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Management of Phytonematodes Infecting Vegetables in Ekiti and Ondo States Using Hydromorphic Fields

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ABSTRACT

Background and Objective: Phytonematodes are a serious problem in vegetable fields, through their feeding habits they impair vegetable roots making it difficult for nutrient absorption and consequently lower yields. Field experiments were conducted in 2016 and 2017 to investigate the effects of hydromorphic fields and conventional fields planted to *Amaranthus cruentus*, *Solanum macrocarpon* and *Telfairia occidentalis* on nematode populations in Ekiti and Ondo States Nigeria. **Materials and Methods:** A total of 60 soil samples were collected from five Local Government Areas (LGAs) visited in the states. Soil samples were collected from two hydromorphic fields and two conventional fields in all the LGAs visited. Nematodes were extracted, counted and analyzed using Analysis of Variance. The nematodes were identified under a compound microscope based on their morphological features. **Results:** The hydromorphic fields consistently and significantly reduced the populations of *Meloidogyne*, *Rotylenchulus* and *Hoplolaimus*, their effects on *Pratylenchus* and *Helicotylenchus* was in consistent, while the populations of these nematodes were significantly high in conventional fields planted to the vegetables. **Conclusion:** The study suggested that hydromorphic fields may be an effective strategy in nematode management.

KEYWORDS

Amaranthus cruentus, *Solanum macrocarpon*, *Telfairia occidentalis*, conventional fields, fadama fields

INTRODUCTION

Vegetables are very important in our daily diets. They supply food in the form of minerals, vitamins and fibres[1]. They contain medicinal properties and as such used in the treatment and management of a number of diseases. *Telfairia occidentalis* is rich in iron; and as such the extract is used by anemic patience[2]. *Solanum macrocarpon* is used in the treatments of abdominal worms and stomach-aches in children and to ease delivery in pregnant women[1] while *Amaranthus cruentus* is used to prevent blindness among children[3].

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These vegetables are used in making soups and stews that can be eaten with a number of staples[1]. Despite their usefulness, their production in Nigeria is on the low ebb due to a number of factors one of which is the attacks by pests and pathogens.

A number of nematodes have been reported on a number of vegetables. *Helicotylenchus*, *Dolichodorus* and *Meloidogyne* have been reported to cause significant reduction in leaf yield of *T. occidentalis* and *A. cruentus* in Nigeria[4]. Nematodes attack plants from the roots and as they feed on the roots they reduce the rate at which plant root system performs its normal functions. Control of these pests becomes important. The use of synthetic nematicides has been reported to be effective in nematode control but they have negative impact on man and the environment[5]. These have resulted in the development of other strategy in nematode management. The use of hydromorphic fields also known as fadama in Hausa language, for vegetable production can be effective in nematode control. This is because it is rich in organic matter and it is usually saturated with water. These two factors can create unfavourable conditions for nematode. The objective of this study was to investigate the effects of hydromorphic fields and conventional fields (normal farmer's or upland field) on plant-parasitic nematodes on *A. cruentus, S. macrocarpon* and *T. occidentalis*.

MATERIALS AND METHODS

Soil samples were taken from hydromorphic and conventional farmers' fields planted to *Amaranthus cruentus*, *Solanum macrocarpon* and *Telfairia occidentalis* in two States of Southwest Nigeria namely, Ekiti and Ondo between the months of May and October 2016. Selected Local Government Areas (LGA) were visited for soil sampling. They comprised three LGA areas in Ekiti (Ikole, Ilejemeje and Ido-Osin LGA) and two in Ondo (Akoko Northeast and Akoko Southwest).

A total of five LGA were visited for soil sampling. In each LGA, samples were taken from four farms (two from hydromorphic fields and two from conventional fields). Twenty soil samples were taken in fields sown to *A. cruentus*, *S. macrocarpon* and *T. occidentalis* giving a total of 60 samples in the two states.

Farmers grew their vegetables on hydromorphic fields and conventional fields. The sizes of farmer's plots ranged from two to six plots of 17 m by 11 m each per farmer. The farmers grew their vegetables with urea fertilizer (Indorama) applied in micro dosage at 4 g/bed to their plots. Samplings were done six weeks after planting.

Sample collection: Soil samples were collected from each farm close to the root zone of 20 vegetables in a zigzag manner with soil auger of depth 15 cm and diameter 1.9 cm. The soil samples were added together to form a composite sample and 200 mL sample was taken from the composite soil sample for nematode assay. Sub-sample was taken from the bulk sample for nematode analysis. The samples were taken to the laboratory and nematode analysis was conducted immediately. This procedure was repeated in all the farms that were visited.

Nematode analysis: Nematodes were extracted from the 200 mL sub-samples taken from the bulked sample, using the modified Baermann tray extraction method of Whitehead and Hemming[6]. The suspension containing the nematodes was concentrated to 20 mL by sieving it with 45 μm sieve. The nematodes recovered were killed by heat and fixed in a water suspension containing two drops of formaldehyde[7]. The nematodes were under a microscope in a nematode counting dish. Nematodes from each sample were then identified under a compound microscope to genus level, using their morphological characteristics as described by Coyne *et al*.[8].

The sampling process was repeated in 2017, during the same months, the first year sampling was carried out.

Statistical analysis: Nematode counts were log-transformed [Log10 (x+1)] and analyzed, using Analysis of Variance (ANOVA) with (SAS) Software Version 9.1[9,10]. Treatment means were separated using Fisher' least significant difference (LSD) at ($p \leq 0.05$).

RESULTS

The populations of *Meloidogyne, Hoplolaimus* and *Rotylenchulus* recorded in conventional plots sown to *A. cruentus* were significantly ($p \leq 0.05$) higher than those recorded in hydromorphic plots sown to the same vegetable in Ekiti and Ondo States in 2016 and 2017 (Table 1). In 2016 and 2017, populations of *Pratylenchus* and *Helicotylenchus* recorded in conventional plots were not significantly ($p \leq 0.05$) higher than those recorded in hydromorphic fields in the two states.

In 2016 and 2017, populations of *Meloidogyne*, *Hoplolaimus* and *Rotylenchulus* recorded in conventional fields were significantly ($p \leq 0.05$) higher than those recorded in hydromorphic fields sown to *S. macrocarpon* in Ekiti and, Ondo States (Table 2). Populations of *Helicotylenchus* and *Pratylenchus* in conventional fields were not significantly ($p \leq 0.05$) different from those in hydromorphic fields in the two states in 2016 and 2017.

The populations of *Meloidogyne*, *Helicotylenchus*, *Hoplolaimus*, *Pratylenchus* and *Rotylenchulus* recorded in hydromorphic plots and conventional plots sown to *T. occidentalis* plots were not significantly ($p \leq 0.05$) different from each other in Ekiti and Ondo States in 2016 and 2017 (Table 3). Except that, in Ekiti State, the populations of *Helicotylenchus* and *Pratylenchus* recorded in fadama plots were significantly ($p \leq 0.05$) higher than those recorded in conventional plots in both years.

The populations of *Pratylenchus* recorded in hydromorphic fields were also significantly ($p \leq 0.05$) higher than those recorded in conventional fields in 2017 in Ondo State. *Hoplolaimus* populations were significantly ($p \leq 0.05$) higher in conventional fields in comparison with those recorded in hydromorphic fields in Ondo States in 2016 and 2017, while the populations of *Rotylenchulus* were significantly ($p \leq 0.05$) higher in conventional plots than those in fadama in Ondo State in 2016.

Table 1: Effects of hydromorphic fields and conventional fields on phytonematodes infecting *Amaranthus cruentus* in Ekiti and Ondo States

	J2/200 mL soil				
Treatments/state and year	*Meloidogyne*	*Helicotylenchus*	*Hoplolaimus*	*Pratylenchus*	*Rotylenchulus*
Ekiti State 2016					
Hydromorphic	0.89	1.97	0.66	0.88	0.92
Conventional fields	1.85	1.60	1.64	0.96	1.65
LSD ($p \leq 0.05$)	0.23	0.38	0.18	0.25	0.22
Ekiti State 2017 trial					
Hydromorphic	1.20	1.91	0.72	0.37	0.71
Conventional fields	2.12	1.67	1.82	0.35	1.64
LSD ($p \leq 0.05$)	0.32	0.26	0.26	0.08	0.24
Ondo State 2016					
Hydromorphic	0.79	0.57	0.08	0.59	0.43
Conventional fields	1.72	0.62	0.64	0.55	1.33
LSD ($p \leq 0.05$)	0.77	0.42	0.5	1.03	0.69
Ondo State 1017					
Hydromorphic	0.86	1.41	0.35	0.98	0.93
Conventional fields	1.64	1.4	1.49	0.29	1.78
LSD ($p \leq 0.05$)	0.58	1.72	0.67	1.03	0.82

Each value is a mean of four replicates

Table 2: Effects of hydromorphic fields and conventional fields on phytonematodes infecting *Solanun macrocarpon* in Ekiti and Ondo States

	J2/200 mL soil				
Treatments/state and year	*Meloidogyne*	*Helicotylenchus*	*Hoplolaimus*	*Pratylenchus*	*Rotylenchulus*
Ekiti State 2016					
Hydromorphic	1.57	1.91	0.74	1.24	0.95
Conventional fields	2.06	1.56	1.48	0.46	1.67
LSD ($p \le 0.05$)	0.34	0.48	0.55	0.56	0.45
Ekiti State 2017					
Hydromorphic	1.52	1.83	0.63	1.18	1.01
Conventional fields	1.97	1.62	1.38	0.73	1.76
LSD ($p \le 0.05$)	0.31	0.44	0.45	0.71	0.66
Ondo State 2016					
Hydromorphic	1.39	1.43	0	0.58	0.31
Conventional fields	1.95	0.93	0.82	0.3	1.47
LSD ($p \le 0.05$)	0.39	0.91	0.8	0.32	0.67
Ondo State 1017					
Hydromorphic	1.29	1.69	0	0.6	0.33
Conventional fields	1.94	1.01	1.03	0.4	1.49
LSD ($p \le 0.05$)	0.55	0.49	0.93	0.29	0.65

Each value is a mean of four replicates

Table 3: Effects of hydromorphic fields and conventional fields on phytonematodes infecting *Telfairia occidentalis* in Ekiti and Ondo States

	J2/200 mL soil				
Treatments/state and year	*Meloidogyne*	*Helicotylenchus*	*Hoplolaimus*	*Pratylenchus*	*Rotylenchulus*
Ekiti State 2016					
Hydromorphic	0.81	1.86	0.61	1.55	0.79
Conventional fields	1.56	0.92	0.78	0.79	1.08
LSD ($p \le 0.05$)	0.9	0.5	0.61	0.28	0.97
Ekiti State 2017					
Hydromorphic	0.89	1.83	0.81	1.69	0.814
Conventional fields	1.4	0.83	0.59	0.54	1.12
LSD ($p \le 0.05$)	0.99	0.34	0.6	0.61	1.05
Ondo State 2016					
Hydromorphic	0.84	1.55	0.06	0.87	0.73
Conventional fields	1.49	1.17	0.78	0.77	1.22
LSD ($p \le 0.05$)	1.15	0.52	0.24	1.22	1.51
Ondo State 2017					
Hydromorphic	0.95	1.65	0.15	1.35	0.66
Conventional fields	1.58	0.73	1.03	0.58	1.78
LSD ($p \le 0.05$)	1.26	1.04	0.39	0.76	0.81

Each value is a mean of four replicates

DISCUSSION

The results of the study showed that hydromorphic fields sown to *A. cruentus*, *S. macrocarpon* and *T. occidentals* significantly reduced the populations of *M. incognita, Hoplolaimus* and *Rotylenchulus* in comparison with conventional fields. The findings of the current study agreed with those of Amulu *et al.*[11] who reported significant reductions in the populations of *Meloidogyne*, *Hoplolaimus* and *Rotylenchulus* spp. in fadama plots in comparisons with those in upland plots sown to vegetables. The low populations of the nematodes recorded in hydromorphic plots may be due to the alluvial deposits on the field during flood seasons. These deposits are rich in organic materials[11]. On decomposition they produce nematode-toxic substances such as nitrogenous compounds[12]. Hydromorphic plots are usually saturated with water during the rainy season but retain moisture during the dry season for vegetable production[13]. The proliferation of nematodes is usually impeded in waterlogged soils. This might have contributed to the low populations of plant parasitic nematodes recorded in the hydromorphic fields, as many of the nematodes might have been killed during the flooding seasons[14].

The populations of *Helicotylenchus* spp. and *Pratylenchus* spp. were not reduced in hydromorphic plots; and in some cases, hydromorphic plots recorded higher numbers of either *Helicotylenchus* spp. or *Pratylenchus* spp. than conventional fields. This result was consistent with the findings of McSorley and Gallaher[15] who reported that the applications of yard waste compost to *Pratylenchus* infested fields grown to corn, yellow squash, or okra did not reduce the populations of the nematode. Also, authors have shown that *Helicotylenchus* thrives in a wide range of soils including organic soils[16].

CONCLUSION

Hydromorphic plots reduced the populations of *M. incognita*, *Hoplolaimus* and *Rotylenchulus* in comparison to conventional plots. This implies that farmers can take advantage of hydromorphic fields in cultivating their crops including vegetables. This is because it can not only make farmers produce their crops during the dry season but can also protect crops from plant parasitic nematodes by supressing their populations and this in turn will maintain crop yields.

SIGNIFICANCE STATEMENT

This study investigated the effects of hydromorphic fields and conventional fields planted to *Amaranthus cruentus*, *Solanum macrocarpon* and *Telfairia occidentalis* on nematode populations in Ekiti and Ondo States Nigeria. The results showed that hydromorphic fields significantly reduced nematode populations in comparison with conventional fields planted vegetables. This implies that it could be an effective strategy in nematode management, hence farmers should take advantage of hydromorphic fields for vegetable production.

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