Host Suitability of Four Potato Cultivars To *Meloidogyne Incognita* Infection Under Greenhouse Conditions

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Abstract

Greenhouse experiment was conducted to evaluate suitability of four potato cultivars i.e. Cara, Draga, Spunta and Solana against *M. incognita* infection at 20±3°C. Results indicated that none of the tested potato cultivars was immune to nematode infection since galls or egg masses on root system of such cultivar was recorded and all plant growth parameters were obviously diminished. Among the tested potato cultivars, Spunta showed the highest percentage reduction values of all plant growth characters. Host category of the tested cultivars was determined according to the relationship between host growth response in term of reduction % of whole plant fresh weight and R Factor recorded that Cara and Draga potato cultivars were classified as moderately resistant (MR), whilst potato cvs. Spunta and Solana were rated as highly susceptible (HS) and susceptible (S), respectively.

Key words: Potato cultivars, host suitability *Meloidogyne incognita,* greenhouse.

Introduction

Potato, *Solanum tuberosum* L. is a major food crop in many countries of the world. In Egypt, Potato is one of the most important vegetable crops which used for local consumption and exported. Major pests of potato include various plant parasitic nematodes cause significant damage by reducing number and size of tubers that resulting in low quality of tubers. Many species of nematodes especially root-knot nematodes have been reported to attack potato in Egypt **(Salem, 2006).** Efforts have to be constantly done to improve the yield of such vegetable crop as they are stable food to million of people. Such increase in yield can be achieved from using higher yielding cultivars. The suitability of a host for plant-parasitic nematodes is expressed as the ability of the nematode to multiply on the plant. Host suitability may be expressed objectively as the ratio of the number of nematode units recovered at the end of the test, the final nematode population density (P_f), to the number of nematode units used to inoculate the plant, the initial population density (Pi) **(Lewis, 1987).** It is well known that plants reacted differently to various nematodes. So, this work was carried out to test four potato cultivars to *M. incognita* infection under greenhouse conditions.

Materials and Methods

1. Source of Nematodes and Preparation of *Meloidogyne incognita juveniles* as Nematode inoculum:

The root-knot nematode, *M. incognita* culture was initiated by single eggmass of previously identified females (**Talyor *et al.,* 1955**) and isolated from galled roots of highly infected tomatoes collected from Mansoura country, Dakahlia governorate, Egypt and propagated on coleus plants, (*Coleus blumei*) plants in the greenhouse of Nematology Research Unit, Agricultural Zoology Department, Faculty of Agriculture, Mansoura University, where this work was done. Nematode inoculum of *M. incognita* juveniles was then prepared according to the method recorded by **Hussey and Barker, (1973).**

2. Host Suitability of Certain Potato Cultivars to *Meloidogyne incognita* Under greenhouse conditions(20±3C°).

Four cultivars of the commercial cultivated potato i.e. Cara, Draga, Spunta and Solana were used. Plastic bags with four pores filled with 3Kg. Steam sterilized sand loamy soil (1:1) (v: v) each were separately planted with one peace tuber of one sprout from each tested cultivar after surface sterilized. Thirty two plastic black bags were used in this experiment, eight for each potato cultivar where four bags of them was inoculated with 2000 J2 of *M. incognita* two weeks after potato germination ,while other four plastic bags left free of nematode inoculums to serve as control treatment. All plastic bags were arranged in block design system and horticuluterally treated the same under greenhouse conditions at 20±3C°. After forty five days of nematode inoculation, plants were uprooted and root systems were washed from adhering soil. Length and fresh weight of shoot, root and shoot dry weight as well as numbers and weight of tubers of each replicate per each cultivar were measured and percent reduction in such plant growth criteria were calculated in relation to healthy plants (The uninoculated ones). Number of juveniles (J_2) in soil of each plastic bag/potato cultivar in addition galls, eggmasses and females per root system were counted and recorded. The infected roots were stained in acid fuschin (**Byrd et al.1983**), washed in tap water and placed in pure cold glycerin (**Goodey, 1957**). After clearing, number of endo-parasitic forms were determined with the aid of a stereomicroscope. The nematode reproduction(R Factor)on each potato cultivar was calculated by dividing the final nematode population (PF) to the initial population (Pi). Root gall index (RGI) and eggmass index(EI) were determined according to the scale given by **Taylor and Sasser (1978)** as follows:0=no galls or eggmasses,1=1-2 galls or eggmasses, 2=3-10 galls or eggmasses, 3=11-30 galls or eggmasses, 4=31-100galls or eggmasses and 5=more than 100 galls or eggmasses. Host suitability was measured according to the designations based on the relation between root gall index (RGI) and nematode reproduction (R Factor)

according to **Canto-Saenz (1983)** as follows RGI<2 & R<1 = resistant(R), RGI<2& R>1= tolerant(T) and RGI>2& R>1 = susceptible. Data were subjected to analysis of variance (ANOVA) **(Gomez and Gomez, 1984)** followed by Duncan's multiple rang tests to compare means **(Duncan, 1955)**.

Results and Discussion

Data in Table (1) and Figure (1) showed the influence of *M. incognita* infection on plant growth parameters of four potato cultivars i.e. Cara, Draga, Spunta and Solana under greenhouse conditions (20±3C°). Results indicated that all plant growth characters of such tested potato cultivars were obviously reduced by *M. incognita* infection to great extent. Among the potato cultivars tested, Spunta showed the highest percentage reduction values of all parameters tested i:e length of plant (97.6%), total fresh weight of plant (75.5%) shoot dry weight (78.7%), number of tuber (58.8%), fresh weight of tuber (96.7%), number of leaves/ plant (94.4%) and number of stolen/ plant (89.7%), respectively followed by Draga cultivar in certain plant growth criteria i.e. total plant length (42.9%) and shoot dry weight (57.1%) respectively and those of Cara cultivar i.e. number of stolen per plant (47.5%) and fresh weight of tuber (33.3%) and then those of Solana cultivar, especially length of plant (30.7%) shoot dry weight (28.6%) and number of leaves per plant (44.7%) respectively, comparing with the uninoculated ones . However, plant growth parameters such as length of plant, total plant fresh weight, fresh weight of tubers of Cara cultivar achieved the lowest percentage reduction values of 13.7, and 33.3% respectively, whereas those of Draga cultivar were restricted to total plant fresh weight (22.7%), number of stolen per plant (37.9%), and leaves/plant (31.5%), and tuber (28.5%) and fresh weight of tuber (21.7%), respectively. Meanwhile, Solana cultivar showed the lowest percentage reduction value of fresh weight of tuber (35.0%). compared to the uninoculated one, respectively (Table1).

Data in tables (2&3) illustrated nematode parameters and host suitability of the tested four potato cultivars revealed that none of these cultivars was immune to *M. incognita* infection, since galls and eggmasses were found on roots of all the tested cultivars. Various numbers of nematode developmental stage and females were also noticed inside their root systems depending upon their degree of resistance. Host category of the tested potato cultivars was determined by the designation given by **Canto-Saenz (1983)** based on Root gall index and R factor. It was found that Cara and Draga cultivars were rated as tolerant cultivars with R Factors 0.76 and 0.47, and RGI equal 2 and 2, respectively, whereas Spunta and Solana cultivars were classified as susceptible host since their root galls indices 4.0 and 2.0 with R factors 1.98 and 1.3, respectively (Table 2).

Table (1): Plant growth response of four potato cultivars as affected by *M. incognita* under greenhouse conditions (20±3°C).

Potato cultivars	Treat.	** Plant Growth Response																	
		Plant length (cm)				Fresh weight (g)				Stolen		Leaves		Tubers				Dry shoot	
		Shoot	Root	Total	Red. %	Shoot	Root	Total	Red. %	No.	Red.%	No.	Red. %	No.	Red. %	WT.	Red. %	WT.	Red. %
Cara	*N	7.3 e	10.2f	17.5f	13.7	3.9e	2.6d	6.5d	11.5	4.0d	47.5	11.5e	43.5	3.4bc	41.2	42.0b	33.3	2.5abc	30.6
	CK	8.5 e	11.8e	20.3f	-	7.8ab	5.3c	13.1b	-	5.9c	-	16.5d	-	4.7b	-	56.0a	-	3.6 a	-
Draga	*N	22.5d	16.0c	38.5d	42.9	4.9de	10.0a	14.9ab	22.7	5.8c	37.9	11.9e	31.5	3.5bc	28.5	46.0b	21.7	1.4 c	36.4
	CK	29.0c	26.0b	55.0b	-	8.7a	7.3b	16.0a	-	8.0b	-	25.0b	-	4.5b	-	56.0a	-	2.2 bc	-
Spunta	*N	22.8d	10.6ef	33.4e	97.6	5.4cd	4.0cd	9.4c	75.5	8.7b	8.04	18.0d	94.4	4.0bc	88.9	30.5c	96.7	1.4 c	44.0
	CK	36.0b	30.0a	66.0a	-	8.5a	8.0b	16.5a	-	16.5a	-	35.0a	-	8.5a	-	60.0a	-	2.5abc	-
Solana	*N	34.5b	9.5f	44.0c	30.7	4.6de	3.6cd	8.2cd	23.2	4.0d	38.5	22.8c	44.7	2.3c	43.5	20.0d	35.0	2.5abc	28.6
	CK	44.0a	13.5d	57.5b	-	6.6bc	3.5d	10.1c	-	6.5c	-	33.0a	-	3.3bc	-	27.0cd	-	3.5 ab	-
$LSD_{P=5\%}$		4.0	1.5	4.3	-	1.4	1.6	2.0	-	1.2	-	2.0	-	1.6	-	9.3	-	1.2	-

*N = 2000 J_2 of *M. incognita*

**Each value is the mean of four replicates.

Means in each column followed by the same letter(s) did not differ significantly at P< 0.05 according to Duncan's multiple- range test.

Reduction% = [(CK – N)/N] X 100

Table (2). Development and reproduction of *M. incognita* infecting four potato cultivars under greenhouse conditions (20±3°C).

Potato cultivars	*Average number of nematodes in..			Total number of nematodes (final population (Pf))	Rate of build up (R)	*No. of galls	RGI	*No. of eggmasses	EI
	Soil	Roots							
	J 2	Dev. stages	Females						
Cara +N	1480.0 c	25.0 b	6.0 c	1511.0 c	0.76	10.0 b	2.0	7.0 b	2.0
Draga +N	899.0 d	27.0 b	7.0 bc	933.0 d	0.47	10.0 b	2.0	8.0 b	2.0
Spunta +N	3890.0 a	42.0 a	18.0 a	3950.0 a	1.98	35.0 a	4.0	20.0a	3.0
Solana +N	2568.0 b	28.0 b	8.0 b	2604.0 b	1.3	10.0 b	2.0	9.0 b	2.0
$LSD_{P=5\%}$	3.4	4.3	1.09	6.5	---	2.8	---	2.8	---

*Each value is the mean of four replicates . N = 2000 j2 of *M. incognita* .

Means in each column followed by the same letter(s) did not differ significantly at P< 0.05 according to Duncan's multiple- range test.

Rate of build-up (R) = Final nematode population (RF)/Initial nematode population

Root gall index (RGI) or egg-masses index (EI) was determined according to the scale given by **Taylor &Sasser (1978)** as follows:

0=no galls or eggmasses, 1=1-2 galls or eggmasses, 2 = 3-10 galls or eggmasses

3=11-30 galls or eggmasses , 4=31-100 galls or eggmasses, and 5=more than 100 galls or eggmasses.

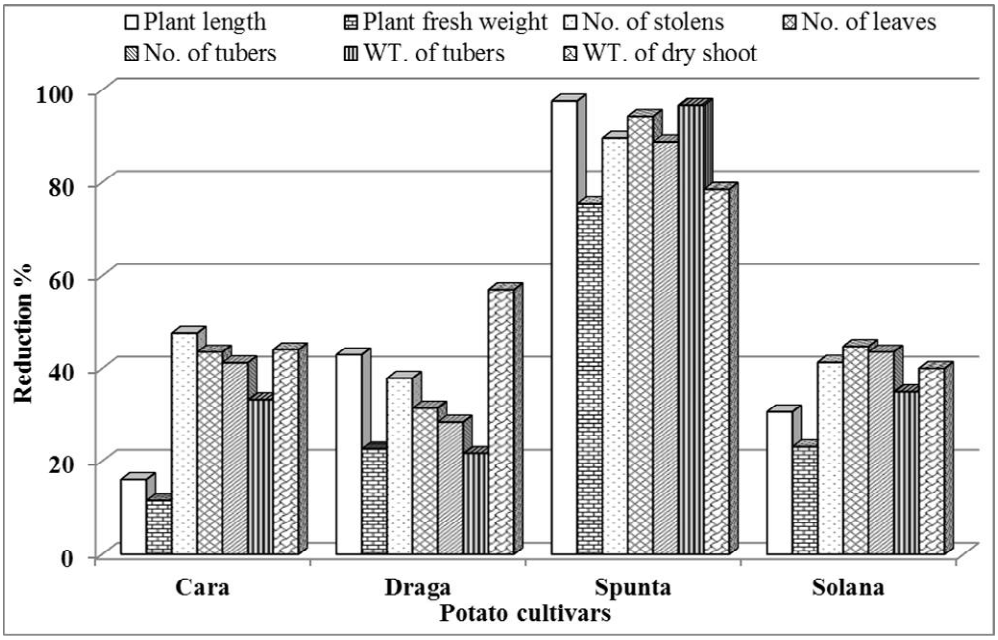

Fig. (1): Reduction percentages in some plant parameters of four potato cultivars as affected by *M. incognita* under greenhouse conditions (20±3°C).

On the other hand, host category of the same four potato cultivars was determined according to the relationship between host growth response in term of reduction % of whole plant fresh weight and R Factor as follows, two cultivars out of the four tested were classified as moderately resistant (MR) i.e. Cara and Draga whilst potato cvs. Spunta and Solana were rated as highly susceptible (HS) and susceptible host (S), respectively. (Table3).

Table (3): Relative susceptibility of four potato cultivars against *M. incognita* infection under greenhouse conditions (20±3°C).

Potato plant cultivars	Plant fresh weight Red.%	R	(1) Host category	RGI	R	(2) Host category
Cara	11.5	0.76	MR	2.0	0.76	T
Draga	22.7	0.47	MR	2.0	0.47	T
Spunta	75.5	1.98	HS	4.0	1.98	S
Solana	23.2	1.3	S	2.0	1.3	S

R=Rate of build-up=Pf

(1) Host category based on the relationship between host plant growth response (% reduction in total plant fresh weight) and reproduction factor (RF) as for as follows: 0-10% reduction in plant growth , RF=0 immune (I), RF < 1, Resistant (R) > 1 Tolerant (T), 11-30% reduction in plant growth, RF< 1, Moderately Resistant (MR), RF>1 Susceptible (S), and 31% < reduction in plant growth, RF< 1 Intolerant (IT), RF>1Highly Susceptible (HS).

(2) Host Category based on relationship between RGI & R Factor according to Canto-Saenz (1983) as follows: RGI ≤ 2 & R ≤ 2 (Resistant), RGI ≤ & R >1 (Tolerant) (T); RGI ≥ 2 & R ≥ 1 (Susceptible (S).

Apparently, this research paper showed that among tested potato cultivars against *M. incognita* infection under greenhouse conditions at 20±3°C, Spunta gave the highest percentage diminishing values of plant growth criteria under this study, followed by Daraga and then Solana in criteria of plant growth characters comparing with the control. Concerning the host category of the tested potato cultivars, none was immune to *M. incognita* infection, since galls or eggmasses on root system of such cultivar was found and all plant growth parameters were reduced with varying number of juveniles and female depending on their degree of resistance. In the meantime, based on the relationship between root-gall index and R factor (**Hadisoeganda & Sasser, 1982**). Draga and Cara cultivars were rated as moderately resistant (MR) hosts, whereas, Spunta cultivar was classified as highly susceptible host (HS) whereas Solana was rated as susceptible(s) to *M. incognita* infection. Moreover, the present results are also in agreement with these of **Shalaby (2008),** in this respect who recorded that Draga and Cara potato were affected by *M. incognita* infection whereas, Spunta was classified as highly susceptible host (HS) to the same nematode infection. Furthermore, the usefulness of these cultivars in crop rotation schemes in contaminated soil with *Meloidogyne* spp. is very limited because none of the tested cultivars showed high degree of resistance to such nematode infection.

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حساسية أربعة أصناف بطاطس للإصابة بنيماتودا

تعقد الجذور "ميلدوجينى أنكوجنيتا" تحت ظروف الصوبة الزراعية

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الملخص العربي

تم إجراء تجربة تحت ظروف الصوبة الزراعية لتقييم أربعة أصناف بطاطس هي: كارا، دراجا، سبونتا، سولانا للإصابة بنيماتودا "ميلدوجينى انكوجنيتا" عند درجة حرارة ٢٠±٣°م. أوضحت النتائج أنه لا يوجد أي من الأصناف المختبرة منيعة للإصابة بالنيماتودا حيت تم تسجيل عقد نيماتودية وكتل بيض على المجموع الجذري لأصناف البطاطس المختبرة، ووجد أن جميع الصفات النباتية المختبرة قد تأثرت بالإصابة بالنيماتودا وأن الصنف أسبونتا أظهر أعلى معدل انخفاض في مقاومته للإصابة بالنيماتودا وتم تقييم الأصناف المختبرة طبقًا للعلاقة بين معدل انخفاض الوزن الرطب الكلى للمجموع الخضري ومعدل تكاثر النيماتودا الذي أسفر على أن صنفي البطاطس كارا ودراجا أنهم أصناف متوسط المقاومة للإصابة (MR) وأما الصنف أسبونتا عالي الإصابة (HS) بينما الصنف سولانا فهو صنف قابل للإصابة (S) بنيماتودا العقد الجذور "ميلدوجيني أنكوجنيتا".