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INTEGRATED CONTROL OF PLANT-PARASITIC NEMATODES ON POTATO WITH ORGANIC AMENDMENTS, NEMATICIDE AND MIXED CROPPING WITH MUSTARD

by
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Summary. Increase in the population of plant-parasitic nematodes on potato (*Solanum tuberosum*) was significantly arrested when mustard (*Brassica juncea*) was also grown alongwith potato in alternate rows. There was further suppression in the population of parasitic nematodes when soil was also treated with oil-seed cakes and leaves of neem (*Azadirachta indica*) and castor (*Ricinus communis*) and a nematicide, carbofuran. As a consequence of reduction in nematode population there was an increase in the yield of potato. The beneficial effects of all the above treatments persisted in the next growing season when okra (*Abelmoschus esculentus*) was grown.

Incorporation of organic matter into the soil has been practiced by farmers for many years. Similarly, intercropping of mustard with wheat, barley and many vegetables has also been very common. Both these practices are aimed at increasing crop production. The present study was undertaken to investigate whether such practices have any relevance to integrated nematode management.

Materials and methods

A field with a high population of plant-parasitic nematodes (Table I) was thoroughly ploughed and divided into beds measuring 10 m^2. These were separately treated with carbofuran at 5 kg a.i./ha, oil-cakes, chopped fresh leaves of neem or castor at 110 Kg N/ha and inorganic fertilizers-urea at 110 Kg N/ha, superphosphate and murate of potash at 55 Kg P-K/ha. The beds receiving the nematicide were also given fertilizers at the same rate. Untreated beds served as control. There were three replicates of each treatment. The beds were watered to facilitate decomposition of the organic matter. Potato (*Solanum tuberosum* L.) cv. 'Kufri-Chandramukhi' and/or mustard [*Brassica juncea* (L.) Czern. *et* Coss.] were sown in alternate rows. Nematode populations before treating the soil as well as after termination of the experiment were determined by processing representative soil samples of each bed by Cobb's sieving and decanting, and Baermann funnel techniques (Southey, 1986). Yields of potato and mustard were recorded. After harvesting the crop, the plots were again prepared with the same layout and okra cv. 'Pusa Sawani' was sown without providing additional fertilizers. After three months nematode populations from each bed and plant growth of okra were determined to assess the residual effect of the treatments of the preceding crop.

Results and discussion

Population of all plant-parasitic nematodes, predominently *Meloidogyne incognita* (Kofoid *et* White) Chitw., increased in untreated potato beds, whereas there was a general decline in numbers of plant-parasitic nematodes when mustard was grown. The interculture of potato with mustard caused either a decrease or a marginal increase in the population densities of most of the nematode species (Table I).

Application of cakes and leaves of neem and castor, and carbofuran led to a significant decrease in the population build-up of plant-parasitic nematodes. The effect was more or less the same in all these treatments. Inorganic fertilizers also caused reduction in nematode densities but the reduction was not as pronounced as in the case of other treatments (Table I).

Integration of different soil treatments and intercropping was found highly beneficial for reducing nematode populations. The efficacy of different combinations was more than that achieved by either of the treatments (Table I).

As a consequence of reduction in nematode population there was an increase in the yield of potato or mustard when grown alone (Table I). However, there was marginal decrease in the yield of both the crops when grown to-

TABLE I - *Effect of oilcakes and leaves of neem and castor, and a nematicide on the population of plant-parasitic nematodes and yield of potato and mustard.*

Crop	Treatment	Nematode population/250 g soil								Crop yield (tonnes/ha)		
		Hop	Hel	Tyl	Trh	Rot	Mel	Lon	Total	Potato		Increase over control %
Potato	*Initial popolation*	300	270	180	307	295	630	260	2242			
	Untreated	355	318	209	419	371	992	332	2996	10.9	–	
	Inorg. fert.	212	185	175	330	142	467	190	1701	14.4	32.1	
	Neem cake	172	142	151	215	110	216	065	1071	19.8	81.7	
	Castor cake	195	171	144	218	117	224	87	1156	19.1	75.2	
	Neem leaf	250	149	142	223	133	241	92	1230	17.2	57.8	
	Castor leaf	262	185	172	240	152	249	138	1398	15.7	44.0	
	Carbofuran	182	144	143	190	135	213	70	1037	15.1	38.5	
	C.D. ($P = 0.05$)								14.43	0.82		
	($P = 0.01$)								20.22	1.15		
Potato + Mustard	Untreated	277	242	140	349	270	497	242	2017	9.5	–	0.39 –
	Inorg. fert.	219	212	138	342	195	417	138	1661	13.7	44.2	0.40 2.6
	Neem cake	165	137	112	162	95	192	42	905	19.3	103.2	0.61 56.4
	Castor cake	182	137	139	190	101	205	77	1031	18.7	96.8	0.59 52.3
	Neem leaf	192	147	130	215	128	225	57	1094	16.7	75.8	0.49 25.6
	Castor leaf	210	168	141	210	110	238	85	1162	15.0	57.9	0.47 20.5
	Carbofuran	170	110	117	142	90	201	65	895	14.3	50.5	0.40 3.1
	C.D. ($P = 0.05$)								17.92	0.92		0.08
	($P = 0.01$)								25.12	1.28		0.11
Mustard	Untreated	197	175	101	285	205	407	141	1511			0.41 –
	Inorg. fert.	168	184	132	215	182	312	111	1304			0.51 24.9
	Neem cake	162	137	102	103	80	70	35	789			0.95 131.7
	Castor cake	152	160	130	164	92	122	67	887			0.88 113.4
	Neem leaf	170	129	125	185	112	140	48	909			0.71 73.7
	Castor leaf	163	116	128	196	102	177	65	947			0.68 58.5
	Carbofuran	150	82	98	110	62	138	47	687			0.60 46.3
	C.D. ($P = 0.05$)								22.22			0.08
	($P = 0.01$)								31.66			0.12

Hop = *Hoplolaimus indicus* Sher, Hel = *Helicotylenchus indicus* Siddiqi, Tyl = *Tylenchus filiformis*Butschli, Trh = *Tylenchorhynchus brassicae* Siddiqi, Rot = *Rotylenchulus reniformis* Linford *et* Oliveira, Mel = *Meloidogyne incognita* (Kofoid *et* White) Chitwood, Lon = *Longidorus elongatus* (de Man) Thorne *et* Swanger.

gether. This is understandable since both of them shared nutrition and space in the same bed. These results are in agreement with those of Alam *et al.* (1976) who observed that in their experiment reduction in nematode numbers was due to root exudates from *Brassica campestris*.

In the following growing season when okra was grown in the same beds without further treatment, there was an increase in nematode populations in those beds which had received no treatment or inorganic fertilizers for the preceding crop. However, the populations of other treated beds was more or less the same as initial population of the preceding crops. Neem cake proved to be the most effective in reducing the nematode populations as a result of its residual effect in the subsequent okra crop (Table II). These results confirm the earlier findings reported by Singh and Sitaramaiah (1966).

Plant weight and length of okra was higher in beds having mustard in the preceding season followed by beds having potato along with mustard, and potato alone in that order. There was further improvement in these parameters when the oil-seed cakes or carbofuran were given to the beds for the preceding crops, highest being in case of neem cake (Table II).

These findings indicate that the combinations of intercropping with organic amendments in integrated method have given better control than either method alone.

TABLE II - *Residual effect of oilcakes and leaves of neem and castor and a nematicide on the population of plant-parasitic nematodes and plant growth of okra.*

Preceding Crop	Treatment	Nematode population/250 g soil							Plant weight (g)			Plant length (cm)		
		Hop	Hel	Tyl	Trh	Rot	Mel	Lon	Total	Shoot	Root	Total	Shoot	Root	Total
Potato	Untreated	412	428	228	540	940	2040	335	4923	24.3	12.5	36.8	41.5	19.1	60.6
	Inorg. fert.	313	249	177	330	627	848	285	2829	28.5	14.3	42.8	44.4	22.3	66.7
	Neem cake	240	182	95	231	428	617	185	1978	51.7	20.8	72.5	65.7	19.4	85.1
	Castor cake	278	225	122	275	340	712	210	2162	48.4	17.3	65.7	63.2	18.1	81.3
	Neem leaf	269	244	135	310	358	784	218	2318	44.3	16.3	60.6	60.3	20.4	80.7
	Castor leaf	285	259	144	381	405	790	228	2492	39.2	15.8	55.0	58.1	21.3	79.4
	Carbofuran	244	180	90	240	410	615	257	2036	32.3	13.9	46.2	64.7	23.4	88.1
	C.D. ($P = 0.05$)								39.85			5.88			10.74
	($P = 0.01$)								55.87			8.24			15.06
Potato + Mustard	Untreated	353	387	212	449	840	1730	312	4283	25.8	13.2	39.0	42.4	20.2	62.6
	Inorg. fert.	287	244	185	310	550	743	235	2554	30.2	15.4	45.6	45.7	23.1	68.8
	Neem cake	214	132	80	217	345	543	170	1701	52.5	22.4	74.9	68.8	31.0	91.8
	Castor cake	245	210	109	234	292	669	188	1947	49.4	18.2	67.6	64.3	21.4	85.7
	Neem leaf	280	230	120	281	317	690	204	2123	45.7	19.1	64.8	63.4	20.3	83.7
	Castor leaf	289	252	130	287	342	698	138	2136	41.3	16.4	57.7	61.3	21.1	82.4
	Carbofuran	215	140	90	220	310	530	182	1687	34.6	15.3	49.9	63.4	23.1	86.5
	C.D. ($P = 0.05$)								43.58			5.64			11.23
	($P = 0.01$)								61.10			7.91			15.74
Mustard	Untreated	315	314	228	440	802	1460	277	3836	33.2	11.6	44.8	48.3	21.3	69.6
	Inorg. fert.	302	295	222	390	783	933	260	3185	27.4	12.5	39.9	51.4	23.1	74.5
	Neem cake	195	130	87	190	314	510	158	1584	55.1	21.3	76.4	70.4	24.2	94.6
	Castor cake	231	202	100	205	240	630	180	1788	52.2	18.6	70.8	68.5	25.4	93.9
	Neem leaf	255	224	101	212	300	651	190	1933	48.5	15.8	64.3	65.3	24.3	89.6
	Castor leaf	282	217	119	224	295	587	114	1838	44.5	16.1	60.6	60.4	23.4	82.8
	Carbofuran	210	133	85	205	289	481	130	1533	38.7	12.2	50.9	66.2	24.1	90.3
	C.D. ($P = 0.05$)								39.50			8.57			12.33
	($P = 0.01$)								55.40			12.02			17.30

Hop = *Hoplolaimus indicus*, Hel = *Helicotylenchus indicus* , Tyl = *Tylenchus filiformis*, Trh = *Tylenchorhynchus brassicae*, Rot = *Rotylenchulus reniformis*, Mel = *Meloidogyne incognita*, Lon = *Longidorus elongatus*.

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