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EFFECT OF MULCHING MATERIAL AND IRRIGATION FREQUENCY ON YIELD AND ROOT-GALL NEMATODE DISEASE OF OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH) UNDER DRY SEASON FARMING SYSTEM

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ABSTRACT

Yield and root-gall nematode disease of Okra as affected by mulching material and irrigation frequency were evaluated during 2009 and 2010 dry seasons (January to April). The experiment was layed out in a 3 X 4 factorial arranged in randomized complete block design with 4 replications. Okra variety: "Awgu early" highly susceptible to root-gall nematode, *Meloidogyne incognita* was planted at 0.3 X 0.3m in an Ultisol naturally infested by the nematode. Results of the two years showed that black polythene mulch and 12hourly irrigation significantly impaired root-gall nematode disease and improved Okra yield (pods). Severe nematode damage and least pod yield occurred on plants mulched with either palm bunch refuse or no mulching material and irrigated 24 or 36 hourly.

Key words: irrigation frequency, mulching material, okra, root-gall nematode disease and yield.

Introduction

Okra (*Abelmoshcus esculentus* (L) moench) is one of the most important vegetable crops cultivated in temperate and tropical regions of the world (Agunloye, 1986). Its role as an important component of the daily diets of the average African family is because the edible pod is moderately balanced in nutrient constituents (81.1% water; 2.1% protein, 0.2% fat, 8% carbohydrate, 1.7% fibre, 0.8% ash, 0.42% vitamins, 4.7% ascorbic acid and 2.9% minerals) (FAO, 1988). Onyekwelu (1985) reported that mature seeds also contain 20-25% edible oil which can be used in cooking. Mortenson and Bullard (1984) further confirmed the importance of this crop by stating its invaluable medicinal use in treating peptic ulcers.

Following interests generated by this crop, there is the need to sustain its availability throughout the year. This however, has not been possible because it is often traditionally produced under natural rain-fed condition. Root-gall nematode disease caused by *Meloidogyne incognita* is also reported as a major constraint in Okra production during the rainy season (Agu et al 2009; Netscher and Sikora, 1990). To bridge production gap between rainy and dry seasons and reduce root-gall nematode disease on

okra, artificial irrigation in dry season is needed. Mulching to conserve applied irrigation water is also necessary. Information is however lacking on the appropriate mulching material and irrigation frequency for dry season okra production in root-gall nematode infested soil. This study therefore concerned evaluation of effects of different mulching materials and irrigation frequencies on yield and root-gall nematode disease of okra under dry season farming system.

Materials And Methods

The study was conducted during 2009 and 2010 dry seasons (January to April) on a Nigerian Ultisol (FAO/UNESCO, 1997) naturally infested with a root-gall nematode, *Meloidogyne incognita* (Agu, 2008). The experiment was layed out in a 3 X 4 factorial arranged in randomized complete block design with 4 replications. The treatments whose effects on yield and root-gall nematode disease of okra were investigated included: (a) mulching materials (black polythene sheet, palm bunch refuse, wood shavings and no mulch) and (b) irrigation frequencies (12, 24, and 36hourly). These treatments were combined in all possible combinations and randomly assigned to 12 plots per block. Okra seeds, "Awgu early" were first sterilized in 10% commercial sodium hypochlorite (NaOcl) solution for 2 minutes and rinsed 3 times with tap water. These seeds were planted 2 seeds per hole at a planting distance of 0.3 X 0.3m, a plant population of 222, 222 plants per hectare. Emergence took 3 - 4 days after sowing and 5 days after sowing, missing stands were supplied. The irrigation water was applied manually at 3 litres per plot (1.2 X 1.5m) during each irrigation regime. Compound fertilizer (N.P.K. 15:15:15) was applied at 200kg per hectare and hand weeding done 4 and 8 weeks after sowing. Mean soil temperatures were measured throughout the duration of the experiment. Data were collected on pod yield per plant and root-gall nematode damage. The plants' roots were assessed at 14 weeks after sowing by randomly sampling from centre rows of each plot and scored according to Agu and Ogbuji (2001) in which 0 = no infection (no galls), 1 = rare infection (1 - 3 galls), 2 = light infection (4 - 10 galls), 3 = moderate infection (11-30galls) and 4 = severe infection (>, 30 galls). All data for the two years were similar and therefore combined and subjected to analysis of variance as described by Steel and Torrie (1981) and means separated by Fisher's least significant difference (Fisher, 1949) at P = 0.05.

Results

Roots of okra plants mulched with different mulching materials showed significant (P = 0.05) differences in the degree of root-gall nematode damage incurred (Table 1). Plants without mulching material were severely galled (Fig. 1a). The same was true for those mulched with palm bunch refuse. Moderate (Fig. 1b) and Light (Fig. 1c) gallings however occurred on plants mulched with wood shavings and black polythene sheets respectively. Irrigation frequency also significantly affected the amount of root-gall nematode damage on the okra plants (Table 2). Plants on 24 and 36hourly irrigations were severely root-galled (Fig. 1d). This contrasted the lightly galled roots obtained on plants on 12hourly irrigation (Fig. 1e). Interactions

TABLE — 1 EFFECT OF MULCH MATERIAL ON ROOT-GALL NEMATODE DISEASE ON OKRA

Mulching Material	Mean number of root-galls per plant
Black polythene sheets	5.3
Wood shavings	11.2
Palm bunch refuse	33.2
Control (no mulch)	34.7
LSD 0.05	3.6

TABLE — 2 EFFECT OF IRRIGATION FREQUENCY ON ROOT-GALL NEMATODE DISEASE ON OKRA

Irrigation Frequency(hourly)	Mean number of root-galls per plant
12	7.7
24	31.2
36	34.2
LSD 0.05	3.1

TABLE — 3 INTERACTIVE EFFECT OF MULCHING MATERIAL AND IRRIGATION FREQUENCY ON ROOT-GALL NEMATODE DISEASE ON OKRA.

Treatments Interaction	Mean Root-gall Indices (0-4)
BPS x 12	0.33
BPS x 24	0.75
BPS x 36	0.92
WSH x 12	1.92
WSH x 24	2.09
WSH x 36	2.79
PBR x 12	2.55
PBR x 24	3.51
PBR x 36	4.01
NM x 12	2.58
NM x 24	3.52
NM x 36	3.97
LDS 0.05	3.29

* BPS = Black Polythene Sheet, WSH = Wood Shaving, PBR = Palm Bunch Refuse, NM = No Mulch, 12 = 12 hourly irrigation, 24 = 24 hourly irrigation and 36 = 36 hourly irrigation.

TABLE — 4 EFFECT OF MULCHING MATERIAL ON TOTAL POD WEIGHTS OF OKRA

Mulching Material	Mean number of root-galls per plant
Black polythene sheets	227.4
Wood Shavings	223.8
Palm bunch refuse	171.7
Control (no mulch)	154.3
LSD 0.05	9.7

TABLE — 5 EFFECT OF IRRIGATION FREQUENCY ON TOTAL POD WEIGHTS OF OKRA

Irrigation frequency (hourly)	Mean total pod weights per plant (g)
12	327.9
24	236.2
36	213.1
LSD 0.05	47.2

between mulching materials and irrigation frequencies significantly influenced root-gall nematode damage on the plants (Table 3). Okra plants mulched with black polythene sheets and irrigated 12hourly had rarely galled roots. Severely galled roots were however obtained both on control plants and those mulched with palm bunch refuse at 24 and 36hourly irrigations (Fig. 1f).

Harvested fresh pod weights of okra were found to differ significantly with different mulching materials and irrigation frequencies (Tables 4 and 5). Those harvested from plants treated with no mulching material weighed significantly lower than others. Plants mulched with black polythene sheets gave highestfresh pod weights which differed significantly from those of palm bunch refuse mulched plants (Table 4). As shown in Table 5, 12hourly irrigation significantly improved fresh pod weights over those under 24 and 36 hourly irrigations.

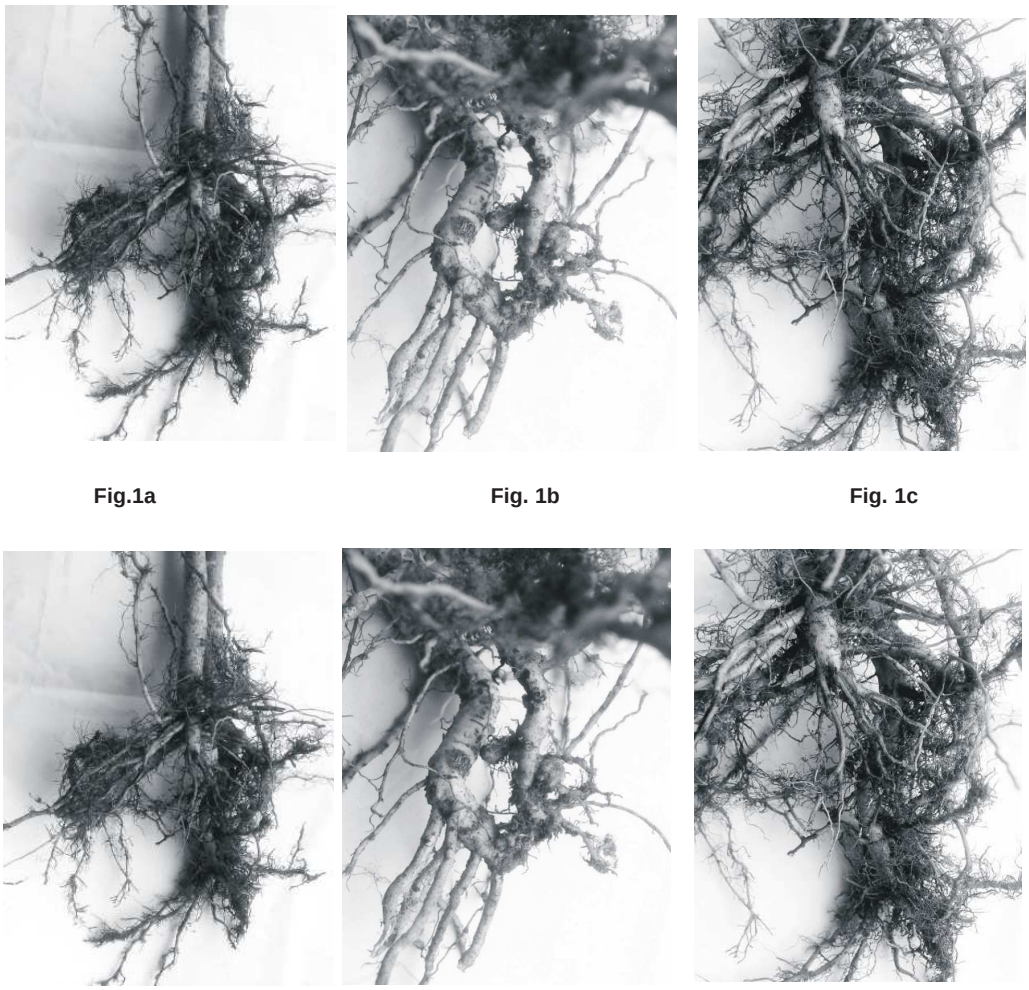

Fig.1a **Fig. 1b** **Fig. 1c**

Fig.1d **Fig. 1e** **Fig. 1f**

Figure 1(a-f). Galling responses of okra roots to *Meloidogyne incognita* at different irrigation frequencies and mulching materials: (a) Severely galled roots at palm bunch refuse and no mulch applications; (b) and (c) moderately and lightly galled roots at wood shavings and black polythene sheets applications, respectively; (d) severely galled roots at 24 and 36-hourly irrigations; (e) lightly galled roots at 12-hourly irrigation; (f) severely galled roots at palm bunch refuse and 24/36-hourly irrigation applications.

Discussion

Results of this study showed that okra plants incurred least root-gall nematode damage when mulched with black polythene sheets and irrigated 12hourly. This could be due to the recorded high mean soil temperature (31.22°C). Karl and Johnannes (1994) stated that the greatest effect of colour of mulch material is on soil temperature and that dark materials warm up faster than light ones. Wallace (1963) reported *Meloidogyne spp* inactivities in the high temperature range of 30 to 40°C. This study however, did not ascertain which of the nematode's activities (hatching, reproduction, movement, development or feeding) were affected.

The significant improvement on okra pod yield associated with black polythene sheet mulch and 12hourly irrigation could be attributed to the fewer root-gall damage on the plant. Agu *et al* (2009) reported lower pod yield on severely root-galled okra plants. This according to Kirkpatrick *et al* (1991) was due to xylem vessels disruption in infected roots causing interruption of nutrient and water translocation to the shoot and consequent interference with carbohydrate synthesis.

Conclusion

Black polythene sheet mulching and 12hourly irrigation at 3litres per 1.2 X1.5m are required for effective control of root-gall nematode disease and improved okra yield under season farming system in a root-gall nematode infested Ultisol.

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