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Biodiversity of Nematodes in Potato Growing Areas of Ordu, Turkey

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Abstract: A survey was conducted to investigate nematode biodiversity in three major potato growing areas, Aybasti, Kabataþ and Korgan districts of Ordu province of Turkey in 2010. In the survey, a total of 24 soil samples were collected from potato fields belonging to these areas where the native ecotypes called Aybasti Beyazi and Aybasti Sarisi occur. The analysis of the soil samples collected from the rhizosphere of potato revealed the presence of 25 nematode taxa belonging to different trophic groups. Nine genera of plant parasitic group, 2 families and 9 genera of bacterivorous group, 3 genera of fungivore group, one genus of predator group and one order of omnivore group were allocated. The incidence and the abundance of the nematotes varied among the three areas. *Pratylenchus* and *Tylenchus* sp., seem to be the most widespread plant parasitic genera because they were both frequent on the potato throughout the three regions. Meloidogyne was found only in a sample of Korgan district with a 720 J2s abundance. The other taxa found were *Helicotylenchus*, *Geocenamus*, *Paratylenchus*, *Psilenchus*, *Filenchus*, *Meloidogyne*, *Tylenchorhynchus*, *Rhabditidae*, *Monhysteridae*, *Cephalobus*, *Eucephalobus*, *Acrobeloides*, *Chiloplachus*, *Cervidellus*, *Acrobeles*, *Wilsonema*, *Plectus*, *Tripyla*, *Aphelenchoides*, *Aphelenchus*, *Ditylenchus*, *Mononchus* sp. and *Dorylaimida*. Plant parasitic nematodes except *Pratylenchus* sp. were not found to be very wide-spread and abundant in the province. On the other hand, free-living nematodes which were considered to be the indicators of soil heath were found divers and abundant.

Key words: Nematodes, biodiversity incidence, abundance, Ordu, potato, Turkey

INTRODUCTION

Potato (*Solanum tuberosum* L.) is an important agricultural tuber crop of Turkey as grown throughout the other countries and one of the top ten commodities as production quantity of Turkey that is ranked 13th in worldwide potato production value. In Turkey, potato (4.397.710 ton) is the third commodity in quantity value after Wheat (20.600.000 ton) and Barley (7.300.000 ton). The Black sea region of Turkey possesses approximately 10% of total potato production of Turkey (Demir and Kadanali, 2010) and Ordu is the province in the Black sea region and ranked first for potato production in the region (Dede, 2004).

Nematodes are the most divers group of organisms in soil ecosystems and function in different ways as their trophic relations. Nematodes usually are easily distinguished by their mouth structure which is associated their food source Theoretically, all trophic groups or some of them can be observed in a single soil sample from any rhisophere at the same time. These are plant parasitic nematodes, bacterivorous nematodes, fungivourous nematodes, pretatory nematodes and omnivorous nematodes (Yeates *et al*., 1993).

After Bongers (1990), diversity and abundance of free living nematodes are associated with the health of soil fauna which serves in organic material decomposition and mineralization. More divers and abundant free-living nematode assemblages are related with healthy and productive ecosystems (Neher, 2001). On the other hand, plant parasitic nematodes are considered to be the cause of yield losses in the crop ecosystems as their virulens and abundance increases.

Plant parasitic nematodes are an important limiting factors in world potato production. Jensen *et al*. (1979) listed 68 nematodes species feed on potato plants worldwide. A number of different nematode pathogens attack potato by using interactions with other hosts or just alone in different threshold densities and cause economical yield losses (Olthof, 1989; Wheeler *et al*.,1994; Philis,1997; Morgan *et al*., 2002; Vovlas *et al*., 2005). Little is known about plant parasitic nematodes affecting potato in Turkey and in the Black sea region. The plant parasitic nematode species associated with potato have been reported in Turkey and world scale. Kepenekci emphasized the species such as *Globodera rostochiensis*, *G. pallida*, *Ditylenchus destructor* Thorne, *Meloidogyne* sp., *Ditylenchus dipsaci* (Kuhn) Filipjev), *Neotylenchus*

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vigissi (Skarbilovich) Goodey), *Nacobbus aberrans* (Thorne) Thorne and Allen), *Pratylenchus*, *Trichodorus* and *Longidorus* sp., as important nematode genera and species in potato production. Erdogus *et al*. (2010) reported *Filenchus cylindricus*, *F. sandneri*, *Lelenchus leptosoma* and *Geocenamus uralensis* from the potato fields as new species. Misirloglu and Ulutas (2011) reported that Kutahya, Usak, Isparta and Burdur potentially favorable for potato growing in terms of plant parasitic nematodes harmful on potatoes as (*Globodera* sp., *Ditylenchus destructor* Thorne, *Ditylenchus dipsaci* (Kuhn) Filipjev, *Meloidogyne* sp., in 2006-2008. In another investigation, *Criconemella*, *Ditylenchus*, *Heterodera*, *Meloidogyne*, *Pratylenchus* and *Tylenchorhynchus* sp. were reported among the plant parasitic nematodes asociated with potato (Mokbel *et al*., 2006).

Yildiz and Elekcioglu (2011) and Yildiz (2012) studied nematode biodiversity in semi-arid Southeast Anatolian region in several ecosystems. They found that in major crops of the region, plant parasitic species were not serious threat in the region while free-living nematodes were well established and divers in wheat fields than cotton and pistachio cultures. However, there is a most no study in Black sea region on the free-living fauna of nematodes in Turkey.

By this study, both plant parasitic and free-living groups are investigated in potato growing areas for the first time in Turkey. The objective of this research is to investigate nematode biodiversity in major potato growin areas of Ordu province with emphasizing abundance and distribution of plant parasitic nematodes species associated with potato and diversity and state of free-living nematode groups.

MATERIALS AND METHODS

The main materials of the study was soil samples collected from potato fields of Ordu province of Turkey in July of 2010 (Fig. 1). Soil samples collected from 24 potato fields that belong to 7, 8, 9 fields in Aybasti, Kabatas, Korgan, respectivelly. In these areas, the native ecotypes called Aybasti Beyazi and Aybasti Sarisi occur.

Soil samples were taken randomly, by sampling 10 or 12 points of a field depending on the size. The samples were taken from the rhizosphere of the potato plants at a depth of 5-30 cm, using a shovel. Each soil sample was thoroughly mixed and 1 kg of sub-sample was taken from a composite soil samples.

The soil samples kept in polythene bags and properly labeled were brought to the University of Ordu Nematology Laboratory. Soil samples were stored at 4°C until used in refrigerator. Then, nematodes were extracted by using modified Bearmen funnel technique from the soil samples (Hooper, 1969). An aliquot of 100 cm^3 soil from the main 1 kg mixed soil subsample was taken and used for the nematode extraction. Then nematodes are counted under light microscope and allocated to trophic groups to the genera level. Ordu is the province located 40°58' 31.1682"N 37°54' 10.8126"E in coordinates. Average

Fig. 1: The major potato growing areas sampled in Ordu province

temperatures and total rainfall of 2010 and 2011 years, respectively are 16.6, 14.4°C and 979.7 and 1369.4 kg m^{-2}. Average elevations of Aybasti, Kabatas, Korgan are 697, 702, 1258 m above sea level, respectively. The climate is classified as a humid subtropical (no dry season, hot Summer) in the regions with a cool temperate moist forest biozone.

RESULTS AND DISCUSSION

Nematodes assemblages found in potato growing areas are shown in Fig. 2. Results suggest that the most abundant and divers trophic group is the bacterivores. Followed by fungivorous group, plant parasitic parasitic group and finally predator and omnivore groups (Fig. 2). One of the way to describe a nematode faunal composition is to look at its trophic structure. Trophic structure also gives a brief information about nematode faunal complex and its environment as the functional diversity in an ecosystem (Yeates, 1998).

The survey results indicated that *Pratylenchus* and *Tylenchus* sp. is the 1st 2 widespread genera in the fields sampled. *Pratylenchus* sp. is the most abundant (70,83/100 cm^3 soil) and frequent (79.16%) genus in the entire study area. From the 24 fields sampled, nine genera of plant parasitic nematodes were found. The two genera *Pratylenchus* and *Tylenchus* sp. were found in all three regions and the genus *Meloidogyne* were encountered in only Korgan district at high numbers (Table 1 and 2). Plant parasitic diversity was 9.7 and 4 genera in Korgan, Kabatas, Aybasti, respectively. The abundance of the most frequent genus *Pratylenchus* sp.

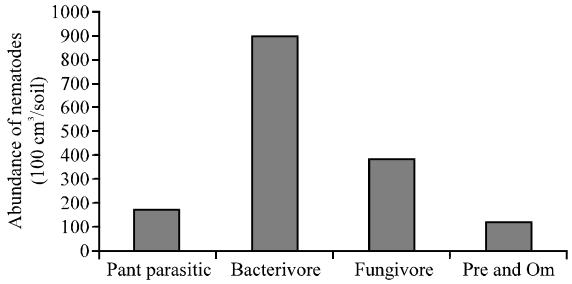

Fig. 2: Nematode trophic groups with their relative abundance

Table 1: Incidence (%) and range of populations (/100 cm^3/soil) of *Pratylenchus*, *Ditylenchus* and *Meloidogyne* sp., associated with potato in the districts

	Pratylenchus sp.		*Ditylenchus* sp.		*Meloidogyne* sp.	
Region	Incid. (%)	Range	Incid. (%)	Range	Incid. (%)	Range
Aybasti	100	40-180	100	20-380	0	0
Kabatas	62.5	0-140	75	0-260	0	0
Korgan	62.2	0-360	100	40-180	11.11	0-720

Abun.: Abundance in 100 cm^3, Incid.: Rate of presence in samples

Table 2: Incidence (%) and abundance (/100 cm^3/soil) of nematode genera of trophic groups associated with potato producing regions of Ordu

	Surveyed districts							
Nematodes	Aybasti		Kabatas		Korgan		All districts	
Plant parasitic	Abun.	Incid.	Abun.	Incid.	Abun.	Incid.	Abun.	Incid.
Pratylenchus sp.	108	100	47	62	62	77	70.83	79.16
Tylenchus sp.	17	42	25	50	42	44	29.17	45.83
Meloidogyne sp.	0	0	0	0	80	11	30.00	4.16
Helicotylenchus sp.	0	0	25	50	17	33	14.17	29.16
Filenchus sp.	0	0	2	12	8	22	4.17	12.50
Psilenchus sp.	14	42	12	12	6	11	10.83	20.83
Merlinious sp.	22	42	5	25	2	11	9.17	25.00
Tylenchorhynchus sp.	0	0	0	0	2	11	0.83	4.16
Paratylenchus sp.	0	0	10	37	11	22	7.50	20.83
Bacterivore								
Rhabditidae	334	100	67	87	145	100	162.50	95.83
Monhysteridae	82	100	77	100	40	66	65.00	87.50
Cephalobus sp.	205	100	135	100	253	88	200.00	95.83
Eucephalobus sp.	248	100	112	75	80	88	143.33	87.50
Acrobeloides sp.	348	100	100	87	317	88	254.17	91.66
Chiloplachus sp.	20	42	2	12	17	44	13.33	29.16
Cervidellus sp.	0	14	2	12	0	0	1.67	8.33
Acrobeles sp.	11	14	0	0	0	0	3.33	4.16
Wilsonema sp.	11	28	0	0	0	0	3.48	8.33
Plectus sp.	68	71	17	37	53	66	45.83	58.33
Tripyla sp.	8	14	2	12	2	11	4.17	12.50
Fungivore								
Aphelenchoides sp.	302	100	187	87	120	77	195.83	87.50
Aphelenchus sp.	88	85	50	75	117	88	86.67	83.33
Ditylenchus sp.	151	100	90	75	82	100	105.00	91.66
Predator and Omnivore								
Mononchus sp.	14	42	32	75	4	22	16.67	45.83
Dorylaimida	140	85	100	100	84	77	105.83	87.50

Abun.: Abundance in 100 cm^3, Incid.: Rate of presence in samples

were 108/100 cm^3 soil, 62/100 cm^3 soil, 47/100 cm^3 soil from Aybasti, Korgan, Kabatas, respectively. *Pratylenchus* sp., had also the highest number of frequency (79.16%) in province scale. In the opinion, this much distribution and abundance may cause some yield reduction agreed with previous studies that concluded sites with high populations of *Pratylenchus* sp., may reduce yields with time due to the interactions with other pathogens such as Verticillium (Martin *et al*., 1982; Francl *et al*., 1987; MacGuidwin and Rouse, 1990). If the genus is identified species as *P. penetrans*, the likelihood would increase. In addition, the stored and infested tubers can initiate a new infestation (Olthof and Wolynetz, 1991). Even if Tylenchus was among the most frequent ones in the survey this group Tylenchus feeds on algae, mosses and lichens (Siddiqi, 2000). In this respect, Tylenchus has no damage potantial on potato. *Meloidogyne* sp., is another important group and it is known that at least ten of Meloidogyne species infest potatoes (Prasad, 2008). *Meloidogyne* sp. was found only in a sample in Korgan at 720 J2s density for this region. Ozarslandan and Elekcioglu (2010) reported that all samples collected from potato crop in mid-Anatolia were belong to *M. chitwoodi*. If the eggs and juveniles number/cm^3 soil of *M. incognita* exceed 128, this results in 80% yield loss of tuber (Russo *et al*., 2007).

Except the nine plant parasitic nematode genera including; *Pratylenchus*, *Tylenchus*, *Helicotylenchus*, *Geocenamus*, *Paratylenchus*, *Psilenchus*, *Filenchus*, *Meloidogyne* and *Tylenchorhynchus* sp., in addition, nine bacterivorus nematode genera including; *Cephalobus*, *Acrobeloides*, *Eucephalobus*, *Plectus*, *Chiloplachus*, *Tripyla*, *Cervidellus*, *Wilsonema* and *Acrobeles* sp. and three fungivorus nematode genera including; *Ditylenchus*, *Aphelenchoides* and *Aphelenchus* sp. were found.

Aphelenchoides sp. (87.5%) and *Aphelenchus* sp. (83.33%) were in high frequencies of incidence in all regions sampled. These nematodes are known fungal feeders and are not known to cause damage to potato (Al-Hazmi *et al*., 1993).

CONCLUSION

To determine nematode assemblages is important in two ways in a given area, first, plant parasitic nematodes are yield limiting factor in crop ecosystems; second, free-living nematodes mostly over-looked in ecosystems are widely accepted as the indicators of soil health. Therefore, researchers covered both components of the nematode fauna in potato growing areas of Ordu province.

In some groups, such as Pratylenchus can damage on potato by the interaction with Verticillium. With this respect, it is very essential to identify nematode groups and to determine their abundances and frequencies of occurence. By this investigation, an important group of nematodes, Pratylenchus was determined in high abundance and frequency of occurience for the major potato producing areas of Ordu province. Fortunately, the most destructive nematode group with a polyphagous nature, Meloidogyne was only found in one locality of the study area. In case of increase of new potato production areas in Ordu, this survey provides a backround for the status of important nematodes. Besides, the study also suggests that free-living nematodes in potato growing areas are divers and abundant enough for an healty ecosystem.

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