INFLUENCE OF DIFFERENT SOIL MEDIA ON THE *Meloidogyne incognita* INFECTIONS ON CUCUMBER (*CUCUMIS SATIVUS*)

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ABSTRACT
Pot experiments on the influence of different soil media on the *Meloidogyne incognita* infections on cucumber (*Cucumis sativus*) were carried out at the screen house of Federal College of Agriculture Ishiagu Ivo Local Government Area Ebonyi State on 2014. The treatments were sterilized top soil, Rice husk Ash and sharp river sand at different ratios (1:1:1, 1:1:3, 1:2:3,1:1:2, 1:2:1, 1:3:2, 1:3:1 and control 1:0:0) and were fitted into Completely Randomized Design with nine (9) replications. Data were collected on vine length (cm), number of leaves, stem girth (cm), leaf area (cm) at 3,5,7 and 9 weeks after inoculation (WAI). Number of fruit at harvest, weight of fruits (kg) at harvest, number of galled root, number of galls per root and nematode population per 100 g. The data collected were subjected to statistical analysis of variance (ANOVA). Results showed that the soil media 1:2:1, 1:3:2 and 1:3:1 reduced the number of galled root and number of galls per root. The growth and yield parameters were all significantly ($P < 0.05$) increased. It is recommended that soils areas with high incidence of nematode attack should be amended with top soil, Rice Husk ash and sharp river sand at the ratio of 1:2:1, 1:3:2 or 1:3:1 for best result in reducing nematode population below economic threshold level.
Keywords: Soil media; *Meloidogyne incognita*; Infections; Ratios; Screen house

INTRODUCTION

Cucumber, (*Cucumis sativus*) is a widely cultivated plant from the family *cucurbitaceae*. It probably originated from Southern region of Asia and widely cultivated for its fruits. It is a tender annual with a rough, succulent, trailing stem and hairy leaves. The creeping plant has large leaves that form a canopy over the fruit and eaten as vegetables.

Nem and Sarkar (2011) reported that cucumbers are good source of Copper, Molybdenum, Panthothenic acid Potassium, Manganese, Phosphorus, Magnesium, Biotin and Silica which are the important health promoting minerals.

There are many varieties of cucumber but they are basically divided into two; slicing and picking cucumber. Slicing cucumber are those varieties cultivated for consumption in fresh form and are characterized by fairly large in size, green in colour and thick-skinned e.g. Burpless, straight 8, salad bush etc while pickling cucumbers are cultivated not for consumption in fresh form and are characterized by smaller in size, thinner skin and mostly under-go pickling before consumption though may be eaten in fresh form like Bush pickle, black-spine types, white-spine types, Carolina. Cucumbers are rich in essential vitamins and minerals. It also has low fat, sugar and dietary fibre (Marie, 2013).

Nematode attack on cucumber is amongst the major problems militating against the production of cucumber in the tropics. Nematodes are usually controlled by the use of chemicals (nematicides) which are not environmentally friendly, costly, and unaffordable to most farmers resulting to increase in the cost of production. Therefore, there is a need to look for alternative control measures that are environmentally friendly, relatively cheap and affordable to farmers.

The objectives of this study were to evaluate performance of cucumber in different soil media and determine the levels of nematode infections on cucumber in the different soil media.

MATERIALS AND METHODS

The experiment was carried out at the screen house of Federal College of Agriculture Ishiagu, Ebonyi State of Nigeria during 2014 growing season. Ishiagu is located in the tropical region of the derived savanna zone of southern Nigeria on latitude $5^{0}56^{1}$N and longitude $7^{0}31^{1}$E with average annual rainfall of 1665mm, 88% average humidity and temperature of 28.5^{0}C (FCAI Meteorological Station, 2012).

The experimental design was completely Randomized Design (CRD) with Eight (8) treatments and each replicated nine (9) times.

The treatments (soil media)

The media were obtained from the mixture of top soil, rice husk-ash, and sharp river sand at the ratios below:

TS		RHA		SRS
1	:	1	:	1
1	:	1	:	3
1	:	1	:	2
1	:	2	:	3
1	:	2	:	1
1	:	3	:	2
1	:	3	:	1
1	:	0	:	0

TS = Top soil
RHA = Rice husk-ash
SRS = Sharp river sand

Each treatment was mixed thoroughly with hand trowel, sterilized at the temperature of 80^{0}C for

two hours and allowed to cool. Five kilogram (5kg) of the sterilized media was packed into 7 litres perforated buckets and kept on the platform at spacing of 20 cm by 20 cm between each bucket and 1m between each treatment. The various treatments were labeled accordingly for proper identification.

Planting/sowing

The media were watered for two days after sterilization before planting and cucumber seeds (Straight 8 variety) were sown directly at the middle of the buckets at 2 cm depth, and two seeds per hole were sown in each bucket.

Nematodes eggs extraction/inoculation

Meloidogyne incognita infected roots of India spinach (*Spinacle oleraceae*) were washed thoroughly with distilled water, sliced into pieces and packet into a 500 ml conical flask. 100mls of 0.5% sodium hydrochloride (household bleach) at the ratio of 1:4 was added and tightly covered and shaken vigorously for four minutes to dissolve the gelatinous matrix, thus freeing the eggs from the egg mass. The eggs were collected using sieve and washed immediately with distilled water, using a counting dish; the total numbers of eggs were estimated with the help of microscope.

Inoculation

Inoculation was done two weeks after sowing. Extracted eggs were inoculated 5cm away from each cucumber root at 2 cm depth using ring method with the help of 10 ml syringe and each stand is to receive estimated 3000 eggs then covered properly with soil after inoculation.

Data Collection

Data were collected on Vine length (cm), Number of leaves, Stem girth (cm), Leaf area (cm^2), at 3,5,7 and 9 weeks after inoculation, Number and Weight (kg) of fruits, Number of galled roots and Number of galls per root (Gall index) at harvest. Gall index were scored as follows:

0 = 0 galls, 1 = 1-2 galls, 2= 3-10 galls, 3 = 11-30 galls, 4 = 31 -50 galls and 5= > 50 galls

Data analysis

The data collected were subjected to analysis variance (ANOVA) according to the procedure for the Completely Randomized Design as out lined in Obi (2002). Significant treatment means were separated using least significant difference at 5% level probability.

RESULTS

The treatment significantly ($P < 0.05$) affected the vine length at 3 weeks after inoculation (Table 1). The highest vine length of 40.78 cm was obtained in the 1: 2 : 1 medium which significantly ($P < 0.05$) differed from other treatments except 1 : 3 : 2 medium. The lowest vine length (9: 10cm) was obtained in 1: 1:3 medium.

At 5 weeks, the treatment significantly ($P < 0.05$) affected the vine length with the highest vine length 65.05cm obtain from treatment 1 : 2 : 1 which significantly differed from other treatment except 1 : 3 : 2 medium. The lowest vine length (21.50) was obtain in 1:1:3 medium. At 7 WAI, the highest vine length of 75.33cm was obtained in medium 1:3:2 which significantly ($P < 0.05$) differed from other treatment except 1: 2:1 medium. The lowest vine length (33.20cm) was obtained in 1:1:3 medium.

At 9 WAI, the highest vine length of 80.77cm was obtained in the 1: 3: 2 medium which significantly ($P < 0.05$) differed from others except 1 : 2 : 1 medium. The lowest vine length (33.20cm) was obtained in 1: 1 : 3 medium.

The treatments significantly ($P< 0.05$) affected the number of leaves at 3 weeks after inoculation (Table 2). The highest number of leaves of 11.40 was obtained in the 1: 2 : 1 medium which significantly ($P< 0.05$) differed from other treatments except 1 : 3 : 2 medium. The lowest number of leaves (6.11) was obtained in 1:1:3 medium.

At 5 WAI, the treatments significantly ($P < 0.05$) affected the number of leaves with the highest number of leaves (11.89) obtained in 1:3:2 medium which significantly ($P < 0.05$) differed from other except 1:2:1 medium. The lowest number of leaves (7.33) was obtained in 1:1;3 medium.

At 7 WAI, the treatments significantly ($P < 0.05$) affected the number of leaves with the highest number of leaves (16:67) obtained in 1:3:2 medium which significantly ($P < 0.05$) differed from other treatments except 1:2;1 medium. The lowest number of leaves (7.33) was obtained in 1:1:3 medium.

At 9 WAI, the highest number of leaves (19.22) was obtained in 1:3:2 medium which significantly ($P < 0.05$) differed from other treatment except 1:3:1 medium. The lowest number of leaves (10.29) was obtained in 1:1:3 medium.

Results in Table 3 showed that the treatment significantly ($P< 0.05$) affected the stem girth (cm) at 3, 5, 7 and 9 weeks after inoculation. The highest stem girth of (3.4cm) was obtained in 1 : 3 : 2 medium which significantly ($P< 0.05$) differed from other treatments except 1:2:1and 1 : 3 :1 media. The lowest stem girth (1.9cm) was obtained in 1 : 1 : 3 medium.

At 5 WAI, the highest stem girth (3.2cm) was obtained and in 1:3:2 which significantly differed from other treatments except 1:1:1 and 1:2:1 media. The lowest stem girth (2.1cm) was obtained in 1:1:3 medium. At 7 WAI, the highest stem girth (3.2cm) was obtained in 1:1:2 which significantly differed from other treatment except 1:1:1 and 1:2:1 media. The lowest stem girth (2.1cm) was obtained in 1:1:3 medium. At 9 WAI, the treatments significantly ($P < 0.05$) affected the stem girth with the highest stem girth (3.1cm) obtained in 1:2:1 and 1:3:2 media. The lowest stem girth (1.5cm) was obtained in 1:1:3 medium.

The treatments significantly (P< 0.05) affected the leaf area at 3 weeks after inoculation as presented in Table 4. The highest leaf area (141.62cm^2) was obtained in the 1 :2:1 medium which significantly (P < 0.05) differed from other treatments except 1:3:1 and 1:3:2 media. The lowest leaf area (66.27cm^2) was obtained in 1 : 1 : 3 medium.

At 5 WAI, the highest leaf area (134.11cm^2) was obtained 1:2:1medium which significantly (P < 0.05) differed from other treatments except 1:3:2 and 1:3:1 media. The lowest leaf area (66.27cm^2) was obtained in 1:1:3 medium. The highest leaf area (143.14cm^2) was obtained in 1:2:1 medium which significantly (P < 0.05) differed from other treatments except 1:3:1, 1:1:1 and 13:2 media. The lowest leaf area was obtained in 1:1:3 medium at 7 WAI. At 9 WAI, the highest leaf area (123.20cm^2) was obtained in 1:3:1 medium which significantly (P < 0.05) differed from other treatments except 1:3:2, and 1:2:1 media. The lowest leaf area (48.55cm) was obtained in 1:1:3 medium.

The treatments did not have any significant (P>0.05) effect on the number of galled roots at harvest (Table 6) but the gall index was significantly (P < 0.05) affected. The highest number of galls per stand (45) was obtained in 1:1:3 medium and lowest number of galls per stand 1.9 was obtained in 1:2:1 medium.

In nematode population per 100 g of soil, the treatments significantly (p < 0.05) affected the population and the highest nematode population (3.2) was obtained in 1:3:3 medium while lowest nematode populations (1.8) was obtained in 1:2:1 and 1:3:1 media.

Table 1: Effect of different soil media on the vine length (cm) at 3, 5, 7 and 9 weeks after inoculation (WAI)

Soil media	3 WAI	5WAI	7WAI	9WAI
1 : 1: 1	25. 28	49.20	55.56	55.56
1 : 1: 3	9. 10	21.50	33.20	33.20
1 : 1 : 2	23. 74	37.46	46.56	46.57
1 : 2 : 3	22. 00	37.52	38. 00	43.50
1 : 2 : 1	40 .78	65.05	65.10	67.67
1: 3 : 2	35 .24	63 .76	75. 33	80. 77
1 : 3 : 1	29. 77	47.92	61.67	60. 70
1: 0 : 0 (Control)	29. 33	45. 12	49.56	50. 70
$LSD_{0.05}$	10.30	16. 21	18.39	18. 17

Table 2: EFFECT OF DIFFERENT SOIL MEDIA ON THE NUMBER OF LEAVES AT 3, 5, 7 AND 9 WEEKS AFTER INOCULATION (WAI).

Soil media	3WAI	5WAI	7 WAI	9WAI
1: 1 : 1	9: 33	1.89	10. 33	11. 56
1: 1 : 3	6.11	6.33	7.33	10. 29
1 : 1 : 2	8.56	10.33	13.00	12.33
1 : 2 : 3	7.67	9.00	10.56	12.13
1 : 2 : 1	11.40	11.67	11.22	14.67
1 : 3 : 2	10.00	11.89	16.67	19.44
1 : 3 : 1	9.56	10.11	14.44	16.44
1 : 0 : 0 (control)	8.22	9.00	9.33	10.89
$LSD_{0.05}$	1.33	2.54	4.34	4.68

Table 3: EFFECT OF DIFFERENT SOIL MEDIA ON THE STEM GIRTH (CM) AT 3, 5, 7, AND 9 WEEKS AFTER INOCULATION (WAI).

Soil media	3WAI	5WAI	7WAI	9WAI
1 : 1 : 1	3.1	3.1	3.1	2.2
1 : 1: 3	1.9	2.1	2.1	1.5
1 : 1 : 2	2.8	2.9	2.9	1.9
1 : 2 : 3	2.6	2.6	2.6	2.6
1 : 2 : 1	3.2	3.1	3.1	3.1
1 : 3 : 2	3.4	3.2	3.2	3.1
1 : 3 : 1	3.2	2.9	2.9	2.4
1: 0 :0	2.9	2.7	2.7	2.7
$LSD_{0.05}$	0.4	0.7	0.7	0.8

Table 4: EFFECT OF DIFFERENT SOIL MEDIA ON THE LEAF AREA (CM) AT 3, 5, 7 AND 9 WEEKS AFTER INOCULATION. (WAI)

Soil media	3WAI	5WAI	7WAI	9WAI
1 : 1:1	115.33	115.33	124.91	71.67
1 : 1 : 3	66.27	66.27	76.08	48.55
1 :1 : 3	99.45	95.09	105.12	56.57
1 : 2 : 3	84.96	77.87	98.98	71.43
1 : 2 :1	141.62	134.11	143.14	121.55
1 : 3 : 2	129.10	130.68	121.07	122.53
1 :3 : 1	131.84	127.85	139.10	123.20
1 : 0 : 0	97.40	96.76	100.31	83.18
$LSD_{0.05}$	30.01	29.66	29.05	22.87

Table 5: EFFECT OF SOIL MEDIA ON NUMBER AND WEIGHT (G) OF FRUITS AT HARVEST

Soil Media	Weight of fruits	Number of fruits
1:1:1	35.6	0.4
1:1:3	4.7	0.1
1:1:2	20.1	0.1
1:2:3	18.4	1.1
1:2:1	111.1	1.4
1:3:2	120.0	1.3
1:3:1	106.1	1.3
1:0:0	65.8	1.7
$LSD_{0.05}$	0.69	0.45

Table 6: Effect of soil media on Number of galled roots, gall index and nematode population at harvest

Soil media	Number of galled roots	Gall index	Nematode population
1:1:1	2.7	3	2.6
1:1:2	6.3	4.5	3
1:1:3	6.1	4.3	3
1:2:1	1.9	1.9	1.8
1:3:2	2.3	2.6	2
1:3:1	2.4	2.3	1.8
1:0:0(control)	8.3	4.9	4.8
LSD(0.05)	1.02	0.89	0.04

DISCUSSION

The mixture of top soil, Rice Husk Ash (RHA) and sharp River sand at different ratios gives significant results in all the parameters measured. According to Mateille *et al*, (2009), that soil structure and texture influence nematode attachment, sandy soils were more favourable than clay. The media with high RHA seems to be clay – loamy in nature, increasing the soil media water holding capacity, thereby giving poor condition for nematode development. The least value 1.9 was obtained in 1:2:1 medium for both number of galled root and number of galls per root while for nematode population index, the least value (1.8) was obtained in 1:3:2 medium.

Cherife, *et al*, (2008) also said that RHA contain enough silicon which act as biological induce of plant innate defense responses and this also has contributed to reduction in number of galls and nematode population index. The presence of silicon and potassium in RHA and high content of RHA in some media has accounted for root-knot nematode suppression and well development of growth parameters.

FFTC, (2001) reported that RHA increases the availability of phosphorus, and phosphorus enhances early root formation, growth greater flowering and quality fruits and seeds production (Silva and Uchida, 2000) together with root-knot nematode suppression which reflected on the production of highest number of fruit (1.7%) in 1:3:2 medium and least number 0.1% in 1:1:3 and 1:1:2 media. The depression of nematode activities on the plant may have been contributed by the increased phosphorous which confers resistance to diseases on plants

The study indicates that rice husk ash when used as soil amendment could control nematode attack on plants. Farmers are therefore advised to us rice husk ash in an area of high nematode attack to

reduce nematode population and increase yield for it is readily available, cheap and not hazardous to both plants and animals.

REFERENCES

Cherife M.A, Asselin and Belaner,R.R, (2004) Defense responses induced by soluble silicon in cucumber roots infected by *pythium spp*. Phytopathology, 84:236 – 242.

Food and Fertilizer Technology Center (2001): Application of Rice Husk Characoal. FFTC leaflet for Agriculture No. 4 food and fertilizer Technology center, Taipei.

Marie, D. (2013). Nutritional value of cucumber. Newsletter of Livestrong Foundation pg 1.

Mateille T. Duponnois, R., Diop, M.T., (2009). Influence of abiotic soil factors and the host plant on the infection of photoparasitic nematodes of the genus Meloidogyne by the actinomycete parasitoid pasteuria penetrans. Agronomic 15, 581 – 591.

Nema, N.K and Sarkar, N.B. (2011). Cucumis sativus- fruit potential antioxidant, antihyaluronidase and anti-elastase agent. Arch Dematol Research 303(4) 247-252.

Obi, I. U. (2002). Statistical methods of detecting difference between treatment means and research methodology issue of laboratory and field experiment.

Silva J. and Uchida R.S. (2000). Plant Nutrient management in Hawaii's soil: Approaches for Tropical and sub – Tropical agriculture and Human Resources, University of Hawii at Manoa, Honolulu.