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EDITED BY:

Jayeoba, J.O., Idoga, S., Olatunji, O., Jimin, A.A., Adaikwu, A. O.,
Ibrahim, F. and Anikwe, M.A.N.

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NEMATODE POPULATION AS INFLUENCED BY DIFFERENT TILLAGE PRACTICES IN MAIZE-COWPEA CROPPING SYSTEM

ADESINA ABUDLKABIR WAHAB*, AFE ISAAC ADE, ISMAIL ADESHINA SANUSI

Affiliation: College of Agriculture, Kwara State University Malete, Kwara state,

Corresponding email: loukinse@gmail.com

ABSTRACT

Nematode population varies with different cultural practices and soil manipulation techniques. For this purpose, a study was conducted to determine effect of tillage practices on nematode population in a maize-cowpea cropping system. Tillage practices evaluated were plough (P), plough and harrow (PH) and traditional (heap) (T) while cropping patterns were sole-cowpea (SC), sole-maize (SM) and maize-cowpea intercrop (MC) at different spacing (60cm x 30cm; 60cm x 60cm; 60cm x 15cm). Parameters included plant height, number of leaves, number of branches (cowpea), leaf area index, nematode population and yield parameters. There is no difference between growth parameters after statistical analysis but numerically, there is. The yield was analyzed in tons/ha where cropping pattern: SM and cowpea in MC performed better (1.13 and 8.5 in tons/ha respectively). SM yield was better on T (0.96 t/ha) while SC yield was better on plough and harrow (9.39 t/ha). Trend observed for cropping pattern: M > M in MC, C in MC > C, nematode population fluctuated with crop age and tillage practice maize: T > PH > P, cowpea PH > P > T. Generally, when subjected to land equivalent ratio (LER), MC recorded highest LER of (2.74) on a plough and harrow land.

Key words: cropping pattern, tillage practices, maize-cowpea yield, nematode population

INTRODUCTION

Tillage as the technique of mechanically manipulating soil to provide positive environment for good seed germination and crop growth which in its effect control weeds, maintain infiltration capacity and soil aeration (agroinfo.in, 2015). It also refers to the agricultural preparation of soil by mechanical agitation of various kinds, such as digging, stirring, and overturning. Its system are often classified by the amount of surface residue left on the soil surface while its practice differs to which extends the soil is disturbed which results from how much pressure was exerted on the soil (Wikipedia, 2016).

Generally, the amount of covered residue on soil surface significantly influenced erosion control and formed the basis for two broad classifications of tillage systems namely those in which crop residues are removed or burned before tillage operation and those in which crop residues are deliberately left in the field for incorporation into soil using tillage equipment. Of course, this residue cover partially depends on the amount and quality of residue left after harvest, which

may vary greatly among crops and harvest method (Bertol *et al.*, 1997).

Although, No-till relies on plant residue to protect the soil and aides in postponement of the warming of the soil and crop growth but it promote chemical usage and environmental hazard. When combined with cover crops, tillage helps replace lost organic matter, slows the deterioration of the soil, improves soil drainage, increases soil water and nutrient holding capacity, and allows soil organisms such soil borne microorganisms to flourish. Soil tillage affects biological properties within a soil profile through its effect on soil mixing and loosening, crop residue status and hydrothermal regime (Mamman, 2009).

The primary benefit of soil biological activity is to builds soil structure which produced good crop growth and yield. Organic compounds produced during decomposition and other microbial processes act as a glue to bind individual soil particles together into aggregation. The effect of different tillage systems on biological environment can be variable which in often case could be detrimental to crop growth and yield. According to Fujita *et al.*, (1992), most of the

soil borne microorganism causes diseases that result into major limitation to crop production, particularly vegetable crops. They are often difficult to control, even with conventional strategies. Fungal, plasmodiophorid, oomycete, and bacterial pathogens, as well as viruses and plant parasitic nematodes, may all cause soil-borne diseases (Sarmah and Sinha, 1995).

Plant Parasitic nematodes are microscopic nematodes, some of which are soil-borne, that must have living host plant tissue to feed upon in order to grow and reproduce. Every crop has at least one plant parasitic nematode that infects it, most of them being root feeders (Sarmah and Sinha, 1995). Maize is subject to attack by a number of plant-parasitic nematodes. These pests attack the root system of maize plants and decrease the efficiency of roots in taking up water and nutrients. The damage can be apparent to roots and above-ground portions of plants ultimately reducing crop yield. The degree of damage is related to the types and population levels of nematodes present as well as the environmental conditions present in a field. Several species of nematodes are known to cause losses to cowpea throughout the world. (Caveness and Ogunfowora, 1985) listed 55 species of plant parasitic nematodes associated with cowpea production. The root-knot nematodes *Meloidogyne incognita* and *M. Javanica* are also documented to cause major losses, with *M. Incognita* indicated to be the most detrimental species to cowpea (Sarmah and Sinha, 1995). An estimated 59% loss of cowpea grain yield caused by *M. Incognita* was reported for Nigeria (Ogunfowora, 1976), while (Olowe 1978) found a seedling mortality rate of up to 80% for cowpea grown in soil with a *M. Incognita* population density of 1300 second-stage juveniles /L. A comprehensive survey of cowpea growing areas in Nigeria revealed root-knot nematodes present in 100% of the 248 farms included, with *M. incognita*, *M. javanica*, and *M. Arenaria* present in 52%, 44%, and 40% of the samples, respectively (Olowe, 2004). Under optimal conditions a root knot nematode female can hatch from its

egg and be ready to lay eggs in approximately 20 to 25 days.

In Northern guinea savanna of Nigeria *Pratylenchus goodeyi* dominates the plant-parasitic nematode communities, despite the major importance of maize-cowpea as a staple food in these areas (Davies, 1995). However, there is little understanding of how differences in soil management practices affect nematodes and the damage they cause to crop growth and yield. Generally, in Nigeria the maize-cowpea cropping systems are characterized by subsistence small-farm production (Kara-mura *et al.*, 1999) where the predominant nematode species is *P. goodeyi* (Kashaija *et al.*, 1994). Existing data concern mainly the effects of mulching and intercropping on nematode communities dominated by *R. similis* and *Helicotylenchus multicinctus* (Kashaija *et al.*, 1994), nutrient-nematode (*R. similis*) interactions (Davies, 1995; Kashaija *et al.*, 1994) and root damage caused by *P. goodeyi* on plants grown under poor management conditions (Olowe, 2004). Tillage practices are a farm operation that cannot be totally ignored, as a matter of fact to the least soil disturbance such as land clearing. Therefore, there is need to incorporate the best combination of tillage practice and cropping system with lesser effect of nematode significance and encouraging more yield. In this study, the plant-parasitic nematodes populations were determined in maize-cowpea cropping systems in three different tillage practices. The aim was to assess the influence of tillage practices on nematodes population in maize-cowpea cropping system under a classified soil and to estimate the effects of different tillage practices on nematode population

MATERIALS AND METHODS

Experimental site

The experiment was carried out at Teaching and Research Farm of Kwara State University, Malate (KWASU T&R) in Moro Local Government Area of Kwara State. The Farm has latitude 8°11' N and longitude 4°44' E at 365 above sea level. It consists of the Farm Center and area for the teaching and

research activities of the Department of Crop Production, Agricultural Economics and Extension Services, Animal Production, Fisheries and Aquaculture.

The field study was conducted during the 2016 - 2017 growing season. The soil was classified as Typic plintustalf soil - the soil type range from loamy sand to sandy clay loam in the subsoil (Wahab *et al.*, 2016) and soil reactions range from moderately acidic to slightly acidic (Alabi *et al.*, 2017).

Experimental procedure

The pre-planting operation includes the preparation of land and pre-planting soil sample. The experimental design is a split plot arrangement in randomized complete block design at two factor level which are tillage practices and cropping pattern. Soil samples were taken at 15cm depth to determine variation in nematode population with growth stages. Fertilizer application was based on blank recommendation rate for the zone which is 120kgN, 60kgP₂O, 60kgK₂O (Olowoake *et al.*, 2015). Control of insects were done due to army worm infestation on maize plots using cypermethrine+Dimethoate (C+D) at the rate of 1litre (L) C+D in 200L of water per hectare (ha) while cowpea insect infestation were controlled at two weeks interval (*Maruca vitrata*, *Ooteca mutabilis*) and finally harvesting of maize crop were done when the stalk have dried as well as cowpea.

Experimental design and layout

The experimental design was Split-split in factorial arrangement. The main plot was tillage practices while the sub plots was cropping pattern. Each of the factors were at three levels replicated three times

Tillage practices also known as the land preparation for this experiment consist of three tillage practices which are

- **Plough land:** This involves the use of plough implement with a cutting blade fixed in a frame drawn by a tractor, for cutting furrows in the soil and turning it up.
- **Plough and harrow land:** This involves double operation that included ploughing

and harrowing for turning and loosening the soil.

Traditional (heap) method: This is a land preparation in which the soils are heaped around to form a hollow high soil.

The size of land was approximately 11m x 23m, each plot size is 7.5m x 3m with three replicates each. After preparation of land, soil sample were taken from each plot at 15cm deep with soil auger.

Planting operation: each main plot of 7.5m x 3m was divided into sub-plot of 2.5m x 3m and it was planted as follows

Sole maize: A plot length of 2.5m x 3m was planted with sole maize in spacing of 60cm x 60cm.

Sole cowpea: This is the planting of only cowpea on a sub-plot of 2.5m x 3m at spacing of 60cm x 30cm.

Maize-Cowpea: This involves the intercropping of cowpea and maize on a sub plot of 2.5m x 3m at different spacing in which cowpea was planted at 60cm x 15cm while maize was planted at 60cm x 60cm inter and intra respectively.

Post planting operation: post planting operations include the activities carry on the farm after planting such as weeding, spraying of insecticides, fertilizer application, taking of soil samples and data collection.

Soil Sampling Procedure for Nematode Determination

Before taking a soil sample for nematode analysis, I ensured that the equipment is clean and there is no possibility of contamination from a previous sample. The procedure for sampling a field depends on the purpose of the sample. Usually, symptoms of nematode damage are depressed, circular or oval areas of stunted and or yellowish plants in the field. Thus, the highest nematode counts will usually be at the edges of the damaged area and not in the middle. Therefore, it would be advantageous to take the sample at the edge of the damaged area where plants still appear healthy (Olowe, 2004). Several samples of soil were collected at 0 - 15cm depth on each sub-plot. The samples were collected from the root zone where roots are most abundant. The samples taken are mixed gently and

packed into laboratory (Lab) sample bags for transport to Lab. Nematode extraction is done using Whitehead and hemming procedure (1965). This operation was carried out at five weeks intervals to determine the variations of nematodes with time

Plant Materials

The plant materials (seeds) used is obtained from Shao open market. The cowpea seed is a local variety called "Bewehey" while the maize seed is an improved variety. These plant materials are obtained to suits the prescription to local farmers because they have access to those seeds.

Data collection and analysis

Data collected on the field during growth stage are soil samples at five weeks interval, plant heights, number of leaves, number of branches, leaf area (length and breadth), and leaf area index. While data collected at harvest are weight of grains with cob, weight 100 maize seeds, weight of 1000 cowpea seed, weight of dry matter and land equivalent ratio (LER).

The Land Equivalent Ratio (LER) for the experiment was determined using the formula below as described by Dariush *et al*, (2006):

$$LER = LA + LB = YA/SA + YB/SB$$

Where LA and LB are the LERs for the individual crops

YA- Yield of maize on intercrop

SA- Yield of sole maize

YB- Yield of cowpea on intercrop

SB- Yield of sole cowpea

Data was processed using Analysis of Variance (ANOVA) and means were separated using DUNCAN Multiple Range Test at 5% level of probability. The statistical package used was Statistical Analysis System (SAS).

RESULTS

Table 1 shows the results of the pre-planting soil analysis of the study site at 0 - 15cm and 15 - 30cm depth. The soils pH ranges from 7.3 - 7.2 indicating a slightly alkaline soil, while percentages total Nitrogen and organic carbon decreases down the depth (the range

were 2.82 - 1.34 % and 26.6 - 12.95 % respectively). Also the available Calcium, magnesium, potassium and sodium reduces down the depth ranging from (3.24 - 2.5, 2.7 - 2.08, 0.95 - 0.62, 0.39 - 0.28 respectively). There is high Exchangeable acidity and manganese at the upper layer of the soil (15 cm than 30 cm) at the rate of 0.5 - 0.3 and 35.3 - 27.9 respectively. Iron and copper increased down the depth at (2.0 - 3.6 and 0.79 - 0.91 respectively) while Zinc finally decreased downward at 4.98 - 2.44. The sand particles increases downward (852 - 872 kg), the silt particles decreases down the depth (94 - 74 kg) while the clay particles remain constant across the depth at (54 kg). The soil was classified into Typic Plinthustalf (appendix 1) because it has an ustic moisture regime, it is an Alfisol and the percentage cation exchange capacity is greater than 35% in the sub soil with Typic Plinthite soils. It contain kandic horizon at the surface profile while at the sub-surface area it contain an Argillic horizon.

Table 2 - 5 shows the effect of cropping pattern and tillage practices on maize plant height, number of leaves, leaf area index and yield parameters.

Cropping pattern: Table 2 reflected that there is no significant difference in maize plant height as influenced by the treatments imposed. However, at week 4, maize in MC grows taller than SM maize (7.38 cm and 8.30 cm respectively) but as from week 6 - 10 maize in SM elevated than those maize in MC. The same trend was observed on table 4 which expresses the leave area index of treatments imposed. On table 3, the effect of cropping pattern on numbers of leaves indicated that SM had more leaves than maize in MC at week 6 and 8. Table 5 shows the effect of cropping pattern on maize yield where maize weight with cob for SM (63 g) is bigger than maize cob weight in MC (43.30 g). Similar trend was obtained on the dry matter weight but there was little difference in their weight of 100grains (22.18 g and 21.84 g) and yield/ha (1.13 and 0.78 ton/ha).

Table 1: Pre-planting Soil analysis results of the study site

Soil properties	Depth	
	0 - 15 cm	15 - 30 cm
pH (H ₂ O)	7.30	7.20
Av.P (mg/g)	17.15	29.05
O.C (%)	26.6	12.95
TN (%)	2.82	1.34
Ca	3.24	2.50
Mg	2.70	2.08
K	0.95	0.62
Na	0.39	0.28
Ex.acidity	0.50	0.30
Mn	35.30	27.9
Fe	2.00	3.60
Cu	0.79	0.91
Zn	4.98	2.44
Clay	54.00	54.00
Silt	94.00	74.00
Sand	852.00	872.00

pH (H₂O) = water acidity in the soil; Av.P (mg/g) = Available Phosphorus; OC% = percentage Organic Carbon; %TN = Total Nitrogen; Ca = total calcium; Mg = Magnesium; K = potassium; Na = Sodium; Ex. acidity = Exchangeable Acidity; Mn = Manganese; Fe = iron; Cu = Copper; Zn = Zinc.

Tillage: The effect of TP on maize plant height as presented on table 2 shows that there is no significant differences between the tillage practices but throughout the growth stage, the maize on PH and T plots continuously grow taller than the maize on the P plot. Table 3 showed the effect of TP on numbers of leaves in which PH and T have more leaves than P at week 4 and 6 but at week 8 and 10 T plot has more leaves than PH and P (11.18; 10.20 and 10.43 respectively). The results obtained on table 4 showed that at week 4, 6 and 8 the T plot had higher LAI (62.93, 210.75, and 204.70 cm² respectively) than P, and PH, but getting to week 10, PH plot has higher LAI (284.70 cm²) while P plot has the least (234.94 cm²). Table 5 shows the effect of tillage practices on maize yield, although there is no significant difference in the yield of P, PH and T but the P plot has the least weight with cob (39.98 g) and dry matter weight (750.00

g) while little differences was observed on their weight of 100grains of P, PH and T (20.65 g, 22.37 g, 22.97 g).

Table 6 - 9 showed the effect of cropping pattern and tillage practices on cowpea plant height, number of leaves, leaf area index and yield parameters.

Cropping pattern: The effect of CP on cowpea plant height as presented on table 6 showed that there is no significant differences in treatments imposed. However, at week 4.8 and 10 C intercrop grows taller than SC cowpea (14.38 cm, 14.09 cm and 17.74 cm respectively). Table 7 showed the effect of CP on cowpea number of leaves in which at week 4 C in the intercrop had more leaves than SC cowpea (57.66 and 20.20 respectively) but as from week 6 - 10 SC cowpea had more leaves than in C cowpea intercrop. Table 8 showed the effect of CP on LAI wherein throughout the growth stage cowpea in SC had higher LAI than those in C intercrop. Table 9 showed the effect of CP on cowpea yield where SC cowpea weighed more (1000 seed weight) than C cowpea intercrop (139.64 g and 135.93 g) and yield/ha (ton/ha), while C cowpea had higher dry matter weight than SC (477.78 g and 422.22 g).

Tillage: The effect of TP on cowpea plant height as presented on table 6 shows that there is no significant differences between the tillage practices where at week 4 the C on P plot grow taller than the C on PH and T plot (17.18, 7.53 and 8.88 respectively) while as from week 6 - 10, the trend of cowpea plant height as influenced by tillage practices was T>PH>P. Table 7 showed the effect of TP on numbers of leaves and branches wherein at week 4 the T plot had more leaves (119.64) but at week 6 P plot had more leaves (119.64) while at week 8 T plot had higher number of branches (8.07) and at week 10 P plot had more branches (9.52). Table 8 showed the effect of TP on LAI in which at week 4 the T plot had more LAI (14.71) but at week 6 PH plot had high LAI (31.50) while at week 8 T plot had higher LAI (14.69) and at week 10 PH plot had higher LAI (20.05).

TABLE 2: Effect of Cropping Pattern (CP) and Tillage Practices (TP) on maize plant height at successive growth periods

Treatment	Plant height (cm)			
	Weeks after sowing			
	4	6	8	10
Cropping pattern (CP)				
Sole maize (SM)	7.38	18.64	62.48	82.72
Maize + Cowpea (M)	8.30	17.45	31.12	74.97
Lsd (5%)	3.26	5.47	15.97	21.61
Tillage practice (TP)				
Plough (P)	6.14	16.07	40.20	66.51
Plough and harrow (PH)	6.87	17.14	50.47	80.87
Traditional (T)	10.51	20.93	49.72	89.15
Lsd (5%)	3.99	6.70	19.55	26.47
C*T	NS	NS	NS	NS

NS = Not significant

TABLE 3: Effect of CP and TP on maize number of leaves at successive growth periods

Treatment	Number of leaves			
	Weeks after sowing			
	4	6	8	10
CP				
SM	6.82	9.18	9.60	10.38
M	7.17	8.94	9.22	10.83
Lsd (5%)	0.84	1.97	1.35	1.11
TP				
P	6.52	8.07	9.57	10.43
PH	7.10	9.50	9.57	10.20
T	7.37	9.62	9.10	11.18
Lsd (5%)	1.03	2.41	1.65	1.36
C*T	NS	NS	NS	NS

NS = Not significant

TABLE 4: Effect of CP and TP on maize leaf area index at successive growth periods

Treatment	Leaf Area Index (cm ²)			
	Weeks after sowing			
	4	6	8	10
CP				
SM	48.65	191.51	185.62	289.17
M	54.11	136.76	172.69	240.66
Lsd (5%)	27.08	82.79	88.90	66.39
TP				
P	47.13	113.11	161.61	234.94
PH	44.08	168.54	170.86	284.70
T	62.93	210.75	204.99	275.10
Lsd (5%)	33.17	101.39	108.88	81.31
C*T	NS	NS	NS	NS

NS = Not significant

TABLE 5: Effect of CP and TP on maize yield

Treatment	Weight of maize with cob (g)	Weight of 100 grain seeds (g)	Dry matter (g)	Yield in tons/ha (SM)	Yield in tons/ha(M intercrop)
P					
SM	62.76	22.18	866.67	1.13	N/A
M	43.30	21.81	844.44	N/A	0.78
Lsd (5%)	21.79	3.81	59.62	0.05	0.05
TP					
P	39.98	20.65	750.00	0.88	0.63
PH	52.90	22.37	816.67	1.15	0.75
T	66.20	22.97	1000.0	1.43	0.96
Lsd (5%)	26.69	4.67	73.02	0.05	0.05
C*T	NS	NS	NS	NS	

N/A = Not applicable and NS = Not significant

TABLE 6: Effect of CP and TP on cowpea plant height at successive growth periods

Treatment	Plant height (cm)			
	Weeks after sowing			
	4	6	8	10
CP				
Sole cowpea (SC)	8.01	13.08	11.69	13.44
Cowpea + Maize (C)	14.38	12.23	14.09	17.74
Lsd (5%)	14.92	1.73	1.65	2.46
TP				
P	17.18	11.97	12.87	14.37
PH	7.53	11.46	11.77	12.57
T	8.88	14.53	14.02	19.84
Lsd (5%)	18.27	2.12	2.02	3.02
C*T	NS	NS	NS	

NS = Not significant

TABLE 7: Effect of CP and TP on cowpea number of leaves at successive growth periods

Treatment	Number of leaves			
	Weeks after sowing			
	4	6	8	10
CP				
SC	20.20	132.33	8.13	9.42
C	57.66	62.14	7.76	9.35
Lsd (5%)	18.27	27.88	0.95	0.75
TP				
P	20.50	119.64	7.89	9.52
PH	19.64	90.56	7.88	9.28
T	76.65	81.51	8.07	9.37
Lsd (5%)	22.38	34.14	1.17	0.92
C*T		NS	NS	NS

NS = Not significant

TABLE 8: Effect of cropping pattern and tillage practices on cowpea leaf area index at successive growth periods

Treatment	Leaf Area Index (cm ²)			
	Weeks after sowing			
	4	6	8	10
CP				
SC	12.91	32.17	14.49	20.02
C	12.56	22.57	12.53	18.31
Lsd (5%)	3.45	19.27	2.48	1.93
TP				
P	11.75	22.22	12.07	17.88
PH	11.74	31.50	13.77	20.05
T	14.71	28.40	14.69	19.57
Lsd (5%)	4.22	23.60	3.04	2.36
C*T		NS	NS	NS

NS = Not significant

TABLE 9: Effect of CP and TP on cowpea yields

Treatment	Weight of 1000 cowpea seeds (g)	Dry matter (g)	Yield in tons/ha (SC)	Yield in tons/ha (MC)
CP				
SC	139.64	422.22	4.61	N/A
C	135.93	477.78	N/A	8.5
Lsd (5%)	18.97	50.74	0.07	0.07
Tillage practice (T)				
Plough	138.67	366.67	4.55	8.57
Plough and harrow	141.73	466.67	4.44	9.39
Traditional	132.97	516.67	4.73	7.73
Lsd (5%)	23.24	62.14	0.07	0.07
C*T	NS		NS	NS

N/A = Not applicable and NS = Not significant

Table 5 shows the effect of TP on C yield, although there was no significant difference in the yield of P, PH and T. but the PH plot had the highest weight of 1000 C seeds (141.73 g) while T plot had the lowest weight because it had the highest dry matter weight (516.67 g).

Figure 2 shows that at week 5, the *P spp* is at its peak on PH SM with a mean of five (5) whereas there is no *P spp* recorded on all the intercrop (maize+cowpea) of all the tillage practices. The highest population was however observed on PH MC and T SC with the same mean at week 10 while *P spp* were

not recorded on plough plots of all the three cropping pattern as indicated on Figure 3. Figure 4 indicates that *T spp* recorded on the P SM plot is highly significant at week 5 compared to the other treatments but at 10th week the peak of population moves from P SM plot to PH SM and average population on the PH MC and TSC with zero percent of *T spp* on other plots as shown on Figure 5. Figure 6 shows that at week five the highest population of *H spp* appear on P SM plot with mean of 6.5 and its lowest population on T (MC) (no *H spp*) but at week 10 the treatment (T MC) with initial zero population in week

5 has the highest population of 14.5 means as shown on Figure 7, meaning that the T (MC) encourage the growth of *H spp*.

Figure 8 shows the variation of *M spp* indicating that the spp is at its peak on P SC plot with a means of about 8.4 and close to 50 % of the population on P SC, PH MC and T SM. While at week 10 the *M spp* shoot up from 8.5 on P SC to about 15 on PH MC as shown on Figure 9. Thus, this signifies that cowpea is a convenient host supporting the growth of *M spp*.

At week 5 the highest population of *S spp* was on P SM with a mean count of seven (7) indicated on figure 10, five weeks later the population shoots up to a mean count of ten (10) on P MC, PH SM, T SM and T MC observed on Figure 11, while PH SM did not encourage the growth of *S spp*, meaning that with time the population of *S spp* would keep increasing on a SM and MC cropping system. Table 11 shows the LER for MC yield in which the highest value is 2.74 recorded on PH tillage practices while the lowest is 2.30 on T tillage practices. The CP LER is 2.54 indicating that the component crop had advantage in intercrop when compare to each component alone. The trend of the LER for the cropping pattern and tillage practices is PH>P>CP>T.

EFFECTS OF TP AND CP ON NEMATODE VARIATION AFTER PLANTING

Keys:

- 11.00 – plough sole maize (P SM)
- 21.00 – plough and harrow sole maize (PH SM)
- 12.00 – plough sole cowpea (P SC)
- 22.00 – plough and harrow sole cowpea (PH SC)
- 13.00 – plough maize+cowpea (P MC)

23.00 – plough and harrow maize+cowpea (PH MC)

31.00 – Traditional sole maize (T SM)

32.00 – Traditional sole cowpea (T SC)

33.00 – Traditional maize+cowpea (T MC)

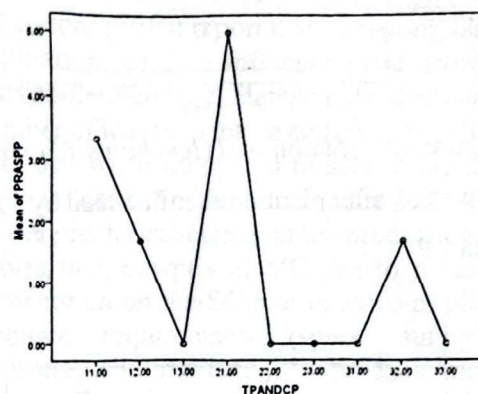


Figure 2: Variation of *Pratiencus (P) spp* at week 5 after planting as influenced by TP and CP

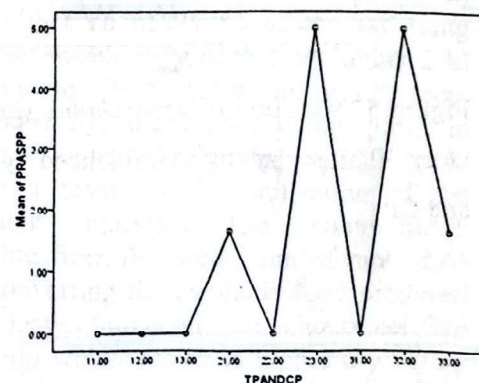


Figure 3: Variation of *Pratiencus spp* at week 10 after planting as influenced by TP and CP

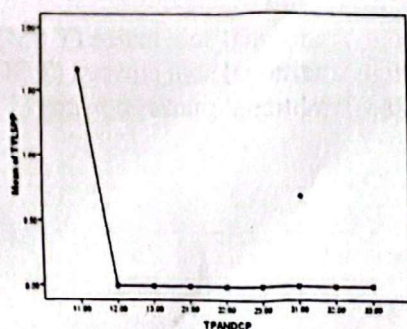


Figure 4: Variation of *Tylenchulus (T) spp* at week 5 after planting as influenced by TP and CP

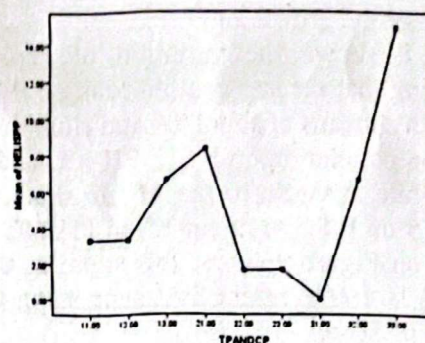


Figure 7: Variation of *H spp* at week 10 after planting as influenced by TP and CP

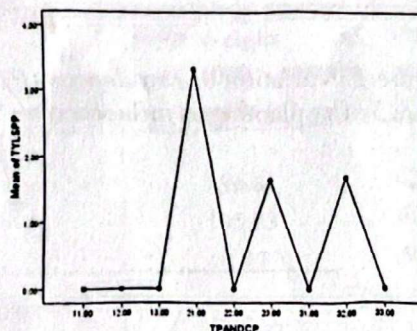


Figure 5: Variation of *Tylenchulus spp* at week 10 after planting as influenced by TP and CP

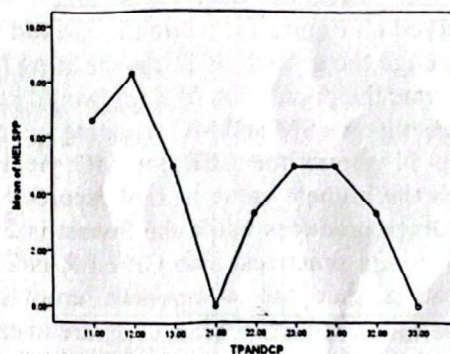


Figure 8: Variation of *Meloidogyne (M) spp* at week 5 after planting as influenced by TP and CP

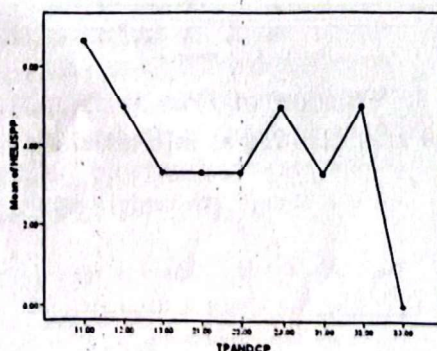


Figure 6: Variation of *Helicotylenchus (H) spp* at week 5 after planting as influenced by TP and CP

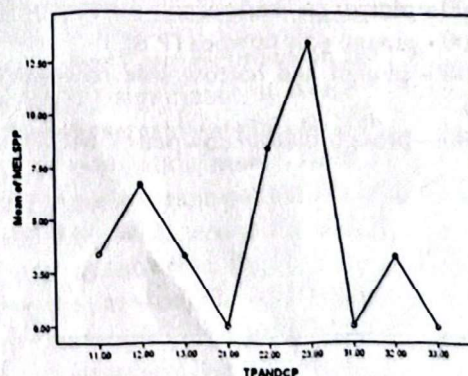


Figure 9: Variation of *Meloidogyne spp* at week 10 after planting as influenced by TP and CP

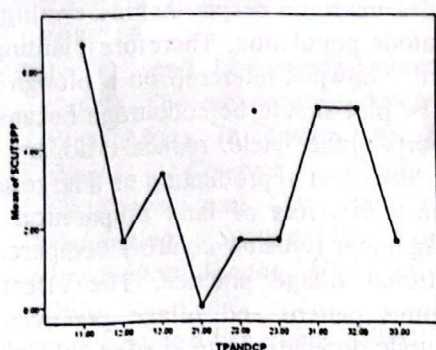


Figure 10: Variation of *Scutellonema bradys(S) spp* at week 5 after planting as influenced by TP and CP

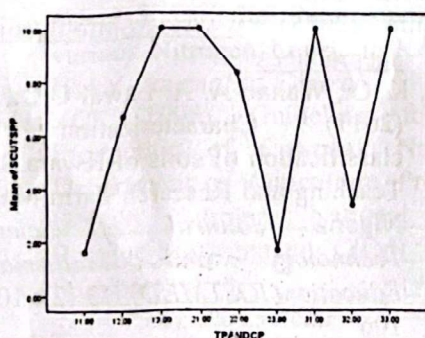


Figure 11: Variation of *S spp* at week 10 after planting as influenced by TP and CP

Table 10: Land equivalent ratio for M+C yield (tons/ha) as determined from the equation on chapter 3.3

Treatments	LA maize	LA cowpea	LER
CP	0.69	1.86	2.54
P	0.72	1.89	2.61
PH	0.65	2.11	2.74
T	0.67	1.63	2.30

DISCUSSION

Cropping pattern: The growth pattern observed and recorded on maize (sole and intercrop) indicted that there is competition

in terms of nutrient uptake, sunlight and space. However, cowpeas in MC grow taller than SC as a result of beneficial relationship between the cowpea and the maize in the intercrop. This is in line with El Naim and Jabereldar (2010) report that increasing plant population per area influence plant growth. This could thereby explained the reduction in number of leaves in maize and cowpea in MC with age when compared to sole maize and cowpea leaves and leaf area index as the SC shows greater efficiency in the production of leaves than cowpea in MC due to reduced competition on the SC plot in terms of plant resource requirements (space, sunlight, moisture, and nutrients) to produce more leaves. This in turns resulted to higher production of leaves by SC which account for high LAI recorded on cowpea in SC. Thus, it simply means that there is high tendency to absorb more light for photosynthesis activities within SC that is in line with (Coulibaly and Lowenberg-Deboer, 2002) report that about 95 % of the incoming radiation would be absorbed by higher LAI leading to high yield in most crop. Consequently, the higher grains yield in tons/ha obtained in sole cropping. This could be as a result of full utilization of the available nutrients (no competition), resulting from the production of more LAI and converting the available food produced in the leaves into economic value rather than intercrop which produces higher dry matter weight. Generally, the trend of crop growth and development as influenced by cropping pattern is Sole cropping > MC intercrop.

Tillage practice: The trend of maize plant height as influenced by tillage practices is T>PH>P. This could be attributed to the height of the T with finer and loosen soils resulting from soil manipulation in T and PH which provide a suitable environment for adequate plant growth (Friday and James, 2002), drier and warmer obtainable in T and PH tillage operations (Ditch, 1986). The adequate utilization of mineralized nutrient

from buried residue that were released for plant uptake and conducive environment that encourage adequate moisture availability and soil temperature could be responsible for the higher leaf area index and crops yield recorded on PH and T plots. Also, better yield recorded on the PH and T plots could be attributed to high moisture conservation and warmer temperature for crop use (Ditch, 1986).

The analysis and interpretation of the nematodes population continued to increase with time showing a trend of $H\ spp > M\ spp > S\ spp > P\ spp > T\ spp$. This implies that the age of crop influence the population of nematodes thereby constitutes major effect on the growth of maize and cowpea. However, MC cropping pattern has the highest nematode population then the SM and SC having the smallest population with H and $M\ spp$ at the highest population. In respect to the tillage practice the P plot encouraged more nematode population followed by T plot and PH with the least with increase in crop age. Also, this could explained the reason for growth and development pattern in the intercrop compared to sole cropping while the lower nematode population in the PH and T may be as a result of the finer and loosen soil that were reported to influence the hatching nematode eggs and development (Ghambari-Bonjar and Lee, 2003; Cusicanqui and Lauer, 1999; Fujita *et al.*, 1992).

Land equivalent ratio (LER) is important in comparing yield of the main crop in mixture and its yield in pure stand, it is expected that the combination of component species in mixture will be more productive than the species grown as a sole crops. Mazaheri and Overys (2004) documented that an LER of 1.0 or less indicating that there is no difference in yield between the intercrop and the collections of monocropping, while any value greater than 1.0 indicates that there is yield advantage for intercropping. Therefore all the combination shows great advantage of intercropping system with PH having the highest LER of 2.74.

CONCLUSIONS

This study shows greater efficiency on both T and PH growth and yield of maize + cowpea intercrop despite having the highest nematode population. Therefore planting of maize + cowpea intercrop on a plough and harrow plot should be encourage because it supports higher yield, reduce drudgery and minimizes cost of production on a large scale farming in terms of land preparation and management (erosion control) compared to traditional tillage practice. The effect of cropping pattern and tillage practices on nematode population and yield of sole maize, sole cowpea and maize-cowpea intercrop considered was not significantly differ therefore further research should be carried out to ascertain the concluded facts.

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