Research Article

Evaluation of Weedicides Concentrations against Root knot Nematode Meloidogyne Incognita on Tomato

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Abstract

Meloidogyne species are known to cause high levels of economic loss worldwide in a multitude of agricultural crops, including tomato. Herbicides are used extensively to control weeds. However, little is known about the non-target effects of herbicides on soil nematode assemblages. The different concentrations of herbicides used in pot culture. The observations to be recorded as Plant growth parameters Fresh weight (g), Shoot length (cm), Fresh root weight, dry shoot weight and population development of M. incognita on tomato (S.S-21) on number of egg Saccs and their population. The concentrations were used 0.25%, 0.5%, 1.0%, 1.25% of Glyphosate 41%, Pyrozo sulfuron 10%WP, Metribuzin 70% WP, Propaquizafop 10% EC.

Keywords: Meloidogyne Incognita, Tomato, Glyphosate 41%, Pyrozo sulfuron 10% WP, Metribuzin 70% WP, Propaquizafop 10% EC

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Introduction

Tomato (Solanum lycopersicum) belongs to the Solanaceae family it is popular vegetable crop worldwide and it is grown on more than 5 × 106 ha with a production of approximately 161 × 106 metric tons. In Africa and Asia account for more than 80% of the global tomato area, with about 70% of world output [1-3]. It is ranked first in the world for vegetables and accounts for 14% of world vegetable production (US$ 1.6 billion market value) [4, 5]. Tomato is a rich source of micronutrients such as minerals, vitamins and antioxidants for a well-balanced human diet. It also contains high levels of lycopene, an antioxidant that reduces the risks associated with several cancers and neurodegenerative diseases [6, 7]. Root-knot nematodes can cause severe damage to the roots of tomato. Symptoms are more prevalent with tropical species compared to temperate root-knot nematodes. Tomato cultivars have different degrees of susceptibility towards different Meloidogyne spp. Damage and yield loss studies conducted so far have shown a considerable difference in degree of susceptibility among tomato cultivars. Moreover, different populations of the same species of Meloidogyne even exhibit different degrees of pathogenicity on a specific tomato cultivar. A tomato cultivar that is absolutely susceptible to one population may be moderately resistant to another population of the same species. Several studies report the damage potential of different Meloidogyne spp. on different tomato cultivars under pot, microplot and field experiment conditions throughout the world. Experiments were done in different conditions and localities with different experimental approaches, making it difficult to extrapolate the results. In many agro ecosystems worldwide, herbicides are used extensively to control weeds, reduce soil erosion, conserve soil structure and improve labor efficiency. However, herbicides affect more than just weeds; they also impact upon soil biota directly or more frequently indirectly, through the alteration of plant cover and root exudates [8-12]. However, different types of herbicide are associated with negligible, positive or negative effects on various soil organisms' viz. microorganisms, nematodes, arthropods and earthworms [10]. A considerable number of studies have focused on the effects of herbicides on plant-parasitic nematodes, especially root-knot nematodes and cyst nematodes [5]. In most cases, herbicides are usually applied with other agricultural management practices like other pesticides, fertilization and tillage [8]. Because little is known about the non target effects of herbicides alone on soil nematode assemblages, the objective of the present study was to determine whether herbicides affect nematode trophic group composition. The present studies were thus, conducted to work out the nematicidal properties of a few herbicides against *M. incognita* associated with tomato and for their effect on vegetative and reproductive growth characters of the crop.

Materials and Methods

The following materials and methods were used during the present investigations.

Preparation of soil composite, sandy loam soil for growing the test plant was collected from dusty acre farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur. Soil was thoroughly washed with 3- 4 changes of water so as to

remove the soluble leachiest and air dried. This soil was then mixed with well decomposed FYM (3:1) to prepare soil composite and same was used throughout the course of investigation.

Test organism

Root knot nematode *Meloidogyne incognita* obtained from certified seed from the market at Jabalpur it used against tomato (Solanum lycopersicum L.) variety S.S-21 which was susceptible to root knot nematode.

Screening of different concentrations of herbicides against root knot nematode

Glyphosate 41%SL @ 0.25%, 0.5%, 1.0%, 1.25% /1.5 kg soil, Pyrozo sulfuron 10%WP @ 0.25%, 0.5%, 1.0%, 1.25% /1.5 kg soil, Metribuzin 70%WP @ 0.25%, 0.5%, 1.0%, 1.25% /1.5 kg soil, Propaquizafop 10%EC @ 0.25%, 0.5%, 1.0%, 1.25% /1.5 kg soil.

Collection, Isolation, and Maintenance of pure culture of root knot nematode Meloidogyne spp.

Tomato plant roots infected with root knot nematode were collected from Panagar, Jabalpur (M.P.). The infected roots were washed and chopped into small pieces (1cm) and placed over extraction assembly. After 24 hours, freshly hatched second stage larval populations were collected from extraction assembly and inoculated on 21 days old seedling of Tomato (S.S-21). After 45 days, the roots along with soil were gently washed with running water. The single egg mass was picked from infected root and was inoculated on tomato seedling grown in 10 cm earthen pots containing steam sterilized soil to obtain mono specific population. The population obtained from single egg mass was maintained on tomato. This population was used throughout the present investigations.

Extraction assembly

Cobb's sieving and decanting method and modified Baermann Funnel Technique [2] were employed and egg masses were collected over 60 Mesh British Standard (BS) Sieve. Egg masses were further subjected to extraction assembly at room temperature. An extraction assembly had PVC-ring of 110 mm diameter holding double layered wet tissue paper supported by gauze cloth and tightly stretched with a rubber band. Extraction dish was placed over a piece of sponge measuring 15 cm × 15 cm for providing form support from the bottom to the tissue paper and allowing a fast passage of water and suspension containing freshly washed egg masses on 60 mesh B. S. Sieve was poured with the help of a jet of water. Assembly was later kept on a glass bowl (yera make) holding 60 ml of aqua-guard water. Extraction assembly was so placed, that the upper layer of water in glass bowl touches the stretched base of extraction dish to ensure a thin film leaving no air bubble. The extraction was carried out at room temperature and the second stage juveniles (j2) were collected after 24 and 48 hr. The extraction was further continued till 72 to 96 hr and juveniles emerged within 96 hr were used for the inoculation after calibrating the population.

Effect of inocula of Meloidogyne incognita on growth parameters of Tomato (cv. S.S-21) and nematode multiplication

Seeds of S.S-21 variety of tomato were surface sterilized with 0.1% mercuric chloride solution for one minute and subsequently washed three times in sterile water. The disinfected seeds so obtained were sown in 10 cm diameter earthen pots holding 200 cm3 steam sterilized soil. In each pot, two plants were transplant at an even depth of 2 cm. After establishment single plant was retained in each pot. After 10 days when seedlings attained a height of 10 cm the pots were inoculated with inoculum. To obtained second stage larval population for inoculation, egg masses were collected from six weeks old infected plants of tomato and were kept in extraction dish for overnight for extraction. The populations (second stage larvae) so obtained were utilized to test the different levels of inocula on growth parameter of the tomato seedlings. The larval population was assessed by drawing five, aliquant of 1 ml each from 100 ml nematode suspension in a beaker and then multiplied by hundred to know the total population present in 100 ml beaker larvae which were dispersed individually in 10 ml of sterile water. Thus there were five treatments along with control. In control pots 10 ml of sterile water alone was used. Inoculation of tomato seedlings with desired level of inoculum were carried out by removing the soil around root in radius of 2.0-2.5 cm and dispersing the required populations by dispenser holding appropriate populations in 10 ml water. After inoculation, the roots were covered with thin layer of fresh steam sterilized soil. These pots were irrigated with 100 ml of fresh water as and when required. The glass house temperatures were ranged between 28-320C during the course of investigation. The experiment was terminated after 45 days of transplanting. Observations on plant height, fresh and dry shoot and root weight, galls and egg masses / root system and soil population / 200 cm3were recorded. For extraction of nematodes

from roots each pot was flooded with water to saturate the soil and then immediately entire roots system along with soil was tapped out carefully by inverting the pot. The roots were washed with a gentle stream of running tap water to obtain intact root system. The extraction of nematode from the soil was carried out by modified Cobb's sifting and gravity technique to estimate the nematode population. For obtaining the fresh weight, whole root system was gently pressed between two pads of blotting paper and cut into small pieces of 2-3 cm and its weight was recorded. The larval population emerging from the roots was counted daily until extraction of maximum population.

Efficacy of herbicides against M. incognita

The four herbicides were further homogeneously mixed with the sterile soil composite at different concentrations viz. 0.25%, 0.5%, 1.0%, 1.25% per 500 g soil and filled in 10 cm pots containing 500 g soil. The pots were irrigated with fresh tap water and kept on the glass house bench. Then 21 days old seedlings of tomato were transplanted in the pots. Each pot received one seedling. On establishment of roots the pots were inoculated with 1000 freshly hatched second stage juveniles of M. incognita. The pots were randomized on glass house bench. Each treatment replicated three times. Experiment was terminated 35 days after inoculation. The following observations were recorded viz., plant height, fresh and dry weight of shoot, fresh weight of root, number of galls, number of egg saccs, number of eggs per sacc and final soil population.

Results and Discussion

I have collected five varieties of tomato from Karnataka (Dist- Kolar) where they grow commercially by farmers in an polyhouse and open field condition. These varieties are evaluated to test susceptibility for reproduction of root knot nematode (Meloidogyne spp.). Among these varieties noticed that SS 21 is highly susceptible and it can be used for further investigations.

Varieties	No. of galls	No.of egg saccs	J2 from eggs	Soil population
1. SS 21	115	115	250	380
2. DS 22	65	65	170	250
3. S 22	30	30	110	180
4.American sathna	8	8	55	120
5. Damini131	20	20	90	170

Gall index (Taylor and Sasser, 1978)

Scale	Galls/egg saccs	Reaction Index
0	0	Immune
1	1-10	highly resistant
2	11-20	moderate resistant
3	21-40	slightly resistant
4	41-100	succeptible
5	>100	highly succeptible

Effect of Glyphosate 41% SL herbicide on root knot and plant growth at four levels of concentrations against root knot nematode *M.incognita* infestation in tomato (SS 21).The addition of herbicide result reduction in extent of galling on roots was minimum (11.6) at 1.25 percent followed by (12) at 1.0 percent,(12.3) at 0.5 percent and (13) at 0.25 percent concentration. Similar trend of reduction was noticed for egg saccs also. The population of J2 decreased beyond the initial population in un treated tomato. Application of herbicide suppress number of eggs /egg mass in all the treatments when compare to untreated control. There was significant improvement for all growth parameters viz shoot height, shoot weight (fresh and dry) and root weight at 1.25 percent compare to other levels of concentrations and untreated control. Maximum (11.3 cm) improvement was noticed for plant height at 1.25 percent dose where as fresh and dry shoot weight, root weight were also significant at 1.0, 0.5 and 0.25 levels of doses (**Table 1**).

The effect of different concentration of Pyrozo sulfuron 10% WP on number of galls, egg masses and hatching of *M.incognita* when soil was amended with Pyrozo sulfuron 10% WP. Highest concentration 1.25% of herbicide improved fresh shoot weight (0.51 g), shoot length (18.3 cm), fresh root weight (0.25 g) and dry shoot weight (0.24 g)

significantly. However, all the treatments at this level of concentration showed better growth over the untreated control. Reduction in vigor of fresh root was exhibited in central plants when compared with different concentration of treatments.There was inhibition of galls, egg masses and juveniles hatch in the treatments over the control. Pyrozo sulfuron 10% WP affected hatching of J2 from eggs which are protected by egg saccs during the development and reproduction. The lowest galls (6) along with egg saccs (6), number of eggs/sacc (120) was noticed in present study. Out of 120 eggs/saccs only 363.3 J2 were emerged when tomato plants were grown in presence of 1.25 percent concentration of herbicide.The observation indicated that highest dose of Pyrozo sulfuron 10% WP inhibit the reproduction of *M.incognita*, simultaneous trend of inhibition was observed with other concentrations in present investigations (**Table 2**).

Table 1 Effect of Glyphosate 41% SL at different concentration on growth parameters and population development of *M. incognita* on tomato (S.S-21)

Treatments	Concentrations	Observations							
		Fresh soot weight (g)	Shoot length (cm)	Fresh root weight (g)	Dry shoot weight (g)	No.of galls	No. of egg saccs	No.of eggs/ sacc	Soil populn
Glyphosate 41% SL	0.25%	0.21	9.6	0.04	0.08	13	13	221.6	186.6
	0.5%	0.25	10.3	0.05	0.1	12.3	12.3	216.6	196.6
	1.0%	0.26	11	0.06	0.12	12	12	215	215
	1.25%	0.31	11.3	0.08	0.14	11.6	11.6	211.6	218.3
	control	0.18	5.53	0.01	0.04	30	30	350	185.6
	SEm	0.053	0.788	0.010	0.027	0.604	0.604	6.268	10.255
	CD5%	0.159	2.389	0.029	0.082	1.833	1.833	19.012	28.978

Table 2 Effect of Pyrozo sulfuron 10% WP at different concentration on growth parameters and population development of *M. incognita* on tomato (S.S-21)

Treatments	Concentrations	Observations							
		Fresh soot weight (g)	Shoot length (cm)	Fresh root weight (g)	Dry shoot weight (g)	No.of galls	No. of egg saccs	No.of eggs/sacc	Soil populn
Pyrozo sulfuron 10% WP	0.25%	0.35	12	0.1	0.09	11	11	170	311.6
	0.5%	0.41	14	0.12	0.11	10	10	155	330
	1.0%	0.42	15	0.2	0.17	8.6	8.6	133.3	340
	1.25%	0.51	18.3	0.25	0.24	6	6	120	363.3
	control	0.18	5.53	0.01	0.04	30	30	350	185.6
	SEm	0.021	0.400	0.007	0.008	0.591	0.591	3.832	6.226
	CD5%	0.063	1.213	0.020	0.023	1.792	1.792	11.623	14.818

Effect of Metribuzin 70% WP on root knot and plant growth at four levels of concentrations are summarized in table (3). The significant effect of herbicide against root knot nematode *M.incognita* infestation in tomato (SS 21).The addition of herbicide result reduction in extent of galling on roots was minimum (5.6) at 1.25 percent followed by (8.3) at 1.0 percent, (9.6) at 0.5 percent and (10) at 0.25 percent concentration. Similar trend of reduction was noticed for egg saccs also. The population of J2 decreased beyond the initial population in un treated tomato. Application of herbicide suppress number of eggs /egg mass in all the treatments when compare to untreated control. There was significant improvement for all growth parameters viz shoot height, shoot weight (fresh and dry) and root weight as compare to control. Maximum (18.6 cm) improvement was noticed for plant height at 1.25 percent dose where as fresh and dry shoot weight, root weight were also significant at 1.0, 0.5 and 0.25 levels of doses. The observation indicated that highest dose of Metribuzin 70% WP inhibit the reproduction of *M.incognita*, simultaneous trend of inhibition was observed with other concentrations in present investigations (**Table 3**).

Effect of Propaquizafop 10% EC on root knot and plant growth at four levels of concentrations are summarized in table (4). The significant effect of herbicide against root knot nematode *M.incognita* infestation in tomato (SS 21).The study revealed effect of four concentrations on the number og eggs and emergence of larvae of *M.incognita*. The mean number of hatch inhibition was indicated that 1.25 percent concentration of Propaquizafop 10% EC gave (235) inhibition of eggs at 1.25 percent concentrations. However emergence of J2 at 1.0, 0.5 and 0.25 percent showed 250,

275 and 305 eggs/ egg sacc respectively. Observations on tomato growth parameters show significant and superior response over the control. However highest dose of herbicide indicated significant difference at each level of treatment than untreated control. The J2 population in soil at 1.25 percent concentration is maximum (220) gave better result compare to other concentrations of treatment (**Table 4**).

Table 3 Effect of Metribuzin 70% WP at different concentration on growth parameters and population development of *M. incognita* on tomato (S.S-21)

Treatments	Concentrations	Observations							
		Fresh soot weight (g)	Shoot length (cm)	Fresh root weight (g)	Dry shoot weight (g)	No.of galls	No. of egg saccs	No.of eggs/sacc	Soil populn
Metribuzin 70% WP	0.25%	0.44	13	0.11	0.1	10	10	166.6	318.3
	0.5%	0.51	14	0.14	0.12	9.6	9.6	151.6	336.6
	1.0%	0.57	16.1	0.23	0.19	8.3	8.3	130	346.6
	1.25%	0.63	18.6	0.27	0.25	5.6	5.6	113.3	370
	control	0.18	5.53	0.01	0.04	30	30	350	185.6
	SEm	0.010	0.261	0.006	0.006	0.535	0.535	3.273	6.507
	CD5%	0.031	0.792	0.018	0.018	1.621	1.621	9.928	15.638

Table 4 Effect of Propaquizafop 10% EC at different concentration on growth parameters and population development of *M. incognita* on tomato (S.S-21)

Treatments	Concentrations	Observations							
		Fresh soot weight (g)	Shoot length (cm)	Fresh root weight (g)	Dry shoot weight (g)	No.of galls	No. of egg saccs	No.of eggs/sacc	Soil populn
Propaquizafop 10% EC	0.25%	0.13	5.6	0.03	0.045	12	12	305	180
	0.5%	0.14	6.6	0.04	0.05	11.3	11.3	275	190
	1.0%	0.2	7	0.05	0.05	10.3	10.3	250	205
	1.25%	0.27	7.3	0.06	0.07	10	10	235	220
	control	0.18	5.53	0.01	0.04	30	30	350	185.6
	SEm	0.046	0.656	0.011	0.022	0.519	0.519	3.450	3.741
	CD5%	0.140	1.988	0.033	0.066	1.576	1.576	10.465	11.479

Use of herbicides not only help in eradicating the weed plants but can also have role in reducing the population density of the nematodes. In the present finding the result obtained showed that herbicides viz, Glyphosate 41% SL, Pyrozo sulfuron 10%WP,Metribuzin 70%WP, Propaquizafop 10%EC mitigated the deleterious effect of nematode and thereby enhancing the growth parameters of the tomato plants. The finding indicates that these herbicides exhibits marked reduction in galls, egg masses and J2 in soil. Worldwide conservation technologies have greatly to minimize soil loss. Use of herbicide application have been extensively adapted for the control of weeds, reduce soil erosion, conserve soil structure and improve the labour efficiency. These results are in agreement with the findings of [9] with the metribuzin (M) alone and in combination, on hatching, penetration, development, and reproduction of Meloidogyne incognita (race 3) invitro. [7, 11] Reported that Application of integrated protocols including, urea, IAA combined with the herbicide pendimethalin deserves consideration in the future tactics to maximize the efficiency of nematode control, associated weeds infestation and promoting the yield. IAA either single or combined application showed a potential effects in suppressing root knot nematode M. incognita j2 in soil and increasing eggplant yield. These results are in agreement with the findings of [1].

Conclusion

All the herbicides were significant effect on plant growth parameters but Metribuzin 70% WP is more effective at 1.25 % concentration when compare to others three herbicides.

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