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Impact of Spraying with *Saccharomyces cerevisiae* and Some Commercial Nutrients on Lettuce Plant (*Lactuca sativa* L.) Productivity and Prevention of Some Insect Pests

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study was carried out during two winter seasons of 2014/2015 at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt to investigate the effect of spraying with *Saccharomyces cerevisiae* NCAIM Y 00216 and commercial nutrients (super blue green and Novatrein) with different levels of mineral fertilizers on productivity of lettuce (*Lactuca Sativa* L. cv. Balady) and its protection from some insect pests (*Aphids gossypii* and *Empoasca lybica*) and assisted predators (*Scymnus* spp. and True spider). Pants were sprayed twice times at 30 and 45 days after transplanting.

The results indicated that vegetative growth, yield and its components and chemical constituents were promoted with all spraying materials as compared to control (sprayed with water). Generally, spraying plants with *S. cerevisiae* with different levels of mineral fertilizers showed significant increases in vegetative growth, yield and its components and chemical constituents than sprayed

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by other treatments as well as control. T2 treatment (Foliar spray with liquid culture of *S. cerevisiae* at 4 mL^{-1} + 100% NPK) gave the highest increases over control in N, P, K and protein %, which exhibited 4.08, 0.48, 4.84 and 25.49% compared to treatment of control that gave 3.12, 0.41, 4.08 and 19.54% at season 2014, respectively. Results of season 2015 gave a similar trend. On the other hand, the entomological results showed that plants treated with *S. cerevisiae* caused higher infesting to insect pests and assisted predators because it was more suitable for insect feeding as compare other treatments. Therefore, limit application of chemicals could be recommended for lank pest control.

Keywords: Saccharomyces cerevisiae; super blue green; novatrein; insect pests; assisted predators; lettuce.

1. INTRODUCTION

The lettuce (*Lactuca sativa* L.) is an annual plant of the family *Asteraceae*. It is most of ten grown as a leafy vegetable most popular among the salad crops and cultivated since 4500 BC in the Mediterranean area. It is rich in vitamins and minerals, which are highly required for human health and it facilitates digestion because it contain a lot of cellulose. In addition to, it improve sleep because it contains lactocin and lactucopicrin [1].

The excessive use of nitrogen fertilizers raises the major cost in lettuce production and creates degradation for the agricultural environment as well as affects the soil fertility, therefore, it has become essential to use untraditional fertilizers as supplements or substitutes for chemical nitrogen fertilizer. So, biostimulants are the solution to decrease the chemical fertilizer in vegetables production and can be decease the infestation with some insect pests. Biostimulants has called the attention of vegetables and in the last few decades it became a subsequent positive alternative to the chemical fertilizer and decrease the great pollution occurred in our environment [2,3].

Saccharomyces cerevisiae is considered a plant growth promoting yeast for different crops. It can be play a beneficial role in cell division and cell enlargement [4]. Yeast as a natural stimulator which, contain protein, carbohydrates, nucleic acid, lipids, and a lot of minerals such as P, K, Na, Fe, Mg, S, Zn, Mn, Cu and Si. In addition to hormones, thiamin, riboflavin, pyridoxine and other growth regulating substances, biotin, B12 and folic acid [5]. In this regard, El-Desouky [6] found that spraying tomato plants with yeast (*Saccharomyces cerevisiae)* had significantly increased plant length, leaves No. /plant, branching and leaf area / plant.

Super blue green extract as a natural stimulator is also characterized by its richness in organic acids, amino acids vitamins and auxins which produced from algae. Abd El-Aal [7] showed that, significant increase was existed in many morphological characteristics as stem length and diameter, number of formed branches and leaves /plant, fresh and dry weight of both stems and leaves, total leaf area /plant and specific leaf weight of Sweet ananas melon plant by using seaweed extract.

Novatrein application for different crops was a great importance due to contain high levels of macro and micro elements (N, P, K, Fe, Cu, Zn, Mo and Mn) as well as, vitamins and amino acids. In this respect, using novatrein due to increase vegetative growth such as plant fresh weight, plant height, plant dry weight, essential oil, yield and its quality of marjoram [8].

Recently, great attention has been focused on the possibility of using natural and safety substrates, *i.e.,* vitamins and yeast in order to improve plant growth, yield (quantity and quality) and plants protection of pests [9].

A variety of methods is recommended for the protection of some vegetable crops grown in open fields against insect pests by using liquid fertilizers to increase resistance of plants to insects and insecticide infusions based materials, biological preparations and synthetic chemicals [10].

Ali and Abd-Allah [11] showed to investigate the effect of spraying with vitamins (B1 and C), and yeast for protection from pea leaf miner (*Liriomyza pisi*), legume aphids (*Aphis craccivora* Koch) and two spotted spider mite (*Tetranychus urtica* Koch) attacking pests of sugar pea cv. Gaint grown in sandy soil.

Hence, the aim of this study was to improve vegetative growth, chemical content and yield as well as protection from insect pests (*A. gossypii* and *E. lybica*) and associated predators (*Scymnus spp*. and true spider) of lettuce plants using some biostimulators.

2. MATERIALS AND METHODS

Two field experiments were carried out at Sakha Horticultural Research Station Farm, Kafr El-Sheikh Governorate, Egypt during two winter seasons of 2014/15 to study the effect of foliar spray with *S. cerevisiae* and commercial nutrients (super blue green and Novatrein) on productivity of lettuce (*Lactuca sativa* L. cv. Balady) and protection from some insect pests and assisted predators.

According to Chapman and Pratt [12], some physical and chemical analysis of the experimental soil (0-30 cm) is presented in Table 1.

The studied treatments were arranged in a randomized complete block design with four replication as tabulated in Table 2. The plot area was 24 m^2, every plot consisted of 8 rows, 5 m in length and 60 cm in width, with about 75 plants in every plot.

Plants were sprayed twice times at age 30 and 45 days after transplanting.

The recommended mineral fertilizers for commercial lettuce production as follows; Ammonium sulphate (20.6% N) was applied at the rate of 238 kg ha^{-1} in two equal portions at 21 and 45 days after transplanting. Calcium super-phosphate (15.5% P_2O_5) was also applied at the rate of 476 kg ha^{-1} before transplanting and potassium sulphate (48% K_2O) was applied at the rate of 119 kg ha^{-1} in two equal split applications; *i.e.*, 4 and 8 weeks from transplanting.

Harvesting was carried out at 70 days after transplanting in the first and second seasons.

2.1 *Saccharomyces cerevisiae*

Saccharomyces cerevisiae NCAIM Y 00216 was provided by Bacteriology Lab., Sakha Agri. Res. Station. Inoculum growth were prepared using Yeast Peptone Glucose (YPG) medium [13]. It composition (g/L) is: yeast extract, 10; peptone, 10 and glucose, 20. The medium is adjusted to pH 7 and incubated at 30℃ for 12 hours. The liquid culture was used with rate 4 ml/L (5×10^6 cfu mL^{-1}).

2.2 Commercial Nutrients Used

Super blue green and novatrein were obtained from Agricultural Balance Fund, Ministry of Agriculture and Land Reclamation.

- Super blue green compound contains organic acids, amino acids, vitamins and auxins which produced from algae. It was used at 1 L/150 L.
- Novatrein compound contains (5% N, 5% P, 5% K, 1.5% Fe, 1.5% Zn, 1% Mn, 0.5% Mo and 0.5% B). It was used at 1 L/ 300 L.

Table 1. Some physical and chemical analysis of the experimental soil

Season	Mechanical analysis			Texture	PH	EC	O.M	Available elements (ppm)		
	Sand	Silt	Clay			(ds/m)	%	N	P	K
2014	31.53	25.10	43.37	Silty clay	7.5	4.60	2.12	26	11	68.3
2015	33.65	24.17	42.18	Silty clay	7.5	4.96	1.96	37	9.5	65.0

Table 2. Experimental treatments

Treatments	Description
T1	Control, foliar spray with tap water + 100 % NPK.
T2	Foliar spray with liquid culture of *S. cerevisiae* at 4 mL^{-1}+100 % NPK.
T3	Foliar spray with liquid culture of *S. cerevisiae* at 4 mL^{-1} +75 % NPK.
T4	Foliar spray with super blue green at 6.6 ml L^{-1} +100 % NPK.
T5	Foliar spray with super blue green at 6.6 ml L^{-1} +75 % NPK.
T6	Foliar spray with novatrein at 3.3 ml L^{-1} + 100 % NPK.
T7	Foliar spray with novatrein at 3.3 ml L^{-1}+ 75 % NPK.

2.3 Data Recorded

2.3.1 Growth characters

A random sample of three plants from every experimental unit was taken after 60 days from transplanting to investigate the following growth parameters: plant height (cm), number of leaves/plant, fresh weight of leaves (g) and fresh weight/plant (g).

Dry weight of leaves was determined through oven dried of leaves at 70℃ till a constant weight. Leaf area (cm^2) was calculated from relation between area unit and dry weight of leaf according to Koller [14] as follow:

$$\text{Leaf area/plant } (cm^2) = \frac{\text{Leaves dry weight/plant} \times 10 \text{ disks area (cm2)}}{\text{Average dry weight of ten disks}}$$

2.3.2 Yield

The harvesting time (about 70 days after transplanting), all plants from each plot were harvested to measure average head fresh weight (g), yield/plot and consequently total yield ha^{-1} (ton) as well as total soluble solids (TSS)% which determined by a hand refractometer according to A.O.A.C. [15].

2.3.3 Plant mineral content

The previously oven dried leaves were finely ground and wet digested with sulphuric acid and perchloric acid (3:1). Nitrogen, phosphorus and potassium percentages were determined according to the methods described by Pregl [16], Trough and Mager [17] and Browns and Lilliland [18], respectively.

Total crude protein (%) was also calculated by multiplying total nitrogen × 6.25.

Total chlorophyll was determined by Minolta chlorophyll metter SPAD- 502 in the field.

2.3.4 Population density of pests

The experimental unit area was divided into four equal plots, and considered on four replicates. Inspection started 30 days after transplanting before treated and continued after treated till the end of the crop season. Number of *A. gossypii* and *E. lybica* were counted in the field on ten leaves/replicate in the morning (7-9 am). Also, *Scymnus* spp. and True spider were counted on ten/plants/replicate in the field from each treatments.

2.4 Statistical Analysis

All data obtained during both seasons of study were subjected to analysis of variance and significant differences among means were determined at 5% level of significance according to Snedecor and Corchran [19].

3. RESULTS AND DISCUSSION

During the two growing winter seasons, the effects of foliar spray with *S. cerevisiae*, super blue green and Novatrein on productivity of lettuce (*Lactuca sativa* L. cv. Balady) and protection from insect pests (*A. gossypii* and *E. lybica*), as well as assisted predators (*Scymnus spp*. and true spider).

3.1 Vegetative Growth Parameters

Data presented in Table 3 show that all studied vegetative growth parameters plant height (cm), leaf area (cm^2) and number of leaves /plant were significantly influenced by different foliar spray treatments compared with those of the control at 70 days after transplanting during 2014 and 2015 seasons.

The most superior treatment was the spraying with *S. cerevisiae* + 100%NPK-ferilizer (T2) had the highest values *i.e.*, 42.00 and 42.66 cm, and 12.883 and 11.653 cm^2, 39.00 and 42.33, respectively for first and second seasons. The lowest vegetative growth was obtained by spraying with Novatrein + 75% NPK- mineral fertilizer treatment (T7) during the two studied seasons.

Due this to foliar spray with *S. cerevisiae* are known to enhance the growth of vegetables, fruits, and other crops as they are reported to release growth regulators such as auxins (IAA and IBA), gibberellins, cytokinins, and major macro- and micronutrients. These are in agreement with those results obtained by El-Tohamy [20] found that spraying eggplants with *S. cerevisiae* gave higher vegetative growth and yield. Also, Chamangasht [21] they indicated that foliar spray with biostimulants and compost tea as a commercial nutrient product can improve plant growth and yield of lettuce.

As shown in Table 4 different estimated growth characters such as fresh weight per plant and leaves as well as stem height per plant were increased to reach the 5% level of significance with different applied treatments during the two growing seasons compared with control. In general, the results revealed that foliar spray with *S. cerevisiae* followed by spray with super blue green and novatrein gave the highest increases in above parameters over control (tap water spray). Also, it could be noticed that foliar spray with *S. cerevisiae* + 100% NPK-mineral fertilizer (T2) as well increased fresh weight of plant, leaves and stem height as compared to control values. These values recorded 533.33, 443.33 g and 14.26 cm at season 2014 and 520.00, 476.66 g and 14.60 cm at 2015, then the spray with *S. cerevisiae* + 75% NPK-mineral fertilizer (T3), which attained 490.00, 423.33 g and 13.83 cm at season 2014 and 433.33, 420.00 g and 13.96 cm at season of 2015 compared to control (T1) which recorded 335.00, 263.33 g and 9.20 cm at season 2014 and 313.33, 293.33 g and 9.40 cm at season of 2015, respectively.

In this regard, El-Desouky [6] found that spraying tomato plants with biostimulants significantly increased vegetative growth and quality of yield.

Ahmed [22] indicated that spraying garlic plants with dry yeast (3 and 4 g l^{-1}) effectively increased fresh weight and leaves fresh weight per plant as well as quality and storability of plant.

According to the effect of foliar spray with biostimulator (*S. cerevisiae*), and some commercial nutrients products (super blue green and novatrein) on total soluble solids (TSS%), the highest and lowest values were 6.90 and 5.53% at the first season and 6.90 and 5.26% at the second season for T2 and T7 treatments, respectively as shown in Table 5.

Table 3. Effects of different foliar spray and mineral fertilizer on plant height (cm), leaf area (cm^2) and number of leaves of lettuce plants during 2014 and 2015 winter seasons

Characters / Treatments	Plant height (cm)		Leaf area (cm^2)		Number of leaves	
	1st	2nd	1st	2nd	1st	2nd
T1	32.00 e	30.33 f	7.103 f	6.987 e	20.33 d	19.33 e
T2	42.00 a	42.66 a	12.883 a	11.653 a	39.00 a	42.33 a
T3	42.00 a	40.66 b	11.767 ab	10.450 b	40.00 a	39.33 ab
T4	39.33 b	37.66 c	10.903 bc	10.793 ab	36.66 ab	36.33 bc
T5	37.33 c	37.33 c	9.733 cd	10.083 b	30.33 bc	33.33 c
T6	36.33 c	34.00 d	8.973 de	9.040 c	35.33 ab	25.66 d
T7	34.00 d	32.33 e	8.293 ef	8.043 d	24.00 cd	24.66 d

For more details about treatments: T1 to T7 see Table 2
***1st**: first season, **2nd**: second season*
Values followed by the same letters are not significantly different by LSD's test at 0.05 level

Table 4. Effects of different foliar spray and mineral fertilizer on fresh weight (g $plant^{-1}$), fresh weight of leaves (g $plant^{-1}$) and stem height (cm) of lettuce plants during 2014 and 2015 winter season

Characters / Treatments	Fresh weight of plant (g)		Fresh weight of leaves (g)		Stem height (cm)	
	1st	2nd	1st	2nd	1st	2nd
T1	335.00 e	313.33 f	263.33 d	293.33 e	9.20 e	9.40 f
T2	533.33 a	520.00 a	443.33 a	476.66 a	14.26 a	14.60 a
T3	490.00 b	433.33 b	423.33 b	420.00 b	13.83 a	13.96 b
T4	463.33 b	413.33 bc	426.66 b	400.00 c	12.76 b	13.26 c
T5	426.66 c	396.66 cd	413.33 b	380.33 c	11.76 c	13.46 bc
T6	396.66 d	371.66 de	360.00 c	358.00 d	10.50 d	12.66 d
T7	393.33 d	353.33 e	360.00 c	340.66 d	10.06 d	11.50 e

For more details about treatments: T1 to T7 see Table 2
***1st**: first season, **2nd**: second season*
Values followed by the same letters are not significantly different by LSD's test at 0.05 level

Chlorophyll content and total yield (kg ha^{-1}) were significantly affected by different spraying treatments and mineral fertilizer. It has the similar trend of the previous TSS% parameter. This increase in the chlorophyll and yield for treatments may be a result of increasing vegetative growth parameters of lettuce for same treatments.

Abd El-Aal [7] indicated that the effect of spraying 4 times with yeast extract 100 ml L^{-1} on increasing each of chlorophyll a, b and carotenoids concentrations as well as TSS% as compared with the control of sweet ananas melon plants.

Ahmed and Shalaby [23] showed that using seaweed extract of green alga (*E. intestinelis*), red alga (*G. pectinutum*) or commercial seaweed extracts is considered a suitable application to improved vegetative growth and yield of cucumber plants.

3.2 Chemical Constituents

In general, all treatments that contain 100% NPK- mineral fertilizer with foliar spray with *S. cerevisiae,* super blue green and novatrein produced the highest values of N, P, K and protein % compared those contain 75% NPK-mineral fertilizer and control.

Through the two studying seasons (Table 6). T2 treatment gave the highest increases over control in N, P, K and protein %, which exhibited 4.08, 0.48, 4.84 and 25.49% compared to treatment of control that gave 3.12, 0.41, 4.08 and 19.54% at season 2014, respectively. Results of season 2015 gave a similar trend.

Similarly, Masarirambi [24] reported that there was relatively higher macro and micronutrients content in lettuce plants produced by foliar spray with biostimulants than those grown with conventional fertilizers. These effects might be due to the beneficial effects of compost tea as a commercial product which, increase supply of macro and micro nutrients in available form for plants.

Also, Abo Sedera [25] concluded that spraying strawberry plants with amino acids at 0.5 and 1.0 g L^{-1} significantly increased total nitrogen, phosphorus and potassium in plant compared to control treatment.

3.3 Entomological Studies

Under field conditions, all treatments sprayed were affected directly on pest through the mineral nutritional status of the plants, and indirectly by producing healthy plants. Studies were taken to examine the population of insect pests (*A. gossypii* and *E. lybica)*, and predators (*Scymnus spp.* and true spider), through the two studying seasons.

3.3.1 Insects pests

3.3.1.1 Aphis gossypii

Fig. 1 shows the number of *A. gossypii* infesting lettuce plants. From this figure it can be seen that the population density decreased gradually in control treatment until the end of two season. On the other hand, the lowest mean number of *A. gossypii* was recorded 35.50 and 28.25 individuals/10 leaflets on lettuce sprayed by the highest rate of foliar spray with super blue green +100% NPK-mineral fertilizer (T4), respectively.

Table 5. Effects of different foliar spray and mineral fertilizer on total soluble solids, chlorophyll content (SPAD) and total yield (ton ha^{-1}) of lettuce plants during 2014 and 2015 winter season

Characters / Treatments	T.S.S		Chlorophyll (SPAD unit)		Total yield (Ton ha^{-1}.)	
	1st	2nd	1st	2nd	1st	2nd
T1	5.03 e	4.90 e	29.33 f	28.66 g	27.66 e	29.59 c
T2	6.90 a	6.90 a	44.66 a	46.00 a	38.47 a	36.97 a
T3	6.80 a	6.40 b	40.66 b	42.66 b	36.57 ab	35.30 a
T4	6.10 b	6.06 c	38.66 c	40.66 c	34.42 b	34.28 ab
T5	5.80 c	5.20 d	38.66 c	38.66 d	33.80 bc	31.97 bc
T6	5.76 c	5.40 d	35.66 d	36.33 e	31.61 cd	31.30 c
T7	5.53 d	5.26 d	33.66 e	31.66 f	29.95 de	29.64 c

For more details about treatments: T1 to T7 see Table 2
***1st**: first season, **2nd**: second season*
Values followed by the same letters are not significantly different by LSD's test at 0.05 level

Table 6. Effects of different foliar spray and mineral fertilizer on nitrogen, phosphorus, potassium and protein percentage of lettuce plants during 2014 and 2015 winter season

Characters / Treatments	N (%)		P (%)		K (%)		Protein (%)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
T1	3.12 e	3.11 c	0.41 e	0.42 e	4.08 f	4.20 f	19.54 e	19.12 f
T2	4.08 a	4.33 a	0.48 a	0.48 a	4.84 a	4.88 a	25.49 a	27.07 a
T3	3.80 b	4.10 a	0.46 b	0.47 b	4.72 b	4.76 b	23.78 b	25 .62 b
T4	3.64 c	3.73 b	0.44 d	0.47 b	4.64 b	4.73 b	22.74 c	23.35 c
T5	3.55 cd	3.63 b	0.43 d	0.46 c	4.55 c	4.62 c	22.18 cd	22.68 cd
T6	3.41 d	3.60 b	0.41 e	0.45 c	4.33 d	4.51 d	21.27 d	21.89 d
T7	3.24 e	3.30 c	0.41 e	0.43 d	4.20 e	4.39 e	20.20 e	20.64 e

For more details about treatments: T1 to T7 see Table 2
***1st**: first season, **2nd**: second season*
Values followed by the same letters are not significantly different by LSD's test at 0.05 level

Whereas, the highest mean number of *A. gossypii* after 30 and 45 days from treatment was 80.75 and 66.75 individuals/10 leaflets, respectively on lettuce treated by the highest rate of foliar spray with novatrein +100% NPK-mineral fertilizer (T6), compared other treatments.

Ali and Abd-Allah [11] showed that plants treated with yeast were more expose to infesting with pests because the yeast was more suitable to insect feeding.

These results agree with those obtained by Nicholas and Wheeler [26] who noticed that plants sprayed with vitamin B1 or C and yeast enhanced the status of plant physiology including photosynthesis, photoprotection and cell wall growth.

3.3.1.2 Empoasca lybica

During two successive seasons, the correlation between three materials (*S. cerevisiae*, super blue green and novatrein as well as different mineral fertilizer combination treatments among them) were shown in Fig. 2. In general, the population density increased gradually in control treatment throughout the two season and decreased in other treatments.

After 30 and 45 days, the lowest mean number of *E. lybica* was recorded 15.50 and 11.50 individuals/10 leaflets, respectively, on lettuce sprayed by novatrein +100% NPK- mineral fertilizer (T6) compared to lettuce untreated and other treatments. The results were similar trend approximately with *Aphis gossypii* as shown in Fig. 1.

These results were in agreement with Hanafy [27] and El- Lakwah [28] who study the population dynamics of some pests infesting Nili cucumber plantations and had significant effect on the population dynamics of *E. decipiens*, *A. gossypii* and *B. tabaci* for the two cucumber cultivars and compare that population with some foliar application.

3.3.2 Predators

3.3.2.1 Scymnus spp.

Data of the same investigation in 2014 and 2015 lettuce season are presented in Fig. 3. It can be observed the mean number of predators (*Scymnus spp*) was decreased in control treatment until the end of both seasons as compared with other treatment.

The highest mean number of *Scymnus spp*. after 30 and 45 days was 43.25 and 47.50 individuals/10 leaflets, respectively, on lettuce treated by the highest rate of *S. cerevisiae* +100% NPK- mineral fertilizer (T2) however, the lowest mean numbers of *Scymnus spp* after 15 and 30 days was recorded 21.50 and 25.25 individuals/10 leaflets, respectively, on lettuce treated by super blue green +100% NPK-mineral fertilizer (T4) throughout 2014 season and the same results were similar trend approximately at 2015 season.

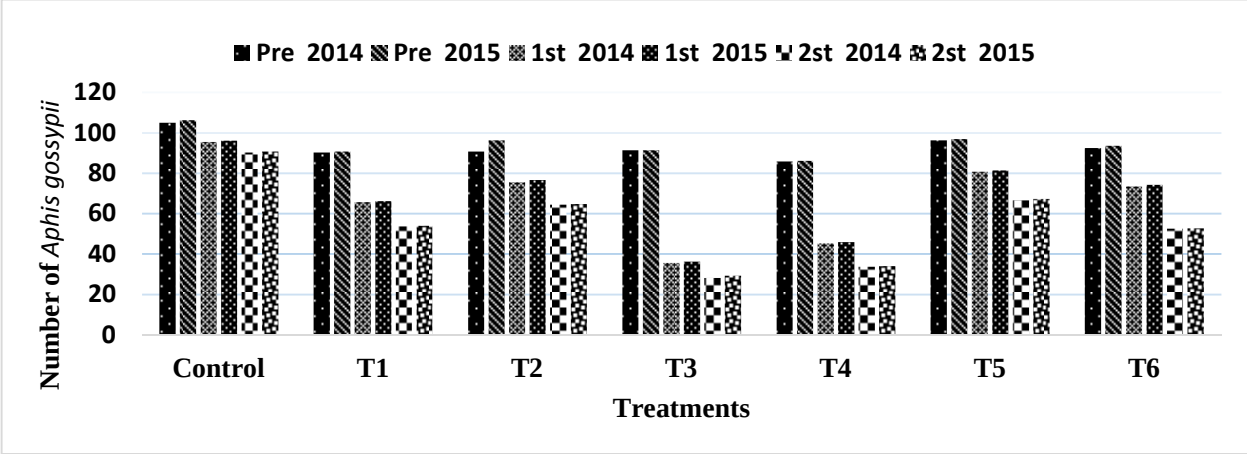

Fig. 1. Number of *Aphis gossypii* infesting lettuce plants throughout seasons 2014 and 2015

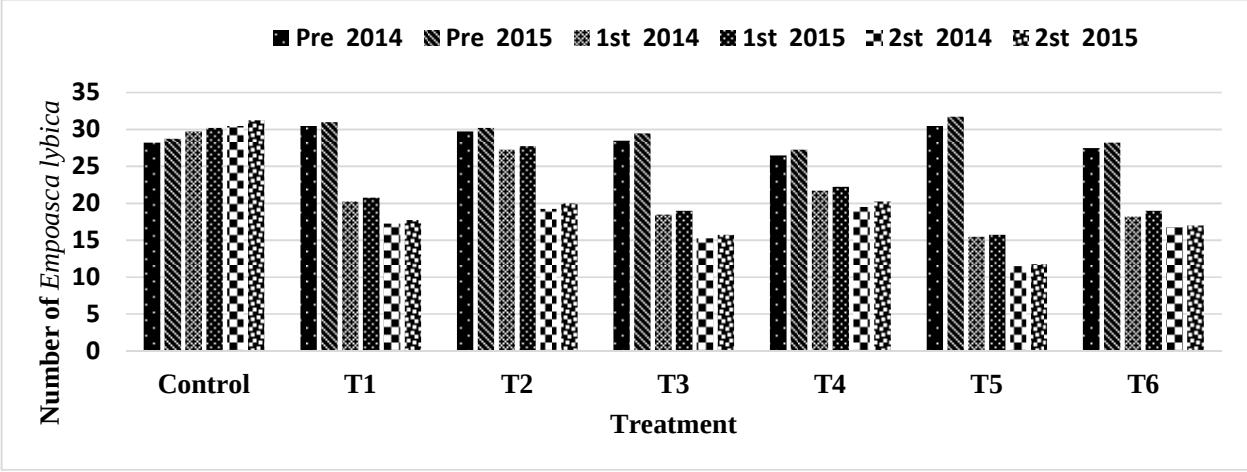

Fig. 2. Number of *Empoasca lybica* infesting lettuce plants throughout seasons 2014 and 2015

Ali and Abd-Allah [11] showed that plants spraying with vitamins (B1 and C) and yeast were sufficient nutrient for plants and the same time to feeding the pests. So, these foliar applications had a significant increase on vegetative growth than control and this may be due to contain natural source of many growth substances (thiamine, riboflavin, niacin, pyridoxine, pantothenate, bioten, cholin, folic acid and vitamin B12) and the most of nutritional elements (Na, Ca, Fe, Mg, K, P, S, Zn and Si) as well as organic compounds (protein, carbohydrates, nuclic acids and lipids), which reflected on plant growth [5].

3.3.2.2 True spider

In general, the population density of true spider decreased in pretreatment and then increased in other treatments through both of two seasons.

It is clear from results of Fig. 4 that the highest mean number of true spider at 2014 season after 30 and 45 days was 25.25 and 30.50 individuals/10 leaflets, respectively, on lettuce sprayed by novatrein + 100% NPK- mineral fertilizer (T6). On the other hand, the lowest mean of true spider after 30 and 45 days was 16.50 and 18.25 individuals/10 leaflets, respectively, on lettuce sprayed by the lowest rate of super blue green + 75% NPK- mineral fertilizer (T5) compared to lettuce untreated and other treatments.

From these results it can be seen that data revealed also that the young lettuce plants recorded true spider lowest populations than older plants, indicating that the older plants were more suitable as a host for that predator than young plants under all different treatments. The results were similar trend approximately with true spider in 2015. The obtained results are in accordance with those reported by Faris [29] and Ali and Abd-Allah [11].

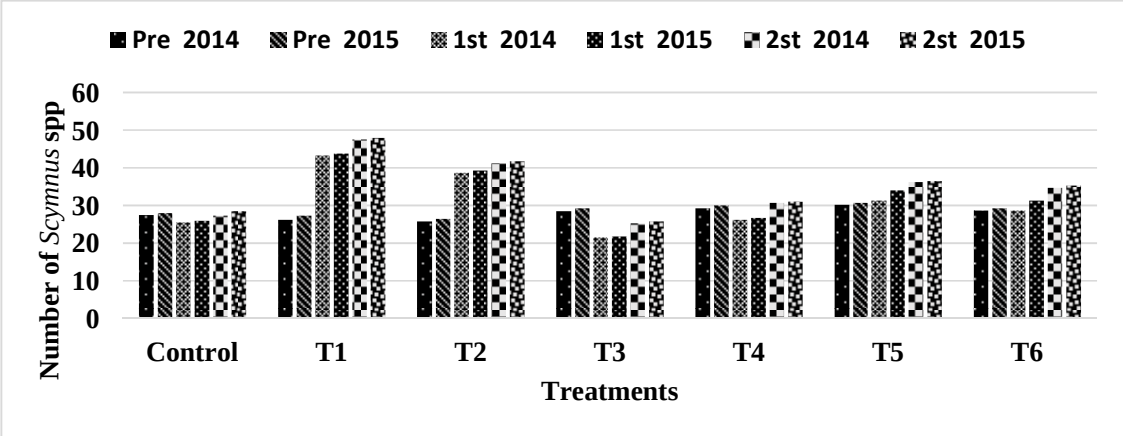

Fig. 3. Number of *Scymnus spp*. infesting lettuce plants throughout seasons 2014 and 2015

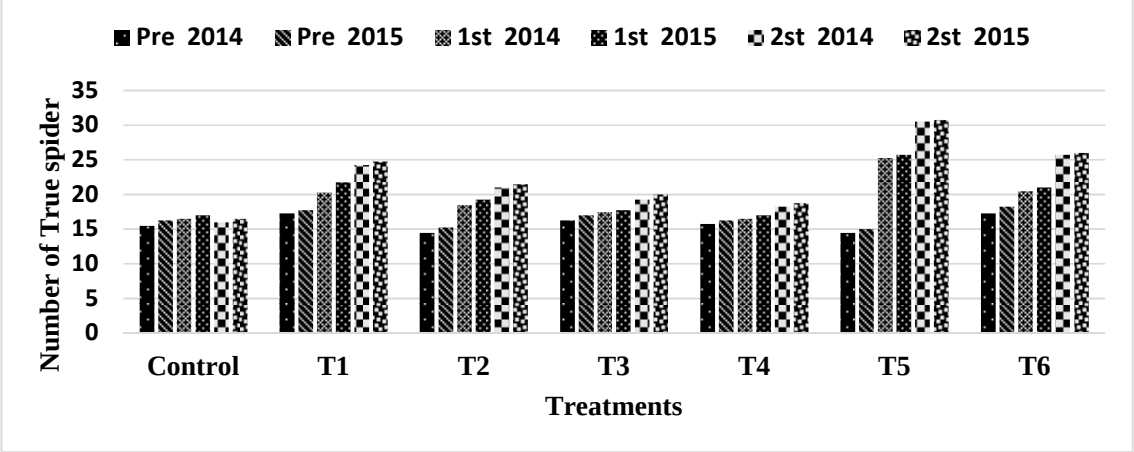

Fig. 4. Number of true spider infesting lettuce plants throughout seasons 2014 and 2015

4. CONCLUSION

Based on the obtained data, it could be concluded that the important of foliar spray with *S. cerevisiae* and commercial nutrients (super blue green and Novatrein) on productivity and plant physiological healthy of lettuce (*L. sativa* L. cv. Balady). In addition, these treatments due to partial protection from some insect pests (*A. gossypii* and *E. lybica*) and assisted predators (*Scymnus spp*. and true spider). Plants treated with previously nutrients were more expose to infesting with pests because they were more suitable to insect feeding as compared to control. So, we recommend farmers to use the suitable combination from mineral and foliar nutrients in order to reduce insect infestation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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