INFLUENCE OF SULPHUR AND CARBOFURAN NEMATICIDE ON ROOT-KNOT NEMATODE AND THE PERFORMANCE OF SOME SUGAR BEET VARIETIES IN SANDY SOIL

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ABSTRACT

Two field trials were carried out in Nubaryia region, El Beheira Governorate, Egypt throughout two successive seasons of 2012/2013 and 2013/2014 to examine the response of five multigerm varieties of sugar beet (*Beta vulgaris, sacchrifera* L.*)* as affected by agricultural sulphur (100 kg/fed.), and nematicide, furan (carbofuran10% G) at 13 kg/fed on root knot nematode, *Meloidogyne incognita* under naturally infected with it. A split-split plots design was used, where sulphur treatments in main plots, the nematicide, in the sub-plots, and sugar beet varieties were sown in the sub-sub- plots. Results obtained cleared that number of galls/ plant significantly affected by sulphur treatments, this finding was true in both growing seasons at the two studied age *i.e.* 3-momth or 6- month. Application of 100 kg sulphur reduced the values of galls from 15.6 to 9.0 in the 1st age corresponding 38 to 25 in the 2nd age. The percent of reduction amounted by 73.33% and 52.0% at age 3 and 6 months respectively. Once more, the differences between sulphur treatments did not reach the level of significant in respect to their effect on galls number in the 2nd seasons of both ages. Concerning carbofuran (C) influence, the results showed that the used nematicide compound significantly reduced the percent values of gall's number, the amount of reduction reached to 140 and 152 % in the 1st and 2nd seasons at age of 3- month corresponding 172 and 226.4 % in 6- month age in the 1st and 2nd season respectively. This result may be indicating to the high specificity against nematode. Regarding the different combination between the studied factors, it could be noted that the 1st and 2nd order interaction were significantly effected on the values of gall's number/ root in both seasons whether at 3-momth or 6-month ages. Once more by the end of growing season (six months), the values of egg masses significantly affected by the individual studied factors. Application of 100 kg sulphur significantly reduced the values of eggmasses/root. As for, the influence of carbofuran nematicide on egg masses, the available data appeared highly response to carbofuran in respect to its effect on egg masses in the two growing seasons, using carbofuran et a reduction in this trait amounted by 113.33 and 137.5% in the 1st and 2nd seasons respectively. Belong to varietal difference in respect to egg masses, the collected results showed sugar beet variety Glorise recorded the lowest value of this trait in both seasons. This finding may be assured the gen make up role in its influence on varieties with respect to

their resistance against nematode infection. The most effect interaction was that between sugar beet varieties and each of sulphar treatment and nematicide. Sugar beet root fresh weight, root diameter and sugar yield/fed increased significantly at the studied rates of nematicide and sulphur in the 1st and 2nd seasons. Root yield had the same trend in the 2nd season only. Sucrose% and sugar extractable% significantly increased at the rates of nematicide and sulphur treatments in both seasons, respectively. Glorise variety cleared the significant superiority over all the other tested ones in sucrose%, without significant variance with lilly variety. The interaction between the used rates of sulphur and carbofuran nematicide had the same effect on root diameter in both seasons. Sulphur treatment at developed root quality and reduced the impurity of juice of sugar beet and increased root growth as well as carbofuran nematicide did. Alpha amino nitrogen in sugar beet roots was significantly influenced by sulphur and carbofuran nematicide interaction in both seasons. Potassium, sucrose and extractable sugar percentages and percentage extractability of root juice were significantly recorded impacts by the interaction between varieties and sulphur levels in both seasons.
Key words: sugar beet varieties, sulphur and carbofuran nematicide, root-knot nematode, *Meloidogyne incognita.*

INTRODUCTION

Sulphur (S) is considered the fourth major plant nutrient, which crops absorb in comparable amounts to that of phosphorus. Moreover, sulphur metabolism provides several efficient mechanisms by which plants are able to tackle abiotic (e.g., xenobiotics and increasing surface ozone levels) and biotic (e.g., pests and diseases) stresses, particularly via glutathione metabolism, which again is closely related to the S supply for plants. The function of sulphur in plants lies in its participation in protein structure in the form of sulphur being amino acids, cystine, and methionine **(Haneklaus *et al.*, 2003)**. Root-knot nematodes (*Meloidogyne* spp.) are sedentary endoparasites and are among the most damaging agricultural pests, attacking a wide range of crops including sugar beet **(Gohar and Maareg, 2005)**. Also **Gohar *et al.*, (2012)** and reported that the interaction effect of sugar beet varieties versus in furrow nematicide application was expressed as maintaining relatively higher plant population in the treated than in untreated plots. Lola and Samba varieties were the most positively influenced by this interaction. The tested six sugar beet varieties attained average percentages increases in sucrose, TSS% and purity percentages by furrow nematicide compared with untreated plots. They added that reduction in galls number/root, gall ratings, egg-masses numbers, and eggs/egg-mass was associated with application in furrow ethoprop nematicide. The variety Ras poly was the steadiest one as affected by in furrow nematicide versus varieties interaction. **Gohar *et al.*, (2013)** concluded that sugar beet varieties (Farida, Pamela, Pleno, Top and Toro) that categorized previously as susceptible had the highest avoidable loss% due with and/or without nematicide Nemacur (Fenamiphos) for both roots and sugar yields/fed., where sugar beet varieties that categorized as tolerant had avoidable loss% less than susceptible ones, also, in roots yield avoidable loss% was greater than in sugar yield. **Hanna (2011)** concluded that an insufficient supply of S to the crop does not only reduce its economic yield, but it also has a decisive influence on the quality of the crop. He added that S fertilization increased yield and resistance of crops against many pathogens, especially crops of high demand for S as rape, onions, garlic, and sugar beet. **Gad and Ismail (2011)**, reported that ferric sulphate, $Fe_2 (SO_4)_3$ is useful in controlling different nematodes especially when added as soil drench. Several studies either in Egypt or abroad reported the importance of selected suitable cultivars for increasing sugar productivity as well as showed the differences among sugar beet varieties in yield and quality and range of their resistance or tolerance against soil parasites especially root-knot nematode. In Egypt, **El-Nagdi *et al.*, (2004**) evaluated thirty varieties of sugar beet infected by *M. incognita*, which were categorized as highly susceptible, susceptible or moderately resistant to the root knot nematode depending on their vigor, calculated as an average of percentages root weight potential and technological characteristics. The combination between host vigor and degree of susceptibility/resistance based on damage index (DI) suggested by **Sharma *et al*., (1994)** gave a better evaluation for the tested varieties. **Gobarah and Mekki (2005)** found that the three sugar beet varieties Ras poly, Kawemira and Top were significantly different in root length and diameter, root weight, root top, sugar and recoverable sugar yields, as well as the same trend was noticed in impurities (Na, K and alpha amino N%). **Nasr and Abd El-Razek (2008)** evaluated six sugar beet varieties under newly reclaimed sandy soil conditions of Sinai. They showed that Oscar poly variety recorded the highest root yield but Monte Bianco variety surpassed all varieties in sugar yield. **Abd El Fattah, *et al*., (2013)** evaluated five of sugar beet cultivars, viz., AS0081, AS0082, HN627, SN626 and Ravel to infection with *Meloidogyne javanica* under naturally field infection. Moreover, host susceptibility rating revealed that sugar beet varieties AS0081, AS0082, HN627 and SN626 can be considered as susceptible varieties, while the variety of Ravel can be considered as highly susceptible one.. They added that Plant growth components, viz. foliage weight, root length, root diameter, root weight and root yield, significantly increased in treated plots compared to untreated plots. **Korayem *et al.* (2012)** found that ten sugar beet varieties differed in yield and quality regarding susceptibility and biochemical reaction to root-knot nematode. **Hozayn *et al*. (2013)** evaluated twelve exotic sugar beet varieties in Nubaryia district in Egypt depending on yield and quality traits basis such as K, N, and Na contents. Heliospoly variety proved to be the best promising variety with the highest root yield, sugar recovery and maximum sugar yield, while the poorest variety was Monte Rosa. Multigerm varieties gave more values of root, yield and quality compared with monogerm varieties. Conversely trend was recorded for impurities components. The Egyptian soils are suffering from high pH values (alkaline) and unavailable macro and micro-nutrients of P, K, Mn and Mg especially in sandy soil**. (Nicholas, 1963)** and **Draycott (1993)** reported that sugar beet grows successfully when the soil pH is near 7.0. **Hocking (1995) and Sexton (1996)** found that S deficiency in sugar beet could be potentially serious not only through an effect on yield but also by altering the N/S ratio. If this ratio is changed by S deficiency, a higher proportion of assimilated N sequestered in storage pools in the form of free amino acids and amides (as alpha amino acids) which are adversely affecting the sugar extraction process or by-products. **El-Kammah and Ali (1996)** reported that the yield of sugar beet root and shoot significantly increased compared with the unfertilized control by elemental sulphur. They added that all quality parameters such as sugar, sugar losses and purity percentages of sugar beet were insignificantly affected by increasing sulphur level from zero to 1.25 ton/fed., but alpha amino nitrogen was increased significantly by adding sulphur with excess nitrogen fertilization. **Hessein (2002)** found that root and sugar yields, sucrose and quality parameter percentages were increased by sulphur treatment compared with non- treated. **Osman and Shehata (2010)** found that foliar spray with sulphur solution significantly increased diameter, fresh weight, and yield of root, while sulphur fertilization with elemental sulphur significantly decreased root quality measurements and insignificantly effected on sugar yield. **Ferweez *et al.* (2011)** concluded that sulphur fertilization up to 200 kg/fed in the form of elemental sulpur mixed with sulphur oxidizing bacteria, had a significant effect on root diameter and length, sucrose % and impurities (alpha amino-N, K and Na%), sugar recovery%, and sugar yield/fed.

This work was conducted to study the influence of sulphur and nematicide, furan (carbofuran10% G) on root knot nematode, *Meloidogyne incognita* as well as yield and quality of five sugar beet varieties under naturally field infected with it.

MATERIAL AND METHODS

Identification of root-knot nematode:

Females of *Meloidogyne incognita* were isolated from infested sugar beet roots collected from Nubaryia district and identified according to the morphological characteristics of the perineal patterns as described by **Eisenback *et al*. (1980)**.

Sugar beet varieties:

Five multigerm sugar beet varieties *i.e*, Lilly, Momet, Meredio, Panther and Glorise were tested.

Treatments:

With and without agricultural sulphur (S, 99%) at the rate of 100 kg/fed., nematicide, furan (carbofuran 10% G) at the rate of 13kg/fed and untreated (control)**.**

Field experiments:

Two field trials were carried out in Abd El-Wahab village, Nubaryia region, El- Beheira Governorate, Egypt (30.866^0 N latitude and 31.1666^0 E longitude at an elevation of 21 m above sea level) throughout two successive seasons of 2012/2013 – 2013/2014. It has an arid climate with cool winter and hot dry summer prevailing in the experimental area. Plot size was 15 m^2 (3 m width x 5 m length *i.e* 1/280 fed.). A split-split plots design was used. Sugar beet varieties were sown randomly the sub-sub plots, the nematicide, furan (carbofuran 10% G) (2,3 dihydro-2,2dimethyl benzofuran-7-yl-methyll carbamate) at the rate of 13 kg/fed was allocated in the sub-plots, and the agricultural sulphur (99% s) treatments at the rate of 100 kg/fed took place in the main plots. Sulpur and nematicide were added before agriculture irrigation. Sowing date was on October 1st in two growing seasons. Soil was sandy, and alkaline in reaction, low organic matter, Phosphorus and Nitrogen contents.

The soil physiochemical and mechanical properties of the experimental site are given in Table (l) according to **Chapman and Pratt (1978)**. Phosphorus fertilizer as calcium super phosphate (15.5% P_2O_5) was applied at 200 kg/fed and potassium was applied as potassium sulphate (48% K_2O) at the rate of 100 kg/fed, which was added at two equal doses; during soil preparation and after thinning. Nitrogen fertilizer was added in the form of ammonium nitrate (33.5%) at the rate of 120 kg N/fed; after thinning (4-6 true leaves = 35 days from sowing), 15 and 30 days later. Other agricultural practices were practiced as recommended. Sprinkler irrigation was applied as plants needed.

Table (1): Soil physical and chemical properties of experimental site.

Practical size distribution				Soluble ions (mq l^{-1})								EC (dSm^{-1})	p^H	Available nutrients (mg/1kg soil)						
Sand%	Silt%	Clay%	Texture	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	So_4^{-}	Hco_3^{-}	Co_3^{-}			N	P	K	Cu	Fe	Mn	Zn
90.98	7.01	2.01	Sandy	0.55	1.0	2.36	0.48	3.50	0.39	0.50	-	0.44	8.50	10.62	6.660	76.16	0.262	3.980	0.618	0.262

The recorded data:

At harvest, a random sample of ten roots was collected from each sub-sub plot to determine the following:

A. Nematode parameters:

Number of galls and egg-masses in roots were recorded after 3 and 6 months of treatments. The percentages of nematode reduction were counted and calculated according to the equation:

Nematode reduction (%) = (Numbers of galls or egg-masses untreated - Numbers of galls or egg-masses untreated/Numbers of galls or egg-masses untreated) X 100

B. Root growth traits:

Root fresh weight (kg), root length (cm) and root diameter (cm) were determined.

C. **Juice quality traits:**

Quality traits were determined in Beet Laboratory at Alexandria Sugar Factory, Alexandria, Egypt. Impurities of juice (meq./100 g beet) α-amino N, Na and K concentrations were estimated according to the procedures of Sugar Company by Automated Analyzer as described by **Cooke and Scott (1993)**.

1. Sucrose (expressed as Pol%) was estimated in fresh samples of sugar beet root using Saccharometer according to the method described by **A.O.A.C. (1984)**.

2. Sugars lost to molasses percentage (SLM %) was calculated according to the following formula shown by **Devillers (1988)**:

SLM% = 0.14 (Na+K)+0.25 (α-amino N) + 0.5

3. Extractable sugar percentage (Ex. S %) was calculated according the formula as proposed by **Dexter *et. al.* (1967)** as follows:

Ex. S. % = Sucrose% - SLM% - 0.6

4. Extractability % = (Extractable sugar% / sucrose %) x 100.

D. Yields:

Sugar beet plants of the two guarded rows of each sub-sub-plot were up-rooted, topped and weighed to determine root, top yields in kg and (ton/fed). Recoverable sugar yield **RSY** (ton/fed) was calculated according to **Devillers (1988)** as follows:

RSY (ton/fed.) = (root yield (ton/fed.) x Ex. S %)/100.

Statistical analysis:

Data were analyzed using an ANOVA of split-split block design (the analytical package **MSTAT-c v 2.1. (1988**). Means of the different treatments were compared using the least significant difference (LSD) test at P≤ 0.05.

RESULTS AND DISCUSSION

Effect of sulphur and carbofuran on *M. incognita* parameters:

Results illustrated in Table (2) point out the effect of sulphur and carbofuran (only or/and in combination) on sugar beet galling. Figures obtained cleared that number of galls/plant significantly affected by sulphur treatments, this finding was true in both growing seasons at the two studied age *i.e.* 3-momth or 6-month. Application of 100 kg sulphur reduced the values of galls from 15.6 to 9.0 in the 1st age corresponding 38 to 25 in the 2nd age. The percent of reduction amounted by 73.33% and 52.0% at age 3 and 6 months respectively. Once more, the differences between sulphur treatments did not reach the level of significant in respect to their effect on galls number in the 2nd seasons of both ages.

Concerning carbofuran (C) influence, the results showed that the used nematicide compound significantly reduced the percent values of gall's number, the amount of reduction reached to 140 and 152 % in the 1st and 2nd seasons at age of 3- month corresponding 172 and 226.4 % in 6- month age in the 1st and 2nd season respectively. This result may be indicating to the high specificity against nematode.

The results obtained in Table (2) revealed number of galls/root significantly affected by the examined varieties, As sugar beet variety Glorise attained the lowest value of gall' number/root at age of 3-month in the 1st season, sugar beet varieties Meredio and Moment recorded the lowest value of this trait at the same age. However, in the two ages of the 2nd season sugar beet variety Glorise recorded the lowest values of gall' number/ root. This finding may be indicate that sugar beet varieties differ between their self in respect to their tolerant to nematode infection according to gen make up effect. Regarding the different combination between the studied factors, it could be noted that the 1st and 2ndorder interaction were significantly effected on the values of gall's number/ root in both seasons whether at 3-momth or 6- month ages. It is clearly show that the effective interaction was that between 100 kg sulphar, 10 kg carbofuran with sugar beet variety Glorise. This combination attained the lowest values of gall's number/root. Once more by the end of growing season (six months), the values of egg masses significantly affected by the individual studied factors. Application of 100 kg sulphur significantly reduced the values of egg masses/root. This finding was completely true in both seasons. As for, the influence of carbofuran nematicide on egg masses, the available data appeared highly response to carbofuran in respect to its effect on egg masses in the two growing seasons, using carbofuran et a reduction in this trait amounted by 113.33 and 137.5% in the 1st and 2nd seasons respectively. Belong to varietal difference in respect to egg masses, the collected results showed sugar beet variety Glorise recorded the lowest value of this trait in both seasons. This finding may be assured the gen make up role in its influence on varieties with respect to their resistance against nematode infection. The most effect interaction was that between sugar beet varieties and each of sulphar treatment and nematicide. The lowest value of egg masses was recorded with the interaction between variety Glorise with 10 kg carbofuran. The above mentioned results reassured on the relative importance of varieties in respect to nematode resistance in addition to chemical treatments.

Table (2):Effect of sulphur and carbofuran on number of galls and egg-masses of root-knot nematode, *M. incognita* infesting sugar beet varieties in two growing seasons 2012/13 and 2013/14.

Sulpur (S)	Carbofuran (C)	Galls number after 3 months from sowing											
		2012/2013 season						2013/2014 season					
		Lilly	Momet	Meredio	Panther	Glorise	Mean	Lilly	Momet	Meredio	Panther	Glorise	Mean
S1	C1	٣١.٠	٤٢.٧	١٢.٣	١٨.٧	٨.٧	**٢٢.٧**	١٤.٧	١١.٠	٩.٣	١٨.٠	٣١.٣	**١٦.٩**
	C2	١٣.٠	١٤.٧	٧.٣	٤.٧	٣.٠	**٨.٥**	٤.٧	٣.٣	٦.٧	٤.٣	٣.٧	**٤.٥**
Means		٢٢.٠	٢٨.٧	٩.٨	١١.٧	٥.٨	**١٥.٦**	٩.٧	٧.٢	٨.٠	١١.٢	١٧.٥	**١٠.٧**
S2	C1	٦.٧	١٢.٠	٢٧.٣	٨.٧	١٢.٠	**١٣.٣**	١٣.٧	١٣.٧	٢٠.٣	١٩.٧	٢٠.٠	**١٧.٥**
	C2	٤.٧	٧.٣	٦.٣	٣.٣	١.٧	**٤.٧**	٧.٧	١١.٠	٣.٠	٤.٧	٣.٧	**٦.٠**
Means		٥.٧	٩.٧	١٦.٨	٦.٠	٦.٨	**٩.٠**	١٠.٧	١٢.٣	١١.٧	١٢.٢	١١.٨	**١١.٧**
C x V		١٨.٨	٢٧.٣	١٩.٨	١٣.٧	١٠.٣	**١٨.٠**	١٤.٢	١٢.٣	١٤.٨	١٨.٨	٢٥.٧	**١٧.٢**
		٨.٨	١١.٠	٦.٨	٤.٠	٢.٣	**٦.٦**	٦.٢	٧.٢	٤.٨	٤.٥	٣.٧	**٥.٣**
Means		**١٣.٨**	**١٩.٢**	**١٣.٣**	**٨.٨**	**٦.٣**	**.**	**١٠.٢**	**٩.٨**	**٩.٨**	**١١.٧**	**١٤.٧**	**.**
LSD at 5%		S: 3.9		C: 0.8		V: 1.9		S: NS		C: 0.1		V: 1.8	
		S x C x V: 3.8		S x C: 1.2				S x C x V: 3.5				S x C: 0.2	
		S x V: 2.7		C x V: 2.7				S x C: 2.5				C x V: 2.5	
Galls number after 6 months from sowing													
		2012/2013 season					Mean	2013/2014 season					Mean
S1	C1	٤١.٠	١٠٠.٠	٨٥.٣	٣١.٣	١٥.٣	**٥٤.٦**	٢٣.٣	٦٧.٠	٥٥.٣	٢٤.٣	١٦.٧	**٣٧.٣**
	C2	٢٤.٧	٣١.٣	٢٠.٧	١٨.٠	١٢.٣	**٢١.٤**	١٤.٠	٢٨.٠	٢٤.٧	١٢.٧	٨.٧	**١٧.٦**
Means		٣٢.٨	٦٥.٧	٥٣.٠	٢٤.٧	١٣.٨	**٣٨.٠**	١٨.٧	٤٧.٥	٤٠.٠	١٨.٥	١٢.٧	**٢٧.٥**
S2	C1	٢٩.٠	٤٠.٧	٣٧.٣	٣٦.٠	٢٨.٣	**٣٤.٣**	٤٠.٣	٧٣.٣	٤٤.٣	١٨.٧	١٤.٣	**٣٨.٢**
	C2	٢٠.٠	١٦.٠	١٥.٧	١٨.٠	٨.٧	**١٥.٧**	١٢.٣	٢١.٧	١٠.٧	١٢.٧	٥.٠	**١٢.٥**
Means		٣٢.٨	٦٥.٧	٥٣.٠	٢٤.٧	١٣.٨	**٢٥.٠**	٢٦.٣	٤٧.٥	٢٧.٥	١٥.٧	٩.٧	**٢٥.٣**
C x V		٣٥.٠	٧٠.٣	٦١.٣	٣٣.٧	٢١.٨	**٤٤.٤**	٣١.٨	٧٠.٢	٤٩.٨	٢١.٥	١٥.٥	**٣٧.٨**
		٢٢.٣	٢٣.٧	١٨.٢	١٨.٠	١٠.٥	**١٨.٥**	١٣.٢	٢٤.٨	١٧.٧	١٢.٧	٦.٨	**١٥.٠**
Means		**٢٨.٧**	**٤٧.٠**	**٣٩.٨**	**٢٥.٨**	**١٦.٢**	**.**	**٢٢.٥**	**٤٧.٥**	**٣٣.٨**	**١٧.١**	**١١.٢**	**.**
LSD at 5%		S: 1.5		C: 2.0		V: 2.8		S: NS		C: 5.9		V: 4.5	
		S x C x V: 6.0		S x C: 2.8				S x C x V: 3.5				S x C: NS	
		S x V: 4.0		C x V: 4.4				S x V: 7.8				C x V: 7.8	
Egg masses after 6 months from sowing													
		2012/2013 season					Mean	2013/2014 season					Mean
S1	C1	٢٧.٣	٥١.٣	٤٧.٣	٢٦.٠	١٠.٠	**٣٢.٤**	١٦.٧	٥٠.٧	٤٠.٠	١٨.٠	١١.٠	**٢٧.٣**
	C2	١٨.٠	٢٥.٣	١١.٧	١١.٣	٩.٣	**١٥.١**	١٠.٠	٢١.٣	١٩.٣	٩.٠	٤.٧	**١٢.٩**
Means		٢٢.٧	٣٨.٣	٢٩.٥	١٨.٧	٩.٧	**٢٣.٨**	١٣.٣	٣٦.٠	٢٩.٧	١٣.٥	٧.٨	**٢٠.١**
S2	C1	٢٢.٠	٣٢.٠	٣٣.٣	٢٢.٠	١٦.٧	**٢٥.٢**	٣٠.٠	٤٥.٠	٣٢.٣	١٢.٣	١٠.٠	**٢٥.٩**
	C2	١٥.٣	١١.٧	١١.٣	١٣.٣	٧.٣	**١١.٨**	١٠.٠	١٧.٣	٨.٠	٩.٣	٣.٠	**٩.٥**
Means		١٨.٧	٢١.٨	٢٢.٣	١٧.٧	١٢.٠	**١٨.٥**	٢٠.٠	٣١.٢	٢٠.٢	١٠.٨	٦.٥	**١٧.٧**
C x V		٢٤.٧	٤١.٧	٤٠.٣	٢٤.٠	١٣.٣	**٢٨.٨**	٢٣.٣	٤٧.٨	٣٦.٢	١٥.٢	١٠.٥	**٢٦.٦**
		١٦.٧	١٨.٥	١١.٥	١٢.٣	٨.٣	**١٣.٥**	١٠.٠	١٩.٣	١٣.٧	٩.٢	٣.٨	**١١.٢**
Means		**٢٠.٧**	**٣٠.١**	**٢٥.٩**	**١٨.٢**	**١٠.٨**	**.**	**١٦.٧**	**٣٣.٦**	**٢٤.٩**	**١٢.٢**	**٧.٢**	**.**
LSD at 5%		S: 5.1		C: 4.3		V: 3.6		S: 1.0		C: 1.8		V: 2.6	
		S x C x V: NS		S x C: NS				S x C x V: 6.4				S x C: NS	
		S x V: 5.1		C x V: 5.1				S x V: 3.2				C x V: 3.2	

S1 = without adding Sulphur (zero) S2 = adding Sulphur by rate (100 kg/fed) C1 = without adding Carbofuran, nematicid (zero) C2 = adding Carbofuran, nemaicid by (13 kg/fed) .

Results in Table (3) revealed that the percentages reduction of galls had the highest values after 3 months of sowing with sulphur plus carbofuran (84.2%) in Panther variety in the first season and (87.1 %) in Glorise variety in the second season (Table3). The reduction (%) of galls was 77.4% with sulphur only in Lilly variety and 73.7% with carbofuran only in Panther variety in the first season, while carbofuran only (87.1%) in Glorise variety, followed by Panther and Momet varieties in the second season (Table, 3). After six months of sowing, the percentages reduction of galls had the highest values with sulphur plus carbofuran in Momet variety (84.0%) and Meredor variety (81.2) in the first season, while it was 80.0% in Meredor variety and 73.8% in Momet variety in the second season. Results, also, showed that the percentages egg-masses were highly reduced with sulphur plus carbofuran in Meredor variety in the first and second seasons(76.6 % and 80.0%), followed by carbofuran only in Meredor variety in the first season and Momet variety in the second season (Table3). The present results revealed that differences in nematode infestation were occurred among sugar beet varieties towards sulphur and carbofuran. These results are agreement with those recorded by **Abd-El-Khair *et al.* (2013)**. They mentioned that the host susceptibility rating revealed that the varieties of Ras-Poly, DS 9001 and Manila can be considered as susceptible, while the varieties of Dema-Poly and Chems can be considered as highly susceptible.

Table(3):Effect of sulphur and carbofuran on percentages nematode reduction of galls and egg-masses of root-knot nematode, *M. incognita* infesting sugar beet varieties.

Treatments		Sugar beet Varieties	Nematode reduction %					
			2012/13			2013/2014		
			3 months	6 months		3 months	6 months	
Sulphur	Carbofuran		Galls	Galls	Egg masses	Galls	Galls	Egg masses
Sulphur (Zero)	With (13 kg/fed.)	Lilly	58.1	39.0	37.3	61.5	39.1	41.2
		Momet	65.1	69.0	50.9	72.7	66.7	58.8
		Meredor	41.7	75.3	61.7	22.2	54.5	52.5
		Panther	73.7	41.9	57.7	77.8	45.8	50.0
		Glorise	66.7	20.0	10.0	87.1	47.1	54.5
Sulphur (100 kg/fed.)	Without (zero)	Lilly	77.4	29.3	18.5	-	-	-
		Momet	72.1	59.0	37.3	-	11.9	11.8
		Meredor	-	56.5	29.8	-	29.1	20.0
		Panther	52.6	-	15.8	-	20.8	33.3
		Glorise	-	-	-	35.5	17.6	10.0
	With (13 kg/fed.)	Lilly	83.9	51.2	44.4	38.5	47.8	41.2
		Momet	83.7	84.0	76.5	0.0	73.8	66.7
		Meredor	50.0	81.2	76.6	66.7	80.0	80.0
		Panther	84.2	41.9	50.0	72.2	45.8	50.0
		Glorise	77.8	40.0	30.0	87.1	70.6	72.7

(-) The galls or eggmasses number increase over control.

Elemental sulphur might be oxidized to sulphuric acid by sulphur-oxidizing bacterium (*Thiobacillus* sp.) resulting in lowering the pH value of the soil. This acidification of the soil may increase the solubility of phosphorus and micronutrients originally present in the soil **(Ryan and Stroehelin, 1979 and Sadiq, 1985)**. The relatively high numbers of nematodes in sulphur -treated plots in the present study could be attributed to improvement in soil properties and nutritional status of plants. These results are agreement with those obtained by **(Korayem & Osman, 1994, El- Sonbaty & Korayem, 1993 and El-Sheihk *et. al.*, 2006**).

Data in Table (4) showed that all of sugar beet root fresh weight/plant; root diameter and sugar yield/fed significantly increased as affected by the studied rate of carbofuran nematicide and sulphur in the 1st and 2nd seasons. Root yield had the same trend in the 2nd season only. These results were probably due to the positive influence of the used nematicide and sulphur in decreasing the density of nematodes and fungus, ensuring favorable growth conditions for sugar beets, which positively reflected in higher values of these traits. However, opposite significant tendency was shown by top yield/fed in the 1st season. On the other hand, the results manifested that root length was insignificantly influenced by the used sulphur and/or nematicide in both seasons. These results are in agreement with those obtained by **Gohar *et al.* (2012); Gad and Ismail (2011)** and **Ferweez *et al.* (2011).** As for the variation among the evaluated sugar beet varieties, data in (Table 4) cleared that Momet variety showed the significant superiority over the other tested ones in root fresh weight, and root diameter in the 2nd season.

Table (4): Some sugar beet characteristics as affected by adding sulphur, carbofuran nematicide and sugar beet varieties in two growing seasons2012/13 and 2013/14 .

Treatments	Root fresh weight (kg)		Root diameter (cm)		Root length (cm)		Top yield (ton/fed.)		Root yield (ton/fed.)		Sugar yield (ton/fed.)	
	*I	II	I	II	I	II	I	II	I	II	I	II
Carbofuran nematicide (C)												
C1	1.039	1.071	9.6	9.7	27.1	29.8	9.22	9.13	26.88	25.87	4.03	3.81
C2	1.182	1.226	11.5	11.6	25.8	26.4	8.87	8.36	31.96	29.73	5.25	5.02
LSD at 5%	**0.089**	**0.080**	**0.1**	**0.7**	**NS**	**NS**	**0.86**	**NS**	**NS**	**0.71**	**0.04**	**0.11**
Sulphur (S)												
S1	1.037	1.091	9.8	10.0	27.2	28.8	9.22	8.74	26.39	25.80	3.80	3.93
S2	1.185	1.207	11.3	11.3	25.7	27.3	8.87	8.75	32.44	29.80	5.48	4.90
LSD at 5%	**0.033**	**0.057**	**0.3**	**0.3**	**NS**	**NS**	**0.33**	**NS**	**NS**	**1.48**	**0.20**	**0.22**
Varieties (V)												
Lilly	1.101	1.117	10.2	10.3	26.5	28.5	9.23	8.85	29.17	27.15	4.58	4.35
Momet	1.128	1.184	10.8	10.9	25.7	27.0	9.06	8.67	29.52	27.88	4.60	4.35
Meredio	1.124	1.148	10.6	10.7	25.9	27.6	9.10	8.83	29.54	27.70	4.68	4.37
Panther	1.096	1.114	10.4	10.6	27.6	28.6	8.93	8.73	28.93	27.69	4.56	4.48
Glorise	1.105	1.182	10.6	10.9	26.6	28.5	8.89	8.64	29.92	28.58	4.78	4.53
LSD at 5%	**NS**	**0.049**	**0.3**	**0.1**	**0.4**	**0.5**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

*** I = first seaason 2012/2013 II = second season 2013/2014 C1: carbofuran zero/fed.**
C2: carbofuran 13kg/fed **S1: without sulphur zero/fed S2: with adding sulphur 100kg/fed.

Likewise, Momet variety had the thickest roots with significant difference in both seasons. Panther sugar beet variety had the longest roots significantly over the other tested varieties in both seasons. The differences among the tested sugar beet varieties in the abovementioned traits could be referred to their gene make-up. Moreover, the results in Table (5) pointed to insignificant variation among the evaluated sugar beet varieties in top, root and sugar yields/fed in both seasons. These results are in harmony with those obtained by **EL-Nagdy *et al.* (2004); Korayem *et al.* (2012)** and **Hozayn *et al.***

(2013), who recorded significant variances among the evaluated sugar beet varieties infected by *M. incognita* and categorized depending on their vigor.

Data in Table (5) revealed that sucrose% and extractable sugar % significantly increased by applying 13 kg/fed of carbofuran nematicide and by 100 kg sulphur /fed in both seasons. On the other hand, results indicated that extractability% significantly increased in the 1st season as affected by sulphur and carbofuran treatments, with insignificant reduction in the 2nd one. Potassium in roots was significantly reduced as affected by sulphur and carbofuran treatments in the 2nd season only. Similarly, α- amino N significantly reduced by adding 100 kg sulphur in 1st season only. These results may be attributed the role of sulphur in improving of physical and chemical characteristics of alkaline sandy soil by reducing the acidity of root zone reflecting the release some of macro- and micro nutrients within root zone and increasing the activity of micro-organisms in the sandy soil and increasing the absorption and uptake the nutrient from the soil solution, Plants take up sulphur from soil in the form of sulphate (SO_4^-), which is converted into sulphite (SO_3^{2-}) and afterwards in sulphide (S^{2-}). Sulphide is synthesized into cysteine, the final product of the sulphate assimilation. One of the most important cysteine containing peptides is glutathione. Glutathione has many important functions in plants and plays key roles in a plant's defense through the activation of defence genes. Thus, glutathione metabolism can be directly linked to sulphur metabolism, **Zechmann (2011).** Meanwhile, carbofuran nematicide caused the greatest reduction in number of galls, egg-masses/plant, reflecting the healthy roots of sugar beet plants. Likewise, sulphur treatment positively improved root quality, by reducing the impurities in juice in beet roots and increased root growth, as carbofuran nematicide did. These results are in agreement with those obtained by **El-Kammah and Ali (1996); Haneklaus *et al.* (2003)** and **Hanna (2011)**. Data in Table (5) showed that roots sodium content was insignificantly influenced by carbofuran and/or sulphur in both seasons. As for the varietal differences, data in Table (5) showed that Glorise variety had the significant superiority over all the other tested ones in sucrose%. The same trend was shown by Glorise variety in the extractable sugar and extractability percentages in both seasons. Glorise variety gave the lowest significant values of α-amino N compared with the other ones, without significant variance with Lilly variety.

Table (5): Some sugar beet characteristics as affected by adding sulphur, carbofuran nematicide and sugar beet varieties in two growing seasons 2012/13 and 2013/14 seasons.

Treatments	Sucrose%		Impurities (meq./100g beet)						Extractable Sugar %		Extractability%	
			α- amino N		Na		K					
	*I	II	I	II	I	II	I	II	I	II	I	II
Carbofuran nematicide (C)												
C1	14.80	14.59	0.78	0.96	1.22	1.05	3.68	3.64	13.48	13.48	87.08	87.51
C2	16.47	16.78	0.73	0.88	1.22	1.05	3.44	3.43	15.07	15.01	88.54	86.56
LSD at 5%	**0.52**	**0.21**	**NS**	**NS**	**NS**	**NS**	**0.11**	**0.07**	**0.38**	**0.18**	**0.29**	**NS**
Sulphur (S)												
S1	15.40	15.43	0.79	0.95	1.25	1.08	3.63	3.57	12.98	12.93	86.72	87.18
S2	15.87	15.93	0.72	0.88	1.19	1.02	3.50	3.50	15.57	15.56	88.90	86.90
LSD at 5%	**0.21**	**0.11**	**0.06**	**NS**	**NS**	**NS**	**NS**	**0.09**	**0.20**	**0.10**	**0.20**	**NS**
Varieties (V)												
Lilly	15.83	15.79	0.74	0.88	1.11	0.94	3.53	3.53	14.20	14.19	87.89	86.94
Momet	15.25	15.39	0.80	0.97	1.28	1.12	3.47	3.45	14.05	13.93	87.57	86.16
Meredio	15.50	15.55	0.73	0.90	1.16	0.99	3.58	3.55	14.31	14.29	87.89	87.40
Panther	15.58	15.64	0.80	0.95	1.31	1.14	3.67	3.58	14.29	14.27	87.60	87.00
Glorise	16.00	16.04	0.72	0.87	1.24	1.07	3.55	3.54	14.53	14.53	88.09	87.69
LSD at 5%	**0.38**	**0.19**	**0.06**	**0.07**	**0.10**	**0.10**	**NS**	**0.05**	**0.22**	**0.15**	**0.23**	**NS**

*** I = first seaason 2012/2013 **II = second season 2013/2014 C1: carbofuran zero/fed. C2: carbofuran 13kg/fed **S1: without sulphur zero/fed S2: with adding sulphur 100kg/fed.**

On the contrary, Lilly variety showed significant reduction in roots Na content compared with all varieties, without significant variance with Meredio variety in both seasons. Meanwhile, variety Momet was superior significantly over all ones in 2nd season only in roots K content. The varietal differences in the previous characteristics may be due to the construction of whole pooled genes of sugar beet varieties.

Data in Table (6) showed that root fresh weight was significantly affected by the interaction between the applied rates of sulphur and carbofuran nematicide in both seasons. In the 1st one, the difference in this character was more pronounced as affected by the application of carbofuran and sulphur than when carbofuran was used without sulphur. In the 2nd season, the difference between carbofuran in its influence on root fresh weight/plant was insignificant without sulphur application. Meantime, the significant variance in this trait as affected by carbofuran nematicide appeared when sulphur was added.

The interaction between the used rates of sulphur and carbofuran nematicide had the same effect on root diameter in both seasons. Alpha amino N in sugar beet roots was significantly influenced by sulphur and carbofuran nematicide interaction in both seasons. Insignificant variance in this quality trait was detected under sulphur with or without application of nematicide, in the 1st season. However, the difference in this trait reached the level of significance as affected by the tested rate of carbofuran, without the addition of Sulphur in the 2nd season. Sucrose, extractible sugar and extractability percentages showed the same trend of that of α-amino nitrogen in the 2nd season.

Table (6): Some sugar beet characteristics as affected by the interactions among the added sulphur and carbofuran nematicide in the two growing seasons 2012/13 and 2013/14.

Sulphur (S)X Carbofuran (C)		Root fresh weight (kg)		Root diameter (cm)		α- amino N (meq/100 g beet)		Sucrose %	Extrac-table Sugar%	Extra-ctability %	Top yield (t./fed)	Root yield (t./fed)
		*I	II	I	II	I	II	I	II	I	II	I
S1	C1	0.991	1.042	9.2	9.6	0.85	0.89	15.74	13.85	87.96	8.62	22.85
	C2	1.088	1.101	9.9	9.9	0.71	1.03	17.43	15.51	89.01	9.66	30.90
S2	C1	1.083	1.140	10.3	10.5	0.73	0.87	18.43	16.51	89.56	9.84	29.93
	C2	1.281	1.313	12.7	12.8	0.73	0.91	19.13	17.21	90.00	8.58	33.98
LSD at 5%		**0.047**	**0.081**	**0.4**	**0.4**	**0.09**	**0.03**	**0.16**	**0.15**	**0.13**	**0.48**	**1.81**

***I = first seaason 2012/2013 II = second season 2013/2014 C1: carbofuran zero/fed.**
C2: carbofuran 13kg/fed S1:without sulphur zero/fed S2: with adding sulphur 100kg/fed.

The result in Table (6) show that sucrose%, extractability %, and root yield/fed in the 1st season, as well as extratable sugar% in the 2nd one, were significantly affected by the used levels of carbofuran and sulphur. The difference in each of these traits was more distinguished in case of applying carbofuran without sulphur. On the other hand, the difference in top yield/fed was more clear with the application of both sulphur and carbofuran. These results may be due to the effect of S supply which changing the ph of soil towards the acidity which followed by increasing the availability of many elements from the soil to the root zone and develop the activity of absorption and the root become more healthy and resistance the penetration by macro and micro-organisms. The root of sugar beet resistance for penetration by root knot nematode increased by applying the tested nematicide which make a protection around the root zone during root growth until the harvest by reducing the number of galls and the egg-masses of nematodes. These results are agreement with those **Draycott (1993); El-Kammah and Ali (1996); Haneklaus *et al.* (2003)** and **Hanna (2011)**.

Data in Table (7) pointed to a significant effect on root diameter attributed to the interaction among the tested sugar beet varieties and the applied rates of sulpher in 1st season. It was noticed that Momet variety significantly surpassed Panther without application of sulphur, but the performance of Panther was improved, when 100 kg sulphur was added. So, the difference in root diameter with Momet became insignificant. Root length and Na content were substantially influenced by the interaction of sugar beet varieties x sulphur rates in 1st season. It was found that Panther and Momet varieties varied statistically without application of sulphur, while insignificant variance was noticed when sulphur was added. Glories variety significantly surpassed Momet variety without adding sulphur. However, in this trait insignificant difference was recorded between the two varieties when100 kg of sulphur was applied in the 2nd season. In both seasons, the variance between Lilly and Momet varieties succeeded to reach the level of significance without adding sulphur, whereas, insignificantly difference in Na content with 100 kg sulphur/fed.

Table (7): Some sugar beet characteristics as affected by the interactions among sulphur treatments and varieties in the two growing seasons 2012/13 and 2013/14.

Sulphur (S) x Varieties (V)		Root diameter (cm)	Root length (cm)		Na (meq/100 g beet)		K (meq/100 g beet)		Sucrose%		Extractable sugar%		Extractability %	
		*I	I	II	I	II	I	II	I	II	I	II	I	II
S1	Lilly	9.4	27.2	30.4	1.17	0.93	3.49	3.04	16.71	16.63	14.76	14.75	88.30	88.64
	Momet	10.1	25.5	28.0	1.46	1.22	3.29	2.86	16.45	16.15	14.48	14.22	87.95	88.07
	Meredio	9.7	26.4	29.6	1.29	1.05	3.40	2.98	16.61	16.44	14.66	14.54	88.21	88.39
	Panther	9.5	29.1	30.1	1.35	1.11	3.47	3.00	16.76	17.14	14.78	15.22	88.08	88.73
	Glorise	9.9	27.5	30.8	1.18	0.94	3.56	3.10	17.27	16.57	15.32	14.68	88.70	88.56
S2	Lilly	11.3	25.9	26.6	1.08	0.94	3.57	3.15	18.15	18.95	16.22	17.07	89.32	90.05
	Momet	11.7	25.8	26.1	1.14	1.01	3.65	3.19	18.17	18.63	16.21	16.70	89.12	89.63
	Meredio	11.7	25.5	25.7	1.07	0.94	3.77	3.26	18.49	18.66	16.54	16.76	89.40	89.82
	Panther	11.6	26.1	27.2	1.30	1.17	3.88	3.31	18.41	18.93	16.39	16.98	88.99	89.69
	Glorise	11.9	25.7	26.3	1.33	1.20	3.55	3.12	18.29	18.72	16.32	16.79	89.21	89.71
LSD at 5%		**0.2**	**0.6**	**0.7**	**0.15**	**0.15**	**0.22**	**0.07**	**0.32**	**0.26**	**0.48**	**0.26**	**0.29**	**0.25**

*** I = first seaason 2012/2013 II = second season 2013/2014**
S1:without sulphur zero/fed S2:with adding sulphur 100kg/fed.

Data in Table (7) show that K content, sucrose, extractable sugar, and extractability percentages were significantly affected by the interaction between varieties and sulphur in both seasons. In the 1st one, combined data showed that Momet and Glorise varieties statistically varied without sulphur application. Then, the difference between the two varieties failed to reach the level of significance in roots K content, and percentages of sucrose, extractable sugar and extractability traits with 100 kg/fed sulphur. In the 2nd season, it could was found that Momet and Panther varieties significantly differed without adding sulphur in the previously metioned traits. However, the variance between the two varieties did not reach the level of significance with the addition of 100 kg/fed sulphur.

Results in Table (8) showed that the interactions between applied carbofuran nematicide and sugar beet varieties were significantly effected on root diameter and length, top yield and Impurities components (N, Na and K). It was cleared that Momet variety had a significant surpassed the others without carbofuran application for root diameter. Moreover, it had a significantly devolved by adding 13 kg/fed of carbofuran. In both seasons, Panther variety had a significantly surpassed Momet variety with and/or without furan application of root length. On the contrary, Panther variety gave the worse content of Potassium compared Momet variety was the best without or/and with the addition of 13 kg of nematicid in 2nd season. Glorise variety had a significantly surpassed Lilly variety with and/or without applied 13 kg/fed of nematicide in both seasons for top yield. However, for α- amino N in the 1st season either Gloris or Meredio varieties compared Panther variety without Carbofuran nematicide attained the highest variances compared with the others.

Table (8): Some sugar beet characteristics as affected by among between carbofuran nematicide treatments and varieties in two growing seasons 2012/13 and 2013/14.

Carbofuran(C) X Varieties (V)		Root diameter (cm)	Root length (cm)		Top yield (t./fed)		Impurities (meq/100 g beet)			
							α- amino N	Na		K
		*I	I	II	I	II	I	I	II	II
**C1(zero)	Lilly	9.8	27.2	28.8	8.99	8.54	0.75	1.04	0.86	3.17
	Momet	10.4	26.6	28.0	9.35	8.73	0.85	1.38	1.19	3.05
	Meredio	10.0	26.9	28.9	9.31	9.21	0.73	1.14	0.95	3.12
	Panther	9.9	27.8	28.9	9.01	8.54	0.89	1.38	1.20	3.22
	Glorise	10.1	27.4	29.4	9.48	9.08	0.73	1.39	1.21	3.12
C2(13kg/fed)	Lilly	10.9	25.9	28.2	9.72	8.98	0.72	1.20	1.02	3.02
	Momet	11.5	24.7	26.1	9.02	8.68	0.74	1.23	1.04	3.00
	Meredio	11.4	25.0	26.3	9.25	8.78	0.72	1.22	1.04	3.12
	Panther	11.2	27.4	28.4	9.07	8.77	0.71	1.26	1.08	3.09
	Glorise	11.8	25.8	27.7	8.54	8.03	0.71	1.12	0.93	3.10
LSD at 5%		**0.2**	**0.6**	**0.7**	**0.57**	**0.57**	**0.09**	**0.15**	**0.15**	**0.07**

*** I = first season 2012/2013 II = second season 2013/2014**
****C1: carbofuran zero/fed. C2:carbofuran 13kg/fed**

Although, α- amino N was reduced, insignificantly variance was recorded among varieties with controlling nematode by adding 13 kg/fed carbofura. The first order interaction between applying carbofuran and varieties was significantly effected on root Na content in both seasons. The variety Glorise distinctly, was significantly superior and given the worst content of Na content without addition of carbofuran. Mean time, Lilly variety had the lower Na content. Although, the content of Na in all varieties was reduced by addition 13 kg/fed of nematicide significantly variances was disappeared between variables inside the interactions.

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تأثير الكبريت و مبيد الكربوفيران علي خفض نيماتودا تعقد الجذور وسلوك بعض أصناف بنجر السكر في الاراضي الرملية

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أجريت تجربتان حقليتان في منطقة النوبارية بمحافظة البحيرة في أرض مزارعين في موسمين ٢٠١٢/٢٠١٣م وموسم ٢٠١٣/٢٠١٤م وذلك لاختبار خمسة أصناف بنجر سكر عديدة الأجنة وهم (ليللي، موميت، ميريديو، بانثر وجلوريس) بالمعاملة بالكبريت بمعدل ١٠٠ كجم/فدان والمعاملة بمبيد الفيوران (الكربوفيران ١٠% محبب) بمعدل ١٣ كجم/فدان منفردين أو معا علي خفض اعداد نيماتودا تعقد الجذور(*ميلودجين انكوجنيتا*) بالمقارنة بالقطع الغير معاملة (كنترول) في الاراضي المصابة طبيعيا بهذة النيماتودا. كان التصميم الإحصائي المستخدم القطع المنشقة مرتين، حيث زرعت الخمسة أصناف عديدة الأجنة في القطع الرئيسية وتم اضافة الكبريت نثراً علي الخطوط قبل رية الزراعة في القطع الشقية الأولي بينما كانت المعاملة بمبيد الكربوفيران نثراً علي التربة في القطع الشقية الثانية علي الخطوط بعد الزراعة وقبل رية الزراعة. وكانت من اهم النتائج المتحصل عليها حساسية كل أصناف بنجر السكر المذكورة سابقا للإصابة بنيماتودا تعقد الجذور ولكن بدرجات مختلفة فكان الصنف موميت أعلاهم إصابة والصنف جلوريس أقلهم أصابه.

كما أظهرت النتائج أن متوسط اعداد العقد الجذرية للنيماتودا علي جذور أصناف بنجر السكر تأثرت بمعنوية تراوحت ما بين ١٥,٦ - ٥٩,٠ عقده نيماتودية/جذر للمعاملة بالكبريت منفرداً بعد ثلاث شهور، بينما تراوحت ما بين 38- 25 عقده نيماتودبة/جذر بعد ست شهور، وأن نسبة النقص في العقد النيماتودية كانت ٧٣,٣٣% و ٥٢,٠% بعد ثلاث وست شهور بالترتيب علي التوالي. بينما أدت المعاملة بالمبيد الكربوفيران منفرداً نقصا معنويا تراوحت١٤٠% و ١٥٢% عقده نيماتودية/ جذر بعد ثلاث وست شهور بالترتيب علي التوالي.

وفيما يتعلق بالمعاملة بالكبريت ومبيد الكربوفيران معا أنقصت بمعنويه أعداد العقد النيماتودية في فترتي ثلاث وست شهور. وكانت المعاملة بالكبريت + مبيد الكربوفيران أعلي نقص في أعداد كتل البيض مقارنة بالقطع الغير معاملة (كنترول) خلال موسمي الزراعة. جميع المعاملات اعطت نسبة خفض في اعداد العقد الجذرية وكتل البيض للنيماتودا لكل الأصناف خلال موسمي الزراعة ولكن كانت اعلي نسبة خفض للعقد النيماتودية كانت

المعاملة بالكبريت ومبيد الكربوفيران معا في الموسم الثاني للزراعة بينما لكتل البيض للنيماتودا في الموسم الأول والثاني للزراعة. زادت معنوياً قيم كل من متوسط وزن الجذر، وقطر الجذر، ومحصول السكر طن/فدان في الموسمين باضافة معدلات الكبريت ومبيد النيماتودا. كما أعطي محصول الجذور طن/فدان نفس الاتجاه في الزيادة عندما أضيف الكبريت و مبيد الكربوفيران معا في الموسم الثاني فقط. زادت قيمة كلا من نسبة السكروز ونسبة السكر المستخلص معنويا عند معدلاً اضافة ١٣ كجم مبيد الكربوفيران/فدان، واضافة ١٠٠ كجم كبريت/فدان في كلا الموسمين علي التوالي. تفوق الصنف جلوريس معنويا علي الاصناف المدروسة في صفة نسبة السكروز. كان للتفاعل بين معدلات الكبريت مع مبيد الكربوفيران نفس التأثير عل متوسط وزن الجذر وقطر الجذرفي الموسمين.

ادت المعاملة ١٠٠ كجم كبريت/فدان + ١٣ كجم مبيد الكربوفيران/فدان بتحسن معنوي في صفات الجودة المدروسة وتقليل الشوائب في العصير. كما تأثرت معنوياً نسب كل من صفات البوتاسيوم، والسكروز، والسكر المستخلص ونسبة الاستخلاص في عصير البنجر بالتفاعل بين الأصناف المدروسة واضافة الكبريت في كلا الموسمين. ادي التفاعل بين الأصناف المدروسة واضافة مبيد الكربوفيران الي اختلافات معنوية في صفات نمو الجذر والشوائب.

مما سبق نوصي بأستخدام الكبريت كمحسن لخواص التربة وكذلك يزيد من تحمل النباتات للأصابة بنيماتودا تعقد الجذور بالإضافة الي ترشيد أستخدام المبيد النيماتودي في حقول بنجر السكر في منطقة النوبارية.