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Categorization of certain imported sugar beet varieties as affected by population density of root knot Nematode, *Meloidogyne incognita* in Egypt

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Abstract : Under open field conditions, ten sugar beet (*Beta vulgaris* L.) varieties were evaluated for their susceptibility/resistance against root knot nematode, *Meloidogyne incognita* according to nematode damage index (DI) which was calculated as an average of gall index, gall size and gall area. The percentage host vigor was calculated as an average of percentages root and leaf weight potentials and the tested technological characteristics (%sucrose, % purity and %total soluble solids) which used as a new scale to assess host reaction. The degree of susceptibility/resistance according to DI was combined with the percentage host vigor of each variety to give a better evaluation and clear relationship between nematode infection and sugar beet variety yield quality and quantity. On this basis, sugar beet varieties were categorized into nine varieties as tolerant (BTS 237, BTS301, BTS302, BTS303, Gazelle, Meridi, Panther, SN626 and Tenor) and one as highly resistant (SN627) against root knot nematode. The highly resistant or tolerant sugar beet varieties determined in this study could be recommended for breeding programme and could be introduced in integrated pest management for controlling root knot nematode.

Key words: Sugar beet varieties, *Meloidogyne incognita*, damage index, host vigor.

Introduction

Sugar beet (*Beta vulgaris* L.) is considered the most important source of sugar production after sugar cane. The rapid increase in world population, especially in the developing countries including Egypt, requires an increased agricultural production in quantity and quality. The sedentary endoparasitic root-knot nematodes (*Meloidogyne* spp.) rank high among nematode pests in Egypt[1,2, 3,4,5,6,7], attacking a wide range of crops including sugar beet[8,9.10]. Sugar beet yield losses due to damage by plant parasitic nematodes to be 12% in Egypt which incite annual losses of 1, 244,462.5 metric tons (= $ 55 million)[4]. Maareg *et al.*, (1998)[11] classified some sugar beet varieties into highly susceptible, susceptible and moderately resistant against the root knot nematodes, *M. incognita* and *M. javanica* based on number of galls or egg masses. El-Nagdi *et al*.(2004)[12] evaluated thirty varieties of sugar beet infected by *M. incognita*. Some varieties were classified as highly susceptible, susceptible or moderately resistant to root knot nematode on the basis of their vigor and damage index (DI) which were combined together to introduce a better evaluation for the tested varieties. Also, Abd-El-Khair (2013)[13] reported that *Meloidogyne* spp.were the most common in sugar beet in certain governorates in Egypt. They added that evaluated five sugar beet varieties exhibited various degrees of susceptibility to *M. incognita* depending on their damage index. The present research aimed at evaluating new imported sugar beet varieties and their plant vigor against root knot nematode, *M. incognita* under field conditions.

Materials and Methods

This study was conducted in clay loam soil field naturally infested with root- knot nematode(*M. incognita*), under a spraying irrigation system by overhead sprinklers during the 2014-2015 season in Nubaryia region, El- Beheira Governorate, Egypt. The experimental field was divided into five blocks and each block was divided into ten plots, each measuring 3 × 3.5 m^2 (= 10.5 m^2 i.e. 1/400 Feddan) and consisted of five rows spaced 50 cm apart. There were five replicates (rows) per variety according to a completely randomized block design. The ten varieties in Table 1 were sown in the first week of October, 2014. All varieties were managed throughout the growing season by standard agricultural practices and were irrigated as needed.

Eight months after sowing, plants were harvested in May 21, 2015. The roots (tubers) were gently washed to avoid the adhering soil. The tested sugar beet varieties were evaluated on the basis of the scale suggested bySharma *et al*.(1994)[14] depending of damage index (DI) which is an average of gall index, gall size and gall area. The percentage total yield weight potential was calculated for each variety by dividing total yield of each variety (root and leaf weights) on the highest total yield of a given one multiplied by 100. Total soluble solids percent (%TSS) was measured in fresh weight of roots by using hand refractometer. The percentage sucrose was determined according to Le-Docte (1927)[15], percentage juice purity was determined as ratio between %sucrose and %TSS as described by Carruthers and Oldfield (1961)[16]. % Plant vigor was calculated as an average of percentages both total yield potentials and technological characteristics under study.

Table (1). Seed type and origin of sugar beet varieties used in the study.

Origin	Seed type	Variety
Germany	Multigerm	BTS 237
Germany	Multigerm	BTS301
Germany	Multigerm	BTS302
Germany	Multigerm	BTS303
Denmark	Multigerm	Gazelle
Germany	Multigerm	Meridi
Germany	Multigerm	Panther
Netherlands	Monogerm	SN626
Netherlands	Monogerm	SN627
Germany	Multigerm	Tenor

Results

The host responses of ten sugar beet varieties belonging to monogerm and multigerm to root knot nematode, *M. incognita* infestation are shown in Table (2). The degrees of susceptibility/resistance of the tested varieties were determined according to scale suggested by Sharma *et.al.* (1994)[14] based on damage index (DI) scale. They were classified into four varieties as highly susceptible, five as susceptible and one variety as moderately resistant to root knot nematode. Table (3) showed average of quantitative (the percentages total yield potentials) and qualitative (total soluble sugars (%TSS), % sucrose and% purity) characteristics of the various varieties in the form of the percentage plant vigor. Based on the percentage plant vigor, the tested varieties were classified into ten varieties as less affected in the form of host reaction. Based on combination between degree of host susceptibility/resistance and host reaction mentioned before, the tested sugar beet varieties were categorized into nine varieties as tolerant (BTS 237, BTS301, BTS302, BTS303, Gazelle, Meridi, Panther, SN626 and Tenor) and one as highly resistant (SN627) against root knot nematode (Table 4).

Table (2). Relative susceptibility of ten sugar beet varieties against *Meloidogyne incognita* under field conditions.

Sugar beet varieties	No. of galls	Gall index (GI)	Gall size (GS)	Gall area (GA)	Damage index (DI)*	Host resistance/susceptibility
BTS 237	79	7.8	7.0	7.0	7.3	Highly susceptible
BTS301	44	6.0	5.5	5.5	5.7	Susceptible
BTS302	63	7.3	6.5	6.5	6.8	Susceptible
BTS303	55	6.8	6.0	6.0	6.3	Susceptible
Gazelle	70	7.5	7.0	7.0	7.2	Highly susceptible
Meridi	53	7.3	7.0	7.0	7.1	Highly susceptible
Panther	59	7.0	7.0	7.0	7.0	Susceptible
SN626	35	5.5	5.0	5.0	5.2	Susceptible
SN627	28	5.0	5.0	5.0	5.0	Moderately resistant
Tenor	110	8.8	9.0	8.5	8.8	Highly susceptible

-Values are averages of five replicates (plant roots).

-*Damage index (DI) according to Sharma *et al.* (1994)[14] which is an average of gall index, gall size and gall area.

Table (3). Technological characteristics, total yield (leaf and tuber weights) and plant vigor of ten sugar beet varieties against *Meloidogyne incognita* under field conditions.

Sugar beet varieties	% TSS	% S	% P	Leaf fresh weight (ton/fed.)	Tuber weight (ton/fed.)	Total yield (leaf and tuber weights)	%Potential of total yield*	% plant vigor**
BTS 237	21.0	17.3	82.5	9.2	26.5	35.7	93.5	53.5
BTS301	21.6	17.0	78.6	10.3	25.7	36.0	94.2	52.9
BTS302	21.3	17.0	79.8	9.4	28.7	38.1	99.7	54.5
BTS303	21.6	16.7	76.9	8.9	27.7	36.6	95.8	52.8
Gazelle	21.0	16.3	79.4	8.0	25.2	33.2	86.9	50.9
Meridi	20.0	16.7	83.4	8.7	25.2	33.9	88.7	52.2
Panther	21.3	17.3	82.8	8.0	27.1	34.1	89.3	52.7
SN626	21.0	17.3	82.6	8.0	23.6	31.6	82.7	50.9
SN627	21.0	17.7	84.2	9.3	28.9	38.2	100.0	55.7
Tenor	20.6	17.0	82.4	8.2	24.7	32.9	86.1	51.5

--Values are averages of five replicates (plant roots).

-*The percentage total yield potential = total yield of each variety /the highest total yield of a given variety multiplied by 100. %TSS= Total soluble solids, %S= Sucrose, %P=Purity.

- **%Plant vigor = an average of (% total yield potential +% total soluble solids +% sucrose+ % purity).

Table (4). Different host reactions and categories of ten sugar beet varieties to *Meloidogyne incognita* under field conditions.

Varieties	Nematode parameters		Host parameters		Host category***
	Damage index (DI)	Host resistance/susceptibility*	Host vigor %	Host reaction**	
BTS 237	7.3	Highly susceptible(HS)	53.5	Less affected (LA)	Tolerant(T)
BTS301	5.7	Susceptible(S)	52.9	Less affected (LA)	Tolerant(T)
BTS302	6.8	Susceptible(S)	54.5	Less affected (LA)	Tolerant(T)
BTS303	6.3	Susceptible(S)	52.8	Less affected (LA)	Tolerant(T)
Gazelle	7.2	Highly susceptible(HS)	50.9	Less affected (LA)	Tolerant(T)
Meridi	7.1	Highly susceptible(HS)	52.2	Less affected (LA)	Tolerant(T)
Panther	7.0	Susceptible(S)	52.7	Less affected (LA)	Tolerant(T)
SN626	5.2	Susceptible(S)	50.9	Less affected (LA)	Tolerant(T)
SN627	5.0	Moderately resistant(MR)	55.7	Less affected (LA)	Highly resistant(HR)
Tenor	8.8	Highly susceptible(HS)	51.5	Less affected (LA)	Tolerant(T)

-*Host resistance/susceptibility: according to Sharma *et al*. (1994)[14].

-Host reaction:** 0-30% host vigor= Highly affected (HA), 31-50% host vigor=Moderately affected (MA), 51-100 host vigor= Less affected (LA).

-*Host category:** HS or S+HA=HS; HS or S +MA=S; HS or S+LA=T; HR or MR or R+HA=MR; HR or MR or R+MA=R; HR or MR or R+LA=HR; HS=Highly susceptible, S=Susceptible, HR=Highly resistant, MR=Moderately resistant, R=Resistant, T=Tolerant.

Discussion

In this study, the infestation of the tested sugar beet varieties either monogerm or multigerm varied in their susceptibility/resistance against root knot nematode, *M. incognita* infection. These varieties were categorized according to damage index(DI) suggested by Sharma *et al*.,(1994)[14] and the percentage plant vigor was calculated as an average of percentages total yield potentials + technological characteristics(total soluble solids%, sucrose% and purity%) as suggested by El-Nagdi *et al*. (2004)[12]. The present results showed that four varieties were classified as highly susceptible, five varieties as susceptible and one variety as moderately resistant to root knot nematode based on DI scale. It is worthy to notice that all of the tested sugar beet varieties were classified as less affected (LA) on the basis of the percentage plant vigor scale in the form of host reaction. However, the combination between the percentage plant vigor and DI scale indicated that nine cultivars were categorized as tolerant to this nematode in the form of host category. The same sugar beet varieties were categorized by Youssef and El-Nagdi (2015)[17] under screen house conditions into one variety which was considered highly susceptible (BTS303), four varieties as susceptible (BTS 237, Gazelle, Meridi and SN627), one variety as highly resistant (Panther), three varieties as resistant (BTS301, BTS302 and SN626) and one variety as tolerant (Tenor) in the form of host category. The different responses of the tested varieties in the screen house compared to that in the open field may be due to soil type and size, soil temperature and other abiotic and biotic factors. Plant susceptibility/resistance could be attributed to the dominant nematode species or strain, physiological and chemical status of the plant[18,19,20] and soil temperature[21,22].

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