INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 16, No. 1, p. 344-348, 2020

RESEARCH PAPER OPEN ACCESS

Severity of damage by *Scutellonema bradys* on the yield of some selected yam species in Makurdi, Benue state

Oluwatayo Juliana Iye*[1], Adepoju Isaiah Olusesan[2]

[1]*Department of Crop and Environmental Protection, Federal University of Agriculture, Makurdi, Benue state, Nigeria*

[2]*Department of Crop Production and Protection, Federal University, Wukari, Taraba state, Nigeria*

Key words: Severity, *Scutellonema bradys,* Yam, Makurdi

http://dx.doi.org/10.12692/ijb/16.1.344-348 Article published on January 30, 2020

Abstract

Field evalution of the reactions of 10 *Dioscorea rotundata* varieties (TDr 89/02157, TDr 95/18942, TDr 95/19177, TDr 95/18988, TDr 95/18894, TDr 95/19158, TDr 97/00925, TDR 03/60193 and three *Dioscorea alata* varieties (TDa 98/01166, TDa 98/01176 and TDa 99/00240 to *Scutellonema bradys* was carried out at the Teaching and Research Farm, University of Agriculture, Makurdi. Results showed significant (P = 0.05) variation in dry rot incidence which increased during the period of storage. *Dioscorea alata* species proved to be non-host to *Scutellonema bradys* as the nematodes were unable to survive in the roots and cause damage. Variations in the yield parameters (fresh weight of tubers, number of tubers per stand, number of tubers per plot) was significant (P = 0.05). *Dioscorea alata* plots produced significantly (P = 0.05) bigger tubers (2.7kg and above) which were free of nematodes.

* **Corresponding Author:** Oluwatayo Juliana Iye ✉ leosessy@yahoo.com

Introduction

Yam (*Dioscorea* spp.) is a generally accepted starch staple food produced throughout Africa. A greater volume of global yam yield is produced in the 'yam belt', where Nigeria, Ghana and Côte d'Ivoire are the largest producers (Coyne *et al.,* 2012; Ekanayake and Asiedu, 2003; FAOSTAT, 2010). Production therefore occurs across a range of agro-ecological zones and climates, and includes different yam species. The most important yams cultivated across the region include *D. rotundata* Poir. (white yam), followed by *D. alata* L. (water yam) and *D. cayenensis* Lam. (yellow yam) (Dansi *et al.,* 2013; Asiedu and Sartie 2010). Numerous pests and diseases are associated with yam in West Africa, but the yam nematode, *Scutellonema bradys* (Steiner & LeHew) Andrássy, constitutes one of the most difficult pest problems faced by farmers in the economic production of the yam (Kwoseh, 2000; Coyne *et al*., 2006). It usually cause decay of yam tubers known as "dry rot disease" which begin with light yellow or brown lesions below the outer skin and gradually progress deeper into the tuber as the nematodes feed and multiply turning infected tissues brown to black.

Yam nematodes invades developing tubers by way of the tuber growing- point, alongside emerging roots and shoots, and also through cracks or damaged areas in the suberized epidermis (Carsky *et al.,* 2010). Dry rot is clearly observed during storage but it may develop in the field prior to harvest. Infected tubers, which are used for planting, but are not treated, provide inoculum to infect the new crop resulting in the cyclical perpetuation of the disease from store back to the field (Coyne *et al.,* 2012). Dry rot of yams alone causes a marked reduction in the quality, market value and edible portions of tubers and these reduction are much more severe in stored yams, losses of whole tubers can be as high as 80 to 100%.

The degree of post-harvest damage to by *S. bradys* varies but it is more pronounced in Nigeria, a country that account for more than 70% of the total yam production in the world (Baimey, 2007; Mignouna *et al.* 2016; Enchill 2017).

Scutellonema bradys, Meloidogyne *incognita* and *pratylenchus* spp in some areas, is responsible for heavy losses of yams in storage (Luc *et al.,* 2005). *Scutellonema bradys* occur in tropical soils where they cause visible damage to yams. Earlier researches had reported a relationship between the presence of the yam nematode *Scutellonema bradys* and potato tuber cracking and distortion, similar to the symptoms that the nematode causes on yam tubers (Coyne and Claudius-Cole 2009; Coyne *et al.,* 2011). The objective of this study is to establish varietal difference in the yield and severity of *scutellonema bradys* on different yam species.

Materials and method

Field trial was carried out in the teaching and research farm of the college of Agronomy, Federal University of Agriculture, Makurdi to assess the varietal difference in the yield and severity of *Scutellonema bradys* on different yam species. The yam varieties used are:

1. TDr 89/02157- *Diosorea rotundata* (White yam)
2. TDr89/02672- *Diosorea rotundata* (White yam)
3. TDr95/18922- *Diosorea rotundata* (White yam)
4. TDr 95/18949- *Diosorea rotundata* (White yam)
5. TDr 95/19177- *Diosorea rotundata* (White yam)
6. TDr 95/18988- *Diosorea rotundata* (White yam)
7. TDr 95/18894- *Diosorea rotundata* (White yam)
8. TDr 95/19158- *Diosorea rotundata* (White yam)
9. TDr 97/00925- *Diosorea rotundata* (White yam)
10. TDr 03/00193- *Diosorea rotundata* (White yam)
11. TDa 98/01166- *Dioscorea alata* (water yam)
12. TDa 99/00240- *Dioscorea alata* (water yam)

The experiment was laid out in arandomised complate block design with three replicatates. Each replicate was represented by a plot containing 20 yam stands. Yams were planted on mound spaced at 1m x 1m. land preparetion and weeding were done manually. Planting sett was 200g. staking was also done with bamboo stakes. Fertilizer application (NPK- 15:15:15) was at the rate of 30g/ mound eight weeks aftermplanting (WAP) infected field served as source of inoculum. Yams in the field were artificially infested using infected soils for which the nematode content had been estimated.

Nematode counts were recorded as numbers per 100cm^{-3} soil . matured tubers upon a visual, quantitative inspection were rated for severity of the disease symptoms on a 0-10 scale (Oluwatayo *et al.,* 2011).

0 = clean tuber

2 = small yellowish lesions

4 = Dark brown lesions on tuber

6 = Continuous dark dry rot layer on tuber

8 = Deep cracks in the tuber skin

10 = Malformation of tuber and flaking off of parts of the epidermal layers.

Tubers were stored and sampled at harvest, four weeks after harvest, eight weeks after harvest and twelve weeks after harvest to examine for disease severity. Infected tubers were characterized by dry rot tissue underneath. Record was also taken of tuber weight in storage at every sampling period. Nematodes were extracted from soil by a modifield Baermann funnel extraction method (Whitehead and Hemmings, 1965). Data collected include percentage stand at harvest,number of seed tubers, number of ware tubers, yield of ware tubers, total fresh weight of tubers, tuber weight in storage, diesease severity. Data obtained were subjected to analysis of variance and means seperated by Duncan's multiple Range Test (DMRT).

Results and discussion

Results showed significant (p≤ 0.05) difference in percentage plant stand at harvest and total fresh tuber yield among the two species and between *D.rotundata* and *D. alata*. However , number of seed tubers, number of ware tubers and yield of ware tubers was not significantly different among *rotudata* and *alata* species and between *rotundata* and *alata* varieties (Table 1). The highest mean number and weight of yield tubers, and ultimately total fresh tuber yield were recorded in TDr 89/02157, TDr 95/18949, TDr 95/18988, TDr 97/00925, TDa98/01166 and TDa 99/00240 while the lowest number and weights of ware tubers were recorded in TDr 95/18922 and TDr 03/00193. This study showed significant (p≤ 0.05) variation in visible symptoms of bradys infection and the extents of damage cause by the nematodes on the yam species. The level ranged from not susceptible to very susceptible. On the symptoms of infection, there was either an absence or presence of necrosis on the tubers when examined . vary few nematodes were recorded from the field of experiment at the time of planting, indicating the importance of *s.bradys* judging by the observed result (Table 2). Significant differences (p≤0.05) in level of susceptible yam varieties i.e disease severity , with the very susceptible ones recording the most pronounced lesions.

Table 1. Yield of *rotundata* and *alata.*

varieties	% stand at harvest	No. of seed tubers/plot	No. of ware Tubers/plot	Yield of ware Tuber/plot	Total fresh Tuber Yield/plots
TDr 89/02157	92.67a	21.67a	10.33a	17.77a	30.43ab
TDr 89/02672	77.67b	18.00a	7.33a	14.67a	27.57ab
TDr 95/ 18922	79.33b	26.33a	5.00a	10.67a	25.07b
TDr 95/18949	91.00a	22.00a	10.33a	20.47a	34.70a
TDr 95/19177	77.67b	24.00a	6.33a	13.33a	26.13ab
TDr 95/18988	92.67a	21.67a	10.33a	17.77a	30.00ab
TDr 95/18894	77.67b	24.00a	6.33a	13.33a	26.00ba
TDr 95/19158	77.67b	18.00a	7.33a	14.67a	27.50ab
TDr 97/00925	91.00a	22.00a	10.33a	20.47a	30.70ab
TDr 03/00193	79.33b	26.33a	5.33a	10.67a	25.00b
TDa98/ 01166	92.67b	21.67a	10.33a	18.76a	32.67a
TDa 98/01176	77.67b	18.00a	7.33a	15.00a	33.11a
TDa 99/00240	91.00a	22.00a	10.33a	21.00a	34.66a

Values are means of three replicates. Within experiments means followed by the same letter in vertical columns are not significantly different as judged by Duncan Multiple Range Test (DMRT).

TDr= Tropical Dioscorea *rotundata* AH= At harvest

TDr= Tropical *Dioscorea alata* WAH – Weeks after harvest

Table 2. Influence of *S. bradys* on tuber yield (weight in gram).

S/NO	Varieties	AH	4WAH	8WAH	Disease severity
1	TDr 89/02157	400.4f	360.6g	340.6f	7.66
2	TDr 89/02672	363.2fg	33.4gh	312.2fg	7.74
3	TDr 95/ 18922	579.2e	550.2e	523.6d	8.02
4	TDr 95/18949	4146.0a	3801.6a	3583.2a	5.34
5	TDr 95/19177	1104.6c	1050.2c	975.0c	4.74
6	TDr 95/18988	1666.2b	1566.4b	1450.8b	0.00
7	TDr 95/18894	336.0gh	318.4gh	306.6fg	7.97
8	TDr 95/19158	533.0e	478.0f	446.4e	6.34
9	TDr 97/00925	345.0fgh	304.0gh	283.0fg	6.80
10	TDr 03/00193	392.0fg	336.0gh	307.0fg	6.56
11	TDa 98/ 01166	336.0gh	323.8gh	310.0fg	0.00
12	TDa 98/01176	658.0d	608.4d	546.0d	0.00
13	TDa 99/00240	290.0h	281.0h	265.0g	0.00

Values are means of three replicates. Within experiments means followed by the same letter in vertical columns are not significantly different as judged by Duncan Multiple Range Test (DMRT).

TDr= Tropical Dioscorea *rotundata* AH= At harvest

TDr= Tropical *Dioscorea alata* WAH – Weeks after harvest

The three *dioscorea alata* varieties used for the study (TDa 98/01166, TDa 98/01176, TDa 99/ 00240) had no symptoms of infection (Table 2). The four most susceptible hosts were TDr 89/02157, TDr89/02672, TDr95/18922 and TDr 95/18894. Significant weight loss was observed in infected tubers as compared to the non- hosts (Table 2).

Agronomically, resistant variety may compare favorably with other available means of control in terms of its yield on infected land and its effect on nematode populations. In this study, emphasis was placed on susceptibility as expressed by the severity of disease, that is, the ability of *S. bradys* to survive and multiply on tubers. The results from the field trial showed that the survival of the nematodes in the tubers of *Dioscorea alata,* was limited, whereas, presence of dry root observed on the tubers confirms their susceptibility to *S. bradys* attack. The three *D. alata* varieties evaluated are non-hosts and are immune to penetration by the yam nematode. The normal sprouting of infected tubers is suppressed and when sprout, the performance is lesser than the ones obtained from healthy seed yam (Tchannen *et al.,* 2005; Claudious-cole *et al.,* 2017). The susceptible tubers develops crack longitudinally, and flaking off of yam periderm. This is so because *S. bradys* is completely an endoparasite in yam tubers. The dry rot was revealed by peeling the skin. The color seen at first was yellowish and later become brown to dark coloration. The *S.bradys* cans results to loss of edible part of tubers, reduced tubers weight or moisture loss (Aigbewi *et al.,* 2015). In a similar experiment on screening of new clones (*D.alata and D. rotundata*) in nematode prone ecology, Ettien *et al.* (2013) observed nine varieties of *D. rotundata* that are more resistant to *S. bradys,* and *Meloidoghne*, while *D. alata* were less tolerant. However, there is no firm evidence of resistance to *S. bradys* in yams. Use of resistant varieties should maximize and stabilize yields through their effects on nematode population dynamics. Crop yield depend upon initial nematode density and rate of reproduction, and the inherent insensitivity of the host. The value of the resistant variety therefore depends upon the interrelationship of the mechanism of resistance with the biology of the host and the nematode. Crops resistant to *S.bradys* suffered less or no damage than susceptible varieties. The resistant reaction is less harmful than the susceptible one, but more importantly, the resulting suppression of nematode multiplication reduced damage. These resistant plants do have potential use yam nematode management programs.

Conclusion

Although the *S. bradys* population observed on the field of study was very low (150- 200/plots), it was able to attack the tubers and cause significant effect.

This therefore confirms *S. bradys* as an economic pest of yam. The varieties used in this reseach were selected for their yield and food quality. To maximize yield of the *D.rotundata* therefore, clean or treated setts should be use. The *D. alata* varieties could be planted on any soil and maximum yield is granted.

References

Aighewi BA, Asiedu R, Maroya N, Balogun M. 2015. Improved propagation methods to raise the productivity of yam (*Dioscorea rotundata* Poir.). Food security **7(4),** 823-834.

Asiedu R, Sartie, A. 2010. Crops that feed the world 1. Yams. Food Security **2(4),** 305-315.

Baimey HK. 2007. *Scutellonema bradys* as a pathogen of yam in Benin (Doctoral dissertation, University of Pretoria).

Carsky RJ, Asiedu R, Cornet D. 2010. Review of soil fertility management for yam-based systems in West Africa. African Journal of Root and Tuber Crops **8(2),** 1-17.

Claudius-Cole AO, Kenyon L, Coyne DL. 2017. Effect of pre-plant treatments of yam (*Dioscorea rotundata*) setts on the production of healthy seed yam, seed yam storage and consecutive ware tuber production.

Coyne D, Claudius-Cole A. 2009. *Scutellonema bradys*, the yam nematode, newly reported affecting Irish potato (*Solanum tuberosum*) in Nigeria. Plant Pathology **58(4).**

Coyne D, Williamson V, Tchabi A, Baimey H, Rotifa I. 2012. Comparison of Pathogenicity Of Geographically Separate Populations Of Scutellonema Bradys on Yam (*Dioscorea* Spp.) In West Africa [Comparación De La Patogenicidad De Poblaciones Geográficamente Separadas De Scutellonema Bradys En Ñame (*Dioscorea* Spp.) En El Oeste De África]. Nematropica **42(2),** 181-190.

Coyne DL, Akpheokhai LI, Adeniran AF. 2011. The yam nematode (*Scutellonema bradys*), a potential threat to potato (*Solanum tuberosum*) production in West Africa. Plant Pathology **60(5),** 992-997.

Dansi A, Dantsey-Barry H, Dossou-Aminon I, Kpenu EK, Agré AP, Sunu YD, Assogba P. 2013. Varietal diversity and genetic erosion of cultivated yams (Dioscorea cayenensis Poir-D. rotundata Lam complex and *D. alata* L.) in Togo. International journal of Biodiversity and Conservation **5(4),** 223-239.

Ekanayake IJ, Asiedu R. 2003. Problems and perspectives of yam-based cropping systems in Africa. Journal of Crop production **9(1-2),** 531-558.

Enchill AK. 2017. Parasitic Nematodes Associated With Yam (*Discorea rotundata*) and Morphometric Characterization of *Scutellonema Bradys* in the Krachi Nchumuru District, Ghana (Doctoral dissertation, University of Ghana).

Ettien JBD, Sorho F, Brahima K. 2013. Screening of new yam clones (D. alata and D. rotundata) in nematode prone ecology of guinea savanna zone in West Africa. Journal of Applied Biosciences **61,** 4540-4550.

Luc M, Bridge J, Sikora RA. 2005. Reflections on nematology in subtropical and tropical agriculture. Plant parasitic nematodes in subtropical and tropical agriculture 1-10.

Mignouna D, Akinola AA, Abdoulaye T, Maroya N. 2016. Economic impacts of yam productivity research in West Africa: A case of Yiifswa Project (No. 310-2016-5407).

Oluwatayo JI, Asiedu R, Adesiyan SO. 2011. Allelophathic potential of plant extracts against *Scutellonema bradys*. African Journal of Root and Tuber Crops **9(1),** 30-37.

Tschannen AB, Escher F, Stamp P. 2005. Post-harvest treatment of seed tubers with gibberellic acid and field performance of yam (*Dioscorea cayenensis-rotundata*) in Ivory Coast. Experimental agriculture **41(2),** 175-186.

Whitehead AG, Hemming JR. 1965. A comparison of some quantitative methods of extracting small vermiform nematodes from soil. Annals of applied Biology **55(1),** 25-38.