

Using Different Fertilizers for Controlling two Spotted Spider Mite *Tetranychus urticae* Koch in Green Beans Plant

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ABSTRACT

The present study aims to use foliar and bio organic fertilizers instead of chemical pesticides for controlling the two spotted spider mite in green bean plants. Effect of different concentrations of two types of foliar fertilizers (Novatreen and Potassen-F), two types of Bio Organic Fermented Liquid Manure [Animal Manure (A. M.) and Animal Neem Manure (A. N. M.)] and one recommended acaricide (Ortus) on population of two spotted spider mites *Tetranychus urticae* Koch ,as well as on the growth and yield of green bean were studied. The number of mites were recorded before and after treatment. The treatment of A. N. M. caused highest reduction in mites population (95 % reduction) followed by Ortus which recorded 91 % reduction in mites population comparing with the control treatment (water) at the first season. While at the second season, Ortus caused the highest reduction in mites population (95 %) followed by A. N. M which recorded 93 %, followed by 87% when A. M. was applied. Novatreen and Potassen-F recorded reduction of 86 & 81 % and 84 & 83 % comparing with the control during the two successive seasons (2012 & 2013), respectively. Control treatment recorded 84 & 88.28 individual /Leaf, as mean numbers of mites during the two successive seasons 2012 & 2013 , respectively. While the maximum population peak of mites were 110 & 115 individual / Leaf at 5 & 13 of June during the two successive seasons 2012 & 2013, respectively. The reduction in mites population due to the above treatments reflected on the green bean yield which increase from 126 % and 116% when treated with Novatreen up to 150% and 120% by applying of A. N. M. over control at the first and second season, respectively. Green bean yield of control represented 1683.33 and 1827 Kg/Fed. , at the two successive seasons, 2012 & 2013, respectively.

Key words: Green bean, *Tetranychus urticae* (Koch), foliar fertilizers, Bio organic manure, Novatreen and Potassen-F, Ortus, Neem plant and yield .

Introduction

Egypt has a significant advantage in the production of horticultural commodities including green bean for export, based on its geographic position and agro-climatic conditions. With a share of 25% in the Dutch market, Egypt is the main exporter of green beans to the Netherlands just ahead of Spain (24%) and Kenya (20%) (HEIA,2003). Therefor expansion in green bean cultivated area has exhibited impressive growth in Egypt during the past several years with a cultivated area of 2.4% of total world cultivated area of bean, producing about 3.5% of total world production of green bean (FAO Statistics,2004) . The Egyptian annual growth in the production of green beans represents half of the world's total growth (Wijnands, 2004).

More than 130 species of two spotted spider mites known, TSSM is the major pest species on agricultural crops worldwide (Wu, *et al.*, 1990; Ho, 2000 ;Takafu, *et al.*, 2000). The Two-spotted spider mite (TSSM), *Tetranychus urticae* Koch (Acari: Tetranychidae) is considered a major pest decreasing plant growth and yield on different agricultural crops including bean plants (Farouk & Osman 2009). Most of the difficulties in controlling this pest are initial detection and economically levels that are closely associated with insecticide applications (Iftner and Hall , 1984).

Fertilizers are normally added to the soil, but it is known that the plants can absorb nutrition which is applied directly into the leaves. The possibility of killing other insects by plant nutrient supplements is to be explored further(Sung-Ching Hsieh, 1995).The possibility of solving the transportation and application problems associated with the adoption of compost technology was explored by applying the manure extract from cassava peel and tithonia plant composts in form of foliar spray or liquid fertilizer as nutrient source and botanical insecticide. Insect pests of the plant that received foliar spray of compost extracts were minimal compared with non fertilized plants and those that received soil incorporated NPK fertilizer. This imply a dual role of this compost extract as a foliar sprays as source of nutrients and materials for controlling insect pests (Akanbi, 2007) . Liquid manures are the fermented preparations obtained by active fermentation of plant or animal residues. A mixture of different plants results in good quality liquid manure . The solution that is

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produced after the fermentation in a biodigester can be used for provide nutrients to crops by foliar sprays, besides protect crops from pests and diseases. Thus it help to avoid the use of synthetic chemicals like fertilizers and pesticides . Once part of the solution is diluted in 10 parts of water and sprayed on the foliage of the crops (Thimmaiah , 2010). Liquid organic fertilizer is a product from the bio-fermentation of vegetables, fruits, and animal wastes fermented with sugar and useful microbes. (Apai and Thongdeethae, 2002).

Anaerobic transformation of organic wastes is a process which involves many different groups of bacteria, such as hydrolysing, acidifying, acetogenic and methanogenic bacteria (Demirel and Scherer, 2008). During hydrolysis stage, most insoluble organic compounds, that is, carbohydrates, proteins, fats are decomposed to soluble monosugars, amino acids and fatty acids (Conrad, 1999; Parawira *et al.*, 2008) , followed by the acidifying bacteria convert water-soluble chemical substances, including hydrolysis products to short-chain organic acids (formic, acetic, propionic, butyric, pentanoic), alcohols (methanol, ethanol), aldehydes, carbon dioxide and hydrogen. From decomposition of proteins, amino acids and peptides, (Ntaikou *et al.*, 2010; Classen *et al.*, 1999; Conrad, 1999). ceto-genesis: In this process, the acetate bacteria convert the acid phase products into acetates and hydrogen which may be used by methanogenic bacteria (Schink, 1997). Methanogenesis: Methane in this phase of the process is produced from substrates which are the products of previous phases, that is, acetic acid, H₂, CO₂ and formate and methanol, methylamine or dimethyl sulfide. (Demirel and Scherer, 2008) . A decrease in pH value was observed during the first few days of digestion due to the high volatile fatty acids formation.

Neem (*Azadirachta indica* A. Juss) is perhaps the most useful traditional medicinal plant in India. In Field experiments ,the mixture of Neem and wild garlic was more effective in reducing population densities of whitefly and aphid than either plant extract applied alone. In conclusion, results of this study suggested a synergistic effect of fermented plant extracts of Neem and wild garlic as a bio-pesticide (Nzanza and Mashela , 2012).

The present investigation relates to broadly applicable method of protecting plants or crop against pests, by successive foliar sprays of plant nutrient and foliar fertilizers in aqueous solutions of extreme pH values, without employing toxic organic materials . Fertilization levels can also influence insect and mite population dynamics and pest management strategies. High levels of fertilization may improve the nutritional quality of the plants for phytophagus Pests ,(Benz, *et al.*, 1995) .

This study aims to investigate the effect of different kinds of foliar fertilizers and liquid fermented animal farmyard manures alone and or combined with local medical plant Neem parts on pest infestation and productivity of the green bean plants to reduce the dependence of the chemical pest control and avoid its harmful on human and environment .

Material and Methods

Preparation of Bio Organic Liquid Manures (Bio gas manure):

Liquid manures are the fermented preparations obtained by active fermentation of plant and animal residues. It is prepared using animal farm dung as base material and addition of green plants, leaves of Neem trees. The basic principle is to allow a mixture of animal residues with water in rate of 1: 2 w/v. to ferment over a certain period in a plastic water container. Other plastic water container is taken of animal residues , Chopping of fresh Neem leaves (small pieces), and water with rate of 1:1 :4 w/w/v (closed & covered the containers). The Contents stirred every 3 days for four weeks .The biomass will get fully fermented passes through three stages as described previously by (Classen *et al.*, 1999 ; Conrad, 1999; Parawira *et al.*, 2008; Demirel and Scherer, 2008; Ntaikou *et al.*, 2010) (Some bioactive compounds produced during organic fermentation, Figures (1and 2),and the liquid manure would ready in 10 : 20 day for use. The liquid manure should be sieved and diluted with water before spraying. The standard dilution is one part liquid manure in ten parts water and sprayed on the foliage, (Thimmaiah , 2010).

Physical and chemical parameters analysis of organic matter during Fermentation:

pH was measured using pH meter .Sample from manure at start (after three days) and during anaerobic fermentation was oven dried (70°C); ground and wet digested using a 1 : 1 mixture of H₂SO₄ and perchloric acid HClO₄ acids (V/V). In the digested product, Total nitrogen was determined by the Kjeldahl method while potassium content was determined by flame photometer (Chapman and Pratt,1961) . Total organic carbon (TOC) was determined by the method described by Yeomans and Bremner (1989). TS were determined from the solids dried at 105°C (Standard Method 2540 G).

VS were determined from the subtraction of the solids dried at 505°C (Standard Method (APHA, 1995) . Phosphorus content was determined by a colorimetric method. Moreover, protein and carbohydrate were estimated using the methods outlined by (A.O.A.C. 1990) .

Volatile fatty acids (VFAs): Three samples are centrifuged for 30 min, and then filtered. The samples are diluted with deionized water, then added to some drops formic acid, capped and stored in a refrigerator until measurement is done and (VFA) concentrations in g/L are measured by a gas chromatograph (GC).

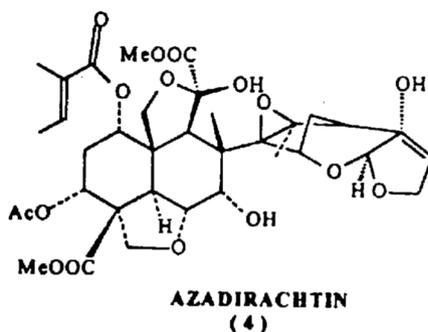


Fig. 1 : Azadirachtin From Wikipedia, bioactive compounds from Neem.

CH ₃ -CooH	CH ₃ -NH ₂	CH ₃ -CH ₂ OH
Acetic acid	Methyl Amine	Methanol
HCOOH		CH ₃ (CH ₂) ₃ COOH
Formic acid		Butyric acid(IUPAC)

Fig. 2: Some median by products are the active ingredients through anaerobic digestion (Demirel and Scherer ,2008).

Preparation of the field for sowing :

Two field experiments were conducted in a private farm at Qalubia Governorate , Egypt during two successive seasons 2012 and 2013. Green beans (*Phaseolus vulgaris.L.*) Cultivar Giza 3 was acquired from seeds production unit, Agriculture Research Centre, Egypt. In Egypt, green bean fields need about 50-100 kg ammonium sulfate 200- 300 kg superphosphate 50- 100 kg of potassium sulfate / fed. The dates of sown were (5th and 8th Feb.), during the two successive seasons (2012 & 2013) ,respectively.

Six treatments with three replicates arranged in a complete randomized block design, were examined . A quarter of the recommended NPK fertilizers application dose applied as top dressed were incorporated during soil preparation before planting. After three weeks, plants were fertilized with another quarter of recommended fertilizers application. Two treatments (Ortus and Control), only fertilized with full the recommended NPK fertilizers dose as top dressed, while other fourth treatments were supplied by have dose of the recommended artificial NPK fertilizers as top dressed and the other demand fertilizers were supplied as foliar spray repeated three times . The water soluble liquid fertilizer treatments were applied as foliar spray initially at 28 day after sowing, for all treatments and subsequently in 15 days intervals at the two successive seasons. Treatments with the tested materials and their concentration were evaluated in six treatments:

1. Ortus. (50 ml / 100 L/ water)
2. Animal Manure,(A.M.) with concentration of 10 %.
3. Animal Neem Manure (A.N.M.)with concentration of 10 %
4. Potassen foliar fertilizer Spray (0.16 %) contains K 30 % + P 8 %
5. Novatreen foliar fertilizer Spray (0.33 %) contains N 8 % + P 5% + K 5% + Fe 0.4 % + Zn 0.3 % + Mn 0.3 % + B 0.05 + Mo 0.3 % .
6. Water used as control.

The efficiency of previous treatments on control of the two spotted spider mite expressed as mites population on plants as well as growth and yield were recorded.

Effect of population of mites :

The numbers of mites on green bean plants leaves were counted and recorded before and after spraying with the tested materials were inspected at 22 and 23 April during the two growing seasons, respectively, 5 days intervals for 11 counts. To evaluate the effect of treatments, 10 leaves were cut from each treatment in the

experiment plot and the number of moving stages of mites were counted under stereo-binocular. Corrected mortality and the reduction percentages of mites were calculated by using the Henderson -Tilton formula (Henderson-Tilton's formula , 1955).

$$\text{Corrected \%} = \left(1 - \frac{n \text{ in Co before treatment} \times n \text{ in T after treatment}}{n \text{ in Co after treatment} \times n \text{ in T before treatment}} \right) \times 100$$

Where n: number of mites

Results and Discussion

Physical and chemical parameters analysis of organic matter during Fermentation:

Data in table (1) showed the percentages of carbohydrates, proteins, fats and dry matter of organic matter during hydrolysis stage of Fermentation, most insoluble organic compounds, that is, carbohydrates, proteins, fats ,dry matter, Total carbon and volatile solid were decomposed and decreased from 54,26.30,7, 58 ,36 and 67.33 % at the start of fermentation to 12 ,10,8.4 ,42 27.2 , and 34.4 % 7 days during fermentation , the percentages of total solid and volatile solids were high and decrease after 7 days due to hydrolyzing bacteria and acetate bacteria , so the VFA generation in the beginning was high due to higher acidogenesis and lower methanogenic activity. The initial pH drop from 7.2 into 5.3 due to rise volatile fatty acid concentration this results in agreement with (Conrad, 1999 and Parawira *et al.*, 2008) which reported that, during hydrolysis stage, most insoluble organic compounds, that is, carbohydrates, proteins, fats are decomposed to soluble monosugars, amino acids and fatty acids, a decrease in pH was observed during the first few days of digestion due to the high volatile fatty acids formation.

Table 1: Physical and Chemical parameters of organic matter during Fermentation.

Parameters	(3days)	(7 days)	Parameters	(3days)	(7 days)
Carbohydrates %	54.00	12	T. N. %	1.60	3.00
Total Protin %	26.30	10.0	P %	0.21	1.98
Fats %	7.000	8.4	K %	0.98	2.01
D. M. %	58.00	42	S %	0.06	0.77
Total Carbon %	36.80	27.2	Mg%	0.09	0.14
VS %	67.33	34.4	Ca %	0.10	0.48
T. VFA g./L	3.44	6.4	Zn %	0.08	0.02
PH	7.2	5.3	C/N ratio	23	9.1

Population of Mites on Green Bean:

Figure (3) showed that the population of *Tetranychus urticae* mites appeared on green bean plants (*Phaseolus vulgaris*. L.) after two weeks of sowing in a few numbers and started to increase by elapsing the time till reached maximum peaks on green bean plants, which represented 115 & 120 Mites / leave at 18 and 24 of Mar ,while the population of *Tetranychus urticae* mites in treated plots with the tested materials at the same time ranged between 2 to 11 individual / leave during the two successive seasons, respectively.

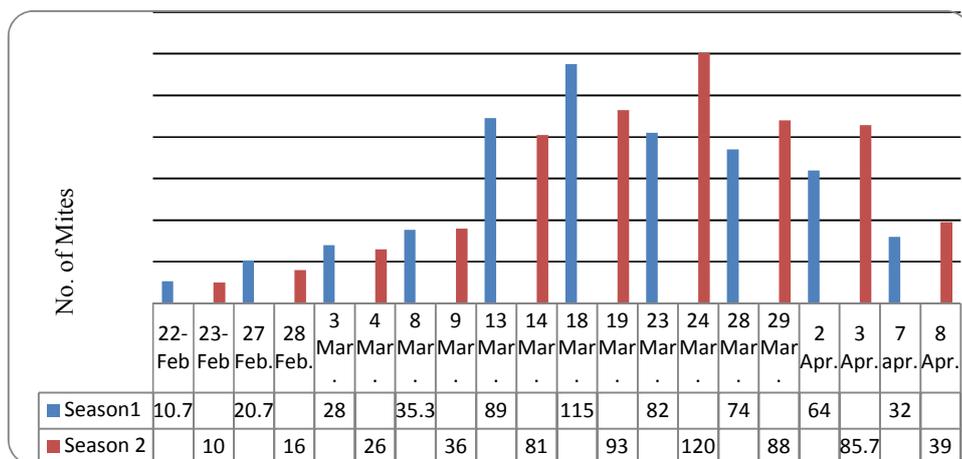


Fig 3: Population dynamic of the two spotted spider mites *Tetranychus urticae* (koch) on green bean plants (*Phaseolus vulgaris*.L.) during the two successive seasons , 2012 &2013 .

The treatments and cultivated season:

Generally, data recorded in Tables (2 & 3) showed that all tested treatments caused high reduction in mites population infested the green bean plants which was ranged between (3.39 – 10.13 and 3.56 – 12.33 Mite /Leaf) in the opposite of control treatments (84 and 88.33 Mite / Leaf),during the two successive seasons , respectively.

First season 2012:

As shown in Table (2), the mean number of the tetranychid mite , *T. urticae* was considerably decreased when using the tested materials in comparison with the control (water). The recorded number of mites varied according to the type of treatment. The highest number of mites was noticed when potassen-F was used (9.89 individual/Leaf), while the lowest recorded mite number was recorded with using of bio organic animal Neem manure (3.39 individual/ Leaf). On the other hand ,the ratio of population reduction as shown in resulted data showed that when the tested material were used ,the obtained population reduction recorded ,can be arranged in ascending ordered, (A.N.M.); Ortus ; A.M.; Novatreen and Potassen-F which represented 95, 91, 87, 86 and 80.14 % reduction in mite population , respectively. Also ,table (2) shows that , A.N.M. recorded least number of mites on the green bean leaves (3.39 individual/ Leaf) and recorded the highest reduction percentage (95 %) in mites population infested green bean plants , followed by Ortus which recorded (4 individuals/Leave) ,with reduction percentage in mites reached to (92 %) , followed by the treatments of A. M. and Novatreen recorded (8.28 & 8.28 individual / Leaf)with 87 & 86 % reduction percentage in mites population infested green bean plants respectively during the first season , while Potassen-F recorded the least reduction percentage (81 %) , during the first season .

When taken the green bean yield (Kg) ,Table (2) in consideration, the obtained data indicated that the yield as affected by the suppression of the mites population caused by treatments were 3894, 4083.33, 4203.33, 3796 and 3802 Kg./feddan with 131,143,150,126 and 126 % increase in yield, respectively.

Table 2: Effect of treated with different tested materials on mite's population and final green bean yield during first season, 2012

Treatments	Conc.	Population after spraying (individuals/Leaf)		Green beans yield (Kg / fed)	Yield increase%
		Mean No	Reduc.%		
ORTUS	50 cm /100 L	4.00 c	91	3894.00 a	131
Bio O. (A. Manure)	10%	8.28 b	87	4083.33 a	143
Bio O. (A. Neem Manure)	10%	3.39 c	95	4203.33 a	150
Novatreen (Foliar Fertilizer)	1%	8.28 b	86	3796.00 a	126
Potassen-F(Foliar K)	0.16	9.89 b	80.14	3802.00 a	126
Control	Water	84.00 a	--	1683.33 b	--
LSD at 5%		2.45	--	342.21	--

Second season 2013 :

The same trend recorded in 2012 ,recorded for the second cultivated season 2013. The obtained tabulated data in table (3) showed that the recorded mite population by Ortus , A. M., A. N. M., Novatreen (Foliar Fertilizer) and Potassen-F(Foliar K)were (3.6 ,9.44, 5.17, 12.33 and 11.33 Mite / Leaf), when the same order of treatments were used in comparison with (88.33 individual / Leaf) in case of control . The obtained ratio of population reduction recorded 95,87,93,84 and 83 % , respectively ,when the same order of treatments was used . Also , table 3 shows that at the second season, Ortus recorded the least number of mites on the green bean leaves (3.6 individual /L.) with highest reduction percentage (95 %)in mites infestation of green bean plants , followed by A.N. M. which recorded (5.17 individual / Leaf) with (93 %) reduction in mites infestation, followed by the treatments of A. M. and Novatreen ,recorded (9.44 & 12.33 individual / Leaf)with (87 & 84 %) reduction percentage in mites population infested green bean plants respectively during the second season , while Potassen-F recorded the least reduction percentage (83 %) , during the second season.

The same previously mentioned table showed that the effect of treatment with defferent marerials reflected on the green bean yield .The highest green bean yield was recorded 4023 Kg / fed when Bio O.A.N.M. was used as treatment tool ,while the lowest recorded level of yield was obtained when potassen-F was used as treatment recorded 3637.67 kg/Fed. table (3), so From the obtained data in table (3) it was noticed that, the increase in yield ratio was very high with Bio O.A.N. M. which recorded 120 % increase in yield, while the lowest ratio was noticed when Potassen-F was used as treatment in this experiment during 2013 cultivated season which recorded 116 % increase in green bean yield.

Table 3: Effect of treatment with different tested materials on mite's population and final green bean yield during second season, 2013 .

Treatments	Conc.	Population after spraying (individuals/Leaf)		Green beans yield (Kg / fed)	Yield increase %
		Mean No.	Reduc.%		
ORTUS	50 cm /100 L	3.56 e	95	3818.00 b	109
Bio O. (A. Manure)	10%	9.44 c	87	3897.00 b	113
Bio O. (A. Neem Manure)	10%	5.17 d	93	4023.00 b	120
Novatreen (Foliar Fertilizer)	1%	12.33 b	84	3949.67 b	116
Potassen-F(Foliar K)	0.16	11.33 b	83	3637.67 b	99
Control	Water	88.33 a	--	1827.00 a	--
LSD at 5%		1.133	--	469.69	--

Discussion:

From the data obtained showed that all tested materials caused grate effect on suppress the mites infestation . The two fermented formulation of ,liquid animal manure alone and or in compination with Neem leaves caused high effect on suppression of mites population this due to their contents of many bio active ingredient as organic acids ,alcohols ,VFA ,Fenolic compounds, dimethyl sulfide compounds as byproducts produce throw anaerobic fermentation for organic materials and other byproduct compounds produced from anaerobic fermentation for Neem leaves as Azadirachtin . The result was in agreement with (Demirel and Scherer, 2008)and in accordance with the findings by (Chawla *et al.*, 1995)who reported that, field experiments with tomato showed that fermented plant extracts of Neem and wild garlic, alone or in combination, have an insecticidal properties to maintain lower population densities of whitefly and aphid., (Nzanza and Mashela , 2012).who reported that in conclusion, results of a study showed that mixture of Neem and garlic fermented plant extracts were more effective in suppressing population densities of aphid and whitefly, than either plant extract alone.In another side , the results showed that the treatments not only ,caused better suppression of the pest infestations but also the final green bean (*Phaseolus vulgaris* L.) yield responded to all of the treatments except control treatment ,but the treatment responses were not significantly different comparing to the chemical acaricide (Ortus). Although, the chemical acaricide (Ortus), tended to have the highest reduction percentages in pest populations at the second season, while at the first season was at the second rate in reduction in the mites infestation when compared and arranged with the other treatments, so it came at levels third and fourth in yield production at first and second seasons , respectively . The application of liquid anaerobic fermented animal farm west manure showed a high efficiency for controlling the mite infestation and caused high yield production , but its effect raised in treatment(A.N.M.) due to add Neem leaves in production of boi organic fermented manure process which showed better suppression of pest infestations when recorded highest reduction percent in mite population during first and second season, respectively, in addition recording the highest final green bean yield for the two successive seasons . So ,the two treatments of bio organic fermented manure consider the superior over other treatments, this due to present many median byproducts compounds as organic and volatile acids , as formic, acetic, propionic, butyric, pentanoic), alcohols (methanol, ethanol), aldehydes, , methylamine or dimethyl sulfide, Azadirachta from Neem leaves and other bio compounds in addition to growth hormones , vitamins ,macro and micro elements ,resulting from anaerobic fermentation process which conceder active ingredients for control plant pests from one side and as good nutrition source resulted fort and healthy plant from another side also the successive spraying of foliar fertilizers (Potassen and Novatreen) gave good resultes.So the results also , in a harmony with , Luiz Dimenstein & Nes Ziona (2013) ,who mentioned that successive foliar sprays of plant nutrients and foliar fertilizers in aqueous solutions of extreme pH values, without employing toxic organic materials .Repeatedly applied sprays causing the pH changes provides an effective, cheap, and environmentally friendly way of fighting plant pests , And (Akanbi, 2007)who reported that , Insect pests of the plant that received foliar spray of compost extracts were minimal compared with non fertilized plants and those that received soil incorporated NPK fertilizer, and Sung-Ching Hsieh,(1995)who suggests a dual role of the compost extract foliar sprays as source of nutrients and materials for controlling insect pests, also, in agreement with Thimmaiah , (2010) who reported that ,The solution that is produced after the fermentation in a biodigester can be used for provide nutrients to crops by foliar sprays ,protect crops from pests and diseases ,help to avoid the use of synthetic chemicals like fertilizers and pesticides

The obtained data leads to conclusion , that bio organic .liquid .animal Neem .manure was the most responsive treatment to green bean on growth and yield in comparison to foliar Novatreen and other treatments in addition to the possibility of using fertilizers spraying teqnique especially fermented organic manure and its modification for controlling plant pests and It can be involved in the IPM programs to avoid environment contamination and produce clean food product .

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