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Research Article

Evaluation of Some Nematicides for the Control of Meloidogyne Incognita on Okra

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ABSTRACT

In the present investigation an experiment dealing with chemical control has been performed using three nematicides, (a) Foratox – 10 G in 0.5, 0.7, 0.9 kg per acre a.i.; (b) Rugby – 10 G in three doses 0. 3, 0.5, 0.7 kg per acre a.i.; and (c) Diafuran-3 G in doses 0.6, 0.9 and 1.2 kg per acre a.i. In general, Rugby 10 G with all it's doses brought down nematode infection. Higher doses of Diafuran (40 kg / acre) and Foratox (9 kg /acre) also exhibited better growth in host and nematode infestation was reduced to considerable degree.

Key Words: Nematode, Chemical Control, Nematicides, Crop

INTRODUCTION

Nematicides by definition are chemicals that are toxic to nematodes. Death results from contact with a lethal dose or concentration of the nematicide. The primary advantage of chemical control over that of other methods was that the nematode population was reduced to a very low density within a matter of days after the chemical was applied enabling the grower to plant a crop soon after treatment or in some cases at the time of treatment. In case of annuals, the crop was mature before the residual population of nematode had increased to a level which would damage the crop. In addition to nematodes, fungi, bacteria and weeds are also controlled resulting in increased production. Chemical control also results in more efficient use of moisture and mineral elements in the soil, resulting in increased stands and a more uniform growth of the crop.

A desirable nematicide possessed a high rate of nematode killing in a short period of time, a low phytotoxicity and a little or no plant absorbed residue that would lead to toxicity in case of food crops. On the other hand, a long residual activity in the soil would be beneficial for the subsequent crop planted in the same field. A knowledge of nematode present and the level of infestation in the soil was an important prerequisite against the needless treatment with nematicides.

For the first time, Kuhn (1881) applied carbon disulphide to control the sugarbeet nematode, *Heterodera schachtii* in Germany. Bessey (1911) reported CS_2 to be most effective against root-knot nematodes in field on small scale trails at Rothamsted Experiment Station, Mathews (1919) observed the effectiveness of chloropicrin against root-knot nematodes. Johnson and Godfrey (1932) extended the work of Mathews in California and then in Hawaii and achieved good control of root-knot nematodes attacking vegetables.

The use of methyl bromide for nematode control as a soil fumigant was suggested long back (Christie and Cobb, 1940). With the use of methyl bromide in field as well as under green house conditions Taylor (1943) found good control of root-knot nematodes.

Among the systemic nematicides, Temik in all application and Nemaphos as side drenching exhibited a fairly high nematicidal effect against *Meloidogyne* spp. (Dl-Muro, 1970). Sivakumar *et al.*, (1973) showed that while seed treatment with carbofuran may not give absolute protection against the root-knot nematode, it can be effectively employed to reduce the severity of infestation in *Abelmoschus esculentus*.

Number of nematicides were screened by Dickson (1977) for the control of various nematodes on apple, sugarbeet, *Poa pratensis*, cabbage, celery, okra, peach, potato, strawberry, sweet potato and tobacco. Of the 27 tests reported 23 were carried out in U.S.A., 2 in India and one each in Italy and Ecuador. However, Sivakumar *et al.*, (1976) revealed the persistence of nematicidal activity in seed treatment of okra with carbofuran and aldicarb sulphone.

Efficacy of temik for the control of root-knot and wilt disease of *Abelmoschus esculentus* was studied by Sharma and Midha (1977). Though, Sitaramaiah and Vishwakarma (1978) reported the relative efficacy of selected non-volatile nematicides viz; fensulfothion, carbofuran, mocap, phorate and aldicarb at different

doses in field for control of *Meloidogyne incognita* and *M. javanica* on okra and tomato.

Mahajan (1978) and Jain (1990) reported the efficacy of carbofuran for the control of *M. incognita* and *M. javanica* respectively on okra. Evaluation of mephosfolan for nematode and insect control in okra, cowpea and tomato was revealed by Prasad *et al.*, (1982). It was reported that fenamiphos significantly suppressed populations of *Paratrichodorus christii* and lessened root-galling caused by *Meloidogyne incognita* in okra and soybean (Rhoades, 1985).

Reddy and Singh (1983) investigated that aldicarb applied at 1 kg a.i./ha significantly reduced the population of *M. incognita* on okra, brinjal, French bean and cowpea. However, Singh *et al.,* (1988) showed an increase in the concentration of P, K, Ca, Zn, Cu, Mn and B, and a slight decrease in Fe and Mg in okra leaves treated with nematicides (Aldicarb and carbofuran at 1 & 2 kg. a.i./ha). Adverse effect of phenamiphos on soil nematodes and resultant increased yield of cowpea, pea and okra was studied by Sethi and Meher (1989).

Kochansky and Feldmesser (1989) revealed the structure – Activity studies on nematicidal activity of Dialkyl carbamates and thiocarbamates. Though effect of carbamate, organophosphate and avermectin nematicides on oxygen consumption by three *Meloidogyne* spp was studied by Nordmeyer and Dickson (1989).

In plant-parastic nematodes, acetylcholinesterase inhibition by crbamate and organophosphate nematicides was reported by Opperman and Chand (1990). Roy *et al.,* (1990) screened nineteen O,O-diaryl O-2 chloroethyl phosphates for toxicity against *M. incognita*. Out of which three phosphates showed good nematicidal activity *in vitro* and further in treated soybean plants.

Trivedi and Tiagi (1983) and Pandey and Trivedi (1990) evaluated some chemicals for the control of *Meloidogyne incognita* on *Capsicum annuum*. However, Prasad *et al.* (1991) revealed the efficacy of monocrotophos36 WSC as spray treatment against plant parasitic nematodes infecting brinjal. Ten pesticidal chemical namely Thiride, Dithane M45, Bavistin, Aldrin 30 E.C., Monocrotophos, Thimet 10 G, Furadan 3 G, Phorate 10 G, Ziram and Satum were tested against *M. incognita* infesting soybean variety T-49. All the chemicals except Bavistin and Ziram were effective in reducing nematode larval population (Mishra & Gupta, 1991).Efficacy of carbofuran in control of root knot nematode was reported by Adegbite and Agbaje (2007) and Myjada *et al.,* (2011) on yam and groundnut respectively.However,Adenkule and Fawole (2003) depicted both chemical and non chemical control of *M.incognita* infecting cowpea under field conditions.

MATERIALS AND METHODS

The present study was undertaken to evaluate the efficacy of three systemic insecticides as nematicides and tried in local soil and atmospheric conditions.

Three chemicals (Table 1) Vegfru Foratox – 10 G (O-O-Diethyl – S (ethylthio) methylphosphorodithioate) an organophosphate granular systemic insecticide, Vegfru Diafuran - 3 G (2,3-dihydro-2-2-dibenzofuran-7-yl-methyl carbamate) as systemic carbamate insecticide and Rugby 10 G, a systemic nematicide were used in the form of granular soil application at the preinoculation stage – Each chemical was used in three doses viz :

1. Vegfru Foratox – 10 G – 5, 7 and 9 kg a.i./acre.
2. Vegfru Diafuran – 3 G – 20, 30 and 40 kg a.i./acre
3. Rugby – 10 G – 3, 5 and 7 kg a.i./acre

The calculated quantity of the granular chemical was mixed with 1 kg of steam sterilized sandy – loam pot soil. Surface sterilized seeds of *Abelmoschus esculentus* L. Moench cv Pusa sawani were sown in 15 cm pots containing chemical mixed autoclaved soil. Seedlings were thinned to one per pot. Three week old seedlings were inoculated with 1000 freshly hatched second stage juveniles per pot in three holes around the root which were then plugged by pot soil. The treatments were replicated four times, untreated pots served as control. The plants were treated weekly with Hoagland's complete nutrient solution. Observations were taken sixty days after inoculation. Various growth parameters viz.: root and shoot length, their fresh and dry weight and fruit weight was measured. Efficacy of chemical was considered to be based on number of galls and eggmasses per plant; eggs per eggmass, final soil population of pathogen and reproduction factor. For counting the final soil population, Cobb's sieving and decanting method, followed by incubation in Baermann's funnel technique was used. Plants were rated for root-knot index on a 0-5 Taylor & Sasser's rating scale as shown in Table 2. Data was subjected to statistical analysis.

RESULTS

The relative efficacy of Vegfru Foratox – 10G, Vegfru Diafuran – 3G and Rugby 10 G, all systemic granular chemicals was determined in the present experimental effort against root-knot nematode in pots. All the three chemicals enhanced plant growth except treatments

Table 1: Nematicides / Insecticides used for the chemical control of root-knot disease in okra

S. No.	Name of Chemical	Trade Name	Manufacturer / Company	Active Ingredient
1.	0-0-Diethyl-S(ethiylthio) methylphosphorodithioate	Vegfru Foratox-10G	Pesticides India	5.7 and 9 kg a.i./acre
2.	2,3-dihydro-2-2-dibenzofuran-7-yl-methyl carbamate	Vegfru Diafuran-3G	Pesticides India	20, 30 and 40 kg a.i./acre
3.	0-ethyl S, S-di-Seobutyl phosporodithioate	Rugby-10 G	Rallis India Limited Agrochemical Research Station	3,5 and 7 kg a.i./acre

with lowest dose (5 kg a.i./acre) of Foratox – 10 G and reduced root galling in okra. Rugby – 10 G was most effective followed by Foratox – 10 G and Diafuran – 3 G.The fruit weight, root-shoot length, fresh and dry weight of okra increased when they were grown in soils treated with the highest dose of all the three chemicals. Shoot and root length was much greater in chemical treated plants in comparison to untreated pots except in plants treated with Vegfru Foratox – 10 G (5 kg a.i./acre). Shoot and root length was maximum in Rugby – 10 G (7 kg a.i./acre) followed by Foratox – 10 G (9 kg a.i./acre) and Diafuran – 3 G (highest dose).

The fresh and dry weight of shoot 42.7 g and 4.1 g respectively was best observed in Rugby – 10 G (highest dose) followed by Foratox – 10G (highest dose) and Rugby – 10G (5 kg a.i./acre). Similar trend of increase fresh and dry weight was observed in root when compared with control (Table 2).

The fruit weight was highest in Rugby – 10 G – 7 kg a.i./acre (16.3 g) followed by Foratox – 10 G – 9 kg a.i./acre (15.1 g); Rugby – 10 G – 5 kg a.i./acre (13.6 g) and Diafuran – 3 G – 40 kg a.i./acre (13.4g). Conclusively we could infer that fresh and dry weight and length of root-shoot and fruit weight in untreated control plants was significantly lower than treated plants except in Vegfru Foratox – 10 G (5 kg a.i./acre) where root length was same as that of untreated control but number of galls were comparatively less than untreated plants. Better growth, enhanced flowering and fruiting was observed in treated plants whereas untreated plants showed less vigour, delay in flowering and fruiting and apparent chlorosis in leaves. Any toxic effect of the chemical was not observed in treated plants.

All the nematicides reduced the number of galls and eggmasses per plant significantly in comparison to untreated control. Multiplication rate of pathogen was lowered although to varying extents by application of these nematicides (Table 2, Fig. 1). There was a linear trend of decrease in number of galls, consequentially R.K.I. (Root-Knot index) too, when a chemical was applied with higher doses expressing inversely proportional behavior of chemical and resultant disease incidence. Similar trend was observed in final soil population of the pathogen. Minimum R.K.I. was observed in plants grown with Rugby – 10 G (7 kg a.i./acre) i.e. 3.23 followed by Vegfru Foratox – 10 G (9 kg a.i./acre) treated plants i.e. 3.61, Diafuran 3 G (highest dose) (4.04) followed by other chemicals and their variable doses.

Final soil population and reproduction factor was very low in treated plants against untreated infected plants. Soil population was minimum in Rugby – 10 G (7 kg a.i./acre) treated plants. However, it ranged from 1059 – 4978.5 in chemical applied soils and 6186.7 in control plants. Reproduction factor too decreased significantly in treated plants as compared to untreated diseased plants. A fewer number and smaller sized eggmasses and eggs per eggmass were found to occur on treated plants and differed significantly from control (Table 2, Fig. 1).

In general all the three chemicals used as nematicides were successful in bringing about better growth, higher vigour and less disease incidence in treated plants as against control plants where no chemical was applied.

DISCUSSION

Preliminary efforts for screening and consequentially systemic reduction in root-knot severity in okra was attempted by Sivakumar *et al.* (1973, 1976);

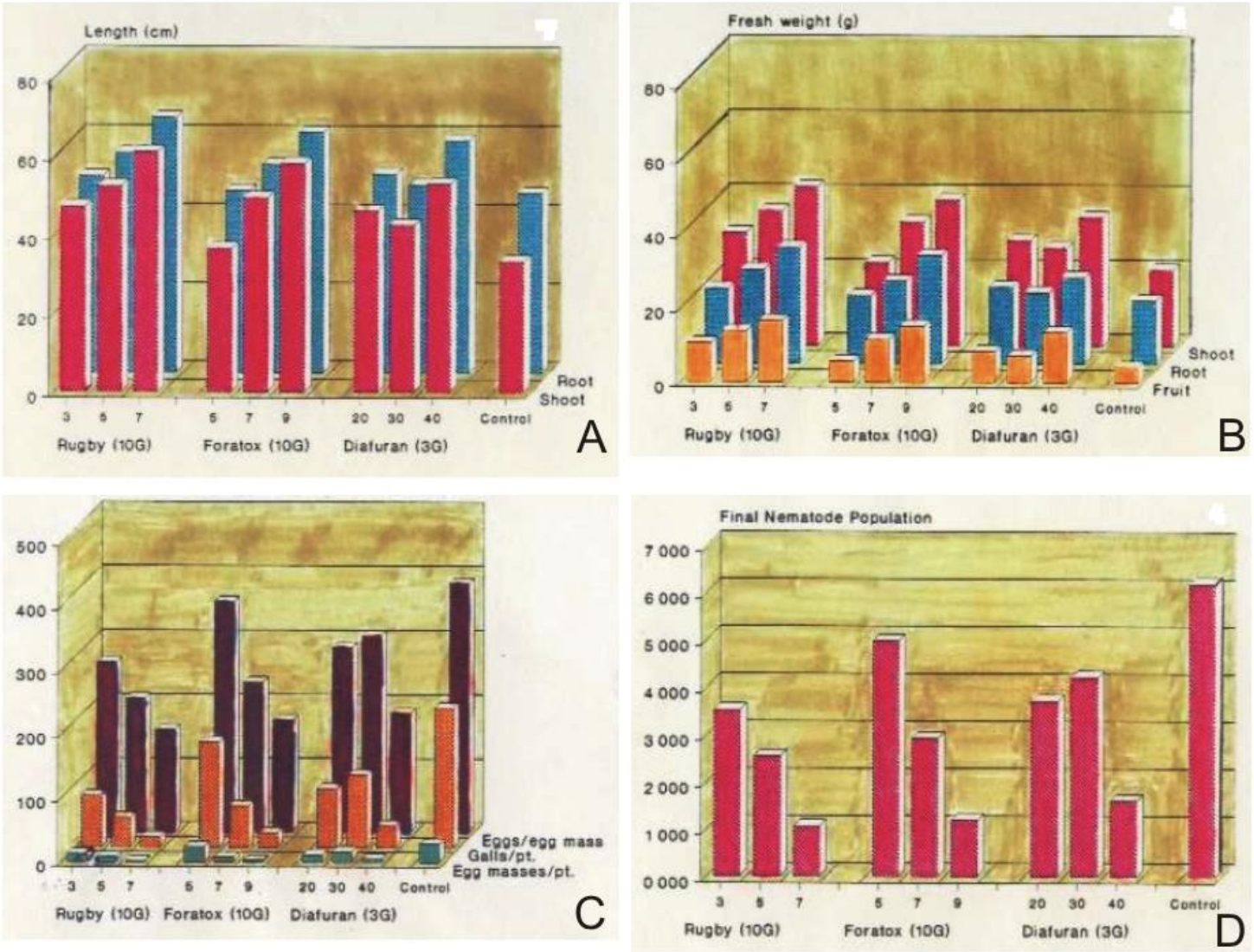

Figure 1 (A-D): Effect of some nematicides on *Meloidogyne incognita* infected *Abelmoschus esculentus*

Table 2: Evaluation of some chemicals for the control of *Meloidogyne incognita* on *Abelmoschus esculentus* (observations are mean of 4 replicates).

S. No.	Chemicals	Dose in kg/ acre a.i.	Length (cm)		Fresh Wt		Dry Wt. (g)		Fruit Wt. (g)	No. of galls per plant	No. of eggm-asses per plant	No. of eggs per egg-mass	R.K.I.	Final Nemat-ode Populati on	Repro-duction factor
			Shoot	Root	Shoot	Root	Shoot	Root							
1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**	**16**
1.	Ruby	3	47.2	50.2	30.3	20.1	2.8	2.2	10.4	80.5	12.7	264.5	4.71	3514.7 (59.28)	3.51
	(10g)	5	52.4	56.1	36.2	25.3	3.6	2.5	13.6	46.5	8.2	209	4.22	2539.7 (50.38)	2.53
		7	61.2	65.1	42.7	31.3	4.1	3.1	16.3	15.5	1.7	160.2	3.23	1059.0 (32.53)	1.05
2.	Foratox	5	36.7	46.5	22.4	18.4	2.2	1.7	5.5	164.2	23.7	360	5.0	4978.5 (70.55)	4.97
	(10g)	7	49.6	53.2	33.4	22.3	3.4	2.1	11.4	63.7	7.7	234.2	4.47	2919.2 (54.02)	2.91
		9	58.3	61.4	39.2	29.2	3.9	2.7	15.1	22.7	2.7	175.5	3.61	1202 (34.66)	1.20
3.	Diafuran	20	46.2	50.9	28.4	20.7	2.5	1.9	8.3	92.2	11.2	288.5	4.88	3708.2 (60.89)	3.70
	(3g)	30	42.6	48.1	26.3	19.2	1.8	1.7	7.1	113.0	16.5	307.2	5.0	4214.7 (64.91)	4.21
		40	53.2	59.3	34.5	23.3	3.3	2.3	13.4	34.2	5.5	185.7	4.04	1607.7 (40.09)	1.60
4.	Control		33.1	46.0	20.6	17.2	2.1	1.5	4.1	218.5	29.5	389.7	5.0	6186.7 (78.65)	6.18
	SEM ±		0.16	0.14	0.60	0.16	0.21	0.08	0.10	1.27	0.82	1.85	0.04	3.09	0.06
	CD at 5%		0.32	0.28	1.24	0.33	0.43	0.18	0.21	2.60	1.67	3.79	0.08	6.32	0.12
	1%		0.44	0.38	1.67	0.45	0.59	0.24	0.29	3.51	2.25	5.10	0.11	8.52	0.16

Dickson (1977); Sitaramaiah and Vishwakarma (1978). Systemic chemicals viz. : Vegfru Foratox – 10 G, Vegfru Diafuran – 3 G and Rugby – 10 G were tried as nematicides for controlling most hazardous root-knot nematode in okra. All the three chemicals in different doses effectively reduced root galling and enhanced crop yield to varying degrees. All the treatments at their highest dose level gave best results with lowered R.K.I. final soil population and reproduction factor, where phytotoxicity of chemicals was meager in front of their beneficial levels, hence are suggested for further use, to okra growers as valuable nematicides against root-knot infection in the standing crop of *Abelmoschus esculentus*. Amongst all the levels of chemicals and their doses best growth was observed with Rugby – 10 G (7 kg a.i./acre), other doses of Rugby – 10 G have also proved satisfactory followed by Foratox – 10 G (higher doses) and Vegfru-Diafuran – 3 G. Plant growth i.e. root and shoot length, fresh and dry weight of plants with Vegfru-Foratox – 10 G (5 kg a.i./acre) was similar to that of control except that disease manifestation was slightly lower than untreated controlled plants, suggesting that Foratox – 10 G if used should be applied only at higher doses i.e. 7 and 9 kg a.i./acre in which plant growth was much better than untreated plants and disease expression was also at lower index.

Advantage of the latest concept of using systemic nematicides like Rugby-10 G, Vegfru Diafuran – 3g and Vegfru Foratox – 10 G is that it can be readily taken by roots from the soil and then translocating the chemicals to upper feeding sites of nematodes whereby they kill nematodes. Presumably they were taken by nematodes during feeding or enter in nema body through cuticle in contact with soil. Nonfumigants are further recommended since they are not generally toxic to plants having an advantage of post plant application.

Nematicides belonging to organophosphates (Vegfru Foratox – 10 G) and carbamate (Vegfru Diafuran – 3 G) are basically insecticides but have proved beneficiary in controlling nema pathogens of various vegetables and fruit plants. The efficacy of these nematicides have also been confirmed by Pandey and Trivedi (1990) in their studies on chilli infested by root knot nematode *Meloidogyne incognita*.

Unlike fumigant nematicides, the mode of action of carbamate and organophosphate was reasonably certain. It was accepted that these compounds acted by the inhibition of acetylcholinesterase (ACHE) at cholinergic synapses in the nematode nervous system. Inhibition of ACHE was most likely explanation for the observed effect of organosphosphate and carbamate nematicides on the orientation behavior of nematodes (Wright, 1981; Opperman and Chang, 1990).

Thus, these chemicals act by impairing nematode neuro-muscular activity, thereby, reducing their movement, invasion, feeding and consequentially the rate of development and reproduction (Evans, 1973 and Nelmes et al., 1973). However, at substantial rates the chemicals acted against the root-knot nematode by inhibiting egg hatching, their movement and host invasion by infective juveniles and checked further development of second stage juveniles that had penetrated the roots (Bunt, 1987).

Larval emergence, penetration and development of *Meloidogyne incognita* was also adversely affected by application of higher doses of carbofuran (Mahajan, 1978). Adverse effects of phenamiphos on soil nematodes and resultant increased yield of cowpea, pea and okra was reported by Sethi and Meher (1989). However, leaves of okra plants treated with nematicides (Aldicarb and Carbofuran) showed increased mineral nutrients concentration (Singh et al., 1988).

In the present investigation none of the preinoculation treatment eradicated infection completely and none was phytotoxic. Nematicides although comparatively expensive can in reasonable doses limit the growing menace of the root-knot nematode and bring about significant increase in yield in treated plants. Conclusively from the present study Rugby – 10 G expressed best plant growth with minimum disease symptoms, final soil population and reproduction factor, hence, can be suggested for use by farmers.

REFERENCES

Adegbite AA and Agbaje GO (2007). Efficacy of Carbofuran in control of root knot nematode *Meloidogyne incognita* race 2 in hybrid yam varieties in southwestern Nigeria, Electronic Journal of Environmental Agricultural and Food Chemistry **6** (6) 2083-2094.

Adenkule OK and Fawole B (2003). Chemical and non chemical control of *M.incognita* infecting cowpea under field conditions, Moor .Journal of Agricultural Research **4** (1) 94-99.

Bessey EA (1911). Root-knot nematode and its control U.S. Department. Agriculture. Bulletin. 217 : 89.

Bunt JA (1987). Mode of action of nematicides. IN: Vistas on Nematology:a commemoration of the 25th anniversaryof the society of nematologist.(Edited by J.A.Veech and D.W.Dickson). Society of Nematologist,Inc.Hyattsiville,MD 461-468.

Christie JR and Cobb SG (1940). The inefficacy of methyl bromide fumigation against the *Chrysanthemum* foliar nematode. *Proceedings Helminthological Society*. Washington **7** 62.

Dickson DW (1977). Winchester, Va USA American Phytopathological Society Fungicides Nematicide Test Results of 1976 (1977) 32, 213-227. Department of Entomology and Nematology, Archer Road Lab. Univ of Florida, Gainesville, F132601 USA.

DI-Muro A (1970). Row treatment efficacy in *Meloidogyne* control International Tobacco conference (5th) Hamburg, Pairs: Coresta 33-34.

Jain RK (1990). Eficacy of carbofuran for the control of root-knot nematode (*Meloidogyne javanica*) in tomato and okra. International. Newsletter **7** 11-12.

Johnson MD and Godfrey GH (1932). Chloropicrin for nematode control. Indian Engineering Chemistry **24** 311-313.

Kochansky J and Feldmesser J (1989). Structure – Activity studies on nematicidal activity of dialkyl carbamates and thiocarbamates. Journal of. Nematology. **21** 158-163.

Kuhn J (1881). Bericht uber die Ergebnisse der in Auftrage des vcreins fur Rubenzucker Industrie des Destchen Rieches aufaefuhrten vurssuche zer Ermittelung der Ursache der Ursache der Rubeninudigket des Bodeus und zur Erforsctung der Natur der nematoden. *Ber Physiol. Lap. Landw. Lust. Univ. Halle*. 3 153.

Mahajan R (1978). Efficacy of carbofuran for control of *M. incognita* on okra. Indian Journal of. Nematology **8** 91-92.

Matthews DJ (1919). Report of the work of the W.B. Randall Research Assistant from October 1st, 1918 to Dec. 31st, 1919. *Report. Experiment. Research. Station. Cheshunt* **5** 18-21.

Mishra SM and Gupta P (1991). Chemical control of *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 associated with soybean. Current Nematology **2** 145-146.

MYJada Gungula DT and Jacob I (2011).Efficacy of Carbofuran in controlling root-knot nematode *M.javanica* whitehead 1949 on cultivars of Banbara Groundnut (Vigna Subterranea L.' Verdc) in yola, Nigeria. International Journal of Agronomy. Article I D 358213 5 pages doi 1155/2011/358213.

Nelmes AJ Trudgill DL and Corbett DCM (1973). Chemotherapy in the study of plant parasitic nematodes symp. British. Society of. Parasitology **II** 95-112.

Nordmeyer D and Dickson DW (1989). Efect of carbamate, organophosphate and Avermectin nematicides on oxygen consumption by three *Meloidogyne* spp. Journal of. Nematology. **21** 472.

Opperman CH and Chang S (1990). Plant-parasitic nematode acetylcholinesterase inhibition by carbamate and organophosphate nematicides. Journal of Nematology. **22** 481-488.

Pandey R and Trivedi PC (1990). Evaluation of some chemical for the control of *Meloidogyne incognita* on *Capsicum annuum*. Current Nematology **1** 61-66.

Prasad D Gopal M Mukherjee I Kalda TS and Khan E (1991). Efficacy of monocrotophos 36 WSc as spray treatment against plant parasitic nematodes infecting brinjal. Current Nematology **2** 127-132.

Prasad D Singh RP Srivastava KP Agnihotri NP and Sethi CL (1982). Evaluation of mephosfolan for nematode and insect control in okra, cowpea and tomato. Indian Journal of. Nematology **12** 277-284.

Reddy PP Singh DB (1983). Chemical control of *Meloidogyne incognita* on selected crops. *Nematologia mediterranea* **11** 197-198.

Rhoades HL (1985). Comparison of fenamiphos and *Arthrobotrys amerospora* for controlling plnt nematodes in central Florida. Nematropica **15** 1-7.

Roy NK Prasad D and Taneja HK (1990). Evaluation of o,o-Diaryl o-2-chloroethyl phosphates against root-knot nematode. Current nematology **1** 145-150.

Sethi CL and Meher HC (1989). Effect of phenamiphos on soil nematodes and yield of cowpea, pea and okra. Indian Journal of. Nematology **19** 89-94.

Sharma NK and Midha SK (1977). Efficacy of temik for the control of wilt disease of *Abelmoschus esculentus* L. Indian Journalof. Nematology. 7 80-82.

Sitaramaiah K and Vishwakarma SK (1978). Relative efficacy of selected non-volatile nematicides in field for control of root-knot nematodes on okra and tomato. Indian Journal of. Nematology 8 32-42.

Sivakumar CV Kuppaswamy S and Meerzainuddin M (1973). Evaluation of carbofuran seed treatment for the control of root-knot nematode on okra. Indian Journal.of Nematology 3 71-72.

Sivakumar CV Palaniswamy S and Nagnathan TG (1976). Persistance of nematicidal activity in seed treatment of okra with carbofuran and aldicarb sulfone. Indian Journal of. Nematology. 6 106-108.

Taylor AL (1943). Soil fumigation with chloropicrin for control of the root-knot nematode, *H. marioni*. Phytopathology 33 116-117.

Trivedi PC and Tiagi B (1983). Control of root-knot on chilli with nematicides. Journal. of Research. Assam. Ari. Univ. 4 65-66.

Wright DJ (1981). Nematicides : Mode of action and new approaches to chemical control. IN : Plant parasitic nematodes, Vol. III (Eds. B.M. Zuckerman and R.A. Rohde). Academic Press New York 421-449.