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RESPONSE OF ONION BULB YIELD TO SOME BIO- STIMULANTS

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ABSTRACT

Two field trials were carried out during the two successive winter seasons of 2019/2020 and 2020/2021. The experiments were conducted in a Private Farm at Manshia Radwan District, Abou Kabir Region, Sharkia Governorate, Egypt. Onion cv. Giza 6 Mohassan was selected for this study at sandy loam soil . The aim of this work was to study and evaluate the role of some bio-stimulants on bulb yield of onion.

The experiment was included 10 treatment groups as follows:

1) *Dry yeast extracts (4 g/L),*
2) *Seaweed extracts (2 ml / L),*
3) *Garlic oil extract (2.0 ml /L),*
4) *Bee Pollen (2 g /L),*
5) *Dry yeast extract (2 g/L) + Bee pollen extract (1g L),*
6) *Foliar spray with potassium humate (1.5 ml/L),*
7) *Dry yeast (2 g /L) + seaweed extract (ml/L),*
8) *Garlic oil extract (1 ml/L) + Dry yeast extract (1 g /L) + bee pollen extract (1/2 g /L) + seaweed extract (1/2 ml/L),*
9) *Dry yeast extract (1 g /L) + bee pollen (1/2 g /L) + Seaweed extract (1/2 ml. /L),and*
10) *Control (without any addition).*

A randomized complete block design (RCBD) was used for these treatments (with three replicates).

***Results revealed that** the treatment of garlic + dry yeast + bee pollen + seaweed extract, being the most effective in bulb yield of onion in both growing seasons. This treatment followed by the treatments of dry yeast + bee pollen + seaweed extracts, dry yeast + seaweed extracts, potassium humate and seaweed extracts, respectively.*

***Conclusively,** the treatment of garlic extract + dry yeast + bee pollen + seaweed extracts, followed by the combinations between them, and the treatment of potassium humate increased the onion bulb yield and its components under the same conditions of this study.*

Key words: Natural products - potassium humate – bulb yield of onion

INTRODUCTION:

Onion is one of the most important commercial vegetable crops grown in Egypt. The onion bulbs are rich in minerals like phosphorus, calcium and vitamin C. The pungency in onion is due to volatile oil (allyl- propyl disulphide) (Aykroyd, 1963). Onion is considered as a surface feeder and so requires heavy dosage of nutrients. But the indiscriminate usage of chemical fertilizers has depleted the soil environment resulting in decrease of organic matter content, yield and quality of crops which necessitates to find out organic supplement sources for maintaining the soil fertility and to achieve the sustainable crop production.

Moreover, beside its importance for local consumption great potentiality as export commodity to some European and Arabic markets. Egypt is the seventh largest onion producer on a global level and onion are the third most important product in the country after oranges and potatoes. According to the latest Agricultural Export Council data (2018). Egypt produced 1.75 million tons of the red (1.6 million) and golden (580 thousand) varieties. 476 thousand tons were exported abroad, mainly to the EU, Arab countries, Asian countries and Russia. As for 2018, Egypt is expecting to produce 2 million tons with the objective of exporting 600 thousand tons of them after the new agreements stipulated by the government with China, Australia and South Africa.

Onion (*Allium cepa*, L.) is one of the most important vegetable crops grown in Egypt, as well as it is one of the major exportable vegetable crops. The total cultivated area amounted by 202 thousand fed., which produced 3.115.842 ton (FAO, 2018).

Onion bulbs make an important contribution to human's diet, having vitamins, flavonoids, macro and micro elements.

Seaweeds extracts are considered as bio-fertilizers, many studies in the past three decades have found wide application in modern agriculture for the use of marine macro algae as whole or finely chopped powdered algal manure or aqueous extracts. Liquid extracts of seaweeds have been used as foliar sprays for several crops. Al-Jabouri *et al.,* (2009) reported that the seaweed extract contains growth promoting hormones (IAA and IBA), cytokinins, trace elements (Fe, Cu, Zn, Co, Mo, Mn, Ni), vitamins and amino acids.

Application of K is one of the most important factors that influence the growth and productivity of onion as it plays an important role in translocation of sugars (Awatef *et al.*, 2015).

Many researchers found that potassium increased the productivity of onion (Aisha and Taalab, 2008; Shaheen *et al*., 2009, de Resande and Costa, 2014 and Khalifa *et al*., 2017).

Yeast as a natural source of cytokinins-stimulates, cell division and enlargement, as well as the synthesis and enlargement and as the synthesis of protein, nucleic acid and chlorophyll (Shakr and Fathy, 2002 and Al-babilie, 2018).

Yeast extract is a natural component contains many of the nutrient elements and cytokinins, which is safe and non-pollutant. It has a considerable amounts of amino acids (Rania *et al*., 2011 and Fawzy *et al*., 2012), mineral elements, carbohydrates, reducing sugars, enzymes and vitamins B1, B2, B3, B12 (Aisha *et al.*, 2007, and Abdel-Rahim *et al.*, 2019).

It is used as a kind of biofertilizers in soil fertilization or in foliar application on the shoots of vegetable crops (Shafeek *et al.*, 2015). This is because of its content of many nutrient elements and of being productive compounds of some growth regulator compounds such as auxins, gibberellins and cytokinins (Abdel-Rahim *et al*., 2019).

Bee pollen (BP) is aggregate of flower pollen composed from several plant sources by honeybees by collecting millions of floral pollen grains and mixing it with plant nectar and bee saliva rich in enzymes thus altering its composition and improving its therapeutically potential (Carpes *et al*., 2007). It is a substantial source of proteins (25-30%), lipids, including fatty acids and sterols, rich source of free amino acids; more than 12 vitamins, 28 minerals, 59 trace elements, 11 enzymes or coenzymes, carbohydrates (35-65%), which are chiefly glucose, fructose and sucrose, as well as antibiotic substances, antioxidant substances, carotenoids, polyphenolics such as flavonoids and carbohydrates (Attia *et al.*, 2011). Furthermore, Shafeek *et al.*, (2015) indicated that bee pollen contains a noticeable source of compounds with health protective potential and antioxidant activity, as well as improving growth, yield and bulb quality of onion.

Augusic (1990) stated that garlic bulb is rich in antioxidant phytoch-emicals that include organo sulfur compoundsm, as well as flavonoids such as allixin, which is capable of scavenging free radicals. Moreover, Ide *et al*.(2002) and Shafeek *et al.*, (2015) showed that fructosyl arginine is a potent antioxidant, identified in aged garlic extract which forms and increases during the natural aging process and thus may contribute to the biological activities of processed garlic.

Humic substances play a key role in recycling of nutrients (Paksoy *et al.*, 2010). Humates are used in soil or sprayed on plants (foliar application) mainly because of their very high content of humic acids, ranging from 30 to 60% and can be taken up easily by the roots (Mac Carthy ,2003 and Mahmoud and Hafez, 2010), Combining organic and mineral inputs has been realized as most

economical for maize and soybean crops (Abdel-Razzak and El-Sharkawy, 2013).

Therefore, the present study was planned to evaluate the efficacy of seaweed ,dry yeast , garlic oil and bee pollen extracts and potassium humate (K. humate) applications to improve yield attributes of onion.

MATERIALS AND METHODS:

Two field experiments were carried out during the two successive winter seasons of 2019/2020 and 2020/2021. The experiments were conducted in a Private Farm at Manshia Radwan District, Abou Kabir Region, Sharkia Governorate, Egypt. Onion *cv.* Giza 6 Mohassan was selected for this study. The aim of this work was to study and evaluate the role of some bio stimulants on growth, chemical composition and yield of onion.

To determine the physical and chemical characteristics of the soil, four samples of soil were randomly taken from the experimental soil surface (0-30 cm deep) and mixed thoroughly before analysis. The analysis of the tested soil samples was determined according to the standard methods reported by Jackson (1973), (Table, 1). The selected onion transplants (with average of 8 mm in diameter and 25 mm in length) were planted in November 10th 2019 and November 3rd, 2020 seasons, respectively.

Table (1): The physical and chemical properties of the experimental soil (average two seasons)

Characters	Values
Sand %	49.00
Silt %	28.80
Clay %	22.20
Texture	Sandy loam
pH (at 1: 2.5 W/V)	7.50
EC (dS/m) at 25 °C	1.48
Ca CO^{-}_{3} %	1.90
OM %	1.85
Total Nitrogen (N)	60.00
Total Phosphorus (P)	19.80
Total Potassium	280.6

The experiment was included 10 treatment groups as follows:

1) Dry yeast extracts (4 g/L)., 2) Seaweed extracts (2 ml / L), 3) Garlic oil extract (2 ml /L), 4)Bee Pollen (2 g /L), 4) Dry yeast extract (2 g/L) + Bee pollen extract (1g L), 5), 5) Foliar spray with potassium humate (1.5

ml/L), 6) , 7) Dry yeast (2 g /L) + Seaweed extract (ml /L), 8) Garlic oil extract (1 ml /L) + Dry yeast extract (1 g /L) + Bee pollen extract ($^1/_2$ g /L) + Seaweed extract ($^1/_2$ ml /L), 9) Dry yeast extract (1 g /L) + Bee pollen ($^1/_2$ g /L) + Seaweed extract ($^1/_2$ ml. /L), 10) Control (without any addition).

A randomized complete block design (RCBD) was used with three replications . One plot was used for each replicate and three replicates were used for each treatment. Each plot area was (12.25 m^2) which consisted of 7 rows (3.5 m long and 0.5 m wide). Onion transplants were planted on the two sides of each row at a distance of 7 m apart.

Four sources of extracts were used e.g., garlic, dry yeast, seaweed and bee pollen, foliar spray with potassium humate and distilled water (as control). These treatments were foliar sprayed on onion plants three times; the first time was after two months from transplanting, the second time was three weeks after the first treatment and the third one was after three weeks after the second treatment.

Preparation of the extract's substances solution was as follow:

a) Garlic extracts preparation:

Forty grams of garlic (*cv*. Balady) were grinded and dissolved in 200 cm^3 of distilled water by using a mixer and then, the volume was completed to one liter, and the following volumes of garlic extract were used (Abd El-Mageed *et al.*, 2009).

(b) ***Yeast solution preparation:***

One gram of dry yeast was dissolved in one liter of distilled water resulted in 1000 ppm concentration. Thus, to obtain 750 and 500 ppm concentrations, 750 and 500 mg were each dissolved in one liter of water, respectively. The analysis of dry yeast are presents shown in Table (2)

Table (2): . The chemical analysis of used activity dry yeast

Characters	**Value**
Protein (%)	34.87
Ash (%)	7.55
Glycogen (%)	6.54
Fats (%)	2.09
Cellulose (%)	4.92

(c) ***Seaweed extract:***

The source of seaweed extracts was the commercial product Oligo-x produced by the company of Unions for Agricultural Development in Cairo, Egypt. Seaweeds extract analysis (Table, 3) as Oligo-x.

Table 3: The chemical and biochemical analyses of seaweed compost seaweed extract Characteristics

Items	Value
Moisture %	30.4
pH	6.2
EC (dS/m)	1.5
Total Nitrogen %	2.1
Organic matter %	33
Organic Carbon %	19.12
C/N ratio	01:13
Total amino acid %	0.3
Total Phosphorus %	0.9
Total Potassium %	1.6
Calcium %	0.11
Magnesium %	0.10
Sulphur (%)	1.1
Fe (ppm)	1400
Mn (ppm)	160
Zn (ppm)	90
Cu (ppm)	130
I (ppm)	15
Total auxins (ppm)	125
Cytokinins (Adenine) (ppm)	80

(d) ***Bee pollen:***

Bee-pollen was obtained from the apiary of the Honeybee Research Section, Plant Protection Research Institute, Sakha, Kafrelsheikh, Egypt. Bee-pollen were homogenized to be a fine powder and packed in polyamide-polyethylene bags and stored at -16°C until use. Treatments were prepared by mixing the bee-pollen into the basal diet at the rate of 0% (control), 0.2% (T_1), 0.4% (T_2) or 0.6% (T_3).

(e) ***No. of sprays with humic acid (potassium humate):***

Black granules of potassium humate 85% humate and 15% potassium its origin from Spain were mixed with tap water and sprayed on the growing onion plants at the treatment rate 2 g L^{-1}.

Recorded data:

Bulb yield characteristics:

1- **Bulb diameter (cm)** after 120 days from planting, and also after harvest at these time periods: were recorded as five plants at these timelines were randomly taken, bulb diameter were recorded.

1- Fresh yield (ton/fed) after harvest: was calculated as an average yield per three plots from each treatment, and was calculated per fed as follow:

Fresh yield/treatment (ton/fed) = Average yield of the three-plot x 4200
Area of the plot.

2- Total yield (ton/fed), marketable yield (ton/fed.) and culls bulbs (ton/fed.): harvested fresh plants were left in a shaded place in the field for two weeks until drying, and then the samples were counted and weighed and data of total yield (ton / fed), average bulb weight (g) were recorded. Culls bulbs *i.e*., double, bolter and bulbs with undesired color and size were separated and the rest were considered as marketable yield.

***Statistical analysis*:**

All obtained data were subjected to the statistical analysis of variance and means were compared by the L S D procedure as described by Snedecor and Cochran (1984). The SAS program software (version 14.0) was used to analyze all data shown in these studies (SAS, 2004).

RESULTS AND DISCUSSION

Bulb yield and its components:

Data for the influence of seaweed extract, garlic oil, bee pollen extract, dry yeast extract, and its combined effect on bulb yield and its components of onion, *i.e*. bulb diameter , average bulb weight, total bulb yield/ feddan, marktable bulb yield/ feddan and culls bulb yield/ feddan are presented in Tables (4 and 5).

Regarding the treatment of garlic oil + dry yeast + bee pollen + seaweed extracts, being the most effective in bub yield and its components of onion plants. This treatment is true in both growing seasons and followed by the treatments of dry yeast + bee pollen + seaweed extracts, dry yeast + seaweed extracts and potassium humate, respectively.

In this concern, as the important role of the different chosen extracts and potassium humate, Ide *et al.*, (2002) pointed out that garlic extract is rich in antioxidant phytochemicals which include organ sulfur compounds that are

increased the biological activities and consequently, it increased the bulb yield and its components.

Moreover, Shehata *et al.*, (2012) demonstrated that yeast extract contains many hormones and minerals, like as cytokinins that stimulates cell division and enlargement and activities the biochemical compounds to increased the bulb yield of onion and its components. In addition, Morais et al. (2011) illustrated that bee pollen extract is a substantial source of proteins, lipids, amino acid, vitamins and carbohydrates that activates the biological processes in plant and then increases the bulb yield of onion and its components.

As for the important role of potassium humate, Awatef *et al*. (2015) and Muhammad *et al*.(2018) concluded that potassium (K) is an essential plant macronutrient and plays an important role in many vital physiological processes to plant nutrient and water uptake, nutrient transport, , then increase the bulb yield .

These results are in accordance with those obtained by El-Morsy *et al.* (2011); de Resende and Costa (2014); Hidangmayum and Sharma (2017); Al-babilie (2018) and Dahab *et al*., (2018) who working with garlic extract, seaweed extract, K- fertilizer, and dry yeast extract, respectively.

Conclusively, the treatment of garlic extract + dry yeast + bee pollen + seaweed extracts, followed by the combinations effect between them, and the treatment of potassium humate increased the bulb yield and its components, of onion under the same conditions of this study.

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إستجابة محصول أبصال البصل لبعض المنشطات الحيوية

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جريت تجربتان حقليتان خلال موسمى شتويين ناجحين ٢٠١٩/٢٠٢٠ ، ٢٠٢٠/٢٠٢١. تم إجرائها فى مزرعة خاصة بمنطقة منشية رضوان التابعة لمدينة أبو كبير – محافظة الشرقية – مصر على صنف البصل جيزة ٦ محسن لدراسة وتقييم دور بعض المنتجات الطبيعية على نمو، محتوى كيمائي ومحصول أبصال البصل.

اشتملت التجربة على ١٠ معدلات كما يلي:
مستخلص الخميرة الجافة (٤ جم/لتر) ، مستخلصات أعشاب البحر (٢ مل/لتر)، مستخلص زيت الثوم(٢ ملم/لتر)، حبوب لقاح النحل (٢ جم/لتر)، ٢ جم/لتر مستخلص الخميرة الجافة + ١ جم/لتر حبوب لقاح النحل ، الرش بهيومات البوتاسيوم (١.٥ مل/لتر)، ٢ جم/لتر مستخلص الخميرة الجافة + ١ مل/لتر مستخلص أعشاب البحر/ ١ مل/لتر مستخلص زيت الثوم + ١ جم/ لتر مستخلص الخميرة الجافة + ١/٢ جم/لتر مستخلص حبوب لقاح التحل + ١/٢ ملى/لتر مستخلص أعشاب البحر، ١ جم مستخلص الخميرة الجافة + ١/٢ جم/لتر حبوب لقاح النحل + ١/٢ ملى/لتر مستخلص أعشاب البحر، الكونترول (بدون معاملة).

صممت التجربة بنظام القطع الكاملة العشوائية فى ثلاث مكررات.

أوضحت النتائج أن مستخلصات زيت الثوم + الخميرة الجافة + حبوب لقاح النحل + أعشاب البحر، هى المعاملة الأكثر كفاءة على نمو، محتوى كيمائي، محصول البصل خلال موسمى النمو. هذه المعاملة متبوعة بمعاملات مستخلصات الخميرة + حبوب اللقاح + أعشاب البحر، مستخلصات الخميرة الجافة + أعشاب البحر، هيومات البوتاسيوم، مستخلصات أعشاب البحر على التوالي.

التوصية: ويمكن أن نوصى بأن المعاملة مستخلصات الثوم + الخميرة الجافة + حبوب اللقاح + أعشاب البحر، متبوعة التراكيب الثنائية منها، معاملة هيومات البوتاسيوم قد زودت نمو البصل، المحتوى الكيماوى، محصول الأبصال ومكوناته تحت نفس ظروف التجربة.