tree roots, *Tylenchulussemipenetrans* from the soil of Cordyline Ornamental plants with the scientific name of *Cordylineaustralis*, *Fatsia japonica*, *Nephrolepisexallata*, *Euonymus japonica*, *Ophiopogon japonica* and *Cyperusalternifolius* were the Ornamental hosts. These plants are not the host of this nematode because it cultivated between the citrus trees. The larvae of citrus plant root identified in the soil, but there was not any nematode contamination after the investigation of root. It was proved that larvae belong to the roots of citrus plant, because Horse mane plant or other plant cultivated around the contaminated citrus trees and the larvae counted.

Although root knot nematodes, Nematodes of stem, foliage and buds extracted from ornamental plant, so it is essential to research about the effect of pathogenesis and extent of damage on ornamental plants. Nematodes of roots and *Fusarium* fungus effects on *Gerbera* plant and produce gland as a result of Hypertrophy, hyperplasia and root rot [42]. Since most ornamental greenhouse of province is infected with root rot disease and these nematodes increase the amount of disease [36] so we must do some research about the interaction of these two factors. Due to the abundance of *D. dipsaci*. and *Aphelenchoides* species in greenhouse of province, we must investigate the effects of them on ornamental plants. Plants like (lily) *Iris sibirica*, *Cycas revolute*, *Liliumlongiflorum*, *Canna wyoming* are plethora with Bulbs and rhizomes and transport by flower pot and these plants are contaminated to the *M. javanica* and it is essential to do some preventive measure for transfer of pot, Rhizomes and Bulbs to other countries. *D. dipsaci* species identified and *Iris sibirica* and *Cycas revolute* plant which plothra with bulbs are hosts of these species, so the transfer of bulbs to other greenhouses, city, province and other neighboring parts of the country must be investigate. Most of contamination in greenhouse of Nowshahr was type of plant parasitic nematodes. Nematode population was low in some greenhouses; due to disinfect of the soil. Population, diversity and pollution of greenhouses were different in outdoor plant, because temperature, humidity and light provided during the year. There was contamination with nematodes and root decay saw in sampling, so this can suggested the interaction of them. But not investigated in culture medium of laboratory.

CONCLUSION

Totally nine genera and 10 species (*M. javanica* , *Aphelenchoides* , *D. dipsaci* , *Helicotylenchus* , *Scutellonemabrachyurus* , *M.brevidens* , *P. thornei* , *P. vulnus* , *Paratylenchus* and *Tylenchulussemipenetrans*) Belonging to eight families and Tylenchidae and Tylenchidae family (from this family of the following genera *Filenchus* , *Boleodorus* , *Psilenchus* , *Basiria* and *Neopsilenchus*) extracted and identified. *M. javanica*, *Helicotylenchus*, *Aphelenchoides*, *D. dipsaci* and *Tylenchidae* are the most nematode in greenhouse of Mazandaran province with 25, 20, 15, 8, 38.5 frequency percentage. *M. brevidens*, *P. thornei*, *P. vulnus*, *Scutellonemabrachyurus* and *Paratylenchus* had frequency percentage of 4, 3.5, 2, 1 and 0.6. 32 out of 74 ornamental plants were the hosts of *M. javanica*, 21 plants were the host of *Aphelenchoides* and 12 plants were the host of *D. dipsaci* that 43, 25, 14 contaminated samples to these nematodes reported.

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I have been received B.S. degree from the Tabriz University, Tabriz, Iran. In plant protection engineering, in 1991 and MS from Azad University, Tehran, Iran. Plant pathology in 1996. and also PhD degree from Bangalore university, India, in the faculty of science in environmental science in 2009. currently I have been working an associate professor in the plant protection research station of nashtaroud, Mazandaran Province North of Iran my research interests pesticide residue, integrated pest management, plant disease, organic farming and also as a lecture in the university