Plant Archives Vol. 16 No. 2, 2016 pp. 893-896 ***ISSN 0972-5210***

MAJOR SOIL BORNE FUNGAL AND PLANT PARASITE NEMATODE STATUS OF VEGETABLE CROPS IN AND AROUND GAUTAM BUDDHA NAGAR OF WESTERN UTTAR PRADESH, INDIA

B. K. Goswami and Archana Singh

Amity Centre for Biocontrol & Plant Disease Management, Amity University, Sector - 125, Noida (U.P.), India.
E-mail : bgoswami@amity.edu, archoo_85@yahoo.com

Abstract

During a series of systematic surveys of vegetable crops in and around Gautam Buddha nagar ,U. P were found to be badly damaged by soil borne maladies referred as 'hot spots' having been dominated by major diseases *viz*., wilt/rot causing fungi and also phytonematodes on both transplantable vegetables like tomato, brinjal, cabbage, chili crops while okra as an example for directly seeded ones. The work was mainly concentrated on soil microflora status of 'hot spots' in regards to soil borne maladies particularly fungal and phytonematodes. Under this 'land to lab' based study confining to survey, isolation, identification and percentage count of soil borne major pathogens helped in providing useful baseline data responding to soil health which in turn, shall also assist in selecting fields under investigation to be treated as 'sick or healthy fields'. Accordingly vegetable growers shall be guided as to which crops are advisable to cultivate in their fields under investigation and which others are not to be encouraged on the basis of host and non-host in respect to high percentage count of specific soil borne maladies out of above stated ones.

Key words : Phyto nematodes, hot spots, baseline data, rhizosphere and rhizoplane, soil borne maladies.

Introduction

Among plant parasitic nematodes, particularly endoparasitic sedentary root knot nematode *Meloidogyne* spp. in vegetable crops in addition to causing serious disease independently have also been reported to cause 'disease complexes' on the common hosts together where the former has been reported to predispose for the fungal attack. The root knot nematode, which is known to have a wide host range and endophytic one is one of the most destructive enemies reported to cause damage from 30%-90% in yield of vegetables (Reddy *et al*., 1985; Goswami and Singh, 2013). The problem faced by the vegetable growers in and around Gautam Buddha Nagar district of Uttar Pradesh arising from heavy loss in yield of their produces through major soil borne 'hidden enemies' particularly phytonematodes cohabiting with wilt/rot causing fungi out of which root knot nematode and wilt causing fungus both being 'vascular bundle feeders' mainly on solanaceous crops causing synergistic effects on the common hosts, tomato, brinjal, chilli (Goswami *et al*., 2010). Similar examples of synergistic effects on okra by root knot nematode and root rot fungi (Golden and Van Gundy, 1975). Recently, disease-complex occurrence have been recorded in cabbage crop around G.B. Nagar of Western U.P by concomitant invasion of stunt nematode and root rot fungus causing 25%-55% loss in yield (Neetu Singh and Goswami-2016).

The extensive studies initiated in and around vegetable growers fields of G.B. Nagar apparently showed dominance of solanaceous crops with some farmers exclusively cultivating okra. Reasonably wide belt of cole crops predominantly grown by local farmers shown to be occupied by mainly cabbage.

Out of the above crops and also through closer interaction of local farmers, it was learnt that the vegetable growers have been cultivating the same solanaceous vegetables including another susceptible crop okra adding to its more susceptibility to root knot nematode for the past uninterrupted five crops while for the other major crop cabbage cohabiting with the stunt nematode was also continuously standing for a year comprising of three successive crops.

The present paper dealing through extensive surveys is mainly targeted towards important vegetable crops *viz*. tomato, chilli, brinjal, okra and cabbage used in our daily life with the mission of increasing their quality and productivity through collection of baseline data of specific hidden enemies out of soil borne phytonematodes and fungi which would be of immense importance and guideline for the safe and cost effective management strategies through selecting non host/resistant crops without using any toxic chemical pesticides most of which in recent years have been banned being carcinogenic and wrecking the human immune system.

Materials and Methods

Through extensive surveys of vegetable growers fields in and around Gautam Buddha nagar district of Western U.P. targeting rhizosphere and rhizoplane soil of diseased plants of 'hot spots'. Soil and roots were separated in the laboratory, soil samples were thoroughly but gently mixed. One hundred grams of each composite soil sample were used for nematodes extraction by the modified Baermann funnel technique as described by Hooper *et al*. (2005). Nematodes obtained were enumerated using a dissecting microscope. Plant parasitic nematodes were enumerated and identified to genera and species based on morphological characteristics (Maggenti, 1971), except free living nematodes which were counted but not characterized. Specimens were killed in 60°C hot water, fixed in FAA(Formalin Acetic Acid and Alchohol) and mounted in glycerol for identification using stereo binocular microscope at various magnifications. Endoparasite sedentary, Root knot nematodes, *Meloidogyne incognita* and *M. javanica* were identified on the basis of larval and stylet characters (Franklin, 1979; Hartman and Sasser, 1985) in addition to the perennial pattern infecting all the solanaceous vegetable crops, tomato, brinjal, chilli and malvaceous crop okra. Ectoparasitic nematodes, *Helicotylinchus* sp (spiral nematode). *Hoplolamus* sp (lance nematode) were collected from heavily infested roots of most of the vegetables while *Tylencorinchus brassicae*, stunt nematode (Handoo, 2000) was reported from cruciferous vegetable, cabbage. From a number of hot spots out of above surveys isolations of mycoflora were done from the rhizosphere of heavily infested roots and galled roots through soil dilution technique (Martin, 1950). The identification of isolated mycoflora were carried out following Barnett and Hunter (1987).

The consistently occurring mycoflora from rhizosphere through their colonies and conidial characters were identified as *Aspergillus terreus, A.niger, Alternaria solani*, *Curvularia lunata*, *Cladosporium oxysporum*, while out of the rhizoplane and from the small root bits cut around the galled and the infected roots after surface sterilization with 0.001% '$HgCl_2$' and incubated for a week the fungal species *i.e. Scleretonia sclerotium*, from cabbage *Rhizoctonia solani*, *R. bataticola* from okra, *Fusarium oxysporum* f. sp. *lycopercisi* from tomato, brinjal, chilli *P. lilacinus* from galled root of all surveyed crops were recovered and maintained on PDA and PD broth (Lilly, 1965).

Results and Discussion

Out of all the surveyed fields, the villages Sukhlalpur, Bilsuri, Pilkhanwali, Malagarh of Sikandrabad block and Birampur, Chakbirampur of Jewar block in and around G.B. Nagar were observed to be dominated by solanaceous crops while in the same block of Sikandrabad, district Bulandshahar majority of the farmers around the villages Hiralal Garhi, Mandawra, Pran Garhi were found to be growing mostly Cole crops like cabbage, cauliflower.

The soil borne maladies from these two broadly divided farmers of the same block were recorded to be different, the former solanaceous crop having been exhibited both, wilt causing fungus and root knot nematode while cabbage dominated fields were observed to be victimized with root rot fungal diseases along with some ectoparasitic nematode like *Tylenchorhynchus brassicae*, *Helicotyenchus dihystera*, *Hoplolamus indicus* etc. (Netscher and Sikora, 1990) out of which the former, also referred as stunt nematode, showed its presence around only the rhizosphere of cabbage while other two were observed around more number of host roots with low percentage count.

In the present investigation, a noteworthy observation of the migratory ectoparasitic nematode *viz*. *Trichodorus*, *Xiphinema* and also species of *Dolichodorus* were recorded out of which former two genera are well known soil borne virus vectors belonging to order Dorylaimida (Hewitt *et al*., 1958; Van Hoof, 1964; Ngele and Kalu, 2015).

The work was also concentrated on soil status of hot spots in regards to soil borne maladies. In this study, heavy infestation of *Fusarium* spp. and *Meloidogyne* spp in Malvaceous and solanaceous crops *i.e.* okra, brinjal, chilli, were recorded particularly in villages *viz*. Raipur of G.B. Nagar, Pilkhanwali, Malagarh and Bilsuri of Sikandrabad area.

On uprooting, most of the stunted plants showed heavy galling of root knot nematodes. The examination of rhizosphere soil around the galled roots showed an average population of 8-12 larvae/g root knot nematode larvae in all the villages, which is considered to be very

Table 1 : Percent contribution of plant parasite nematode species in different field crops of G. B. Nagar.

S. no.	Isolated Phyto Nematode (PN)	Percentage count				
1.	Endo/Ecto parasite	**Tomato**	**Brinjal**	**Chilli**	**Okra**	**Cabbage**
2.	*Meloidogyne incognita*	37	20	37	34	-
3.	*M.javanica*	31	52	31	27	-
4.	*Tylencorhynchus brassicae*	-	-	-	-	67
5.	*Helicotylinchus dihystera*	8	7	9	11	17
6.	*Hoplolamus indicus*	7	12	5	9	16
7.	*Trichodorus* sp.	3	4	6	9	
8.	*Dolichodorus* sp	9	3	5	7	
9.	*Xiphinema* sp.	5	2	7	3	

Table.2 Percent contribution of fungal species in different field crops of G.B nagar

S. no.	Isolated fungi	Tomato	Brinjal	Chilli	Okra	Cabbage
1.	*Aspergillus niger*	11	13	11	17	14
2.	*Aspergillus terrius*	10	10	9	10	8
3.	*Alternaria solani*	5	-	8	-	-
4.	*Curvularia lunata*		11	4	-	4
5.	*Cladosporium oxysporum*	5	8	-		
6.	*Dreshleria sp.*			-	3	7
7.	*Fuserium oxysporum f.sp.lycopercisi*	32	28	20	-	-
8.	*Paecilomyces lilacinus*	7	11	5	19	-
9.	*Rhizoctonia solani*	5	-	19	-	
10	*Rhizoctonia bataticola*	-	-	-	23	27
11.	*Sclerotina sclerotiorum*	-	-	-	-	29
12.	*Trichoderma harzianum*	10	8	9	11	11
13.	*Trichoderma viride*	15	12	6	5	9

high as compared to minimum threshold level of 2 larvae/ g soil. This high density of *M. incognita* larval population clearly reflected to the heavy loss of solanaceous crops which was also exhibited by heavy galling and finally affecting both the quality and the productivity of the respective crops. Further in these heavily infested fields of root knot nematode, as a rare occasion, both the conspicuous species *viz*. *M. incognita* and *M. javanica* have been recorded. From the above extensive surveys around cabbage fields it is thus amply clear that almost a pure culture of stunt nematodes *Tylencorhynchus brassicae* dominating over other plant parasitic nematodes proven to be most favorable host for cabbage (Wacake, 2007; Maina *et al*., 2009) as encountered from the rhizosphere adhered infested soil and in association with root rot fungi causing huge damage (synergistic effect) to the crops. Similar observations of spiral nematode *H. dihystera* have also been recorded evidenced by a remarkably high population around the rhizosphere soil of cabbage (table 1).

This was observed that in addition to predominately occurring of both the species of sedentary endoparasitic nematodes, *M. incognita* and *M. javanica*, being encountered on solanaceous vegetables and okra crops.

Out of the soil mycoflora collected from the root zones of solanaceous, okra and cabbage, the consistently occurring fungi were species of *Aspergilli, Penicillium oxysporum, Curvularia lunata*, *Alternaria alternata.* The wilt causing fungus *Fusarium oxysporum f.sp.lycopercisi* was conspicuous in solanaceous crops while the root rot causing fungi *Rhizoctonia solani, R.bataticola* was prominently expressed in both okra ,cabbage latter showing heavy infestation of dry rot i.e. *Sclerotinia sclerotiorum.* In addition to the above mentioned pathogenic fungi few more commonly and consistently occurring fungal bioagents *viz*., *Trichoderma harzianum, T. viride, Paecilomyces lilacinus, Cladosporium oxysporum* were also identified from both the hot spots (table 2).

Out of which *Trichoderma* spp. are known mycoparasite (Chet, 1987; Tran, 1998; Benitez, 2004) and *P. lilacinus* alongwith *C. oxysporum* are known for their potential against eggs and egg masses of root knot nematode (Khan and Goswami, 2001, 2002). The presence of major soil borne maladies is attributed to farming practices such as continued cultivation of the same crop year after year and as it emerged during the survey.

Lack of inadequate knowledge and technical gaps, could also have contributed to high pathogen densities. This is the first approach, using soil borne maladies data comprising wide range of crops and their respective pathogens favorable as a pathological parameter or markers to be used as guidance for selection of ideal cropping sequence. Such parameters of measurement to be supplied to the farmers expected to be highly helpful guidance through selecting suitable crops ignoring the highly susceptible ones. This would protect themselves for loss in yield and also the quality.

Acknowledgement

We acknowledge the constant encouragement and moral support of our Founder President Hon'ble Dr. Ashok Kumar Chauhan and Dr. W. Selvamurthy, President-Amity Science, Technology & Innovation Foundation (ASTIF), Amity University, Uttar Pradesh, Sector – 125, Noida (U.P.).

References

Benitez, T., A. M. Rincon, M. C. Limon and A. C. Codon (2004). Biocontrol mechanisms of *Trichoderma* strains. *Int. Microbiol.*, **7(4)** : 249-260.

Chet, I. (1987). Trichoderma application, mode of action andpotential as a biocontrol agent of soil-borne plantpathogenic fungi. In: Innovative Approach to Plant Disease Control Chet (Ed) John Wiley & Sons, New York, USA, 137-160.

Chitwood, D. (2003). Reseach on plant parasitic nematodes biology conducted by United States Department of Agriculture-Agriculture research services. *Pest Management Science*, **59** : 748-753.

Franklin, M. T. (1979). *Taxonomy of the genus Meloidogyne*, Pp. 37–54. In: Root-knot nematodes (*Meloidogyne* species) Systematics,Biology and Control (Lamberti, F. and C.E. Taylor, eds.), New York, Academic Press.

Goswami, B. K. and Neetu Singh (2010). Transfer of IPM packagethrough training and demonstration against insect-pest,wilt fungus and root knot nematode on okra and tomato. TIFAC, DST Final Report, 1-51.

Goswami, B. K. and Neetu Singh (2013). A farmer friendly and Economic IPM Strategy to Combat the Soil Borne Fungal and Root-Knot Nematode Diseases Infecting Horticultural Crops. *International Journal of Economics and Management Engineering*, **3(6)** : 262-267.

Goswami, B. K., D. V. Singh, C. L. Sethi and J. N. Gupta (1970). Studies on association of root-knot nematodes, *Meloidogyne incognita* (Kofoid and White) Chitwood and *Sclerotium rolfsii* Sacc. in brinjal (*Solanum melongena* L.). *Indian Phytopathol.*, **23** : 587–589.

Golden, J. K. and S. D. Vangundy (1975). Diseases complex of okra and tomato involving the nematode Meloidogyne and the soil inhabiting fungus *Rhizoctonia solani*. *Phytopathology*, **65** : 265 - 273.

Goswami, B. K. and Neetu Singh (2013). A farmer friendly andEconomic IPM Strategy to Combat the Soil Borne Fungaland Root-Knot Nematode Diseases Infecting Horticultural Crops. *International Journal of Economics and Management Engineering*, **3(6)** : 262-267.

Hewitt, W. B., D. J. Raski and S. E. Goheem (1958). Nematode vector of soil borne fan leaf virus of grapevines. *Phtopathology*, **48** : 68-95.

Hartman, K. M. and J. N. Sasser (1985). Identification of *Meloidogyne* species on the basis of differential host test, morphological and perennial pattern in An advanced treatise on *Meloidogyne*2 Methodology Ed. K. R. Barker C.C Carter and J. N. Sasser, **2** : 69-78.

Handoo, Z. (2000). A key and diagnostic compemdium to thespecies of the genus *Tylenchorhynchus* cobb, 1913(Nematoda : *Belonolaimidae*). *J. Nematode*, **32**:20-34.

Hooper, D. J., J. Hallmann and S. Subbotin (2005). Methods for extraction, processing and detection of plantand soil nematodes. In: Luc, M., Sikora, R. A. and Bridge (Eds.). Plant Parasitic Nematodes in Subtropical and TropicalAgriculture,. wallingford, U. K.: CAB International, 53-86.

Kofoid, C. A. and W. A. White (1919). A new nematode infection of man. *J. Amer. Med. Assoc.*, **72** : 567–569.

Khan, M. R. and B. K. Goswami (2001). *Cladosporium oxysporum*, an egg parasitic fungus of *Meloidogyne incognita*. *Indian J .Nematol.*, **32** : 169–170.

Khan, M. R. and B. K. Goswami (2002). Evaluation of *Paecilomyces lilacinus* isolates against *Meloidogyne incognita* infecting tomato. *Int. J. Nematol.*, **12** : 111–114.

Maina, M. J., J. W. Waceke and G. M. Kariuki (2009). Plant–parasitic nematodes associated with cabbage, Department of plant and microbial sciences, Kenyatta University, Nairobi, 14-50.

Ngele, K. K. and U. N. Kalu (2015). Studies on different species of plant parasitic nematodes attacking vegetable crops grown in Afikpo North L. G. A, Nigeria. *DRJAFS*, **3(4)** : 88-92.

Reddy, D. D. R. (1985). Analysis of crop losses in tomato due to Meloidogyne incognita. *Indian J. Nematol.*, **15**:55– 59.

Singh, Neetu and B. K. Goswami (2016). Incidence of disease-complex causing synergistic effects on cabbage caused by stunt nematode and dry root rot fungus (in press).

Tran, T. T. (1998). Antagonistic effectiveness of *Trichoderma* against plant fungal pathogens. *Plant Protection*, **4**:35-38.

Van Hoof, H. A. (1964). *Trichodurus teres*, a vector of rattle virus. *Netherlands J. Pl. Path.*, **70** : 187-189.

Waceke, J. (2007). Plant parasitc nematodes associated with cabbages in Kenya.