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RESEARCH ARTICLE

EFFECT OF BREAD YEAST TREATMENT ON THE GROWTH AND PRODUCTIVITY OF POTATO CROP

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ABSTRACT

Research conducted at the Agricultural Research Center in Idleb Governorate to investigate the effect of the treatment with bread yeast in some growth and productivity characteristics of Agria potato variety. Complete randomized block design was established with 5 replicates. The treatments used were soaking the tubers for plantation with foliar spray, foliar spray only and control without any treatment. The following measurements were recorded in this research: plant height, plant yield, biological yield and block productivity. Results indicate that the treatment of yeast soaking and spraying was significantly higher in all the studied parameters compared to the control. Whereas the treatment of yeast spray only was significantly higher of the control in plant productivity and experimental block yield. While the treatment of yeast soaking and spraying was significantly upper of the treatment of yeast spray only in the productivity per plant.

INTRODUCTION

Potatoes (*Solanum tuberosum* L.) are cultivated for their tubers, which is eaten boiled, grilled, fried or processed. Potato are called second bread because of their high nutritional value. Each 100 g of tubers contains 79.8 g of water, 76 calories, 2.01 g protein, 0.1 g fat, 17.1 g carbohydrate, 0.5 g fiber, 0.9 g ash, 7 mg calcium, 53 mg phosphorus, 0.6 mg iron, 3 mg sodium, 4.7 mg riboflavin, 1,5 mg niacin, 20 mg vitamin C (Watt and Merrill, 1963). Potato protein contains large amounts of free amino acids, with the exception of amino acid histamine. Potato protein and animal protein are equal in proportion of the amino acid lysine. The protein in the potato is only 28-51% of total nitrogen. Overall, the nitrogen content of the potato tubers ranges from 0.11-0.58% and the dissolved protein forms about 30-50% of this quantity, while the insoluble protein content is about 10%, the rest is in the form of amides and formed more than 50% non-protein nitrogen (Homedan and Zedan, 2004). Carotene is significantly higher in yellow potato tubers compared with white pulp tubers, with about 138 mg per 100 g in yellow, and 0.021 mg per 100 g in white (Olabi and Al-Waree, 1997). The percentage of vitamin C in the newly harvested tubers is 26 mg per 100 g, while the rate in the stored tubers is reduced to 20 mg per 100 g (Smith, 1968). It is concentrated in the tubers to the highest level at the beginning of the yellowing of the leaves of the plants and then decreases if the delay of the harvest, and is in two images; reduced (ascorbic acid) and oxidized (Dihydro acid ascorbic), and the last form forms 0-14% of it and does not benefit the body because it is transformed when cooking and is not reduced to ascorbic acid again, therefore it is a loss of part of the tuber content of this vitamin (Cray and Hughes, 1978). Despite the low content of tubers of niacin, it is one of the richest vegetables with this vitamin. Potato tubers contain most of the elements lacking in milk, such as iron, copper, manganese, iodine, and are a good source of potassium, phosphorus and iron but are poor in calcium. Potato tubers also contain a number of organic acids, mainly oxalic, citric, malic, tartaric and others (Ayyubi and Muhammad, 1997). The greenish tubers of potato (exposed to sunlight) contain solanine, which is concentrated directly under the skin or around the eyes, which is conferring unacceptable bitter flavor when it reaches about 20 mg and become toxic tubers unsuitable for use in nutrition at a height of more than 26 mg (Homedan and Zedan, 2004). Potato is used as animal feed and starch is extracted from tubers which is used in the manufacture of paper, food and adhesives. It is also used in the textile industry. Tubers are also used in the fermentation industry to extract alcohols such as ethanol, butanol, and extract organic acids such as citric, lactic and glucose from sugars (Olabi and Al-Waree, 1997). The bread yeast (*Saccharomyces cerevisiae*) is a kind of the used biofertilizers in soil fertilization or in foliar application on the shoots of vegetable crops (El-Ghamriny *et al.,* 1999; Agamy *et al.,* 2013). Yeast extract is a natural component contains many of the nutrient elements, which is safe and non-pollutant. Many studies indicated that yeast is one of the

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richest source of high quality protein, namely the essential amino acids like lysine and tryptophan etc. (Abou zaid, 1984); contains the essential minerals and trace elements, namely calcium, nitrogen, phosphorus, potassium, magnesium, cobalt, iron etc. (Hesham and Mohamed, 2011); carbohydrates, reducing sugars, enzymes and the best sources of the B-complex vitamins such as B1, B2, B6 and B12 (Castel franco and Beale, 1983; Spencer *et al.,* 1983; Somer, 1987; Fathy and Farid, 1996; Khedr and Farid, 2000). Furthermore, yeast extracts contain trehalose-6-phosphate synthase which is a key enzyme for trehalose bio synthesis (Yeo *et al.,* 2000). Additionally, yeast contains many nutrient elements and growth regulator compound like auxins, gibberellins and cytokinins (Ahmed *et al.,* 1994; Glick, 1995; El-Ghamriny *et al.,* 1999). Moreover, yeast is considered as a natural source of cytokinins-stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Kraig and Haber, 1980; Castel franco and Beale, 1983; Spencer et al 1983; Barnett *et al.,* 1990; Fathy and Farid, 1996; Hewedy *et al.,* 1996; Amer, 2004).

The improving of growth, flowering and productivity of some vegetable crops by using foliar application with yeast extract was indicated by Wanas (2002), Amer (2004), El-Tohamy and El-Greadly (2007), Kamal and Ghanem, (2012) and Abou EL-Yazied and Mady (2012), Marzauk *et al.,* (2014) on beans; Hewedy *et al.* (1996), El-Tohamy *et al.* (2008) on eggplant; El-Ghamriny *et al.* (1999), Fathy *et al.* (2000), Wanas (2006), Abou-Aly (2005), Abou EL-Yazied and Mady (2011) on tomatoes; Tartoura (2001), El-Desuki and El-Greadly (2006), Mahmoud *et al.,* (2013) on pea; Taha and Omar (2010), Ahmed *et al.* (2011), Ahmed *et al.,* (2013) on potato plants. El-Bassiony *et al.,* (2014) on kohlrabi. Many investigators reported that spraying plants with yeast extract to the organic fertilization significantly improved plant growth, yield and potato quality (Yeo *et al.,* 2000; Abdel-Mouty *et al.,* 2001; Awad, 2002; Mahmoud, 2004; Gomaa *et al.,* 2005; Ahmed *et al.,* 2013). Therefore, treatments with yeast solution significantly increased plant height, number of tubers, stem and leaves/plant, yield/plant, total chlorophyll, TSS, tuber length, tuber diameter and dry weight of whole potato plant (Hussain and Khalaf, 2008; Sarhan and Abdullah, 2010; Ahmed *et al.,* 2011; Lazim and Ahmed, 2013). Omar (2003) found that the spraying of tomato with the suspension of dry bread yeast at a concentration of 8 g/L had improved most vegetative and floral parameters as well as the characteristics of the yield. As well as, El-Tohamy *et al.,* (2008) found that foliar application of yeast resulted in a significant increment of vegetative growth (including plant height, number of leaves, number of branches and fresh weight of plants) and yield of eggplant compared to control plants. Yeast treatments increased cytokinins content especially at the high level of yeast.

The treatments resulted in a significant increase of N, P and K contents of leaves. Also, Hewedy *et al.* (1996) found that spraying eggplant with the solution of soft bread yeast gave higher yield and marketable fruits than control plants. Furthermore, it has been reported that the leaves content of photosynthesis pigments, carbohydrates and cytokininis, free amino acids, vegetative growth of pea plant, pod yield and quality in addition to nutritive value were increased by increasing the concentration of yeast extract in spraying solution from 1% up to 3% (El-Desuki and El-Gereadly, 2006). Also Mahmoud, et al (2013) found that, yeast extracts improved all the pea tested vegetative growth parameters, green pods yield and pod quality were recorded with using the highest level of yeast extracts (2%). Marzauk *et al.,* (2014) revealed that the highest values of plant growth criteria expressed as plant length, number of leaves and branches as well as fresh and dry weight of leaves, branches and whole plant and the highest values of total pods yield and different organs and the content of nitrogen and protein % in seeds tissues were recorded when sprayed by high level of yeast extract (6 ml/L) with broad bean (*Vicia faba* L.). El-Bassiony *et al.* (2014) showed that the values of dry weight of Kohlrabi plants was increased with foliar spray of bread yeast. Ahmed *et al.* (2016) mentioned that foliar spraying with yeast extract produced the highest significant values from growth and yield parameters and its components of sunflower plant. Rasmussen (1995) points out that the nitrogen is one of the most important factors affecting the growth and development of orchid plant and we can obtain the nitrogen in its organic form from suspension dry bread yeast. Salman and Elaiwi, (2017) indicated that the yeast suspension spraying on squash plant (*Cucurbita pepo* L.) significantly increased of plant length, leaf number, plant dry matter, fruits number and yield at the concentration of 4 g/L compared with control treatment. Therefore, the objective of the present study is to estimate the effect of tuber immersion and foliar spraying with the bio-stimulant (bread yeast) on growth and productivity of potato plant.

MATERIALS AND METHODS

Vegetative material: Potato Agria variety was usedinthis study, from German Company Aggreko. It is a middle of prematurity, spring, autumn and summer plantation, elongated elliptical tuber, yellow pulp, prominent eyes, very dark yellow veneer color approved by the Ministry of Agriculture in Syria for the autumn plantation.

Preparation of the Yeast: Active dry yeast were dissolved in water (50g yeast in 5 liter water) followed by adding sugar at ratio (1 sugar: 1 yeast) for activation and reproduction of yeast. The potato tubers were soaked in this solution for 16 hours before planting. Whereas, the solution used for spraying was prepared as follows: 15 g of yeast was soaked in 1 L of water with the addition of sugar (1 sugar: 1 yeast), and we carried out the foliar spraying in the early morning. The plants were sprayed at a rate of (3) times between each 15 days.

Experimental design: The design of the experiments was established as complete randomized block design with 5 replicates. The following treatments were used: (Soaking the tubers for plantation with foliar spray, foliar spray only, control without any treatment). The parcel was divided into 9 experimental blocks, each block was 100 cm length and 50 cm width (two lines). The distance between the plant and the other within the same line 25 cm.

Measured parameters: The following measurements were taken:

- The plant height (cm) at flowering stage.
- The plant yield (g) after harvest.
- The biological yield per plant (g): taken to the whole plant with its roots and tubers.
- The block yield (g): taken to the tubers weight per block after maturity and harvest.

Statistical analysis: All statistical analyzes of the results were performed by the statistical program (SigmaStat). ANOVA analysis of variance was done to calculate the least significant difference of LSD at the level of significance 5%.

RESULTS

In our study, we treated the potato tubers prepared for cultivation with the bread yeast solution, either by soaking the tubers with the yeast solution, then foliar spraying with the solution or by foliar spraying with the solution only without soaking The results shown in Table (1).

Table 1. The results of treatment with bread yeast

Measured Parameter	Soaking & Spraying	Spraying Only	Control	LSD
Plant height (cm)	38[a]	34.7[ab]	30.7[b]	5.98
Plant yield (g)	608[a]	552[b]	484[c]	25.7
Biological yield per plant (g)	961.04[a]	927.9[ab]	882.8[b]	60.95
Block yield (g)	4776[a]	4846[a]	3630[b]	220.23

* For each parameter, the values carrying the same letter are not significantly different

Plant height: The results showed that treatment with the bread yeast solution achieved significant differences in the height of the plants in the treatment (soaking and spraying potato tubers) and did not achieve differences in the treatment (sprayed potatoes only) where the differences were more and less than the value of LSD successively, compared to the control as shown in Fig. 1.

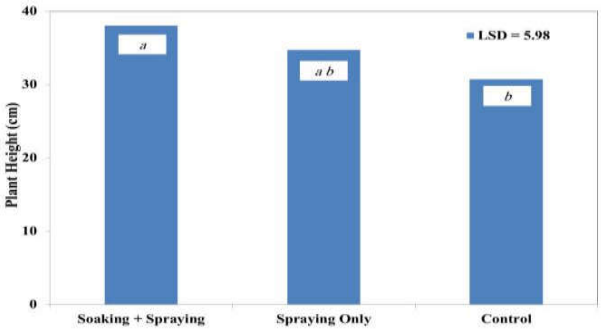

Fig. 1. Effect of yeast treatment on plant height

Plant yield: The results indicated that the treatment with the yeast solution achieved a significant difference in the yield of each plant compared to the control. The treatment was also superior (soaking + spraying), which gave the value of 608 g on the treatment (spraying only) which gave 552 g, while the results of the control was only 484 g. Fig. 2 shows the results obtained.

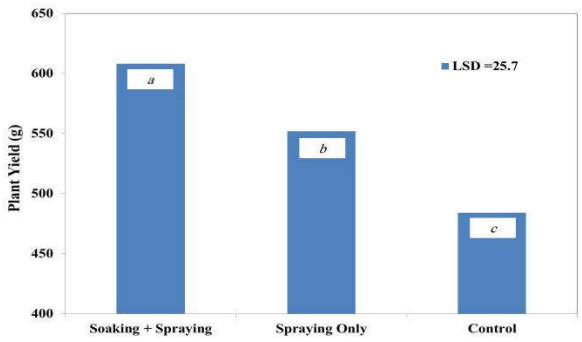

Fig. 2. Effect of yeast treatment in plant yield

Biological yield per plant: Our results revealed that the treatment with yeast suspension realized significant differences in the biological yield of the plant in the treatment (soaking and spraying potatoes) with a value of 961 g/plant and did not realize differences in the treatment (sprayed potatoes only) with a value of 928 g/plant, where the differences were more and less than the value of LSD successively, compared to the control which has a value of 883, as shown in Fig. 3.

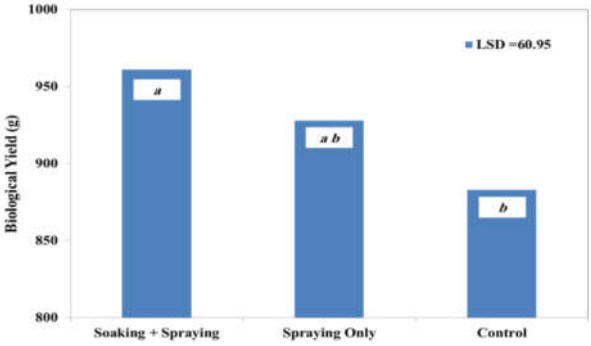

Fig. 3. Effect of yeast treatment on plant biological yield

Block yield: The results revealed that the treatment with the yeast solution achieved a significant difference in the yield per block. The yield of the treatment (potato soaked and sprayed) was 4776 g, which is greater than the result of the control with a difference greater than the value of LSD, therefore, there are significant differences. The yield of the treatment (potato sprayed only) was increased by 4846 g and was greater than the control with a difference greater than the value of LSD, therefore the difference was also significant. Fig. 4 shows the superiority of treatments on the control.

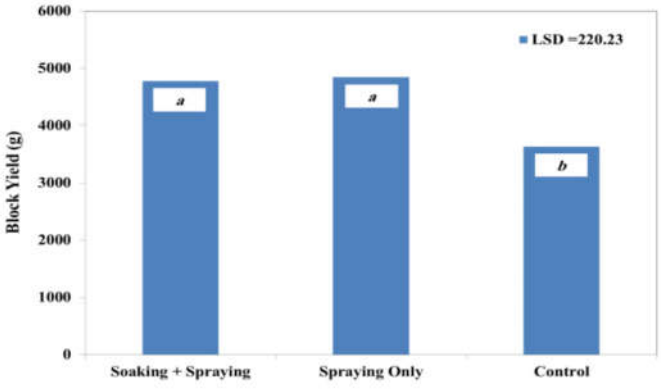

Fig. 4. Effect of yeast treatment in block yield

DISCUSSION

Many studies reported that treatment plants with bread yeast suspension significantly improved plant growth, yield and potato quality in comparison with the control, which are largely consistent with the results we obtained. Whereas, Hussain and Khalaf, (2008) found that spraying yeast solution treatments significantly increased plant height, number of branches/plant, dry matter of vegetative growth, number of tubers/plant, dry matter percentage of tubers, yield/plant, dry matter percentage of tuber, yield/plant and total soluble solid (TSS). All the above mentioned characters were increased with increasing the foliar application of yeast treatments. While, Ahmed *et al.* (2011) demonstrated that increasing of foliar

application of active dry yeast concentrations increased the vegetative growth characters of potato plants in terms of plant length, stem and leaves number/plant, leaf area/plant fresh and dry The positive effects caused by the addition of yeast suspension in improving shoots characteristics might be due to the direct or indirect effect of the yeast throughout its ability in changing the environment of roots, or because the development of the yeast after its analysis into wide groups of amino acids and vitamins. Subba Rao (1984) mentioned that the yeast induce the absorption of nutrient elements by improving the soil pH into acidity. The extract is a valuable source of bio-constituents especially, cytokinins that work as a readily available growth supplement for plants that eventually improve plant production (Ghoname *et al.,* 2009)**.** weight of whole plant. Increasing of the yeast concentrations were gradually increased the productivity of potato plants. Also, tubers quality in terms of specific gravity, starch %, protein % and dry matter % as well as N, P, K and Zn showed positive responses to various yeast concentrations. Likewise, Sarhan and Abdullah, (2010) found that the treatments of yeast suspension caused gradual significant increase suspension caused gradual significant increase in potato plant height, number of aerial stem per plant, leaves area, total chlorophyll and shoots dry matter percentage. Similarly, Lazim and Ahmed (2013) demonstrated the advantages of spray application treatments of dry yeast in vegetative growth characteristics (plant height, number of leaves, shoot dry matter percentage), tuber growth characteristics (tuber length, tuber diameter, tuber dry matter percentage).

Conclusion

Through our research we can conclude the following:

- Treatment with the yeast solution did not achieve significant differences for plant height.
- Treatment with the yeast solution achieved a significant difference in yield of the plant, which gave good results in increasing the productivity of the plant.
- As for the biological yield of the plant, there were no significant differences in treatment with yeast solution.
- The results showed a significant difference in the block yield when treating with yeast solution and gave good results.

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