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Management of root-knot nematodes, Meloidogyne spp. in tuberose using chemicals under nursery conditions

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ABSTRACT: Studies pertaining to root-knot nematodes, Meloidogyne spp. on tuberose with respect tomanage root-knot nematodes, Meloidogyne spp. in tuberose using chemicals under nursery conditions were carried out at Department of Nematology, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat during the year 2020-21. While scanning literature, few chemicals are found effective to control Phytonematodes. To assess the efficacy of new chemicals i.e. fluopyram, Fluensulfone, fluazaindolizine, Chlorantraniliprole,Thiocyclam hydrogen oxalate, Carbofuran and Cartap hydrochloride each with recommended doses. Efficacy of different chemicalsrevealed that application of fluazaindolizine 500 SC @ 600 ml/ha followed by fluopyram 400 SC @ 1000 ml/ha reduced root-knot nematode population and increased growth and development of tuberose.

KEYWORDS:tuberose, root-knot nematode, fluopyram, Fluensulfone, fluazaindolizine, Chlorantraniliprole, Thiocyclam hydrogen oxalate, Carbofuran and Cartap hydrochloride

I. INTRODUCTION

Tuberose (PolianthestuberosaL.) is an ornamental as well as medicinal and aromatic crop grown with varying success under wide environmental conditions ranging from tropical to temperate climates. It is a perennial crop belongs to the family Amaryllidaceae and is native of Mexico. The common name derives from the Latin tuberosa through French tubéreuse, meaning swollen or tuberous in reference to its root system. It is an important commercial cut as well as loose flower crop due to pleasant fragrance, longer vase-life of spikes, higher returns and wide adaptability to varied climate and soil. Tuberose blooms throughout the year and its clustered spikes florets are star shaped, waxy and loosely arranged on spike that can reach up to 30 to 45 cm in length (Anon., 2014).

It is grown in many countries of the world such as Vietnam, China, Brazil, Italy, Iran, UK, USA (Kadam et al., 2019). In India, commercial cultivation of tuberose is popular in West Bengal, Tamil Nadu, Uttar Pradesh, Punjab, Maharashtra, Andhra Pradesh, Karnataka, Assam, Rajasthan, Gujarat. Tuberose is commonly known as Gulchari and Galshabbo in Hindi, Rajanigandha or Nishigandha in Bengali, Sukandaraji and Nelasanpengi in Telegu, Nilasompangi in Tamil and Sugandharaja in Kannada. Tuberose can successfully be grown in pots, borders, beds and commercially cultivated for its various uses. It is generally planted during March-April with the spacing of 30 × 30 cm. The flowers of tuberose are also used for making artistic garlands, floral ornaments, bouquets, buttonholes, gajras and extraction of essential oil. Flowers are ready for harvest in about 80 to 100 days after planting. One hectare of tuberose plantation yields 4-5 lakhs of spikes per year for cut flower purpose. In case of single varieties, 14-15 tonnes/ha of loose flowers may be harvested. In addition, 20-25 tonnes/ha of bulbs and bulblets may be harvested at the end of 3rd year. (Safeenaet al., 2015).

The fresh flowers yield about 0.08 to 0.11 per cent essential oil. The health benefits of tuberose essential oil can be attributed to its properties as an aphrodisiac, deodorant, relaxing and warming substance. It is very popular and priced among perfume manufacturers (Lodha and Telang, 2016). This oil has pleasant fragrance along with chemical components that relax nerves, brain and muscles.

Root-knot nematode, M. incognita has been reported as one of the important limiting factors affecting commercial cultivation of tuberose (Sundarababu and Vadivelu, 1988). The infection of root knot nematode makes the plants highly susceptible to Fusarium oxysporum f. sp. dianthi (Rao et al., 2007). Affected crop showed chlorotic foliage, general stunting, below ground portion with heavy root galling (Johnson, 1970). Problem of root-knot nematode in tuberose was widespread;

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majority of the tuberose fields in North and South India are heavily damaged by the nematodes (Rao et al., 2001). It infect the root system of tuberose and often severely destroys the roots in association with other soil-borne fungi (Saha and Khan, 2016). According to Chawla et al. (2006) it infects tissues of bulb and root and the yield loss was reported up to 10 per cent. Therefore, using bulb as a planting material potentially disseminates root knot nematodes from one place to another. The level of inoculum of M. incognita is directly related to the damage on tuberose. Most of the root knot nematodes (58.35%) were present up to a depth of 5.2 mm, in tuberose bulbs. As per the report of Gowda and Chawla (2014), no nematodes were observed at a depth of >13.0 mm.

II. REVIEW OF LITERATURE

Gowda et al. (2014) conducted an experiment in which carbosulfan 25 EC was evaluated as seed soaking for management of root-knot nematode, M. incognita infecting bulbs of tuberose. Soaking of tuberose bulbs was done in 500, 1000 and 2000 µg/ml of carbosulfan 25 EC for 2 and 4 hrs. of exposure. Absorption of carbosulfan by tuberose bulbs, evaluated by high pressure liquid chromatography (HPLC), ranged from 5.25 µg/ml to 35.44 µg/ml. With the increase in the time of exposure or the concentration of nematicide there was corresponding increase in incorporation of nematicide in the bulb tissues. Hatching from root-knot nematode, M. incognita eggs was reduced significantly by carbosulfan treatment at all the tested concentration (5-35 µg/ml).

Chawlaet al. (2006) carried out investigation on the effect of soaking of the mother bulbs of tuberose (PolianthestuberosaLinn.) cv. Mexican Single with carbosulfan (1000 and 2000 ppm), triazophos (1000 and 2000 ppm) and neem oil (1% and 2%) for one hour revealed that carbosulfan 25 EC was better than triazophos and neem oil in reducing the M. incognita. More than 70% reduction in the number of galls, eggmasses, eggs and the soil population of the juveniles per plant was observed at harvest for bulbs treated with carbosulfan 2000 ppm. Neem oil treatment did not reduce the nematode population significantly.

III. MATERIALS AND METHODS

Bulbs of tuberose cv. Prajwal were sown at 30 x 30 cm spacing of 1.2 x 1.2 m beds. Granular formulations of the chemicals were applied at the time of sowing in furrows and covered with soil. Liquid formulations of the chemicals were applied four days before sowingas drenching. Beds without any chemical application were kept as untreated check.After 60 days of sowing, the experiment was discontinued by removing the seedlings from the nursery and roots were washed gently under running tap water and observations on fresh seedling weight and root-knot index were recorded. Roots were cut in to 2-3 cm length mixed thoroughly and three grams of roots were stained in 0.05 per cent acid fuchsin in lactophenol(Franklin and Goodey, 1949).After cooling, the stained roots were washed gently in tap water to wash off excess stain and then kept in plain lactophenol till they were teased and examined under stereo binocular microscope to count the number of nematodes.

Table 1: List of chemicals tested

Treat. No.	Chemicals	Formulation	g a.i. /ha	Required quantity/ha	Required quantity/bed
T_1	Fluopyram	400 SC	400	1000 ml	0.144 ml
T_2	Fluensulfone	2 GR	560	28 kg	24 g
T_3	Fluazaindolizine	500 SC	300	600 ml	0.086 ml
T_4	Chlorantraniliprole	4 GR	48	12 kg	1.72 g
T_5	Thiocyclam hydrogen oxalate	4 GR	600	15 kg	2.16 g
T_6	Carbofuran	3 G	1000	33 kg	4.7 g
T_7	Cartap hydrochloride	4 G	800	20 kg	2.88 g
T_8	Control	-	-	-	-

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Table 2: Root-knot index Scale

0-5 scale to record root-knot index (Taylor and Sasser, 1978)		
Root Knot Index (RKI)	**No. of galls**	**Reaction**
0	0	Highly resistant (HR)
0.01-1.0	1-2	Resistant (R)
1.01-2.0	3-10	Moderately resistant (MR)
2.01-3.0	11-30	Moderately susceptible (MS)
3.01-4.0	31-100	Susceptible (S)
4.01-5.0	> 100	Highly susceptible (HS)

IV. RESULT

An experiment was conducted to test the efficacy of seven different chemicals viz., fluopyram 400 SC @ 4 kg a.i./ha (1000 ml/ha i.e. 0.144 ml/bed), fluensulfone 2 GR @ 560 g a.i./ha (28 kg/ha i.e. 24 g/bed), fluazaindolizine 500 SC @ 300 g a.i./ha (600 ml/ha i.e. 0.086 ml/bed), chlorantraniliprole 0.4 GR @ 48 g a.i./ha (12 kg/ha i.e. 1.72 g/bed), thiocyclum hydrogen oxalate 4 GR @ 600 g a.i./ha (15 kg/ha i.e. 2.16 g/bed), carbofuran 3 G @ 1000 g a.i./ha (33 kg/ha i.e. 4.7 g/bed) and cartap hydrochloride 4 G @ 800 g a.i./ha (20 kg/ha i.e. 2.88 g/bed) against RKN in tuberose under nursery condition. The experiment was laid out in nematode infested nursery (mixed population of M. incognita and M. javanica) having initial nematode population 203 J_2/200 cc soil.

Germination count/bed

Germination count was found non significant among the various treatments. This revealed that there was no any adverse effect of any treatment on seed germination of tuberose.

Plant stand/bed (Initial/Final)

Differences in initial and final plant stand in beds treated with chemicals and control were non-significant.

Root-knot index (RKI)

The plot treated withfluazaindolizine (T_3) recorded minimum and significantly least root-knot index (1.00) than the rest of the treatments. Next in order were fluopyram (T_1) (1.63) and fluensulfone (T_2) (2.00) and both were remain at par with each other. Chlorantraniliprole (T_4) (2.64) was at par with fluensulfone (T_2) (2.00).Maximum root-knot index was observed in control (T_8) (4.65). Carbofuran (3.65) gave moderate reduction of galls. The reduction in root-knot index due to fluazaindolizine and fluopyrum was to the tune of more than 40 per cent over control (Table 3).

Soil nematode population

Soil population of nematodes was drastically and significantly reduced in fluazaindolizine (165/200 cc soil) followed by fluopyram (229/200 cc soil) and fluensulfone (247/200 cc soil) and they were at par with each other. FNP was recorded maximum in control (466/200 cc soil). The reduction in final nematode population in fluazaindolizine, fluopyram and fluensulfone was found to the tune of more than 10 per cent (Table 3).

Table 3: Effect of different chemicals on management of root-knot nematodes in tuberose nursery

Treatment	Germination count (out of 16 plants)	Root-knot index (0-5)*	Decrease over control (%)	Soil nematode population	Decrease over control (%)
T_1 (Fluopyram)	13	1.28^{e} (1.63)**	40.85	2.36^{cd} (229)***	11.57
T_2 (Fluensulfone)	12	1.41^{de} (2.00)	34.45	2.39^{bcd} (247)	10.36
T_3	12	1.00^{f} (1.00)	53.65	2.22^{d} (165)	16.89

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(Fluazaindolizine)					
T_4 (Chlorantraniliprole)	14	1.63^{cd} (2.64)	24.63	2.42^{bc} (266)	9.15
T_5 (Thiocyclam hydrogen oxalate)	13	1.73^{bc} (3.00)	19.72	2.50^{abc} (316)	6.33
T_6 (Carbofuran)	12	1.91^{b} (3.65)	11.43	2.58^{ab} (383)	3.21
T_7 (Cartap hydrochloride)	13	1.82^{bc} (3.32)	15.57	2.56^{ab} (366)	3.94
T_8 (Control)	12	2.16^{a} (4.65)	-	2.67^{a} (466)	-
S. Em. ±	0.65	0.08	-	0.03	-
CD @ 5%	NS	Sig.	-	Sig.	-
C.V. %	8.90	8.67	-	2.09	-

*0 = Free; 5 = Maximum disease intensity
**Figures in parentheses are re-transformed values of $\sqrt{x}$
***Figures in parentheses are re-transformed values of log
Figures indicating common letter(s) do not differ significantly from each other at 5% level of significanceaccording to DNMRT.

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