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Effect of Latex Seed Dressing with Organic Amendments on the Management of Soil Nematodes

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ABSTRACT
Seed dressing with latex of *Calotropis procera* with oil seed cakes of neem/margosa (*Azadirachta indica*), castor (*Ricinum communis*), mustard (*Brassica compestris*), rocket salad/duan (*Eruca sativa*) were found to be highly effective in reducing the multiplication of nematodes and eventually increased growth and bulk density of woody stem of pigeonpea. The multiplication rate of nematodes was less in presence latex seed dressing. Damage caused by the nematodes was further reduced when seed dressing was along with oil-cakes.

Introduction

The importance of grain legumes (pulses) in world farming systems as well as in human nutrition, has been emphasized in recent years. However, production of many grain legumes is insufficient relative to the needs of human nutrition, particularly in the developing countries where the 'green revolution' has occurred only in case of cereals. Pigeonpea (*Cajanus cajan*) is an important and widely grown pulse crop in India. The area and production of pigeonpea in India are 5583059 hectares and 4290000 tonnes, respectively (FAO, 2018). Pigeonpea is not only a source of vegetable protein, but the woody stem residues have great potential as a substitute to the ever-increasing demand for solid fuel. The combustibility or energy output from woody plant wastes of pigeonpea depends on its bulk density (Jain *et al*., 1986).

For centuries the economically important grain legumes crops have been attached by plant parasitic nematodes throughout the world. This is more so in tropical and subtropical regions. Sasser and Freckman (1987) have recently reported crop losses due to plant-parasitic nematodes on world-wide basis which exceed $100 billion per annum. This figure may increase further as information is yet to come from many developing countries. Crop losses range from slight to less than 1%, to total destruction. The intensity of crop losses depends upon many factors such as population density of the nematode(s), susceptibility of the crop, ecological conditions, soil type and presence of other organisms with which the nematode(s) may interact. Sasser (1989) calculated an average annual loss of about 10% if all crops are considered, while among leguminous crops the losses were 13.7, 10.9, 12.0, 13.2, 10.6 and 15.1% in chickpea, field bean, peanut, pigeonpea, soybean and cowpea, respectively on worldwide basis. Therefore, it is important to check these economic losses by way of adopting suitable nematode control measures.

Materials and Methods

The experimental field was thoroughly ploughed and small beds measuring 2 m^2 prepared, leaving a 0.5 m wide buffer zone between them. The beds were treated with oil-seed cakes namely castor (*Ricinus communis* L.), neem (*Azadirachta indica* A. Juss.), mustard (*Brassica compestris* L.), duan (*Eruca sativa* Mill.) and groundnut (*Arachis hypogaea* L.) @ 110 kg N/ha. Untreated beds served as control. Each treatment was replicated five times which were arranged in a randomized manner. Immediately after treating the soil, the beds were watered and after I week seeds of pigeonpea cv Prabhat line were sown. The experiment was terminated 100 days after seed germination. Nematode population in each bed was determined before treating the soil as well as after terminating the experiment by processing of the representative soil sub-samples with Cobb's sieving and decanting and Bearmann's funnel techniques (Southey, 1986).

Another experiment on above lines was also established in presence of latex seed dressing latex collected from madar plant (*Calotropis procera*) to give a uniform and smooth coating over the seed. The treated seeds were then spread in an enamel tray and allowed to dry in the shade before sowing. The experiments were terminated 3 months after germination. Plants were uprooted and the roots were thoroughly washed with running tap water.

Plant growth characteristics (length, fresh/dry weights of plants and number of pods per plant) and number of root galls per plant were noted. The chlorophyll content of leaves was determined by the method described by Hiscox and lsraelstam (1979). The bulk density of dried stems was calculated by dividing the weight (g) by the instantaneous volume (cm^3) (Jain *et al*., 1986). Statistical analysis of the data for critical difference (C.D.) at P = 0.05 and P = 0.01 levels was done as per procedure described by Pansey and Sukhatme (1978).

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Table 1. Effect of oil-seed cakes in presence and absence of latex seed dressing on growth parameters of pigeonpea (*Cajanus cajan*) cv. Prabhat line in the field (mean of five replicates).

Treatment	*Length (cm)*		*Fresh weight (g)*		*Dry weight (g)*		*Bulk density*		*No. of Pods Plant*	*Chlorophyll content*			*No. of root galls/ plant*
	Shoot + Root	**% Improvement**	**Shoot + Root**	**% Improvement**	**Shoot + Root**	**% Improvement**	**(g/cm^3)**	**Improvement**		**Ch. a**	**Chl. b**	**Total (mg/g)**	
In the absence of latex seed dressing													
Untreated	122.5	-	40.5	-	15.0	-	0.28	-	15.5	1.43	1.09	2.52	115.5
Neem cake	160.5	31.02	69.0	70.37	24.0	60.00	0.32	12.50	28.2	1.78	1.48	3.26	40.0
Castor cake	140.1	14.36	58.0	43.20	21.0	40.00	0.31	10.71	23.3	1.69	1.40	3.09	55.2
Mustard cake	130.2	6.28	52.5	29.62	20.5	36.66	0.31	10.71	22.6	1.56	1.43	2.99	58.0
Duan cake	130.0	6.12	50.0	23.45	19.0	26.66	0.30	6.66	20.4	1.55	1.47	3.02	65.0
Groundnut cake	149.8	22.28	66.1	63.20	22.6	50.66	0.30	12.52	25.5	1.66	1.45	3.11	53.0
CD. (P = 0.05)	6.15		6.04		3.00		0.02		3.21				
CD. (P = 0.01)	8.39		8.25		4.09		0.03		4.38				
In the presence of latex seed dressing													
Untreated	130.0	-	44.0	-	16.0	-	0.28	-	20.8	1.65	1.28	2.93	71.0
Neem cake	180.0	38.46	79.6	80.90	26.8	67.50	0.34	21.42	39.0	1.99	1.68	3.67	32.5
Castor cake	151.2	16.3	65.5	48.86	23.6	47.50	0.33	17.85	26.0	1.89	1.61	3.50	49.5
Mustard cake	142.6	9.69	60.0	36.36	22.9	43.12	0.32	14.28	28.0	1.76	1.63	3.39	52.8
Duan cake	141.0	8.46	59.0	34.09	21.4	33.75	0.31	10.71	29.1	1.75	1.68	3.43	56.2
Groundnut cake	163.0	25.38	75.3	71.13	25.5	59.37	0.33	17.85	31.2	1.90	1.56	3.46	45.5
CD. (P = 0.05)	6.52		6.09		3.21		0.02		3.23				
CD. (P = 0.01)	8.90		8.30		4.38		0.03		4.40				

Table 2. Effect of oil-seed cakes in presence and absence of latex seed dressing on the population of plant parasitic nematodes associated with pigeonpea (*Cajanus cajan*) cv. Prabhat line in the field (mean of five replicates).

Treatment	Population of plant-parasitic nematodes per 200 g soil										
	Hop	**Hel**	**Rot**	**Try**	**Tyl**	**Mel**	**Dor**	**Hem**	**Pra**	**Others**	**Total**
In the absence of latex seed dressing											
Untreated	130	132	570	180	140	1505	140	60	30	25	2782
Neem cake	25	36	116	50	20	279	49	20	-	06	601
Castor cake	30	41	131	57	26	375	43	21	06	09	739
Mustard cake	29	38	144	51	31	410	50	25	12	11	801
Duan cake	28	48	131	62	33	412	58	30	15	17	833
Groundnut cake	26	36	130	45	30	360	50	25	12	09	723
Initial population	57	72	330	115	55	570	95	40	13	15	1362
In the presence of latex seed dressing											
Untreated	95	101	405	101	95	885	75	40	15	20	1832
Neem cake	15	25	80	35	10	108	20	08	-	-	301
Castor cake	20	30	92	42	20	201	35	10	04	-	454
Mustard cake	21	31	100	38	25	300	36	15	06	06	578
Duan cake	15	35	105	50	23	310	46	20	10	08	622
Groundnut cake	10	25	98	36	20	110	35	15	09	-	358
Initial population	57	72	330	115	55	570	95	40	13	15	1362

Hop = Hoplolaimus indicus, Hel = Helicotylenchus indicus, Rot = Rotylenchulus reniformis, Try = Tylenchorhynchus brassicae, Tyl = Tylenchus filiformis, Mel = Meloidogyne incognita, Hem = Hemicriconemoides mangiferae, Pra = Pratylenchus coffeae, Dor = Dorylaims, viz., Longidorus elongates, Xiphinema basiri and Trichodorus mirzai..

Results and Discussion

These studies deal with comparative efficacy of oil seed cakes against plant-parasitic nematodes infecting pigeonpea (*Cajanus cajan* (L.) Millsp.) in presence/absence of seed dressing in the field. As a result of application of oil-seed cakes plant growth significantly improved by way of reduction in the population of nematodes (Tables 1 and 2). Among the oil seed cakes, neem cake proved to be most beneficial followed in order of efficiency by groundnut, castor, mustard and duan cakes (Table 1).

The oil seed cakes, namely neem, castor, mustard, duan and groundnut has caused significant reduction in the population of plant parasitic nematodes (Table 2). The root galling due to *Meloidogyne incognita* was also reduced due to these treatments. These results are in agreement with those of Duhalongsod, 1988; Pandey and Singh, 1990; Gul *et al*., 1990; Dwivedi and Pandey, 1992; Mishra and Pramila, 1997; Anver and Alam, 1999; Anver 2003, Mahalik and Sahoo, 2019; Yadav and Kanwar, 2019.

Various theories have been put forward to explain the mode of action of organic amendments against plant parasitic nematodes. These include: Organic amendments cause changes in the physical and chemical properties of soil which are inimical to nematodes (Ahmad *et al*., 1972). Nematicidal/nematostatic substances such as nimbidin, thionimon and azadirechtin from neem, present in the amendments, are released after dissolution in water, or in other words the organic matter itself is toxic to nematodes (Alam *et al*., 1978; Siddiqui and Alam, 1990). Predacious and parasitic activity of soil microorganisms is enhanced by incorporating the organic matter to the soil (Linford, 1937; Mankau, 1962). Several substances, e.g. ammonia, H_2S, formaldehyde, fatty acids, amino acids, phenols etc., released during decomposition of organic matter arc toxic to many plant parasitic nematodes (Rodriguez-Kabana *et al*., 1965; Alam *et al*., 1978). Metabolites of microbes, which are activated by organic amendments, are toxic to plant-parasitic nematodes (Alam *et al*., 1973; Pandey and Singh, 1990). Vander Laan (1956) had postulated that organic additives induce some sort of resistance in plants against plant-parasitic nematodes. As a result of the application of organic amendments, plant nutrients are released which accelerate root development and overall plant growth and thus helping the plants to escape nematode attack.

Thus it appears that improvement in plant growth of pigeonpea in amended soil was due to reduction in population of plant-parasitic nematodes and also due to their manurial effect (oil-seed cakes contain about 5% N). Increased microbial activity in amended soil is known to bring about unceased conversion of nitrogen to nitrate form. The application of oil-seed cakes provide more and more inducing substrate (nitrate) for the enzyme (nitrate reductase) to accelerate its activity, which results ultimately in increased metabolic activity of plant and then plant growth.

The oil-seed cakes have improved in bulk density by way of nematode control. Additionally, the manorial value of oil-seed cakes might have contributed towards improved bulk density of pigeonpea stem. Thus the improvement in the bulk density would be an additional benefit by way of effective control of nematodes.

Seed dressing with the latex of *Calotropis procera* brought about a significant reduction in the multiplication of the nematodes with a corresponding increase in the plant growth. However, the damage cause by the nematodes was not fully prevented by the latex seed coating. This was evident from the fact that the nematode multiplication was not completely checked. Our results are similar to those of Siddiqui and Alam (1988a,b,c,) who reported poor multiplication of *M. incognita* and *R. reniformis* on tomato, eggplant and okra and of *Tylenchorhynchus brassicae* on cabbage and cauliflower when their seeds were coated with plant lattices.

The effect of plant latex may be due to direct nematode toxicity of the coating rendering an unfavourable environment around the growing points of the plant or acquiring some resistance/tolerance against the nematodes by the emerging roots.

Photosynthetic pigments of the test plants also improved due to the better absorption and translocation of plant nutrients in seed treated plants. All these factors must have contributed towards an overall improvement found in different growth parameters including the bulk density of pigeonpea stem. These findings will help pigeonpea farmers to improve, through cheap and simple nematode control, their crops whose stems provide solid fuel which is an important energy source particularly for the rural sector in the developing countries (Anver & Alam 1989).

The study demonstrates the great potential of oil seed cake and plant lattices as seed dressing materials for the control of plant-parasitic nematodes. This is understandable since oil seed cake and plant lattices are comprised of a pool of biologically active principles which need to be further researched for better utilization. This would provide a safer control of nematodes free from pollution hazards.

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