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COMPARISON OF NEMATODE POPULATION AND THEIR SEASONAL FLUCTUATION IN TURMERIC (*CURCUMA LONGA* L.) UNDER CONVENTIONAL AND DRIP IRRIGATION METHODS

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ABSTRACT
The turmeric crop cultivated under conventional and drip irrigation methods were selected to study the effect of seasonal changes of the population of plant parasitic nematodes. Population densities were monitored at monthly intervals throughout the crop season. It was observed that seasonal fluctuations have a direct effect on the nematode population. The predominant genera of phytoparasitic nematodes recovered from rhizospheric soil samples were *Meloidogyne incognita, Pratylenchus delattrei, Radopholus similis, Longidorus elongatus, Xiphinema elongatum, Hoplolaimus seinhorstii, Helicotylenchus multicinctus, Tylenchorhynchus martini* and *Rotylenchulus reniformis.* Among them the root knot nematode population gradually started to built up right from the time of planting of turmeric and reached its peak around sixth month and declined towards crop maturity.

KEY WORDS: Population fluctuation, phytonematodes, drip irrigation, conventional irrigation, turmeric.

INTRODUCTION

Turmeric (*Curcuma longa* L.) belonging to the family Zingiberaceae is an important spice as well as medicinal plant and contribute a major share in foreign exchange. Indian turmeric is regarded as best quality in the world market because of its high curcumin content. The crop is widely cultivated in many states *viz.,* Andhra Pradesh, Tamil Nadu, Orissa, Karnataka, Kerala, Maharashtra and West Bengal of India. In Tamil Nadu turmeric is being cultivated both under conventional and drip irrigated system. Several biotic and abiotic stresses hamper the sustainable cultivation of turmeric. One of the major pests of high valued agricultural crops are the phytonematodes which are highly diversified organisms exhibiting variations in distribution patterns. The degree of damage done, depends upon the pathogenic potential of population growth of nematodes which are greatly influenced by the population densities. Generally rainfall and temperature reported to affect the nematode population in a particular crop/locality. The fluctuation in nematode population was correlated with major divergences in temperature and moisture (Norton, 1978). Poornima and Sivagami Vadivelu (1998) studied the population fluctuation of phytonematodes in turmeric and revealed that the population of *M. incognita* increased with increase in age of the crop and diminished as the age of the crop advances. Further the authors observed that the *M. incognita* population increased tremendously on receipt of rain with high fecundity and more in peat soil. A study on population dynamics of root knot nematode (*Meloidogyne* spp.) in cardamom revealed the occurrence of high number of second stage juveniles during Mar-Apr. The nematode population in roots increased rapidly during the post monsoon period and declined gradually during the monsoon months. Crop phenology appears to be the major factor in the fluctuation of nematode population than ecological factors like rainfall and soil temperature (Eapen, 1993).

Informations were available on nematodes population and their fluctuations in turmeric cultivated under conventional method of irrigation. Nowadays drip irrigation system is gaining importance in many annual crops including turmeric owing to several advantages than surface irrigation. However, this first work has been carried out on the status of nematode population fluctuation in drip irrigation in comparison with surface irrigation.

MATERIALS & METHODS

Two fields of each one acre planted with turmeric (var: Local) and grown under conventional and drip irrigated method were selected in Coimbatore district. In the selected field 13 plants were tagged and sampled periodically at monthly interval throughout the cropping period to compare the variation in nematode population and its seasonal fluctuation in turmeric grown under conventional and drip irrigated method.

Collection of samples

Samples (250 g) collected from the rhizosphere region at a depth of 15cm @ ten samples per ha were pooled and a composite sample of 250 g was taken using shovel and packed in polythene bag with proper labelling for analysis. Similarly, new feeder root samples (10 g) were collected randomly from 10 plants/ha pooled to derive a composite sample of 10 g and subjected for nematode analysis.

Extraction of nematodes

The extraction of nematodes from soil samples were made by Cobb's decanting and wet sieving method (Cobb, 1918) followed by Modified Baermann's funnel method

(Schindler, 1961). Roots samples were macerated using a waring blender and the nematodes were separated by Modified Baermann's funnel method. The adult nematode population in roots was counted by staining the roots with acid fuchsin lactophenol (Mc Beth *et al.*, 1941).

Assessment of nematode population

To estimate the nematode population the nematode suspension was poured into a measuring cylinder. The number of nematodes was estimated in aliquots of 1 ml taken into a counting dish using a stereozoom microscope. The total population was estimated by converting the counts of sample to total volume with regard to nematode population encountered from soil and root samples.

RESULTS & DISCUSSION

Fixed plot survey to compare nematode population between conventional and drip irrigated turmeric

Soil and root samples were drawn at monthly interval during the entire cropping period from June to March in turmeric (var: local) and analysed for nematodes to compare the nematode population between conventional and drip irrigated method. The result of analysis is furnished in Table 1 and 2.

TABLE 1. Comparison of nematode population in soil (250 g) between conventional and drip irrigated turmeric

Months	System	Nematode population (250 g) in soil										't'-Value
		M. i	*P. d*	*R. s*	*L. e*	*X. e*	*H.s*	*H. m*	*T. m*	*R. r*	Total	
Jun	Conventional	-	-	-	-	-	-	-	-	-		-
	Drip	-	-	-	-	-	-	-	-	-		
Jul	Conventional	7.24	6.56	6.79	5.34	5.12	3.41	2.67	3.45	-	40.58	**2.41**
	Drip	6.01	5.34	5.92	4.96	4.85	2.34	2.02	2.12	-	33.56	
Aug	Conventional	11.08	7.87	8.23	7.87	7.04	4.59	3.65	3.23	2.01	55.57	**2.75**
	Drip	9.97	6.65	6.33	6.05	5.98	3.67	3.02	3.11	-	44.78	
Sep	Conventional	47.98	19.98	13.67	15.98	16.99	15.67	12.88	6.09	2.45	151.69	**2.32**
	Drip	30.07	12.56	10.98	13.78	14.54	13.43	10.23	5.54	2.12	113.25	
Oct	Conventional	70.79	18.34	15.65	18.45	17.24	17.12	8.56	5.34	2.76	174.25	**2.62**
	Drip	63.23	14.33	12.46	15.34	10.45	14.21	5.21	3.21	2.32	140.76	
Nov	Conventional	85.23	21.98	20.05	21.67	15.56	17.45	16.34	11.56	3.12	212.96	**2.80**
	Drip	80.45	17.12	18.23	16.32	10.34	15.44	13.31	8.98	2.45	182.64	
Dec	Conventional	96.67	25.12	23.21	36.44	17.67	19.89	18.13	13.24	4.23	254.6	**2.84**
	Drip	87.45	20.38	19.16	30.32	15.24	14.34	15.33	10.45	2.01	214.68	
Jan	Conventional	80.34	27.34	20.22	19.56	14.33	15.24	14.34	10.21	2.13	203.71	**2.70**
	Drip	74.56	23.20	18.67	17.43	10.45	11.34	10.23	6.56	1.12	173.56	
Feb	Conventional	59.21	20.38	16.34	15.34	11.34	10.67	9.56	7.42	1.23	159.49	**2.45**
	Drip	50.34	15.34	12.39	11.45	6.45	8.45	5.34	5.23	-	114.99	
Mar	Conventional	25.67	18.34	11.20	10.11	9.35	7.23	5.34	3.41	-	90.65	**2.61**
	Drip	20.34	15.23	8.56	5.78	4.34	3.56	2.17	1.56	-	61.65	

Note*:*

M. i- Meloidogyne incognita, P. d- Pratylenchus delattrei, R. s-Radopholus similis, L. e-Longidorus elongatus, X. e-Xiphinema elongatum, H. s-Hoplolaimus seinhorstii, H. m- Helicotylenchus multicinctus, T. m-Tylenchorhynchus martini and *R. r- Rotylenchulus reniformis.*

Generally the nematode population recorded during different months was lesser in drip irrigated turmeric compared to conventional method of flood irrigated turmeric with regard to specieswise *viz., M. incognita*, *P. delattrei, R. similis, L. elongatus, X. elongatum, H. seinhorstii, H. multicinctus, T. martini* and *R. reniformis* or total population of nematodes in both soil and root. In both systems of cultivation the nematode population started to built up gradually after planting and reached their peak around sixth month after planting and then started to decline as the age of crop advanced. The population of *M. incognita* (96.67/250 g soil; 35.22/10 g root), *P. delattrei* (27.34/250g soil; 9.52/10g root), *R. similis* (23.21/250 g soil; 8.90/10 g root), *L. elongatus* (36.44/250 g soil), *X. elongatum* (17.67/250 g soil), *H. seinhorstii* (19.89/250 g soil), *H. multicinctus* (18.13/250 g soil), *T. martini* (13.24/250 g soil) and *R. reniformis* (4.23/250 g soil; 4.29/10 g root) peaked around sixth month was comparatively higher than the peak population of same nematodes at the same period in drip irrigated turmeric (Table 1&2). The population of nematodes associated with turmeric was found to be in higher side in conventional system of flood irrigation compared to drip irrigated method in both roving and fixed plot survey undertaken in the present study (Fig. 1).

Drip irrigation serves to provide the plant with optimum water conditions, thus reducing the influence of nematode stress (Funt *et al.*, 1982). In addition, surface drip irrigation which can maintain a relatively dry soil surface while maintaining crop water requirements would be less conducive than conventional system of irrigation to plant diseases and nematodes (Browne *et al.*, 2002). Further it is reported that the drip irrigation alone reduced the population of *X. americanum* and *P. penetrans* associated with peach root (Funt *et al.*, 1982). Similarly the incidence of lettuce dorp caused by *Scelerotinia minor* and corky root caused by *Rhizomonas suberifaciens* occurred at lower rate under subsurface drip irrigation than under conventional furrow irrigation (Subbarao *et al.*, 1997). Therefore the above findings were related for the lesser occurrence of nematodes in drip irrigated system compared to conventional system of flood irrigation system. Hence it is inferred that the drip irrigated turmeric is less affected by nematodes than conventional method of flood irrigated turmeric.

TABLE 2. Comparison of nematode population in root (10 g) between conventional and drip irrigated turmeric

Month	System	Nematode population (10 g) in root					't'-Value
		M. i	*P. d*	*R. s*	*R. r*	Total	
Jun	Conventional	-	-	-	-	-	-
	Drip	-	-	-	-	-	
Jul	Conventional	4.34	2.10	2.54	1.10	10.08	**2.43**
	Drip	2.12	1.13	1.06	-	4.31	
Aug	Conventional	16.45	3.35	3.67	2.11	25.58	**2.69**
	Drip	12.45	1.32	2.06	1.70	17.53	
Sep	Conventional	19.67	4.56	5.54	2.33	32.10	**2.58**
	Drip	20.33	2.11	3.45	1.00	26.89	
Oct	Conventional	26.45	6.32	7.56	3.57	43.90	**2.82**
	Drip	20.18	4.10	4.98	3.00	32.26	
Nov	Conventional	30.24	7.88	8.90	4.29	51.31	**2.76**
	Drip	25.11	5.45	4.33	2.55	37.44	
Dec	Conventional	35.22	9.52	6.35	3.11	52.2	**2.87**
	Drip	29.87	6.45	3.21	1.19	40.72	
Jan	Conventional	23.57	5.31	4.29	-	33.17	**2.55**
	Drip	18.69	2.44	1.98	-	23.11	
Feb	Conventional	19.45	3.22	3.10		25.77	**2.39**
	Drip	14.33	1.54	2.00	-	17.87	
Mar	Conventional	10.19	2.10	2.13	-	14.42	**2.43**
	Drip	5.39	-	-	-	5.39	

Note*: M. i- Meloidogyne incognita, P. d- Pratylenchus delattrei, R. s-Radopholus similis* and *R. r- Rotylenchulus reniformis.*

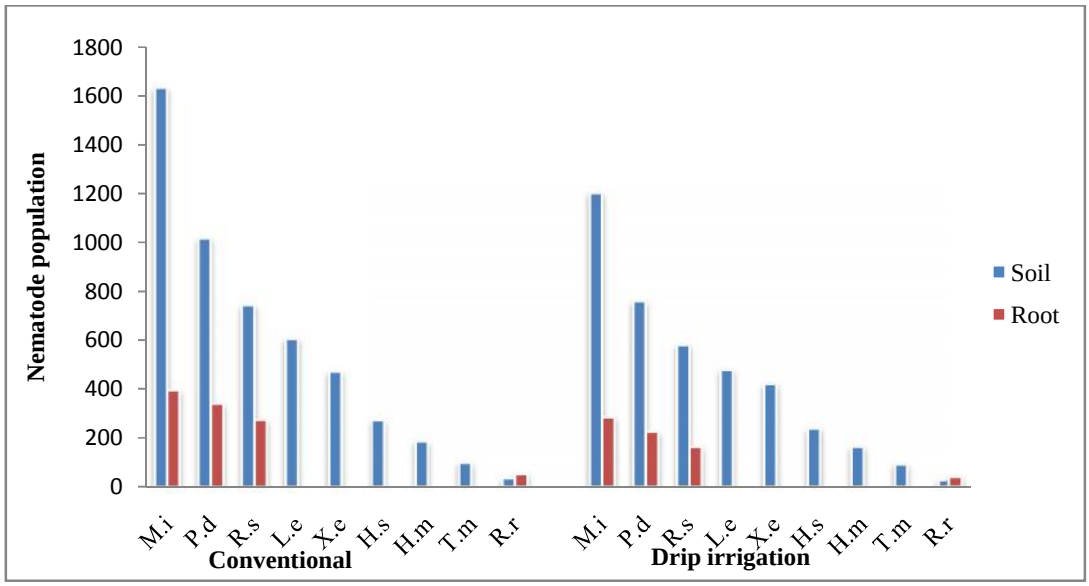

FIGURE 1. Comparison of nematode populations recorded in turmeric in different system of irrigation

Seasonal fluctuation of phytonematodes

Population of nematodes fluctuated with the season and the age of the crop (Fig. 2) population increased just after the rains. *Meloidogyne incognita* was more predominating in number which may attributed to the high reproductive potentiality of this nematode with fecundity range between 200 to 500 eggs per egg mass. A concomitant population of *Longidorus* sp., *Xiphinema* sp., *Tylenchorynchus* sp., *Helicotylenchus* sp. and *Pratylenchus* sp. occurred with *M. incognita* and their population increased in advance in the age of the crop from Sep to Dec. This might be because of availability of more feeder roots to feed upon in the plant as the plant grows. The nematode population decreased with the setting of senescence from Jan to Mar.

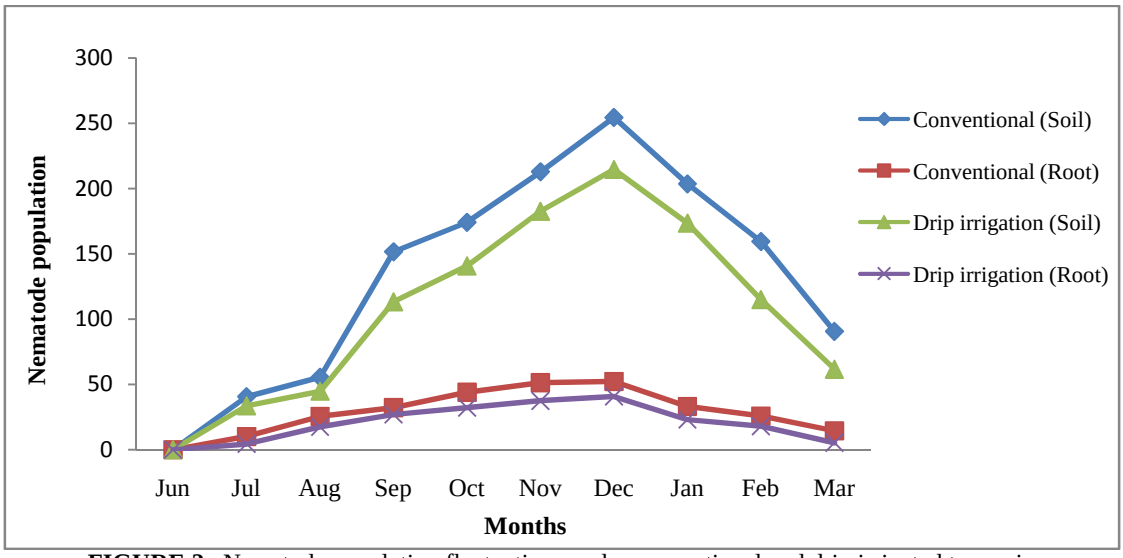

FIGURE 2. Nematode population fluctuations under conventional and drip irrigated turmeric

The root knot nematode population gradually started to built up right from the time of planting of turmeric and reached its peak around sixth month and declined towards crop maturity. In support of the present finding Eapen (1993) reported that *M. incognita* population differed significantly from period to period due to seasonal production of new root biomass. The same author also concluded that crop phenology appears to be the major factor influencing the seasonal fluctuation of nematode in cardamom. Similarly Ramakrishnan (1992) also stated that nematode population of *Hirschmanniella* sp. increased with age of crop upto heading stage in rice. The nematode population was found to increase with the age of the crop because of availability of more feeder root to feed by nematodes and then started to decrease the population (Poornima and Sivagami Vadivelu, 1999) in the crop turmeric itself as observed in the present study.

Therefore, it is suggested that the optimum time to focus required control measure is just before planting as preventive measure or before sixth month as curative measure to achieve good degree of nematode control.

REFERENCES

Browne, G.T., DeTar, W.R., Sanden, B.L. and Phene, C.J. (2002) Comparison of drip and sprinkler irrigation systems for applying metham sodium and managing stem rot on potato. *Plant Disease.* **86,** 1211-1218.

Cobb, N.A. (1918) Estimating the nematode population of soil. *USDA Agriculture Technical Circle.* **1,** 48.

Eapen, S.J., Beena, B. and Ramana, K.V. (2008) Evaluation of fungal bioagents for management of root knot nematodes in ginger and turmeric fields. *Journal of Spices and Aromatic Crops.* **17,** 122-127.

Funt, R.C., Krusberg, L.R., Ross, D.S. and Goulart, B.L. (1982) Effect of post plant nematicides and trickle irrigation on newly planted peach trees. *Journal of American Society* of *Horticulture Science.* 107, 891-895.

Mc Beth, C.W., A.L. Toylor and A.L. Smith (1941) Note on staining nematodes in root tissue. *Proceeding of Helminthological Society of Washington.* **8,** 26.

Norton, D.C. (1978) *Ecology of Plant Parasitic Nematodes.* John Wiley and Sons. Inc. New York, USA, p. 263.

Poornima, K. and Sivagami Vadivelu (1999) Occurrence and seasonal population behavior of phytonematodes in turmeric (*Curcuma longa L.). Pest Management in Horticultural Ecosystems*, **5,** 42-45.

Ramakrishnan, S. (1992) Population dynamics of root knot nematode, *Afro-Asian Nematology Network.* **1,** 39.

Schindler, A.F. (1961) A simple substitute for a Baermanan funnel. *Plant Disease Reporter*, **45,** 747-748.

Subbarao, K.V., Hubbard, V.J. and Schulbach, K.F. (1997) Comparison of lettuce disease and yield under surface drip and furrow irrigation. *Phytopathology*, **87,** 877- 883.