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RESISTANCE TO ROOT-KNOT NEMATODE, *Meloidogyne incognita* IN SOME CUCUMBER (*Cucumis sativus*, L.) INBRED LINES AND THEIR HYBRIDS

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ABSTRACT

Three experiments were conducted in this study. The first experiment included two parts. In the first part, nine inbred lines and susceptible variety Beit alpha (control) belonging to cucumber (*Cucumis sativus*, L.) were evaluated for resistance to root-knot nematode, *Meloidogyne incognita* under greenhouse condition (artificial infestation). In the second part, the five inbred lines resistant, susceptible variety Beit alpha and their hybrids were evaluated for resistance to root-knot nematode, *Meloidogyne incognita* under greenhouse condition (artificial infestation). The second experiment included two parts. In the first part, nine inbred lines and susceptible variety Beit alpha (control) belonging to cucumber (*Cucumis sativus* L.) were evaluated for resistance to root - knot nematode, *Meloidogyne incognita* under field condition (natural infestation). In the second part, the five inbred lines resistant, susceptible variety Beit alpha and their hybrids were evaluated for resistance to root-knot nematode, *Meloidogyne incognita* under field condition (natural infestation). In the third experiment, the five hybrids and their parents were evaluated for some horticultural characters. The first experiment (pot test), in the first part only Line 7 and Line 8 evaluated were moderately resistant to root-knot nematode, *M .incognita*. L_3, L_6 and L_9 inbred lines evaluated were slightly resistant to *M. incognita*. Beit alpha (control) was susceptible to *M. incognita* in two parts. In the second part only the $L_7 \times P_C$ hybrid evaluated was highly resistant. The second experiment (field test), agreed with the first experiment (pot test) in all results except Line 7 evaluated was highly resistant to root-knot nematode ,(*M. incognita*). In the third experiment *C. sativus* line 6 was superior in vegetative characters and yield component. The hybrid $L_9 \times P_C$ was superior for main stem length and early and total yield as number and weight. $L_7 \times P_C$ hybrid was the highest in total yield and the best in fruit length. All hybrids were resistant to *M. incognita* and suitable for using in Egyptian agriculture.

Keywords: *Cucumis sativus*, Cucumber, *Meloidogyne incognita*, Root-knot nematodes, Resistance, Breeding and Horticulture characters.

INTRODUCTION

Cucumber (*Cucumis sativus*, L.) is an important species of cucurbitaceae family. This crop is one of the most vegetable crops grown throughout the world including Egypt. Cucumber is one of the favorable hosts to the root-knot nematodes infection problems encountered by using chemical and cultural control measures of the nematodes emphasize the search for genetic resistance in some cucumber varieties.

Cultivars resistant to one or more of *Meloidogyne spp.* (*M. incognita, M. arenaria, M. javanica and M. hapla*) would be useful to cucumber growers,

providing disease control with minimal use of nematicide (Walters *et al.*, 1998). Some plant breeders and nematologists use only numbers of eggs, number of egg masses, or an egg masses index in determining resistance to root-knot nematodes. These measurements do not always reflect accurately the resistance of plant, because sometimes the cultivars could be highly susceptible to root-knot nematodes and have few egg masses. For accurate determining resistance to root-knot nematodes, gall index (percentage of root galled) may be preferable measure, because susceptible plant usually shows a large percentage of its root galled. There is usually a positive relationship between egg masses and gall index (Walters *et al.*, 1992). When cultigens are resistant under greenhouse and field conditions, this is important since cucumber can be developed under greenhouse condition for root-knot nematode resistance without the possibility of the resistance breaking down in the field after resistant cultivars have been developed (Walters *et al.*, 1999). No significant differences occurred among the Cucumis cultigens for number of eggs or egg masses of *M. hapla*, indicating that all of them were resistant. Based on gall index, number of eggs and number of egg masses, PI 482452 was the most resistant cultigens to the root-knot nematodes (Wehner *et al.*, 1991). In an experiment designed to evaluate different Cucumis cultigens, all *C. metuliferus* accessions evaluated were found to be highly resistant (1% to 10% of roots galled) and some *C. sativus* cultigens were susceptible to the root-knot nematodes tested, with a mean for *M. arenaria* race2 and *M.incognita* race3 (52% of roots with galls), but LJ 90430 was moderately resistant to *M. arenaria* race2 (11% of roots galled), however it was susceptible to *M.incognita* race1 and 3 .LJ 90430 had fewer egg masses per plant than either of the *C. metuliferus* cultigens for *M. javanica* and an average of three egg masses per plant for *M. arenaria* race2. (Walters *et al.*, 1993).

Walters, (1996) released two inbred resistant to root-knot nematodes: i.e. NC-42 and NC-43. NC-42 was selected from of *Cucumis sativus var. hardwickii* accession LJ 90430. It showed high level of resistance to four important root-knot nematodes, *M. arenaria* race1 and 2, *M. javanica* and *M. hapla* Chitwood. Whereas, NC-43 is a selection of *C. sativus var. sativus*. (Southern Pickler) and is resistant to *M.arenaria* race2. The resistance based on gall index for NC-43 to *M. arenaria* race2 was moderate but not as good as the resistance in NC-42; however NC-43 has a more acceptable fruit type than that in NC-42, which has few horticultural useful traits. NC-42 should be used only to develop resistant cultivars but NC-43 could be used directly by growers willing to accept its limitations in fruit yield and quality. NC-43 was not significantly different from Wisconsin SMR-18 c.v. for *M. arenaria* race 2 .resistance based on gall index, but based on RF (reproduction factor), NC-43 was resistant and Wisconsin SMR-18 was susceptible. Data from the germplasm test clearly show the advantage of NC-43 over Wisconsin SMR-18 and Sumter cvs. NC-42 is *C. sativus var. hardwickii* with indeterminate, multiple lateral branching habit and small dark-green leaves. Fruits are small, extremely bitter. While NC-43 is indeterminate and fruits are dark green pickling type. Walters *et al.*, (1997) found the susceptible parent Sumter had a gall index rating that averaged 58%. The resistant parent LJ 90430 had a

mean gall index rating of 5. The cross of resistant LJ 90430 with susceptible Sumter produced F_1 progeny that were susceptible to *M. javanica* indicating that all F_1 plants had more than 35% of their roots galled. The same authors showed that the elite cucumber cultivars with resistance to root-knot caused by *M. arenaria* races 1 and 2, *M. javanica* and *M. hapla* recently developed, and released as Lucia NC-46, ManteoNC-44 and Shelby NC-45. Lucia, Manteo and Shelby are pickling cucumber inbreds with good horticultural traits as well as resistance to several root knot nematodes. Gall index for *M.javanica* and *M. arenaria* races 1 and 2 were significantly lower on three inbreds than on Sumter. Lucia, Manteo and Shelby are indeterminate and monoecious, the fruit length: diameter ratio is short (Shelby 3.0) medium (Manteo 3.4) or long (Lucia 3.9) depending on cultivation. They also found that yield and quality traits evaluated for Lucia, Manteo and Shelby yields of three inbreds were similar to Calypso and greater than Sumter. However, Calypso and Sumter had bitter fruit quality traits than that in the three inbreds.

Montasser, (1982) reported that local Beit Alpha Cucumber cv. was low susceptible hosts for root-knot nematode, *M. javanica.* Koraiem, (1979) found cucumber cultivar Beit Alpha was less susceptible to *M. incognita.*

The objective of this study was to verify the resistance of inbred lines and hybrids as well as to determine their resistance to *M. incognita* under greenhouse and open field conditions besides evaluating some important horticultural characters in these hybrids.

MATERIALS AND METHODS

These studies were carried out under greenhouse and open field conditions at Vegetable Research Division belonging to Horticultural Research Institute, Agricultural Research Center. The field trial was carried out in a private farm at Berkash Village region, Giza Governorate and at the Nematology Research Center of the Faculty of Agriculture Cairo University.

Nine inbred lines of cucumber were developed from the root-knot nematode resistant cucumber cultigens through selection program: *Cucumis sativus* Sumter was developed to Line 1 and Line 2, *Cucumis sativus* Mineu was developed to Lines 3, 4, 5 and 6. *Cucumis sativus* Southern pickler was developed to Line 7 Line 8 and Line 9. These cultigens were obtained from North Carolina State University and the control variety Beit alpha was obtained from Horticultural Research Institute. Two experiments were conducted in this study as follow:

The first experiment:

The first experiment included two parts for testing inbred lines to resistance of root-knot nematode, *Meloidogyne incognita* by determining gall index, galls and egg mass numbers.

1-The first part involved testing of the nine inbred lines and the susceptible variety Beit alpha for resistance under greenhouse condition.

2- The second part involved testing of F_1 hybrids chosen from the previous test based on the degree of resistance to root-knot nematode, *M. incognita.*

Seeds of genotypes were grown in seed beds and then transplanted at second true leaf stage in greenhouse. Seedlings were transplanted in 15cm diameter pots filled with sterilized soil (250cm^3 sand + 250cm^3 clay) single plant/pot. Two weeks after transplantation, plants were inoculated with 10ml of nematode suspension containing 3000 second-stage juvenile of *M. incognita* placed in soil around the base of each plant. Eight weeks from inoculation, plants uprooted and roots washed by water, (Byrd *et al.*, 1972). Roots were stained with acid fuchsin. Numbers of galls and egg masses were counted and statistical analysis of variance, according to Hadisoeganda and Sasser (1982).

The second experiment:

The second experiment included two parts for testing inbred lines to resistance of root-knot nematode, *Meloidogyne incognita* by determining gall index, galls and egg mass numbers.

1-The first part involved testing of the nine inbred lines and the susceptible variety Beit alpha for resistance under field condition.

2- The second part involved testing of F_1 hybrids chosen from the previous test based on degree of resistance to root-knot nematode, *M. incognita*

Seeds of genotypes were grown in seed beds and then transplanted at second true leaf stage in field. The initial population was 78.000 second stage juvenile /250 gm soil. Eight weeks from transplantation, plants uprooted and roots washed by water. Data regarding nematode counts and root gall indices were recorded and subjected to statistical analysis.

Root gall indices were evaluated by determining the percentage of the root system galled on scale (0-100%)

0=Immune.
1-10% = Highly resistant.
11-20% = Moderately resistant.
21-40% = Slightly resistant.
>40% = Susceptible (Barker *et al.*, 1986).

Numbers of galls and egg masses / plant on roots were stained red with acid fuchsin and recorded. Results were subjected to analysis of variance according to Hadisoeganda and Sasser (1982).

In greenhouse trial the experimental design used was complete randomized design with five replicates while field trial was complete randomized block design with three replicates, each replicate consisted of one row 5.0m long and 1.2m wide and 30cm between plants within row from each inbred line. Results were subjected to analysis of variance according to statistical analysis according to Steel and Torrie (1984). Treatments means were compared by least significant difference (L.S.D) at 0.05.

The third experiment:

Seeds of the F_1 hybrids and their parents were sown under greenhouse condition at Dokki Research, for evaluation of some economic characters. The experimental design used was randomized complete blocks with three replicates, each replicate consisted of 10 plants from each genotype and the plants were spaced 50cm apart within row and 120cm in width. The common cultural practices, viz irrigation, fertilization and pest control procedure for

cucumber in commercial production under greenhouses were followed, data were recorded for the following characters on five randomly plants from each genotype:

1. Vegetative growth.
a. The main stem length (cm.).
b. The plant fresh weight (gm).
c. The number of branches: Counting of branches was begun up to 50 cm from the soil on the main stem.
d. The leaf area (cm^2).
2. Yield and yield components:
a. Early yield was determined as the total number and weight of fruits (gm/plant) in each genotype for the first fourteen days from the beginning of harvesting.
b. Total yield was determined as the total number and weight of harvests fruits (gm/plant) for each genotype.
3. Fruit characters: these traits were measured as the mean of all marked fruits from each genotype in each replicate.
a. Fruit length (cm).
b. Fruit diameter (cm).
c. Average fruit weight (gm).

Results were subjected to analysis of variance according to statistical analysis as described by Steel and Torrie (1984). The treatments means were compared by least significant difference (L.S.D) at 0.05.

RESULTS AND DISCUSSION

The first experiment

1-Reaction of some cucumber inbred lines to resistance to root-knot nematode, *Meloidogyne incognita* under pot condition.

Table (1) showed results of ten cucumber genotypes, (nine inbred lines and Beit alpha variety control) which were tested in greenhouse (pot) condition to evaluate their resistance to root-knot nematode, *M. incognita*. Some Cucumis cultigens evaluated had some resistance to *M. incognita*.

Cucumber cultivars Sumter (L_1 and L_2) and Mineu (L_4 and L_5) showed the highest root gall indecies to *M.incognita*. Gall index was lowest on Southern pickler (L_7 and L_8) of all (L_1, L_2, L_3, L_4, L_5, L_6 and L_9). These results agreed with findings of Wehner *et al.*, (1991) and Walters *et al.*, (1993) they reported that Sumter cucumber was more susceptible cucumber to *Meloidogyne incognita, M. javanica* and *M. arenaria*.

Under pot condition lines 7 was found to be moderately resistant (20%), also L_8 reacted as moderately resistant (20%). The lines 9, 3 and 6 reacted as slightly resistant inbred lines; where root gall indices were 23.3, 30.0 and 40.0, respectively. These results agreed with those Wehner *et al.*, (1991), Walters *et al.*, (1993), Walters *et al.*, (1993) Welters *et al.*, (1996) and Walters *et al.*, (1999) they reported that the resistance to *M.arenaria* race2 was found in *C. sativus* southern pickler, Mineu.

Gall numbers of L_7 and L_8 were the lowest mean values of all gall numbers among the other inbred lines under pot condition. The lines 3, 6, 9 exhibited the lowest mean value of gall numbers. The other genotypes exhibited the highest mean values of gall numbers in pots. As for, the egg mass numbers , data presented in Table1 showed that, the five lines ($L_{3, 6, 7, 8}$ and L_9) had low values of either gall indecies, gall numbers, or low values of egg mass numbers. While, the lines $L_{1, 2, 4}$ and P_c showed high values of egg mass numbers. These results confirmed that the five inbred lines L_3, L_6, L_7, L_8 and L_9 had some degree of resistance to root-knot nematode, *M. incognita* and could be used for breeding programs, so as to produce new resistant hybrids.

Table (1): Reaction of cucumber inbred lines and check variety (B.A) for resistance to root-knot nematode, *Meloidogyne incognita* under pot experiment condition.

Genotypes	Root gall index (%)	Gall numbers/root system	Egg mass numbers/root system	Degree of resistance
L_1	73.3	99.33	6.67	S
L_2	50.0	97.33	7.67	S
L_3	30.0	58.67	0.01	S.R
L_4	43.3	93.33	8.03	S
L_5	43.3	90.00	0.01	S
L_6	40.0	89.33	0.01	S.R
L_7	20.0	29.33	0.01	M.R
L_8	20.0	32.00	0.01	M.R
L_9	23.3	37.33	0.01	S.R
P_C	43.3	89.33	13.33	S
L.S.D5%	-	N.S	N.S	-

Where:

L.S.D at 5% level of significance.
$L_1$and L_2(Sumter)
L_3, L_4, $L_5$and L_6 (Mineu)
L_7, L_8 and L_9 (Southern pickler)
P_C :Beit alpha (Parent control)
S :Susceptible (>40%)
S.R: Slightly resistant (21-40%)
M.R: Moderately resistant (11-20%)
N.S: Not significant.

2-Evaluation of new hybrids and their lines for the resistance to root-knot nematode, *Meloidogyne incognita* under pot condition.

The test of the new hybrids, which produced from the crosses between the previously resistant lines with susceptible cucumber variety (Beit alpha). These hybrids and their lines were tested in greenhouse (pots) condition for the resistance to root-knot nematode, *Meloidogyne incognita*.

Data in Table (2) show that, all hybrids and their parents had the lowest root gall indecies under greenhouse condition compared with the susceptible parent. The hybrid $L_7 \times P_c$ gave highly resistant in greenhouse test for gall index (10), while, the parent L_7 reacted as moderately resistant in pot test.

The hybrid $L_9 \times P_C$ gave moderately resistant (20%) in pot test, while the parent L_9 was moderately resistant (16.6%) in pot test. On the other hand, data show that the hybrids $L_3 \times P_C$, $L_6 \times P_C$ and $L_8 \times P_C$ were reacted as slightly resistant in pot test.

Concerning, galls and egg mass numbers, data show, that the susceptible parent (Beit alpha) had the highest values of gall and egg mass numbers in pot experiment. On the other hand, the crosses $L_7 \times P_C$, $L_8 \times P_C$ and $L_3 \times P_C$ in pot test had lowest values of gall and egg mass numbers. All hybrids in pot test showed low numbers of egg masses (1.33). The behavior of all lines used to produce these hybrids concerning galls and egg mass numbers were similar to their hybrids. The hybrid $L_7 \times P_C$ reflected the lowest number of galls (8.0) of all tested genetic populations. Also, the same hybrid gave the null number of egg masses (0.00).

Table (2): Comparison of cucumber inbred lines and their hybrids with the susceptible check variety (B.A) for resistance to root-knot nematode, *Meloidogyne incognita* under pot experiment condition.

Genotypes	Root gall index (%)	Gall numbers	Egg mass numbers	Degree of resistance
L_3	26.6	37.33	1.33	S.R
L_6	36.6	74.67	1.33	S.R
L_7	13.3	24.00	0.00	M.R
L_8	20.0	42.67	2.00	M.R
L_9	16.6	25.33	2.00	M.R
P_C	43.3	84.00	16.00	S
$L_3 \times P_C$	23.3	20.00	1.33	S.R
$L_6 \times P_C$	30.0	58.67	1.33	S.R
$L_7 \times P_C$	10.0	8.00	0.00	H.R
$L_8 \times P_C$	23.3	22.67	1.33	S.R
$L_9 \times P_C$	20.0	45.33	1.33	M.R
L.S.D5%	-	49.60	9.18	-

Where:

L.S.D at 5% level of significance
L_3 and L_6 (Mineu)
L_7, L_8 and L_9 (Southern pickler)
P_C : Beit alpha (parent control)
S : Susceptible (>40%)
S.R: Slightly resistant (21-40%)
M.R: Moderately resistant (11-20%)
H.R: Highly resistant (1-10%)
N.S: Not significant

The second experiment

1-Evaluation of some cucumber inbred lines to resistance to root-knot nematode, *Meloidogyne incognita* under field condition.

Data in Table3 was recorded on ten cucumber genotypes, (nine inbred lines and Beit alpha variety as control) which were tested under field condition to evaluate their resistance to root-knot nematode, *M. incognita*. Some Cucumis cultigens evaluated had some degree of resistance to *M.*

incognita. Sumter (L_1 and L_2), Mineu (L_4 and L_5) showed the highest root gall indecies to *M.incognita*. Root gall index was lower on L_7 than that L_1, L_2, L_3, L_4, L_5, L_6 and L_9. Line 7 was highly resistant (10%) under field test. L_8 proved to be slightly resistant (26.7%) in field. L_9 was the low gall index, L_9 sustained low gall index. L_9 was moderately resistant (16.7%) in field test. The other inbred lines L_3, L_6 were slightly resistant under field test.

As for, gall numbers , L_7 and L_9 had the lowest mean values of gall numbers than the other tested inbred lines. Lines 3, 6 and 8 had low mean values of gall number. The other genotypes gave the highest mean values of gall number in field test. Data presented in Table 3 show that, in the field test. The lines ($L_{3,7,8}$ and L_9) showed low values of egg mass numbers. In summary the five inbred lines L_3, L_6, L_7, L_8 and L_9 had some degrees of resistance to root-knot nematode, and could be used for breeding programs, so as to produce new resistant hybrids. Line1 gave the highest value of root gall index (83.3) and number of galls (110.67) and egg masses (22.67). Conversely, L_7 gave the lowest value of all. The differences among the all tested lines did not reached to be significant.

Table (3): Reaction of cucumber inbred lines and check variety for resistance to root-knot nematode, *Meloidogyne incognita* under field condition.

Genotypes	Root gall index (%)	Gall numbers	Egg mass numbers	Degree of resistance
L_1	83.3	110.67	22.67	S
L_2	46.6	93.33	5.34	S
L_3	23.3	73.33	5.34	S.R
L_4	66.7	94.67	14.67	S
L_5	50.0	105.33	21.33	S
L_6	26.6	90.67	14.67	S.R
L_7	10.0	38.67	2.67	H.R
L_8	26.7	65.33	5.34	S.R
L_9	16.7	43.00	5.34	M.R
P_C	56.7	92.00	10.67	S
L.S.D5%	-	N.S	N.S	-

Where:

L.S.D at 5% level of significance
L_1 and L_2 (Sumter)
L_3, L_4, L_6 and L_8 (Mineu)
L_7, L_8 and L_9 (Southern pickler)
P_C : Beit alpha (Parent control)
S : Susceptible (>40%)
S.R: Slightly resistant (21-40%)
M.R: Moderately resistant (11-20%)
H.R: Highly resistant (1-10%)
N.S: Not significant

2-Evaluation of the new hybrids and their parents for resistance to root-knot nematode, *Meloidogyne incognita* under field condition.

Data as presented in Table (4) show that, all hybrids and their parents had the lowest root gall indecies under field condition compared with the susceptible parent. The hybrid $L_7 \times P_c$ was moderately resistant (16.7%) under field test as expressed by gall index, while, the parent L_7 was highly resistant (10%). The hybrid $L_8 \times P_C$ was moderately resistant (20%), while the parent L_8 was slightly resistant (23.3%). The hybrid $L_3 \times P_C$ was moderately resistant (20%), while the parent L_3 was moderately resistant (20%) under field test. On the other hand, the data show that hybrids $L_6 \times P_C$ and $L_9 \times P_C$ were slightly resistant in field test, while the parents L_6 and L_9 were slightly and moderately resistant, respectively.

Concerning, galls and egg mass numbers, data show, that the susceptible parent (Beit alpha) recorded the highest values of galls and egg mass numbers in field. On the other hand, the crosses $L_7 \times P_c$, $L_8 \times P_c$, $L_9 \times P_C$ and $L_3 \times P_c$ showed the lowest values of galls and egg mass numbers.

In conclusion, genotypes were found to be resistant either under greenhouse conditions or in the field. This is important since cucumber could be developed under greenhouse condition and could be cultivated successfully in field naturally infested with nematodes. Our results indicated that, all inbred lines responded positively resistant to nematode infection therefore, they could be implemented in production and breeding programs under field conditions.

Table (4): Comparison of cucumber inbred lines and their hybrids with the susceptible check variety (B.A) for resistance to root-knot nematode, *Meloidogyne incognita* under field condition.

Genotypes	Root gall index (%)	Gall numbers	Egg mass numbers	Degree of resistance
L_3	20.0	75.67	2.67	M.R
L_6	26.6	76.67	9.33	S.R
L_7	10.0	23.33	1.33	H.R
L_8	23.3	55.33	1.33	S.R
L_9	13.3	42.33	6.67	M.R
P_C	66.6	98.00	9.33	S
$L_3 \times P_C$	20.0	52.00	0.00	M.R
$L_6 \times P_C$	26.7	49.33	2.67	S.R
$L_7 \times P_C$	16.7	21.33	0.00	M.R
$L_8 \times P_C$	20.0	40.00	1.33	M.R
$L_9 \times P_C$	23.3	22.67	1.33	S.R
L.S.D5%	-	37.38	7.02	-

Where:

L.S.D at 5% level of significance
L_3 and L_6 (Mineu)
L_7, L_8 and L_9 (Southern pickler)
P_C : Beit alpha (Parent control)
S : Susceptible (>40%)
S.R: Slightly resistant (21-40%)
M.R: Moderately resistant (11-20%)
H.R: Highly resistant (1-10%)

The third experiment

This experiment was conducted to evaluate five resistant lines and hybrids produced from crosses between these lines and the susceptible variety (B.A) for some vegetative growth, yield and fruit characters.

1. Vegetative growth characters

Data presented in Table (5) show, that the line 6 was significantly increased in main stem length, plant fresh weight and number of branches traits than the other lines and Beit alpha variety while, the line 8 was the highest in leaf area than the other lines and susceptible variety. On the other hand, the line L_7 gave the least in main stem length and number of branches.

Concerning, the hybrids, the data show, in the same Table that all hybrids gave significant values than their parents in main stem length and plant fresh weight. The hybrid $L_8 \times P_c$ gave significant increase than their parents and other hybrids in number of brunches trait. The hybrid $L_9 \times P_C$ gave highest values in main stem length. The hybrid $L_6 \times P_c$ gave significantly increase for plant fresh weight and leaf area traits than the other lines, hybrids and Beit alpha variety. Generally, most of hybrids produced under study showed superiority in most characters than their high parent. These agreed with Ghaderi and Lower (1979), Nienhuis and Lower (1980), Delaney and Lower (1987), Awad (1996) and Abd Rabou (2003) who found highly significant differences in main stem length in cucumber.

Table (5): Vegetative growth characters for inbred lines, (B.A) variety and their F_1's hybrid.

Genotypes	Main stem length(cm)	Plant fresh weight(gm)	Number of branches	Leaf area(cm^2)
L_3	198.00	190.00	2.33	248.99
L_6	237.00	293.33	5.00	186.84
L_7	169.67	196.67	1.33	234.49
L_8	199.33	230.00	2.00	274.52
L_9	227.33	241.67	2.67	268.49
P_C	209.33	233.33	3.00	227.77
$L_3 \times P_C$	210.00	240.00	3.00	257.05
$L_6 \times P_C$	240.00	516.67**	4.00	370.51*
$L_7 \times P_C$	214.67	423.33**	3.00	271.62
$L_8 \times P_C$	252.00*	400.00**	4.67	247.82
$L_9 \times P_C$	276.67*	336.67*	2.67	305.89
L.S.D5%	21.88	79.98	1.94	85.70

Where:

L.S.D at 5% level of significance
L_3 and L_6 (Mineu)
L_7, L_8 and L_9 (Southern pickler)
P_C : Beit alpha (Parent control)

2. Yield and its components

2.1. Early yield /plant.

With regard to early yield as number and weight of fruits per plant, results in Table (6) indicated that, the line L_6 gave highly significant number and weight of fruits for the early yield, than the other lines and commercial

variety Beit alpha. While, the lowest mean value in the number and weight of fruits was obtained by lines L_8 and L_7. On the other hand, the hybrid $L_9 \times P_c$ gave highly significant value for number and weight of fruits than their parents, other lines or the other hybrids, whereas the hybrid $L_6 \times P_c$ gave the lowest number and weight of fruits in early yield. However, their parents gave the highest value. These results may be due to incompatibility between parents. These results are in agreement with these obtained by EL-Mahdy *et al.*, (1992) and Fang *et al.*, (1994).

2.2. Total yield /plant.

In the same Table, data show, that line L_6 gave the highest number and weight of fruit for total yield, comparing with the other lines. Conversely, the line L_7 gave the lowest mean values for number and weight; the differences among the other lines were in not significant as for number and weight of total fruit yield. Data, of the same Table show that, the hybrids $L_7 \times P_c$, $L_8 \times P_c$ and $L_9 \times P_c$ gave the highest values in number and weight of total yield of fruits comparing with their parents and the other hybrids. These results are in agreement with that of Gharib (1991), EL-Mahdy *et al.*, (1992), Awad (1996), Abd EL-Hafez *et al.*, (1997) and Abd Rabou (2003) on cucumber who mentioned significant differences among parents and hybrids for total yield. The hybrids however, recorded higher means than the parents.

Table (6): Early yield and total yield for inbred lines, (B.A) variety, and their F_1's hybrid.

Genotypes	Early fruit number/plant	Early fruit weight(gm)/plant	Total fruit number/plant	Total fruit weight(gm)/plant
L_3	8.33	645.10	15.33	1106.5
L_6	16.67	1206.27	22.67	1570.67
L_7	7.00	419.87	13.33	763.20
L_8	6.00	442.13	17.67	1186.43
L_9	9.67	795.60	14.67	1142.47
P_C	8.33	631.83	14.67	990.67
$L_3 \times P_C$	10.33	784.77	18.33	1283.47
$L_6 \times P_C$	5.00	376.23	22.00	1440.73
$L_7 \times P_C$	10.00	689.00	28.00	2162.7
$L_8 \times P_C$	10.33	732.10	22.67	1515.13
$L_9 \times P_C$	20.00	1289.20	32.33	2071.2
L.S.D5%	2.12	184.71	3.36	300.19

Where:

L.S.D at 5% level of significance

L_3 and L_6 (Mineu)

L_7, L_8 and L_9 (Southern pickler)

P_C : Beit alpha (Parent control)

3. Fruit characters

Data presented in Table (7) show that, the lines L_3, L_6 and L_8 gave highly significant increase as comparing with the commercial variety (B.A) for fruit length while, the line L_9 gave the lowest value. On the other hand, the data show that the hybrid $L_7 \times P_c$ gave longer fruit comparing with their parents. Also, the hybrid $L_9 \times P_c$ gave the lowest value in fruit length .The other hybrid gave insignificant increase as compared with their parents for

this trait. These results agreed with Nienhuis and Lower (1980), Lower *et al.*, (1982), Taha (1989), Awad (1996), Ram *et al.*, (1996) and Abd Rabou (2003) in cucumber.

Data in the same Table show, no significant differences were found among the lines and commercial variety and among hybrids and their parents. These results agreed with those of Zhang and Cui (1993) and Awad (1996) who found no significant difference for fruit diameter in cucumber. The same results were obtained in average fruit weight. But the line L_9 showed higher significant increase than their parents. These results agreed with findings of Owens *et al.,* (1985) and Awad (1996) on cucumber.

Finally, the line L_6 and L_9 and the hybrids $L_6 \times P_C$, $L_7 \times P_C$, $L_8 \times P_C$ and $L_9 \times P_C$ gave the best results for the vegetative traits. Whereas, the line L_6 and the hybrid $L_9 \times P_C$ gave the highest early yield .L_9 and hybrids $L_7 \times P_C$, $L_8 \times P_C$ and $L_9 \times P_C$ were superior in total yield. As for fruit traits, the data show, the lines L_3, L_6 and L_8 and hybrid $L_7 \times P_c$ gave the highest fruit length.

Table (7): Fruit traits for inbred lines, (B.A) variety, and their F_1's hybrids.

Genotypes	Fruit length(cm)	Fruit diameter(cm)	Average fruit weight(gm)
L_3	14.87	2.63	72.27
L_6	14.60	2.43	69.80
L_7	12.43	2.60	57.73
L_8	14.30	2.63	67.42
L_9	10.67	3.20	77.77
P_C	11.30	2.63	67.20
$L_3 \times P_C$	15.20	2.60	70.37
$L_6 \times P_C$	12.40	2.87	65.03
$L_7 \times P_C$	17.87	2.37	76.07
$L_8 \times P_C$	15.23	2.77	67.00
$L_9 \times P_C$	11.07	2.77	64.13
L.S.D5%	1.77	0.35	10.33

Where:

L.S.D at 5% level of significance
L_3 and L_6 (Mineu)
L_7, L_8 and L_9 (Southern pickler)
P_C :Beit alpha (Parent control)

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مقاومة نيماتودا تعقد الجذور في بعض سلالات الخيار وهجنها

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أجريت ثلاث تجارب في هذه الدراسة تحت ظروف الصوبة والحقل المفتوح، حيث اشتملت التجربة الأولي والتي أجريت تحت ظروف العدوى الصناعية (الصوبة) على جزأين هما: الجزء الأول من التجربة تم تقييم تسع سلالات من الخيار والصنف التجاري بيت ألفا لمقاومة نيماتودا تعقد الجذور *M. incognita* .كما جاء الجزء الثاني من هذه التجربة لتقييم خمس من الآباء الحاملة لصفة المقاومة والصنف التجاري بيت ألفا وهجنها لمقاومة نيماتودا تعقد الجذور *M. incognita* . أما التجربة الثانية والتي أجريت تحت ظروف العدوى الطبيعية (الحقل المفتوح) اشتملت أيضا علي جزأين هما: الجزء الأول من التجربة تم تقييم تسع سلالات من الخيار والصنف التجاري بيت ألفا لمقاومة نيماتودا تعقد الجذور *M. incognita* . كما جاء الجزء الثاني من هذه التجربة لتقييم الآباء الخمسة الحاملة لصفة المقاومة والصنف التجاري بيت ألفا وهجنها لمقاومة نيماتودا تعقد الجذور *M. incognita*. خلصت نتائج التجربة الأولي إلي أن السلالات ٧ و٨ ذات مقاومة متوسطة لنيماتودا تعقد الجذور *M. incognita* كما أظهرت السلالات ٣ ، ٦ و٩ مقاومة خفيفة لنيماتودا تعقد الجذور *M. incognita* . في حين أظهر الهجين $L_7 \times P_C$ في الجزء الثاني من التجربة مقاومة عالية لنيماتودا تعقد الجذور *M. incognita* . توافقت نتائج التجربة الثانية (الحقل) مع نتائج التجربة الأولي (الصوبة) فيما عدا السلالة ٧ التي أظهرت مقاومة عالية لنيماتودا تعقد الجذور *M. incognita* بينما أجريت التجربة الثالثة لأجراء التقييم البستاني للسلالات والهجن محل الدراسة ،وقد تفوقت السلالة ٦ على باقي السلالات وعلى الصنف التجاري بيت ألفا من حيث الصفات الخضرية والمحصول . ولقد تفوق الهجين $L_9 \times P_C$ في صفة طول الساق الرئيسي والمحصول المبكر والكلي كعدد ووزن علي باقي السلالات والهجن . في حين أظهر الهجين $L_7 \times P_C$ أعلي محصول كلي كوزن وأفضل الصفات الثمرية من حيث طول وقطر الثمرة.