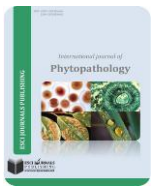

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SUITABLE HOSTS OF ROOT KNOT NEMATODE ATTACK: AN ASSESSMENT ON THE BASIS OF MORPHOLOGICAL SIZE VARIATIONS AND POPULATION DENSITY UNDER FIELD CONDITIONS

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A B S T R A C T

Root knot nematodes (*Meloidogyne* species) are major pests of vegetable crops causing serious losses in quantity and quality of crop yield. This study involves an assessment of their suitable hosts on the basis of variations in their population densities and body sizes in different vegetable crop plants under field conditions. A random survey of root knot nematode infestation in vegetable crops was conducted in 9 villages of Abhanpur block, Chhattisgarh state, Central India, from January 2012 to March 2012. Diseased plants were identified on the basis of above ground symptoms and soil and root samples collected by digging. Extraction of nematodes was done by Cobb's sieving and decantation method and Baerman's funnel technique. Identification was done microscopically by morphological examination of perineal patterns of female nematodes. Body sizes were measured by using an eyepiece/ocular micrometer. Twenty nine percent of the total farm area surveyed suffered from root knot nematode attack. Among the several genera of vegetable crop plants surveyed, *Lycopersicon esculentum, Dolichos lablab, Solanum melongena, Momordica charantia, Daucus carota,Capsicum annum,Cucumis sativus* had root galls. Three species of root knot nematodes *Meloidogyne incognita, M. javanica, M. areneria* were identified from the above hosts and a comparative morphometric analysis of the body, head and neck size ratios of females were done. Non-significant body and head size variations existing between the females from *D. lablab, S. melongena, C. annum, D. carota, L. esculentum* showed that all the crops are equally susceptible to root knot nematode attack. However, on the basis of nematode population density, *D. carrota* appears to be the best suitable host of the *Meloidogyne* species other than *L. esculentum* and *S. melongena*.

Keywords: Population density, size variations, *Meloidogyne spp.*

INTRODUCTION

Root knot nematodes (*Meloidogyne* spp.) characterized by pear- shaped females are widely specific parasites attacking almost every species of higher plant. Besides population density, variations in morphological characters have been reported among the individuals of a species and may be geographical, ecophenotypic or host induced (Ahmed and Jairajpuri, 1981). Pant *et al.* (1983) observed the existence of a correlation between the degree of susceptibility of the host plant and the size of the female nematode. Besides, identification of suitable hosts for root knot nematodes on the basis of galling index, population density and reproduction factors have also been done (Davide, 1980; Davis *et al.* 1992; Zhang and Smith, 1994; Araya and Caswell-Chen, 1994; Cervantes-Flores *et al.,* 2002; Adegbite *et al.*, 2005; Saleh *et al.*, 2009; Gutiérrez-Gutiérrez *et al.,* 2011 and Sajid *et al.*, 2011).This study involves an assessment of the suitable hosts for root knot nematodes on the basis of their population density and morphological size variations in different vegetable crop plants under field conditions.

MATERIALS AND METHODS

Eighteen soil and root unit samples were randomly collected from diseased fields belonging to nine villages , namely, Khursenga, Birejhar, Mura, Chatoud, Gatapar, Mohandi, Kopedih, Ganeshpur and Kotgaon of Abhanpur block, Chhattisgarh state, Central India. Each unit sample was a composite of 20 cores obtained from four corners

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and centre of the field. Sub samples consisting of 200cc of soil and 10 gram of root mixed together were prepared from the unit samples and kept in separate polythene bags, sealed tightly and tagged with relevant information. Storage was done at 4ºC for not more than 7 days. Extraction of nematodes from these subsamples was done by Cobb's sieving and decantation method using sieve sets of sieve sizes 600µ , 250µ, 45µ, 38µ and 25µ and Baerman funnel technique (Taylor and Netscher, 1974; Southey, 1986) Counting of adults and larvae was done under a microscope in a specially designed chambered counting dish.

For identification, killing of the nematodes was done rapidly through heating, up to 65-90°C followed by immediate fixing with 4-5 ml of formalin 4% added to 100 ml nematode suspension (Taylor and Netscher, 1974).The root system was carefully washed with water to remove the adhering soil. The small root bearing knots were cut into pieces and placed in hot (80°C) lacto phenol – cotton blue solution with the help of a forceps and left for 1-3 minutes, allowing the stain to penetrate the material. The excess stain was washed off with water and the material transferred to pure lacto phenol to remove the stain from the plant tissue. The pieces of roots were then put in a petridish, filled with lactophenol or glycerine and observed under the dissecting microscope, (Model No. Olympus, VT-II 238088 Japan).

Meloidogyne females were dissected out from the galls root and placed into a drop of lacto phenol in a slide. The posterior half of the body was cut off with a blade. The lower portion of the cuticle having perineal patterns was further spread and the inner tissue completely removed by a flexible bristle as described by Taylor and Netscher (1974). The perineal patterns were then transferred into a drop of glycerine on a microscopic slide. The cover glass was gently placed and sealed with Zut or glyceel (Jacob and Bezooijen, 1977) and observed under the stereomicroscope with zoom and camera attachment for microphotography (Carl Zeiss Stemi 2000-C, 1000X magnification and Leica DMLS, 1000X magnification).

Sixty three females of the genus *Meloidogyne* (*M. incognita, M. areneria* and *M. javanica*) obtained under field conditions from different vegetable crop plants and belonging to three localities (Chatoud, Birejhar, Kopedih) were measured for the lengths and widths (µm) of their head, neck and body with a micrometer. Size ratios were calculated as the ratio of length/width. Statistical Analysis was done by single way ANOVA with the help of MS office EXCEL.

RESULTS

Twenty nine percent of the surveyed area suffered from root knot nematode attack. Among the several genera of vegetable crop plants surveyed, *L. esculentum, D. lablab, S. melongena, M. charantia, D. carota, C. annum, C. sativus* and *A. viridis* had root galls. The highest nematode population density was observed in *D. carota* (4960 nematodes/200cc soil &10g root) in village Kopedih and *S. melongena* (3524 nematodes/200cc soil & 10g root) in the village Mohandi and Kotgaon. Medium population densities were observed in *A. viridis* (1716) in village Mura; *C. sativus* (1260) in village Chatoud and *L. esculentum* (1458) in villages, Chatoud, Khursenga, Birejhar, and Gatapar. The highest mean root knot nematode population density (8320 nematodes/200cc soil and 10g root) was observed in *S. melongena* in the village Bhilai, followed by village Kotgaon (6720), Kopidih (4960) and Mohandi (4840) (Figures 1 and 2). Most of the villages sampled comprised of Laterite soil type with usage of flood irrigation system.

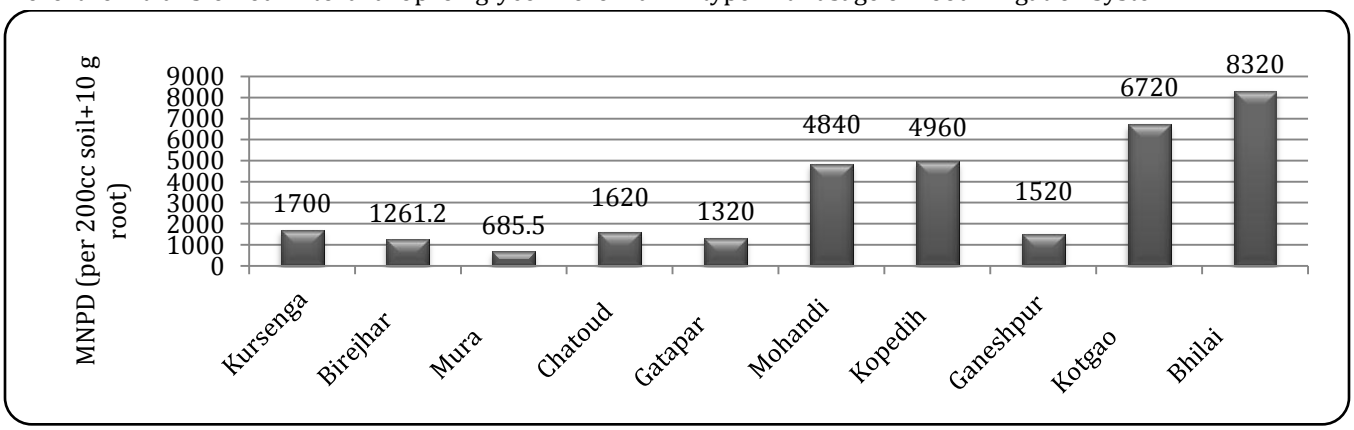


Figure 1. Mean Nematode Population Density in Villages of Abhanpur Block (CG)

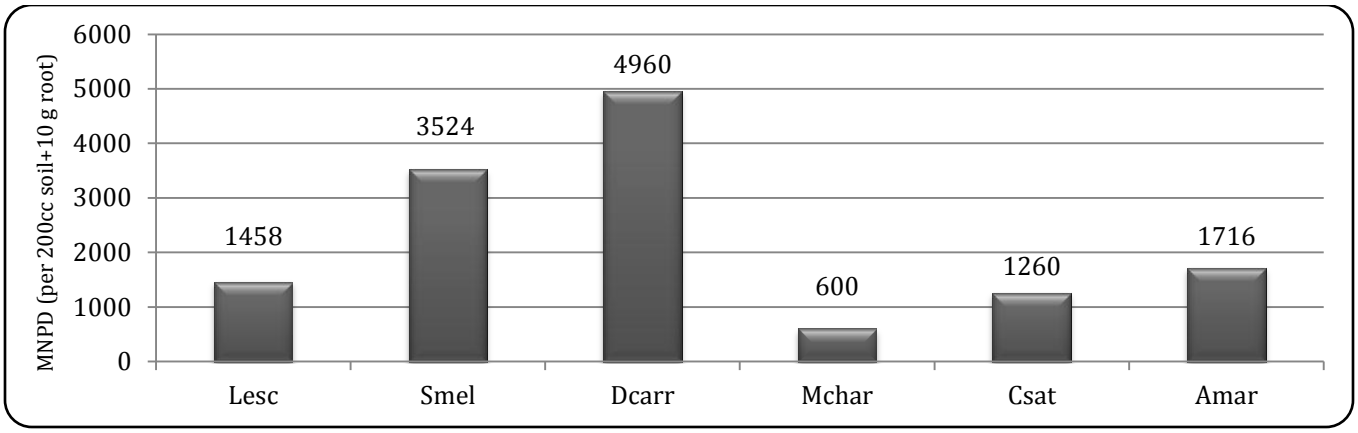
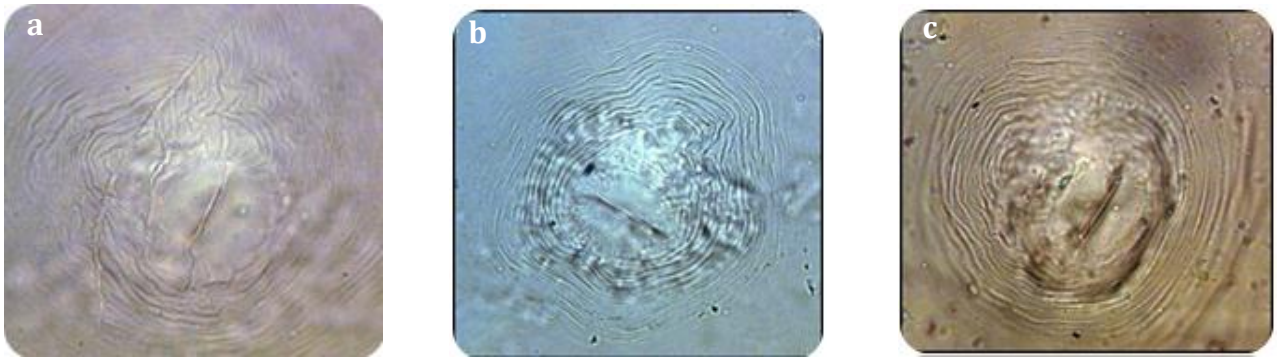


Figure 2. Mean Nematode Population Density (Per 200cc soil + 10g root) cropwise in Abhanpur Block (CG)

On the basis of perennial patterns, three species of *Meloidogyne* [Fig. 3(a) –(c)] *viz., M. areneria, M. incognita,* and *M. javanica* were identified to exist either singly or concurrently. The most frequently occurring species was *M. incognita* (47.61%) attacking *L. esculentum, D. lablab and D. carrotus*. This was followed by *M. javanica* (34.92%) attacking *L.esculentum* and *C.annum* and *M. areneria* (17.46%) attacking *S. melongena*. Species wise, locality wise and crop wise variations in the mean size ratios of *Meloidogyne incognita, M. javanica* and *M. areneria* are depicted in figures 4 to 8. Insignificant variations, species wise, were observed in body and head size ratios, while highly significant variations were observed in neck size ratios ($F=41.86$; $P<0.001$). *M. incognita* procured from different localities showed insignificant variations in body and head size ratios, while significant variations in neck size ratio ($F=31.35$; $P<0.001$) were observed. Similarly, *M. javanica* showed significant variations ($F=35.00$; $P<0.001$) locality wise in neck size ratios only.



Meloidogyne areneria *Meloidogyne incognita* *Meloidogyne javanica*

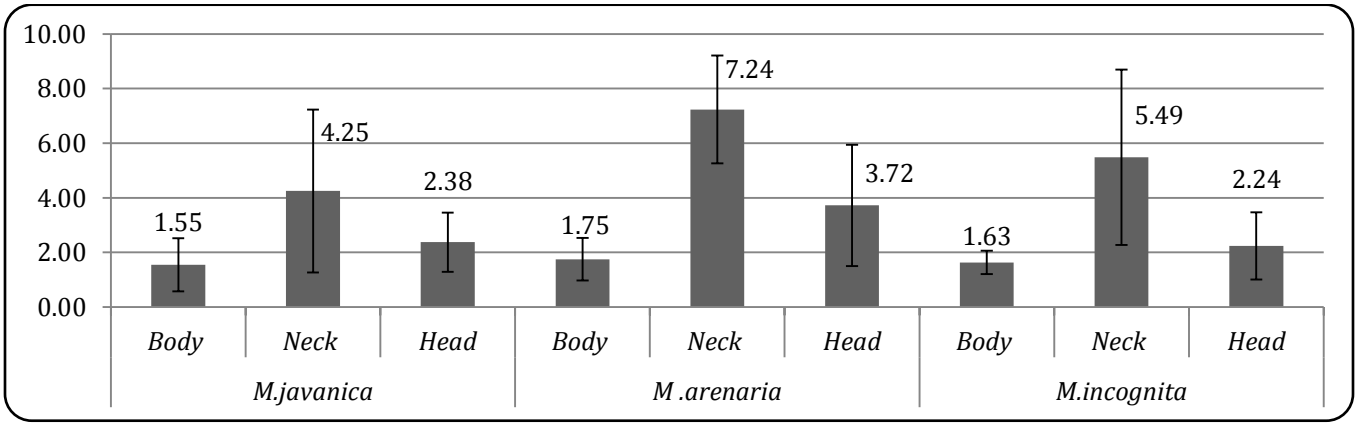


Figure 4. Variations in mean size ratios of *Meloidogyne* spp.

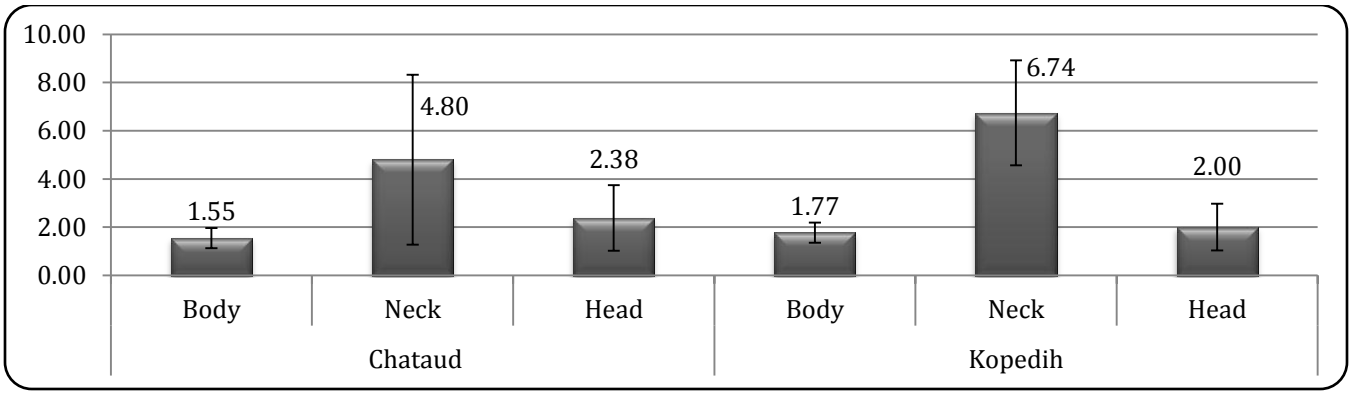


Figure 5. Locality wise variations in size ratios of *M. incognita.*

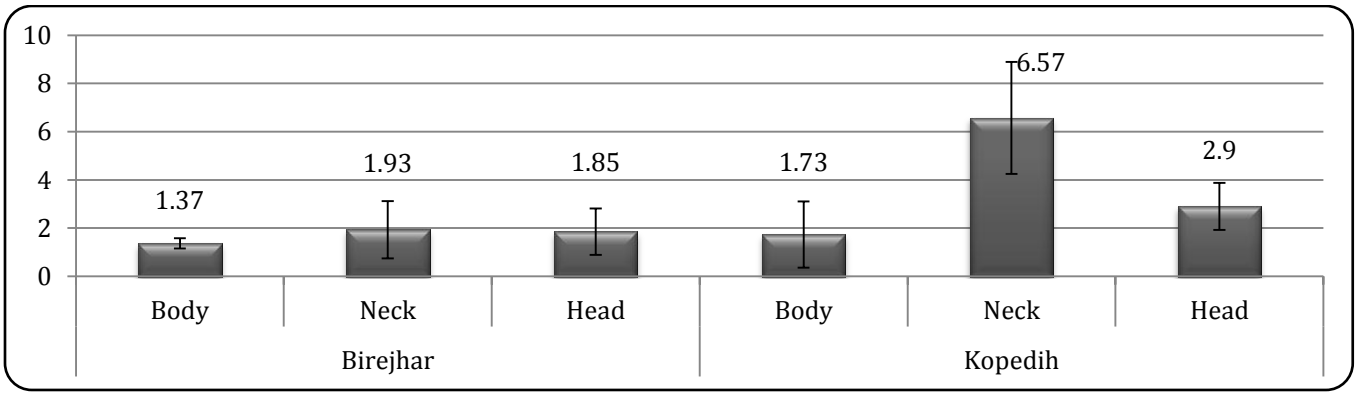


Figure 6. Locality wise variations in size ratios of *M. javanica*.

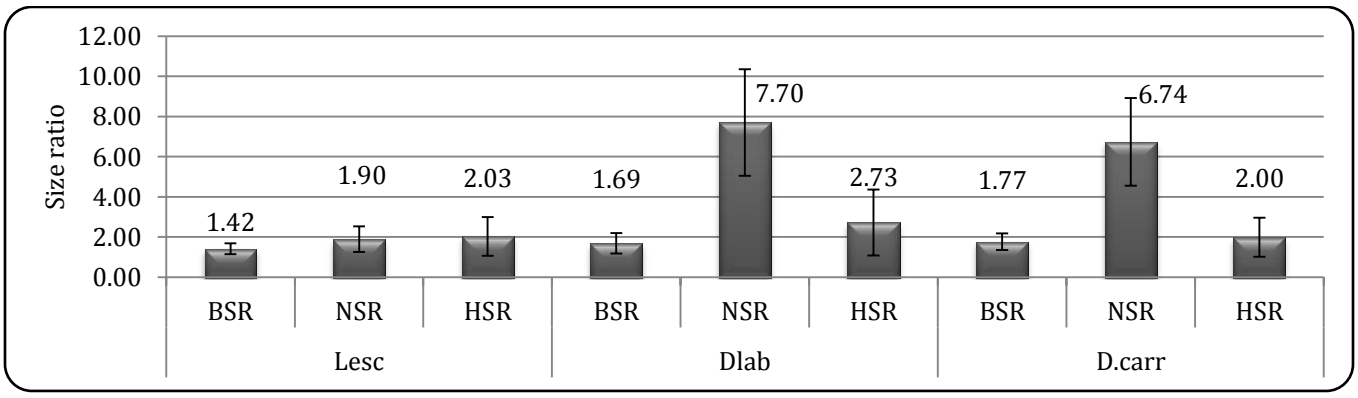


Figure 7. Crop wise variations in size ratios of *M. incognita.*

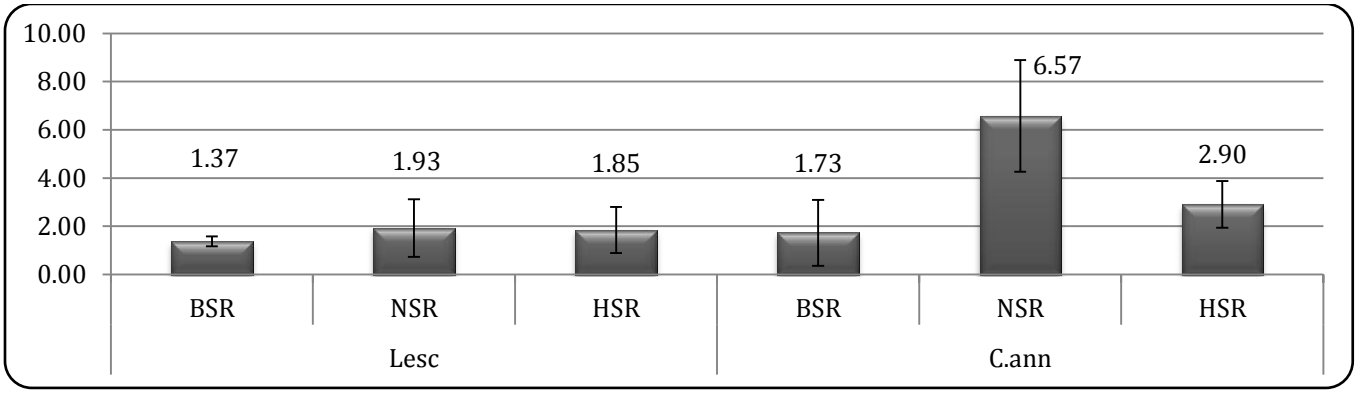


Figure 8. Crop wise variations in size ratios of *M. javanica*.

Highly significant variations in neck size ratios were also observed among *M. incognita* procured from different crop plants, such as, *Lycopersicon esculentum, Dolichus lablab* and *Daucus carota*. Similarly, *M. javanica* procured from *L.esculentum* and *C. annum* also showed significant variations (F=35.00; P<0.001). However, body and head size ratios showed insignificant variations crop wise in both cases.

DISCUSSION

Similar results were obtained by Sao *et al.* (2008) who studied the prevalence of root knot nematode infection in vegetable crops in five districts (Durg, Rajnandgaon, Raipur, Janjgir and Dhamtari) of Chhattisgarh. However, their work did not include Abhanpur block. The total vegetable cropland found to be affected by *Meloidogyne incognita* was 1.79 %. They observed the highest average population density (2169 nematodes/10 gm root and 29993 nematodes / 200 cc soil) in the village Funda (District Durg). Among the several genera of vegetable crop plants surveyed by them *Lycopersicon esculentum, Dolichos lablab and Momordica charantia* showed the presence of root galls with the highest average population density in *Dolichos lablab* in the month of January. Sahu *et al.* (2011) observed *Meloidogyne incognita* and *M. javanica* associated with tomato, brinjal (eggplant), cowpea and bottle gourd to be the predominant nematode species.

Gautam *et al*. (2014) studied the status of root knot nematode infection in vegetable crops in some districts of Central plain region of Chhattisgarh. The overall incidence of infection was 54.54 % and ranged between 30 to 80 %. Out of 13 species of vegetable crops surveyed, 9 were observed to be infected on the basis of nematode population densities in soil and root samples. The most frequently occurring species was *M. incognita* (63.33 %), followed by *M. arenaria* (20 %) and *M. javanica* (16.67 %). Maximum frequency was observed in *Lageneria siceraria* (100 %), and least in *Musa paradisiaca, Daucus carota* and *Amaranthus tristis* (50 %). The mean population density of 2nd stage nematodes ranged between 766 and 9076 nematodes/200cc soil and 10gm roots in samples. The presence of *Meloidogyne incognita and M. javanica* in our samples as the most predominant nematode associated with vegetable crops in this region, corroborates the works of Sahu *et al.* (2011) and Gautam *et al*. (2014).

Powers *et al*. (1991) suggested that size varies with the degree of susceptibility among the *Meloidogyne* species. Non-significant body and head size variations existing between the females from *Dolichos lablab, Solanum melongena, Capsicum annum, Daucus carota, Lycopersicon esculentum* in the present case, shows that all the crops are equally susceptible to root knot nematode attack. However, on the basis of nematode population density *Daucus carrota* appears to be the best suitable host of the *Meloidogyne* species other than *L. esculentum* and *S.melongena***.** This is in contrary to Gautam *et al*. (2014)who reported the frequency of occurrence of *Meloidogyne species* to be minimum in *Daucus carota.* It may also be concluded that the villages Kopedih, Mohandi and Kotgaon were the worst affected among all the villages sampled. The possible fixation of females in different positions of neck movement may be the basis of significant variations in neck size ratio, crop wise, species wise and locality wise.

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REFERENCES

Adegbite, A. A., S. O. Adesiyan, G. O. Agbaje and O. O. Omoloye. 2005. Host suitability of crops under Yam intercrop to root-knot nematode (*Meloidogyne incognita* Race 2) in South-Western Nigeria. Jour. Agric. Rural Develop. in the Tropics and Subtropics(JARTS). 106: 113–118.

Ahmed, N. and M. S. Jairajpuri. 1981. Statistical analysis of variability in a population of *Parahadronchus shakili* (Nematoda), Nematol. Medit. 9: 163-173.

Araya, M. and E. P. Caswell-Chen. 1994. Host Status of *Crotalaria juncea*, *Sesamum indicum*, *Dolichos lablab*, and *Elymus glaucus* to *Meloidogyne javanica*, J. Nematol. 26(4):492-497.

Cervantes-Flores, J. C., G. C. Yencho and E. L. Davis. 2002. Host reactions of Sweet potato genotypes to root-knot nematodes and variation in virulence of *Meloidogyne incognita* populations. HortScience. 37(7): 1112–1116.

Davide, R. G. 1980. Influence of different crops on the dimensions of *Meloidogyne arenaria* isolated from fig. Proc. Helminth. Soc. Wash. 47: 80-84.

Davis, R. M. G., A. W. Meerow and F. G. Bilz. 1992. Host suitability of *Ixora* spp. for the Root-knot nematodes *Meloidogyne incognita* Race 1 and *M. javanica.* J. Nematol. 24(4S): 722–728.

Gautam, S. K., G. Sahu, B. K. Verma and A. N. Poddar.

2014. Status of root-knot nematode (*Meloidogyne* species) disease in vegetable crops of some districts of central plain region of Chhattisgarh state, India. Afr. Jour. Microbiol. Res. 8:1663-1671.

Gutiérrez-Gutiérrez, C., J. E. Palomares-Rius, R. M. Jiménez-Díaz and P. Castillo. 2011. Host suitability of *Vitis* rootstocks to root-knot nematodes (*Meloidogyne* spp.) and the dagger nematode *Xiphinema index* and plant damage caused by infections. Plant Pathol. 60: 575–585.

Pant, V., S. P. Singh, S. Hakim and S. K. Saxena. 1983. Development of Root knot nematode and morphometrics of the females of the nematode *Meloidogyne incognita*, as influenced by different Cucurbits. Indian Jour. Nematol.13: 79-83.

Powers, L. E., R. A. Dunn and R. Mcsorley. 1991. Size differences among root-knot nematodes on resistant and susceptible Alyce clover genotypes. J. Nematol. 23:243-248.

Sahu,R., P.Chandra and A.N. Poddar. 2011. Community analysis of plant parasitic nematodes prevalent in vegetable crops in district Durg of Chhattisgarh, India. Res. Jour. Parasitol. 6: 83-89.

Sajid, A. K., J. Nazir, M. Kamran, I. U. Haq, and M. A. Haq. 2011. Invasion and development of *Meloidogyne incognita* race 1 in different cultivars. Pak. J. Nematol. 29:63-70.

Saleh, N. A., A. S. Al-Hazmi, F. A. Al-Yahya and A. A. M. Dawabah. 2009. Host suitability of different green bean cultivars to *Meloidogyne incognita.* In: 10th Arab congress of Plant Protection. Beirut, Lebanon, 26-30, October 2009. Abstracts book, Arab Journal of Plant Protection. (N11), pg E99.

Sao, R., P. Chandra and A. N. Poddar. 2008. Prevalence of root knot nematode (*Meloidogyne incognita*) infection in vegetable crops in Chhattisgarh. Bio Nature. 28 : 61-67.

Southey, J. F.1986. Laboratory methods for work with plant parasitic and soil nematodes. Ministry of Agriculture, Fish and food, HMSO, London. 202.

Taylor, D. P., and Netscher, C. 1974. An improved technique for preparing perineal patterns of Meloidogyne spp. Nematologica. 20(2), 268-269.

Zhang, F. and D. P. Smith. 1994. Host status of 32 plant species to *Meloidogyne konaensis.* J Nematol. 26(4S): 744–748.