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BIO-CHEMICAL STUDIES FOR PRODUCTION OF ORGANIC COTTON
2--EFFECT OF ORGANIC FERTILIZATION AND BIO-CONTROL ON GROWTH AND ITS ATTRIBUTES

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ABSTRACT

Two field experiments were carried out at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate during two successive seasons of 2012 and 2013. These experiments were conducted to study the probability of using clean agriculture to produce organic cotton and reduce environmental pollution. A randomized complete block design with 4 replicates was used in both seasons, where the following twelve patterns were evaluated with regard to growth and its attributes of the Egyptian cotton (*Gossypium barbadense*, L.), cultivar Giza 86:- Patterns 1, 2, 3 and 4 included two rates of mineral NPK fertilizers (45 kg N: 22.5kg P_2O_5 :24 kg K_2O /fed (the recommended rate) and 60 kg N :30 kg P_2O_5 : 36 kg K_2O /fed) in combination with chemical or bio- control, respectively. Patterns 5, 6, 7 , 8, 9,10, 11 and 12 included two rates of organic NPK fertilizers (45 kg N: 22.5kg P_2O_5 :24 kg K_2O and 60 kg N :30 kg P_2O_5 : 36 kg K_2O /fed) in the form of pigeon refuse as source of N in Patterns 5, 6, 7 and 8 and in the form of phytocompost in Patterns 9, 10, 11 and 12 + in the form of phosphate ore (20 % P_2O_5) +Phosphorein as source of P + in the form of potassium ore (8.2 % K_2O)as source of K in Patterns 5, 6, 9 and 10, in combination with bio- control. In patterns 7, 8, 11 and 12 the source of P was mixed minerals ore (6.14 % P_2O_5) +Phosphorein and the source of K was mixed minerals ore (3.37 % K_2O) and potassium ore, in combination with bio- control.

The obtained results could be summarized as follow:-

Leaf area index and total dry weight per plant were significantly affected by the tested Patterns at all sampling dates in both seasons, in favor of Pattern 8(high organic NPK rate, where the source of N was pigeon refuse, the source of P was mixed minerals ore +Phosphorein and the source of K was mixed minerals ore and potassium ore in combination with bio-control) and Pattern 6 (high organic NPK rate, where the source of N was pigeon refuse, the source of P was phosphate ore +Phosphorein and the source of K was potassium ore in combination with bio-control).

Crop growth rate and net assimilation rate were significantly affected by the tested Patterns at the first and second periods in both seasons, in favor of applying Pattern 8 and pattern 6 at the first period in the first season and at the first and second periods in the second season. In addition, these two Patterns gave the tallest plants with the highest number of fruiting branches, while the shortest plants with the lower number of fruiting branches produced from Pattern 9 (low organic NPK rate, where the source of N was phytocompost, the source of P was phosphate ore +Phosphorein and the source of K was potassium ore in combination with bio- control) in both seasons.

The high mineral NPK fertilizers rate when combined with chemical control (Pattern 2) or bio-control (Pattern 4) significantly increased leaf area index at 79 days from sowing in the first season and at 100 and 121 days from sowing in the second season. Also, these two Patterns significantly increased total dry weight per plant at the three sampling dates and crop growth rate at the first and second periods in both seasons and net assimilation rate at the second period in both seasons and produced the tallest plants with the highest number of fruiting branches and highest internodes number per plant as compared with the recommended rate either with chemical control (Pattern 1) or bio-control (Pattern 3).

Insignificant differences in traits under study were found when using the high mineral NPK fertilizers rate either with chemical control (Pattern 2) or bio-control (Pattern 4) or using the recommended rate either with chemical control (Pattern 1) or bio-control (Pattern 3) which indicate that biological control was effective.

The high organic NPK rate significantly increased leaf area index and total dry weight per plant at 79, 100 and 121 days from planting in 2012 and 2013 seasons and crop growth rate and net assimilation rate at the first and second periods in both seasons and gave the tallest plants with the highest number of fruiting branches as compared with the low organic NPK rate especially when the source of N was pigeon refuse, the source of P was mixed minerals ore + Phosphorein and the source of K was mixed minerals ore and potassium ore in combination with bio- control (Pattern 8) or when the source of N was pigeon refuse, the source of P was phosphate ore + Phosphorein and the source of K was potassium ore in combination with bio- control (Pattern 6).

From the obtained results, it is clear that organic fertilization with 60 kg N: 30 kg P_2O_5: 36 kg K_2O /fed in the form of pigeon refuse as source of N, mixed minerals ore+Phosphorein as source of P and mixed minerals ore and potassium ore as source of K in combination with bio- control (Pattern 8) produced the highest growth of cotton.

Keywords: Organic NPK, Pigeon refuse, Pyto-compost manure, Bio-fertilizer, Bio-control

INTRODUCTION

There are many serious problems related to nutritional factors such as over NPK fertilization and due to insufficient uptake of these chemical fertilizers by plants, where they reach into water bodies, cause eutrophication in water bodies and affect living beings including growth inhabiting microorganism. The excess uses of nitrogen fertilizers in agriculture are costly and also have various adverse effects on soils as depletion of water holding capacity, soil fertility and disparity in soil nutrients. It was felt from a long time to develop some low cost effective and ecofriendly fertilizers which work without disturbing nature. Now, certain species of microorganism are widely used which have unique properties to provide natural products, and serve as a good substitute of chemical fertilizers (Deepali and Gangwar, 2010). A biofertilizer is a substance which contains living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the anterior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant or bio-fertilizer contains biological means, living organisms that synthesis the atmospheric plant nutrient in the soil or in the plant body, or create such an atmosphere in the soil or in the medium in which the organisms are kept (Youssef and Eissa, 2014). The benefits of biofertilizers are cheap source of nutrients, suppliers of macro and micro nutrients, suppliers of organic matter, counteracting negative impact of chemical fertilizers and secretion of growth hormones (Gaur, 2010). Therefore, clean agriculture is based on the use of natural materials and biological control for safe production. The increase of prices of fertilizers had made it unaffordable for common farmers to use it at the recommended rate (Hussain *et al*., 2007).

Phosphorus is one of the major nutrients necessary for crop growth and development. It is the second most limiting nutrient in cotton production after nitrogen. Soil phosphorus availability for crop uptake is pH dependent and alkalinity can adversely affect its uptake. Phosphorus is quite immobile in soils with neutral or high pH and appears in more or less stable calcium phosphates. Added phosphate does not move more than 2-3 mm from the fertilizer particle and is precipitated rapidly to dicalcium phosphate ($CaHPO_4.H_2O$) or octacalcium phosphate, entirely unavailable to crops. Fertilizer phosphate can also be adsorbed on calcium carbonate surfaces.When P losses entering surface water they can induce eutrophication with all the known consequnces. The availability of phosphate will be improved by organic matter (Amberger, 1993). Phosphorus fertilization in form of triple super phosphate (TSP) was negative presumably due to fixation as insoluble calcium phosphate Ca_3 $(PO_4)_2$ (Ali and Elhassan, 2007).The potentiality of high grade rock phosphate (PR, 34/74) as an effective source of P in promoting the growth parameters of cotton is confirmed (Sree *et al.*, 2004).

In photosynthesis, K has the role of maintaining the balance of electrical charges at the site of ATP production. Also, K promotes the translocation of photosynthates (sugars) for plant growth or storage in fruits or roots (Hearn, 1981). Potassium is involved in protein synthesis (Uchida, 2000).

With regard to the effect of mineral NPK on growth, increasing NPK rate increased plant height and dry matter production (Suresh and Chellamuthu, 2006), total dry matter production (Saleem *et al.*, 2008). The application of 125% recommended fertilizers rate resulted in the highest plant dry weight at boll formation and first picking stages (Kumar *et al.,* 2011), dry matter production (Halepyati *et al.*, 2012). Sankaranarayanan *et al.* (2011) found that the existing NPK level recommended for conventional hybrids was not adequate for Bt hybrids as evident from lesser growth, lower reproductive counts and decrease in seed cotton yield. Thus, crop requirements for NPK in excess of 25-50% could help in realizing higher dry weights and yields.

With regard to the effect of organic NPK on growth, addition of farmyard manure FYM recorded the highest values of plant height and sympodia per plant (Kumari *et al.*, 2005), Plants of the FYM treatments were taller (68.4-149.5 cm) and had more main stem nodes per plant (30.5-44.5) as compared to chemical NPK treatments (Blaise *et al.*, 2007). Raut *et al*. (2009) studied the performance of cotton under organic manuring. Application of 4 t vermicompost ha^{-1}+PSB+*Azotobacter* as soil application recorded maximum growth. Abd El-Gayed and Abd El-Hafeez (2014) found that application of rock phosphate at the rate of 150kg /fed. to soil led to significant increase in values of plant height and number of fruiting branches, further increase in rock phosphate level up to 300kg/fed. resulted in further increasing in cotton growth.

Cotton production is adversely affected by many insect pests, which are traditionally being managed by the application of large quantities of insecticides. Although chemical insecticides provide an excellent control in many instances, however, resistance in insect pests of cotton have been reported against many pesticides, which require the use of an increased amount of insecticides. The excessive use of chemical insecticides has produced several undesirable effects including development of resistance to insecticides, toxic residues in lint and seed, environmental pollution, destruction of beneficial organisms and health risks. Therefore, the use of insecticides is un-sustainable and it is imperative to tap alternate methods of insect pests' control. The concept of Integrated Pest Management (IPM) is also becoming popular because it encourages the use of several components in the pest control system in a harmonious combination, which has minimal impact on the environment. Biological control is a basic component of any IPM system and has been used successfully to combat many insect pests. Biological control through parasites and predators can be exploited alone or as an adjunct to other management tactics. Biological control is relatively permanent, safe, economical and environmentally friendly. It can be defined as "the action of parasites, parasitoids, predators and pathogens to keep the pest populations at a lower average than the economic injury level". The use of *Chrysoperla carnea* (Stephens) in conjunction with *Trichogramma evanescens* wasp as bio-control agents is a recognized alternative of insecticides and has been applied successfully for the management of many insect pests. Sarwar *et al.* (2011) reported that aphids appeared to be the most promising host for mass rearing of the predator. Additionally, successful predation on the cotton bollworms eggs evidenced the potential of *Chrysoperla carnea* for the management of cotton bollworms in the field which is an instrumental for biological pest control strategy. Bio-agents are good alternative of insecticides for the control of many insect pests. Spinosad is a product from the naturally occurring soil bacterium, *Saccharopolyspora spinosa.* Spinosad acts primarily on the insect's nervous system at the nicotinic acetylcholine receptor (El-Sheikh *et al.*, 2009).

Therefore, this work aimed to study the probability of using clean agriculture to produce organic cotton by using new approaches in organic sources and to limit the adequate combination of N, P and K for cotton maximum production and minimum insects'infestation under Egyptian agricultural conditions and to evaluate the releases of *Chrysoperla carnea* (Stephens) in conjunction with *Trichogramma evanescens* wasp as bio-control agents and bio-agents in the field to manage the insect pests for economical and quality production of the cotton.

MATERIALS AND METHODS

Two field experiments were carried out at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate during two successive seasons of 2012 and 2013. These experiments were conducted to study the probability of using clean agriculture to produce organic cotton and avoid environmental pollution. A randomized complete block design with 4 replicates was used in both seasons, where the following twelve patterns were evaluated with regard to growth and its attributes of the Egyptian cotton (*Gossypium barbadense*, L.), cultivar Giza 86:- Patterns 1, 2, 3 and 4 included two rates of mineral NPK fertilizers (45 kg N: 22.5kg P_2O_5 :24 kg K_2O /fed (the recommended rate) and 60 kg N :30 kg P_2O_5 : 36 kg K_2O /fed) in combination with chemical or bio- control, respectively. Patterns 5, 6, 7 , 8, 9,10, 11 and 12 included two rates of organic NPK fertilizers (45 kg N: 22.5kg P_2O_5 :24 kg K_2O and 60 kg N :30 kg P_2O_5 : 36 kg K_2O /fed) in the form of pigeon refuse as source of N in Patterns 5, 6, 7 and 8 and in the form of phytocompost in Patterns 9, 10, 11 and 12 + in the form of phosphate ore (20 % P_2O_5) +Phosphorein as source of P + in the form of potassium ore (8.2 % K_2O)as source of K in Patterns 5 , 6, 9 and 10, in combination with bio- control. In patterns 7, 8, 11 and 12, the source of P was mixed minerals ore + Phosphorein and the source of K was mixed minerals ore and potassium ore in combination with bio- control.

Representative soil samples were taken from the experimental soil sites before sowing in both seasons and prepared for analysis, according to Jackson (1973). The results of the soil characterization are shown in Table (1).

Table (1):- Soil analysis* of the experimental site in the two seasons.

Properties	2012 season	2013 season
Sand %	15	17
Silt %	36	32
Clay %	49	51
Texture	Clayay	Clayay
pH	8.3	7.6
EC mmhos/ cm.	1.0	0.68
$CaCO_3$ %	7.0	6.4
O.M. %	1.67	2.0
Total N (mg/100g)	58.5	70
Available N (ppm)	27.9	30.2
Available P (ppm)	15	17
Available K (ppm)	240	300
Available Ca (ppm)	92	52
Available Mg (ppm)	12.3	34
Available Na (ppm)	50	40
Available Fe (ppm)	10.8	10.44
Available Mn (ppm)	1.0	2.6
Available Zn (ppm)	0.8	1.0
Available Cu (ppm)	0.78	3.0

*** Optimizing of Micronutrient Fertilizers Use Project, National Research Centre, Unit of Mariut**

The two organic manures, mixed minerals ore, phosphorus ore and potassium ore were analyzed before use according to Chapman and Pratt (1978) and the amount used of each manure was determined according to its total content of elements in concern and was soil incorporated during seed bed preparation at the rate under study. The results of their properties are shown in Tables 2 and 3.

Table (2): Chemical analysis* for phosphate, potassium and mixed minerals ores.

Item	Phosphate ore	Potassium ore	Mixed minerals ore
SiO_2 %	12.78	70.56	38.56
$Ti0_2$ %	0.02	0.02	0.76
Al_2O_3 %	0.35	16.23	7.8
Fe_2O_3 %	1.12	0.17	3.58
MnO %	0.07	0.02	0.61
MgO %	0.61	0.05	2.47
CaO %	44.12	0.26	13.45
Na_2O %	1.12	3.69	1.32
K_2O %	0.05	8.20	3.37
P_2O_5 %	20.0	0.03	6.14
SO_3 %	1.98	…….	5.38
L.O.I. %	13.62	0.37	7.01

*** Optimizing of El- Ahram Company for Mining and Natural Fertilizers.**

The bio-fertilizer called Phosphorein® used as seed inoculation. Inorganic NPK fertilizers were applied at the rate under study as ammonium nitrate (33.5% N), calcium super phosp hate (15.5% P_2O_5) and potassium sulphate (48% K_2O), respectively. Phosphorus fertilizer was incorporated during seed bed preparation. Nitrogen fertilizer was applied in two equal doses, immediately before the first and the second irrigations. Potassium fertilizer was side-dressed in a single dose before the second irrigation.

Bio-control was applied using natural compounds and native natural enemies of cotton pests i.e. egg parasitoid, (*Trichogramma evanescens*), predator (*Chrysoperla carnea*), microbial agent (*Bacielus thuringiensis var*. Kustaki) with the trade name Protecto® (local, 9.4% W.P) and biocide Spinosad (Tracer 24% SC) against cotton leaf worm, bollworms egg, nymph and sucking insects, while chemical control was done as recommended for conventional cotton production.

The preceding crop was fallow after Sudan grass (*Sorghum vulgare var. sudanese* L.) and Egyptian clover (*Trifolium alexandrinum* L.) "berseem" in the first and second seasons, respectively. The plot size was 14 m^2, (4m x 3.5m) including 5 rows in both seasons. Sowing date was 1^{st} April and 5^{th} April in the first and second seasons, respectively in rows 70 cm apart and the hills 25 cm. apart with two plants / hill after thinning.

Table (3): Analysis* of the two organic manures used in the two seasons

Properties	Pigeon refuse (guano) PR		Compost manure CM	
	2012	2013	2012	2013
Moisture %	20	25	13.5	31.9
Weight of m^3 (kg)	313	330	528	600
pH(1:10 organic manure :water)	7.0	6.8	7.4	7.25
Soluble total salts (1:10 organic manure :water) %	0.31	0.51	0.10	0.39
O.M. ** %	66.20	67.41	33.1	34.14
Organic carbon %	38.4	39.1	19.2	19.8
Total N %	3.85	4.01	1.80	1.83
C: N ratio	9.97:1	9.75:1	10.67:1	10.82:1
P %	3.4	3.3	0.53	0.77
K %	1.95	1.55	0.87	0.78
Ca %	3.42	5.53	1.26	1.24
Mg %	1.01	1.03	0.20	0.26
Na %	0.21	0.46	0.20	0.35
Cl - (1:10 organic manure :water) %	0.035	0.033	0.012	0.011
SO_4^{--} (1:10 organic manure :water) %	0.260	0.200	0.080	0.065
HCO_3^- (1:10 organic manure :water) %	0.009	0.007	0.006	0.004
Fe (ppm)	1230	1980	95.4	156
Mn (ppm)	367	473	270	230
Zn (ppm)	68	71.8	4	31
Cu (ppm)	41.8	35.0	1.5	1.6

*** Optimizing of Micronutrient Fertilizers Use Project, National Research Centre, Unit of Mariut.**

**** Organic matter (O.M.) = Organic carbon x 1.724 (Waksman, 1952).**

Studied characters:-

Growth attributes:-

In the two seasons, sampling commenced 79 days after sowing and continued at 21 days intervals up to 121 days. Four plants of two guarded hills of the middle rows were taken at random from each plot carefully. Samples were immediately transferred to the laboratory. Roots of sample plants were removed at the cotyledonary nodes, then the different plant fractions were washed and oven dried to a constant weight at 70 C^0 and their dry weights were obtained and the following growth attributes were calculated:-

Leaf area index (LAI):-

It is defined as total area of land occupied by the plant. It was computed according to the following formula (Watson, 1958):-

$$\mathbf{LAI} = \frac{\text{LA per plant}}{\text{Plant ground area}}$$

Total dry weight (g/ plant).

Crop growth rate (CGR):-

Crop growth rate of a unit area of a canopy over at any instant in time (t) is defined as the increase of plant material per unit of time. It was computed according to the following formula (Watson, 1958):-

$$\mathbf{CGR} = \frac{(W_2 - W_1)}{(t_2 - t_1)} \quad \mathrm{g/m^2/week}$$

Net assimilation rate (NAR):-

The net assimilation rate of plant at an instant in time (t) is defined as the increase of plant material per unit of assimilation surface per unit of time. It was calculated according to the following formula (Thorne, 1960):-

$$\mathbf{NAR} = \frac{(W_2 - W_1)(L_n LA_2 - L_n LA_1)}{(LA_2 - LA_1)(t_2 - t_1)} \quad \mathrm{g/m^2/week}$$

Where, W_1, LA_1 and W_2, LA_2 refer to dry weight and leaf area at time t_1 and t_2 in weeks, respectively.

Growth traits:-

At harvest, five guarded hills from the second row of each plot were taken to determine:-

Plant height at harvest (cm).
No. of internodes / plant.
Internode length (cm).
No. of fruiting branches / plant.

Statistical analysis

The statistical analysis of the data in the two seasons was done and performed according to Le Clerg *et al*., (1966). The treatments means were compared using LSD at 0.05 level of probability.

RESULTS

Leaf area index:-

Averages of leaf area index as affected by the tested patterns at 79, 100 and 121 days from sowing in 2012 and 2013 seasons are shown in Table 4.

Concerning leaf area index, significant differences were detected among the tested patterns at 79, 100 and 121 days from sowing in both seasons (Table 4).The highest values of LAI (2.51, 2.47, 2.39 and 2.40; 2.87, 2.80, 2.75 and 2.75; 3.43, 3.28, 3.28 and 3.28) were obtained due to Patterns

8, 6, 2 and 4 at 79, 100 and 121 days from sowing, respectively in the first season. Corresponding values were 3.01, 2.86, 2.83 and 2.82; 3.40, 3.11, 3.27 and 3.25; 3.85, 3.84, 3.73 and 3.71, respectively in the second season. However, the lowest values of LAI were obtained due to Pattern 9 at the first, second and third sampling dates, where these values were 1.74, 2.13 and 2.30 in the first season and 2.07, 2.35 and 2.78 in the second season, respectively.

Table (4): Effect of the patterns under study on leaf area index /plant at 79, 100 and 121 days after sowing in 2012 and 2013 seasons.

Treatments	Leaf area index/plant at					
	79 days after sowing		100 days after sowing		121 days after sowing	
	2012	2013	2012	2013	2012	2013
Pattern 1	2.23	2.66	2.58	2.89	3.15	3.41
Pattern 2	2.39	2.83	2.75	3.27	3.28	3.73
Pattern 3	2.25	2.70	2.58	2.91	3.14	3.38
Pattern 4	2.40	2.82	2.75	3.25	3.28	3.71
Pattern 5	1.79	2.25	2.16	2.62	2.40	2.97
Pattern 6	2.47	2.86	2.80	3.11	3.28	3.84
Pattern 7	2.03	2.31	2.29	2.64	2.69	3.12
Pattern 8	2.51	3.01	2.87	3.40	3.43	3.85
Pattern 9	1.74	2.07	2.13	2.35	2.30	2.78
Pattern 10	1.90	2.13	2.28	2.43	2.65	2.92
Pattern 11	1.81	2.21	2.18	2.59	2.39	2.89
Pattern 12	2.09	2.40	2.33	2.68	2.78	3.06
LSD at 0.05	0.12	0.17	0.18	0.18	0.14	0.18
LSD at 0.01	0.16	0.23	0.24	0.25	0.19	0.24

The high mineral NPK fertilizers rate when combined with chemical control (Pattern 2) or bio-control (Pattern 4) significantly increased leaf area index at 79 days from sowing in the first season and at 100 and 121 days from sowing in the second season as compared with the recommended rate either with chemical control (Pattern 1) or bio-control (Pattern 3).

The high organic NPK rate significantly increased leaf area index at 79, 100 and 121 days from planting in 2012 and 2013 seasons as compared with the low rate especially when the source of N was pigeon refuse, the source of P was mixed minerals ore + Phosphorein and the source of K was mixed minerals ore and potassium ore in combination with bio- control (Pattern 8) or when the source of N was pigeon refuse, the source of P was phosphate ore + Phosphorein and the source of K was potassium ore in combination with bio- control (Pattern 6).

Total dry weight per plant (g):-

Averages of total dry weight per plant (g) as affected by the tested patterns at 79, 100 and 121 days from sowing in 2012 and 2013 seasons are shown in Table 5.

Regarding the effect of the tested patterns on total dry weight per plant, data in Table 5 show that, the tested patterns had a significant effect on total dry weight per plant at 79,100 and 121 days from sowing in 2012 and 2013 seasons, where Patterns 8, 6, 2 and 4 resulted in the highest values of total dry weight/plant (48.09, 78.22 and 130.39; 47.00, 76.34 and 125.06; 46.90, 73.25 and 125.70; 46.41, 72.95 and 124.43 g) in the first season and (50.39, 79.98 and 121.10; 49.82, 77.53 and 117.17; 50.01, 76.22 and 115.32; 49.43, 76.00 and 114.82 g) in the second season for the first, second and third sampling dates, respectively. However, the lowest values of total dry weight/plant (35.80, 51.01 and 83.86; 36.69, 55.77 and 81.12 g) were obtained from Pattern 9 at the first, second and third sampling dates in the first and second seasons, respectively.

Among the mineral NPK treatments, the differences were significant with regard to total dry weight per plant at the three sampling dates in both seasons, where the high mineral NPK fertilizers rate when combined with chemical control (Pattern 2) or bio-control (Pattern 4) resulted in the highest values of total dry weight/plant as compared with the recommended rate either with chemical control (Pattern 1) or bio-control (Pattern 3) at the three sampling dates in both seasons.

Table (5): Effect of the patterns under study on total dry weight /plant (g) at 79, 100 and 121 days after sowing in 2012 and 2013 seasons.

Treatments	Total dry weight /plant at					
	79 days after sowing		100 days after sowing		121 days after sowing	
	2012	2013	2012	2013	2012	2013
Pattern 1	45.03	42.74	69.49	65.35	113.39	97.81
Pattern 2	46.90	50.01	73.25	76.22	125.70	115.32
Pattern 3	44.46	42.18	68.83	64.58	112.97	97.18
Pattern 4	46.41	49.43	72.95	76.00	124.43	114.82
Pattern 5	36.39	39.06	53.72	59.34	89.59	88.73
Pattern 6	47.00	49.82	76.34	77.53	125.06	117.17
Pattern 7	38.05	39.33	56.70	60.37	94.86	90.58
Pattern 8	48.09	50.39	78.22	79.98	130.39	121.10
Pattern 9	35.80	36.69	51.01	55.77	83.86	81.12
Pattern 10	36.92	39.70	54.96	60.24	92.55	90.52
Pattern 11	36.01	37.29	51.69	56.07	88.77	84.06
Pattern 12	39.44	40.93	60.10	62.58	101.47	94.08
LSD at 0.05	0.88	1.03	1.79	1.07	2.16	1.68
LSD at 0.01	1.19	1.39	2.41	1.44	2.91	2.26

Table 5 shows that total dry weight per plant was significantly increased due to application of organic NPK fertilizers in combined with bio-control at all sampling dates in both seasons, where Patterns 8 and 6 resulted in the highest values of total dry weight per plant as compared with the other organic NPK Patterns at the three sampling dates in both seasons.

I.3. Crop growth rate (g/m^2/week):-

Averages of crop growth rate (CGR) as affected by the tested patterns at the periods of 79-100 and 100-121 days from sowing in 2012 and 2013 seasons are shown in Table 6.

In regard to the tested patterns effect on CGR (g/m^2/week), the results in Table 6 show that the effect of the tested patterns on CGR was significant at the first and second periods in both seasons, in favor of Pattern 8, where this Pattern caused a remarkable increase and produced the highest CGR values (114.80 and 198.74; 112.71 and 156.65 g/m^2/week) at the first and second periods in the first and second seasons, respectively. However, the lowest values of CGR (57.95 and 125.14; 71.53 and 96.57 g/m^2/week) were obtained due to Pattern 9 at the first and second periods in the first season and due to Patterns 11 and 9 at the first and second periods in the second season, respectively.

Concerning mineral fertilizers treatments effect, the data in Table 6 show significant effect on CGR at the first and second periods in both seasons. The high mineral NPK fertilizers rate when combined with chemical control (Pattern 2) or bio-control (Pattern 4) produced the highest CGR values (100.41 and 101.12; 199.79 and 196.13 and 99.85 and 101.20; 148.94 and 147.91 g/m^2/week) at the first and second periods in the first and second seasons, respectively, as compared with the recommended mineral NPK fertilizers rate when combined with chemical control (Pattern 1) or bio-control (Pattern 3).

Table (6): Effect of the patterns under study on crop growth rate (g/m^2/week) at the periods of 79- 100 and 100- 121 days after sowing in 2012 and 2013 seasons.

Treatments	2012 season		2013 season	
	Period (days after sowing)		Period (days after sowing)	
	79-100	100-121	79-100	100-121
Pattern 1	93.20	167.25	86.13	123.66
Pattern 2	100.41	199.79	99.85	148.94
Pattern 3	92.81	168.18	85.35	124.20
Pattern 4	101.12	196.13	101.20	147.91
Pattern 5	66.02	136.65	77.25	111.96
Pattern 6	111.75	185.63	105.58	151.01
Pattern 7	71.04	145.39	80.12	115.11
Pattern 8	114.80	198.74	112.71	156.65
Pattern 9	57.95	125.14	72.69	96.57
Pattern 10	68.73	143.21	78.24	115.38
Pattern 11	59.73	141.27	71.53	106.63
Pattern 12	78.72	157.57	82.48	120.00
LSD at 0.05	6.28	10.31	3.89	6.07
LSD at 0.01	8.47	13.90	5.24	8.18

With regard to organic NPK manure sources at the two tested rates under bio control, data in Table 6 show significant effect on crop growth rate at the first and second periods in both seasons, in favour of Patterns 8 and 6.

Net assimilation rate (g/m^2/week):-

Averages of net assimilation rate (NAR) as affected by the tested patterns at the periods of 79-100 and 100-121 days from sowing in 2012 and 2013 seasons are shown in Table 7.

Respecting the tested patterns effect, the results in Table 7 show that the tested patterns had a significant effect on NAR (g/m^2/week) at the first and second periods in both seasons. The highest values of NAR (42.73, 42.47, 39.16 and 39.00; 63.12, 61.09, 66.36 and 65.06 g/m^2/week) were obtained due to Patterns 8, 6, 2 and 4 at the first and second periods in the first season. Corresponding values were 35.22, 35.40, 32.78 and 33.34; 43.34, 43.46, 42.54 and 42.54 g/m^2/week, respectively in the second season. However, the lowest NAR values at the first prtiod (29.95 and 29.83g/m^2/week) were obtained due to Pattern 11 in the first and second seasons, respectively. At the second period, the lowest NAR values (56.50 and 37.76 g/m^2/week) were obtained from using Pattern 9 in the first and second seasons, respectively.

Table (7): Effect of the patterns under study on net assimilation rate (g/m^2/week) at the periods of 79- 100 and 100- 121 days after sowing in 2012 and 2013 seasons.

Treatments	2012 season		2013 season	
	Period (days after sowing)		Period (days after sowing)	
	79-100	100-121	79-100	100-121
Pattern 1	38.88	58.41	31.06	39.27
Pattern 2	39.16	66.36	32.78	42.54
Pattern 3	38.53	58.80	30.43	39.49
Pattern 4	39.00	65.06	33.06	42.54
Pattern 5	33.53	59.93	31.79	40.06
Pattern 6	42.47	61.09	35.40	43.46
Pattern 7	32.91	58.41	32.41	39.99
Pattern 8	42.73	63.12	35.22	43.34
Pattern 9	30.02	56.50	32.93	37.76
Pattern 10	32.95	58.10	34.46	43.12
Pattern 11	29.95	61.84	29.83	38.94
Pattern 12	35.67	61.79	32.25	41.85
LSD at 0.05	3.54	3.96	2.21	2.62
LSD at 0.01	4.77	5.34	2.97	3.53

Concerning the effect of mineral fertilizers treatments with regard to NAR, Table 7 shows that NAR was significantly affected by mineral fertilizers treatments at the second period in both seasons where, the highest NAR values (66.36 and 65.06; 42.54 and 42.54 g/m^2/week) resulted from applying the high mineral NPK fertilizers rate when combined with chemical control (Pattern 2) or bio-control (Pattern 4) in the first and second seasons, respectively, while the corresponding lowest values (58.41 and 58.80; 39.27

and 39.49 g/m^2/week) resulted from applying the low mineral NPK fertilizers rate when combined with chemical control (Pattern 1 or bio-control (Pattern 3), respectively.

In respect of organic NPK manure sources at the two tested rates under bio control, Table 7 shows that NAR was significantly increased due to Patterns 6 and 8.

Growth traits:-

Plant height at harvest (cm), number of internodes per plant and internode length (cm):-

Averages of plant height at harvest (cm), number of internodes per plant, internode length (cm) and number of fruiting branches/plant as affected by the tested patterns at harvest in 2012 and 2013 seasons are shown in Table 8.

The data in Table 8 show significant differences in plant height at harvest (cm), number of internodes/plant, internode length (cm) and number of fruiting branches/plant due to the different tested patterns in both seasons. Application of Pattern 8 and pattern 6 gave the tallest plants (163.85 and 162.55; 157.45 and 154.38 cm) with the highest number of fruiting branches (17.25 and 17.05; 17.25 and 17.20) in 2012 and 2013 seasons, respectively, while the shortest plants (141.10 and 138.85 cm) with the lower number of fruiting branches (13.08 and 13.20) produced due to Pattern 9 in the first and second seasons, respectively. The tallest internodes (6.73, 6.71, 6.77, 6.73 and 6.72; 6.65, 6.52 and 6.57 cm) were obtained from Patterns 6, 7, 8, 10 and 12 in the first season and from Patterns 7, 8 and 12 in the second season, respectively. The high values of internodes per plant 24.28, 24.25, 24.23 and 24.15; 24.23, 24.33, 24.15 and 24.15 were obtained from Patterns 2, 4, 8 and 6 in the first and second seasons, respectively. However, the lowest values of internodes per plant (22.05 and 22.18) produced from Patterns 9 and 7 in the first and second seasons, respectively.

In respect of the mineral NPK effect on plant height (cm) at harvest, Table 8 shows significant effect on plant height at harvest in both seasons, in favor of Pattern 2 (high mineral NPK fertilizers rate in combination with chemical control) and Pattern 4 (high mineral NPK fertilizers rate in combination with bio- control), where these two Patterns produced the tallest plants(156.15 and 155.6; 153.13 and 153.23cm) with the highest number of fruiting branches (16.83 and16.85; 17.03 and 17.15) and highest internodes number per plant(24.28 and 24.25; 24.23 and 24.33) as compared with Pattern 1 (low mineral NPK fertilizers rate in combination with chemical control) and Pattern 3(low mineral NPK fertilizers rate in combination with bio-control), where the two latter Patterns gave shorter plants (149.20 and 148.63; 145.25 and 145.15 cm) with the lowest number of fruiting branches(14.15 and 14.18; 14.90 and 14.95) and lower number of intrenodes (22.68 and 22.65; 23.08 and 23.10) in the first and second seasons, respectively.

Table (8): Effect of the patterns under study on plant height at harvest (cm), number of internodes/plant, internode length (cm) and number of fruiting branches/plant in 2012 and 2013 seasons.

Treatments	Plant height at harvest(cm)		Number of internodes / plant		Internode length (cm)		Number of fruiting branches/plant	
	2012	2013	2012	2013	2012	2013	2012	2013
Pattern 1	149.20	145.25	22.68	23.08	6.58	6.30	14.15	14.90
Pattern 2	156.15	153.13	24.28	24.23	6.43	6.32	16.83	17.03
Pattern 3	148.63	145.15	22.65	23.10	6.55	6.29	14.18	14.95
Pattern 4	155.60	153.23	24.25	24.33	6.42	6.30	16.85	17.15
Pattern 5	146.15	143.90	22.23	22.33	6.58	6.44	13.58	13.95
Pattern 6	162.55	154.38	24.15	24.15	6.73	6.39	17.05	17.20
Pattern 7	150.20	147.30	22.40	22.18	6.71	6.65	13.95	14.15
Pattern 8	163.85	157.45	24.23	24.15	6.77	6.52	17.25	17.25
Pattern 9	141.10	138.85	22.05	22.23	6.40	6.25	13.08	13.20
Pattern 10	149.23	145.13	22.20	22.40	6.73	6.48	13.98	14.30
Pattern 11	146.28	143.98	22.85	22.55	6.40	6.39	14.00	14.13
Pattern 12	149.30	147.25	22.23	22.43	6.72	6.57	14.08	14.35
LSD at 0.05	1.73	1.22	0.52	0.59	0.17	0.18	0.46	0.50
LSD at 0.01	2.33	1.64	0.69	0.80	0.23	0.24	0.62	0.67

Insignificant differences in growth attributes were found when using the high mineral NPK fertilizers rate either with chemical control (Pattern 2) or bio-control (Pattern 4) or using the recommended rate either with chemical control (Pattern 1) or bio-control (Pattern 3) which indicate that biological control was effective.

DISCUSSION

Effect of the tested Patterns on growth attributes:-

The positive response of LA and LAI due to Patterns 2 and 4 as compared to Patterns 1 and 3 are mainly attributed to the followings:-

1-Plants with high nitrogen contents had higher levels of endogenous auxins and gibberellins activity, which encourages cell division and elongation as well as initiate meristematic activity, increases leaves number, produce a sufficient assimilation area for maximum photosynthesis, thereby enhancing plant growth (Mengel and Kirkby, 1987).

2- Phosphorus a constituent of cell nucleus is also essential for cell division and development of meristematic tissue, and hence it would have a stimulating effect on increasing the leaf area.

3- Potassium deficiencies can limit the accumulation of crop biomass. This is attributed to (i) a reduction in the partitioning of assimilate to the formation of leaf area or (ii) a decrease of the efficiency with which the intercepted radiation is used for the production of above- ground biomass (Colomb *et al*, 1995).

The increase in LAI due to Patterns 8, 6, 2 and 4 is attributed to the increase in the number of leaves per plant and the average area of leaf. This result may be due to that nitrogen is of extreme importance in plants, where it is a main constituent of protoplasm, nucleic and amino acids, chlorophyll, protein as well as other important substances. Furthermore, plants with high nitrogen contents had higher levels of endogenous auxins and gibberellins activity, which encourages cell division and elongation as well as initiate meristematic activity, increases leaves number, produce a sufficient assimilation area for maximum photosynthesis, thereby enhancing plant growth (Mengel and Kirkby, 1987). In this concern, El–Shazly (2011) found that LA/plant increased with increasing rates of nitrogen and Seadh *et al.* (2012) found that leaf area index was significantly increased by increasing NPK rate.

The high organic NPK rate significantly increased leaf area index. This finding may be due to that pigeon refuse plus phosphate and potassium sources had higher macro and micro nutrients in addition to N which is essential for building up protoplasm and protein as well as induce cell division, which resulted in an increase in cell number and cell size with an overall increase in leaf area. Tewolde *et al.* (2008) reported that fertilization with litter resulted in greater leaf area index.

The positive respone of patterns 2, 4, 6 and 8 on net assimilation rate and total dry weight per plant is mainly dependent on the presence of sufficient leaf area (source) to provide enough photosynthate, and adequate supplies of water and mineral nutrition, where the total dry matter of cotton depends on the size of leaf canopy, the rate at which the leaf functions (efficiency) and the length of time the canopy persists (duration). The production of assimilates by the leaves (source) and the extent to which they can be accumulated in the sink representing the organs that are harvested significantly influences cotton yield.

The positive respone of patterns 2 and 4 as compared with patterns 1 and 3 on net assimilation rate and total dry weight per plant confirms the followings:

1-Nitrogen is a major part of the chlorophyll molecule, which resulted in more photosynthates production and consequently increased dry matter accumulation (Hearn, 1981).

2- Phosphorus decomposes carbohydrate produced in photosynthesis. In photosynthesis and respiration, P plays a major role in energy storage and transfer as ADP, ATP, DPN and TPN. Also, P is a part of the RNA and DNA structures, which are the major components of genetic information of the cell nucleus. Cells can't divide unless there is adequate phosphorus to form the new nuclei. Phosphorus is involved in phosphoglecric compounds and phosphoglycric acid which plays an important role in CO_2 conversion to sugar. Phosphorus works on organizing pH in plant cells because a large portion of it found as ions which works on keeping the hydrogen ion concentration at a level which makes the cell more active in (Uchida, 2000).

3- In photosynthesis, K has the role of maintaining the balance of electrical charges at the site of ATP production. Also, K promotes the translocation of photosynthates (sugars) for plant growth or storage in fruits or roots (Hearn, 1981).

In this concern, Seadh *et al.* (2012) found that NAR and total dry weight/plant were significantly increased by increasing NPK rate. Similar results were obtained by, Suresh and Chellamuthu (2006), Bhalerao *et al.* (2008), Saleem *et al.* (2008), Tayade and Dhoble (2009), Kumar *et al.* (2011) and Halepyati *et al.* (2012).

The increase in net assimilation rate and total dry weight per plant obtained due to organic manures might be due to the physical improvement of applying organic manures to the soil, which were soil aggregation buffering against high pH, slow and balanced soil mineralization, favorable water transmission potentials, resistance to erosion, increasing water holding capacity and soil aeration and soil biological properties and hence increases in nutrients availability and uptake (Mehasen *et al*., 2012). In addition, the constituents of pigeon refuse, phosphate ore, potassium ore and mixed minerals ore from macro and micro nutrients as shown in Tables (2 and 3) and subsequently reflected in these nutrients uptake by plants, where:-

1-Plants grown under high intensity light with a high N supply had greater tolerance to photo – oxidative damage and higher photosynthesis capacity than those grown under similar high light with a low N supply (Cakmak, 2005).

2- Phosphorus deficiency tends to limit the growth of cotton plants, especially when plants are deprived of phosphorus at early stages than later stages of growth (Hearn, 1981).

3- Potassium is involved in protein synthesis (Uchida, 2000), Furthermore, K has an important role in the translocation of photosynthates from sources to sinks (Cakmak *et al*., 1994), and consequently increase plant growth.

4-Magnesium is a vital component for the installation of the chlorophyll molecule and is 2.5% of it, where it is the central molecule in chlorophyll and it is therefore actively involved in photosynthesis.

5- Calcium eficiency affected translocation of carbohydrates, causing accumulation in stems and Roots (Hearn, 1981).

6-Chlorine is essential in photosynthesis, where it is involved in the evolution of oxygen. Chlorine increases cell osmotic pressure and the water content of plant tissues (Uchida, 2000). Chlorine is required by the plants for leaf turgor.

7- Iron is essential in the synthesis and maintenance of chlorophyll in plants and Fe has been, strongly, associated with protein metabolism (Uchida, 2000).

8- Zinc could have a favorable effect on photosynthetic activity of leaves (Ohki, 1976) which improves mobilization of photosynthesis coincidence that increase total chlorophyll (a and b) and directly influences total dry weight.

9- Manganese is involved in the oxidation–reduction process in photosynthesis (Uchida, 2000), it is necessary in photosystem II, where it participates in photolysis. Mn is necessary for splitting water molecule during photosynthesis process (Hill's reaction).

10-The presence of sufficient leaf area (source) to provide enough photosynthate, and adequate supplies of the essential elements (in organic sources) nutrition.

11- Copper is required for the photosynthetic generation of reducing power necessary for CO_2 fixation, an inadequate copper supply will reduce carbohydrate levels and vegetative growth. (Yruela, 2005).

12- constituents of NPK sources (Tables 2 and 3), where they contain higher macro and micro nutrients and subsequently reflected in these nutrients uptake by plants, where they are considered an essential elements for plant growth and have functional roles in enzymatic activation, cation transport across membrane, turgid regulation and energy metabolism. So, it may suggest that the superiority in plant growth was depended on the summation of the role of each element involved.

13-The presence of sufficient leaf area (source) to provide enough photosynthate, and adequate supplies of water and mineral nutrition.

In this concern, Saleem *et al.* (2008) found that increasing rate of integrated plant nutrition levels significantly enhanced total dry matter production (TDM) over control and lower rates of integrated plant nutrition. Raut *et al*. (2009) studied the performance of cotton under organic manuring. Application of 4 t vermicompost ha^{-1}+PSB+*Azotobacter* as soil application recorded maximum growth.

Insignificant differences in growth attributes were found when using the high mineral NPK fertilizers rate either with chemical control (Pattern 2) or bio-control (Pattern 4) or using the recommended rate either with chemical control (Pattern 1) or bio-control (Pattern 3) which indicate that biological control was effective.

Growth traits:-

The significant differences in plant height at harvest due to the different tested patterns is attributed mainly to the differences in number of internodes per plant and/or internode length (cm).

The positive response of patterns 2 and 4 as compared with patterns 1 and 3 on plant height at harvest confirms the followings:

1- Plants with high nitrogen contents had higher levels of endogenous auxins and gibberellins activity, which encourages cell division and elongation as well as initiate meristematic activity, increases leaves number, produce a sufficient assimilation area for maximum photosynthesis, thereby enhancing plant growth (Mengel and Kirkby, 1987),

2- The pronounced improvement due to the application of P, which is a constituent of cell nucleus is also essential for cell division and development of meristematic tissue, and hence it would have a stimulating effect on increasing the plant growth (Russell, 1973). Also, P is required in large quantities in young cells, such as shoots and root tips, where metabolism is high and cell division is rapid (Uchida, 2000).

3- Potassium deficiencies can limit the accumulation of crop biomass. This is attributed to (i) a reduction in the partitioning of assimilate to the formation of leaf area or (ii) a decrease of the efficiency with which the intercepted radiation is used for the production of above- ground biomass (Colomb *et al*., 1995). Because K is needed in photosynthesis and the synthesis of protein, plants lacking K will have slow and stunted growth (Uchida, 2000).

In this concern, Dobermann *et al*. (2005) found that application of 120:60:60 kg NPK ha^{-1} resulted in the tallest plants.Srinivasan (2006) evaluated three fertilizer rates (80: 40: 40, 100: 50: 50 and 120: 60: 60 kg NPK ha^{-1}). The application of 120: 60: 60 kg NPK ha^{-1} resulted in the tallest plants. Reddy *et al.* (2007) found that Bt cotton hybrid Mallika did not respond to the increase in fertilizer levels (recommended rate of NPK at 120:60:60 kg ha^{-1} and at 25 and 50% of the recommended rate) with regard to number of sympodia per plant and Reddy and Gopinath (2008) found that number of sympodia per plant was not significantly influenced due to application of three nutrient levels (recommended dose of NPK fertilizers (RDF; 120:60:60 kg ha^{-1}), 25% more than RDF and 50% more than RDF). Seadh *et al.* (2012) found that plant height and number of fruiting branches/plant were significantly increased by increasing NPK rate.

Respecting the effect of organic NPK manure sources at the two tested rates under bio control on plant height (cm) at harvest, Kumari *et al.* (2005) evaluated the effect of farmyard manure (FYM; 0 or 5 t/ha) along with different combinations of NPK fertilizers on the growth of cotton in deep black cotton soils in India. The cotton cultivar L 604 and the hybrid NCS 145 were selected for the study. Data were recorded for plant height and number of sympodia/plant. Addition of FYM recorded the highest values. Blaise *et al.* (2007) studied the effects of nutrient-management practices on plant growth of Asiatic cotton. Therefore, plant growth and fruiting pattern under four nutrient-management treatments, N, NPK, FYM (10 Mg ha^{-1}), and INM (integrated nutrient management: a combination of NPK and FYM) were quantified during 2000-01 to 2002-03 (years 16 to 18 of a long-term field experiment). Plants of the INM and FYM treatments were taller (68.4-149.5 cm) and had more main stem nodes per plant (30.5-44.5) as compared to N and NPK treatments. In treatment N, the shortest plants (50.9-83.6 cm) and the least number of fruiting structures were produced.

Insignificant differences in growth traits were found when using the high mineral NPK fertilizers rate either with chemical control (Pattern 2) or bio-control (Pattern 4) or using the recommended rate either with chemical control (Pattern 1) or bio-control (Pattern 3) which indicate that biological control was effective.

CONCLUSION

Finally, from the previous results it could be concluded that, it is adivisible to apply Pattern 8(high organic NPK rate, where the source of N was pigeon refuse, the source of P was mixed minerals ore+Phosphorein and the source of K was mixed minerals ore and potassium ore in combination with bio- control) or Pattern 6(high organic NPK rate, where the source of N was pigeon refuse, the source of P was phosphate ore+Phosphorein and the source of K was potassium ore in combination with bio- control) in addition to biological control to obtain the best results in growth and its attributes for cotton variety Giza 86 under the conditions of El-Gemmeiza region.

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دراسات كيموحيوية لانتاج القطن العضوى
٢-تأثير التسميد العضوى والمكافحة الحيوية على النمو ودلائله

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أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالجميزة محافظة الغربية خلال موسمى٢٠١٢، ٢٠١٣م لدراسة امكانية استخدام الزراعة النظيفة لانتاج القطن العضوى وتقليل التلوث البيئى الناتج عن استخدام الأسمدة الكيماوية والمبيدات حيث تم دراسة تأثير ١٢ نظام (النظم ٤،٣،٢،١) تشمل على التوالى معدلين من أسمدة ن، فو، بوالمعدنية (٤٥ كجم ن : ٢٢.٥ كجم فو$_{٢}$أ$_{٥}$: ٢٤ كجم بو$_{٢}$أ) / الفدان، (٦٠ كجم ن : ٣٠ كجم فو$_{٢}$أ$_{٥}$: ٣٦ كجم بو$_{٢}$أ) / الفدان مع المكافحة الكيماوية أو الحيوية،النظم ١٢،١١،١٠،٩،٨،٧،٦،٥ تشمل على التوالي نفس المعدلين باستخدام مصادر عضوية (حيث تم استخدام اضافة النيتروجين في صورة سماد زرق الحمام في النظم ٨،٧،٦،٥ وفى صورة كومبوست نباتى في النظم ١٢،١١،١٠،٩وتم اضافة الفوسفور في صورة خام الفوسفات (٢٠ % فو$_{٢}$أ$_{٥}$) +المخصب الحيوى الفوسفورين،البوتاسيوم في صورة خام البوتاسيوم(٨.٢ % بو$_{٢}$أ) في النظم ١٠،٩،٦،٥ مع المكافحة الحيوية ، بينما في النظم ١٢،١١،٨،٧ كان مصدر الفوسفور هو خام مخلوط المعادن +المخصب الحيوى الفوسفورين ومصدر البوتاسيوم هو خامى مخلوط المعادن والبوتاسيوم) مع المكافحة الحيوية على دلائل النمو(دليل المساحة الورقية- الوزن الجاف الكلى للنبات- معدل نمو المحصول - معدل التمثيل الصافى) ، صفات النمو (طول النبات عند الجنى (سم)- عدد السلاميات/ النبات-- طول السلامية (سم)- عدد الافرع الثمرية / النبات) لصنف القطن المصرى جيزة ٨٦ وكان التصميم المستخدم فى هذه التجربة فى كل من الموسمين هو تصميم القطاعات الكاملة العشوائية فى أربع مكررات.

ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي:

* تأثر دليل المساحة الورقية والوزن الجاف الكلى للنبات عند أعمار النمو الثلاث في الموسمين معنويا بالنظم المختبرة لصالح النظام ٨ (المعدل العالى من أسمدة NPKالعضوية حيث تم اضافة النيتروجين في صورة سماد زرق الحمام ، الفوسفور في صورة خام مخلوط المعادن+المخصب الحيوى الفوسفورين والبوتاسيوم في صورة خامى مخلوط المعادن والبوتاسيوم مع المكافحة الحيوية) والنظام ٦ (المعدل العالى من أسمدة NPK العضوية حيث تم اضافة النيتروجين في صورة سماد زرق الحمام ، الفوسفور في صورة خام الفوسفات +المخصب الحيوى الفوسفورين والبوتاسيوم في صورة خام البوتاسيوم مع المكافحة الحيوية).

*تأثرمعدل نمو المحصول والكفاءة التمثيلية عند مرحلتي النمو الأولى والثانية في الموسمين معنويا بالنظم المختبرة لصالح أستخدام النظامين ٦ و ٨ عند مرحلة النمو الأولى في الموسم الأول وعند مرحلتي النمو الأولى والثانية فى الموسم الثانى بالاضافة الى ذلك أعطى هذان النظامان أطول نباتات تحمل أكبر عدد من الأفرع الثمرية بينما اقصر نباتات تحمل أقل عدد من الأفرع الثمرية نتجت من النظام٩ (المعدل المنخفض من أسمدة NPK العضوية حيث تم اضافة النيتروجين في صورة كومبوست نباتى ، الفوسفور في صورة خام الفوسفات +المخصب الحيوى الفوسفورين والبوتاسيوم في صورة خام البوتاسيوم مع المكافحة الحيوية) في الموسمين.

* أعطى المعدل العالى من أسمدة NPK المعدنية مع المكافحة الكيماوية (النظام ٢) أو مع المكافحة الحيوية (النظام ٤) زيادة معنوية في دليل المساحة الورقية عند ٧٩ يوم من الزراعة فى الموسم الأول وعند عمرى ١٢١,١٠٠يوم من الزراعة في الموسم الثانى, أيضا أعطى هذان التطامان زيادة معنوية فى الوزن الجاف الكلى للنبات عند أعمار النمو الثلاث في الموسمين ومعدل نمو المحصول عند مرحلتي النمو الأولى والثانية فى الموسمين والكفاءة التمثيلية عند مرحلة النمو الثانية فى الموسمين وأطول نباتات تحمل أكبر عدد من الأفرع الثمرية فى الموسمين مقارنة مع المعدل الموصى به سواء مع المكافحة الكيماوية (نظام ١) أو المكافحة الحيوية (نظام ٣).

* لم توجد فروق معنوية فى الصفات موضع الدراسة عند أستخدام المعدل العالى من أسمدة NPK المعدنية سواء مع المكافحة الكيماوية (النظام ٢) أو مع المكافحة الحيوية (النظام ٤) وكذلك عند أستخدام المعدل

الموصى به سواء مع المكافحة الكيماوية (نظام ١) أو المكافحة الحيوية (نظام ٣) مما يشير الى كفاءة المكافحة البيولوجية.

*أدى المعدل العالى من أسمدة NPKالعضوية الى زيادة معنوية في دليل المساحة الورقية والوزن الجاف الكلى للنبات عند أعمار النمو الثلاث في الموسمين و معدل نمو المحصول والكفاءة التمثيلية عند مرحلتي النمو الأولى والثانية فى الموسمين وأطول نباتات تحمل أكبر عدد من الأفرع الثمرية في الموسمين مقارنة مع المعدل المنخفض خاصة عنما يكون مصدر النيتروجين زرق الحمام،ومصدر الفوسفور خام مخلوط المعادن، ومصدر البوتاسيوم خامى مخلوط المعادن والبوتاسيوم (نظام٨) أو عنما يكون مصدر النيتروجين زرق الحمام،ومصدر الفوسفور خام الفوسفات +المخصب الحيوى الفوسفورين و مصدر البوتاسيوم خام البوتاسيوم (نظام٦) .

مما سبق يتضح أن استخدام التسميد العضوى بمعدل (٦٠ كجم ن: ٣٠ كجم فو٢أ٥: ٣٦ كجم بو٢أ) / الفدان حيث تم اضافة النيتروجين في صورة سماد زرق الحمام، الفوسفور في صورة خام مخلوط المعادن+المخصب الحيوى الفوسفورين والبوتاسيوم في صورة خامى مخلوط المعادن والبوتاسيوم مع المكافحة الحيوية (نظام ٨) أعطى أعلى نمو.