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Studies on Chemical Control of Plant Parasitic Nematodes Associated with Sugarcane *Saccharum officinarum* Linn..

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Abstract: During the survey of sugarcane fields, a total of 25 plant parasitic nematode species were found. The nematodes population were high at Tajpur (22.08%) followed by Latif farm (21.71%), and lowest at ARI farm (17.20%). Among the three nematicides tested, application of furadan at 25 kg ha^{-1} significantly reduced nematode population and produced taller plant, greater number of tillers/stool, weight of single cane, total cane yield/plot and sucrose content. Although tenekil and miral reduced nematode population, results better plant growth and gave more yield over control but remained at par to furadan.

Key words: Plant parasitic nematode, sugarcane, chemical control

Introduction

Sugarcane is an important cash crop of Pakistan covering an area of about 1166 million hectares with an annual production of 55700 million tones. However, in Sindh province, it is grown in an area of 271 million hectares with a total production of 17051 million tones (Anonymous, 1999). Unfortunately yield obtained at present, do not fulfill the local crushing requirements, this might be due to several factors, among them plant parasitic nematodes become the serious threads, because of continuous growing of same crop year after year and poor knowledge about this pest. According to Sasser and Freckman (1987), an estimated overall average annual yield loss on the world's major crop due to damage caused by plant parasitic nematodes is 12.3%. In Pakistan the damage to plants caused by nematodes are more serious and complex than in the developed countries, since the climate is suitable for the activity and reproduction of nematodes throughout the year (Maqbool, 1988).

The research workers of the country contributed the knowledge of plant and soil nematodes from time to time. Akhtar (1962) described *Metaphelunchus sacchari* as a new species associated with sugarcane from Lahore. Saeed and Ashraf (1973) reported the occurrence of *Hemicriconemoides mangiferae* on sugarcane from Karachi and adjoining areas. Maqbool *at al.* (1975) recorded 19 species for the first time from Sindh. Untill a huge total of 96 species of nematodes have so far been reported from Pakistan associated with sugarcane (Maqbool and Shahina, 2001).

Besides various soil amendments, the use of nematicides provides effective control of plant parasitic nematodes. Rayees (1988) and Anwar *et al.* (1986) found that carbofuran provide effective control of nematodes in sugarcane crop, while Mehta and Sundararaj (1995) reported that application of carbofuran for the control of *Pratylenchus zea* on sugarcane gave effective results and increased the growth of plant. Haida *et al.* (1993) observed a significant increase in sucrose percent due to carbofuran application in sugarcane.

Materials and Methods

Studies on chemical control of plant parasitic nematodes associated with sugarcane were carried out at Agriculture Research Institute farm, Tandojam, Tajpur, Nasarpur, Khisano Mori, Qubba and Latif Farm, Sindh Agriculture University, Tandojam during 1999-2000.

Soil sampling: A total of 250 moist samples were collected at random, 50 from each location near root zone at the depth of 15 cm. The collected soil samples were kept in polyethylene bags and brought to the laboratory and kept at 10°C for detailed study.

Isolation and identification of nematodes: Nematodes were isolated by standard methods of Sieving and Bearman (Thorne, 1961). Isolated nematodes were preserved in 5% formaldehyde. Temporary slides were prepared in cotton blue stain with cover slips quoted by nail polish. Nematodes were identified up to genera level following the key by Mai (1968).

Estimation of nematodes population: Nematodes were extracted from collected soil samples. Suspension was taken for counting the number of nematodes population and the percentages was workout.

Chemical control: To test the efficacy of nematicides an experiment was conducted in the experimental area of Sugarcane Section, Agriculture Research Institute Farm, Tandojam. Three nematicides namely; furadan, tenekil and miral were applied at the rate of 10 kg/ac. For this purpose a four replicated randomized complete block design was used, keeping a 15x15 m^2 net plot area. Nematicides were broadcast at the time of planting and sown after the plots were irrigated.

Agronomic observation: For recording observations on cane height, tillers/stool and weight of single cane, 10 plants/plot were selected randomly and tagged. At harvest yield/plot was recorded and juice was extracted from selected canes and analyzed for sucrose content. For the effect of nematicides used soil sampling was made randomly both from treated and untreated plots and populations of nematodes were recorded as per procedure mentioned above.

All the collected data were subjected to analysis of variance followed by Gomez and Gomez (1984).

Results and Discussion

Population distribution of nematodes species: Total of 25 nematodes species were found in the soil of five locations (Table 1). It was observed during the survey that at all locations sugarcane crop was newly planted. Therefore, overall populations of nematodes were low. Out of twenty five nematodes species, the population of *Basiria ritteri* was more (9.70%), followed by *Hoplolaimus columbus* (6.28%) and *Hericriconemoides mangiferae* or *Hericriconemoides* spp. (5.31%) respectively. Among the locations, greater population of nematodes (22.08%) was found in the sugarcane field at Tajpur, followed by Latif farm (21.71%) and Khisano Mori (20.61%), while lowest population of nematodes (17.20, 18.40%) were observed in the sugarcane fields at ARI Tandojam and Qubba. The low population of nematodes in soil was due to rotation of crops and use of organic amendments. It was further found that among the locations greater population of *Hoplolaimus columbus* was found at Latif farm (9.32%) and ARI field (10.16), while population of *Longidorus* spp. was higher in field at Tajpur (7.08%), however, *Basiria ritteri* population was more at Khisano Mori (13.39%) followed by ARI Tandojam (10.70%) and Tajpur (10.42%). However, other species were found lowest, although varied between locations. This trend

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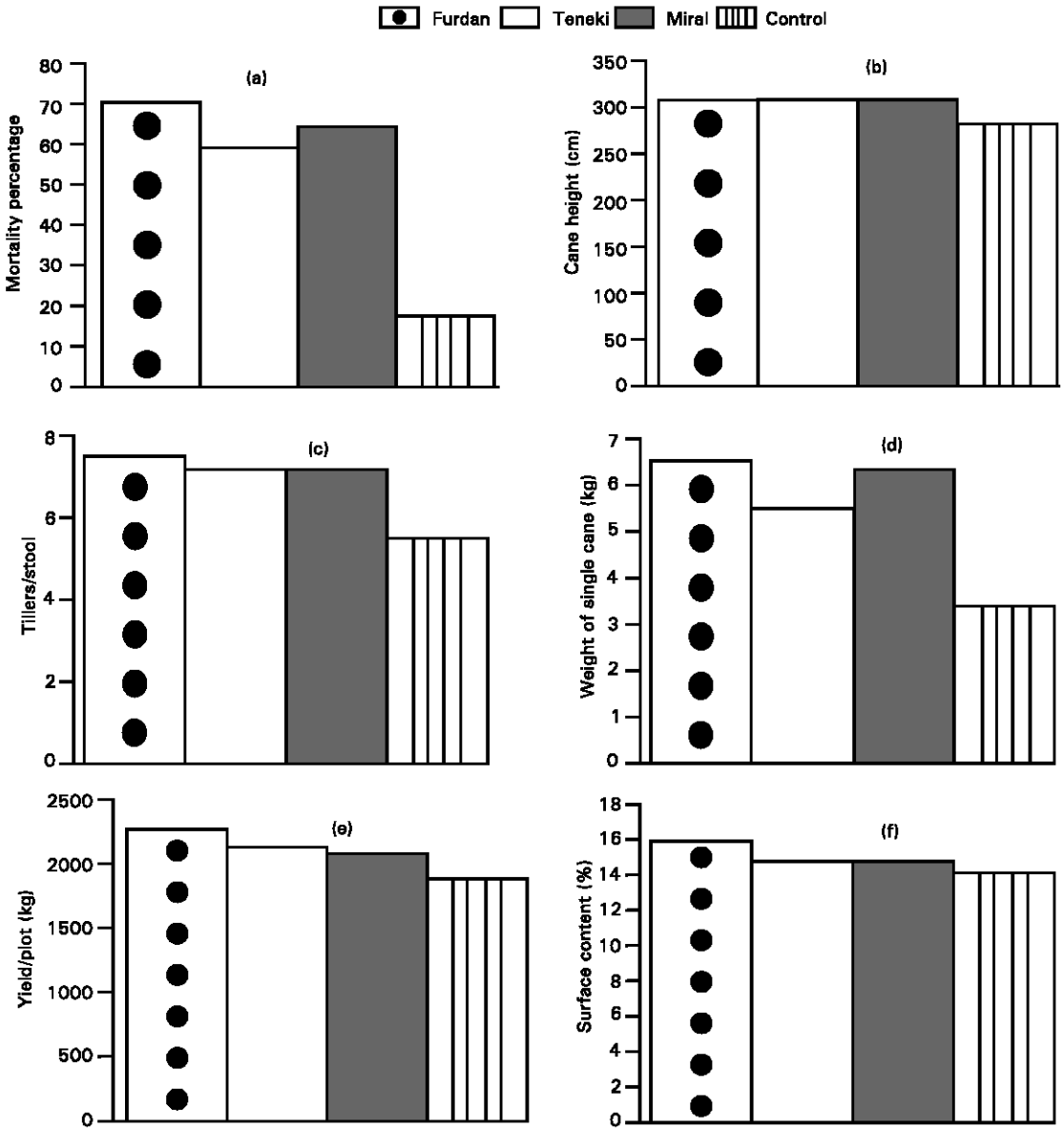

Fig. 1(a-f): Effect of nematicides on the mortality % and on agronomic characteristics of sugarcane crop

demonstrated that *Basiria ritteri* was the serious soil pest of sugarcane. Earlier research workers like Saeed and Ashraf (1973) reported *Hemicriconemoides mangiferae* on sugarcane from Karachi. Maqbool *et al.* (1975) collected more than 500 soil and root samples from sugarcane fields of 36 localities of Sindh region, and he found ratoon crop of sugarcane was heavily infested with plant parasitic nematodes as compared to newly planted crop. He recorded high population of *Helicotylenchus dignicus, Helicotylenchus* spp., *Hoplolaimus* spp., *Xiphinema armericanum, Ditylenchus dipsaci, Helicotylenchus dihystera, H. microdorus, Hoplolaimus columbus, H. indicus, Hemicriconemoides mangiferae, Longidorus* spp., *Meloidogyne incognita, M. javanica, Marlinius brevidens, Paratylenchus* spp., *Quinisulcius capitatus, Rotylenchus buxophilus, Tylenchorhynchus mashhoodi* and *Xiphinema* spp. for the first time from Pakistan. New species were recorded on sugarcane farm time to time by several workers like Hussain and Yasmeen (1976); Maqbool (1982); Maqbool *et al.* (1984); Maqbool and Shahina (1985); Maqbool *et al.* (1985) and Anwar *et al.* (1986).

Chemical control: Plots treated with furadan resulted in greater mortality of nematodes (69.85%), followed by miral (63.64%), while Tenekil found to be less effective and caused lower mortality of nematodes (58.12%). This trend demonstrated that all nematicides reduced nematodes population progressively. Among the nematicides furadan has longer toxicity over rest of the products. These results are in confirmation to those reported by Reyees (1988), he used 5 nematicides and 4 organic amendments in the furrow while planting sugarcane. He found nematodes control with 2 kg a.i. carbofuran was very good. Anwar *et al.* (1986) applied carbofuran (granular 5%) at 60 kg a.i. ha^{-1} and heptachlor (40EC) at 4 liters ha^{-1} to sugarcane ratoons to control plant parasitic nematodes and termites. Mearzainudeen *et al.* (1990) recommended carbofuran at 1 kg a.i. ha^{-1} at time of planting with other cultural practices for the control of plant parasitic nematodes in sugarcane. Haida *et al.* (1993) examined the effect of several organic amendments and carbofuran and found that all treatments reduced nematode population in the field as compared to control.

Table 1: Population fluctuation of various plant parasitic nematodes associated with sugarcane crop at various locations

	Locations											
	ARI field		Latif field		Tajpur		Khisano Mori		Qubba		Mean	
Nematode species	P	%	P	%	P	%	p	%	p	%	P	%
Hemicriconemoides mangiferae	9	4.8	8	3.4	15	6.2	10	4.5	13	6.5	11.0	5.3
Helicotylenchus dihystera	7	3.7	6	2.5	10	4.2	8	3.6	9	4.5	8.0	3.9
Helicotylenchus spp.	10	5.3	11	4.5	13	5.4	9	4.0	12	6.0	11.0	5.3
Xiphinema americanum	6	3.3	5	2.1	8	3.3	14	6.2	15	7.5	9.6	4.6
Ditylenchus dipsaci	9	4.8	4	1.7	3	1.2	2	0.9	4	2.0	4.4	2.1
Helicotylenchus dihystera	3	1.6	8	3.4	9	3.7	3	1.3	2	1.0	5.0	2.4
H. microdorus	16	8.6	13	5.5	10	4.1	8	3.6	3	1.5	10.0	4.8
Hoplolaimus columbus	19	10.1	22	9.3	5	2.1	9	4.0	10	5.0	13.0	6.3
H. indicus	13	6.9	6	2.5	10	4.1	12	5.4	4	2.0	9.0	4.4
Hoplolaimus spp.	3	1.6	8	3.4	12	5.0	7	3.1	4	2.0	6.8	3.3
Longidorus spp.	8	4.3	3	1.3	17	7.1	5	2.2	6	3.0	7.8	3.8
Meloidogyne incognita	3	1.6	3	1.3	6	2.5	9	4.0	4	8.0	4.0	3.8
M. javanica	2	1.1	4	1.7	7	2.9	3	1.3	9	4.5	5.8	2.8
Merlinius microdorus	6	3.2	5	1.1	10	4.2	13	5.8	4	2.0	7.6	3.7
Paratylenchus spp.	7	3.7	9	3.8	4	1.7	2	0.9	3	1.5	5.0	2.4
Quinisulcius capitatus	2	1.1	3	1.3	9	3.7	8	3.6	10	5.0	6.4	3.1
Rotylenchus buxophilus	3	1.6	5	2.1	8	3.3	13	5.8	12	6.0	8.2	4.0
Tylenchorhynchus mashhoodi	6	3.2	9	3.8	12	5.0	13	5.8	9	4.5	9.8	4.7
Xiphinema spp.	4	2.1	3	1.3	10	4.2	12	5.4	7	3.5	7.2	3.5
Paurodontella sohailai	3	1.6	12	5.1	10	4.2	4	1.8	3	1.5	6.4	3.1
Basiria ritteri	20	10.7	15	6.4	25	10.4	30	13.4	19	9.5	20.1	9.7
Cephalenchus sachari	13	6.9	10	4.2	6	2.5	9	4.0	3	1.5	8.2	4.0
Criconemoides spp.	3	1.6	8	3.4	2	0.8	4	1.8	6	3.0	4.6	2.2
Ottolenchus longicauda	9	4.8	13	5.5	10	4.2	4	1.8	5	2.5	8.2	4.0
Parasrotylenchus spp.	3	1.6	2	0.9	9	3.7	13	5.8	20	10.0	9.4	4.5
Percentage		17.2		21.7		22.8		20.6		18.4		100

P = Population

Agronomic observations: All nematicidal treatments significantly produced taller plants as compared to control (Fig. 1a). Plot treated with furadan resulted in taller plant (313.25 cm), followed by miral (307.50 cm) and tenekil (307.0%). However, untreated check recorded lowest plant height (281.75 cm). All nematicides treated plots improved tillering capacity equally as compared to control which produced the lowest number of tillers (Fig. 1b). The greater tillering capacity in nematicidal treated plots was the result of reduction in nematodes population. Maximum cane weight (6.51 kg) was recorded in case of plots treated with furadan, followed by tenekil (6.36 kg) and miral (5.51 kg). While the lowest single cane weight (3.38 kg) was recorded in plots where no chemical was applied (Fig. 1c). Plots treated with furadan and tenekil resulted in significantly greater cane yields (2265.75 and 2147.00 kg/plot), followed by miral (Fig. 1d). Whereas untreated control produced significantly lower cane yield (1847.50 kg/plot). As for as sucrose content are concerned, application of furadan resulted significantly more sucrose as compared to other treatments (15.86%), followed by tenekil and miral (Fig. 1e). While the less sucrose content (14.05%) was recorded in case of plots where no nematicides was applied (control). These results demonstrated that application of furadan followed by tenekil and miral reduced plant parasitic nematodes significantly as compared to control, which in turns cause produced taller, more tillering more single cane weight, more yield and better sucrose content of cane juice. Reyees (1988) used 5 nematicides and 4 organic amendments in sugarcane and observed that all treatments increased cane and sugar yields. Haida *et al.* (1993) examined the effect of application of different organic amendments and carbofuran and observed that all treatments reduced nematode population in the field, increased plant growth and crop productivity significantly. He observed a significant increased in sucrose content due to carbofuran application. Mehta and Sunararaj (1995) used several organic amendments and carbofuran and observed that all treatments increased the plant growth, as measured by shoot and root length and weight.

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