EFFECT OF SPLIT AND AMOUNT APPLICATION OF NITROGEN FERTILIZER TO SUGARBEET ON ROOT-KNOT NEMATODE, *MELOIDOGYNE JAVANICA* AND CROP PRODUCTION UNDER SPRINKLER IRRIGATION IN SANDY SOIL

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Abstract

This study was carried out during the seasons of 2002/2003 and 2003/2004 at West Nubariya area. The aim of this investigation was to study the effect of splitting and levels of nitrogen fertilizer application under sprinkler irrigation in sandy soil in controlling of *Meloidogyne javanica* nematode infecting sugarbeet and the related consequences on yield and quality of the crop.

Obtained results indicated that root yield, sugar yield, extractable sugar % and purity % were increased gradually and significantly with increasing nitrogen level from 67.0 up to 167.5 kg N/fed. but number of galls, larvae, females and eggmasses on sugarbeet root as well as final juvenile larvae of nematode in soil reduced as the level of nitrogen raised.

Splitting nitrogen application had a significant effect on extractable sugar %, root juice purity %, roots yield and sugar yield of sugarbeet as well as numbers of galls and developmental stages of root-knot nematode, *M. javanica* in sugarbeet root and soil. Application of nitrogen in five equal portions, significantly increased roots and sugar yields as well as extractable sugar % and purity of roots juice %, but galls number and developmental stages of nematode were significantly reduced compared with application in four or three or two equal portions application.

From these results, interaction of the two investigated factors , resulted in marked influence on roots and sugar yields as well as numbers of nematode's galls and eggmasses in root and juvenile larvae in sugarbeet soil.

It could be concluded that application of 167.5 kg N/fed. as ammonium nitrate in five equal portions at 30, 45, 60, 75 and 90 days after sowing gave the highest increase in roots yield and sugar yield of sugarbeet as well as the highest reduction in nematode's galls and eggmasses in root and final juvenile larvae in sugarbeet sandy soil under sprinkler irrigation system. This exceeded the other treatments including systemic nematicide treatment (Fenamiphos 10 % granules at the rate of 10 kg/fed.). This information would allow producers to make more informative decisions regarding high performance of sugarbeet crop in the highly contaminated sandy soils by plant parasitic nematodes.

INTRODUCTION

Plant parasitic nematodes (specially, root-knot nematodes) can be considered as one of the important pests that attack various economical crops and caused severe damage. Egyptian climate is suitable for the activity and reproduction of nematodes. Sandy soils in this country are very favourable to nematode infestation.

The loss in roots and sugar yields of sugarbeet in West Nubariya region as a consequent of root-knot nematode attack, ranged from about 0.7 - 50.8 % and from about 11.8 – 68.4 %, respectively (Gohar, 2003). Reduction of crop losses due to nematodes is one way of increasing crop yields; therefore chemical control methods must be tested and optimized to improve growth and yield of economical crops. At the same time some additive, such as fertilizers may be tested in order to decrease the role of nematicides to minimize the environmental pollution and make the control process more economical. Many investigators studied the effect of applying fertilizer in mineral form on plant parasitic nematodes. Abd-Elrahman (1977) used ammonium sulphate and ammonium nitrate fertilizers, and reported that ammonium sulphate was more effective than ammonium nitrate in controlling *Tylenchulus semipentrans* Cobb, 1913 on lime seedlings. Singh *et al.* (1983) and Khan *et al.* (1986) found that the damage of tylenchid nematodes decreased with an increase in dosage of urea in both aubergine or okra. Also, Badr (1988) reported that the use of nitrogen fertilizers, thiourea, urea formaldehyde and urea reduced significantly the number of *Meloidogyne javanica* (Treub,1885) Chitwood, 1949 population and improved the growth of tomato plants. Maareg *et al.* (2000) mentioned that potassium sulphate, potassium nitrate were the most effective in reducing population of *M. javanica* nematode followed by super phosphate and super treble in tomato field.

The aim of the present study was to investigate the effect of split and amount of nitrogen fertilizer (ammonium nitrate) application to sugarbeet field on root-knot nematode, *M. javanica* and on crop production in sandy soil under sprinkler irrigation.

MATERIALS AND METHODS

Two field experiments were carried out during the season of 200/2003 and 2003/2004 on sandy soil, naturally highly infested with *Meloidogyne javanica* nematode larvae (initial population was 2100 and 1875 juvenile larvae/ 300 ml soil in the first and second seasons, respectively) at West Nubariya region cultivated with sugarbeet, *Beta vulgaris* L. to investigate the effect of split and amount of nitrogen application on controlling of *M. javanica* and the related consequences on yield and quality of the sugarbeet crop. Some physical and chemical properties of the soil at 30 cm depth were determined (Cotteine, 1980) and the data are presented in Table (1). The experimental soil was fertilized with 100 kg P_2O_5/fed. in the form of calcium super phosphate (15.5 % P_2O_5) and 50 kg K_2O/fed. in the form of potassium sulphate (48 % K_2O) during soil preparation. The preceding crop was peanut in the two seasons.

Each experiment included ١٧ treatments, 16 of which were the combination between four levels and four application methods of nitrogen fertilizer as follows:

- Nitrogen fertilizer as ammonium nitrate (33.5 % N) levels:

1. 200 kg ammonium nitrate (67 kg N/fed.)
2. 300 kg ammonium nitrate (100.5 kg N/fed.)
3. 400 kg ammonium nitrate (134 kg N/fed.)
4. 500 kg ammonium nitrate (167.5 kg N/fed.)

- Nitrogen application method:

  Each level of nitrogen fertilizer was applied as follows;

  1. In two equal portions at 30 and 60 days from sowing
  2. In three equal portions at 30, 45 and 60 days from sowing
  3. In four equal portions at 30 , 45, 60 and 75 days from sowing
  4. In five equal portions at 30 , 45, 60 , 75 and 90 days from sowing

This is in addition to a comparable nematicide treatment, using systemic nematicide Fenamiphose 10 % granules at the rate of 10 kg/fed., this 17^{th} treatment received 67 kg N/fed.

A split plot design with four replications was used; the nitrogen levels were allotted randomly in the main plots. Whereas, nitrogen application methods were allotted in the sub-plots.

Each sub-plot included six ridges 60 cm apart and 5 m length, thus the area of the sub-plot was 18 m^2. Sugarbeet, cultivar's Hillma was sown on the 17^{th} and 20^{th} September in the first and second seasons, respectively. Seed were sown in hills, 20 cm apart. Thirty days after sowing, thinning to one plant per hill was carried out. Other recommended agronomic practices were carried out as usual. At maturity (210 days from sowing), plants of each plot were harvested to determine the root yield and sugar yield/fed.. Also, extractable sugar % and root juice purity % were determined according to Reinefield method as described by Harvey and Dutton (1993). Roots were washed free of soil (10 roots were taken. randomly per plot). The total number of galls, larvae, females and egg masses were counted and calculated per root system . Also, the number of final population of juvenile larvae in 300 ml soil was recorded. Data were subjected to analysis of variance and Waller – Duncan test was used to distinguish treatment means (Waller and Duncan,1969)

RESULTS AND DISCUSSION

Presented results in Table (2) indicated that the nitrogen levels significantly influenced nematode galls and egg masses numbers per root system in the two seasons and combined analysis. Reduction % in galls and egg masses numbers significantly increased by increasing nitrogen level up to 167.5 kg/fed. The reduction % in galls number was 31.1, 55.2 and 74.6 % due to increasing nitrogen application level from 67.0 to 100.5, 134.0 and 167.5 kg/fed. respectively, in combined analysis. Whereas, the corresponding reduction % in egg masses number increased by 13.9, 66.9 and 91.7 % as a result increasing of nitrogen level, respectively as shown in Table (2).

Also, nematode galls and egg masses numbers/root system were influenced significantly by splitting (partitioning) of nitrogen fertilizer application. Number of galls and egg masses per root was significantly decreased by splitting nitrogen in five equal portions compared with in four; three and two equal portions applications in the first and second seasons as well as combined analysis. Generally, the reduction % in nematode galls and egg masses numbers / root system were (39.3 & 26.9), (61.8 & 70.6) and (77.6 & 81.8), as a result of nitrogen application in three, four and five equal portions, respectively, compared with nitrogen applying in two equal portions.

Numbers of nematode larvae and females in root system and final juvenile larvae in soil were influenced significantly by nitrogen levels in the first and second seasons as well as combined analysis. Reduction % in these numbers significantly decreased by increasing nitrogen level from 67.0 up to 167.5 kg/fed. In general, the reduction percentage in number of larvae and females in root system was 19.5, 35.1 and 54.7 %, however, the reduction in juvenile larvae number in soil was 30.6, 53.9 and 82.1 % as a result of increasing nitrogen level from 67.0 to 100.5, 134.0 and 167.5 kg/fed., respectively as shown in Table (3).

Splitting of nitrogen application significantly affected larvae and females number in root system and the final juvenile larvae in soil in the two seasons and combined analysis. Addition of nitrogen in five equal portions significantly decreased number of larvae and females in root system and final juvenile larvae in soil than addition in four or three or two equal portions. Generally, the addition of nitrogen in three, four and five equal portions increased significantly the reduction percentage of larvae and females number in root system (by 20.6, 35.9 and66.9 %, respectively) and final juvenile larvae in soil (by 31.5, 72.7 and 80.2 %, respectively) than addition in two equal portion (Table 3).

Results of nematicidal of nitrogen application (as ammonium nitrate) in sandy soil of sugarbeet fields indicated that the percentage reduction of root-knot nematode, *Meloidogyne javanica* either on roots or in soil were gradually increased with increasing nitrogen level (from 67.0 up to 167.5 kg/fed.) and splitting of nitrogen in application (from in two up to in five equal portions). The efficiency of nitrogen fertilizer as an ammonium nitrate could be due to produce excess ammonia in soil as reported by Alam (1991), ammonia decreased the population of certain plant parasitic nematodes in soil. Also, Maareg *et al.* (2000) found that ammonium nitrate and potassium nitrate at level of 100 kg N/fed. for each, reduced the total larvae and females (by 67.5 and 72.9 %) and (by 48.4 and 69.9 %) for the first and the second above mentioned fertilizers, respectively.

Extractable sugar and root juice purity % was significantly influenced by nitrogen levels in the first and second seasons as well as in the combined analysis. Increasing nitrogen level from 67.0 up to 167.5 kg/ fed. significantly increased extractable sugar and root juice purity %. The increase in extractable sugar percentage was 12.8, 27.4 and 42.7 %, , while the root juice purity percentage increased by 0.1, 1.1 and 1.3 %, as a result of increasing nitrogen level from 67.0 to 100.5, 134.0 and 167.5 kg/fed., respectively (Table 4). Similar results were obtained by Tawfik (2000) who found that extractable sugar and roots juice purity % significantly increased with increasing nitrogen level. On the other hand, Nemeat-Alla (1997) found that nitrogen decreased extractable sugar percentage, also, Assey *et al.* (1992) reported that purity percentage was not significantly affected by nitrogen level.

Extractable sugar and root juice purity percentage were also significantly influenced by splitting nitrogen application in the first and second seasons as well as combined analysis. Addition of nitrogen in five equal portions significantly increased percentage of extractable sugar than addition in four or three or two equal portions in both seasons and combined analysis. The same trend was recorded in root juice purity percentage without significant differences in purity percentage of beet root juice between addition of nitrogen in four and five equal portions treatments in both seasons and combined analysis. The present results are in harmony with those obtained by Tawfik (2000).

The results in Table (5) revealed that the root yield of sugarbeet was significantly influenced by nitrogen level in the two seasons and combined analysis. Increasing nitrogen level from 67.0 to 100.5;134 and 167.5 kg/fed. generally increased root yield of sugarbeet root yield of sugarbeet was about 17.8, 32.2 and 59.2 % due to adding 100.5,134.0 and 167.5 kg N/fed., respectively compared to addition of 67.0 kg N/fed. The increase in root yield due to the increase in nitrogen level is a result of the effect of nitrogen in increasing the metabolic activity in plants, which contributes to the increase in the accumulation of metabolites in plant tissues and this, in turn, increases the weight of root. Similar results were reported by Toor and Bains (1994); Tawfik (1994 and 2000); Nemeat-Alla (1997) and Hasan (2000).

Nitrogen levels, also, exerted significant effect on sugar yield/ fed. in both seasons and the combined analysis. Nitrogen fertilization significantly increased the sugar yield/fed., and any increase in nitrogen level was always followed by a significant increase in sugar yield (Table 5). The sugar yield increased by about 33.3, 77.8 and 122.2 % due to adding 100.5, 134.0 and 167.5 kg N/fed., respectively as compared with addition 67.0 kg N/fed. level. These results agree with those obtained by Nemeat-Alla (1997), Hasan (2000) and Tawfik (2000).

Results in Table (5) showed also that the root yield of sugarbeet was significantly affected by splitting of nitrogen application in the two seasons and combined analysis. Appling nitrogen in five equal portions significantly increased root yield of sugarbeet per fed. as compared with in four or three or two equal portions of nitrogen application. In general, sugarbeet plants received nitrogen in two equal portions produced the lowest root yield (16.7, 17.9 and 17.3 tons/fed.), while, those received nitrogen in five equal portions produced the highest ones (22.1, 22.2 and 22.2 tons/fed.) in the first and second seasons as well as the combined analysis, respectively. These results are similar to those obtained by Frank and Peterson (1988) who found that applying 180 kg nitrogen in six's 30 portions produced significantly more than did applying in three's 60 kg portions or two's 90 portions. Also, Tawfik (2000) found that the highest root yield of sugarbeet was obtained with application of nitrogen fertilizer in four equal portions, whereas, the lowest one was obtained with application in two equal portions. Table (5) showed also that the sugarbeet plants received nitrogen in two equal portions produced significantly the lowest sugar yield/ fed. in the two seasons and combined analysis. Generally, sugar yield of sugarbeet was significantly increased by 18.2, 31.8 and 54.5 %. With applying of nitrogen in three, four and five equal portions, respectively; more than did application in two equal portions. The trend of results is similar to that reported by Tawfik (2000) who found that sugar yield was significantly increased by splitting nitrogen application in three or four equal portions than in two equal portions application.

The interaction between split and level of nitrogen fertilizer application for number of galls, egg masses and final juvenile larvae was significant in the first season only; and for root yield and sugar yield was significant in both seasons and second season only, respectively.

The consequent effects of interaction between split and amount of nitrogen fertilizer application in sugarbeet fields on number of galls and egg masses/ root system and final juvenile larvae per 300 ml soil (Tables; 6,7 and 8) indicated that the reduction % in number of galls, egg masses and juvenile larvae was significantly increased with increasing level (up to 100.5, 134.0 and 167.5 kg N/fed.) and splitting (in three or four or five equal portions) of nitrogen application compared to 67.0 kg N/fed. level in two equal portions application. The sugarbeet plants received nitrogen level 167.5 kg N/ fed. in five equal potions recorded the highest reduction % in galls, egg masses (on root) and final juvenile larvae (in soil), while those received 100.5 kg N/fed level in two equal portions recorded the lowest ones. By emphasizing the comparison between the initial population, Pi (2100 juvenile larvae/300 ml soil in the first season and final population (Pf). The results (Table 8) revealed that the Pi was influenced by levels and splitting nitrogen application. Applying of 167.5 kg N/fed. in five equal portions gave the highest reduction (96.4 %) in Pi. However, the systemic nematicide, Fenamiphose gave 90.4 % reduction compared with Pf (115.0 larvae/300 ml soil).

Root yield and sugar yield/ fed. of sugarbeet as affected by level and splitting of nitrogen application, in both seasons and the second season, respectively, are shown in Tables (9&10). Generally, the root yield and sugar yield, significantly increased by increasing nitrogen level. Also, applying of each nitrogen level in five equal portions produced significantly root yield and sugar yield more than did application in four or three or two equal portions. The highest root yield (26.9 and

27.0 ton/fed.) were obtained by applying nitrogen at the level of 167.5 kg N/fed. in five equal portions in the first and second seasons, respectively. While, the lowest one (12.5 ton/fed.) was obtained by applying nitrogen at the level of 67.0 kg N/fed. in two equal portions in the first season. The same trend was recorded in sugar yield, the highest and the lowest yields (4.9 and 1.2) of sugar/fed. were obtained by applying of 167.5 kg N/fed. level in five equal portions and of 67.0 kg N/fed. level in two equal portions, respectively.

In short, the nematicide, Fenamiphos significantly decreased nematode population on root (by 77.1, 84.4 and 68.3 % in number of galls, egg masses and larvae & females, respectively), but it reduced nematode counts of soil juvenile by 82.1 %. Also, Fenamiphos significantly increased the extractable sugar, roots juice purity, roots yields and sugar yield by 40.2, 1.4, 38.6 and 94.4 %,respectively, compared with the 67.0 kg N/ fed. level as check treatment (Tables, 2, 3, 4, and 5).

From the previous results, it could be noticed that sugarbeet plants received 167.5 kg N/ fed. as ammonium nitrate in five equal portions at 30, 45, 60, 75 and 90 days after sowing showed better enhancement in roots yield and sugar yield and resulted the highest reduction in nematode galls (95.0 %), egg masses (96.2 %), in root and final juvenile larvae (95.1 %), in soil compared with the results of the level of 67.0 kg N/fed. in two equal portions application (Tables, 6, 7, and 8) and nematicide Fenamiphose 10 % G at 10 kg/fed. (Tables 2&3).

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Table (1): Some physical and chemical properties of the experimental soil.

Soil characteristics	Values over seasons	
	2002/2003	2003/2004
• **Physical properties**:		
Sand	70.68	72.72
Fin sand	20.89	19.76
Silt	2.10	2.52
Clay	6.34	5.75
Texture class	Sandy	Sandy
Saturation %	26.30	24.20
O.M. %	1.83	1.86
$CaCo_3$ %	4.80	4.00
PH (1 : 2.5 soil suspension)	7.75	7.93
E.C., m mhose/ cm.	1.23	1.33
• **Chemical properties**:		
Cations and anions (meq/ L):	3.23	3.50
Calcium	2.90	3.12
Magnesium	5.03	5.26
Sodium	1.50	1.71
Potassium	-----	-----
Carbonate	3.73	4.01
Bicarbonate	5.00	5.41
Chloride	3.40	3.93
Sulphate		
• **Available nutrients (ppm):**		
N	89	99.00
P	25	28.00
K	125	156.00
Fe	2.40	2.06
Mn	1.50	107
Zn	0.40	0.50
Cu	0.30	0.30

Table (2): Effect of level and split of nitrogen fertilizer application on Root-knot nematode, *Meloidogyne javanica* galls and egg masses numbers on sugarbeet roots in comparison with nematicide, Fenamiphos under sprinkler irrigation.

Studied Factors	Galls number/ root system				Egg masses number/ root system			
	1st season	2nd season	Combined analysis	Red. %	1st season	2nd season	Combined analysis	Red. %
Nitrogen levels (kg/ fed)								
67.0 kg	272.0^{a}	272.0^{a}	272.0^{a}	-----	525.4^{a}	533.7^{a}	529.6^{a}	-----
100.5 kg	190.7^{b}	183.9^{b}	187.3^{b}	31.1	450.6^{b}	461.1^{b}	455.9^{b}	13.9
134.0 kg	128.6^{c}	114.9^{c}	121.8^{c}	55.2	196.0^{c}	154.6^{c}	175.3^{c}	66.9
167.5 kg	71.7^{d}	66.2^{d}	69.0^{d}	74.6	78.0^{d}	97.5^{d}	43.9^{d}	91.7
Method of Nitrogen application								
In 2 equal portions	302.8^{a}	290.0^{a}	291.4^{a}	-----	559.6^{a}	572.1^{a}	565.9^{a}	----
In 3 equal portions	185.8^{b}	167.9^{b}	176.9^{b}	39.3	431.7^{b}	395.0^{b}	413.4^{b}	26.9
In 4 equal portions	102.6^{c}	120.1^{c}	111.4^{c}	61.8	159.5^{c}	172.8^{c}	166.2^{c}	70.6
In 5 equal portions	71.8^{d}	59.0^{d}	65.4^{d}	77.6	99.3^{d}	107.0^{d}	103.2^{d}	81.8
Comparable Nematicide								
Fenamiphos 10 % (10 kg/fed)	55.7	70.7	62.2	77.1	76.0	88.7	82.4	84.4

- Means followed by the same letters are not significantly different.

Table (3): Effect of level and split of nitrogen fertilizer application on Root-knot nematode, *Meloidogyne javanica* larvae and females in sugarbeet roots and final population of juvenile larvae in soil in comparison with nematicide, Fenamiphos under sprinkler irrigation.

Studied Factors	Larvae and females/root system				Final juvenile larvae/300 ml soil			
	1st season	2nd season	Combined analysis	Red. %	1st season	2nd season	Combined analysis	Red. %
Nitrogen levels (kg/ fed)								
67.0 kg	1256.3a	1165.5a	1210.9a	-----	448.0a	500.3a	496.6a	-----
100.5 kg	1036.7b	913.8 b	975.3 b	19.5	303.0 b	385.7 b	344.4 b	30.6
134.0 kg	868.6c	703.2 c	785.9 c	35.1	194.3 c	263.0 c	228.7 c	53.9
167.5 kg	662.2d	433.9 d	548.1 d	54.7	97.0 d	80.7 d	88.9 d	82.1
Method of Nitrogen application								
In 2 equal portions	1383.7a	1207.5a	1272.3 a	-----	520.8 a	533.0 a	526.9 a	----
In 3 equal portions	1098.8b	922.1 b	1010.5 b	20.6	322.0 b	400.0 b	361.0 b	31.5
In 4 equal portions	871.2 c	760.1 c	815.7 c	35.9	101.3 c	186.0 c	143.7 c	72.7
In 5 equal portions	516.7 d	326.7d	421.7 d	66.9	98.0 d	110.7 d	104.4 d	80.2
Comparable Nematicide								
Fenamiphos 10 % (10 kg/fed)	457.3	310.0	383.7	69.8	115.0	63.0	89.0	82.1

*Means followed by the same letters are not significantly different

Table (4): Effect of level and split of nitrogen fertilizer application on extractable sugar and juice purity percentage of sugarbeet infected with Root-knot nematode, *Meloidogyne javanica* in comparison with nematicide, Fenamiphos under sprinkler irrigation.

Studied Factors	Extractable sugar percentage				Root juice purity percentage			
	1st season	2nd season	Combined analysis	Inc. %	1st season	2nd season	Combined analysis	Inc. %
Nitrogen levels (kg/ fed)								
67.0 kg	11.5 d	11.8 d	11.7 d	-----	81.9 d	83.9 b	82.9 c	-----
100.5 kg	13.0 c	13.4 c	13.2 c	12.8	82.1 c	83.9 b	83.0 c	0.1
134.0 kg	14.6 b	15.0 b	14.8 b	27.4	82.6 b	84.9 a	83.8 b	1.1
167.5 kg	16.3 a	17.1 a	16.7 a	42.7	82.9 a	85.0 d	84.0 d	1.3
Method of Nitrogen application								
In 2 equal portions	12.9 d	13.1 d	13.0 d	-----	80.2 c	83.8 b	82.0 c	----
In 3 equal portions	13.2 c	14.5 c	13.9 c	6.9	82.0 b	83.9 b	83.0 b	1.2
In 4 equal portions	13.7 b	15.1 b	14.4 b	10.8	82.6 a	84.9 a	83.8 a	2.2
In 5 equal portions	14.7 a	15.8 a	15.3 a	17.7	82.7 a	85.0 a	83.9 a	2.3
Comparable Nematicide								
Fenamiphos 10 % (10 kg/fed)	16.3	16.4	16.4	40.2	83.5	84.6	84.1	1.4

- Means followed by the same letters are not significantly different.

Table (5): Effect of level and split of nitrogen fertilizer application on root yield and sugar yield of sugarbeet infected with Root-knot nematode, *Meloidogyne javanica* in comparison with nematicide, Fenamiphos under sprinkler irrigation.

Studied Factors	Root yield (ton/ fed.)				Sugar yield (ton/ fed.)			
	1st season	2nd season	Combined analysis	Inc. %	1st season	2nd season	Combined analysis	Inc. %
Nitrogen levels (kg/ fed)								
67.0 kg	14.8 d	15.5 d	15.2 d	-----	1.7 d	1.8 d	1.8 d	-----
100.5 kg	17.4 c	18.3 c	17.9 c	17.8	2.3 c	2.5 c	2.4 c	0.1
134.0 kg	21.2 b	21.5 b	21.4 b	40.8	3.1 b	3.2 b	3.2 b	77.8
167.5 kg	23.5 a	24.8 a	24.2 a	59.2	3.8 a	4.2 a	4.0 a	122.2
Method of Nitrogen application								
In 2 equal portions	16.7 d	17.9 d	17.3 d	-----	2.2 d	2.3 d	2.2 d	----
In 3 equal portions	18.2 c	19.4 c	18.8 c	8.7	2.4 c	2.8 c	2.6 c	18.2
In 4 equal portions	19.9 b	20.6 b	20.3 b	17.3	2.7 b	3.1 b	2.9 b	31.8
In 5 equal portions	22.1 a	22.2 a	22.2 a	28.3	3.2 a	3.5 a	3.4 a	54.5
Comparable Nematicide								
Fenamiphos 10 % (10 kg/fed)	21.4	20.7	21.1	38.8	3.5	3.4	3.5	94.4

* Means followed by the same letters are not significantly different

Table (6): The results effect of interaction between split and level of nitrogen application on nematode galls number/ root system in the first season.

N-application method / N-level (kg/fed.)	Number of nematode galls per root system of sugarbeet			
	Two equal portions	Three equal portions	Four equal portions	Five equal portions
67.0 N	475.7 a	290.3 c	186.6 f	135.4 hi
100.5 N	336.7 b	208.2 e	126.7 i	91.4 j
134.0 N	243.4 d	169.2 g	65.6 k	36.2 l
167.5 N	155.3 g	76.2 k	31.3 l	24.0 l

* Means followed by the same letters are not significantly different

Table (7): The results effect of interaction between split and level of nitrogen application on number of nematode egg masses/ root system in the first season.

N-application method / N-level (kg/fed.)	Number of nematode egg masses per root system of sugarbeet			
	Two equal portions	Three equal portions	Four equal portions	Five equal portions
67.0 N	907.7^{a}	775.9^{c}	240.5^{f}	177.4^{gh}
100.5 N	804.5^{bc}	676.2^{d}	223.9^{fg}	97.9^{j}
134.0 N	385.7^{e}	201.1^{fg}	110.0^{ij}	87.7^{j}
167.5 N	140.9^{hi}	73.0^{kl}	63.7^{kl}	34.3^{l}

- Means followed by the same letters are not significantly different

Table (8): The results effect of interaction between split and level of nitrogen

N-application method / N-level (kg/fed.)	Number of nematode final juvenile larvae number in 300 ml soil			
	Two equal portions	Three equal portions	Four equal portions	Five equal portions
67.0 N	886.5^{l}	548.4^{k}	202.0^{h}	155.1^{fg}
100.5 N	565.6^{k}	343.2^{i}	174.0^{gh}	129.2^{def}
134.0 N	412.4^{j}	199.2^{h}	101.0^{cd}	64.6^{ab}
167.5 N	140.0^{ef}	117.0^{de}	88.0^{bc}	43.0^{a}

application on nematode final juvenile larvae number in 300 ml soil in the first season.

Table (9): The results effects of interaction between split and level of nitrogen application on root yield / ton/ fed. in the two seasons.

N-level (kg/fed.)	N-application method	Root yield per ton per feddan							
		First season				Second season			
		Two equal portions	Three equal portions	Four equal portions	Five equal portions	Two equal portions	Three equal portions	Four equal portions	Five equal portions
67.0 N		12.5^{l}	14.0^{k}	15.8^{i}	16.8^{h}	13.9^{l}	15.4^{k}	16.0^{j}	16.7^{i}
100.5 N		15.0^{j}	16.7^{h}	18.0^{g}	19.9^{f}	16.1^{j}	17.4^{h}	18.7^{g}	20.8^{e}
134.0 N		18.1^{g}	20.0^{f}	21.9^{d}	24.7^{b}	18.7^{g}	20.5^{f}	22.3^{d}	24.3^{c}
167.5 N		21.0^{e}	22.0^{d}	23.9^{c}	26.9^{a}	22.8^{d}	24.1^{c}	25.4^{b}	27.0^{a}

- Means followed by the same letters are not significantly different

Table (10): The results effects of interaction between split and level of nitrogen application on sugar yield / ton/ fed. In the second season.

N-level (kg/fed.)	Sugar yield per ton per feddan			
	N-application method			
	Two equal portions	Three equal portions	Four equal portions	Five equal portions
67.0 N	1.2^{k}	1.7^{j}	2.2^{i}	2.3^{i}
100.5 N	1.6^{j}	2.5^{h}	2.7^{fg}	3.0^{e}
134.0 N	2.6^{gh}	3.1^{e}	3.4^{d}	3.8^{c}
167.5 N	3.9^{c}	4.1^{b}	4.1^{b}	4.9^{a}

تأثير كمية السماد النيتروجيني المضاف و عدد مرات الإضافة لبنجر السكر على نيماتودا تعقد الجذور، مليدوجين جافانيكا وعلى إنتاجية المحصول تحت نظام الري بالرش في الأراضي الرملية

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أجريت هذه الدراسة خلال موسمي ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤ في منطقة غرب النوبارية. و كان هدف البحث هو دراسة تأثير كمية السماد النيتروجيني المضاف و عدد مرات إضافتها بأجزاء متساوية تحت نظام الري بالرش في الأراضي الرملية في السيطرة على نيماتودا تعقد الجذور، مليدوجين جافانيكا التي تصيب بنجر السكر و ما يترتب على ذلك من تأثيرات على كمية و جودة المحصول.

أشارت النتائج المتحصل عليها أن كلاً من محصول الجذور و محصول السكر و النسبة المئوية للسكر القابل للاستخلاص و النسبة المئوية لنقاوة عصير الجذور يتحقق بهم زيادة تدريجية و معنوية بزيادة مستوى إضافة السماد النيتروجيني من ٦٧,٠ إلى ١٦٧,٥ كجم /فدان. و على العكس من ذلك، بالنسبة لأعداد التعقدات الجذرية و اليرقات و الإناث و كتل البيض على جذر بنجر السكر و كذلك التعداد النهائي ليرقات الطور الثاني المعدي في التربة، يحدث لهم خفض معنوي كلما ارتفعت كمية السماد النيتروجيني المطبق.

و قد بينت النتائج أن هناك تباين في التأثير ذو معنوية على النسبة المئوية للسكر القابل للاستخلاص و على النسبة المئوية لنقاوة عصير الجذور و على كلاً من محصول الجذور و السكر، كما كان هناك تأثير معنوي على عدد التعقدات الجذرية و الأطوار الغير ناضجة لنيماتودا تعقد الجذور، مليدوجين جافانيكا في جذور بنجر السكر و في التربة. وأوضحت النتائج أن تطبيق السماد النيتروجيني على خمس أجزاء متساوية أحدثت زيادة ذات تباين معنوي في كلاً من محصول الجذور و السكر و كذلك الحال للنسبة المئوية للسكر القابل للاستخلاص و النسبة المئوية لنقاوة العصير، كما خفضت بتباين معنوي عدد التعقدات الجذرية و تعداد الأطوار الغير ناضجة للنيماتودا و ذلك بالمقارنة بالمعاملات التي قسمت فيها كمية السماد النيتروجيني على ٤ أجزاء أو ثلاثة أو أثنين متساويات. كما نتجّ عن التفاعل بين عاملي الدراسة (مستويات و عدد الأقسام المتساوية لكمية السماد النيتروجيني) تأثير ذو تباين واضح على محصولي الجذور و السكر و أيضاً تأثير على عدد التعقدات الجذرية للنيماتودا و كتل البيض في الجذور و في التربة بالنسبة ليرقات الطور المعدي.

و مما سبق يمكن استنتاج أن تطبيق مستوى ١٦٧,٥ كجم نيتروجين للفدان في صورة نترات الأمونيوم على خمس أجزاء متساوية و ذلك بعد ٣٠ و٤٥ و ٦٠ و ٧٥ و ٩٠ يوماً بعد الزراعة، أعطى أعلى زيادة في محصول الجذور و محصول السكر و بالمثل أعطى أعلى خفض في عدد التعقدات الجذرية و كتل البيض في الجذر و كذلك نتجَ عنه أعلى خفض في تعداد يرقات النيماتودا في تربة بنجر السكر الرملية و ذلك تحت نظام الري بالرش.و تفوقت هذه المعاملة على كل المعاملات الأخرى بما في ذلك معاملة المبيد النيماتودي الجهازي (فيناميفوس ١٠ % محبب بمعدل ١٠كجم/فدان). هذه المعلومات التي برزت من النتائج سوف تسمح للمنتجين أن يتخذوا قرارات أكثر دقة مؤسسة على معلومات تأخذ بعين الاعتبار تحقيق الأداء العالي لمحصول بنجر السكر في الأراضي الرملية شديدة التلوث بالنيماتودا المتطفلة على النبات.