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Impact of K-Humate and Yeast Extract Combined with NP Fertilization on Soybean Seed Yield, Quality and Protection against some Pests

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ABSTRACT

Two field experiments were conducted at a special farm, in El Mansoura, Dakahlia Governorate, Egypt, during the two growing summer seasons of 2018 and 2019 to find out the influence of soil drench by potassium Humate (KH) and yeast extract (YE) as foliar application alone or combined (KH+YE) under different rates of N and P fertilization on plant growth, yield, quality and protection against some pests of soybean plants (*Glycine max* L.), c.v. Giza 111. The treatments of NP fertilization rates were arranged in the main plots and the HK and YE were arranged in sub-plots in a split-plot design with three replicates. Results indicated that the application of soil drench KH and YE spraying and (KH+YE) had a positive effect on growth parameters, photosynthetic pigments, seed yield and yield components of the soybean plants. The duel application (KH+YE) showed a significant augmentation in all studied parameters compared to the control under 50, 75 and 100% of the recommended mineral fertilization does (RFD). The whitefly *Bemisia tabaci* Genn. represented the most pest attacking soybeans with a ratio around 56 % followed by *Aphis cracivora* Kock. (30%), While *Tetranychus urticae* Koch. ranged (8-10%) respectively. But mealybug *Phenococcus solani* Ferrisia in % occurrences a ratio around (3-6%) during 2018 and 2019 seasons. In treatment were spray (combined of KH+YE) decreased population of *B. tabaci* Genn. (9.75 nymphs /10 leaves). Therefore, this investigation revealed that the synergistic effect of HK (5 ml l^{-1}) and YE (4 g l^{-1}) in combination treatment with 75% NP is important for improving plant quality and this decreased insect infestation and the environmental pollution caused by repeated application of agricultural chemicals as mineral fertilizers and pesticides.

Keywords: K-Humate (KH) - Yeast extracts (YE) - NP fertilization - Soybean - Seed yield - sucking pests.

INTRODUCTION

Soybean (*Glycine max* L.) is one of the major crops in the world, at the same time soybean seeds are a great source of oil and proteins for human and animal feed (Yin *et al*., 2011). Soybean seeds, besides oil and proteins, contain sugars and phenolics as well. Primary metabolites are essential for growth, development and reproduction, while secondary metabolites such as phenolic are associated with plant defense against pests and survival mechanisms under abiotic and biotic stress (Bellaloui, 2012). Soybean obtains 65 % - 85 % of its needs through the symbiotic nitrogen fixation process (Rao and Reddy, 2010). The soybean area Egypt was 32983 fed. in 2017, with an average yield of 1.377 t fed^{-1} and total production of 45918 t (Agricultural Statistics Bulletin, Economic Affairs Sector, Ministry of Agriculture).

The need for more nutritious foods is driving the development of techniques to boost plant resistance to phytophagous insects. Nutrition refers to the chemicals that organisms need for growth, tissue maintenance, and reproduction, as well as the chemicals that are needed to sustain these functions. It may assess pest resistance or susceptibility. Carbohydrates, fats, amino acids, fatty acids, minerals, and vitamins are among the qualitative dietary requirements of insects. Insects obtain nutrients from plants by feeding. The beneficial effect of potassium predominates in the case of plant hoppers and Coleoptera, while the numbers of signs of depression or relaxation are equivalent in the case of Lepidoptera and mites.

Potassium humate is a kind of highly effective organic potash. Humic acids, such as K-Humate, have been shown to promote plant growth and yield by influencing pathways involved in cell respiration, photosynthesis, protein synthesis, water and nutrient absorption, and enzyme activity (Chen *et al*., 2004). K-Humate causes an increase in crop quality and tolerance of a plant to biotic and abiotic stresses as drought, salinity, diseases and pests (Gadimov *et al*., 2007). Humic acid is beneficial to growth soybean plants, yield components and nutrient uptake (Helmy, 2015). Humic acid assimilates minor and major elements, activates or inhibits enzyme, causes changes in membrane permeability resulting in protein synthesis and activating biomass production which stimulates plant growth (El-Ghamry *et al*., 2009). Potassium provides high resistance against insect–pests. Potassium increase enhance secondary compound formation, metabolism, carbohydrate accumulation, and insect pest damage to plants (Kiran Bala *et al*., 2018).

Yeast is one of the richest sources of high quality protein, namely the essential amino acids like lysine, tryptophan etc., contains the essential minerals and trace elements, namely calcium, cobalt, iron etc. and the best sources of the B-complex vitamins such as B1, B2, B6 and B12. The extract is a valuable source of bio-constituents especially, cytokinins Amer (2004), that works as a readily available growth supplement for plants that eventually improve plant production Ghoname *et al.* (2009). The use of dry yeast as a foliar spray has been found to be effective in several studies was found to increase the growth, yield and quality (Fathy and Farid 2000) on some vegetable crops (Abou El-Yazied and Mady 2012) and on broad bean.

The use of mineral fertilisers is critical for plant growth, development, and yield production.. Nitrogen (N) is an

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important nutrient essential for plant growth and physiological processes, as it enters in all enzyme composition and enhances vegetative growth and yield (Sayed *et al*., 2014). Phosphorus (P) is an essential macro-element and has a vital role in enhancing the process of photosynthesis, protein, phospholipids, and in improving both the growth and yield of legume crops. Moreover, P can enhance leaf area, nucleus the formation, cell division, carbohydrate metabolism, formation of chlorophyll, nodule numbers and mass of legumes and increase their capacity in the biological fixation of atmospheric N (Yadav *et al*., 2013). Legumes need a lot of energy and high amounts of P in the fixation symbiotic process of atmospheric N (Schulze *et al*., 2006). Plant growth parameters (plant height, number of branches and leaves/plant, dry weight of branches and leaves/plant), yield, and its components all improved when nitrogen and phosphorus (NP) fertiliser levels were increased (Mishra *et al.* 2010).

Soybean plants are attacked by many insect pests, among of which are the piercing-sucking insects such as aphids, *A. cracivora* Kock.; leafhoppers, *Empoasca* spp. and whitefly, *B. tabaci* Genn. (Abd-El-Samad *et al.,* 2011; Khattab *et al*., 2012 and Salem, 2016). The whitefly *B. tabaci* Genn. biotype B has become a serious problem for soybean farmers, as it can significantly reduce yield. In an integrated pest management (IPM) programme, using whitefly-resistant soybean cultivars is an important strategy (Vieira *et al.,* 2011).

The biosynthesis or accumulation of proteins, free amino acids, and sugars, which may have attracted insects, increases as nitrogen levels rise. Whitefly, for example, is used to feed on okra. It was discovered that applying only nitrogen or a higher dose of nitrogen increased the aphid population, whereas applying phosphorus and potassium with or without nitrogen reduced the population build-up. Effects of Nitrogen on ArachnidaTwo-spotted spider mite increases on Beans/peaches (Kiran Bala *et. al.* 2018).

The control programs must be developed to control the insect pests of soybean without using insecticides which cause environmental pollution, destruction of beneficial insects and insect resistance too many insecticides. Therefore, breeding lines and cultivars, as resistant plants are much better than the use of chemicals for pest control. From the point of view of the farmers, entomologists and others, the use of resistant cultivars to insect species represents one of the simplest and most convenient methods in insect pest control (Dent,1991).

Therefore, the aim targets of the current investigation are increasing soybean seeds yield, improving seed quality and protection against four pricing-sucking pests (whitefly, *B. tabaci* Genn. (Hemiptera: Aleyrodidae), *A. cracivora* Kock. (Homoptera: Aphididae), *T. urtica* Koch.(Acari: Tetranychidae) and cotton mealybug, *P. solenopsis* Ferrisia, Tinsley (Hemoptera: Pseudococcidae) through the addition of K-Humate (KH) and yeast extract (YE) separately and in combination (KH+YE) under different rates of N and P fertilization as sake of rationalization the use of mineral fertilizers.

MATERIALS AND METHODS

Field Experiments:

The present study was carried out for two summer seasons of 2018 and 2019 at a private farm on a clay soil at middle Nile delta in El Mansoura (Gadila village), Dakahlia Governorate, Egypt, to evaluate the influence of soil drench by potassium Humate (KH) and foliar application by yeast extract (YE) individually or in combination (KH+YE) under different rates of N and P fertilization on plant growth (PG), seed yield (SY), seeds quality (SQ) and protection against some pests of soybean plants.

The experiment was laid out in a split-plot design arranged in a complete randomized block design (CRBD) with three replications. Three NP levels (50, 75, and 100%) of the recommended fertilizers doses (RFD) treatments were randomly arranged in the main plots where the four treatments, i.e. control (without addition), KH, YE and combined application of (KH+YE) treatments were randomly distributed in the sub-plots. The total number of tests was carried out on 36 plots with the same plot area of 10.5 m² (3.5 m length x 3m width). Each plot was contained 6 rows and the distance between the rows was 0.5m. Agronomic practises in general were kept normal and uniformed for all the treatments. Seeds of soybean plants (*Glycine max* L.) C.V. Giza 111 from Food Legumes Research Section, Field Crops Research Institute (FCRI), Agricultural Research Center (ARC), Giza, Egypt, were sown at a rate of 35 kg fed^{-1} on the second week of May for the two successive growing seasons (2018 and 2019) under investigation**.** All treatments (KH), (YE) and composition (KH+YE) were sprayed three times in the vegetative stage, beginning of the flowering and early pod formation growth 30, 45 and 60 days from sowing. Average numbers of four pricing sucking pests on soybeans per 10 leaves with different treatments during two seasons were counted.

Mineral Fertilizers Application Rates:

Mineral fertilizers application, NP 100%, 75% and 50% of the recommended dose of NP application rates (40 kg N fed^{-1}, 23.25 kg P_2O_5 fed^{-1}). Fertilizers were applied as calcium superphosphate (15.5% P_2O_5) during land preparation wearers N fertilizer was splited in two equal doses as ammonium sulphate (20.6% N).

Potassium humate (KH) and Yeast Extract (YE) Characteristics:

Potassium humate (KH) was applied on plant root area was drenched 5 ml l^{-1} at three times during the growth periods of, beginning of flowering, setting and early pod formation growth stages at 30, 45 and 60 days from sowing. At the same time, the leaves of the plants were sprayed with yeast extract 4 g l^{-1} alone or incorporated together.

Yeast extract (YE) was prepared from brewer's yeast (*Saccharomyces cerevisiae*), dissolved in water (4 g l^{-1}) (Abu Khouder *et al.,* 2019). followed by adding sugar at a ratio of 1:1 and kept for 24 hr for reproduction in a warm environment then subjected to two periods of freezing and thawing for yeast cell disruption and releasing their bio-constituents directly before usage (Nassar *et al*., 2011).The elementary composition of K-humate (KH) and Yeast extract (YE) is presented in Tables (1and 2).

Plant Growth Parameters Data:

Vegetative parameters:

Random samples of 5 plants from each plot were taken 70 days after planting. All vegetative growth parameters i.e., plant height (cm), number of branches plant^{-1}, the fresh and dry weight of plant^{-1} (g) were determined, Chlorophyll contents a , b , (a + b) and Carotenoids in fresh leaves (mg g^{-1} FW) was estimated according to the method described by Gavrilenko and Zigalova (2003).

Seeds yield, its components, quality and Chemical constituents:

At harvesting time (120 days after planting), No. of pods plant^{-1}, 100 seed weight (g), seed weight plant^{-1} (g) and seed yield (kg fed^{-1}) were determined. Seed samples were collected then oven-dried at 70 °C and finely ground and wet digested using concentrated sulfuric acid and hydrogen peroxide (H_2O_2) according to FAO method (FAO, 1980). Chemical constituents as N, P and K uptake (kg fed^{-1}) in seeds were determined in wet digested extract used the methods described by Mertens (2005 a and b). Crude Protein content (%) was calculated by multiplying N percentage ×6.25 and the percentage of seed oil content was determined using Soxhlet apparatus according to A.O.A.C. (2000).

Table 1. Chemical analysis of potassium humate (KH) used in the study.

pH	EC, dS m^{-1}	O. M, %	C, %	C/N	Macro elements (%)			Micro elements (mg kg^{-1})			
					N	P	K	Fe	Zn	Mn	Cu
8.50	56.80	21.98	12.75	7.33	1.74	0.27	9.50	105	2.75	1.49	0.40

Table 2. Chemical analysis of bread yeast extract used in the study*.

Macro elements (%)		Vitamins (mg / 100 g DW)		Amino acid (%)	
N	6.88	Vit.B1	23.33	Alanine	1.69
P	0.66	Vit.B2	21.04	Arginine	1.49
K	0.95	Vit.B6	20.67	Lysine	1.13
Mg	0.19	Vit.B12	19.17	Glycine	1.45
S	0.48	Thimain	23.21	Glutamic acid	3.76
Micro elements (mg kg^{-1})		Folic acid	26.22	Others (%)	
		Pyridoxine	22.09		
Fe	107	Biotin	20.04	Carbohydrates	7.2
Zn	77	Insitol	20.43	Crude Protein	2.2
Mn	43	Riboflavin	27.29	Crude Fat	33.21
Cu	5	Nicotinic acid	73.92	Crude Fiber	3.8

*Chemical analysis of bread yeast extract according to (AL-Amery *et al.* 2017).

Entomological studies:

Samples:

After 15 days from sowing data, a weekly random sample of 25 leaflets/plot (one leaf per plant), was placed in a paper bag and transferred to the laboratory. Each plant was carefully examined in the morning from 6-8 O'clock. Total numbers of four piercing-sucking pests; whitefly, number of immature stages, of *B. tabaci* Genn. (nymphs); aphids, *A. cracivora* Kock., *T. urtica* Koch. and cotton mealybug, *P. solenopsis* Ferrisia per sample were recorded and examined by using a Binocular microscope .

Before sowing, a representative soil sample was taken from the experimental site at a depth of 0-30 cm to determine some physical and chemical properties using the methods defined by Page *et al*., (1982) and Klute, (1986), and the results are shown in Table (3).

Table 3. Physical and chemical, properties of the experimental field soil samples during years 2018 and 2019 before planting.

Growing Seasons	$CaCO_3$ (%)	O.M (%)	Particle size distribution (%) Coarse sand	fine sand	Silt	Clay	Texture class
1 st	1.87	2.01	5.03	16.12	45.37	33.48	Clay Loom
2 nd	1.92	2.11	5.16	16.74	41.15	36.95	Clay Loom

Growing Seasons	pH (1 : 2.5) Soil :Water suspension	EC dSm^{-1} (Soil paste Extract)	Available nutrients (mg kg^{-1}) Macro N	P	K	Micro Fe	Mn	Zn
1 st	7.87	2.21	59.6	7.95	432	2.65	1.28	0.93
2 nd	7.83	2.10	58.7	7.39	418	2.58	1.24	0.89

Growing Seasons	Soluble ions in soil paste extract (meq l^{-1}) Cations Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Anions CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
1 st	7.92	5.43	6.47	2.31	0.00	8.32	8.63	5.18
2 nd	6.84	4.60	7.64	1.95	0.00	8.56	7.47	5.00

Statistical analysis

All obtained data were statistically analyzed and significant differences among treatments means were determined at $P \leq 0.05$ by using LSD test and Duncan's Multiple Comparisons Test. According to Gomez and Gomez (1984), the current study's data were statistically analysed using CoSTATE Computer Software.

RESULTS AND DISCUSSION

I- Photosynthetic Pigments and Vegetative Growth

A - Effect of N and P fertilizers level:

Results in Table (4) clearly indicated that all vegetative growth parameters were significantly affected by the application of mineral N and P fertilizers in both growing seasons. Using fertilizers at 100% of the recommended dose gave the highest photosynthetic pigments and vegetative growth characters as compared with applying 75% or 50% of the recommended dose. This result was confirmed during the second growing season. This increment in photosynthetic pigments and vegetative growth of soybean plants by increasing the level of NP-fertilizers from 50% up to 100% may be due to the role of NP on plant growth development i.e. Nitrogen is essential for the synthesis of chlorophyll, enzymes and proteins. Phosphorus is essential for root growth, phosphoproteins, phospho-lipids and ATP, ADP formation. This result is in harmony with those reported by Abdalsalam and Al-Shebani (2010) on local mung bean, Bhangu and Virk (2019), who stated that the photosynthetic pigments and vegetative growth of soybean plants were improved by increasing the levels of nutrient fertilizers application.

B -Effect of KH and YE

Data presented in Table (4) show effect of KH as soil application and YE as foliar spraying on photosynthetic pigments (Chl. a , b , a + b and carotenoids) and vegetative growth characters of soybean during the two assigned seasons of 2018 and 2019. It was evidently clear that most of the applied treatments greatly improved all studied growth characters of soybean plants with various significant degrees compared with those of control in both seasons. In addition, the maximum stimulatory effect existed in plants those treated with 5 ml l^{-1} KH and 4 g l^{-1} YE during the two growing seasons as compared with either individual application or control plants. Yousif *et al.*, (2019) referred that positive significant effect when using humic acid and bread yeast caused increase in photosynthetic pigments and vegetative growth characters it may due to the role of humic acid improving the soil fertility and increasing the availability of nutrient elements and consequently increased plant growth as well as to the ability of yeast to increase the production of stimulants for plant growth, especially Gibberellins, Auxins and Cytokinins which work to improve the plant cell division and its growth. Increase of chlorophylls and carotenoids content may be the effects of humic substances on plant growth, nutrient absorption, and lateral root growth are also referred to as the "auxin-like effect," which is caused by the activation of ATPase activity in the plasma membrane (Zandonadi *et al.,* 2019). AL-Tawaha (2011) and (Abdel- Rahman *et al.,* 2020) concluded that soybean growth parameters were affected by yeast extract spraying because it was the best source of plant promoter hormones that enhance plant growth and being a natural source of phytohormones especially cytokinins that enhance cell division and cell enlargement. Likewise, the significant promotive effect of KH or YE on Photosynthetic pigments and vegetative growth of some legumes was reported by Meganid *et al.,* (2015) on common Bean, El-Shafey *et al.,* (2016) on faba bean, AL-Amery and Mohammed (2017) on snap bean and Faiyad *et al.,* (2019) on cowpea.

Table 4. Mean values of photosynthetic pigments and Some vegetative growth characteristics in soybean as affected by potassium Humate (KH) soil application and foliar spraying of yeast extract (YE) under different rates of N and P fertilization over the two growing seasons of 2018 and 2019.

Treatments*		Photosynthetic Pigments (mg g^{-1} F. W)				plant height	No. of branches	Plant Weight, (g)	
		Chl.(a)	Chl.(b)	Chl.(a+b)	Carotenoids	(cm)	Plant^{-1}	Fresh	Dry
NP fertilizers Levels									
NP 100 % RFD		0.645a	0.502a	1.147a	0.825a	100.4a	9.55a	297.3a	41.02a
NP 75 % RFD		0.601b	0.459b	1.060b	0.778b	94.26b	8.11b	276.3b	38.11b
NP 50 % RFD		0.528c	0.398c	0.926c	0.731c	80.26c	6.15c	211.8c	29.03c
$L.S.D._{0.05}$		0.004	0.005	0.008	0.012	1.98	0.35	5.69	1.66
KH and YE application									
Control		0.527d	0.397d	0.924d	0.692d	80.51d	6.33d	241.2d	33.21d
KH		0.604c	0.463c	1.068c	0.797c	89.01c	7.73c	260.4c	35.88c
YE		0.613b	0.471b	1.084b	0.806b	95.03b	8.41b	270.4b	37.05b
KH+YE		0.622a	0.480a	1.101a	0.816a	102.01a	9.26a	275.1a	38.07a
$L.S.D._{0.05}$		0.004	0.004	0.005	0.004	2.04	0.40	4.19	1.28
Effect of interaction									
	Control	0.541f	0.412g	0.953g	0.711j	90.67d	7.85cd	276.7d	38.31c
NP 100 %	KH	0.670c	0.523c	1.193c	0.853c	97.41c	9.45b	295.6b	40.92ab
RFD	YE	0.679b	0.532b	1.211b	0.863b	103.10b	9.98b	306.8a	42.19a
	KH+YE	0.691a	0.540a	1.231a	0.872a	110.40a	10.90a	310.1a	42.67a
	Control	0.526g	0.397i	0.923i	0.691k	81.33ef	6.52fg	244.5e	33.60d
NP 75 %	KH	0.617e	0.470f	1.087f	0.798f	90.93d	7.85cd	278.4d	38.53c
RFD	YE	0.626d	0.479e	1.105e	0.807e	98.87c	8.53c	288.3c	39.24bc
	KH+YE	0.634d	0.489d	1.123d	0.816d	105.90b	9.55b	293.8bc	41.07ab
	Control	0.513h	0.382j	0.895j	0.673l	69.52g	4.63h	202.4g	27.73f
NP 50 %	KH	0.526g	0.397i	0.923i	0.740i	78.69f	5.90g	207.1g	28.19f
RFD	YE	0.534fg	0.403hi	0.937h	0.749h	83.11e	6.72ef	216.2f	29.72ef
	KH+YE	0.540f	0.410gh	0.950g	0.760g	89.72d	7.34de	221.5f	30.48e
$L.S.D._{0.05}$		0.008	0.007	0.009	0.007	3.54	0.68	7.25	2.21

*** KH= potassium Humate and YE= yeast extract.**

C- Effect of the interaction treatments:

Data in Table (4) showed the impacts of interaction between KH, YE under three levels of N, P on photosynthetic pigments (Chl.a , b , a + b and carotenoid contents) in soybean leaves and growth parameters.We noticed that photosynthetic pigments and growth parameters of soybean plants were significantly increased by KH as a soil drench and YE as foliar spraying during the two seasons under investigation. The combination of soil drench by KH and foliar application by YE with 100% NP gave the highest values of growth parameters during the two growing seasons as compared with either individual application or control plants. With the use of KH and YE, the yield for the 75% NP was higher than 100% NP without treating. The beneficial effect of KH and YE on metabolism and biological activity, as well as their stimulating effect on photosynthetic pigments and enzyme activity, may be responsible for the soybean's increased vegetative development. Zaghloul *et al.*, (2015), Abdel Naby *et al.*, (2016) on Pea Plants and Fouda (2017), obtained similar results on Faba bean.

II-Yield, its components and quality

A - Effect of N and P fertilizers level

Data in Table (5) show the effect of NP fertilizers application on seed yield, its components, quality and nutrient contents. Results clear that seed yield was significantly and gradually increased by increasing the level of mineral fertilizers application from 50%, 75% up to 100% of the recommended dose of NP fertilizers application. Yield components, i.e. No. of pods plant^{-1}, 100 seed weight and seed weight plant^{-1} , as well as protein and oil percentage were significantly increased with increasing the level of NP-fertilizers application. These results were true in both growing seasons. This increment in seed yield and improving quality by increasing the level of N and P application could be ascribed to a significant increase in root activity and photosynthetic rate of soybean plants (Table, 5) which in turn affect on improving seed yield, its components and quality. These results are in harmony with those reported by EL-Bassiouny *et al.,* (2010) and Gai *et al., (*2017). Phosphorus is beneficial to legume growth because it promotes extensive root production and thus ensures a good yield Hefzy *et al.,* (2015). Uptake results showed clear increase due to increase fertilization rate from 50%, 75% and 100% from RFD. The data of N uptake showed 39.2%, 50.3% increase over 50% fertilization treatment of 75 and 100% N fertilization rate. P and K uptake were showed the same trend of data with 40.6%, 74.5 and 34.9%, 51.8% for P and K respectively for 75 and 100% fertilization rate of Phosphorus. These findings were in agreement with Bhangu and Virk (2019), who stated that the photosynthetic pigments and vegetative growth of soybean plants were improved by increasing the levels of nutrient fertilizers application.

B -Effect of KH and YE

Presented data showing the effect of KH and YE on seed yield , its components ,quality and NPK nutrients uptake of soybean plants are presented in (Table 5) during the two growing seasons. The obtained results in both two seasons were significantly increased by KH or YE. Application of KH +YE gave the highest values of soybean yield, its components and quality parameters. The increase in productivity and quality of the KH treatments most probably was due to the increase of availability and nutrients supply in the root zone (Selim *et al.,* 2009). Furthermore, humic acids are an essential source of organic matter, and their effects on yield and its components may be due to their enhancing impact on nutrient uptake, resulting in plant growth stimulation (higher biomass production), and thus on total pod yield and its components (Zhang *et al.,* 2003). Moreover, the role of KH in improving growth Indirect by straightening out soil fertility, which makes nutrients more available and concerning reaching out plant cell walls on the root surface so that plant can take up nutrients (Olaetxea *et al.,* 2018). It is evident that seed oil content as a percentage increased when soybean plants were treated with KH +YE. This may be due to the effect of enhancing the biosynthesis of seed oil of soybean plants. On the other hands, The superiority impact of KH+ YE compared to control may be due to YE application and its contents of proteins ,vitamins and its ability to produce hormones such as (Cytokinins, IAA, GA3) which significantly affect on both plants and symbiotic microorganism (AL-Amery and Mohammed 2017).

Table 5. Mean values of seed yield, their components and quality in soybean as affected by (KH) (YE) under different rates of N and P fertilization over the two growing seasons of 2018 and 2019.

Treatments*		No. of pods plant^{-1}	100 seed weight (g)	Seed weight plant^{-1}	Protein (%)	Oil (%)	Seed yield (kg Fed^{-1})	Seed Nutritive contents, (Kg Fed^{-1})		
								N	P	K
NP fertilizer levels										
NP 100 % RFD		187.25a	19.64a	61.85a	41.11a	20.86a	1670.5a	81.03a	3.70a	27.86a
NP 75 % RFD		170.75b	18.25b	55.82b	39.70b	19.48b	1510.0b	75.04b	2.98b	24.75b
NP 50 % RFD		118.50c	15.17c	47.82c	35.08c	18.63c	1293.5c	53.91c	2.12c	18.35c
L.S.D.$_{0.05}$		3.71	0.14	1.32	0.91	0.36	74.18	2.19	0.18	1.11
KH and YE application										
Control		127.33d	15.87d	46.47d	34.69c	18.66c	1261.0d	54.57d	1.95d	17.80d
KH		152.67c	17.53c	55.05c	40.91a	19.52b	1488.7c	75.26b	3.21b	25.53b
YE		170.33b	18.14b	58.39b	37.52b	19.89b	1575.3b	69.21c	2.84c	23.39c
KH+YE		185.00a	19.20a	60.74a	41.40a	20.55a	1640.3a	80.94a	3.72a	27.90a
L.S.D.$_{0.05}$		6.03	0.09	2.04	0.74	0.44	38.90	1.79	0.18	0.95
Effect of interaction										
NP 100 % RFD	Control	151.00f	17.85f	54.07de	36.94d	19.30ef	1461.0de	63.33e	2.60fg	21.46f
	KH	182.00d	19.62c	60.74c	43.63ab	20.56bc	1639.0c	87.60b	4.01b	29.20bc
	YE	200.00b	20.10b	64.81ab	39.69c	21.18b	1750.0b	79.85c	3.59c	27.89cd
	KH+YE	216.00a	20.98a	67.78a	44.19a	22.38a	1832.0a	93.34a	4.61a	32.88a
NP 75 % RFD	Control	129.00h	16.36g	45.26h	34.38e	18.82f	1230.0h	56.32f	1.92h	17.94h
	KH	166.00e	18.03e	56.15d	42.66b	19.30ef	1518.0d	81.50c	3.28d	27.51d
	YE	189.00cd	18.47d	60.00c	38.44c	19.65de	1619.0c	73.92d	2.93e	23.98e
	KH+YE	199.00bc	20.14b	61.85bc	43.31ab	20.15cd	1673.0c	88.42b	3.77bc	29.58b
NP 50 % RFD	Control	102.00i	13.40j	40.07i	32.75f	17.87g	1092.0i	44.07g	1.34i	14.00i
	KH	110.00i	14.94i	48.26gh	36.44d	18.69f	1309.0g	56.67f	2.35g	19.88fg
	YE	122.00h	15.86h	50.37fg	34.44e	18.83f	1357.0fg	53.85f	2.01h	18.29gh
	KH+YE	140.00g	16.47g	52.59ef	36.69d	19.11ef	1416.0ef	61.05e	2.79ef	21.23f
L.S.D.$_{0.05}$		10.45	0.16	3.53	1.27	0.77	67.38	3.11	0.31	1.65

*** KH= potassium Humate and YE= yeast extract.**

Soybean seeds elemental constituents as N, P, and K uptake were observed in Table 5. Plants that received KH+YE followed by application with KH then YE while the control treatment gave the lowest values of these nutrients contents, N uptake data indicated increase with 26.8, 37.9 and 48.3% over control treatment, P uptake results showed increase with 64.6, 45.6 and 90.8% over control treatment whereas K-uptake data showed 43.4, 31.4 and 56.7% over control treatment for KH, YE and KH+YE application treatments respectively. This trend of results was observed as average of the two growing seasons. The use of HA may contribute to enhancing the level of organic carbon and nitrogen in the soil,. humic acid increases plant production and enables plants to absorb more nutrients. In this respect, these findings were in harmony with those obtained by Mohamed (2005) he pointed out that that active dry yeast as a foliar application had a beneficial effect on chemical constituents of pea plants. According to Stevenson (1994), the application of humic acid through irrigation water can increase soil organic matter, which improves nutrient retention and increases soil microbial activity, which converts nutrients from organic to mineralized form. Yousef *et al.,* (2019) obtained that a significant increase among humic acid (18m L^{-1}) and bread yeasts extract (4g L^{-1}) which gave the highest nutrient content (N, P and K%) compared with an untreated plant that recorded the lowest value of broad bean plant.

C- Effect of the interaction treatments

Data in Table (5) indicated that the effect of interaction between KH and YE under three levels of N and P fertilization treatments on soybean yield, , its components , as well as crude Protein and oil in conjunction with N, P and K contents. The combination between of K-humate and yeast extract with 75 or 100% NP of the recommended rates (RFD) gave the highest significant values in this respect. However, application 50 %NP (RFD) showed the lowest studded parameters recorded data. In this respect, Fouda (2017) found that the foliar application of humic acid with soil addition of 75% from recommended dose P-fertilizers significantly increased all growth, yield parameters and quality as well as N, P and K concentration in leaves and pods for faba bean plants. This might be due to the Humic acid buffered soil pH and increased availability of N, P and K in soil. In addition, Abu Khouder *et al.,* (2019) reported that the combined effect between 100 kg N/ha and 4 g/l foliar application dry yeast extract enhancing vegetative growth characters yield components, total yield , quality and N, P and K concentration of snap bean pod.

III- Entomological results

Data presented in Table (6) showed that no real differences were noticed or recorded for the distribution of four pests attacking soybeans plants during the two seasons (2018-2019) except mealybug *P. solani* Ferrisia.

Generally, whitefly, *B. tabaci* Genn. represented the most pest attacking soybeans with a ratio of around 56 % followed by the *A. cracivora* Kock. (30%), While *T. urticae* Koch. ranged (8-10%) respectively. But occurrence percentage of mealybug *P. solani* Ferrisia as a ratio around (3-6%) during 2018 and 2019 seasons.

Table 6. The total number of collected four pricing sucking pests on soybeans all over the seasons and the occurrence percentages associated with soybeans during two successive seasons in summer 2018 and 2019.

The main sucking pests	2018		2019	
	Total number	Occurrence %	Total number	Occurrence %
B. tabaci Genn.	3747	55.76	3796	55.54
A. cracivora Kock.	2071	30.82	2031	29.71
T. urticae Koch.	694	10.32	598	8.25
P. solani Ferrisia	208	3.10	410	6
Total	6720	100 %	6835	100 %

Table 7. Average numbers of four pricing sucking pests on soybeans per 10 leaves with different treatment (KH, YE and KH+YE) during summer seasons 2018 and 2019.

Treatments*	***B. tabaci* Genn.**		***A. cracivora* Kock.**		***T. urtica* Koch.**		***P. solani* Ferrisia**	
	2018	2019	2018	2019	2018	2019	2018	2019
Control	52.08a ±61.89	51.08a±51.88	13.00a±25.88	12.00a±24.38	9.17 a±6.58	9.11 a±5. 81	7.83 a±15.35	6.13 a±14.35
KH	23.00bc ±21.04	21.00bc±22.15	12.08 a±11.33	11.17 a±10.12	9.50 a±11.26	8.50 a±10.22	1.75 a±3.81	1.45 a±3.21
YE	34.42abc ±26.31	32.12abc±27.20	19.17 a±17.38	16.20 a±15.23	12.92a±13.72	12.90a±12.44	6.42 a±15.96	6.92 a±13.23
KH+YE	9.75 bc ±6.34	10.70 bc±4.34	17.42 a±18.69	16.34 a±18.69	10.00a±7.85	10.22a±8.00	1.92 a±3.27	1.81 a±2.13

*** KH= potassium Humate and YE= yeast extract.**

Table (7) shows that the overall mean of all pest observations revealed that the population of *B. tabaci* Genn. on various treatments ranged between (52.8 aphids /10 leaves) in control to (9.75 aphids/10 leaves) in treatment (combined application of K-humate and yeast extract) the highest recorded of aphid population and 32.12 ±27.20 yeast extrt act found to be significantly superior over all treatments. Treatment (yeast extract) revealed that the highest number of all main pests population, but application of K-Humate indications of depression all pests of observation. Pricing sucking pests feed on the plant's essential nutrients and piercing on the leaves and fruiting stems -they cause the foliage of soybeans to turn yellow. These insects also cause soot-like fungus to grow on the plant, which inhibits photosynthesis Aphids which were one of the most important pests of soybeans preferred to colonize prostrate varieties to erect ones in growth habit (Kiran Bala *et. al.*, 2018). A high density of trichomes is positively correlated with oviposition by *B. tabaci* Genn. on several different host crops, such as cotton soybean (Vieira *et. al.*, 2011). During the growing season of 2015, the cotton mealybug *P. solani* Ferrisia appeared for the first time in a few numbers on soybean, according to El-Sarand (2017). In the 2016 season, the infestation began in small numbers on August 12th and steadily increased before harvest. Nymphs and Adults of cotton mealybug were observed on leaves, buds, stems, and pods, feed on the plant sap producing fewer pods of smaller size.

CONCLUSION

The results suggest that using potassium humate (KH, $5m\ l^{-1}$) and the environmentally safe and costless yeast extract (YE, $4g\ l^{-1}$) to encourage the productivity and quality of soybean plants. The soil application of potassium humate and foliar spraying of yeast extract can minimize the environmental pollution by reducing the use of 25% of chemicals fertilizers (NP), balanced and timely nutrient management practises for soybeans contribute to long-term yield and quality growth, as well as plant health and environmental risk reduction. Balanced nutrition combined with mineral fertilisers can help with integrated pest management by reducing the amount of damage caused by pests and diseases while also reducing the amount of inputs needed to control them. Farmers benefit from balanced fertilisation because it increases income without requiring them to use less inputs. So, we recommend farmers to use a suitable combination of mineral and foliar nutrients in order to reduce insect infestation.

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التأثير المشترك لهيومات البوتاسيوم ومستخلص الخميرة مع التسميد المعدنى النيتروجينى والفوسفاتى على إنتاجية وجودة محصول البذور لفول الصويا والحماية من بعض الآفات الحشرية

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أجريت تجربتان حقليتان خلال فصلي صيف 2018 و 2019 في مزرعة خاصة بقرية جديلة أرضها طينية القوام في المنصورة - محافظة الدقهلية- مصر بهدف دراسة تأثير اضافة هيومات البوتاسيوم (KH) إضافة أرضية بجانب الجذور (5 مل / لتر) و/ أو مستخلص الخميرة (YE) رش ورقي (4 جرام / لتر) تحت معدلات مختلفة من الأسمدة المعدنية النيتروجينية والفوسفاتية تمثل 50 ، 75 و 100% من المعدل السمادى الموصى بها والتداخلات بينهما على صفات النمو ومحتوى الأوراق من الكلوروفيل والمحصول ومكوناته ونسبة البروتين والزيت ومحتوى العناصر وبعض الآفات لصنف جيزة 111. حيث تم توزيع معاملات التسميد النيتروجينى والفوسفاتي فى القطع الرئيسية كما وزعت معاملات هيومات البوتاسيوم و مستخلص الخميرة فى القطع التحت رئيسية حيث تم ترتيب المعاملات في تصميم القطع المنشقة بثلاث مكررات ، حيث تم توزيع ثلاثة مستويات للتسميد النيتروجيني والفوسفاتي (100 و 75 و50 ٪ من المعدلات الموصى بها) بشكل عشوائي في المخططات الرئيسية وأربعة معاملات: التحكم (بدون تطبيقاتControl) ، هيومات البوتاسيوم (KH) ، مستخلص الخميرة (YE) ، والتطبيق المشترك لهيومات البوتاسيوم مع مستخلص الخميرة (KH+YE) تم ترتيبها عشوائيًا في المخططات الفرعية. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى :- أظهرت النتائج أن اضافة هيومات البوتاسيوم أو رش مستخلص الخميرة أدت إلى زيادة معنوية فى صفات النمو الخضري ومحتوى الأوراق من الكلوروفيل والمحصول ومكوناته ونسبة البروتين والزيت ومحتوى العناصر في بذور فول الصويا. أظهرت النتائج تفوق التطبيق المزدوج (هيومات البوناسيوم + مستخلص الخميرة) لجميع الصفات قيد الدراسة.- أظهرت النتائج أن أقل القيم عند إضافة 50% من الأسمدة المعدنية النيتروجينية والفوسفاتية الموصي بها بينما تحققت أعلى القيم عند إضافة100% من المعدل السمادى الموصى به. أظهرت نتائج التفاعل المشترك بين هيومات البوتاسيوم ومستخلص الخميرة مع مستويات التسميد النيتروجيني والفوسفاتي زيادة جميع الصفات المدروسة عند اضافة هيومات البوتاسيوم و/ أو مستخلص الخميرة مع 75% من التسميد النيتروجيني والفوسفاتي الموصى به مقارنة بإضافة 100% بدون اضافة هيومات البوتاسيوم و مستخلص الخميرة. أظهرت نتائج أمتصاص النيتروجين زيادة قدرها 26,8 ، 37,9 و 48,3 % أعلى من معاملة المقارنة ، أما إمتصاص الفوسفور فقد زاد بمقدار 45,6 ، 64,6 و 90,8 % أعلى من معاملة المقارنة بينما كان إمتصاص البوتاسيوم أعلى من معاملة المقارنة بمقدار 31,4 ، 43,4 و 56,7 % متأثرة بمعاملات إضافة هيومات البوتاسيوم و رش مستخلص الخميرة و أخيرا إضافة و رش الخليط منهما على الترتيب. و من ناحية أخرى أثر زيادة معدل التسمسد النيتروجينى و الفوسفاتى من 50% الى 75 و 100% من المعدل الموصى به من المقرر السمادى حيث زاد إمتصاص النيتروجين 39,2% و 50,3% عند التسميد بمعدل 75 ، 100% مقارنة بمعدل 50% ، أما إمتصاص الفوسفور و البوتاسيوم فقد تأثر إيجابياً مع زيادة معدل التسميد بنفس الطريقة حيث بلغ إمتصاص الفوسفور 40,6 و 74,5% أعلى من ال 50% معدل تسميد كذلك لوحظ زيادة إمتصاص البوتاسيوم بنفس الطريقة الى 34,9 و 51,8% عند زيادة معدل التسميد إلى 75و 100% من المعدل الموصى به على الترتيب. كما أظهرت النتائج أن الذبابة البيضاء هي الأكثر مهاجمة لفول الصويا بنسبة 56٪ يليها حشرة المن (30٪) بينما تراوحت نسبة الإصابة بالعنكبوت الأحمر 8-10%. على التوالي ولكن النسبة المئوية للإصابة بالبق الدقيقي في الموسم الأول كانت بأعداد قليلة بواقع 208 حشرة على فول الصويا، ثم ازداد التعداد تدريجياً حتى نهاية الموسم الثاني حيث بلغ عددهم 410 حشرة بنسبة تتراوح (3-6٪) خلال موسمي 2018 و 2019. حيث أظهر المتوسط العام لجميع الآفات في المعاملات التي تم رشها أن تعداد حشرة الذبابة البيضاء تراوحت بين (52.8 حورية / 10 أوراق) في الكنترول الي (9.75 حورية / 10 ورقة) في المعاملة (خلط هيومات البوتاسيوم و الخميرة). وتم تسجيل اكثر عدد من حشرة المن في معاملة رش الخميرة. كما أظهرت معاملة (مستخلص الخميرة) أعلى عدد لكل متوسطات الآفات، ولكن معاملة هيومات البوتاسيوم كانت هي الأفضل في خفض تعداد كل الآفات. ومن ثم يمكننا قول أن إضافة هيومات البوتاسيوم (5 مل / لتر) ورش مستخلص الخميرة (4 جرام / لتر) ثلاث مرات خلال فترة النمو الخضري و بداية التزهير وتكوين القرون (30 و 45 و 60 يومًا من البذر) أدت إلى خفض تعداد الآفات تحت الدراسة وخفض معدل إستخدام السماد المعدنى النيتروجيني والفوسفاتي 25% دون أن يؤدى إلى إنخفاض المحصول أو زيادة التلوث البيئى.