Evaluation of Some Root-knot Nematode Management Strategies in Sugarbeet Fields at West Nubaryia District

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Abstract

Two field trials were carried out in west Nubaria district, throughout two successive seasons of 2016/2017 – 2017/2018 to evaluate multiple strategies based on reducing the interval between seeding and seedling emergence, by increasing the speed of germination and seedling emergence to offer the most important escape strategy from soil-borne pathogens, the acceleration of germination and plant emergence and sometimes the improvement of seed viability and the acceleration of seedling growth was done by means of what so called EPD (Early Plant Development or fast initial growth) under protection using certain nematicides. Along with those field trials, pot experiment was done at outdoor for 60 days to assess host suitability (resistance) designations of studied varieties i.e. *Beta vulgaris* subsp. *Vulgaris*, Sahar var. and Helsinki to root-knot nematode, *Meloidogyne incognita*. Experimental design was a factorial arranged split-split plot with variety as main plot, plowing depth as split plot in the form of strip-plot arrangement of six treatments and treatment as split-split with four replicates was used. Quantitative scheme for assignment of Canto-Saenz's host suitability for root-knot nematode showed that sugarbeet variety, Helsinki is tolerant and Sahar variety is susceptible. Evaluated treatments i.e. strategies were varied combinations their components consisted from EPD, Abamectin, Oxamyl 10% G and Nemastop and were compared with control treatment. Analysis of variance for the combined data of the studied two seasons significantly at $P \leq 0.05$ marked out the effect of various treatments. Studied Treatments impact individually or in combinations on root-knot nematode parameters, as nematodes number/g soil, knot disease severity % and drop rate % results indicated that sugarbeet variety Helsinki overcame Sahar variety positively for the abovementioned parameters; also, 30 cm-plowing depth outperformed the other two depths in the same issues. Managements treatments distinctly revealed that (EPD + Nemastop), (Nemastop) and (EPD) achieved the best results to reduce all studied root-knot nematode parameters Most likely with a plowing depth of 30 cm. Individual treatments showed that at the level of variety, monogerm Helsinki outperformed polygerm variety, Sahar in all abovementioned parameters. At plowing depth level, 30 cm-plowing depth was mostly had superior positive effect on all recorders. At the level of treatments, (EPD + Nemastop) had a distinguish effect on root and sugar yield per fed., sugarbeet variety, Helsinki overcome Sahar variety. Also, 30 cm-plowing depth had the lead in achieving preferred results, as well treatments (EPD + Nemastop), (Nemastop) and (EPD). Interactions of combined treatment as well showed distinguished results for those parameters mentioned above as combined treatments implied one of those distinguish individuals. Interaction effect of combined treatments got promising results as they implied any of individual treatment that previously showed positive results concerning the same nematode parameters.

Keywords: sugarbeet –root-knot nematodes – seed treatment – plowing depth - EPD – nematicides.

Introduction

Sugarbeet, Beta *vulgaris* var. *Saccharifera* L. was the second major sugar crop grown in newly reclaimed soil. Sugarbeet, which contributed. Currently, in Egypt sugarbeet is deliberated as the first sugar crop in Egypt cultivated in 492.708 feddans contributing 57.7% of sugar production with an average production of 21.06 tons per feddan (Annual Report of Sugar Crops Council, December 2018). Increase in production is attributed to higher procurement prices especially for sugarbeets (GAIN Report, 2019).

As sugarbeet production growing, challenges augmenting, among these challenges in newly reclaimed soils the root knot nematodes are included within the genus *Meloidogyne* Goldi, and belong to a comparatively small but important polyphagous assemblage of extremely adapted obligate plant pathogens (Abad et al., 2003). Due to their endoparasitic mode of living and feeding, root knot nematodes interrupt the physiology of the plant and able to cause great losses in production and quality of sugarbeet crop (Gohar and Maareg, 2005) and, therefore, are of great economic importance and compile control strategies is required. Chemical nematicides, due to their high availability and easy applicability, are usually preferred for their effective control; though, their excessive and continues use caused direct toxicity to predators, pollinators, fish and man, had adverse effects on soil health and environment and cause poor soil fertility, productivity and pesticides residues in products. The problems associated with nematicides application turned the workers vision to focus on new strategies and new alternative agents for nematode management programs in sugarbeet production. Historically, growers have utilized whole field nematode control strategies because of their incapability to position and recognize areas of differing nematode densities to allocate application of nematicides in a site-specific approach inside fields (Evans et al., 2002). Site-specific application of nematicides offers a chance to get better nematode control efficiency. Use of treated seed can reduce chemical use by 99.4% compared to aerial applications and 88% compared to a banded in-furrow treatment (Frye, 2009). The use of seed treatment, however, is an attractive alternative for nematode control since it requires less chemical input than large scale field nematicide applications, thereby reducing environmental impact and lowering investment costs. Chemical seed treatment is only active in the rhizosphere of soil surrounding the root system of young plants and therefore reduces the risk of undesired accumulation. Treating seeds directly reduces the high cost associated with all other application forms and reducing effects on beneficial and compatible with other IPM strategies (Gohar et. al. 2014).

The more advanced for seed treatment is the main objective for this study through experiencing new strategy depend on reducing the interval between seeding and seedling emergence, by accelerating the speed of germination and seedling emergence to offer the most important escape strategy from soil-borne pathogens.

To achieve these goal new technological solutions were employed in this investigation known EPD (Early Plant Development or fast initial growth). They are characterized by the application of special technologies of seed (Kolarić *et. al*, 2015). These procedures seeds are practically "be activated", has a faster initial growth, balanced germination, faster assembly lines under protection by proper nematicide which expectantly may result reduction in root-knot disease severity and superior productivity.

Materials and Methods

2.1. **Plant Materials**. Seeds of the tested sugarbeet varieties Helsinki as monogerm variety and Sahar as polygerm (Germany and Netherlands, respectively), (CECD 2019).Varieties were commercial and obtained from the certified sugarbeet varieties pool of Alexandria Sugar Company.

2.2. Nematicides and substances used:

2.2.1 **Abamectin®** as liquid formulation is a macrocyclic lactone derived from the soil bacterium Streptomyces avermitilis that has been shown to have nematicidal properties (Putter et al. 1981) and a different mode of action than the other currently available nematicides (Tuner and Schaeffer, 1989). The rate of application 40 ml feddan-1

2.2.2. **Oxamyl (Vydate®)** a granule containing 10% w/w for the suppression of nematodes in potatoes, beet, carrots and parsnips. Active ingredient Oxamyl (carbamate).... Apply the granules at 0.03 kg/100m in the seed furrow at drilling to a minimum depth of 2.5cm, Apply Vydate® 100 GR into planting furrow before irrigation.

2.2.3. **Nemastop®** as suspension formulation is a natural product consist of herb *Allium sativum* (garlic) extracts (thio- compounds - Allyl Disulfide + Allyl cysteine) 8% (Harris *et.al.* 2001) and natural organic matter effective in fighting nematodes. The rate of application 10 L feddan^{-1}

2.3. **Preservative substances for accelerating germination and growth used (Early Plant Development- EPD):** A combination of Biplantol®, humic acids and Stockosorb® have been employed in coating seeds:

2.3.1. **Biplantol®**, an organic, homeopathic product supposed to promote root development (Bioplant Naturverfahren GmbH, Konstanz, Germany).

2.3.2. **Humic acid**, known to improve water penetration into seeds, promote germination, and stimulate root growth (Mackowiak *et al*. 2001; Atiyeh *et al*. 2002).

2.3.3. **Stockosorb®**: It is a cross-linked potassium based polyacrylate/ polyacrylamide hydrophilic polymer which is nutrient free (Ghebru *et al*. 2007; Gorim *et al*. 2009).

The combination of above agents represented the coating of the sugarbeet seeds, coat share % as the mass of the coated seeds; the optimum coat share used was coat share 50-75 % and calculated as follows:

$$Coat.share.\% = \frac{Mass.of.individual.coated.seed - Mass.of.individual.uncoated.seed}{Mass.of.coated.seed} \times 100$$

(Gorim, 2014)

2.4. **Experimental Fields** and Sugarbeet Growing Conditions. The experimental site located at Adam Village, Tiba Supervision, West Nubaria Sector (30°37'31.40"N, 29°58'9.26"E), which was naturally infested with *Meloidogyne incognita* in. The soil type was sandy soil containing distinctly low percentage of organic matter (0.39 %), with a pH of 8.01. The average particle size distribution was 87.2 % sand, 6.5 % fine sand, 2.0 % silt and 4.3 % clay. The field had been planted for sugarbeet for numerous years before launching this study. Sowing dates for the two field experiments were at 18th of October 2017 and 2018. Three levels of plowing depth were conducted (P1= 30 cm, P2= 40 cm and P3= 50 cm). The used plow was chisel plow with Standards number of 7 blades arranged on two rows, the first one with 3 blades and the second with 4 blades, spacing between blades 45 cm, the plow gullet measured 75 cm, plowing depth is changeable controlled by the two wheels of depth adjusting (Gauge wheels), maximum depth reaches 55 cm, the used tractor was Fiat® 4×4 wheel drive with capacity of 130 hp. Conventional crop management was followed as recommended for sugarbeet production in the region. All crop production practices were performed by the grower, and fertilization was based on soil nutrient analysis. Irrigation was drip irrigation system 50 × 20 cm. In the drip irrigation system, polyethylene drip lines of 16 mm in diameter had in-line type emitters. The distance between emitters along the drip line was 0.33 m and the discharge of one emitter was 4 L /fed. under the running pressure of 1.5 atm.

2.5. **Experimental design** was a factorial arranged split-split plot with plowing depth as main plot, variety as split plot in the form of strip-plot arrangement of treatments and treatment as split-split with four replicates was used. Sub-subplots consisted of six rows (50 cm spacing) by 7.0 m in length (3 m ×7.0 m = 21.0 m2) i.e. 1/200 Fed. with four replicates. The experimental setup was repeated for the succeeding trial in 2018.

2.6. **Soil Disinfestations Treatments** were applied to individual plots. Five treatments plus an untreated control were established in a randomized complete plot design with four replicates per treatment at each location every season.

Treatment symbols	Soil Treatment	Application
T_1	EPD	Seed treatment (coating)
T_2	Nemastop®	Seed treatment (soaking)
T_3	Vaydet®	**In the seed furrow at drilling**
T_4	EPD + Abamectin®	Seed treatment (coating + soaking)
T_5	EPD + Nemastop	Seed treatment (coating + soaking)
T_6	Control	Standard seed & free furrow of chemicals

2.7. **Nematode soil population densities** were estimated from composite soil samples were taken from each plot just before applying the soil disinfestations treatments (P0) and after the treatments at planting (Pi) to determine soil nematode densities. On each sampling time, twelve soil cores were taken per plot using a vertical soil core sampler and cores were mixed in a composite soil sample. Nematodes were extracted from sub-samples using a modified Bearman's tray method as described by Barker (1985), where at harvest, P_f was determined by taking composite soil samples dug with a spade around the roots of 10 to 12 plants distributed randomly at each site. Nematodes were extracted using a modified Bearman's tray method as described by Barker (1985), and identified and counted under a compound microscope. To identify the *Meloidogyne* species, ten females were collected from infected roots under a stereo microscope. to identify the RKN species in accordance with their perineal pattern.

2.8. **Host suitability** resistance designations of studied varieties i.e. *Beta vulgaris* subsp. *Vulgaris*, Sahar var. and Helsinki: The host efficiency (reproduction factor 'RF') was calculated, where 'RF' = Pf/Pi, with Pf being final population in 250 cm3 of soil and Pi being the initial inoculums. Final assessment of the various genotypes was based on modified Canto-Saenz's host resistance designations scheme (Gohar *et al*., 2013) as given in (Table, A).

Table (A):-Adapted Quantitative scheme for assignment of Canto - Saenz's host suitability (resistance) designations modified for sugarbeet by (Gohar *et. al.* 2013).

Degree of resistance (DR)	Host efficiency ^{z} (R-factor)	Plant Damage (Gall index)^y
Resistant **(R)**	≤1	≤2
Moderately Resistant **(MR)**	≤1	≈2
Tolerant **(T)**	>1	≤2
Susceptible (S)	>1	>2
Hyper susceptible (HYS)	≤1	>2

^{Z} reproductive factor: RF = Pf/Pi where Pi = initial population density and Pf = final population density, ^{Y} Gall index: 0 = no gall formation; 5 = heavy gall formation source: Sasser *et al* (1984) designations modified by (Gohar *et. al.* 2013).

2.9. **Assessment of tested nematodes management strategies efficacy%** against the root-knot nematode on sugarbeet. To evaluate the experimented efficacy % of management strategies against root-knot nematode, the numbers of nematodes in the soil and disease severity were determined. The nematode numbers in the soil were detected by Baermann funnel apparatus. Finally, the first couple of drops of water from the bottom of the tube were gathered by slowly releasing the clamp on the tubing, and then the density of larvae was examined under the microscope. For the disease severity detection, the gall indices we rerecorded at the termination of experiments on the scale rating chart as described above. The six-control strategies efficacy was calculated as described by (Xue *et al.* 2009).

Disease severity, drop rate % and control strategies efficacy were calculated as following:

Disease severity % =

$$\left[\sum \frac{the.number.of.root-knot.disease.plants.in.this.index \times disease.index}{total.plants.investigated \times highest.root.index-knot.disease.index} \times 100\%\right]$$

Drop rate %=

$$\frac{the.number.of.J2.in.control.treatment - the.number.of.J2.in.strategy.management.treatment}{the..number.of.J2.in.control.treatment} \times 100\%$$

Management strategy efficacy %=

$$\frac{disease..severity.in.control.treatment - disease..severity.in.strategy.treatment}{disease..severity.in.control.treatment} \times 100\%$$

2.10.**The impact of strategy treatments on the yield** of sugarbeet as roots and sugar ton/fed.

Data Recorded:

In each plot (sub- plot), the outer two ridges (1^{st} and 6^{th}) were considered as a belt, while, the 2^{nd} and 5^{th} ridges were devoted for plant growth sampling, the two central ridges to determine roots and top yields at harvest. The collected data in the two experiments involved the following traits:

Yield characters:

1- Root yield (tons/ fed).

2- Sugar yield (tons/ fed) = Roots yield/ fed × Sucrose% according to the equation given by (Suheri, 2007).

Statistical analysis:

Bartlett's test (Snedecor and Cochran, 1989) is used to examine the null hypothesis, homogeneity of variances for the two season's records, thus, data of the two seasons were combined for analysis of variance (ANOVA) according to Steel and Torrie (1981). using MSTAT version 4 (1987), followed by testing significant differences among the means of different treatments were separated by Duncan's Multiple Range Test at 0.05 probability according to Duncan (1955).

Results and discussion

1. Host suitability resistance/ susceptibility designations of studied varieties for root-knot nematode, *M. incognita*:

The resistance/susceptibility of two sugarbeet varieties was measured by gall index (GI) as an indicator for plant damage, and host efficiency (R factor) as an indicator for nematode reproduction according to Quantitative scheme for assignment of Canto-Saenz's host suitability (resistance) - (Canto-Saenz host suitability designations modifications by Gohar *et. al.*, 2013).

The result of the varietal assessment is illustrated on Table (A), revealed that Helsinki variety supported relatively high nematode reproduction (R >1) with fairly plant damage (GI≤2) and was therefore rated as tolerant. The subsequent category implied sugarbeet variety Sahar which supported nematode reproduction (R >1) with high plant damage (GI >2) and was therefore rated as susceptible (Table, 1).

Table 1. Host suitability (resistance) Designations of studied varieties i.e. *Beta vulgaris* subsp. *Vulgaris*, Sahar var. and Helsinki tested for root-knot nematode, *M. incognita*

Sugarbeet varieties	Root gall index*	J2/250 cm^3 of Soil (Pi)	R-factor host efficiency**	Host status***
Polygerm Sahar	3.4	921	2.3	Susceptible
Monogerm Helsinki	1.7	959	2.4	Tolerant
Mean	2.6	940	2.4	
LSD 0.05	1.1	386		

*Gall index: 0= no gall formation; 5= heavy gall formation.

**Reproduction factor: R= Pf/Pi, where Pi =initial population (400 J2/250 cm^3 soil) density and Pf= final population density

*** Host status based on Canto-Saenz host suitability designations modified for sugarbeet by Gohar *et. al*., 2013)

Gohar *et. al.* (2013) concluded there are three categories for sugarbeet varieties as response to *M. incognita*, the first seriously affected the second included reasonably affected varieties as Tolerant ones and the third as severely affected with nematode represented variety as Hyper susceptible one.

2. Effect of multiple Management approaches on root- knot nematodes number/g soil:

Denoting to results in Table (2), the monogerm sugarbeet variety, Helsinki harbored an average of number of 2.7 larvae/ g soil significantly less than those harbored by polygerm variety Sahar (2.8 larvae/g soil). Also, plowing depth had some effect on the number of larvae / g soil, whereas 30 cm-plowing depth scored the lower number (2.3 larvae/ g soil). All studied plowing depths varied significantly at $P \leq 0.05$ than each others.

From Table (2), evaluation the effect of management treatments on root-knot nematode number as larvae /g soil compared with the control treatment, showed that all tested treatments significantly reduced the population of root-knot nematode in the soil, also it could be noticed that there were significant differences among all tested managements at $P \leq 0.05$. The best record was for treatment T_2 (Nemastop) - 2.4 larvae / g soil, followed by T_5 (EPD + Nemastop) - 2.8 larvae / g soil.

Table 2. Effect of multiple Management approaches on root- knot nematodes number/g soil, in sugarbeet field by combine analysis of 2016/ 17 and 2017/ 18 growing seasons.

Varieties	Plowing depth	Treatments T_1	T_2	T_3	T_4	T_5	T_6	Mean
Polygerm Sahar	**30**	1.8	1.9	3.0	2.9	2.0	5.2	**2.3**
	40	3.8	2.2	4.2	3.6	1.3	6.1	**3.0**
	50	3.4	2.0	4.0	3.8	1.8	6.5	**3.0**
Mean		**3.0**	**2.0**	**3.7**	**3.5**	**1.7**	**5.9**	**2.8**
Monogerm Helsinki	**30**	1.8	2.9	3.3	2.8	0.5	7.0	**2.3**
	40	3.5	2.6	2.3	1.9	2.1	8.0	**2.5**
	50	4.1	3.0	3.5	3.4	3.5	9.0	**3.5**
Mean		**3.1**	**2.8**	**3.0**	**2.7**	**2.0**	**8.0**	**2.7**
Plowing depth	**30**	1.8	2.4	3.2	3.0	1.4	6.1	**2.3**
	40	3.5	2.4	3.4	2.9	1.7	7.1	**2.8**
	50	3.8	2.5	3.9	3.8	5.3	7.8	**3.9**
Mean		**3.1**	**2.4**	**3.5**	**3.2**	**2.8**	**7.0**	**3.0**

T_1 = EPD, T_2= Nemastop, T_3= Vaydet, T_4= EPD + Abamectin, T_5= EPD + Nemastop, and T_6= Control

L.S.D$_{0.05}$

Varieties (V)	0.035		
Plowing depth (P)	0.031	Treatments (T)	0.033
V x P	0.030	V x T	0.029
P x T	0.032	V x P x T	0.032

The interaction effect of combined treatments for variety × plowing depth on number of root-knot nematode larvae / g soil had significant differences among them at P ≤ 0.05. Sugarbeet varieties, Helsinki and Sahar recorded the same value of lowering population f root-knot nematode larvae at 30 cm-plowing depth (2.3 larvae /g soil), the least effect was with Helsinki variety at 50 cm-plowing depth (3.5 larvae /g soil). Interaction effect of combined treatments for variety × Management treatments on population of root-knot nematode / g soil showed that there were significant differences among those combinations at P ≤ 0.05. Sugarbeet variety, Sahar had the lead to reduce root-knot nematode larvae with treatment T_5 (EPD + Nemastop) - 1.7 larvae / g soil followed by Helsinki variety with the same treatment (2.0 larvae / g soil), followed by Sahar variety with T_2 (Nemastop) – 2.0 larvae /g soil. All interaction effect for variety × plowing depth had significant differences among them at P ≤ 0.05 never the less the all had satisfactory effect to reduce population of root-knot nematode compared with control treatment (Table, 2).

From same Table (2), results confirmed that interaction effect of plowing depth × management treatments on larvae numbers / g soil achieved significant differences among them at P ≤ 0.05. The most influence combination was 30 cm-plowing depth with T_5 (EPD + Nemastop) - 1.4 larvae / g soil followed by 40 cm-plowing depth with the same treatment (1.7 larvae / g soil), followed by 30 cm-plowing depth with T_1 (EPD) – 1.8 larvae / g soil.

The combined treatments of variety × plowing depth × management treatment (V × P × T) had significant interaction effect mostly at P ≤ 0.05 on larvae numbers / g soil. Among all combinations there were significant differences, in the front, sugarbeet variety, Sahar at 40 cm-plowing depth with treatment T_5 (EPD + Nemastop) had the lowest larvae number /g soil (1.3), followed by the same variety at 30 cm depth with treatment T_1 = EPD (1.8 larvae/ g soil), followed by variety Helsinki at 30 cm-plowing depth with treatment T_1 = EPD by the same value (1.8).

3. Effect of multiple approaches for controlling root- knot nematodes on disease severity % in sugarbeet:

Results in Table (3) revealed that calculated disease severity % for the two tested sugarbeet varieties, differed significantly at P ≤ 0.05, whereas, the monogerm variety, Helsinki got an average of root-knot disease severity 17 %, while, the polygerm variety, Sahar got disease severity % greater than Helsinki (26.5 %). Plowing depth recorded significant difference among the at P ≤ 0.05, the highest disease severity % recorded for 40 cm-plowing depth. Management treatments had occasionally significant difference among them at P ≤ 0.05, treatment of T_5 (EPD + Nemastop) achieved the best result whereas it had the lowest disease severity (13.1 %), followed by treatment T_2 (Nemastop) – (14.9 %). All management treatments reduced root-knot severity % significantly compared with control treatment (35.1 %).

Interaction effect of combined treatments on root-knot disease severity % showed in Table (3) confirmed that variety × plowing depth had significant differences among them at P ≤ 0.05, sugarbeet variety, Helsinki at 40 cm-plowing depth and at 30 cm followed by the same variety with 50 cm-plowing depth reduced root-knot disease severity to 16.4 %, 16.6 % and 17.9 %, respectively. The best reduction of disease severity % to Sahar variety was with 50 cm-plowing depth (21.4 %). Interaction variety × Management treatments reduced root-knot disease severity % compared with control, the best reduction was obtained by sugarbeet variety, Helsinki with treatment T_5 (EPD + Nemastop) – 13.1 % , followed by sugarbeet variety, Sahar with the same treatment (T_5) – 14.3 %, followed by Sahar variety with T_2 (Nemastop) – 14.7 %, followed by Helsinki variety with treatment T_4 (EPD + Abamectin) – 14.8 %. All combined treatments of variety and management treatments reduced root-knot severity % significantly compared with control treatment at $P \leq 0.05$.

Table 3. Effect of multiple approaches for controlling root- knot nematodes on disease severity % in sugarbeet field by combine analysis of 2016/ 17 and 2017/ 18 growing seasons.

Varieties	Plowing depth	Treatments						Mean
		T_1	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	
Polygerm Sahar	**30**	14.8	15.2	22.8	22.2	17.2	90.3	**30.4**
	40	26.0	15.1	31.0	23.3	12.3	58.6	**27.7**
	50	20.3	13.8	25.0	23.2	13.5	32.5	**21.4**
Mean		**20.4**	**14.7**	**26.3**	**22.9**	**14.3**	**60.5**	**26.5**
Monogerm Helsinki	**30**	13.0	16.7	18.1	16.3	10.3	25.0	**16.6**
	40	17.1	14.1	13.5	12.7	13.0	28.2	**16.4**
	50	17.6	14.4	15.9	15.5	15.9	28.3	**17.9**
Mean		**15.9**	**15.1**	**15.8**	**14.8**	**13.1**	**27.2**	**17.0**
Plowing depth	**30**	13.8	15.9	20.3	18.6	12.5	36.1	**19.5**
	40	20.3	14.8	18.6	16.3	12.4	38.2	**20.1**
	50	19.1	14.1	19.1	18.6	14.4	31.0	**19.4**
Mean		**17.7**	**14.9**	**19.3**	**17.8**	**13.1**	**35.1**	**19.7**

T_1 = EPD, T_2= Nemastop, T_3= Vaydet, T_4= EPD + Abamectin, T_5= EPD + Nemastop, and T_6= Control

L.S.D$_{0.05}$	
Varieties (V)	0.119
Plowing depth (P)	0.067
Treatments (T)	0.139
V x P	0.096
V x T	0.196
P x T	0.240
V x P x T	0.339

The most promising results for reducing root-knot severity as interaction effect of plowing depth × Management treatments, all were with T_5 (EPD + Nemastop), at 40 cm, 30 cm and 50 cm-plowing depths (12.4, 12.5, and 14.4 %, respectably). All plowing depths with treatment T_2= Nemastop had the second rank in reduction of root-knot severity % compared with control treatment (Table, 3).

The combined treatments of variety × plowing depth × management treatment (V × P × T) had significant interaction effect on reduction of root-knot disease severity % at $P \leq 0.05$. the best reduction was obtained by Helsinki variety at 30 cm-plowing depth with treatment T_5 (EPD + Nemastop) – 10.3 %, followed by Sahar variety at 40 cm-plowing depth with treatment T_5 (EPD + Nemastop) – 12.3 %, followed by 13.0 % reduction of disease severity % obtained by Helsinki variety at 40 cm-plowing depth with treatment T_5 (EPD + Nemastop). All combinations had significant differences among them at $P \leq 0.05$ (Table, 3).

4. Effect of multiple approaches for controlling root- knot nematodes on drop rate %:

Results in Table (4) illustrated drop rate % as an indicator for efficiency for management trails, whereas, it's a calculation depend on the difference between the number of J2 in control treatment and the number of J2 in tested treatment divided on the number of J2 in control treatment multiplied by 100%, thus, as number of J2 in tested treatment decreases the value of drop rate % increases signifying the powerful rate % of tested management method.

Sugarbeet monogerm variety, Helsinki recorded drop rate 66.0 % greater than that recorded by polygerm variety, Sahar (53.1) with highly significance at $P \leq 0.05$. Concerning plowing depth effect on drop rate %, there were significant difference among three tested plowing depth, in the lead, 30 cm-plowing depth (61.5 %) followed by 40 cm-plowing depth (60.6 %) and then 50 cm-plowing depth (50.5 %). All tested management treatments had significant effect on drop rate %, whereas, T_2 (Nemastop) got the highest drop rate % (64.9 %), followed by T_5 (EPD + Nemastop) – 61.8 %. The smallest effect on drop rate % was recorded by T3 (Vaydet) – 49.7 % (Table, 4).

Regarding combined treatments interaction effect of variety × plowing depth on drop rate % showing in Table (4), confirmed that there were significant differences among combined treatments at $P \leq 0.05$. The soaring effect was 69.2 % for sugarbeet variety, Helsinki at 40 cm-plowing depth, followed by the same variety at 30 cm-plowing depth (67.7 %) and at 50 cm-plowing depth (61.2). As well combined treatments interaction effect of variety × management treatments on drop rate % presented significant differences among them at $P \leq 0.05$. The combined Helsinki variety × T_5 (EPD + Nemastop), topped obtained values of drop rate % (76.1%), followed with Sahar variety with the same treatment (70.5 %), whereas, the smallest value was recorded by combined treatments of Sahar variety with treatment T_3 (Vaydet) – 37.7 % drop rate (Table, 4).

Table 4. Effect of multiple approaches for controlling root- knot nematodes on drop rate % in sugarbeet field by combine analysis of 2016/ 17 and 2017/ 18 growing seasons**.**

Varieties	Plowing depth	Treatments						Mean
		T_1	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	
Polygerm Sahar	**30**	65.4	63.4	42.3	43.5	61.7	0.0	**55.3**
	40	37.7	63.3	31.4	41.0	78.3	0.0	**50.3**
	50	47.1	69.3	39.2	41.1	71.6	0.0	**53.7**
Mean		**50.1**	**65.4**	**37.7**	**41.9**	**70.5**		**53.1**
Monogerm Helsinki	**30**	74.2	58.1	53.4	59.7	93.1	0.0	**67.7**
	40	55.9	67.9	71.5	76.3	74.2	0.0	**69.2**
	50	54.6	67.2	60.6	62.7	61.1	0.0	**61.2**
Mean		**61.5**	**64.4**	**61.8**	**66.2**	**76.1**		**66.0**
Plowing depth	**30**	69.8	60.8	47.9	51.6	77.4	0.0	**61.5**
	40	50.8	65.6	51.5	58.6	76.2	0.0	**60.6**
	50	50.8	68.3	49.9	51.9	31.8	0.0	**50.5**
Mean		**57.2**	**64.9**	**49.7**	**54.0**	**61.8**		**57.5**

T_1 = EPD, T_2= Nemastop, T_3= Vaydet, T_4= EPD + Abamectin, T_5= EPD + Nemastop, and T_6= Control

$L.S.D_{0.05}$

Varieties (V)	0.119
Plowing depth (P)	0.067
Treatments (T)	0.139
V x P	0.096
V x T	0.196
P x T	0.240
V x P x T	0.339

Interaction effect on drop rate % induced by combined treatments plowing depth × management treatments presented in table (4) revealed significant differences among them at $P \leq 0.05$. the highest values for drop rate were obtained by 30 cm plowing × T_5 (EPD + Nemastop) – 77.4 %, followed 40 cm-plowing depth with the same treatment (T5 – 76.2 %), followed by 30 cm-plowing depth with T_1 (EPD) – 69.8 % drop rate. On the other hand, the weakest effect was recorded for 30 cm-plowing depth with T_3 (Vaydet) – 47.9 % drop rate.

Also, combined treatments of variety × plowing depth × management treatment (V × P × T) had significant interaction effect mostly at $P \leq 0.05$ on drop rate %. The superior obtained effect was recorded by Helsinki variety × 30 cm-plowing depth × T_5 (EPD + Nemastop) – 93.1 %, followed by combined treatments Sahar variety × 40 cm-plowing depth × T_5 (EPD + Nemastop) – 78.3 % followed by Helsinki variety × 40 cm-plowing depth × T_4 (EPD + Abamectin) – 76.3 % drop rate. The smallest effect recorded by Sahar variety at 40 cm-plowing depth with T_3 (Vaydet) – 31.4 % drop rate.

Digesting findings in Tables 2 – 4, that illustrating effect of treatment individually or in combinations on root-knot nematode parameters, as nematodes number/g soil, knot disease severity % and drop rate %. Results indicated that sugarbeet variety Helsinki overcame Sahar variety positively for the abovementioned parameters; also, 30 cm-plowing depth outperformed the other two depths in the same issues. Managements treatments distinctly revealed that T_5 (EPD + Nemastop), T_2 (Nemastop) and T_1 (EPD) achieved the best results to reduce all studied root-knot nematode parameters. Interaction effect of combined treatments got promising results as they implied any of individual treatment that previously showed positive results concerning the same nematode parameters. Considering the tested sugarbeet varieties for susceptibility to *M. incognita* (Table 7) the two cultivars according to Canto-Saenz's host suitability (Sasser *et al.*, 1984) designations modified by (Gohar *et. al.* 2013)., can be distinguished to two categories, the first involves susceptible variety i.e. Sahar seriously affected by root-knot nematode, *M. incognita* that larger values of nematodes number/g soil, knot disease severity % and lesser value of drop rate %. The second category in this concern was reasonably affected by root-knot nematode as Tolerant, due to sugarbeet variety, Helsinki which recorded lesser values of nematodes number/g soil, knot disease severity % and larger value of drop rate %. Results in these Tables (2-4) in full consistency with those in below Tables (6 & 7). Obviously, Nemastop has reasonable nematicidal effect on root-knot nematodes, Gohar *et. al.* (2014) revealed that 14 days after planting in plots receiving Nemastop seed treatment showed density of nematode population declined gradually up to the third week (21 DAS) and turn down sharply towards mid-season and considered a promising seed treatment for lowering the population density of root-not nematodes, regarding that Nemastop has nematicidal effect also possess thio-compounds - Allyl Disulfide + Allyl cysteine) 8%

which activate as antioxidants (Harris *et. al.* 2001), that might delay any probable tissue damage in early infestation, these features provide wide spectrum longevity of protection in rhizoplane of the roots . EDP Called EPD (Early Plant Development). They are characterized by the application of particular technologies to seed. These measures applied to seeds are practically "be activated", has a quicker initial growth, balanced germination, closer assembly lines which finally results in superior productivity. Thus, combining EPD with Nemastop would provide faster plant development under protection. The efficiency of seed treatment was more visible under stress germination conditions. In optimum conditions washing and priming speeded up seed germination compared to control seeds. However, under the shortage and excess of water the acceleration of germination of the same seeds took place. Seeds of different sugarbeet varieties differed significantly in their germination rate Orzeszko- Rywka and Podlaski (2003). Since the current study used one sugarbeet seeds varieties (Sahar and Helsinki), hence the variations in germination parameters are due to varying treatments i.e. nematicides and/or EPD as well as varieties. Although, the efficiency of seed treatment depended on initial seed quality, the worse the seed vigor, i.e. the slower the germination, the higher the efficiency of seed treatment (Draycott *et al*. 2002). But it can be said by other means from the control treatment in this study that seed susceptibility was between susceptible and tolerant for the studied varieties Thus, the promising variation in nematode parameters control is a result mainly for the tested nematicidal seed treatments and EPD technology.

5. Efficacy % of multiple approaches for controlling root- knot nematodes in sugarbeet fields:

Findings in Table (5) pointed up the calculations of efficacy % of multiple attempts to control root- knot nematodes in sugarbeet fields by information of disease severity in both control treatment and experienced treatment. There was significant difference between the two tested sugarbeet varieties for their contribution in root-knot nematode control efficacy %, whereas, polygerm sugarbeet variety, and Sahar achieved 61.28 % and monogerm variety, Helsinki achieved 44.83 %. At the level of sole treatment of plowing depth, 40 cm-plowing depth scored the highest contribution in root-knot nematode control efficacy (56.86 %), followed by 30 cm-plowing depth which contributed in nematode control efficacy by 55.07 % with significant differences along all tested plowing depths at $P \leq 0.05$. Efficacy % of root-knot nematode management treatments scored significant variations among them, whereas, treatment T_5 (EPD + Nemastop) was at front with control efficacy 62.15 %, followed by treatment T_2 (Nemastop) which scored control efficacy 57.24 %. The smallest control efficacy % obtained by treatment T_3 (Vaydet) - 44.49 %.

Table 5. Efficacy % of multiple approaches for controlling root- knot nematodes in sugarbeet field by combine analysis of 2016/ 17 and 2017/ 18 growing seasons

Varieties	Plowing depth	Treatments						Mean
		T_1	T_2	T_3	T_4	T_5	T_6	
Polygerm Sahar	**30**	83.61	83.17	74.75	75.42	80.95	0.00	**79.58**
	40	55.63	74.23	47.10	60.24	79.01	0.00	**63.24**
	50	37.52	57.52	23.05	28.59	58.45	0.00	**41.02**
Mean		**58.92**	**71.64**	**48.30**	**54.75**	**72.80**		**61.28**
Monogerm Helsinki	**30**	48.00	33.20	27.60	34.80	58.80	0.00	**40.48**
	40	39.35	49.99	52.12	54.96	53.90	0.00	**50.07**
	50	37.81	49.12	43.82	45.23	43.82	0.00	**43.96**
Mean		**41.72**	**44.10**	**41.18**	**45.00**	**52.17**		**44.83**
Plowing depth	**30**	61.77	55.96	43.77	48.48	65.37	0.00	**55.07**
	40	46.86	61.26	51.31	57.33	67.54	0.00	**56.86**
	50	38.39	54.52	38.39	40.00	53.55	0.00	**44.97**
Mean		**49.01**	**57.24**	**44.49**	**48.60**	**62.15**		**52.30**

T_1 = EPD, T_2= Nemastop, T_3= Vaydet, T_4= EPD + Abamectin, T_5= EPD + Nemastop, and T_6= Control

$L.S.D_{0.05}$	
Varieties (V)	0.119
Plowing depth (P)	0.067
Treatments (T)	0.139
V x P	0.096
V x T	0.196
P x T	0.240
V x P x T	0.339

In brief, results in Table (5) pointed out that sugarbeet variety, Sahar contributed in root-knot nematode control efficacy % by percentage higher that inputted by Helsinki, also, management treatment T_5 (EPD + Nemastop) recorded the highest control efficacy % followed by T_2 (Nemastop). 40 cm and 30 cm-plowing depths scored the higher values of root-knot nematodes control efficacy %. As regards of interaction effect of combined treatments on control efficacy %, it could be pragmatic that any combined treatment implied any of treatment with richer effect individually resulted in good impact on root-knot nematode control efficacy %.

The computed efficacy % for management strategy revealed that efficacy depend on the input of every factor involved individually or in combinations, as any of factor performed well realistic return is expected as well as in combination this is in consistency with all above tabulated data. Gohar *et. al.* (2009) declared that significant performance of the cumulative effect by two effective combined means to manage root-knot nematodes as the best opportunity in reducing the nematode population and improving plant health.

This introduces an ideal integration of management components against soil borne diseases like root-knot nematode. All management components in the study viz. the two bioagents, bioregulator and the nematicide are environment-friendly economic material and easy to apply by farmers. The British Germans Seed Company has achieved a 50% reduction in the plant emergence time by using seed priming (Burks 2008). The economic effects of sugarbeet seed priming in the UK have resulted in a 4% root yield gain and a technological yield of sugar of 5% (Jaggard *et al*. 2009).

Effect on main yield components of sugarbeet:

6. Effect of multiple trails for controlling root- knot nematodes on roots yield (tons/ fed):

Results in Table (6) demonstrate impact of compound attempts to control root-knot nematodes on roots yield /fed. Variety effect exposed that sugarbeet variety, Helsinki achieved average of 23.30 tons root yield /fed, soaring sugarbeet variety, Sahar which scored 19.67 tons /fed. With significant difference at $P \leq 0.05$. Regarding effect of plowing depth, findings showed that depth of 30 cm scored the highest tonnage (22.24 /fed.), followed by 40 cm-plowing depth (21.37 tons/fed.) without significant difference between them.

Results in Table (6) also, signify that management treatments had distinct effect on roots **yield** /fed. Treatment T5 (EPD + Nemastop) achieved the highest rank in this concern (25.893 ton roots /fed.) followed T2 (Nemastop) - 23.119 ton roots /fed. with significant difference between them at $P \leq 0.05$. The minimal effect recorded for management treatment T_3 (Vaydet) 18.633 ton roots /fed.).

The effect interaction of combined treatments can be deduced from Table (6), as variety × plowing depth (V × P); the highest level of tonnage roots/fed. (24.32) achieved by sugarbeet variety, Helsinki at plowing depth 40 cm. The second ranked combination was also, sugarbeet variety, Helsinki but at plowing depth 30 cm (23.89 ton roots /fed.) without significant difference between them.

Table 6. Effect of multiple approaches for controlling root- knot nematodes on root yield (ton/ fed) in sugarbeet field by combine analysis of 2016/ 17 and 2017/ 18 growing seasons

Varieties	Plowing depth	Treatments						Mean
		T_1	T_2	T_3	T_4	T_5	T_6	
Polygerm Sahar	30	24.197	23.536	16.483	17.100	21.667	4.611	**20.60**
	40	13.625	22.919	12.644	15.728	27.172	7.044	**18.42**
	50	17.703	24.772	16.605	15.913	25.024	12.748	**20.00**
Mean		**18.508**	**23.743**	**15.244**	**16.247**	**24.621**	**8.135**	**19.67**
Monogerm Helsinki	30	25.922	20.348	19.512	20.557	33.108	15.162	**23.89**
	40	19.127	23.669	25.337	26.449	26.998	13.348	**24.32**
	50	19.419	23.470	21.217	22.965	21.390	12.296	**21.69**
Mean		**21.489**	**22.496**	**22.022**	**23.323**	**27.165**	**13.602**	**23.30**
Plowing depth	30	25.059	21.942	17.998	18.828	27.387	9.887	**22.24**
	40	16.376	23.294	18.991	21.088	27.085	10.196	**21.37**
	50	18.561	24.121	18.911	19.439	23.207	12.522	**20.85**
Mean		**19.999**	**23.119**	**18.633**	**19.785**	**25.893**	**10.868**	**21.49**

T_1 = EPD, T_2= Nemastop, T_3= Vaydet, T_4= EPD + Abamectin, T_5= EPD + Nemastop, and T_6= Control

L.S.D$_{0.05}$	
Varieties (V)	0.358
Plowing depth (P)	0.383
Treatments (T)	0.745
V x P	0.543
V x T	1.054
P x T	1.288
V x P x T	1.825

For the interaction effect of joined treatments variety × Managements treatments (V × T), sugarbeet variety, Helsinki × Treatment T5 (EPD + Nemastop) gave the highest tonnage /fed. (27.165 roots tons). Followed by Sahar variety × Treatment T5 (EPD + Nemastop) - 24.621 root tons /fed. with significant difference between them at $P \leq 0.05$.

Regarding interaction effect of plowing depth × management treatment (P × T) on roots tonnage /fed., in the lead plowing depth 30 cm × Treatment T5 (EPD + Nemastop) scored 27.387 tons followed by plowing depth 40 cm × Treatment T5 (EPD + Nemastop) - 27.085 tons/fed. without significant difference between them at $P \leq 0.05$ (Table, 6).

The combined treatments of variety × plowing depth × management treatment (V × P × T) had an interaction effect on roots tonnage /fed. as in the lead sugarbeet variety, Helsinki × plowing depth 30 cm × Treatment T5 (EPD + Nemastop) - 33.108 tons /fed. followed by Sahar variety at plowing depth 40 cm with Treatment T5 (EPD + Nemastop) - 27.172 ton roots /fed, with significant difference between them at $P \leq 0.05$ (Table, 6).

7. Effect of multiple approaches for controlling root- knot nematodes on sugar yield (ton/ fed):

Results in Table (7) showed that varieties had no significant difference between them for sugar yield tonnage/fed. at $P \leq 0.05$. Concerning plowing depth effect on sugar yield/fed., plowing depth 30 cm was in the front (4.14 tons sugar/fed.), followed by plowing depth 40 cm followed by plowing depth 50 cm (4.03 and 3.87 tons sugar, respectively), with significant differences among them at $P \leq 0.05$. The best management effect on sugar yield / fed. was T_5 (EPD + Nemastop) achieved 4.943 tons sugar/fed. followed by T_2 (Nemastop) that recorded 4.374 tons sugar/fed. without significance difference between them at $P \leq 0.05$.

The combined treatments i.e. variety × plowing depth had interaction effect on sugar yield /fed. And there were significant differences among them $P \leq 0.05$, whereas, Helsinki variety × 40 cm-plowing depth had the lead in sugar production ton/fed. (4.66). followed by the same variety at 30 cm-plowing depth (4.56 tons/ fed.), followed by Sahar variety at 30 cm-plowing depth (3.73 tons /fed.). Interaction effect of variety × management treatments on sugar yield/fed. exhibited some significant differences at $P \leq 0.05$, sugarbeet variety, Helsinki × T_5 (EPD + Nemastop) recorded the highest sugar yield/fed. (5.133 tons), followed by Sahar variety with the same Management treatment (T_5) - 4.753 tons sugar/ fed., whereas the weakest effect obtained by sugarbeet variety, Sahar with treatment (T_3= Vaydet), that had value of 2.822 tons sugar /fed., (Table, 7).

Illustration in Table (7) revealed that interaction of plowing depth × management treatments for 30 cm-plowing depth × T_5 (EPD + Nemastop) recorded the first rank in sugar production tons/ fed. (5.218 tons) followed 40 cm-plowing depth with the same treatment (T_5) - 5.138 tons sugar /fed. without significance at $P \leq 0.05$, followed by 30 cm-plowing depth with T_1 (EPD) - 4.702 tons sugar /fed., whereas, the slightest activity was at 30 cm-plowing depth with (T_3= Vaydet) - 3.227 tons sugar /fed. The combined treatments of variety × plowing depth × management treatment (V × P × T) had significant interaction effect occasionally at $P \leq 0.05$ on sugar yield/fed., whereas, in the front was activity of Helsinki variety at 30 cm-plowing depth with T5 (EPD + Nemastop) - 6.275 tons sugar /fed., followed by Sahar variety at 40 cm-plowing depth by T_5 (EPD + Nemastop) with significant difference at $P \leq 0.05$. Whereas, the inadequate effect was for Sahar variety at 40 cm-plowing depth with Vaydet (2.117 tons sugar /fed.)

Table 7. Effect of multiple approaches for controlling root- knot nematodes on sugar yield (tons/ fed) in sugarbeet field by combine analysis of 2016/ 17 and 2017/ 18 growing seasons**.**

Varieties	Plowing depth	Treatments						Mean
		T_1	T_2	T_3	T_4	T_5	T_6	
Polygerm Sahar	30	4.407	4.273	2.852	2.932	4.161	0.721	**3.73**
	40	2.538	4.269	2.117	2.763	5.275	1.111	**3.39**
	50	3.176	4.673	2.644	2.772	4.823	2.004	**3.62**
Mean		**3.374**	**4.405**	**2.538**	**2.822**	**4.753**	**1.279**	**3.58**
Monogerm Helsinki	30	4.998	3.919	3.602	4.021	6.275	2.596	**4.56**
	40	3.766	4.579	4.820	5.140	5.001	2.309	**4.66**
	50	3.678	4.531	4.082	4.223	4.121	2.283	**4.13**
Mean		**4.148**	**4.343**	**4.168**	**4.461**	**5.133**	**2.396**	**4.45**
Plowing depth	30	4.702	4.096	3.227	3.476	5.218	1.658	**4.14**
	40	3.152	4.424	3.468	3.952	5.138	1.710	**4.03**
	50	3.427	4.602	3.363	3.498	4.472	2.143	**3.87**
Mean		**3.761**	**4.374**	**3.353**	**3.642**	**4.943**	**1.837**	**4.01**

T_1 = EPD, T_2= Nemastop, T_3= Vaydet, T_4= EPD + Abamectin, T_5= EPD + Nemastop, and T_6= Control

$L.S.D_{0.05}$

Varieties (V)	0.135
Plowing depth (P)	0.087
Treatments (T)	0.139
V x P	0.161
V x T	0.228
P x T	0.279
V x P x T	0.383

In short, from Table 4-6, concerning roots, top and sugar yields per fed., it could be seen that at the level of individual treatments i.e. variety, plowing depth and treatment and their effect on yields (root, top, sugar/fed.), sugarbeet variety, Helsinki overcome Sahar variety. Also, 30 cm-plowing depth had the lead in achieving preferred results, as well treatments T5 (EPD + Nemastop), T_2 (Nemastop) and T_1 (EPD). Interactions of combined treatment as well showed distinguished results for those parameters mentioned above as combined treatments implied one of those distinguish individuals. Positive returns towards sugarbeet plants are consequences for what early happened in the early stages of sugarbeet plants development (as illustrated in three previous Tables), from preserving higher number of sugarbeet plants /fed. after thinning and at harvest and reducing loss. These are in consistency with findings of Chomontowski *et. al*. (2019) stated that the higher vigor of seeds caused by priming was associated with the acceleration of leaf development and the increase in plant dry matter during the growing season. As a result, seed priming contributes to a significant increase in the technological yield of sugar. Also, Gohar *et. al.* (2013) pointed out that sugarbeet varieties categorized as tolerant were the best genotype with highest beet root yield, sugar recovery and ultimately gave maximum sugar yield.

There is no conformity in the literature relating to the effect of tillage practices on the pathogen stress and the resultant disease severity on the subsequent crops. Some investigations report that conservative tillage practices reduce disease intensity on the following crops, measured up with minimum or no tillage pattern (Hofgaard *et al*. 2016). In contrast, other studies suggest that conventional tillage practices enhance some diseases while they reduce others over time (Schroeder and Paulitz 2006). Among the few studies on possible interactions between two or more factors showed significant and complex interactions between seedbed physical as well as chemical components, crop variety and their overall impact on the disease severity (You and Barbetti 2017a; You and Barbetti 2017b; You *et al.* 2017). Tillage practices can markedly affect the germination environment of seeds by inducing changes in temperature and moisture of the topsoil, seed-soil contact and the amount of crop residues. (Pittelkow *et. al*., 2015).

Proper protection of crops is very important for a good sugarbeet yield. Proper protection makes repeated use of chemicals to seeds and young plants. At West Nubaria District where experiments are performed.

Conclusions and Recommendations:

Based on the findings of the two examined seasons conducted under agroecological conditions of West Nubaria district for the effect of the variety, plowing depth and management treatments applied to sugarbeet seeds on root-knot nematode infestation indices, roots and sugar yields per fed, it can be concluded:

- Effect of treatments individually or in combinations on root-knot nematode parameters, as nematodes number/g soil, knot disease severity % and drop rate %. Results indicated that sugarbeet variety Helsinki overcame Sahar variety positively; also, 30 cm-plowing depth outperformed the other two depths in the same issues. Managements treatments distinctly revealed that (EPD + Nemastop), (Nemastop) and (EPD) achieved the best results to reduce all studied root-knot nematode parameters. Interaction effect of combined treatments got promising results as they implied any of individual treatment that previously showed positive results concerning the same nematode parameters.

- At the level of variety, monogerm sugarbeet variety, Helsinki outperformed polygerm variety, Sahar. At plowing depth level, 30 cm-plowing depth was mostly had superior positive effect on all recorders of the abovementioned readings.
- Root and sugar yield per fed., it could be seen that at the level of individual, sugarbeet variety, Helsinki overcome Sahar variety. Also, 30 cm-plowing depth had the lead in achieving preferred results, as well treatments (EPD + Nemastop), (Nemastop) and (EPD). Interactions of combined treatment as well showed distinguished results for those parameters mentioned above as combined treatments implied one of those distinguish individuals.
- Understanding and manipulating cropping practices and seed technology, are assuming an increasingly important role as an alternative to chemical pesticides. This scenario highlights the importance to define not only how seed germination and seedling emergence (SGE) will be impacted in the absence of one or more current chemical seed treatments, but to explore the effectiveness of nonchemical seed treatments such as seed priming (Dewar 2017; Kathage *et al*. 2017)..
- The appropriate selection of varieties for an exacting product area contributes to better and steadier production of cultivated crops. In order to cost-effective production and processing of sugarbeet cultivation it is reasonable to saw varieties of all three main directions of selection: Z (high content of sugar), N (normal) and E (high yield) (Bojovic *et al*., 2014).

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تقييم بعض إستراتيجيات لمكافحة نيماتودا تعقد الجذورفي حقول بنجر السكر بمنطقة غرب النوبارية

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أجريت تجربتان ميدانيتان في منطقة غرب النوبارية ، على مدار موسمين متتاليين من 2017/2016 – 2018/2017 لتقييم إستراتيجيات متعددة تستند إلى تقليل الفترة مابين زراعة البذور وظهور البادرة وذلك من خلال زيادة سرعة الإنبات وظهور البادرات لتقييم أهم إستراتيجية للهروب من مسببات الأمراض التي تنقلها التربة لتسريع الإنبات وظهور النباتات فوق سطح التربة و تحسين حيوية البذور وتسريع نمو البادرات عن طريق ما يسمى EPD (التكشف المبكر للنبات أو النمو الأولي السريع) وذلك تحت الوقاية بإستخدام بعض المبيدات النيماتودية. إلى جانب التجارب الحقلية تم إجراء تجربة أصص في الهواء الطلق مدتها 60 يوما لتقييم حساسية صنفي بنجر السكر (سحر و هلسنكي) لنيماتودا تعقد الجذور ميليدوجين إنكوجنيتا.وكان تصميم التجارب الحقلية عبارة عن تصميم القطع المنشقة مرتين، حيث كان الصنف في القطعة الرئيسية وأعماق الحرث كان في القطعة المنشقة تحت الرئيسية على هيئة شرائح طولية أما معاملات المكافحة بما فيها المقارنة كانت 6 معاملات في القطع المنشقة الثانية أو تحت تحت الرئيسية بأربع مكررات. والمعاملات المختبرة او الإستراتيجيات المختبرة، مكوناتها من , EPD و الأبامكتين والأوكساميل 10% محبب والنيماستوب وتوليفات فيما بينها ومقارنتها مع معاملة الكنترول. أظهر المخطط الكمي كانتو سانشيز لتقدير مدى ملاءمة العائل لنيماتودا تعقد الجذور وأوضح أن صنف بنجر السكر ، هلسنكي هو متحمل لتلك الديدان والصنف سحر حساس لها.كما أوضح تحليل التباين للبيانات المجمعة للموسمين المدروسين معنوياً وبأحتمال $P \leq 0.05$ تأثير المعاملات المختلفة منفردة أو مجتمعة أثرت على قراءات نيماتودا تعقد الجذور، كعدد النيماتودا /جم تربة والنسبة المئوية لشدة مرض تعقد الجذور ٪ ونسبة انخفاض النسبة المئوية لليرقات أو بما يسمي النسبة المئوية لمعدل الخفض في الإصابة، أشارت نتائج إلى أن بنجر السكر هلسنكي تفوق على الصنف سحر بشكل إيجابي للقراءات المذكورة أعلاه ؛ أيضا ، تفوق عمق الحرث 30 سم على عمقين آخرين في نفس القراءات. أظهرت معاملات المكافحة بوضوح أن (النيماستوب + EPD) يتبعها معاملة النيماستوب منفردة ثم EPD منفردة حققوا أفضل النتائج لخفض جميع قراءات نيماتودا تعقد الجذور وعلى الأرجح مع عمق حرث 30 سم . حقق تأثير التفاعل للمعاملات التي تتضمن المعاملات الفردية ذات النتائج الواعدة التي سبق أن أظهرت نتائج إيجابية فيما يتعلق بقراءات النيماتودا نفسها أفضل النتائج.. أظهرت المعاملات الفردية أنه على مستوى الصنف ، تفوق الصنفة هلسنكي وحيد الأجنة على الصنف سحر عديد الأجنة قي جميع القياسات المدروسة . عند مستوى عمق الحرث ، كان لعمق 30 سم تأثير إيجابي متفوق بالنسبة لأعماق الحرث المختبرة. على مستوى معاملات المكافحة كان لـ (النيماستوب + EPD) تأثير مميز على القراءات التي تتعلق بعدد النبات / فدان. بعد الخف و النسبة المئوية للخسائر في عدد النباتات ، يليه في التأثير معاملة النيماستوب ثم معاملة EPD . فيما يتعلق بتأثير التفاعل ، يمكن ملاحظة أن جميع النتائج الواعدة للمعاملات المنفردة التي في توليفات فيما بينها مرتبطة بنفس الصنف المذكور أو عمق الحرث / أو معاملات المكافحة.. صنف بنجر السكر هلسنكي صُنف على انه متحمل وبالنسبة لمحصول الجذور ومحصول السكر، تفوق الصنف هلسنكي على الصنف سحر. وأيضا عمق الحرث 30 سم كان في المقدمة في تحقيق النتائج المفضلة وكذلك معاملة (النيماستوب + EPD) يتبعها معاملة النيماستوب ثم معاملة EPD. فيما يتعلق بتأثير التفاعل للتوليفات بين المعاملات أيضاً بالمثل أظهرت نتائج مميزة للقراءات المذكورة آنفاً طالما كان من مكوناتها المعاملات التي أظهرت تفوق منفردة.