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Effect of sugar beet as a trap crop on the population density of *Meloidogyne incognita* infecting subsequent common dry bean

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Abstract

Sugar beet (*Beta vulgaris* L.) cv. Gazelle was planted under screen house conditions to assess its ability as a trap crop to reduce population density of root-knot nematode, *Meloidogyne incognita* on subsequent common dry bean (*Phaseolus vulgaris* L.). Treatments were made by removing whole plant or cutting sugar beet above the surface of soil in each pot 6, 12, 18, 24, 30 and 36 days after nematode inoculation. The population density of root-knot nematode as indicated by the number of galls and egg-masses on roots of sugar beet increased gradually as influenced by the time of gathering. Root-knot nematode started to lay egg-masses after the 18th day to the 24thday till the end of experiment. On subsequent common dry bean, root-knot nematode significantly ($p \leq 0.05$) reduced on that cultivar of dry bean as influenced by the tested treatments made to sugar beet i.e. cutting or uprooting (removal) and time of harvest. In general, the nematode parameters as indicated by the numbers of galls, egg-masses and hatched juveniles on roots of dry bean and number of juveniles in soil were higher on dry bean plants replacing cutting sugar beet than those on dry bean plants replacing uprooted sugar beet within the most periods. In contrast, plant growth parameters were higher for dry bean plants replacing uprooted sugar beet than parameters for plants replacing cutting sugar beet.

Key words: Sugar beet, common dry bean, trap crop, *Meloidogyne incognita.*

One of the simplest and most cost-effective ways of controlling nematodes is through the use of crop rotations including trap crops to break the life cycle of nematode pests. Also, susceptible plants can be planted to a given period in soil highly infested with nematodes, then when they were removed or uprooted from the soil before nematodes have reproduced or laid eggs on the roots, nematode numbers were reduced (LaMondia & Brodie, 1986; Amin & Youssef, 1997; Chen *et al*., 2001; El-Nagdi & Youssef, 2004). Hafez & Sundararaj (1998) stated that before planting sugar beet, oil radish or mustard were planted as trap crops for reducing *Heterodera schachtii* on sugar beet. They reduced population density of nematode from 87-92% for oil radish and from 62-84% for mustard. Also, the same authors (2000) added that oil radish cv. Adagio and white mustard cv. Metex as trap crops reduced *Heterodera schachtii* population and percentage nematode reduction occurred by using oil radish than from white mustard. Hence, this research aimed at testing the preceding sugar beet (susceptible plant) as trap crop for controlling root-knot nematode, *M. incognita* infecting subsequent common dry bean.

Materials and Methods

Seeds of sugar beet (*Beta vulgaris* L.) var. Gazelle were sown in 15cm diam. clay pots filled with 2 kg solarized clay loam soil (1:1) in January, 2015. After germination, plants in each pot were thinned to one plant/pot. Each pot was inoculated with 1000 newly hatched juveniles of *Meloidogyne incognita*, one month after planting with three replicates for each treatment. All pots were arranged in a randomized complete block design in a screen house at 20±5ºC air temperature. Treatments in group 1 were made by cutting plants above the surface of the soil in each pot 6, 12,18,24,30 and 36 days after nematode inoculation. Other treatments in group 2 were made by uprooting whole plant (removal) from the soil at the same mentioned periods in each pot. Number of galls and egg-masses on roots of cutting sugar beet plants were counted at each period. After each period, the pots in each group were sown with seeds of common dry bean (*Phaseolus vulgaris* L.) cv. Giza 2. Similar replicates planted with dry bean without any treatments served as control. Thirty six days after germination for each treatment, dry bean plants were harvested. The nematodes in soil were extracted from an aliquot of 250g soil by sieving and decanting method according to Barker (1981). Then, the dry bean roots were examined for the number of galls and egg-masses and number of the hatched nematode juveniles on roots was extracted by incubation method (Young, 1954). The reduction in nematode parameters was compared to nematode-inoculated dry bean without any treatment. Also, common dry bean growth criteria including shoot length, dry and fresh weights and fresh weight of roots were recorded.

Results

Data on the number of galls and egg masses of *M. incognita* indicated that they fluctuated on roots of sugar beet var. Gazelle at different periods as the number of galls developed at the 12th day after nematode inoculation. Then it gradually increased till the 36th day after inoculation (Table 1). The root-knot nematode laid egg-masses after the 18th to the 24th days till the end of this experiment, then they gradually increased till the 36th day after nematode inoculation. On subsequent common dry bean, results revealed that the number of nematodes significantly ($p \leq 0.05$) reduced and differed on roots of common dry bean as follows: After cultivating dry bean cv. Giza 2 replacing sugar beet cv. Gazelle in the same pots, the root-knot nematode reduced on that cultivar of dry bean as influenced by the tested treatments made to sugar beet i.e. cutting or uprooting (removal) and time of harvest. In general, the nematode parameters as indicated by the numbers of galls, egg-masses and hatched juveniles on roots and number of juveniles in soil were higher on dry bean plants replacing cutting sugar beet than those on dry bean plants replacing uprooted sugar beet within each period (Table 1).The nematode number reductions for those of galls and egg-masses at each period by either of the two methods and time of planting were calculated compared with those occurred in inoculated plants without any treatments (control). Dry bean growth parameters including shoot length, shoot fresh and dry weights and fresh weight of roots increased as affected by planting time of dry bean replacing sugar beet and method of sugar beet harvesting compared to dry bean plants inoculated with nematode without any treatment (control). In general, these parameters were higher for plants replacing uprooted sugar beet than parameters for plants replacing cutting sugar beet (Table 2).

Discussion

It was obvious that that planting sugar beet var. as a susceptible crop to the root-knot nematode can serve as a trap crops to that nematode infecting subsequent dry bean at the same pot. This can be achieved by cutting or removal preceding sugar beet before planting dry bean at the same pot. In this experiment, the root-knot nematode initiated its egg-masses deposition after the 18th day to the 24th day after nematode inoculation till the end of experiment. Hence, it advised to uproot the preceding sugar beet at this period. Consistency with this result, hatching of *Heterodera rostochiensis* eggs was stimulated by cultivation of *Solanum nigrum* and large numbers of juveniles invaded its roots. As a result, total numbers of nematodes was reduced in soil (Jenkins & Taylor, 1967). Also, oil radish stimulated hatching of sugar beet cyst nematode eggs, then plants were chopped and incorporated into the soil. After decomposition, the number of nematodes in soil was reduced (Hafez, 1994). At the same trend, Hafez & Sundararaj (1999) indicated that planting mustard or buckwheat as trap crop preceding sugar beet increased its yield due to reduction in population of *Heterodera schachtii.* LaMondia (1998) compared tobacco, black nightshade and tomato to assess their efficacy as trap crop for reducing *Globodera tabacum tabacum*. Nematode populations of tobacco cyst nematode were reduced up to 96% by removal tomato and or resistant tobacco grown for 3 to 6 weeks and by 80% by using nightshade or susceptible tobacco grown for the same periods. The potato cyst nematode *(Globodera pallida*) numbers were effectively reduced by the potato trap plant. Three potato cultivars with different degrees of resistance to potato cyst nematode were grown as the main crops.

Table 1. Nematode parameters of root-knot nematode, *Meloidogyne incognita* on common dry bean as affected by the method of sugar beet harvest.

Treatments		Common dry bean						Sugar beet	
		Nematode parameters						Nematode parameters	
		No. of J_2 in soil (200g)	No. of hatched J_2	No. of galls	Red. %	No. of egg-masses	Red. %	No. of galls	No. of egg-masses
Control		393Ba	910 Aa	50 Aa	0	36 Aa	0	-	-
After 6	a	83D	223 B	15A	70	7CD	81	-	-
days	b	150*c	140 bc	7c	86	4cd	89	-	-
After 12	a	300BC	0D	7D	86	2 D	94	-	-
days	b	303ab	80cd	14b	72	9*b	75	2	-
After 18	a	210*C	117BCD	13C	74	10 BC	72	-	-
days	b	110c	100 bcd	8c	84	7	81	2	-
After 24	a	160CD	143BC	10CD	80	4CD	89	-	-
days	b	133c	187b	14b	72	8* b	78	8	3
After 30	a	560*A	167*BC	21*B	58	15* B	58	-	-
days	b	257b	50cd	8c	84	3 cd	92	7	2
After 36	a	280*BC	70CD	22*B	56	15*B	58	-	-
days	b	105c	10d	5c	80	3cd	92	11	7

Values are averages of three replicate; a=Cutting; b=Uprooting; *Significant at 0.05 probability according to T-test for comparison between cutting and uprooting treatments within each period; Figures followed by the same letter (s) are not significantly different at 0.05 probability according to Duncan's Multiple Range Test. Small letters for cutting; Capital letters for uprooting for comparison among all periods.

Table 2. Growth parameters of common dry bean infected by the root-knot nematode, *Meloidogyne incognita* as affected by the method of sugar beet harvest.

Treatments		Growth parameters of common dry bean			
		Shoot length (cm)	Shoot fresh weight (g)	Shoot dry Weight (g)	Root weight (g)
Control		30.3BCa	6.6 Bc	1.7 Cd	2.8
After 6	a	29.5C	12.6 B	2.0 BC	4.0
days	b	34.0a	13.5 bc	3.9* abc	3.9
After 12	a	36.5*A	18.5*A	4.5* A	3.2
days	b	31.7a	10.8 c	3.2 cd	2.7
After 18	a	35.0BC	9.7 B	3.2 B	3.1
days	b	35.0a	15.4 bc	4.1* abc	4.2
After 24	a	30.7BC	11.1 B	2.3 BC	2.6
days	b	37.7*a	18.3*ab	3.6* bcd	2.7
After 30	a	35.0BC	19.3 A	4.2 A	4.9
days	b	40.7*a	19.4 a	5.5* a	4.1
After 36	a	31.0BC	11.8 B	2.5 BC	2.9
days	b	32.5a	12.3 c	4.2* ab	3.4

Values are averages of three replicates; a=Cutting, b=Uprooting; *Significant at 0.05 probability according to T-test for comparison between cutting and uprooting treatments within each period; Figures followed by the same letter (s) are not significantly different at 0.05 probability according to Duncan's Multiple Range Test. Small letters for cutting;Capital letters for uprooting for comparison among all periods.

Highly resistant potato cultivar planted as a main crop replacing the trap plant reduced the post-harvest soil infestation by nematodes and other pathogens. Moderately resistant cultivar replacing the trap crop reduced the soil infestation. The trap crop alternated with a susceptible potato cultivar as a main plant, increased soil infestation slightly but compared to non trap crop, the degree of control reached 96% (Scholte, 2000).

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