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Host Choice in *Rotylenchulus* Species

Y. S. Rathore*

Principal Scientist (Retd.), Indian Institute of Pulses Research, Kanpur-208 024 (U.P.) India

*Corresponding Author E-mail: yogendra_rthr@yahoo.co.in

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ABSTRACT

The reniformis nematodes of the genus Rotylenchulus (Haplolaimidae: Nematoda) are sedentary semi-endoparasites of numerous crops. There are ten species out of which R. reniformis and R. parvus are important, and three species (R. amanictus, R. clavicadatus, R. leptus) are monophagous: two on monocots and one on Rosids. In general, Rotylenchulus species are capable of feeding from very primitive Magnoliids to plants of advanced category. Preference was distinctly observed towards the plants in Rosids (42.779%) followed by monocots (23.949%) and Asterids (21.755%). The SAI values were also higher for these groups of plants. The study on lineages further revealed intimate affinity to febids (25.594%), followed by commelinids (18.647%), malvids (16.088%), lamiids (11.883%), and campanulids (9.141%). Poales contribution within commelinids was 65.353%. Maximum affinity of Rotylenchulus species was observed by their association with plants from families Poaceae (7), followed by Fabaceae (6), Malvaceae (6), Asteraceae (4), Oleaceae (4), Soanaceae (4) and so on.

Key words: *Agiosperms, Gymnosperms, APG IV system, Reniform nemtodes, Monocots, Rosids, Asterids*

INTRODUCTION

Plant parasitic nematodes pose a great constraint on food and fruit production throughout the world. Damage caused by plant nematodes has been estimated at US $ 80 billion per year [11]. The reniform nematodes of the genus *Rotylenchulus* (Haplolaimidae : Nematoda) are sedentary semi- endo-parasites of numerous herbaceous and woody plants[17]. They are predominantly distributed in tropical and subtropical climates. Out of ten species of *Rotylenchulus*, *R. reniformis* and *R. parvus* are important and pose significant threat to large number of crops, whereas the other eight species are of limited importance. It has been observed that nematodes, in general, parasitize hosts from selected group of plants as observed by Rathore and Ali[13] in *Meloidogyne incognita*, Rathore and Tiwari[14] in root-knot nematodes, Rathore and Tiwari[15] in *Aphelenchoides* species, and Rathore[12] *Xiphinema americanum.* It was, therefore, obvious to study the host preference of *Rotylenchulus* species in relation to various host plants and particularly to their affinity to taxonomic group(s) of plants.

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MATERIAL AND METHODS

Host plants of different species of *Rotylenchulus* reported by Nemaplex[10] and Marias and Swart[9] were downloaded and arranged according to the APG IV[1] system of classification of angiosperms which is based on molecular and morphological studies of plants. The families and orders thus reported in the literature were changed to as mentioned by the Wikipedia[18] for different plants. This resulted in placing of certain plants to new families and also placing existing families to new families/orders. Readers, therefore, may not find the same names of families and orders as reported earlier in the literature. APG IV system is delineated to several clades. But broadly speaking, angiosperms divided into monocots and eudicots (dicotyledons) clades and Eudicots into basal and core Eudicots. The classification is still in the developing stage and many families yet to find suitable place. These uncertain families/ orders have been tentatively placed in COM clade. The affiliation of host plants was decided on the basis of number of hosts parasitized as well as by computing the Affiliation Indices following the method of Rathore and Tiwari[14]. General Affiliation Index (GAI) was calculated for different *Rotylenchulus* species and Specific Affiliation Index (SAI) for taxonomic groups of plant species. Some ratios viz., species:genus, species:family and species:order were also calculated to support the host affinity. The terms mono-, oligo-, and polypagous were adopted as defined by Berneys and Chapman[3].

RESULTS AND DISCUSSION

Results are reported in Table 1 through 4. Perusal of Table 1 revealed that *Rotylenchulus* species, in general, are capable of parasitizing on all kinds of plants from very primitive Magnoliids to plants of developed category. However, preference was distinctly observed towards the plants of certain groups like monocots, Rosids and Asterids. Rosids contributed 42.779% plants followed by monocots (23.949%) and Asterids (21.755%). The SAI values were also higher for these groups of plants *viz.*, 1.242, 1.064, and 0.823 for Rosids, monocots and Asterids, respectively and supported the preference based on percent host plants in each taxonomic group. Contribution of Superasterids (4.570%) and COM clade (4.388%) in host range is worth mentioning and both of them got high SAI values because more host plants got grouped comparatively in less number of families and orders. Gymnosperms were also accepted as preferred hosts by some *Rotylenchulus* species (Table 1).

When the preference to taxonomic groups was evaluated on the basis of ratios of host species to their genera, families and orders, the highest ratios were observed in monocots, Rosids and Asterids indicating closeness of food plants with their genera, families and orders.. The same was also visualized in case of Superasterids and COM clade plants where host species utilized less number of families and orders and ultimately showed greater intimacy although had less number of host plants (Table 1).

Association of host plants in three major taxonomic clades was further evaluated by placing number of plants to different lineage groups (Table 2). Febid group contributed 25.594% host plants followed by malvids (16.088%). In Asterids, 11.883 and 9.141% plants were parasitized in lamiids and campanulids, respectively. However, in monocots, the commelinids showed maximum affinity having 18.647% plants and within commelinids , the Poales contribution was to the tune of 65.353%. In spite of large number of plants in the host range, *Rotylenchulus* species preferred plants of certain taxonomic groups.

Information on host range of individual species of *Rotylenchulus* is givan in Table 3. Out of ten *Rotylenchulus* species, *R. anamictus, R. clavicaudatus and R. leptus* showed monophagy and two were monophagous on monocotyledons and one on Rosids. Among the polyphagous species only *R. macrodoratus* and *R. parvus* had moderate number of host plants. The biggest host range was of *R. reniformis* which reported to invade 460 plant species from all taxonomic groups. The GAI values of all the monophagous species was 1.000, whereas in polyphagous species it ranged from 0.500 to 0.737 except in

R. reniformis where large number of host species grouped in much less number of genera, families and orders. *R reniformis* followed the same trend as was depicted for combined description of all the species of *Rotylenchulus*. The major contribution in the host range of *R. reniformis* was of febids (20.840%) and malvids (14.625%) followed by monocots (commelinids) (15.539%), lamiids (8.592%) and campanulids (7.861%). In addition to that *R. parvus* and *R. reniformis* also hosted on one each gymnosperm plants of family Cupressaceae and Cycadaceae, respectively.

Host plants in some families invited more than one Rotylenchulus species. The greater affinity was exhibited by seven *Rotylenchulus* species to host plants in Poaceae, followed by 6 in Fabaceae and Malvaceae and four each in Asteraceae, Oleaceae and Solanaceae (Table 4).

Hutchinson[7] divided dicotyledons in lignosae (trees and shrubs-a fundamentally woody group) and herbaceae (herbs or rarely shrubs-a fundamentally herbaceous group). For discussion, when families of all the host plants of *Rotylenchulus* species were placed in lignosae and herbaceae divisions, it was observed that about 60% of plant species fell in lignosae. This suggests that *Rotylenchulus* species prefer woody plants as their hosts except the ones which are monophagous on monocotyledons.

Gaur *et al.*[6] reported that host range of *R. reniformis* comprise more than 350 plant species including many important crops and weeds that support nematode population in the absence of host crops. Gaur and Perry[5] observed that *R. reniformis* preferred dicotyledons and results of the present study are in agreement of observations of these authors. Robbinson *et al.*[16] expressed his dissent because more dicot plants are present in nature as compared to monocots. It may be more useful if explanation is restricted to our observations i.e. host range of the nematodes in general and/or of any particular species. Similarly, there is a point of disagreement for a reported host plant. It would be better if it retested in the same locality and on the species it was reported earlier as a host. Ecological conditions and host cultivar or variety would undoubtedly play a great role in deciding the acceptability. Variation could also be due to different pathotypes or races prevailing in different ecosystems. Dasgupta and Seshadri[4] reported occurrence of two races (Race-A and Race-B) in India. Arias *et al.* [2] and Leach *et al.*[8] demonstrated genetic variability in *R. reniformis* populations using microsatellite markers suggesting that the pathogenic population of *R. reniformis* could be another species.

Molecular characterization of six valid known species of *Rotylenchulus viz., R. clavicaudus, R. leptus, R. macrodoratus, R. macrosoma, R. reniformis* and *R. sacchari* revealed that *R. reniformis* and *R. macrosoma* have sister relationship, but that relationship between other species remain unresolved [17]. In our study, however, *R. macrosoma* had very few host species (only eight), whereas *R. reniformis* 4604. However, all the plant species in the host range of *R. macrosoma* are also present in the host range of *R. reniformis*.

Table 1. Association of *Rotylenchulus* species with different host parameters

Taxonomic clade	Host species	Genera	Families	Orders	SAI
Magniliids	8 (1.463)	6 (1.791)	5 (4.000)	5 (5.128)	0.667
Monocots	131(23.949)	89 (26.567)	22 (17.600)	14 (17.949)	1.064
Eudicots	2 (0.366)	2 (0.597)	2 (1.600)	2 (2.564)	0.667
Superrosids	2 (0.366)	2 (0.597)	1 (0.800)	1 (1.282)	1.00
Rosids	234 (42.779)	116 (34.627)	43 (34.400)	31 (39.744)	1.242
Superasterids	25 (4.570)	15 (4.478)	9 (7.200)	3 (3.846)	1.00
Asterids	119 (21.775)	92 (27.463)	36 (28.800)	19 (24.359)	0.823
COM clade	24 (4.358)	11 (3.283)	5 (4.000)	2 (2.564)	1.444
Gymnosperms	2 (0.366)	2 (0.597)	2 (1.600)	2 (2.564)	0.667
Figures in parentheses are percent values					

Table 2. Distribution of host species in different lineages of important clades

Rotylenchulus spp.	MONOCOTS			ROSIDS			ASTERIDS		
	Alismatales	Lilinoid	Commelinids	Vitales	Fabids	Malvids	Ericales	Campanulids	Lamiids
R. anamictus	-	-	-	-	1	-		-	-
R. borealis	-	-	4	-	3	1		-	4
R. brevitubulus	-	-	1	1	-	1		1	-
R. clavicaudatus	-	-	1	-	-	-		-	-
R. leptus	-	-	1	-	-	-		-	-
R. macrodoratus	-	-	-	1	11	2		1	4
R. macrosoma	-	-	1	-	4	-		-	3
R. parvus	-	-	7	1	7	3		4	7
R. rentiformis	10	19	85	1	114	80	4	43	47
R. sacchari	-	-	2	1	-	1		1	-
TOTAL	10	19	102	5	140	88	4	50	65

Table 3. Host taxonomic relationships with *Rotylenchulus* spp.

S.No.	*Rotylenchulus species*	Taxonomic classification of host plants	No. of host species	GAI	Status
1	*R. anamictus*	**Rosids**-Fabaceae (1) *Acacia* sp.	1	1	Monophagous
2	*R. borealis*	**Monocots**-Poaceae (4) *Sorghum bicolor, Sorghumvulgare, Triticum durum, Zea mays;* **Rosids**-Fabaceae (3) *Arachis hypogaea, Phaseolus vulgaris, Pisum sativum*; Malvaceae (1) *Gossypium hirsutum*; **Asterids**-Convolvulaceae (1) *Ipomoea batatas*; Solanaceae (3)*Capsicum annuum, Solanum lycopersicum, Solanum tuberosum*	12	0.737	Polyphagous
3	*R. brevitubulus*	**Monocots**-Poaceae (1) *Zea mays*; **Rosid**s-Malvaceae (1) *Gossypium hirsutum*; Vitaceae (1) *Vitis* sp.; **Aster-ids**-Asteraceae (1) *Helianthus annuus*	4	0.5	Polyphagous
4	*R. clavicaudatus*	**Monocots**-Strelitziaceae (1) *Strelitzia* sp.	1	1	Monophagous
5	*R. leptus*	**Monocots**-Poaceae (1) *Bambusa* sp.	1	1	Monophagous
6	*R. macrodoratus*	**Magnoliids**-Lauraceae (1) *Laurus nobilis*; **Rosids**-Anacardiaceae (1) *Pistacia vera*; Fabaceae (3*) Ceratonia siliqua, Glycine hispida,G. max*; Fagaceae (2) *Quercuscalliprinos, Q. frainetto*; Malvaceae (1) *Gossypium hirsutum;* Moraceae (1) *Ficus carica*; Rosaceae (4*) Eriobotrya japonica, Prunus armeniaca, P.amygdalus, P.domestica*; Urticaceae (1) *Parietaria officinalis;*Vitaceae *(1) Vitis vinifera;* **Superasterids**- Caryophyllace (2) *Dianthus barbatus, D. caryophyllus;* **Asterids** Apocynaceae (1) *Nerium oleander*; Araliaceae (1) *Hedera helix*; Lamiaceae (2) *Mentha* sp., *Phlomis fruticosa*; Oleaceae (1) *Olea europaea*	22	0.571	Polyphagous
7	*R. macrosoma*	**Monocots**-Poaceae (1) *Zea mays*; **Rosid**s- Fabaceae *(4) Arachis hypogaea, Cicer arietinum, Glycine max, Phaseolus vulgari*s; **Asterids**-Oleaceae (1) *Olea europaea;* Solanaceae *(2) Solanum lycopersicum, S. tuberosum*	8	0.667	Polyphagous
8	*R. parvus*	**Monocots**-Cyperaceae (1) *Cyperus* sp.; Poaceae (6)*Cynodon dactylon, Hordeum vulgare, Pennisetum americanum, Saccharum officinarum, Sorghum bicolor, Zea mays***; Eudicots**-Proteaceae (1*) Macadamia sp.*;**Rosids**-Brassicaceae (1) *Brassica oleracea*; Caricaceae (1) *Carica papaya;* Cucurbitaceae *(1) Cucumis sativus*; Fabaceae (5) *Crotalaria juncea, Glycine max,Medicago sativa, Phaseolus vulgaris, Vigna unguiculata;* Malvaceae *(1) Gossypium hirsutum;* Rosaceae *(1)Prunus persica*; Vitaceae (1) *Vitis vinifera*; S**uperasterids**-Amaranthaceae (1) *Beta vulgaris*; Nectaginaceae (1) *Bougainvillea* sp.; **Asterid**s-Apiaceae (2) *Apium graveolens, Daucus carota*; Apocynaceae (1)*Carissa* sp.; Asteraceae (1) *Lactuca sativa*; Lamiaceae (2) *Thymus* sp., *Thymus vulgaris*; Oleaceae (1) *Oleaeuropaea*; Pittosporaceae (1) *Pittosporum* sp.; Solanaceae (3) *Nicotiana tabacum, Solanum lycopersicum,S. tuberosum*; **Gymnosperms**-Cupressaceae (1) *Cupressus* sp.	33	0.53	Polyphagous
9	*R. reniformis*	**Magnoliids**-Annonaceae (1) *Annona squamosa*; Lauraceae (3) *Cinnamomum zeylanicum, Persea americana, Persea gratissima*; Myristicaceae (1) *Myristica fragrans*; Piperaceae (2) *Piper betle, Piper nigrum;***Monocots**- Amaryllidaceae (3) *Allium canadense, A.cepa, A. sativum***;** Araceae (10) *Colocasia esculenta,Dieffenbachia compacta, Epipremnum aureum, Philodendron mexicanum, P. selloum, Xanthosoma atrovirens, X. caracu, X. nigrum, X. sagittifolium, X. viola*ceum; Arecaceae (23) *Acoelonhaphe wrightii, Archontophoenix alexandrae, Areca catechu, Bismarckia nobilis, Carepenteria acuminata, Caryota mitis, Chamaedorea cataractarum, C. elegans, Chamaerops humilis, Coccothrinax sp., Neodypsis decaryi, N. lastelliana, Palmaceae sp.,Phoenix roebelenii, Ptychosperma elegans, Ravenea rivularis, Rhapis excelsa, Sabal palmetto, Syagrus romanzofina, Thrinax morrissi,*		1.265	Polyphagous

Trachycarpus fortunel, Washingtonia robusta, Wodyetia bifurcata; Asparagaceae *(8) Asparagus densiflorus,A. sprengeri, Beaucamea recurvata, Chlorophytum comosum, Cordyline fruticosa, Dracaena draco, Sansevieria sp., S. trifasciata*; Asphodelaceae (3) *Aloe vera,Asphodelus fistulosus, Hemerocallis sp.;* Bromeliaceae *(7) Ananas ananssoides, A. ananssoides X A. cosmos,A. bractetus, A. cosmos,A. comosus X Pseudananas sagenarius, A. erectifolius,* P. *sagenarius*; Commelinaceae (4) *Commelina bengh*alen*sis, C. diffusa, C. elegans, C. erecta;* Cyperaceae *(3) Ambristylis miliaea, Cypers esculentus, C. rotundus;*Dioscoreaceae (4) *Dioscorea alata, D. cayenensis, D.polygonoidis, D.rotundata*; Helicooniaceae (1) *Heliconia* sp.; Musaceae (4) *Musa acuminata, M. martini, M.* sapientum, Musa sp.; Orchidaceae (1) *Orchidaceae* sp.; Poaceae *(40) Andropogon sorghum, Avena fatua, A. sativa, A. strigosa, Chloris gayana, Cynodon ium annulatum, Digitaria decumbens, D. criantha, D.sanguinalis, D. violascens, Echinochloa crus-galli, Eleusine indica, Eragrostis pilosa, Hordeum pusillum, Imperata cylindrica, Leptochloa colonicus, Lolium multiflorum, Oryza sativa, Panicum dichotomiflorum, P. maximum, Paspalum conjugatum, P. dilatatum, Rottboellia*cochinchinensis, R. exaltata, Saccharum officinarum*Secale cereale, Setaria barbata, S. glauca, S. pumila, S.viridis, Sorgum bicolor, S. bicolor X S. arundinaceum,S. halepense, S. vulgare, Triticum aestivum, Urochloaplatyphylla, U. texana, Zea mays*; Zingiberaceae (3)*Elettaria cardamomum, Hedychium coronarium, Zing*iber sp.; **Eudicots**-Papaveraceae (1) *Argemone Mexicana* **Superrosids**-Crassulaceae (2) *Echeveria* sp., *Kalanchoe* sp.; **Rosids**-Anacardiaceae (2) *Mangifera indica, Schinusterebinthifolius*; Begoniaceae (2) *Begonia cucullata, B.semperflorens*; Bixaceae (1) *Bixa orellana;* Brassicaceae(10) *Brassica campestris, B. napus, B. nigra, B. oleracea,B. rapa, Coronopus didymus, Lepidium virginicum, Raphanus sativus, Sinapis alba, S. arvensis;* Caricaceae (3)*Carica gracilis, C. papaya, Vasconcellea cauliflora;* Cleomaceae (2) *Cleome aculeata, C. viscosa*; Cucurbitaceae (13) B*enincasa hispida, Citrullus lanatus, Cucumismelo, C. sativus, Cucurbita maxima, C. moschata, C.pepo, Lagenaria siceraria, Luffa acutangula, L. cylindrica,Momordica balsamina, M. charantia, Trichosanthes dioica*; Fabaceae (84) *Aeschynomene americana, A. virginica, Arachis hypogaea, Caesalpinia pulcherrima, Cajanus acutifolius, C. albicans, C. cajan, C. cajanifolius, C.goensis, C. grandifolius, C. lanceolatus, C. lineatus, C. platycarpus, C. reticulatus, C. scarabaeoides, C. sericeus,C. volubilis, Canavalia ensiformis, Cassia (Senna) obtusifolia, C. accidentalis, C. siamea, C. tora, Cicer arietinum,Crotalaria anagyroides, C. breviflora, C. juncea, C. lanceolata, C. mucronata, C. spectiabilis, C. virgulata, Desmodium tortuosum, Dolichos lablab, Flemingia macrophylla,F. stricta, F. stobilifera, Glycine hispida, G. max, Indigofera anil, I. hirsuta, I. suffruticosa, Lablab purpureus, Lathyrus hirsutus, Lupinus albus, Medicago lupulina, Mucunadeeringiana, M. puriens, Phaseolus aureus, P. lathyroides,P. limensis, P. lunatus, P. semierectus, P. vulgaris, Pisumsativum, Poinciana pulcherrima, Prosopis chilensis, Psophocarpus tetragonolobus, Pueraria lobata, P. montana, P. phaseoloides, Rhynchosia aurea, R. bracteata, R.cana, R. densiflora, R. minima, R. rothii, R. rufescens, R.suaveolens, R. sublobata, Sesbania exaltata, S.herbacea,S. punctata, Trifolium alexandrinum, T. incarnatum, T.pratense, T. repense, Trifolium sp., T. subterraneum,Trigonella foenum-graecum, Vicia faba, V. billosa, Vigna aconitifolia, V. mungo, V. radiata, V. unguiculata;* Fagaceae (1) *Quercus calliprinos*; Geraniaceae (1) *Geraniumcarolinianum*; Malvaceae (51*) Abelmoschus esculentus, A.moschatus, Abutilon theophrasti, Adansonia digitata,Anoda cristata, Cienfuegosia drummondii, Corchorussiliquosus, Gossypium anomalum, G. arboreum, G. aridum, G. armourianum, G. australe, G. barbadnse, G. bickii, G.davidsonii, G. gossypioides, G. harknessii, G. herbaceum,G. hirsutum, G. klotzschianum, G. longicalyx, G. raimondi,G. somalense, Gossypium sp., G. stocksii, G. sturtianum,G. thurberi, G. tomentosum, G. trilobum, Grewia asitica,Hibiscus canabinus, H. coccineus, H. costalus, H. diversifolius, H. esculentum, H. furcellatus, H. lasiocarpus, H.macranthus, H. militaris, H. mutabilis, H. radiatus, H. rosa-sinensis, H. sabdariffa, H. syriacus, Malvaviscusarboreus, Modiola multifida, Sida rhombifolia, S. sapinosa, Theobroma cacao, Urena lobata, Waltheria indica;*Moraceae (6) *Artocarpus altilis, A. heterophyllus, Ficus*benjamina, *F. carica, F. elastica, F. lyrata*; Myrtaceae (1)*Syzygium malacense*; Onagraceae (1) *Oenothera laciniata;*Rosaceae (5) *Fragaria vesca, Malus sylvestris, Prunus armeniaca, P. insititia, P. persica*; Rutaceae (7) *Citrus aurantiifolia, C. jamibhiri, C. limon, C. reticulata, C. sinensis, Citrussp.,Murraya paniculata*; Sapindaceae (1) *Litchi chinensis*; Urticaceae (3) *Laportea aestuans, Parietaria floridana,Phenax sonneratii*; Vitaceae (1) *Vitis vinifera*; Zygophylla-ceae (1) *Tribulus terrestris;* **Superasterids**-Aizoaceae (1)*Trianthema portulacastrum;* Amaranthaceae *(11) Amar-anthus dubius, A. retroflexus, A. rudis, Amaranthus sp.,A. spinosus, A.*

		viridis, Beta vulgaris, Chenopodium album ,*C. murale, Kochia scoparia, Spinacia oleracea;* Caryophyllaceae (1) *Spergula arvensis;* Polygonaceae (5) *Cocc-oloba uvifera, Polygonum convolvulus, P. lapathifolium,Rumex acetosella, R. crispus;* Portulacaceae (1) *Portulaca oleracea*; Molluginaceae (2) *Mollugo hirta, M. verticilatan***Asterids**-Acanthaceae (2) *Beloperone guttata, Justicia brandeegeana*; Apiaceae (6*) Anethum graveolens, Centella asiatica, Daucus carota, Foeniculum vulgare, Hydro-cotyle asiatica, Petroselinum crispum;* Apocynaceae *(2)Carissa carandus, Nerium olender;* Araliaceae (3) *Scheff-lera (Brassaia) actinophylla, S. arboricola, Polyscias guilfoyle*; Asteraceae (34) *Ageratum conyzoides, Ambrosia artemisiifolia, Arctium lappa, Artemisia vulgaris, Bidenspilosa, Blumea hieracifolia, Calendula officinalis, Callist-ephus chinensis, Cichorium intybus, Conyza bonariensis,Crepis aponica, Cynara scolymus, Emilia coccinea, E. fosberghii, E. javanica, E. sonchifolia, Erechtites valerianaefolia, Erigeron albidus, E. canadensis, Galinsoga quadri-radiata, Helianthus annuus, Lactuca sativa, Partheniumcrispum, P. hysterophorus, Sonchus oleraceus, Synedrella nodiflora, Tagetes erecta, T. patula, Taraxacum officinale, Vernonia cinerea, Xanthium sp., X. strumarium, Youngia japonica, Zinnia elegans*; Balsaminaceae (1) *Impatiens balsamina;* Bignoniaceae (1) *Radermachera sinica;*Convolvulaceae (8) *Argyreia nervosa, Convolvulus arvensis, Ipomoea batas, I. hederacea, I. lacunosa, Jacquemontia tamnifolia, Merremia tuberosa, Turbina corymbosa;*Lamiaceae (7) *Coleus blumeri, C. scutellarioides, Laminumamplexicaule, Leonotis nepetifolia, Leucas urticaefolia,Mentha sp., Staschy arvensis;* Loganiaceae (1) *Buddlejaasiatica*; Oleaceae (2) *jasminum officinale, Olea europaea;* Pedaliaceae *(1) Sesamum indicum;* Plantaginaceae (1)*Plantago lanceolata;* Polemoniaceae (1) *Phlox drummondii;* Rubiaceae (8) *Coffea arabica, C. canephora, C.excelsa, Richardia pilosa, R. scabra, Spermacoce assurgens, S. confusa, S. latifolia;* Sapotaceae *(1) Manikarazapota;* Scrophulariaceae *(1) Capraria biflora;* Solanaceae *(12) Capsicum annuum, C. frutescens, Datura stramonium , Nicotiana tabacum, Physalis angulata, Solanum lycopersicum, S. melongena, S. nodiflorum, S. nigrum, S. pimpinellifolium, S. torvum, S. tuberosum;* Theaceae *(1) Camellia sinensis;* Verbenaceae *(1) Stachytarpheta jamaicensis;* ***COM clade-***Euphorbiaceae (18) *Acalypha arvensis,Codiaecum variegatum, Euphorbia heterophylla, E. hirta,E. hypericifolia, E. milii, E. mutans, E. opthalmica, E.pulcherrima, E. thymifolia, Manihot esculenta, M. utilissima, Phyllanthus amarus, P. carolinensis, P. emblica, P. niruri,P. urinaria, Ricinus communis;* Malpighiaceae *(1) Malpi-ghia glabra;* Oxalidaceae *(1) Averrhoa carambola;* Passifloraceae *(3) Passiflora seemannii, P. edulis, Modiola caroliniana;* Violaceae *(1) Viola sp.;* **Gymnosperms**-Cycadaceae *(1) Cycas revolute*			
10	R. sacchari	**Monocots**- Poaceae *(2) Saccharum officinarum, Zea mays;* **Rosids**-Malvaceae (1) G*ossypium hirsutum*; Vitaceae *(1) Vitis sp.;* **Asterids**-Asteraceae *(1) Helianthus annuus*	*5*	0.538	Polyphagous

Table 4. Distribution of *Rotylenchulus* species to different families and orders

Host Clade	Host order	Host family	*Rotylenchulus* species	No. of sp.
Magnoliids	Laurales	Lauraceae	*R. macrodoratus, R. reniformis*	2
	Magnoliales	Annonaceae	*R. reniformis*	1
		Myristaceae	*R. reniformis*	1
	Piperales	Piperaceae	*R. reniformis*	1
Monocots	Alismatales	Araceae	*R. reniformis*	1
	Arecales	Arecaceae	*R. reniformis*	1
	Asparagales	Amaryllidaceae	*R. reniformis*	1
		Asparagaceae	*R. reniformis*	1
		Asphodelaceae	*R. reniformis*	1
		Orchidaceae	*R. reniformis*	1
	Commelinales	Commelinaceae	*R, reniformis*	1
	Dioscoreales	Dioscoreaceae	*R. reniformis*	1
	Poales	Bromeliaceae	*R. reniformis*	1

		Cyperaceae	*R. parvus, R. reniformis*	2
		Poaceae	*R. borealis, R. brevitubulus, R. leptus, R. macrosoma, R. parvus, R. reniformis, R. sacchari*	7
	Zingiberales	Heleconiaceae	*R. reniformis*	1
		Musaceae	*R. reniformis*	1
		Strelitziaceae	*R. clavicaudatus*	1
		Zingiberaceae	*R. reniformis*	1
Eudicots	Proteales	Proteaceae	*R. parvus*	1
	Ranunculales	Papaveraceae	*R. reniformis*	1
Superrosids	Saxifragales	Crassulaceae	*R. reniformis*	1
Rosids	Brassicales	Brassicaceae	*R. parvus, R. reniformis*	2
		Caricaceae	*R. parvus, R. reniformis*	2
		Cleomaceae	*R. reniformis*	1
	Cucurbitales	Begoniaceae	*R. reniformis*	1
		Cucurbitaceae	*R. parvus, R. reniformis*	2
	Fabales	Fabaceae	*R. anamictus, R. borealis, R. macrodo-ratus, R. macrosoma, R. parvus, R. reniformis*	6
	Fagales	Fagaceae	*R. macrodoratus, R. reniformis*	2
	Geraniales	Geraniaceae	*R. reniformis*	1
	Malvales	Bixaceae	*R. reniformis*	1
		Malvaceae	*R. borealis, R. brevitubulus, R. macrodo-ratus, R. reniformis, R. sacchari*	5
	Myrtales	Myrtaceae	*R. reniformis*	1
		Onagraceae	*R. reniformis*	1
	Rosales	Moraceae	*R. macrodoratus, R. reniformis*	2
		Rosaceae	*R. macrodoratus, R. parvus, R. renifor-mis*	3
		Urticaceae	*R. macrodoratus, R. reniformis*	2
	Sapindales	Anacrdiaceae	*R. macrodoratus, R. reniformis*	2
		Rutaceae	*R. reniformis*	1
		Sapindaceae	*R. reniformis*	1
Superasterids	Caryophyllales	Aizoaceae	*R. reniformis*	1
		Amaranthaceae	*R. parvus, R. reniformis*	2
		Caryophyllaceae	*R. macrodoratus, R. reniformis*	2
		Mulluginaceae	*R. reniformis*	1
		Nyctaginaceae	*R. parvus*	1
		Polygonaceae	*R. reniformis*	1
		Portulacaceae	*R. reniformis*	1
Asterids	Apiales	Apiaceae	*R. parvus, R. reniformis*	2
		Araliaceae	*R. macrodoratus, R. reniformis*	2
		Pittosporaceae	*R. parvus*	1
	Asterales	Asteraceae	*R. brevitubulus, R. parvus, R. reniformis, R. sacchari*	4
	Ericales	Balsimanaceae	*R. reniformis*	1
		Polemoniaceae	*R. reniformis*	1
		Sapotaceae	*R. reniformis*	1
		Theaceae	*R. reniformis*	1
	Gentianales	Apocynaceae	*R. macrodoratus, R. parvus, R. renifor-mis*	3
		Loganiaceae	*R. reniformis*	1

		Rubiaceae	*R. reniformis*	1
	Lamiales	Acanthaceae	*R. reniformis*	1
		Bignoniaceae	*R. reniformis*	1
		Lamiaceae	*R. macrodoratus, R. parvus, R. reniformis*	3
		Oleaceae	*R. macrodoratus, R. macrosoma, R. parvus, R. reniformis*	4
		Pedaliaceae	*R. reniformis*	1
		Plantaginaceae	*R. reniformis*	1
		Scrophulariaceae	*R. reniformis*	1
	Solanales	Convolvulaceae	*R. borealis, R. reniformis*	2
		Solanaceae	*R. borealis, R. macrosoma, R. parvus, R. reniformis*	4
COM clade	Malpighiales	Euphorbiaceae	*R. reniformis*	1
		Malpighiaceae	*R. reniformis*	1
		Passifloraceae	*R. reniformis*	1
		Violaceae	*R. reniformis*	1
	Oxalidales	Oxalidaceae	*R. reniformis*	1
Gymnosperms	Cycadales	Cycadaceae	*R. reniformis*	1
	Pinales	Cupressaceae	*R. parvus*	1

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