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Marigold (*Tagetes erecta* L.) as interplant with cowpea for the control of nematode pests

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Abstract: Field experiment to control nematode pests of cowpea (Ife Brown variety) with marigold (*Tagetes erecta* L.) as interplant was carried out. Marigold plants were planted within the rhizoplane and rhizosphere of cowpea grown on naturally nematode infested field. Nematode pests of cowpea encountered on the experimental field were *Meloidogyne* spp., *Pratylenchus* spp., and *Helicotylenchus* spp. The experiment was laid out in a randomised complete block design with five treatments replicated five times. The results of this experiment show that cowpea (Ife Brown variety) is susceptible to nematode pests, and marigold that were planted within the rhizoplane and rhizosphere significantly controlled the nematode pests thereby enhanced the growth rate (plant height, root length, number of leaf per plant) and grain yield (number of pod and seed) per cowpea plant. Moreover, marigold plants significantly suppressed the gall on cowpea roots and soil nematode population. Planting of marigold within the cowpea rhizoplane and rhizosphere is suggested as control measure against nematode pests of cowpea.

Key words: cowpea (Ife Brown variety), marigold, nematode, interplant, rhizoplane, rhizosphere.

Introduction

Nematicidal activities of plant materials have been reported to vary from plant to plant. This variation has also been attributed to the differences in the chemical composition and concentration of the toxic compounds present in different plants (Olabiyi, 2004; Oladoye *et al*, 2007).

Marigold, *Tagetes erecta*, is a weed which is not common in Nigeria. Marigold had been reported to contain 5-(3-buten-1-ynyl) 2,2-bithienyl and alpha terthienyl (Morallo-Rejesus and Decena, 1982). Alpha terthienyl, in a synthetic form had been reported to be the active component in marigold (Kanagy and Kaya, 1986). The root of marigold was reported to contain flavonoid (Olabiyi, 2006). The type of flavonoid in the root of marigold are Di-hydro flavonoid, flavones and flavonones lacking a free5-OH (Bamiduro, 2001). The root of marigold has also been reported to contain amines, amides, phenols and ketones (Olabiyi, 2004).

Natural plant products are at the present research focus because of their ability to produce environmentally less harmful but efficacious chemical substances (Schmutterer, 1990). It is envisaged that natural plant products would replace or minimize the use of highly toxic and persistent synthetic chemicals (Jackai *et al*, 1992).

The objective of this research is therefore to harness the chemical exudates from the root of marigold plant in the control of nematode pests of cowpea through the planting of marigold within the cowpea rhizoplane and rhizosphere.

Material and Methods

A field experiment on the control of nematode pests of cowpea with marigold was carried out during 2006 cropping season at the Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The experiment was laid out in a randomized complete block design with five treatments replicated five times. The experiment was conducted on plant parasitic nematode infested field, measuring 300 m^2 each divided into 5 blocks of 5 plots. Alley ways measuring 1m wide were left in-between each plot and other to prevent treatment interaction.

Cowpea seeds (Ife Brown) were sown four seeds per stand and two rows per ridge at spacing of 25 cm within the row. Three weeks after planting, cowpea plants were thinned to two healthy seedlings per stand. Two days later, one or two marigold plant(s) were planted within the rhizoplane and rhizosphere of the cowpea. Cowpeas that were planted alone (without interplant with marigold) served as the control. Manual weeding and insect control with foliar application of Karate 2.5EC at the rate of 1.0 litre ha^{-1} were carried out.

At harvest (12 weeks after planting), data were collected on plant height, number of leaf per plant, root length, number of seed per pod, number of pod per plant, grain yield per plot and roots of cowpea were assessed for galls and scored after Taylor and Sasser (1978) on a scale of 0-5, where 0 = 0 number of gall, 1 = 1-2 galls, 2 = 3-10 galls, 3 = 11-30 galls, 4 = 31-100 galls and 5 = more than 100 galls.

All the data were subjected to analysis of variance and Duncan's multiple range tests to partition the differences between the means.

Results

The effects of planting marigold within the rhizoplane and rhizosphere on mean plant height, number of leaf per plant and root length are shown in Table 1. Cowpea plants on which marigold were planted within their rhizoplane and rhizosphere have significantly ($p<0.05$) higher plant height and number of leaves, and longer root length than the cowpea that were not interplant with marigold (cowpea alone - control). The result presented in Table 1 shows that cowpea that were interplant with marigold have significantly ($p<0.05$) higher growth rate than those cowpea that were not interplant with marigold (control). The cowpea plants in the control plots have significantly ($p<0.05$) reduced plant height of 12.8 cm while cowpea plants in which marigold were planted within their rhizoplane and rhizosphere have plant height range between 17.5 cm and 21.5 cm. All these suggest that nematode pests in the soil suppressed the growth of cowpea in the control plots and that marigold plants enhanced cowpea growth rate.

Table 1: Effects of marigold on the growth of cowpea (Ife Brown) grown on nematode infested soil.

Treatments	Average plant height	Average number of leaves/plant	Average root length
Cowpea + 1 marigold planted within rhizoplane	17.5a	40.5a	27.4ab
Cowpea + 2 marigold planted within rhizoplane	20.8a	42.8a	28.8a
Cowpea + 1 marigold planted within rhizosphere	18.6ab	38.5a	26.5b
Cowpea + 2 marigold planted within rhizosphere	21.5a	39.8a	29.5a
Cowpea alone (control)	12.8c	17.9b	14.1c

Means followed by the same letter(s) along the same column are not different statistically @ $p<0.05$.

Result presented on Table 2 indicates the effects of marigold within the cowpea rhizoplane and rhizosphere on the average cowpea grain yield per plot, number of cowpea seeds per pod and number of cowpea pods per plant. The result shows that marigold within the cowpea rhizoplane and rhizosphere significantly ($p<0.05$) enhanced cowpea grain yield, number of seeds per pod and number of pods per plant when compared with the control experiment.

Table 2: Effects of marigold on the yield of cowpea (Ife Brown) grown on nematode infested soil.

Treatments	Average grain yield/plot (kg)	Average number of seeds/pod	Average number of pods/plant
Cowpea + 1 marigold planted within rhizoplane	3.5a	18.1a	19.5a
Cowpea + 2 marigold planted within rhizoplane	3.7a	18.8a	20.1a
Cowpea + 1 marigold planted within rhizosphere	3.3a	16.8a	20.5a
Cowpea + 2 marigold planted within rhizosphere	3.6a	16.8a	19.0a
Cowpea alone (control)	1.7b	8.1b	9.5b

Means followed by the same letter(s) along the same column are not different statistically @ $p<0.05$.

The result presented on Table 3 shows that cowpea plants, which marigold were planted within their rhizoplane and rhizosphere, have significantly ($p<0.05$) lower root gall index than the control cowpea plants, which were not interplant with marigold. Significantly high root gall index (3.5) in the control cowpea plant indicates that root knot nematodes were of high population in the soil and that the test crop (cowpea - Ife Brown) is susceptible to root knot nematode. Significantly ($p<0.05$) low root gall (0.5 – 1-1) was observed on the cowpea roots on which marigold were planted within their rhizoplane and rhizosphere. This might suggest that marigold suppress root gall formation and root knot nematode population.

Table 3: Effects of marigold on the root gall of cowpea (Ife Brown) grown on nematode infested soil.

Treatments	Average root gall index
Cowpea + 1 marigold planted within rhizoplane	0.7a
Cowpea + 2 marigold planted within rhizoplane	0.5a
Cowpea + 1 marigold planted within rhizosphere	1.1b
Cowpea + 2 marigold planted within rhizosphere	0.9ab
Cowpea alone (control)	3.5c

Means followed by the same letter(s) along the same column are not different statistically @ $p<0.05$

The result on Table 4 shows the population and percentage reduction of the nematode pests of cowpea encountered on the experimental field. The nematode pests encountered on the experimental field were *Meloidogyne* spp., *Pratylenchus* spp., and *Helicotylenchus* spp. It was observed that the population of nematode pests were significantly ($p<0.05$) reduced by marigold which were planted within the cowpea rhizoplane and rhizosphere. In contrast, nematode population on the plots where marigold were not planted (control) increased significantly ($p<0.05$).

Table 4: Soil nematode population in 200 ml soil sample at planting (initial population) and harvest (final population).

Treatments	*Meloidogyne* spp.		*Pratylenchus* spp		*Helicotylenchus* spp	
	Initial population	Final population	Initial Population	Final population	Initial population	Final population
Cowpea + 1 marigold planted within rhizoplane	615	246a	100	31a	218	49a
Cowpea + 2 marigold planted within rhizoplane	608	238a	98	37a	209	47a
Cowpea + 1 marigold planted within rhizosphere	611	241a	96	34a	211	51a
Cowpea + 2 marigold planted within rhizosphere	617	257a	104	32a	216	48a
Cowpea alone (control)	609	1091b	102	165b	208	289b
	NS		NS		NS	

NS = Not Significant
Means followed by the same letter(s) along the same column are not different statistically @ $p<0.05$.

Discussion

The results of this study indicated that marigold that were planted within the cowpea rhizoplane and rhizosphere controlled the nematode pests significantly ($p<0.05$), enhanced the average plant height, grain yield, root length, number of pod, leaf and seeds of cowpea. Moreover, marigold plants significantly ($p<0.05$) suppressed the galls on the cowpea roots. The results show that marigold is capable of controlling field nematode pests of cowpea when planted within rhizoplane and rhizosphere the effect of which might be as a result of exudates (bio-nematicides) being released into the soil by the marigold.

Some plants have been reported by several investigators to be resistant to nematode while some few plants have been reported to produce bio-nematicidal exudates.

Crotalaria, velvet bean and rye had been reported to be resistant to root-knot nematode and suggested for inclusion in crop rotation scheme in nematode endemic soil (Yepsen, 1984; Peet, 1996). Sudan grass and sorghum were reported to contain a chemical, dhurrin, which degrades into hydrogen cyanide, which is very powerful bio-nematicide (Luna, 1993; Forge et al 1995; Wider and Abawi, 2000). Oil raddish had been used as a green manure to reduce stubby root nematode (*Trichodorus*) and root lesion nematode (*Pratylenchus*) in Idaho potato field (Anon, 2001). Oil radish could be planted as trap crop for the sugar beet cyst nematodes; its root exudes chemical that simulate hatching of nematode eggs. But the larvae that emerge after such stimulation had been reported not able to develop into reproductive female, thereby significantly reducing the population densities in the soil and crop at the next harvesting season (Hafez, 1998).

Planting of rape or mustard in rotation strawberries have been reported to checkmate the increase in population of some nematode pests (Brown and Morra, 1997). Marigold had been reported to act as a bio-nematicide (Olabiyi, 2004; Olabiyi *et al* 2006). It had been reported that nematode attacks the root of marigold, the root of marigold releases ozone, a bio-nematicide thereby killing the nematode pests (Ogden, 1997).

Conclusion

From the present study, it is evident that planting of marigold within the rhizoplane and rhizosphere could control nematode pests of cowpea. Also the soil nematode population and root gall are significantly reduced. Marigold as interplant within cowpea rhizoplane and rhizosphere is therefore suggested as a control measure against nematode pests of cowpea.

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