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Synergetics of Seasonality and Contrasting Pest Management Strategies on Community Dynamics of Soil Nematodes in Tomato-Growing Agroecosystem

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ABSTRACT

Nematodes are valuable bio-indicators of soil disturbance in agricultural practices. A study on the seasonal changes of nematode community was conducted during period of May 2017 to March 2018 in historically tomato growing agro-farms in Northern part of Kathmandu valley. The purpose of the study was to explore the effect of seasons and pest management practices on nematodes community. The field experiments were set up within the plastic tunnels of Tomato *(Lycopersicon esculentum,* srijana strain) cultivated farm to manage the insect pest. We observed the effect of seasons on community composition of nematodes. In this experiment, four types of replicating plots (5 m ×5m) were established and treated: cattle manure (MP), pesticides (PP), botanical pesticides (BP), and control plot (CP). Maximum indicative species are clustered in manure and control plots especially in summer season. Our study indicates the combine effect of treatment systems and seasonality in community composition of nematodes rather than season and treatment alone. There was significantly ($P>0.05$) low abundance of nematodes with pesticides applying plots in both seasons (winter and summer). Plant feeder and fungal feeder (functional group and feeding guilds) are more responsive towards moisture content and soil temperature whereas bacterivores (cp-2) are associated towards the total nitrogen and organic carbon content in the soil. The combined effect of seasons and treatment strategies that regulate the resources availability is attributed for shaping the nematode community in this experiment.

Key Words: Diversity; Trophic Groups; Feeding Guilds; Soil Nutrients; Physical Parameters; Indicator Species

BACKGROUND:

The importance of soil organisms for maintaining soil functionality and regulating processes that support ecosystem services like nutrient and water retention carbon storage and pest resistance is widely recognized (Wall 2012, Mulder et al. 2005). Among soil animals, nematodes occur in high diversity and density in every soil and sediment type (Treonis and Wall 2005, Wu et al. 2011), therefore can also be used to indicate the biodiversity status (Bhusal et al. 2015). They are very diverse in terms of trophic preferences (plant feeders, fungivores, bacterivores, omnivores and predators) in the soil food web that represents variable life history strategies (Bongers 1990, Bongers and Ferris 1999, Yeates 2003). They are involved in fundamental ecological processes like decomposition and nutrient cycling (De Goede and Bongers 1998) and their functional composition is indicative of the major channels of energy transfer across the decomposition pathways in soil. Therefore, they play a decisive role in ecosystem services (Wolters 2000, Jouquet et al. 2006, Van Der Heijden et al.2008) such as control of soil organic matter (SOM) physical structure along with soil community as well as and aboveground vegetation dynamics (DeDeyn and Vander Putten 2005). A number of nematode community indices (Bongers 1990, Ferris et al. 2001) have been developed and successfully applied to monitor land use changes management effects environmental disturbance (Tsiafouli et al. 2007, Moura and Franzener 2017). Their indices have been broadly used to assess the soil condition across landscape level and climate change monitoring (Bhusal et al. 2015,Tsiafouli et al. 2017). Thus nematode community structure is a sensitive indicator of the soil status and environmental disturbances (Dufrene and Legendre 1997, Bongers and Bongers 1998, Bongers and Ferris 1999, Zhao and Neher 2013) in agricultural as well as natural soil. Similarly, nematodes community composition comparing organic and conventional farming systems have been done for commercial fields with different crop managements (Neher and Olson 1999). It is known that the composition of soil nematodes is influenced by environmental variables such as vegetation soil type season soil moisture level and soil organic matter (Goralczyk 1998, Briar et al. 2007). The loss of nematofauna causes a serious decline in ecosystem services consequently bringing about socio-economic losses and ultimately food security. The loss of species from food webs due to agricultural intensification (Tsiafouli et al. 2017, Sun et al. 2013) random use of pesticides and other management strategies are the possible causes of loss of soil nematodes that demands more rigorous investigation in sustainable soil conservation in agricultural farms especially in developing countries like Nepal. In Nepal majority of the farming practices depends on the traditional seasonable crop farming where the yield is very low as compared to the farming effort. Current scenario prevails diverse challenges in agriculture system such as extensive use of chemicalpesticides, lacks of sustainable soil biodiversity conservation policy including land use plan and strategy. Chemical pesticides (including weedicides) are still the primary choice of over 80 % farmers for weed and insect pest management (Rijal et al. 2018). Therefore, this country is constantly under pressure to reduce the chemical pesticides and demanding of effective and sustainable eco-friendly pest management techniques to maintain the sustainability in soil ecosystem (Sjacob and Van Bezooijen 1984, Giri et al. 2009).

In this study Seasonal variation in the soil nematode communities was investigated under field experimental approach in the tomato growing Farm. We performed five treatment plots to evaluate the response of soil nematodes in differently managed insect pest strategies in historically Tomato (*Lycopersicon esculentum*) growing field. Our major aim in this study is to compare the seasonal variation in abundance and diversity of nematodes their functional group and guilds within five differently treated plots for pest management and to determine how species richness and functional diversity of this fauna is vary with soil physical parameters.

MATERIALS AND METHODS:

Site Description:

The field experiment was carried in Tokha Municipality (27^{0} 46' 12.69'' N to 85^{0} 19' 44.86" E) of Northern part of Kathmandu valley. The experimental site is a traditionally tomato growing agricultural land where Tomato *(Lycopersicon esculentum*- Srijana Strain) is cultivated for commercial purpose.

Experimental Design:

The field experiments were set up within the plastic tunnels of Tomato *(Lycopersicon esculentum*srijana strain) cultivated farm to manage the insect pest to find variation of nematofauna with management practices. In this experiment four types of replicating plots (size 5×5 sq.) were established i.e. Cattle manure treated plot (MP) Pesticides treated plot (PP) botanical pesticides treated plots (BP) and control plot (CP) and 9 replicating soil samples were randomly collected from each plot. Thus the sampling strategy represents: 2 seasons X 4 plots X 9 samples were collected for extraction of soil nematodes. The experimental plots were well separated (with plastic bar and tin covered) so as to prevent the adulteration among the experimental plots. In manure plot (MP) mixture solution of cattle urine and dung (50% cattle urine and dung and 50% water) is applied at the rate of 1 L every 30 days. In the pesticide plot (BP) extract of Timur *Xanthoxylum armatum* (Tewary 2005) powder was applied (100 g L^{-1} water per plot) but in the pesticides plot (PP) plot (mixture of chlorprrifos 50% and cypermethrin 5% EC- 2 mL L^{-1}) chemical pesticide were applied whereas no treatment was applied in control plots.

Nematode Extraction and Identification

Soil samples were randomly collected from different plots (soil cores -diameter 3.5 cm and depth 15 cm) in each of the plots. Nematodes were extracted by the modified Cobb's sieving and decanting method from the soil samples (S'jacob and Van Bezooijen 1984). A subsample of 100 g soil (wet weight) was used for extraction. Nematodes were collected after 72 hr. Total numbers of nematodes were immediately counted using a stereo microscope at 40x magnification for the abundance estimation. For further analysis, nematodes were heat killed and fixed with 4% formaldehyde. Later from each sample at least 50 nematodes were randomly counted from each sample under stereoscopic microscope. Later nematodes were photographed and identified genus level using the identification keys of (Bongers 1994). They were subsequently allocated to a trophic group (Bacterivores Fungivores plant parasitic and Predatory) according to (Yeates 2003) and to life history strategies (c–p scales) based on (Bongers 1990) as well as Functional guilds were assigned by combining the trophic groups to the c-value (Ferris et al. 2001). The colonizer-persister (c-p) values of nematode taxa have been scaled (1-5 scale) based on r-k life-history characteristics that are useful in interpreting the trophic status of the soil food web in different habitats (Bongers 1990). Functional guilds are defined as a matrix of nematode feeding habits with the biological ecological and life history characteristics embodied in the c-p classification. Total organic carbon (C) was estimated by Walkley and Black method (1934) whereas total content of nitrogen was determined by Kjeldahl method.

RESULT

Treatments and Seasonality Interaction for Generic Abundance:

We performed the discriminate analysis (DA) to ordinate pattern of nematodes abundance by interface the interface of treatment plots and seasons. The abundance of nematode genera wasordinate in two significant axes (Figure 1) higher variation was observed in control plot (CPW and CPS) and manure plots (MPW and MPS) comparing other treatment strategies. There is a tendency

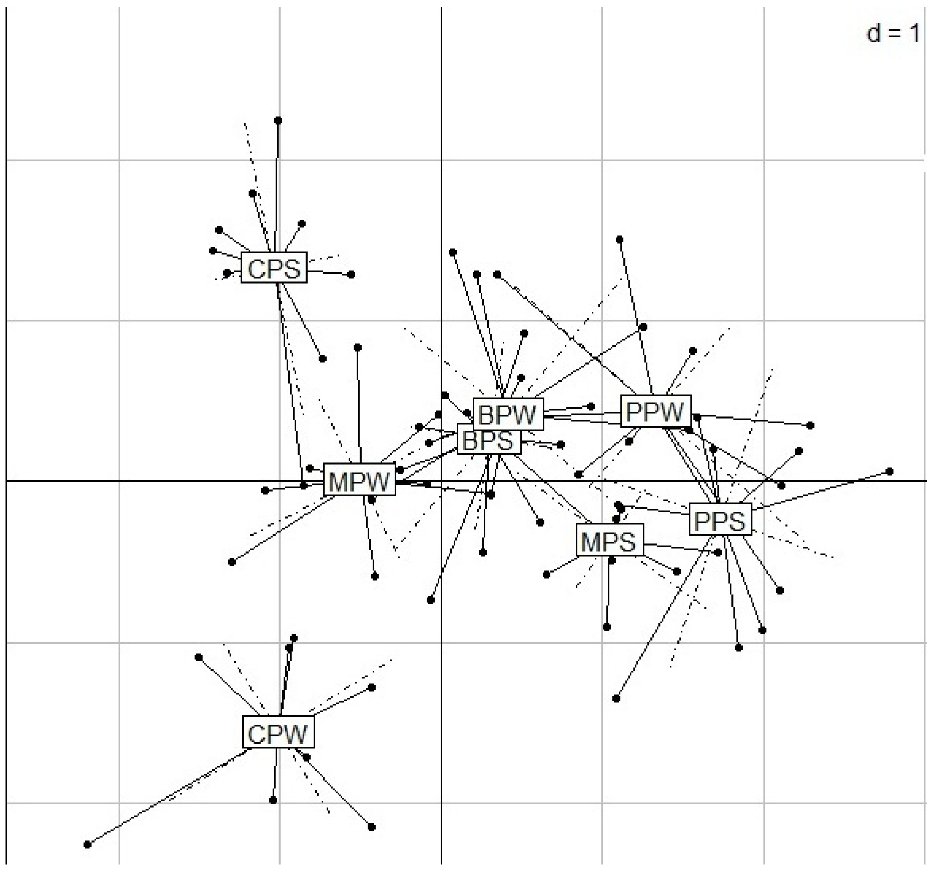

Figure 1. Two axes (DA) ordination of nematodes abundance genera with interaction of treatment plots and seasons (Control plot winter-CPW, Control plot summer-CPS, Manure plot winter-MPW, Manure plot-summer-MPS, Botanical plot winter-BPW, Botanical plot summer-BPS, Pesticides plot winter-PPW, Pesticide plot summer-PPS).

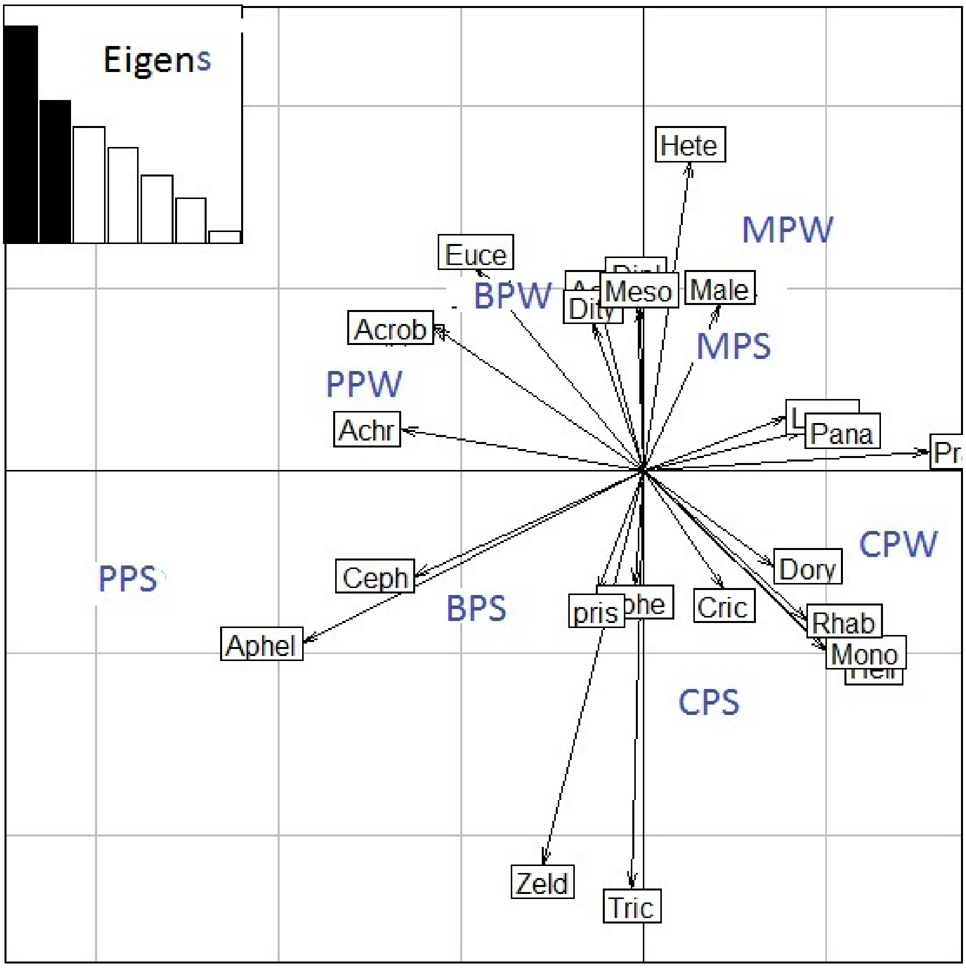

Figure 2. Ordination (Between-class analysis-BA) of abundance of genera with seasons*plots.Ac *(Acrobeles),* Acc *(Acrobeloides),* Accc *(Achromadora),* App *(Aphelenchoides),* Ap *(Aphelenchus),* Ce *(Cephalobus),* Cr *(Criconemella),* Di *(Ditylenchus),* Do *(Dorylaimus),* Eu *(Eucephalobus),* Hee *(Helicotylenchus),* He *(Heterocephalobus),* Lo *(Longidorous),* Ma *(Malenchus),* Dii *(Diploscapter),* Me *(Mesorhabiditis),* Mo *(Mononchus),* Pa *(Panagrolaimus),* Prr *(Pratylenchus),* Pr *(Prismatolaimus),* Rh *(Rhabditis),* Tr *(Trichodorous),* Ze (Zeldia).

of plot wise pattern rather than combine effect of plot and season. Likewise,the patterns of generic abundance in our data were performed by between class analyses (BA). This analysis revealed the abundance of genera in treatments and seasons interface has well separated. The higher number of generalwere distinguished towards non pesticides applying plots such as manure plot (MPW MPS) and control plots (CPS CPW) in both seasons rather than pesticides treated plots (Figure 2).

Indicator Species Analysis (ISA)

We did Indicator Species Analysis (ISA) was done based on labdsv package in R (Dufrene and Legendre 1997. The maximum nematodes genera were identified and classified (Maxcls) in manure plot s in summer seasons (MPS) and thereafter the botanical pesticides treated plot in summer (BPS). In contrast the minimum nematodes genera were indicative for pesticides applied plots (PP) for both seasons but no specific indicator genera were found in the pesticides applying plot during winter season (Table 1).

Effect of Trophic Composition and Functional Guilds

To find the effect of seasonality and treatment plots on the nematodes trophic groups and functional guilds we performed generalized linear model (GLM). The model selection in this case was based on sum minimization of Akaike Information criteria (AIC) backward and forward

Table 1. Indicator Species Analysis (ISA) of nematodes genera with treatment plots *seasons. Maximum classified in samples (Maxcls) and individual classification level (indcls)

Genus	BPS	BPW	CPS	CPW	MPS	MPW	PPS	PPW	Maxcls	indcls
Acrobeles	0.14	0.08	0.12	0.11	0.25	0.18	0.06	0.05	**MPS**	0.25
Acrobeloides	0.15	0.14	0.10	0.12	0.24	0.10	0.09	0.06	**MPS**	0.24
Achromadora	0.15	0.13	0.17	0.06	0.23	0.11	0.11	0.04	**MPS**	0.23
Aphelenchoides	0.18	0.13	0.16	0.14	0.11	0.09	0.15	0.04	**BPS**	0.19
Aphelenchus	0.19	0.11	0.17	0.19	0.16	0.11	0.05	0.03	**BPS**	0.18
Cephalobus	0.22	0.14	0.14	0.15	0.12	0.09	0.09	0.04	**BPS**	0.22
Criconemella	0.12	0.10	0.27	0.15	0.15	0.14	0.03	0.04	**CPS**	0.27
Ditylenchus	0.16	0.20	0.12	0.17	0.12	0.16	0.04	0.04	**BPW**	0.20
Dorylaimus	0.08	0.20	0.17	0.17	0.19	0.14	0.02	0.03	**BPW**	0.20
Eucephalobus	0.17	0.14	0.11	0.13	0.19	0.20	0.03	0.03	**PPS**	0.27
Helicotylenchus	0.07	0.11	0.27	0.18	0.15	0.15	0.05	0.02	**CPS**	0.21
Heterocephalobus	0.12	0.18	0.10	0.14	0.25	0.16	0.01	0.03	**MPS**	0.25
Longidorous	0.18	0.21	0.11	0.11	0.11	0.18	0.04	0.06	**BPW**	0.32
Malenchus	0.12	0.03	0.23	0.22	0.32	0.04	0.03	0.02	**MPS**	0.21
Diploscapter	0.08	0.13	0.19	0.21	0.16	0.17	0.03	0.03	**CPW**	0.20
Mesorhabiditis	0.17	0.13	0.13	0.13	0.19	0.19	0.03	0.05	**MPS**	0.19
Mononchus	0.17	0.10	0.20	0.26	0.12	0.13	0.02	0.01	**CPW**	0.26
Panagrolaimus	0.11	0.06	0.21	0.15	0.20	0.21	0.02	0.03	**PPS**	0.21
Pratylenchus	0.08	0.05	0.15	0.28	0.22	0.17	0.03	0.02	**CPW**	0.24
prismatolaimus	0.24	0.09	0.15	0.17	0.21	0.06	0.03	0.05	**BPS**	0.28
Rhabditis	0.16	0.10	0.18	0.28	0.09	0.15	0.03	0.02	**CPW**	0.28
Trichodorous	0.35	0.06	0.21	0.18	0.06	0.12	0.01	0.02	**BPS**	0.35
Zeldia	0.19	0.14	0.40	0.03	0.09	0.08	0.03	0.03	**CPS**	0.40

selection. Our analysis indicated that the mean abundance of functional groups and guilds are vary with interaction of season and treatment plots. The abundance of all functional groups (Table 2) and trophic guilds (Table 3) are significantly lower in all pesticides applying plots in both seasons. There was significant effect on the abundance of nematodes especially on all functional groups except predatory group in control plots in both seasons. The combine effect of treatment plots and seasons has no any significant variation in Bacterial fungal and plant feeders but the mean abundance of predatory nematodes is significantly affected with interface of treatment and seasons. Similarly, Manure applying plots in both seasons has no any significant effect in most of the cases in both seasons at least in predatory guilds (Pre4).

Effect of Soil Physical Parameters with Functional Groups and Guilds

The soil C:N ratio has often been used as a sensitive indicator for the assessment of soil nutrient quality and decomposition channel in soils. Soil physical parameters with functional groups and guilds were investigated. The most important climatic components affecting nematodes community are moisture availability, organic carbon and total nitrogen in soil (Sun et al. 2013). We performed two-way DCA ordinations to find the relation of functional groups, functional guilds and soil parameters (Figure 3). Plant feeder and fungal feeder (functional group and guilds) are responsive to soil water content and soil temperature especially Fug2 (Fungal feeder cp-2) and plf3 (Plant feeder cp-2) and allied for these parameters. Similarly, bac2 (Bacterivores cp-2) are more responsive to total nitrogen content and organic carbon in the soil whereas predatory groups and guilds (pre4) exhibit regressive relation with specified parameters.

Table 2. Generalized linear model to explore the effect of seasons and treatment plots (as factors) on abundance of functional group (Bacterivores- bac, fungivores- fug, plant feeder-plf and predatory-pre of free living soil nematodes.

	Estimated	Std.error	t-test	P-value
bac				
(Intercept)	242.67	15.71	15.45	0
BPW	44	22.22	1.98	0.05
CPS	18.11	22.22	0.82	0.42
CPW	34.33	22.22	1.55	0.13
MPS	10.56	22.22	0.48	0.64
MPW	9.22	22.22	0.42	0.68
PPS	176.44	22.22	7.94	0
PPW	182.22	22.22	8.2	0
fug				
(Intercept)	35.44	4.85	7.32	0
BPW	15.11	6.85	2.21	0.03
CPS	3.33	6.85	0.49	0.63
CPW	0.33	6.85	0.05	0.96
MPS	4.89	6.85	0.71	0.48
MPW	15.11	6.85	2.21	0.03
PPS	26.11	6.85	3.81	0
PPW	30.56	6.85	4.46	0
plf				
(Intercept)	188	16.53	11.37	0
BPW	40.89	23.38	1.75	0.09
CPS	40.22	23.38	1.72	0.09
CPW	30.33	23.38	1.3	0.2
MPS	50.33	23.38	2.15	0.04
MPW	36.89	23.38	1.58	0.12
PPS	117.67	23.38	5.03	0
PPW	145.78	23.38	6.24	0
pre				
(Intercept)	48	5.57	8.62	0
BPW	0.44	7.87	0.06	0.96
CPS	35.56	7.87	4.52	0
CPW	46.33	7.87	5.89	0
MPS	11.78	7.87	1.5	0.14
MPW	15.22	7.87	1.93	0.06
PPS	36.22	7.87	4.6	0
PPW	40.22	7.87	5.11	0

Table 3. Generalized linear model to find the interaction of season and treatment plots on the abundance of functional guilds (Bacterivores- bac1 and bac2, fungivores- Fug2, plant feeder-plf1, plf2, and plf3 and predator-pre4)

	Estimate	Std.Error	t-test	p value
bac1				
(Intercept)	86.44	7.49	11.54	0
BPW	27.67	10.6	2.61	0.01
CPS	27.78	10.6	2.62	0.01
CPW	3.22	10.6	0.3	0.76
MPS	3.67	10.6	0.35	0.73
MPW	8.44	10.6	0.8	0.43
PPS	70.44	10.6	6.65	0
PPW	70.44	10.6	6.65	0
bac2				
(Intercept)	158.33	11.77	13.45	0
BPW	38.56	16.65	2.32	0.02
CPS	59.89	16.65	3.6	0
CPW	55.33	16.65	3.32	0
MPS	15.89	16.65	0.95	0.34
MPW	50	16.65	3	0
PPS	112.67	16.65	6.77	0
PPW	122	16.65	7.33	0
fug2				
(Intercept)	35.44	4.85	7.32	0
BPW	15.11	6.85	2.21	0.03
CPS	3.33	6.85	0.49	0.63
CPW	0.33	6.85	0.05	0.96
MPS	4.89	6.85	0.71	0.48
MPW	15.11	6.85	2.21	0.03
PPS	26.11	6.85	3.81	0
PPW	30.56	6.85	4.46	0
plf2				
(Intercept)	31	12.76	2.43	0.02
BPW	15	18.05	0.83	0.41
CPS	31	18.05	1.72	0.09
CPW	54.67	18.05	3.03	0
MPS	45.89	18.05	2.54	0.01
MPW	29	18.05	1.61	0.11
PPS	21.67	18.05	1.2	0.23
PPW	22.22	18.05	1.23	0.22

Continued

Table 3. Continued

bac1	Estimate	Std.Error	t-test	p value
plf3				
(Intercept)	137.89	12.39	11.13	0
BPW	57.11	17.52	3.26	0
CPS	31	17.52	1.77	0.08
CPW	7.11	17.52	0.41	0.69
MPS	43.44	17.52	2.48	0.02
MPW	65.67	17.52	3.75	0
PPS	77.89	17.52	4.45	0
PPW	107.33	17.52	6.13	0
pre4				
(Intercept)	64.11	5.76	11.14	0
BPW	13.11	8.14	1.61	0.11
CPS	29.22	8.14	3.59	0
CPW	38.67	8.14	4.75	0
MPS	1.67	8.14	0.21	0.84
MPW	4.44	8.14	0.55	0.59
PPS	51.67	8.14	6.35	0
PPW	55.56	8.14	6.82	0

DISCUSSION:

We hypothesized that the contrasting insect pest management alters the soil properties reflecting onsoil community structure. Our analyses showed that the relationships among components of the soil parameters alter the community composition of nematodes. It is indicative that the pesticides applying plots has low species richness and community composition compared to eco-friendly treatment plots such as manure and botanical applying plots in both seasons. This suggests that micro habitat alternation due to contrasting pest management practices under seasonal influence vary on soil community including nematodes community composition (Neher 1999, Bardgett and Van der Putten 2014). Many researchers indicated the resource dynamics and microphysical parameters in agro-ecosystem following seasons dynamics playing the leading role in shaping nematode community composition (Ekschmittet al. 2003, Bakonyi et al. 2007). The most abundant trophic group in all plots and seasons was the Bacteriovores although there were significant differences among plot and season interface. This is effect on basal resource modification and availability under the synergetic of treatment strategy and seasons. This study exhibited the response of nematode communities to the resource quantities and microclimate in seasonal influence rather than the pest management strategies alone. Resource dynamics and microphysical parameters with seasons attribute the change in taxonomic and functional composition of nematodes playing the leading role in shaping nematode community composition (Liang et al 2002, Ekshmitt et al. 2003, Bakonyi et al. 2007). This study investigated the combined effect of seasons and treatment for pest management rather than their separate effects only.

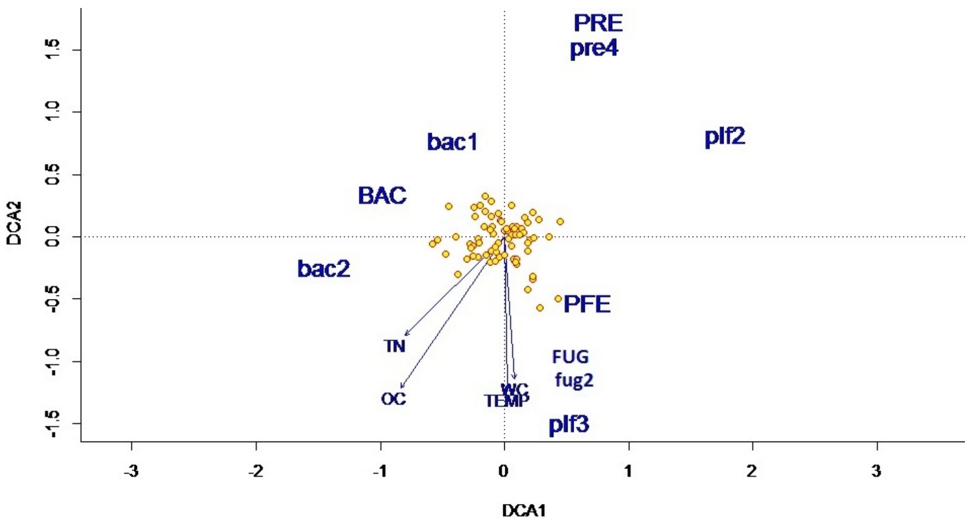

Figure 3. Effect of soil properties on functional group and functional guilds. Bacterivores (BAC), bacterivorous functional guilds of c-p=1 and c-p= s2(bac1, bac2), Fungivorous (FUG), Fungivorous of c-p2(fug2), Plant feeder (PFE), plant feeder of c-p 2 and 3 (plf2, plf3), predatory nematodes(PRE) and predatory nematodes of c-p4(pre4).

We observed high increase of nematodes diversity and abundance in the organically treated plot rather than chemically treated plots indicating lethal effect of the chemical treatment on soil nematodes. In our ordination the abundance of genera was well separated at the interface of plot and seasons. The higher generic number present in manure (MPW MPS) and control plots (CPS CPW) relatively in pesticides applying plots. The fungivores groups are sensitive toward the temperature and moisture parameters in our analysis. Many researchers indicated fungal feeders are more responsive towards low moisture content and drier soil (Bongers and Bongers 1998, Bakonyi et al. 2000, Brair et al. 2012). Fungal feeder groups area more stress tolerant suggesting fungal-dominated decomposition pathway occurs where cellulose and lignin rich litter material is the main source of nutrient input to the soil food web (Gupta and Bhusal 2018,Ferris et al. 2001).The fungivores were the major group of nematodes contributing to soil mineralization.) reported that the abundance of many free-living nematodes particularly bacterivore and fungivore nematodes was also correlated with the concentration of many soil nutrients(Liang et al. 2009).Previous work found thatfungivores are strongly associated with soil pH and thus are a good indicator of changes in these soil properties with long time series (Wasilewska 2006). An increase in the relative abundance of fungivores within the total nematode community provides information about increasing soil acidity (Ruess 2003). In our study significantly higher abundance of nematodes presents the manure applying and control plots especially in summer season. This may have affected by the external inputs of cattle manure (nutrient availability) enhance the soil fertility on the abundance and diversity variation. The response variation in our system by functional guilds was probably attributed to change in microhabitat characteristics as well as the effect of resources variation especially in manure plots. Increased bacterial nematodes in MP in both seasons compared to other plots especially found decreased in pesticides plot probably indicating chemical effect on nematodes community in other plots (Bongers and Ferris 1999, Goralczyk 1998, Bardgett et al. 2008, Kapagianni et al. 2010). Local habitat in terms of resource variability and combination of other physical parameters varying influence in the composition of soil nematodes (Neher et al. 2005, Nielsen et al. 2011). There was reduction of nematodes genera in the both seasons (S W) especially in pesticides applying plots attributing the effect of pesticides inputs in our system. Previous work indicated that the reduction of diversity and abundance of nematode genera after treatment of some chemicals viz. metham (PenMouratov et al. 2008). Some genera such as *Aphelenchoides, Cephalobus, Prismatolaimus* and *Zeldia* are associated with the summer season sampling of plots in pesticides treatment plots (PPS and BPS). In our indicator analysis the most of the genera are associated towards the manure applying plots in summer following the control and botanical pesticides plots. The least species indicators are linked to pesticides plots. It results probably suggesting the most disturbance soil in pesticides treating plots rather than other experimental sites in all seasons. In our ordination most of the disturbance sensitive nematodes like predatory nematodes are ordered towards the control plots (CPS and CPW) whereas bacterivores nematodes are associated towards the manure plots (MPW and MPS) probably attributed higher enrichment in manure plots in both seasons (Bongers and Ferris 1999, Ferris et al. 2001, Neher 2001). The proportions of the different feeding groups in the soil nematode community vary between treatment systems and seasons and they are influenced by a variety of factors physical and biological characteristics of the soil that influence the abundance of nematodes (Freckman and Ettema 1993, Ferris et al. 2001,Ekschmittet al 2003, Treonis and Wall 2005). Our result enrichment-opportunist bacterivore guilds (bac1) that are more associated in enrich condition of soil. The predatory group in our study is less responsive with physical parameter such as temperature and water content probably attributing that they depend on the density of other prey nematodes rather than direct physical parameters.

CONCLUSION

The application of chemical pesticides for the pest management is adversative for the richness and abundance of soil nematodes in our study. Moisture is one of the most important physical components affecting community composition of soil nematodes for both seasons (winter and summer). The response variation in our system by nematodes communities was attributed to change in microhabitat characteristics of plots effecting of resources variation under seasonal influence. The significant effect of moisture content temperature and nitrogen and carbon availability has contribution for the variation of abundance of community composition indicating that the impacts on soil nematode communities were mediated by water content level in both seasons. This study investigated the combine effect of seasons and treatment rather than seasons and treatment of pest management strategies alone. Similarly, the availability of soil nutrients such as organic carbon and total nitrogen is attributed with tropic composition i.e. fungal and bacterial nematode community that determine decomposition pathway. This study insight the need of sustainable pest management techniques should be applied therefore to prevent the loss of soil speciesand soil functionality for sustainable in agro-ecosystem in Tomato growing farms. In this sense the knowledge of rural producers is important in order to encourage practices of sustainable pest management systems that cause the soil biodiversity maintenance.

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