REACTION OF SOME POTATO CULTIVARS TO *MELOIDOGYNE INCOGNITA* INFECTION WITH REFERENCE TO N, P, K AND TOTAL CHLOROPHYLL STATUS.

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ABSTRACT

A greenhouse experiment was conducted to study the reaction of three potato cultivars i.e. Cara, Draga, Spunta to *Meloidogyne incognita* infection through certain plant growth parameters; and rate of nematode reproduction and development. Results indicated that all tested parameters were obviously reduced by *M. incognita* infection to various degrees. Of the potato cultivars tested, sponta showed the highest percentage of reduction values of plant length (60.3%), total fresh weight of plant (35.7%), shoot dry weight (16.7%), tuber diameter (35.7%), number of tuber (40%), tuber fresh weight (49.2%), number of leaves/plant (27.3), and Leave area (16.2%)., respectively, followed by Draga and Cara cultivars in certain growth Parameters as compared with the uninoculated ones. Due to the relationship between root gall index (RGI) and reproduction factor (RF), Draga and Cara cultivars were rated as resistant hosts, whereas, Sponta cultivar was considered as susceptible host to *Meloidogyne incognita*, since its root gall index was 3 (RGI≥2), associated with R factor value of 1.89(R≥1). With respect to the status of nitrogen, phosphorus, and potassium concentrations in leave or tuber as well as starch content, T.ss %, vitamin-C in tuber and total chlorophyll in leave for the potato cultivars tested against *M. incognita*, infection were recorded and discussed.

Key words: *Meloidogyne incognita*, potato cultivars. i.e. Cara , Draga , Spunta , Nitrogen , phosphorus , potassium , T.s.s , starch , vitamin-c , chlorophyll content.

INTRODUCTION

Potato, *solanum tuberosum* L. is a major food crop in many countries of the world including Egypt. Efforts have recently been devoted to improve potato yield quality as well as cultivars in order to expand their cultivated area to include the newly reclaimed soils in Egypt. Potato is subjected to be attacked by various plant parasitic nematodes that causing great damage by reducing number and size of tubers and low quality (Talavera, *et al.*, 1998).In Egypt, many species of nematodes, especially, root-knot nematodes were recorded to invade potato (Abd-Allah, 1999, Shady, 2002 and Salem, 2006). The host suitability of certain potato cultivars to the infection of root-knot nematodes *Meloidogyne spp*. was recorded by several workers (Canto-Saeynz and Brodie, 1986 and 1987, Ahmed, 1989, Anter, 1989, Brown *et al*., 1991, Janssfn *et al.*, 1995, Aboul-Eid and Youssef, 1998, Abd-Allah, 1999, and Shady, 2002). Due to the lack informations about certain potato cultivar in relation to root-knot nematodes, *Meloidogyne incognita* infection, therefore, the present work aimed to study the reaction of these potato cultivars i.e. Draga, Cara, Spunta to *Meloidogyne incognita* infection under greenhouse conditions with reference to nitrogen, phosphorus and potassium concentrations in leave or tubers as well as starch contents, (total soluble solids) T.s.s% , vitamin-C, in tuber and total chlorophyll contents in leaves status.

MATERIALS AND METHODS

I- Source of nematodes and preparation of *Meloidogyne incognita* eggs as nematode inoculum:

Second stage juveniles (J_2) and eggs of *meloidogyne incognita* (kofoid& White) Chitwood, were obtained from a pure culture of *M. incognita* that was initiated by single eggmass and propagated on coleus ,(*Coleus blumei)*plants in the greenhouse of nematology research Unit, Agricultural Zoology Department , faculty of Agriculture , Mansoura University , Egypt, where this experiment was carried out. Nematode inoculum of M. incognita eggs was then prepared according to the method recorded by Hussey and Barker, (1973).

II –Host suitability of certain potato cultivars to *Meloidogyne incognita* under greenhouse condition.

Three cultivars of the commercial cultivated potato i.e. Cara, Draga, sponta 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 cultivars after surface sterilized. Eighteen plastic bags were used in this experiment, six for each potato cultivar where three bags of them was inoculated with 2000 eggs of *M.incognita* fifty days after seed germination. While other three bags left free of nematode inoculum and served as control treatment. Plastic bags then received water as needed. All plastic bags were arranged in block design system and agronomically treated the same under greenhouse condition at 22±1.5C°. Seventy days after 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 were measured and percent reduction in such growth parameters were calculated in relation to healthy plants (the uninoculated ones). Number of juveniles (J_2) per soil of each plastic bag / potato cultivar, galls, eggmasses and females per root system were counted and recorded. The infected roots were stained in acid fuschin (Byrd, 1983), washed in tap water and placed in pure cold glycerin (Goodey, 1957). After clearing, numbers of endo-parasitic froms were determined with the aid of a stereomicroscope. Concerning N, P and K determination, 0.2g. of dry weight of shoot was subjected to chemical analysis as follows: total nitrogen content was determined according to the improved kjeldahl method (A.O.A.C, 1980) modified by distilling the ammonia into saturated boric acid solution and titration with (0.1Nacl) standard.Total phosphorus was colorimetrically determined using the chlorostannous reduced Molybdophosphoric blue colour method, while total potassium was flam photometry estimated as described by Jakson (1967). Chlorophyll content was spectrophotometrically measured in leaves of the harvested plant using Fadeel's method (1962) chlorophyll concentrations were calculated according to Wellburn and Lichtenthaler (1984). The content of chlorophyll was then expressed in mg/g.F.wt of leaves, T.s.s was measured by using hand refractometer(A.O.A.C,1980) the nematode reproduction (R factor) on each cultivar was calculated by dividing the final nematode population (Pf) to the initial nematode population (Pi). Root gall index (RGI) and egg-mass index (EI) were determined according to the scale given by Taylor and Sasser (1978) as follows: 0= no galls or egg-masses, 1= 1-2 galls or egg-masses, 2= 3-10 galls or egg-masses, 3= 11-30 galls or egg-masses, 4= 31-100 galls or egg-masses and s= more than 100 galls or egg-masses. 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 $\leq$2 &R $\leq$ 1) résistant, (R); (RGI $\leq$2 & R>1) tolérant (T) and (RGI$\geq$2& R$\geq$1) susceptible. Data were subjected to analysis of variance (ANOVA) (Gomez and Gomez, 1984), followed by Duncan's multiple range tests to compare means (Duncan, 1955).

RESULTS

Data in Table (1) showed the influence of *Meloidogyne incognita* infection on growth parameters of three potato cultivar seedlings i.e. Spunta, Draga and Cara under greenhouse conditions. Results revealed that all growth parameters of such tested potato cultivars were obviously reduced by *M. incognita* infection to certain extent. Among the potato cultivars tested, Sponta showed the highest percentage reduction values of all parameters tested i.e. length of plant (60.3%), total fresh weight of plant (35.14%), shoot dry weight (16.7%), tuber diameter (35.7%), number of tuber (40%), fresh weight of tuber (49.2%), number of leaves/plant (27.3%) and leaves area (16.2%), respectively, followed by Draga cultivar in certain growth parameters i.e. total fresh weight/plant (34.68%), number of tuber (40%) and tuber diameter (28.3%), respectively and those of Cara cultivar i.e. length of plant (13.9%), shoot dry weight (16.2%), fresh weight of tuber (33.3%),number of leaves/plant (25%) and leaves areas (16.6%), respectively comparing with uninoculated one. However, growth parameters such as length of plant, shoot dry weight, fresh weight of tuber, number of leaves/plant and leaves area of Draga achieved the lowest percentage reduction values of 7.9%, 6.5%, 19.4%, 8.3% and 6.5%, respectively, whereas those of Cara cultivar were restricted to total fresh weight of plant (24.4%), tuber diameter (19.2%), and number of tuber (20%) as the lowest percentage reduction values as compared with uninoculated ones, respectively(Table 1). Data in Table (2) illustrated the concentrations of N, P and K either in leaves or tubers of the tested potato cultivars that were obviously decreased by nematode infection as compared with uninoculated ones. Likewise, similar results were obtained with starch content (%), T.s.s (%), vitamin-c (m/mg) in tuber and total chlorophyll content in leave of the three potato cultivars viz, sponta, Draga and Cara comparing with uninoculated plants. None significant differences between the potato cultivars tested regarding tuber or leave contents under study were recorded. Of the potato cultivars tested, tubers of Draga achieved the lowest percentage of reduction in N (0.113%), P (0.15%) and K (0.15%) concentrations and starch content (0.04%), followed by Cara with values of 0.74%, 0.15%, and 0.15%; and 0.03%, whereas Spunta accomplished the highest percentage of reduction with values of 0.187%, 0.19% and 0.15%, and 0.028%, respectively as compared with uninoculated ones. Moreover, T.s.s% recorded equal values that were amounted to 0.05% reduction for each potato cultivars, however, Draga and Cara showed low percentage of reduction values of vitamin-c which were amounted to 0.01% each, while that of sponta was more higher value of 0.06%, respectively. Meanwhile, in the case of total chlorophyll content, potato c.v. Cara achieved the highest percentage of reduction value of 0.66%, followed by Draga with value of 0.41%, whereas Spunta showed the least value (0.23%), respectively as compared with uninoculated ones.(table 2).

DISCUSSION

Potato cultivar i.e. Spunta, Draga and Cara which widely cultivated in Egypt were screened against *Meloidogyne* incognita infection under greenhouse condition. The designations of Canto- Saenz (1983) based on the relationship between root gall index as indicator of plant damage and rate of nematode increase (R factor) as indicator of nematode reproduction or host efficiency were used to determine tolerant or resistant or susceptible cultivars. These plant growth and nematode parameters indicated that none of tested cultivars was tolerant to *Meloidogyne incognita.* while cultivars of Draga and Cara were classified as resistant whereas potato cv. Sponta was rated as susceptible host .These findings are in accordance with these by Shady, (2002)and Aboul-Eid and Youssef(1998) with respect to potato cv. Sponta as susceptible host to *Meloidogyne incognita* infection. On the other hand, the present results disagreed with the finding of Abd-Allah (1999) who reported that Draga cultivar was considered as susceptible host to *M. incognita* infection. On the other hand, the present results disagreed with the finding of Abd-Allah (1999), who reported that Draga cultivar was considered as susceptible host to *M. incognita* infection. Meanwhile his result on sponta as susceptible host to *M. incognita* supported the present investigation in this respect. Concerning results in N, P and K concentrations, in leaves as well as in tuber; their starch contents, T.ss% and vitamin-c content as well as total chlorophyll contents of the three potato cultivars tested as influenced by *Meloidogyne incognita* infection, revealed that all these growth parameters were affected negatively by nematode infection to certain extent. These findings were supported by those recorded by Salem (2006) who reported that N, P and K concentrations in leaves of eggplant were obviously reduced by *M. incognita* infection. On the other hand results of the present work on total chlorophyll content, that recorded by nematode infection disagreed with the findings reported by Salem (2006) who said that nematode infection without any materials added revealed the highest percentage of increase of total chlorophyll content with value of 51.3%over the untreated un inoculated plant. In conclusion the present investigation indicated that potato cv. Spunta appeared as susceptible host to *M. incognita* infection accompanied with a slight percentage of reduction in N, P and K

concentrations either in leaves or tuber along with starch content, T.ss, vitamin-c as well as total chlorophyll content although literature revealed that nematode infection increased the total chlorophyll content a situation which can lead to the need of more research to be done in this respect.

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الملخص العربى

" مدي اصابة بعض اصناف البطاطس بنيماتودا " ميليدوجيني انكوجينيتا " مع الاشارة الي تركيزات النيتروجين والفوسفور والبوتاسيوم والمحتوي الكلي للكلوروفيل "

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في تجربة بالصوبه تم دراسة رد فعل ثلاثة اصناف من البطاطس هي الكارا والدراجا والاسبونتا للاصابه بنيماتودا "ميليدوجيني انكوجنيتا" من خلال بعض مقاييس النمو وتطور وتكاثر النيماتودا. اسفرت النتائج الي ان جميع المقاييس المختبرة انخفضت بوضوح بسبب الاصابة بالنيماتودا وكان صنف اسبونتا اكثر الاصناف المختبرة في اظهار اعلي قيم انخفاض في طول النبات (60.3%) والوزن الرطب الكلي للنبات (35.14%) والوزن الجاف للمجموع الخضري (16.7%) وقطر الدرنة (35.7%) وعدد الدرنات (40%) والوزن الرطب للدرنات (49.2%) وعدد الاوراق لكل نبات (27.3%) ومساحة الورقة (16.2%) علي التوالي يليه في ذلك كل من صنفي الدراجا والكارا في بعض الصفات المختبرة .

كما اظهرت العلاقة بين معدل العقد النيماتوديه علي المجموع الجذري ومعدل تكاثر النيماتودا الي ان الصنفين الدراجا والكارا اعتبارهما مقاومان للاصابه بالنيماتودا بينما كان الصنف اسبونتا قابل للاصابه بها حيث ان معدل العقد النيماتودية اكثر من قيمه 2 وهو (3) ومعدل التكاثر اكثر من 1 وهو 1.89 علما بان نتائج تركيزات النيتروجين والفوسفور والبوتاسيوم سواء في الاوراق او الدرنات وكذا محتوي النشا و المواد الصلبة الذائبه وفيتامين "س" في الدرنات والمحتوي الكلي للكلوروفيل في الاوراق كانت سلبيه بالنقص بسبب الاصابه بالنيماتودا في جميع اصناف البطاطس المختبرة وتم تسجيلها ومناقشتها .

Table (1). Plant growth response of three potato cultivars as influenced by *Meloidogyne incognita* under greenhouse conditions.

Potato cultivars	Treatments	**Plant Growth Response															
		Length (Cm)		Fresh weight (g)		Total f. wt of plant (g)	Red %	Shoot Dry wt. (g)	Red %	No of stolen	Tuber diam (cm)	Red %	No of tuber	Red %	Fresh wt. of tuber (g)	Red %	No of leaves	Leaves area (cm^2)
		shoot	root	shoot	root													
Spunta	N*	7.5 d	6.2 c	13.14 b	6.76 c	19.80	35.14	0.35 e	16.7	5 a	3.00 b	35.7	3 b	40	32.68 b	49.2	8 c	0.31 d
	Ck	8.1 c	26.4 a	18.37 ab	12.16 b	30.53	------	0.42 c	------	6 a	4.67 a	-----	5 a	-----	64.35 a	-----	11 b	0.37 c
Draga	N*	9.4 c	25.2 a	19.78 a	6.66 d	26.44	34.68	0.43 b	6.5	5 a	3.39 bc	28.3	3 ab	40	53.04 ab	19.4	11 ab	0.43 ab
	Ck	10.8 b	26.8 a	21.28 ab	19.2 d	40.48	------	0.46 a	------	7 a	4.73 a	-----	5 a	----	65.84 a	-----	12 a	046 a
Cara	N*	8.0 b	9.3 b	14.88 ab	2.52 c	17.40	24.41	0.31 d	16.2	5 a	3.87 c	19.2	4 ab	20	43.67 ab	33.3	11.55 c	0.35 cd
	Ck	9.3 a	10.8 b	18.82 a	4.2 a	23.02	-----	0.37 bc	------	6 a	4.79 a	-----	5 a	-----	65.5 a	-----	15.4 b	0.42 b

N= 2000 eggs of *M. incognita.
****Each value is the mean of three replicates.**

Table (2): N, P, and K concentration of leaves, tuber seeds, and percentage tuber starch and T.ss. and vitamin C content as well as chlorophyll content in three potato cultivars as influenced by the infection of *Meloidogyne incognita* under greenhouse conditions.

Characters		**Plant Growth Parameters of :**											
		Leaves			Tubers						leaves		
Potato cultivars	Treatments	N mg/gm	P ppm	K ppm	N mg/gm	P ppm	K ppm	Starch %	T.s.s %	V.c M/mg	chlorophyll content m/g		
											Chlorophyll A	Chlorophyll B	Total
Spunta	N*	2.65 f	0.24 f	2.84 f	1.47 f	0.26 f	1.66 e	13.43 e	6.56 f	18.35 f	0.220 f	0.776 bc	0.996
	Ck	2.95 a	0.27 c	3.22 c	1.81 c	0.32 c	1.95 c	13.82 bc	6.92 c	19.62 a	0.476 e	0.820 bc	1.296
Draga	N*	3.23 b	0.26 d	3.14 e	1.73 d	0.29 e	1.89 c	13.67 cd	6.79 d	18.51 d	0.660c	0.616 c	1.276
	Ck	3.84 a	0.29 a	3.45 b	1.95 a	0.34 b	2.18 a	14.33 a	7.14 a	18.72 b	0.623 b	1.333 a	2.156
Cara	N*	2.74 e	0.25 e	2.95 d	1.56 e	0.28 d	1.79 a	13.57 de	6.69 e	18.44 e	0.543 d	0.970 b	1.513
	Ck	3.01 c	0.29 b	3.34 a	1.89 b	0.33 a	2.11 b	13.99 b	7.05 b	18.33 c	0.963 a	1.400 a	2.363

N= 2000 eggs of *M. incognita

**** Each value is the mean of three replicates.**

Table (3): Host suitability of certain potato cultivars the infection of *Meloidogyne incognita* under greenhouse conditions.

Potato cultivars	*Average number of nematode in			Total number of nematode (pf)*	Rate of build-up (R)	No. of galls *	RGI*
	Roots		Soil/250g				
	(J2)	females					
Spunta +N	161.9 a	20.3 a	3633.3 a	3795	1.89	21.7 a	3
Draga +N	28.7 c	9.0 b	967.0 b	995.6	0.49	10.0 b	2
Cara +N	31.0 b	7.2b	1570 b	1601	0.80	10.0 b	2

N= 2000 eggs of *M. incognita*.
Each value is the mean of three replicates.

*** Rate of build-up (R) = $\frac{\text{final population}}{\text{Initial population}}$**

**** 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.**

***** Host category based on: relationship between RGI & R factor according to canto-saenz (1983) as follows: (RGI ≤ 2 & R ≤ 1) resistant (R), (RGI ≤ 2 & R > 1) tolerant (T); (RGI ≥ 2 & R ≥ 1) susceptible (S).**