THE USE OF ORGANIC MANURE IN THE MANAGEMENT OF PLANT- PARASITIC NEMATODE IN NIGERIA

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ABSTRACT

This review focused on the sophisticated methods of controlling nematodes that are out of reach of most farmers. The study which made use of secondary data, primarily evaluated the use of organic manure in the management of plant-parasite nematode in nigeria. The effects of synthetic pesticides misuse around the world include costly environmental pollution and disruption of balance of nature in addition to their high cost and non availability. There is therefore the need to investigate methods which will maximize crops production under the prevailing farming systems suitable to local farmers. Several organic products have been shown to possess nematicidal properties and are available, inexpensive and economical methods of nematode management. As an alternative to chemical control, it has been shown that organic manure can release ammonia, phenols, azadirachtin, selannin, meliantriol and many other substances, which show nematicidal properties. The use of organic manure was found to be easy and economical in controlling plant-parasitic nematodes.

Keywords: *Organic manure, plant-parasitic nematode, pesticides, nematicidal properties*

INTRODUCTION

Organic manure is any plant or animal, material or their byproducts added to the soil to improve its fertility. This includes farmyard manures, compost manures, household refuse, sawdust, green manures and non edible oil seed cakes (Wachira et al., 2009). The materials or bye products however must be decomposable. The term management plant parasite refers to the maintenance of pest populations by the use of either individual strategies or combination of strategies at the level where they are incapable of causing detectable reduction of yield or quality of a crop or harm to human and animal health (Lale, 2006). Nematodes are members of phylum Nematohelminthes of the animal kingdom, they are worm like and sometimes called the eel worms, they spend most of their life in the soil (McGrawhil, 2002). They are tiny, worm-like multicellular animals adapted to living in water, they move in the films of water that cling to soil particles.

Nematodes are common in soil all over the world (Dropkin, 1980; Yepsen, 1984). Some plant parasitic nematodes have the greatest impact on crop productivity when they attack the roots of seedlings immediately after seedling germination (Ploeg, 2001). Although nematodes are generally regarded as silent enemies, losses of up to 80% have been associated with them in vegetable fields that are heavily infested (Siddiqi, 2000; Kaskavalci, 2007). For decades, the control of plant-parasitic nematodes has mainly depended on chemical nematicides (Akhtar and Malik, 2000). Although, nematicides are efficient and fast-acting, they are currently being reappraised with respect to the environmental hazards associated with them. In addition, they are relatively unaffordable to many small-scale farmers. The persistent pressure on farmers to adopt strategies that do not pollute the environment has increased urgency in the search for alternative sustainable methods to regulate nematodes (Pinkerton *et al.*, 2000; Mashela *et al.*, 2008). One of the alternative strategies for management of plant-parasitic nematodes is the application of organic manure in the soil (Agyarko and Asante, 2005). According to Alam (1979) the management of nematode using soil organic manure has been adopted in Egypt. Oka *et al.* (2000) point out that organic amendments have consistently been shown to have beneficial effects on soil nutrients, soil physical conditions, soil biological activity and thereby improving the health of plants and reducing populations of plant parasitic nematodes. On the other hand, populations of free-living nematodes have also been shown to have increased rapidly following the addition of organic substrate (Akhtar and Malik, 2000). Kimenju *et al.* (2004) report that application of organic amendments stimulated the activity of natural antagonist of plant parasitic nematodes. The addition of various organic materials to the soil have resulted in a distinct suppression of plant-parasitic nematodes and several increase in yield has also been obtained by the use of the organic manure. The effectiveness of organic manure in the management of plant-parasitic nematodes has been by (Fawole 1981, Subramaniya, 1990, Martin, 2006 and Egunjobi, 1985). This study aims at reviewing the use of organic manure for the management of plant-parasitic nematodes.

RESULTS AND DISCUSSION

Nematode suppressive crops combat nematodes naturally, several plants minimize nematode damge in vegetable crops. These plants produce nematicidal (killing) and nemastatic (suppressive) organic compunds that are toxic to nematodes. These compounds are released by plants after incorporated into the soil as a green manure. Some marigolds, a few varieties of chrysanthemums, castor beans, and partidge peas, several Crotalaria spp., velvet beans, and rapeseed are considered plant-parasite nematode suppressive plants (Edward, 2009). When incorporated into the soil, organic substrate undergo biologically mediated decomposition to release NH_4^+, formaldehyde, phenols and volatile fatty acids, among other compounds which can kill or supress nematode population (Wang *et al,* 2004).

Number of seeds per pod, number of pod per plant and grain yield per plot varied significantly among the treatments as shown on the table 2. The cowpea plants treated with both decomposed and un-decomposed wild sunflower leaf, maize stover and cassava peel gave significantly higher results (Olabiyi, *et al.*, 2007). Number of seeds per pod, number of pod per plant and grain yield per plot varied significantly higher in the compost treated plots than in the control. Addition of compost to soil decreased nematode pest and resulted in increased crop growth and yield. This might be due to the fact that addition of compost to the soil increases soil nutrient status, changes the physical and tropic structure of soil which might affect the plant growth and yield performances. This is in agreement with the observations of Akhtar and Mahmood (1996) and Pandey (2000) on various economic food crops. When organic manure breaks down, the nutrients and toxicants are released into the soil. While the released nutrients enhanced crop growth and yield, the toxicants help to checkmate the soil inhabiting plant-parasitic nematodes which equally gives resultant increase in crop growth and yield. Growth and yield characteristics of the African yam bean were affected by root-gall nematode damage at the various organic manure treatments. Leaf area index, leaf area growth rate, plant height, number of shoots, leaves and seed bearing pods and weights of dry pods and seeds were significantly reduced at high disease severities resulting from sawdust, municipal garbage and no manure applications. Plants treated with poultry and farmyard manures gave significantly higher yields than those of other organic manures. This was because rare root-galls occurred at poultry and farmyard manure applications. Plants with fewer root-galls would translocate more nutrients to vegetative organs than heavily galled roots (Otiefa and Elgindi, 1962). Miller and Donahue (1990) report that organic residues with C:N ratios of 20:1 or narrower have sufficient nitrogen to supply to the decomposing microorganisms and also to release for plant use.

Significant effect was observed in number of nematode in soil as affected by all treatments application as shown on table 4. The lowest population of nematode in the soil was recovered in incorporated sawdust in the final population and the highest population was obtained under control plots. There was a significant difference under control plots and mulched yard waste. This was attributed to the production of nematicidal compound during break down of organic materials incorporated into the soil. This could be as a result of improved soil structure and fertility, release of nematotoxins and other nematode antagonistic agents (Akhtar and Malik, 2000). Suppression of plant-parasitic nematodes by a variety of organic soil amendment has been reported by a number of authors (Cherif, 1998). There is substantial evidence that the addition of organic matter in the form of compost manure will decrease nematode pest population and associated damage to crops (Walker, 2004; Oka and Yermiyahu, 2002; Akhtar and Alam, 1993; Stirling, 1991).

Significant effect was also observed in relation to the number of nematodes in the soil treatments application as observed from the above table. Gombo (1998) in his experimental research shows that degradation o neem leaves on the incidence of root-knot nematodes have shown significant effect in reducing the number of root-knot nematodes population drastically in the soil this is in agreement with the odservations of sveral other researchers that numberrous plants species producing allelochemicals with antagonistic effect towards certain populations of plant-parasitic nematodes have been reported worldwide (Chitwood, 2002). Additionaliy, plant extracts from allelopathic species (e.g neem, Azadiracht indica, Tagetes spp., Brassica spp) hae been tested for their use as nematicides example selannin, meliantriol (Akhtar and Alam, 1993; Akhtar and Mahmood, 1996; Chitwood, 2002; Oka and Yerimiyahu, 2002 Tsay et al., 2004; Walker; 2004). the nematicidal effect of these extracts can be ascribed tothe presence of phytochemical compounds in their tissues or to the result of the degradation process, like some polytheinyls, isothiocyanates and glucosinolates (Chitwood, 2002; St1991).

Nutrient constituent analysis showed that the different organic manures varied significantly in amounts of potassium, phosphorus, ammonium (in form of nitrogen), organic carbon and carbon/nitrogen ratios. These observations agree with that of Otiefa (1959) and Huber (1980) who state that root-gall nematode damage on Lima bean decreased with increased ammonium supplied to the plant. Pandey (2000); Akhtar and Mahmood (1996) also report that when organic manure breaks down, they release nutrient and toxicant, the nutrient increase soil fertility and also enhance plant growth and yield and then the toxicant regulate the plant-parasitic nematodes.

The number of root knot nematode in the root was significantly affected by all treatment as shown on table 7. Pindar (1999) finds out that farmyard manure have shown significant effect in reducing the level of infestation of nematode population in the roots and control plot which had the highest level of infestation of nematodes recovered from 5g of roots table 7. This is similar to the comprehensive studies conducted by Koenning et al (2003) who has revealed the nematicidal potential of organic products used as soil amendments. Yield from treated plot are higher than that of the untreated control plot. Treatment four has the highest yield while the lowest yield was obtained from the control plot. There is substantial evidence that the addition of neem leaves in the form of compost manure will decrease nematode pest populations that are associated with damage to crops (Stirling, 1991; Akhtar and Alam, 1993; Oka and Yermiyahu, 2002; Walker, 2004). This could be as a result of improved soil structure and fertility, release of nematotoxins and other nematode antagonistic agents (Akhtar and Malik, 2000).

Sale (2004) finds out from his studies that yield from treated plot was significantly higher than that of untreated control plot. Treatment one has highest yield and there is a significant difference among all treatments. This is simply because nematode multiplies freely and intensifies their activities in the untreated plot while their growth was checked in the treated plots and the resulting high population may lead to yield loss. The nematode and newly formed host tissue serve as a metabolic sink into which the plant divert nutrient that was normally sent to leaves, flowers and fruits. This result in less vigorous growth and consequently the yield and this study agreed with the previous experiment reported by Everts et al (2006), that there is increase in yield and reduction in nematode population.

Inhibition of egg-hatch of *Meloidogyne incognita* varied with treatments as shown on table 10. The extract of *Azadirachta indica* (neem) was the most effective, followed by *Chromolaena odorata* (siam weed), *Nicotina tabacum* (tobaco), *Carica papaya* (Pawpaw), *Cannabis sativa* (hemp), *Cassia alata and Vernonia amygdalina* (bitter leaf or Ewuro). All of these were effective inhibitors of egg-hatch of *M.incognita* race 2 at concentration 2.5% w/v (250g/10liters of water) while *Mitracarpum verticillatum* (Irawo ile), *Parkia biglobosa* (Irugba-oso), *Jatropha gossypiifolia*, *Calotropis procera*, *Ficus exasperate* can be classified as a very good inhibitors of hatch *M.incognita* while the least percentage inhibition was obtained from distilled water. All the neem formulation applied protectively did not differ significantly from the control in reducing nematode invasion within roots as shown in Table 11. The roots of plants treated with both concentrations (0.05 and 0.01) of *Azadirachta* contained a significantly low number of J2 compared to those treated with the cake and leaves. The number of J2 in the roots of plant treated with cake and leaves were not significantly different from the control. Meloidogyne spp (Kofoid and white) chit wood, eggs exposed to concentration of root extract of siam weed (chromolaena odorata), neem (Azadirachta indica), castor bean (Ricinus comminus L.) and lemon grass (Cybopogon citatus) 100% concentration of root extract of siam weed and neem exhibiton of egg hatch and larval mortality. While 100% concentration of root extract of castor bean and lemon grass exhibit 93% and 95% inhibition of egg hatch and 62.1% and 75% larval mortality respectively. Egg inhibition and larval mortality decreased with an increase in dilution of all the extracts. Similarly with an increase in exposure time, juvenile was also increased.

At 0.5% the highest percentage of nematode mortality was caused by extract of marigold at 67% followed by pyrethrum at 39% and basil 26%. At 2.5% concentration, the greatest percentage of nematode mortality was achieved by neem (100%) followed by marigold (27%), basil (55%) and china berry 54% concentration, the highest percentage of nemadote mortality (100%) was achieved by neem and marigold, pyrethrum 67% basil 61% and china berry 56% at 5% concentration. It is shown that the inhibition effect of an extract on nematode decreased by increasing extract concentration. The tested plant extracts of basil, marigold, pyrethrum, neem and china berry proved to be effective against *M.incognita.* These results are in agreement with those obtained by Akhtar and Mahmood (1993). The nematicidal effect of the tested extracts may possibly be attributed to their high contents of certain oxygenated compounds which are characterized by their lipophilic properties that enable them to dissolve the cytoplasmic membrane of nematode cells and their functional groups interfering with the enzyme protein structure (Knoblock *et al.*, 1989). The mechanism of plant extracts action may include denaturing and degrading of proteins, inhibition of enzymes and interfering with the electron flow in respiratory chain or with ADP phosphorylation. Eucalyptus spp and its leaves have shown antibiotic activity (Inouye *et. al.*, 2001). Their decoction is used for repelling insects and vermin (Morton, 1981). The use of aqueous and ethanol extracts of different parts viz, leaves, stem, bark and fruit of Eucalyptus reduced the hatching of egg of *M. javanica* to a varying degree and the aqueous leaf extract was found more effective and stopped hatching after 72 hours.

CONCLUSION

It is evident from these review works that organic manure is very effective in suppressing plant- parasitic nematodes and enhanced maximum crop production. It is therefore concluded that farmers should adopt and practice the application of organic materials into the soil on their farms where nematodes have been destructive to crop production since these methods has shown to be easy and economical in controlling plant-parasitic nematodes and enhances maximum crop production, moreover that the use of synthetic nematicides by subsistent farmers is plagued with several limitations such as prohibited cost and lack of expertise in their application.

Table 1: Reaction of Nematode Suppressive Crops to Root-Knot Nematode Species.

		Root-Knot Species		
Suppressive	**Southern**	**Peanut**	**Northern**	**Javanese**
French Marigold				
Tangerine	**	**	**	--
Happy Days	--	--	--	**
Lemondrop	**	--	--	--
French Dwarf Double	--	--	--	--
Crysanthemum				
Escapade	**	--	--	--
Castor Bean				
Bronze King	**	--	--	--
Hale	--	**	--	--
Partridge Pea	--	**	--	--
Crotalaria				
Showly Crotalaria	**	**	--	**
Florida Velvetbean	**	**	--	**
Common Vetch				
Cahaba White	**	**	--	**
Vantage, Nova II	--	**	--	**
Vanguard, Warrior	--	**	--	**
Rapeseed				
Jupiter, Cascade, Elena Indore, Humus, Bridger, Dwarf Essex	**	–	–	**

Source: Edward, 2009. *** indicates a high level of suppression; -- indicates no suppression or on available*

Table 2: Effect of compost on the yield of cowpea cv. Ife Brown infected with nematode pest.

Treatment	ASP	APP	AYP(kg)
Decomposed wild sunflower leaf	15.5a	16.8a	3.0a
Decomposed maize stover	13.9a	14.4b	3.2a
Decomposed cassava peel	15.7a	14.3b	2.95a
Un-decomposed wild sunflower leaf	13.1a	14.0b	2.9a
Un-decomposed maize stover	13.6a	15.5ab	3.00a
Un-decomposed cassava peel	14.7a	15.5ab	2.88a
Control	6.3b	9.2c	1.52b

Means followed by the different letter(s) along the column are not staistically different at 5% probability level.

Source: Olabiyi et al., 2007. *ASP = Avera geseeds per pod; APP = Average pod per plant; AYP = Average yield per plot(kg)*

Table 3: Growth and yield characteristics of African yam bean as affected by root-gall nematode *(M. Incognita)*

OM	DI(%)	S	LAI	GR	NS/S	NL/S	PH	NSBP/S	DWP	1000S	NCSH
NM	62.78	5.00	2.62	154.48	7.70	139.04	198.44	9.00	36.36	136.76	31.07
SD	67.03	5.00	2.90	168.17	7.23	144.30	194.05	8.64	32.14	128.26	36.56
S	44.54	3.01	4.14	244.38	12.18	167.15	232.43	13.42	68.82	155.24	12.04
P	20.15	2.12	7.76	322.12	12.04	231.18	256.48	23.01	55.22	218.00	2.84
FY	22.63	2.43	7.22	312.44	13.24	236.14	261.22	24.61	161.78	226.18	3.01
MG	45.19	4.16	4.14	258.62	10.28	198.24	220.13	10.04	54.06	121.67	21.54
C	44.16	3.12	6.06	301.12	12.44	222.06	240.33	15.10	84.21	164.18	10.18
LSD0.05	4.86	0.52	1.12	20.01	20.01	8.15	12.02	3.18	12.23	18.86	2.07

Source: Agu, 2008. **Key:** ***NM*** *= No manure;* ***SD*** *= Sawdust;* ***S*** *= Swine;* ***P*** *= Poultry;* ***FY*** *= Farmyard;* ***MG*** *= Municipal garbage;* ***C*** *= Compost* ***LSD*** *= Least square difference;* ***OM*** *= Organic Manure 2.5tons/ha;* ***DI*** *= Disease Incidence (%) ;* ***S*** *= Severity (1-5 scale);* ***LAI*** *= Leave area Index;* ***GR*** *= Growth rate (cm2/day);* ***NS/S*** *= Number Shoots/stand;* ***NL/S*** *= Number leaves/stand;* ***PH*** *= Plant height (cm);* ***NSBP/S*** *= Number of seed bearing pods/stand;* ***DWP*** *= Dry weight of Pods (gm);* ***1000S*** *= 1000 seeds (gm);* ***NCSH*** *= Nematode counts/200cc of soil at harvest*

Table 4: Effect of sawdust and yard waste on initial and final nematode population recovered from 100cm^3 of soil

Treatment	IP (per 1oocm3)	FP (per 100cm3)
Incorperated sawdust	182.66	111.33
mulched sawdust	173	161.66
Incoeperated yard waste	166	149.66
Mulched yard waste	179.66	169.66
Control	170.66	211.33
SE (-+)		13.01
LSD (0.05)		30.1

Source: Cherif, 1998. *Initial population (IP); Final population FP*

Table 5: Effect of degradation of neem leaves on initial and final population of root-knot nematode recovered from 100cm^3 of soil.

Treatment		IP (per 100cm^3)	FP(per 100cm^3)
T1		2127.8	133.3
T2		2113.3	126.7
T3		203.3	113.3
T4		1336.7	104.0
T5		112.0	57.7
SE	-+	-	1.73
LSD	(P< 0.05)		

Source: Gambo, 1998.

Table 6: Approximate percentage of organic carbon, ammonoium (nitrogen form), potassium, phosphorus, carbon/nitrogen ratio of organic manures (dry weight basis)

Constituent	Sawdust (%)	Poultry (%)	Farmyard (%)	Municipal (%)	compost (%)	Swine (%)
Organic carban	60.0	20.0	50.0	40.0	40.0	45.0
Ammonium (N)	0.1	6.5	4.0	0.5	1.3	1.5
C:N ratio(C/N)	600:1	4:1	12:1	80:1	30:1	30:1
Potassium (K)	5.0	1.0	2.0	4.0	3.0	2.0
Phosphorus (p)	2.0	1.0	1.5	2.0	3.5	1.0

Source: Agu, 2008.

Table 7: Effect of farm yard manure on the population of root knot nematode recovered from 5g root

Treatment	Root - knot per 5g of root
Cow dung 7t/ha	64.0
Cow dung 5t/ha	146.7
Sheep manure 7t/ha	94.7
Sheep manure 5t/ha	125.0
Control	270.0
SE (-+)	16.67
LSD (P<0.06)	38.44

Source: Pindar, 1999.

Table 8: Effects of neem leaves on yield of okra infected by nematode

Treatment	Fresh fruit yield (ton/ha)
T1 (Neem leaves at 2.0t/ha)	0.16
T2 (Neem leaves at 2.5t/ha)	0.20
T3 (Neem leaves at 3.0t/ha)	0.23
T4 (Neem leaves at 3.5t/ha)	0.27
T5 (Neem leaves at 0t/ha)	0.8
SE ±	0.02
LSD (P< 0.05)	45.12

Source: Galadima, 2004.

Table 9: Effects of degradation of neem leaves on yield of tomato infected by nematode

Treatment	Fresh fruit yield (ton/ha)
(Neem leaves at 2.0t/ha)	2.09
(Neem leaves at 2.5t/ha)	1.83
(Neem leaves at 3.0t/ha)	1.59
(Neem leaves at 3.5t/ha)	1.23
(Neem leaves at 0t/ha)	1.01
SE ±	0.11
LSD (P< 0.05)	0.19

Source: Sale, 2004. Values are means of three replicate

Table 10: Percentage inhibition of egg hatch of Meloidogyne spp by leaf extract of some plants

Plant species	common name	hatching concentration	% inhibition
Azadirachta indica	neem	2.5%W/V (250g/10L)	93.30
Cannabis sativa	hemp	2.5%W/V (250g/10L)	88.25
Calatropis procera	apple of Sodom	2.5%W/V (250g/10L)	67.13
Carica papaya	pawpaw	2.5%W/V (250g/10L)	89.90
Cassia alata	candle bush	2.5%W/V (250g/10L)	85.50
Chromolaena odorata	siam weed	2.5%W/V (250g/10L)	91.50
Jatropha gossypiifolia	jatropha	2.5%W/V (250g/10L)	68.50
Ficus exasperate	sand paper fig	2.5%W/V (250g/10L)	60.50
Mitracarpum verticillanum	tropical girdle pot	2.5%W/V (250g/10L)	77.85
Nicotiana tabacum	tobacco	2.5%W/V (250g/10L)	90.50
Ocinum gratissimum	African basil	2.5%W/V (250g/10L)	75.83
Parkia bigblobosa	Africa locust bean	2.5%W/V (250g/10L)	70.25
Venonia amygdalina	Bitter leaf	2.5%W/V (250g/10L)	82.50
Distilled water		2.5%W/V (250g/10L)	55.80

Source: Ayodele (2011)

Table 11: Invasion and development of Meloidogyne javanica in root of tomato treated protectively with neem formulations.

Neem Formulation	G per 100kg of soil	J2 per root	Egg mass per root	Eggs per egg mass
Cake	3.0	126	53	683
Leaves	3.0	130	112	663
Aza	0.05	85	118	784
Aza	0.1	68	88	494
Control	98	196	821	
SED	164	15.2	138	
Probability	<-0.01	-<0.01	-<0.05	

Source: Javed et. al., 2007

Table 12: Effect of concentration of plant root extracts on egg hatch, and exposure time on larval mortality on Meloidogyne spp

Plant	Concentration (%)y	No of egg Egg y	Egg hatch hatching inhibition after 7 days	larval mortality(% after 12h	24hy	48y
C. odorata	100	27.5a	100.0a	100.0a	100.0a	100.0a
	20	20.3b	92.5b	91.0b	98.8a	97.0a
	10	20.0b	72.8c	14.6c	35.9b	56.7b
	5	17.2c	72.6c	5.0d	7.8c	15.9c
	0	22.7b	19.2d	0.0e	2.5d	2.5d
A.indica	100	22.20a	100.0a	100.0a	100.0a	100.0a
	20	18.8a	88.7b	81.0b	89.0b	90.0b
	10	15.5b	67.8c	12.3c	27.9c	45.9c
	5	14.5b	66.8c	1.7d	6.8d	14.6d
	0	14.2b	16.3d	0.0d	0.0e	0.0e
R.communis	100	18.9a	94.2a	62.1a	68.3a	75.6a
	20	21.7a	76.9b	21.1b	27.9b	38.9b
	10	21.6a	58.5c	14.2c	23.6c	26.8c
	5	20.6a	44.7b	6.7d	9.0d	12.3d
	0	14.1b	14.1a	0.0e	1.7e	1.7e
C.citatrus	100	24.4a	96.2a	75.0a	77.6a	87.5a
	20	17.8b	76.1b	17.1b	26.8b	50.0b
	10	12.5c	65.7c	14.1c	13.5c	24.7c
	5	12.8c	52.8d	3.3d	6.7d	13.5d
	0	22.1a	14.8e	0.0d	0.0e	0.0e

Source: Ranjitsingh and Sucheta, 2009

Table 13: Effect of certain concentration of some plant extracts on Meloidogyne spp

	Nematode mortality (%) Tested concentration		
Treatment	0.5%	2.5%	5%
Basil	26	55	61
Marigold	67	72	100
Pyrethrum	39	48	67
China berry	20	54	56
Neem	16	100	100

Source: Susan and Noweer (2005)

Table 14: Effect of different parts of aqueous extract of Eucalyptus on hatching and mortality of *Meloidogyne javanica*

Treatment	0Hrs	24Hrs	48Hrs	72Hrs
		Hatching %		
Control	21	19	38	38
Leaves	21	24	5	0
Stem	18	28	17	11
Bark	14	50	14	14
Fruit	19	37	16	5
LSD (0.05)	-	-	-	3.297
		Mortality %		
Control	23	4	4	13
Leaves	15	7 1	4	33
Stem	8	13	24	25
Bark	15	7	13	40
Fruit	10	10	20	40
LSD (0.05)	-	-	-	9.566

Source: Shahnaz et al. (2007)

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