MPRI-JPAS | INTERNATIONAL JOURNAL OF PURE AND APPLIED SCIENCE
VOL. 17 NO.9 SEP-2021 ISSN: 1660-5332

EFFECT OF DIFFERENT LEVELS OF N.P.K FERTILIZER ON ROOT-KNOT NEMATODE (*MELOIDOGYNE* SPP) ASSOCIATED WITH SWEET POTATO (*IPOMOEA BATATAS*) IN THE NORTHERN GUINEA SAVANNA OF NIGERIA

[1]MAIJAMA'A, N. A., [2]CHIMOYA, I.A. AND [3] TUTI N. Z.

[1,2,] Department of Forestry Technology, Federal Polytechnic Mubi P.M. B. 35 Mubi Adamawa State. [3]Department of Horticultural Technology, Federal Polytechnic Mubi P.M. B. 35 Mubi Adamawa State

Abstract

A field experiment was conducted to evaluate the effects of different rates of N.P.K fertilizer on the management of Root knot nematode on sweet potato and to identify the best N.P.K fertilizer rate for the control of Root knot nematode (Meloidogyne spp) and optimum tuber yield of sweet potato. Randomized Complete Block Design (RCBD) was employed. The insecticidal treatments consisted of three rates of fertilizer (0.24kgha, 0.16kg/ha and 0.08kg/ha). Results of the study consistently indicated there was significant (P<0.05) differences among the different rates of fertilizer treatments on Root knot nematodes population, number of tubers, tubers weight, tubers diameter, and tuber yield throughout the study period. The higher fertilizer rate of 0.24kg/ha, gave the best control of the nematode pest, followed by 0.16kg/ha and 0.08 kg/ha rate with significant reduction in nematode population, higher number of tubers, tuber weight, tuber diameter and tuber yield , compared to

KEYWORDS: *N.P.K, Fertilizer, Level, Root-knot Nematodes, Sweet potato and Tuber*

control. Consequently, the best tuber yield was obtained from 0.24kg/ha rate, while yields obtained from 0.16kg/ha and 0.08kg/ha were statistically similar in that order. It could be recommended that N.P.K fertilizer rates, 0.24kg/ha was the most effective in the control of nematodes (*Meloidogyne* spp.) and in enhancing the tuber yield of sweet potato.

INTRODUCTION

Sweet potato *(Ipomea batatas* L.) belongs to the family *Convolvulaceae.* The family *Convolvulaceae* has about 45 general and 1000 species, but only sweet potato *(Ipomea batata,*(L.) . is of economic importance as food. Sweet potato is a native of tropical America and is more widely grown in the developing country than any other root crops, it is grown in the tropical, sub-tropical and warmer temperate zones.It is an important food and vegetable crop that is widely distributed throughout the world particularly in the tropics and provides essential minerals, vitamins and carbohydrate in the diet of many people in the tropical country (Onwueme, 1978). Due to its versatility and adaptability, sweet potato ranks as the world's fifth most important food crop after wheat, rice, maize, and cassava. More than 133 million tons are produced globally per year. Asia is the world's largest sweet potato-producing region, with 125 million tons of annual production (Sivikumar, 2014). Nearly half of the sweet potato produced in Asia is used for animal feed, with the remainder primarily used for human consumption, either as fresh or processed products. In contrast, although African farmers produce only about 7 million tons of sweet potatoes annually, most of the crop is cultivated for human consumption. African yields are quite low -about one third of Asian yields -indicating huge potential for future growth.

Sweet potato Production in the Northern Guinea Savannah Region of Nigeria is seriously affected by pests and diseases particularly the Root knot nematodes. This is as a result of the infestation seen on the potato plant, like warty and knobby symptoms and evidences of root knot nematode galls on the sweet potato tubers, yellowing and stunting, loss of vigor, wilting due to lack of moisture, decay of tissues due to secondary infections and yield losses (Olabiyi, 2007). Information on the effects of nematodes on sweet potato is very rare and scanty. More than 80 species of mites and nematodes are associated with sweet potato these cause damage by feeding on roots, tubers and foliage of all the pests which attack sweet potato. The sweet potato weevil *(Cylas formicarius* and *Cylas puncticollis)* are the most important and significant. Sweet potato weevil can be controlled by crop rotation, use of uninfected cuttings, proper field sanitation, irrigation and mulching. More so, sweet potato is affected by several different diseases in the field, some of which also affect the storage life of the tubers. Most appear to be widespread, but damage levels vary.Sweet potato responds well to fertilizer, particularly if the land has been cropped for some time (Agdegbite & Adesiya, 2005 ; Adekunle & Akinlau, 2007).

Fertilizer requirements vary depending on soil type, native fertility, previous cropping, cultural practices and cultivar grown. Nutrient elements have specific function in crop growth and development. Nitrogen fertilizer had been found to increase tuber yield, tuber dry matter and starch content in most sweet potato varieties. (Xie Yi Zhi (1990) recommended the optimum level of K as 120kg K/ha to increase the root yield and pest management. This may be partly caused by its capacity to fix atmospheric N through association with symbiotic, non-modulating bacteria. A very wide range of N fertilizer requirement has been reported for sweet potato but much depends on the cultivar, soil type and climatic condition (Sullivan *et al.,* 2000). The chemical N fertilizers are rapidly lost by either evaporation or by leaching in the drainage water which extends to other dangerous environmental pollutions that threaten human and animal health. (Juo and Wilding,1996).

MATERIALS AND METHODS

Study Area

The study was carried out at the Teaching and Research Farm of the Faculty of Agriculture University of Maiduguri in January 2017. Maiduguri is situated between latitude 11° 40' N and longitude 13° 50' E in Borno State, Northern Guinea Savanna of Nigeria.

Field Experiment/Experimental Design

The sweet potato Orange Flesh Vine Potato that is resistant to sweet potato virus disease (Anwar etal., 2007) was planted for the experiment and was sourced from the National Root Crop Research Institute, (NRCRI) Umudike, Abia state Nigeria. NPK 15:15:15 fertilizer was sourced from Borno State Agricultural Development programme (BOSADP). The treatments are N.P.K 15-15-15 at the rate of (T_1= 0.08g/ha, T_2=0.16kg/ha, T_3= 0.24kg/ha and control = 0.0kg/ha) laid out in a randomized complete block design with 3 replicates. The plot size is 3 x 2 m, with inter and intra row spacing of 0.5 and 1.0 m respectively. Prior to ridging (Initial), at the middle of production (medium) and at harvest (final) soil samples of the experimental site were randomly collected using soil auger differently in all the plots grown to sweet potato with different rate of fertilizer treatments (T_1= 80g, T_2=160g, T_3= 240g and control = 0g). Each plot was divided into four units. On each plot, four soil samples were randomly collected in zigzag movement using soil auger. The sample were properly harmonized, labeled and sealed in a perforated polythene bag and placed in a container which was later transferred to the Biological Science Departmental laboratory of University of Maiduguri within 24hours of collection for nematode extraction (Azhar & Seddiiu, 2007). The land was mechanically ploughed and harrowed prior to manual ridging. The sweet potato was cut into 20cm length and planted on ridges spaced at 0.5m apart (intra-row) and 1m apart (inter-row) (0.5 x 1m spacing) with 2m corridor left between plots and replicates. There are total of 36 plots with each replicate having twelve. Each of the plots was banded at both ends to avoid flow of fertilizer treatments between plots. Periodically vines of each treatment plots were trained/dragged to their respective plots to avoid nutrient flow between plots. All cultural practices for sweet potato production were adhere to and regular weeding was carried out as at when due. No pesticide or herbicide was applied throughout the period of the experiment. Harvesting was done at 5 months after planting.

Extraction of Nematodes from Soil Sample

Nematodes were extracted from soil samples using whitehead and Heming Olabiyi's (2008) tray Method being economically recommended for developing countries (Rahila etal., 2008). This involves placing two thin layers of tissue paper unto a wire netted plastic basket, placed in a plastic tray. 220ml was taken from each soil sample and sprayed evenly on the tissue paper in the wire netted plastic baskets. 400ml of tap water was added gently and until the whole sample became wet by capillary movement of water, the set up was allowed to stay for 24hours without disturbance. The active juvenile larvae passed through the filter paper in to the water in the tray. After wards, solution of water containing nematodes was poured gently and carefully into the beaker and was allowed to settle for five (5) hours. Excess water was pupated and the remaining solution was agitated and divided into three in different Petri dish. Each of the Petri dish was placed under a stereomicroscope for counting. The nematodes populations were then counted using the formula:

$$\text{Nematodes Population} = \frac{X_1 + X_2 + X_3\ldots\ldots}{3+3+3} \times \frac{\text{Final volume of water (mls)}}{1}$$

Where: $X_1 + X_2 + X_3$ are the nematodes in each Petri dish

This gives the approximate number of nematodes in 220 mls of soil sample taken from the field. To know the effect of inorganic fertilizer on population of nematode and yield of sweet potato, data were collected on Vine length, Vine number, Vine weight, nematodes population (initial, medium and final) and yield.

Data Analysis

All data collected were subjected to analysis of variance (ANOVA). Significant means were compared using New Duncan Multiple Range Test (NDMTR).

RESULTS AND DISCUSSION

Root knot nematode (*Meloidogyne* spp) is among the major insect pest of sweet potato (*Ipomeas batatas*) in Nigeria. The present study assessed the efficacy of three different doses of N.P.K fertilizer (0.24kg/ha, 0.16kg/ha, 0.08kg/ha and 0.00kg/ha) for the management of Root knot nematodes *Meloidogyne* spp and optimum tuber yield of sweet potato in the Northern Guinea Savanna of Nigeria. The findings of the study consistently revealed that the higher N.P.K fertilizer dose (0.24kg/ha) gave the best control of the nematode pest, followed by 0.16kg/ha and

0.08kg/ha with significant reduction in nematode population, higher number of tubers, tuber weight, tuber diameter and higher tuber yield compared to the control (0.00kg/ha). This could be attributed to the higher dose of the fertilizer which effectively reduced the population of the nematodes. This is in agreement with the work of Xie, (2010) which states that sweet potato plants that received 200kg/NPK fertilizer recorded significantly ($P<0.05$) lower nematode population than the control. The use of fertilizer in management of Nematode and enhancement of sweet potato growth can help the poor-resource farmers to improve on its sweet potato production.

This result concurs with the earlier findings that highest and most significant tuber production was found from the plots treated with inorganic fertilizer which was as a result of high potassium content of the inorganic fertilizer used. The work of potassium in this situation is that it accelerates translocation of photosynthesis from leaves to tubers by increasing its photosynthetic efficiency. This was in consonance with the findings of (Kareem, 2013) that the yield of sweet potato is significantly depressed if potassium is missing. However, eliminating phosphorus does not affect the yield. It has been established that high K levels also increased leaf area duration and excessive leaf growth is suppressed, resulting in higher root yield. Furthermore, the key factors for increased sweet potato yield are the careful regulation of N levels and liberal supply of K to increase sink capacity and photosynthesis.

In the present study, longer tubers were recorded with the application of 0.24, 0.16 and 0.08kg/ha, compared to control (0.00kg/ha). The result of the present study further shows that tuber weight was 1.06kg with the application of (0.24kg/ha),(0.7kg) with the application of 0.16kg/ha, and (0.58) with the application of 0.08kg/ha respectively. This was probably due to nematode activity at the root zone, which affected the performance of the roots and this translated into low yield by the control plants. This agrees with the findings of Adesiyan *et al*., (1990) who reported that nematode can affect the performance of crops by reducing its quality and quantity. The findings imply that N.P.K fertilizer is also effective in managing most importantly the potassium, as it aided in the well establishment of tuber diameter. This agrees with the work of Kareem, 2010 which stated that potassium is important for phloem translocation, activator of many enzymes and tuberisation. Fruit yield was also consistently higher (2.087 t/ha) with the application of 0.24kg/ha, of fertilizer, (1.722 t/ha) and (1.590t/ha) when 0.16kg/ha and 0.08kg/ha of N.P.K fertilizer was applied compared to 1.087 t/ha in the control. Consequently, there was a reduction in nematode population,

and increased in tuber weight, and tuber diameter, the best tuber yield was obtained from 0.24kg/ha dose, while yields obtained from 0.16kg/ha and 0.08kg/ha was equally high.
The efficacy of the best fertilizer treatments could be as the result of its ability to enhance the physiological activities (protein synthesis, photosynthesis, respiration, cell division and enlargement). (Sivakumar, 2014). Thus, higher dose of fertilizer proved to be effective as an alternative pesticide and greatly increased number of tubers, tubers weight, tuber diameter and increased tubers of sweet potato.In conclusion, the present results have demonstrated the effectiveness and of 0.24kg/ha dose in the control of nematodes by reducing its population, increasing number of tubers, higher tuber weight, tuber diameter and tuber yield. Therefore, N.P.K fertilizer can be used in the management of Root knot nematodes, hence its use can be encourage among the sweet potato producing farmers in Sudan Savanna particularly those in Maiduguri against nematodes control for optimum sweet potato production in the dry region.

CONCLUSION

This study investigated the effects of different rates of N.P.K fertilizer on the management of Root knot nematodes on sweet potato in Maiduguri, Borno state, and Northern Guinea Savanna of Nigeria. The findings of this study showed that apart from 0.24kg/ha fertilizer rate, which proved to be effective against nematode pest in this experiment, 0.16kg/ha and 0.08kg/ha rates were also found to be effective against nematode infestation and damage. However, 0.24kg/ha is the most effective for increased tuber yield of sweet potato. These treatments had significantly reduced the population of nematode, increased tuber numbers, tuber weight, tuber diameter and tuber yield. The effectiveness of the best fertilizer treatments could be as the result of its ability to enhance the physiological activities such as protein synthesis, photosynthesis, respiration, cell division and enlargement.

RECOMMENDATIONS

1.From the foregoing results of these studies, among the N.P.K fertilizer rates, 0.24kg/ha was the most effective in the control of nematodes (*Meloidogyne* spp.) and in enhancing the tuber yield of sweet potato, and is therefore recommended for use against the nematode pest.
2.Application of 0.24kg/ha of N.P.K fertilizer control insect pest best and produced high yield, hence, there is a need to encourage it among sweet potato farmers for adoption.

Table 1: Effect of different rates of NPK fertilizer on the population of Nematode on sweet potato in Maiduguri during 2017 dry season

Treatments	**Nematodes Population**		
	Initial	Mid-Season	Final
0.08kg/ha of NPK Fertilizer	31.7^{ab}	30.0^{b}	28.3^{b}
0.16kg/ha of NPK Fertilizer	19.7^{bc}	18.3^{c}	17.7^{c}
0.24kg/ha of NPK Fertilizer	12.0^{c}	11.0^{c}	10.0^{d}
Control (0g)	42.0^{a}	41.0^{a}	40.0^{b}
Mean	26.4	25.0	24.0
SE±	4.67	0.75	1.02
LSD	16.15	2.58	3.54

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan Multiple Range Test. (NDMRT)

Table 2: Effect of different rates of NPK fertilizer on the Number of tubers of sweet potato in Maiduguri during 2017 dry season

Treatments	**Number of tubers**		
	Initial	Mid-Season	Final
0.08kg/ha of NPK Fertilizer	22.3^{a}	19.0^{ab}	33.6^{ab}
0.16kg/ha of NPK Fertilizer	22.5^{a}	21.7^{ab}	33.8^{ab}
0.24kg/ha of NPK Fertilizer	22.7^{a}	39.3^{a}	33.9^{a}
Control (0g)	15.3^{b}	17.0^{c}	28.3^{b}
Mean	23.5	24.5	31.5
SE±	6.85	6.01	4.70
LSD	23.71	20.78	16.26

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan Multiple Range Test. (NDMRT)

Table 3: Effect of different rates of NPK fertilizer on the tubers weight of sweet potato in Maiduguri during 2017 dry season

Treatments	**Tuber weight**		
	Initial	Mid-Season	Final
0.08kg/ha of NPK Fertilizer	0.62^{a}	0.59^{b}	0.58^{b}
0.16kg/ha of NPK Fertilizer	0.70^{a}	0.69^{ab}	0.71^{a}
0.24kg/ha of NPK Fertilizer	0.83^{b}	0.91^{ab}	1.06^{a}
Control (0g)	0.58^{a}	0.56^{a}	0.56^{a}

INTERNATIONAL JOURNAL – PAS
VOL. 17 NO.9 SEP-2021 ISSN: 1660-5332

Mean	0.68	0.72	0.73
SE±	0.12	0.16	0.08
LSD	0.40	0.57	0.28

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan Multiple Range Test. (NDMRT)

Table 4: Effect of different rates of NPK fertilizer on the tuber diameter of sweet potato in
Maiduguri during 2017 dry season

Treatments	**Tuber diameter**		
	Initial	Mid-Season	Final
0.08kg/ha of NPK Fertilizer	6.24^{a}	5.88^{ab}	6.02^{a}
0.16kg/ha of NPK Fertilizer	6.35^{b}	6.79^{ab}	6.88^{a}
0.24kg/ha of NPK Fertilizer	6.69^{b}	7.03^{ab}	7.98^{a}
Control (0g)	5.31^{a}	5.55^{a}	5.63^{a}
Mean	6.15	6.30	6.63
SE±	0.53	0.52	0.34
LSD	1.82	1.81	1.19

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan Multiple Range Test. (NDMRT)

Table. 5 Effect of different rates of NPK fertilizer on the yield of sweet potato in Maiduguri during 2017 dry season

Treatments	Yield t/ha
0.08kg/ha of NPK Fertilizer	1.590^{b}
0.16kg/ha of NPK Fertilizer	1.722^{b}
0.24kg/ha of NPK Fertilizer	2.087^{a}
Control (0g)	1.087^{c}
Mean	1.622
SE±	1.01
LSD	3.51

Means with similar superscript within a column are not significantly different (P>0.05) using New Duncan Multiple Range Test. (NDMRT)

REFERENCES

Adesiyan, S.O., Caveness, F.E., Adenyi, M.O. and Fawole, B. (1990). Nematode Pest of Tropical crops. Hernemann Educational Books 9. Nigeria Ltd pp. 19-25

Anwar, S. A. and Javid, N.Z., Kamaran, M. H., and Javed, M. (2007). Root knot nematode reproduction and galling severity on thirteen vegetable crops, proceedings of international symposium on prospects of horticultural industry (theme-future challenges and production prospects) in Pakistan held at Industry of horticultural Sciences, University of Agriculture, Faisalabad March 2830-2007.

Azhar, R. M. and Seddigui, M. (2007). Nematicidal effects of some botanical against root knot nematodes, *(Meloidognite, javanica)* on tomato *int. plant sci*, 49-52.

Jou, A.S.R and Welding (1996). Soil of the Ecology of the Guinea Congo Rainforest, proceeding of

Kareem, I. (2013). Fertilizer treatment on yield and quality parameters of Sweet potato (*Ipomea batatas*) *Res .J. Chem Env. Sei. Vol 1 issue pp.40-49*

Royal Society of Edinburgh Vol. 10 . *Edinburgh. Scotland, UK*. Pp 15-26

Onwueme, I.C. (1978). Tropical Root and Tuber crops. John Wiley and sons. Newyork. USA pp 234

Olabiyi, T. I. (2008). Pathogenicity Study and Nematotoxic Properties of Some Plant Extracts on the Root Knot Nematodes Pest of Tomato, *Lycopersicon Esculentum* (L.) Mill. *Plant Pathology Journal,* 7(l):45-49.

Olabiyi T. I (2007.)Susceptibility of Sweet Potato (*Ipomea batatas*) Varieties to Root Knot Nematode, *Meloidogyne Incognita*. *American-Eurasian J. Agric. & Environ. Sci.,* 2 (3): 318-320.

Rahila, N.; Mussarat A.; Shagufta, A.; Abdul, H. and Nighat S. (2008). Insecticidal, Nematicidal and Antibacterial activities of *Gliricidia sepium Pakistan Journal Botany* 40(6): 2625-2629. Raining season brinjal *(Solanum melongena L.,*). Haryana J. Hort. Sci., 3(1-2): 1431-145.al

Sivikumar, R. (2014). Mineral nutrients – Role of nutrients essential elements. Micro nutrient. Lecture note for M.Sc. Student at Tamit Nadu Agricultural University Cormbatfore, India.

Trifonovo, Z. and Atanasor, A. (2011). Control of potato cyst nematodes (*Globoderra rostochiensis*) with some plant extracts and neem products Bulgarian.*Journal of Agricultural Science* 17: (5) 623-627.

Xie J, Han YT, Wang CB *et al* (2010) Purple sweet potato pigments protect murine thymocytes from (60) Co gamma-ray-induced mitochondria-mediated apoptosis. *Int J Radiat Biol.*