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RESEARCH ARTICLE

EFFECT OF DIFFERENT SEED SIZE ON THE GROWTH AND YIELD OF TWO INDIGENOUS WATER YAM CULTIVARS PLANTED IN NEMATODE INFESTED SOIL OF MAKURDI, BENUE STATE

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ABSTRACT

A field experiment was conducted at the Teaching and Research Farm of the Federal University of Agriculture, Makurdi, Nigeria in 2019 planting season to determine the effect of different seed size on the growth and yield of two indigenous water yam (*Dioscorea alata*) cultivars planted in nematode infested soil. The seed sizes (50g, 100g, 150g, 200g and 250g) of two water yam cultivars (Chokolo and Sudan) served as the treatment and was laid out in a Randomized Complete Block Design (RCBD). Results obtained showed that the two *D. alata* cultivars were significantly different, as evidenced by their reaction to root knot nematode (*Meloidogyne incognita*) infection, percentage emergence and vigor. Also, the yield attributes such as number of ware tubers and tuber yield were significantly different ($P<0.05$) for the two cultivars tested. The mean value of the yield parameters showed that 250g seed yam of Sudan cultivar gave the highest tuber yield (16.08t/ha) and number of tubers/plot. The result obtained on the nematode activity on the different treatments showed mild damage by the root-knot nematodes (*M. incognita*) on all the different treatments. Result of this study showed that the use of different seed size of water yam tubers has an impact on the tubers production but do not secure the plants from infection by *M. incognita*.

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INTRODUCTION

Yam is one of the most common crop and food across West and East Africa (Ekanayake and Asiedu 2003; Mwirigi 2008; Serenje and Shaali 2010). The demand for the crop is high in the area, yet vegetative propagation of the crop through tubers undermines the quality and quantity of planting materials available, leading to poor production and loss of man power (Worku *et al*., 2013). Yam is noted to be susceptible to a host of pests and diseases, including plant-parasitic nematodes, which affect productivity, tuber quality and storability. Although nematodes are recognized as important yam pests (Bridge *et al*., 2005), nematode species associated with the crop vary significantly across the region. In West Africa, *Scutellonema bradys* and *Meloidogyne spp*. are reported as most important (Bridge *et al*., 2005; Coyne *et al*., 2006), whereas *Meloidogyne spp*. and *Pratylenchus sudanensis* are reported as the key nematode species in East Africa (Coyne *et al*., 2003; Mudiope *et al*., 2007). *Pratylenchus coffeae* is important in Central and South America (Bridge et al., 2005).

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However, many questions about the role of a specific nematode species in limiting yam productivity remain unanswered. While *Meloidogyne* spp. Are widely distributed on yam (Bridge *et al*., 2005; Coyne *et al*., 2003; Coyne *et al*., 2006; Mudiope *et al*., 2007), the pathogenecity and level of damage they cause singly and/or in combination with other nematodes remains unclear. The nematode's role in the decline of yam tuber yields and storability of tubers is also not certain. Amongst the various constraints to production of yam, nematode pests are of significant importance (Bridge *et al*., 2005). To overcome nematode problems on yam, a key area of focus is to target the seed system, farmer awareness and understanding of the problem. Thus, the objective of this study is to investigate two indigenous water yam varieties for root knot nematodes susceptibility and its effect on their yield.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm of the Federal University of Agriculture Makurdi, Benue State, Nigeria. At the growing season of 2019. The initial soil status was determined according to the method by Jackson (1958). Soil samples from 0 – 20cm depth was collected from a total of 100 different spots over the area used for the planting with a soil auger. The 100 samples were bulked, air-dried and sieved with a 2mm sieve. Composite samples were taken and analyzed for physical and chemical properties. The soil nutrient status of the experimental sites at pre-planting was analyzed for the two experimental sites. Two popular D. alata cultivars was used for the experiment being the indigenous varieties which are "Choloko" and "Sudan". The land clearing, construction of mounds, weeding and harvesting were all done manually using cutlass and hoe. The planting was done manually. Varying *D. alata* seed size of between 50-250g was planted on the crest and served as treatments. This was laid out in Randomize Complete Block Design (RCBD) and replicated three times. Weeding was carried out three times before the harvesting while harvesting was carried out at six months after planting.

Data Collection: Data collected include **t**he emergence and crop vigor 4, 8 and 12 weeks, number of stands at harvest, weight of tuber and the result were expresses per plot. Data collected from the experiment was subjected to analysis of variance (ANOVA) using GENSTAT statistical software. Mean separation was done using least significant difference (FLSD) at 5% probability level.

RESULTS

The results of the physical and chemical properties of the soil (0-30cm) of the experimental site is presented in Table 1. The texture of the experimental site was sandy loam and well drained. Available phosphorus of 11.16Mg/Kg-1 plus a uniform soil total nitrogen of 0.84% were low (Bray and Kurtz, 1945). Exchangeable potassium was 0.16MgKg-1 which was classified as moderate (Anderson and Ingram, 1993). Soil pH was strongly acidic (5.23). The value of organic carbon percentage was low (4.74%). The result obtained on the two water yam cultivars (Sudan and Chokolo) indicate a very heterogeneous sprouting of the seed yams used according to the cultivar and size. In general, sprouting is spread out in time. The percentage emergence was observed at 4 Weeks after Planting (WAP), 8 WAP and 12 WAP. A late germination of the seed was observed initially after their setting in culture, but at 12 WAP, majority of the seed sprouted. Results showed that, the different mini tubers exhibited different sprouting abilities (Table 2). The mean number of ware tuber and tuber yield obtained for "Chokolo" cultivar were significantly different ($p < 0.05$). While there's no significant difference ($p < 0.05$) in the mean number of tuber per stand and the mean number of seed yam. There's also no significant difference ($p < 0.05$) in the initial nematode population, Final nematode population and the root gall index (Table 4). The result obtained for "Sudan" cultivar also shows the records of the mean number of ware tuber and tuber yield were significantly different ($p < 0.05$). While there's also no significant difference ($p < 0.05$) in the mean number of tuber per stand and the mean number of seed yam. There's also no significant difference ($p < 0.05$) in the initial nematode population, Final nematode population and the root gall index (Table 5). The following silent findings are drawn on the basis of investigation. The vegetative growth characteristics like days to sprouting, emergence (%), and yield attributes were best in highest weight of tuber (250g) (Table 2). The yield parameters such as tuber yield (t/ha), tuber length (cm), tuber diameter (cm), number of tubers per plant was highest in 250g seed weight of tuber. There's no significant difference in the sprouting percentage recorded for both cultivars (Table 2).

Table 1. Nutrient Analysis of the Experimental Field

Soil Parameter	Makurdi
% Clay	3
% Silt	15
%Sand	82
PH	5.2
Organic C (g/kg)	4.74
Total N (g/kg)	0.84
Ca (cmol/kg)	1.48
Mg (cmol/kg)	1.12
K (cmol/kg)	0.16
Na (cmol/kg)	0.50
CEC (cmol/kg)	3.14
Available P (mg/kg)	7.48

Table 2. Effect of seed yam size on vine length of water yam cultivar Choloko at three intervals

Seed yam size(g)	Length of vines (cm)		
	4WAP	8WAP	12WAP
50g	9.373	25.494	40.995
100g	11.934	37.394	73.14
150g	10.14	42.63	85.77
200g	14.69	46.424	92.595
250g	10.608	39.662	95.01
Mean	11.349	38.29	42.25
LSD(p≤0.05)	ns	ns	ns

Table 3. Effect of seed yam size on vine length of water yam cultivar Sudan at three intervals

Seed yam size(g)	Length of Vines (cm)		
	4WAP	8WAP	12WAP
50g	8.229	26.95	45.27
100g	11.843	28.42	81.18
150g	13.39	28.35	87.45
200g	13.182	53.76	98.55
250g	9.529	29.638	99.6
Mean	11.752	33.418	85.71
LSD(P≤0.05)	Ns	2.08	2.46

DISCUSSION

In this study it was observed that mini tubers harvested and cultivated in the fields, following five categories of mini tubers: 50g; 100g; 150g; 200g and 250g survived, developed new stems and formed tubers. Ovono *et al.* (2010) have shown that c when they were transplanted or directly sown into the field. In wateryam, the effect of tubers size was also very important for the further sprouting. This observation is in agreement with the findings of this study. However, sprouting ability varies with stage of physiological maturity and size (Balogun, 2009). Quality of seed depends on the starch content which is related to sprouting vigor (Park *et al.,* 2009). Bigger mini tubers had more reserves and thus could more easily sprout although the dormant period was generally associated with a minimum of endogenous metabolic activity, resulting in very little loss of storage reserve. These results also confirmed those of (Onovo *et al,* 2010) who showed that more field tubers were physiologically large more the seeding was fast. Then, by aging, their germinal vigor is increased and, consequently, the seeding was accelerated. *Meloidogyne* spp., causes galling to yam roots and tubers, plant growth and yield following their inoculation and establishment on the field. In cases where the initial nematode population density (inoculum) is too low, nematodes are capable of reproducing on yam and cause sizeable reductions in growth and yield

Table 4. Yield and Nematode Index of Chokolo cultivar as influenced by seed size in nematode infested soil

Seed yam size(g)	No of tuber/stand	Average number of ware tuber	Average number of seed tubers	Tuber yield (t/ha)	Initial Nematode Pop	Final Nematode Population	Root Gall Index
50g	1.1	0	1.1	6.2	245	759	3
100g	1.41	0	1.4	15.3	248	675	3
150g	1.81	0.02	1.79	16.81	274	759	3.5
200g	1.53	0.11	1.42	17.62	235	719	3.1
250g	1.75	0.25	1.5	18.31	229	806	3.6
Mean	1.52	0.08	1.44	14.85	247	743	3.3
LSD(P≤0.05)	ns	0.03	ns	2.53	ns	ns	ns

Table 5. Yield and Nematode Index of Sudan cultivar as influenced by seed size in nematode infested soil

Seed yam size(g)	No of tuber/stand	Average number of ware tuber	Average number of seed tubers	Tuber yield (t/ha)	Initial Nematode Pop	Final Nematode Population	Root Gall Index
50g	1.02	0.01	1.01	8.25	278	881	3
100g	1.26	0.03	1.23	16.45	226	845	3
150g	1.23	0.08	1.15	17.36	292	936	3.2
200g	1.33	0.9	1.24	19.12	269	1025	3.5
250g	1.35	0.11	1.27	19.22	283	1181	3.6
Mean	1.24	0.06	1.18	16.08	269.6	973.6	3.3
LSD(P≤0.05)	ns	0.02	ns	2.26	ns	ns	ns

(Bridge *et al.*, 2005; Baimey *et al.*, 2006) Nematode damage on yam disfigures tubers, which appear abnormal and unappealing to the consumer and consequently reduce their marketability and value. Nematode-damaged tubers are therefore more likely to be retained by the farmer for home consumption or as planting material for the following season. *Meloidogyne* spp. has also been shown to affect the quality of yam tuber tissues, which become sugary to taste with infection, and tubers are less preferred by consumers (Mudiope *et al,* 2012). In an attempt to remove the galling by peeling, farmers further reduce the marketable yam quantities (Mudiope *et al,* 2012). From the current study, both *D. alata* cultivars appears to be susceptible of the three most common yam nematode species, which supports previous comparative assessments (Coyne *et al.*, 2006). The relative higher damage observed on *D. alata* corresponded with the relative higher nematode population density and ultimately yield losses. Therefore, strategies that lead towards reducing nematode infection of planting material require attention for developing and implementing at the smallholder farmer level to minimize losses.

Conclusion and Recommendation

Conclusion

The use of different seed sizes of water yam tubers has an impact on tubers production. The cultivar planted also has a fairly good effect on the propagation using mini tubers. The results obtained confirm the possibility of producing tubers from mini tubers, which tubers can be used in field as planting material in order to produce consumable water yams. Tubers obtained on the bigger categories sprouted rapidly than the smaller; all the tubers sprouted. The categories of tubers had effect on yield and other parameters tested. Mini tubers between 50 - 250g could be successfully planted with good yield. Seed yams should be harvested carefully to minimize cuts and wounds. Harvested tubers should be stored in airy, well shaded or covered barns. There's no significant difference in nematode infections with the varying sizes of seeds, uninfected seeds or tubers may be stored for up to 4 months or longer than infected tubers.

This study has taken into account only agronomic parameters. So, in futures studies, it would be interesting to asses not only the production cost of the seeds which can sow one hectare, but also to stand out the socio-economic impact on the population.

Recommendation

From the result of this experiment, farmers should be encouraged to plant bigger seed yams as this could enhance growth in the crops, and better yields. Alternative control measures should also be employed to checkmate losses due to nematodes in the infested soil.

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