Effect of Foliar spraying with Yeast Extract and Hydrogen Peroxide on Yield and Quality of Sweet Potato

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ABSTRACT

The present investigation was carried out during the two summer seasons of 2015 and 2016 at sharnoob vilage, Damanhur city, Behera governorate, Egypt, to study the effect of foliar application of yeast extract , hydrogen peroxide (H_2O_2) and combination of them on growth, yield and quality of sweet potato tuberous roots, using two sweet potato cultivars, Abees and Mabrouka. Generally, the results indicated that Abees cv. recorded maximum values of number of shoots/ plant in the second season, plant length in the first season , foliage fresh weigh/ plant, total sugar %, reducing sugar %, carotene %, dry matter % and starch% contents of roots. Results showed also that spraying of yeast extract gave the highest means values for all studied traits of vegetative characters of two cultivars; in both seasons. Moreover, spraying of yeast extract gave the highest significant means values for total yield of roots/plant, weight of marketable roots/plant, number of marketable roots/plant, total sugar %, reducing sugar %, carotene %,dry matter of roots % and starch% contents in roots compared with other treatments in both seasons. The treatment combination of growing Abees cultivar and yeast extract recorded the highest mean values of the most studied characters compared with other treatments.

Keywords: sweet potato, yeast extract, hydrogen peroxide.

INTRODUCTION

Sweet potato(*Ipomoea batatas* L.) is a very popular vegetable crop and is considered an important source of carbohydrates, vitamins A and C, fiber, iron, potassium and protein (Woolf, 1992). There are several sweet potato cultivars in Egypt such as Mabrouka cv., Abess cv. and 17-8 cvs. .ect. It has been cultivated as table food, as well as, recently the new hybrid progenies Kafer- EL Zayat and Beauregard cvs. (The International potato center 2006).

Dry yeast extract is a natural bio- substance suggested having stimulating, nutritional and protective functions when used on vegetables. Used of yeast extract was found to increase growth, yield and quality of many vegetable crops (Abou EL-Nasr *et.al*. 2001). In this regard, yeasts have been suggested to be enriched source of phytohormones (especially cytokinins), vitamins, enzymes, amino acids and minerals (Barnett *et.al*., 1990; Fathy and Farid, 1996; Khedr and Farid, 2002 and Mahmoud, 2001). It was additionally announced about its stimulatory impact on cell division and expansion, protein and nucleic acid synthesis as well as chlorophyll formation (Castel -franco and Beale, 1983). It is a natural bio substance contains many nutrient elements and productive compounds of semi growth regulator compound like auxins, gibberellins and cytokinins . It is use as soil fertilization or as foliar application of vegetable crops (El-Ghamriny *et al*., 1999). Hussain and Khalaf (2007) reported that using yeast extract increased the vegetative growth characters, yield/ plant, tubers dry matter percentage and total soluble solid (TSS). Ahmed *et al*., (2011) shown that expanding of foliar utilization of active dry yeast concentration expanded the vegetative growth characters, productivity and quality of potato tubers.

Romero and Delgado (2009) noted that hydrogen peroxide (H_2O_2) and antioxidants had positive effect in enhancing potato tuber yield and quality. Mousa *et.al*., (2012) showed the presence of significant differences between the various concentration of H_2O_2 on potato dry matter their results showed that spraying the concentration of 40mM H_2O_2 gave the highest percentage of tuber dry matter compared to the other concentrations, followed by spraying concentrations of 60 and 20 m μ, respectively.

Therefore, the present investigation was designed to disclose the influence of active dry yeast extract, H_2O_2 and the combination between them on vegetative growth, yield and quality of two cultivars of sweet potato.

MATERIALS AND METHODS

The present investigation was carried out during the two summer seasons of 2014 and 2015at Sharnoob village, Damanhur city, Behera governorate, Egypt, to study the effect of foliar application of yeast extract and hydrogen peroxide (H_2O_2), as well as combination of them on growth, yield and quality of two sweet potato cultivars; Abess and Mabrouka. Table (1) shows the physical and chemical properties of the soil field.

The cutting were planted on May 29th for both seasons. The plot area was 22.5 m^2 (3 rows, 0.75m in width and 10 m length with spacing of 25 cm between the cutting).

Table 1: Physical and chemical analysis of the experimental site before starting the experiment.

Saturated soil extract	
pH	7.85
EC,ds/m	1.60
$CaCO_3$,%	2.37%
CEC,meq/kg	31.80
Soluble anions(meq/l)	
Ca^{++}	5.45
Mg^{++}	5.16
Na^{+}	10.4
K^{+}	0.22
Soluble anions(meq/l)	
HCO3-	8.46
CL-	1.66
SO4--	11.40
Particle size distribution (%)	
Sand	38.7
Silt	21.8
Clay	39.5
Soil texture	Clay Loam

The experimental layout was a split –plot, in randomized complete blocks design with three replicates. The main plot was sweet potato cultivars. The sub- plots consisted of three treatments; one concentration of hydrogen peroxide (H_2O_2) 60 mμ, one concentration of yeast extract was prepared 8grame from brewer 's yeast (*Saccharomyces cerevisiae*), dissolved in 1litter of water, combination between them (spray yeast extract in the first and follow that spray H_2O_2 respectively), and control (spray with tap water).

Dry yeast extract, H_2O_2 and combination between them were sprayed to the plants at 30 days from planting up to 120 days every 14 days. The spraying was carried out early in the morning.

The chemical analysis of dry yeast extract, was protein (47.2%) arginine (2.6 %), glycine (2.6%), histidine (1.4%), isolysine (2.9%), leucine (3.5 %), carbohydrate, sugars, protein, fatty acids, amino acids, hormones, macro and microelements in suitable balance, Khedr and Farid (2002).

The normal culture practices were carried out according to the recommendation of the ministry of agriculture. The following data were recorded.

Recorded measurements:

1. Vegetative growth characters:

The following growth attributes were measured, 100 days after planting, using ten random plants from each treatment; plant length (cm), number of shoots/plant and foliage fresh weight (gm./plant) as well as foliage dry matter %.

2-Tuberous root yield and its components:

At harvest time, 130 days after planting, samples of ten random plants were harvested from each plot to record the following data;

1-Total yield of roots/plant (gm.)

2-Weight of marketable roots/plant

3-Total number of roots/plant

4-Number of marketable roots/plant

3-Tuberous root quality:

1- Dry matter (%): was determined by weighing a random sample of fresh roots and then dried at 70c°.

$$\text{Dry matter \%} = \frac{\text{dry weight}}{\text{fresh weight}} \times 100$$

2- Carotene percentage (%) of the roots was determined according to methods described by Arnon (1949).

3- Reducing and total sugars % was determined by Dubios *et al.* (1956).

4- Tuber starch (%) was determined according to the method by A.O.A.C. (1970).

Statistical procedures:

Collected data of the experiments were statistically analyzed according to Snedecor and Cochran (1980). Means separation was done using LSD at 5% level of probability

RESULTS AND DISCUSSION

A- Vegetative Growth Characters:

Data presented in Table 2 show that the cultivar Abees surpassed Mabrouka cultivar for all studied traits of vegetative characters except number of shoot/ plant and foliage dry matter in the first season and plant length in the second season. The detected differences on the vegetative growth characters of the two tested cultivars could be related to their genetic features.

The effect of foliar spraying of yeast, H_2O_2 and their combination on the vegetative growth characters of sweet potato plants are presented in table 2.

Table 2: Effect of foliar spraying of yeast extract, H_2O_2 and their combination on vegetative attributes of the two cultivars of sweet potato in2014-2015 and 2015-2016 summer season

Treatment	Number of shoots/ plant			Plant length(cm)			Foliage fresh weight(gm./plant)			Foliage dry matter%		
	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean
2014/2015												
Control	20.3cd	17.7d	19D	193de	183e	188D	2686.7d	2520e	2603.3D	20.7g	22.3f	21.5D
H_2O_2	27.3b	26.3b	26.8B	271.7b	253.6bc	262.7B	3219c	3133.3c	3176.2B	29.7c	28.3d	29B
Yeast extract	32.7a	34a	33.3A	313.4a	307.3a	310A	3666.7a	3383.3b	3525A	35a	32.7b	33.8A
H_2O_2 + Yeast extract	24bc	22.3c	23.2C	234c	210d	222C	2836d	2727.7d	2781.9C	23.3f	25e	24.2C
Mean	26.1A	25.1A		253A	238.5B		3102.1A	2941.1B		27.2A	27.1A	
2015/2016												
Control	20.7ef	18.7f	19.7D	281.7cde	253e	267.3B	2676.7e	2411.3f	2544D	17.7f	17.3f	17.5D
H_2O_2	28.3b	26.3bc	27.3B	340ab	356.7a	348.3A	3249c	3216.7c	3232.8B	26.7c	24.3d	25.5B
Yeast extract	34a	33a	33.5A	322.7abc	328.3ab	325.5A	3700a	3433.3b	3566.7A	33a	29.7b	31.3A
H_2O_2 + Yeast extract	24.7cd	22.7de	23.7C	303.3bcd	263.3de	283.3B	2851d	2762.7de	28.6.8C	20e	21e	20.5C
Mean	26.9A	25.2B		311.9A	300.3A		3119.2A	2956B		24.3A	23.1B	

Values with the same alphabetical letters, within a comparable group of means, do not significantly differ from one another, according to L.S.D test at 0.05 level of probability.

Spraying of yeast extract gave the highest means values for all studied traits of vegetative growth characters of sweet potato cultivars; in both seasons. However there are no significant differences between spraying of H2O2 or yeast extract regarding plant length in the second season.

Regarding the interaction between treatments and cultivars data show that there are a significant differences for all studied traits of vegetative characters in both seasons. The significant effects of dry yeast extract could be due to providing a natural source of cytokinins that motivate cell division and enlargement as well as the formation of protein, nucleic acid and chlorophyll (Castelfranco and Beale, 1983 and Fathy and Farid, 1996.

The improvement of vegetative growth characters in response to the foliar application of active dry yeast extract may be attributed to its content of different nutrients, higher values of proteins ,vitamins especially B which may play an important role in improving growth and controlling the incidence of fungi diseases (Meyer and Phaff, 1969), Sarhan and Abdullah, (2010) found that the positive effects caused by the addition of yeast suspension in improving shoots characteristics might be due to the development of the yeast after its analysis into wide groups of amino acids and vitamins. The obtained results are in accordance with those reported by Gomaa *et al*. (2005) on potato; Hussain and Khalaf, (2007); Likewise, Sarhan and Abdulah, (2010), found that the application of yeast suspension caused gradual significant increase in plant height, number of aerial stem per plant, leaves area, total chlorophyll, and shoots dry matter % of potato. It is known that yeast is considered as a natural source of cytokinins that stimulate cell division and enlargement as well as the synthesis of proteins, nucleic acids and chlorophyll (Fathy and Farid, 1996).

Moussa *et.al.* (2012) reported that there was no significant effect of the concentrations of H2O2 on plant height and number of branches /plant during the two years of study. Reactive oxygen species (ROS) such as superoxide anions (O^{2-}), hydrogen peroxide (H_2O_2), and hydroxyl radicals (OH^-) are long considered as causing oxidative damage to lipids, proteins and nucleic acids, increasing evidence indicates that they also function as signaling molecules in plants, notably acting as regulators of growth and development, programmed cell death (Mittler *et. al*, 2004).

B- Yield:

The results in Table 3 show that root dry matter %, other yield characters i.e. total yield of roots, weight of marketable roots/ plant, total number of roots /plant and number of marketable roots/ plant were insignificant as a results on two cultivars tested.

Concerning spraying of yeast extract gave the highest means values for total yield of root/plant, weight of marketable root/plant and root dry matter % in both seasons. However, total number of root/plant did not significantly affected by any treatment in the first season, but, in the second season, the highest significant mean value was obtained by spraying of yeast extract or H_2O_2 followed by their combination compared with control. The highest significant means values for number of marketable root/plant were obtained by spraying yeast extract or H_2O_2 in both seasons.

Regarding the effects interaction between treatments and cultivars data show that there are significant differences in both seasons. The treatment combination of growing Abees cultivar and yeast extract recorded the highest mean values of the most yield characters. Similar results were recorded by Ahmed *et. al.,* (2011) they support the fact that, the use of dry yeast extract as a foliar spray leads to an increase of plant growth which causes significant increases in tubers weight per plant and total tubers yield of potato plant. Increasing number of tubers could be due to disturbance of plant hormones involved in tuber formation (Fernie and Willnitzer, 2001). On the other hand, Delgado *et.al.*, (2005) showed that mean weight and number of tubers per plant were not found to be significantly differed under the different H_2O_2 concentration. Ghoname *et.al.*, (2010) noticed that foliar application of yeast increased growth, yield and quality of sweet pepper.

c- Roots quality:

Data in Table 4 show that Abees cv. surpassed Mabruoka cv. for all tuber roots quality studied traits in both seasons. There was significant variation in total carotene contents between the two cultivars of sweet potato. This difference may be due to orange color of Abees compared with Mabroka. That is agreed with Mulokozi, (2003) who observed that the amount of total carotenoid contents differed with cultivars and the deeper the orange colour the more the carotenoid content.

Regarding to foliar spraying treatments yeast extract give the highest mean value of starch content, total sugar, reducing sugar and carotene tuber roots content during both seasons. This result agree with Hussain and Khalaf (2007) found that spraying yeast solution treatments significantly increased dry matter percentage of tubers and total soluble sugar (TSS). They add that tubers quality in terms of starch and dry matter showed positive responses to various yeast concentrations. EL-Tohamy *et.al*., (2015) indicated that T.S.S. of sweet potato were significantly improved especially by the high concentration of yeast.

Table 3: Effect of foliar spraying of yeast extract, H_2O_2 and their combination on yield of roots and its components of the two cultivars of sweet potato in 2014-2015 and 2015- 2016 summer season.

Treatment	Total yield of roots/ plant (gm)			Weight of marketable roots/plant (gm)			Total number of roots/plant			Number of marketable rootsplant			Roots dry matter (%)		
	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean
2014/2015															
Control	1136.7d	1150d	1143.3D	1085d	1096.7d	1090.8D	4bc	5.3a	4.7A	1.3c	2.3bc	1.9B	19.6f	17.5g	18.6D
H_2O_2	1883.3b	1826.7b	1855B	1850.7b	1793.7b	1822.2B	5ab	5.3a	5.2A	3.3ab	3.3ab	3.3A	30.3c	28.3d	29.3B
Yeast extract	2216.7a	2166.6a	2191.7A	2193.3a	2142a	2167.7A	5.3a	3.7c	4.5A	4a	2.7abc	3.3A	33.7a	32.4b	33.1A
H_2O_2 + Yeast extract	1361c	1243.3cd	1302.2C	1319.3c	1200.3cd	1259.8C	4.3abc	4.7abc	4.5A	2.3bc	2.3bc	2.3AB	22.5e	21.9e	22.2C
Mean	1649.4A	1596.6A		1612.1A	1558.2A		4.7A	4.8A		2.8A	2.7A		26.5A	24.9B	
2015/2016															
Control	1231.7d	1225d	1228.3D	1181.7d	1173.3d	1177.5D	3.3d	4.3cd	3.8C	1.3d	2cd	1.6B	20f	18.7g	19.3D
H_2O_2	1950b	1976.7b	1933.3B	1917.7b	1882.7b	1900.2B	5.3abc	5.7ab	5.5A	3bc	3.6ab	3.3A	31.7b	28.6c	30.1B
Yeast extract	2326.7a	2266.7a	22967A	2302.7a	2241.7a	2272.2A	6.39a	5.7ab	6A	4.7a	2.7bc	3.7A	35.3a	32.7b	34.1A
H_2O_2 + Yeast extract	1436.7c	1350cd	1393.3C	1393.3C	1305.7cd	1349.5C	4.6bc	4.6bc	4.7B	2cd	2.7bc	2.3B	23.5d	22.3e	22.9C
Mean	1736.3A	1689.6A		1698.8A	1650.8A		4.9A	5.1A		2.7A	2.7A		27.6A	25.6B	

Values with the same alphabetical letters, within a comparable group of means, do not significantly differ from one another, according to L.S.D test at 0.05 level of probability.

Table 4: Effect of foliar spraying of yeast extract , H2O2 and their combination on quality of two cultivars of sweet potato roots in 2014-2015 and 2015-2016 summer seasons

Treatment	Total sugar (mg/100 g F.W.)			Reducing sugar (mg/100 g F.W.)			Carotene (mg/100 gF.W.)			Starch (mg/100 gF.W.)		
	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean	Abees	Mabrouka	Mean
2014/2015												
Control	5.83e	5.06f	5.45D	3.1f	2.06h	2.58D	2.5e	2.07f	2.29D	15.53d	15.27d	15.4D
H_2O_2	7.13c	6.83d	6.98B	4.03c	3.8d	3.92B	3.9c	3.83c	3.87B	17.33b	17.13b	17.23B
Yeast extract	8.43a	8.06b	8.25A	5.1a	4.87b	4.99A	4.97a	4.53b	4.75A	18.47a	18.17a	18.32A
H_2O_2 + Yeast extract	5.9c	5.8c	5.85C	3.6c	2.93g	3.27C	3d	2.57c	2.79C	16.27c	16.17c	16.22C
Mean	6.84A	6.46B		3.96A	3.42B		3.60A	3.25B		16.9A	16.6B	
2015/2016												
Control	5.63e	5.03f	5.33D	3.07e	2.03f	2.55D	2.5f	2.17g	2.34D	15.1 e	15.17e	15.14 D
H_2O_2	7.1b	6.7c	6.9B	4.13c	3.8cd	3.97B	3.97c	3.87c	3.92B	17.2c	17.07c	17.14B
Yeast extract	8.33a	8.16a	8.25A	5.23a	4.6b	4.92A	5.03a	4.77b	4.9A	18.56a	18.1b	18.33A
H_2O_2 + Yeast extract	5.93d	5.83de	5.88C	3.7cd	2.9e	3.3C	3.03d	2.83e	2.93C	16.07d	16.07d	16.07C
Mean	6.75A	6.43B		4.03A	3.33B		3.63A	3.41B		16.73A	16.6B	

Values with the same alphabetical letters, within a comparable group of means, do not significantly differ from one another, according to L.S.D test at 0.05 level of probability.

On the other hand, Delgado *et. Al.*, (2005) clearly appeared that there was significance increasing of tuber starch percentages ranged from 6.7 to 30 as a result of spraying potato plants twice weekly with 5 or 50 Mm.H_2O_2. Mousa *et.al.*, (2012) found that there were no significant differences between different concentrations (0, 20, 40, 60 mM) of H2O2on the status of total sugars during the two seasons. Also there was no significant effect of the concentrations of H2O2 on the status of reducing sugars content during the first season only.

Regarding the interaction between treatments and cultivars data show that there are significant differences for all tuber roots quality in both seasons. Generally, spraying yeast extract with Abees cv. treatment give a significant effect on tuber root quality i.e. total sugar, reducing sugar, carotene and starch content of roots in both season.

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تأثير الرش بمستخلص الخميرة وفوق أكسيد الهيدروجين على المحصول وصفات الجودة في البطاطا

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محطة بحوث البساتين بالصبحية – الإسكندرية - معهد بحوث البساتين

تم إجراء هذا البحث خلال الموسمين الصيفيين لعامي ٢٠١٥ و ٢٠١٦ في منطقة شرنوب بمدينة دمنهور بمحافظة البحيرة لدراسة تأثير الرش بمستخلص الخميرة النشطة وبيروكسيد الهيدروجين و مزيج بينهما على نمو ومحصول وجودة البطاطا، وذلك باستخدام صنفين من البطاطا، أبيس ومبروكة. ونفذت التجربتان بنظام القطع المنشقة باستخدام تصميم القطاعات العشوائية الكاملة، بثلاث مكررات. القطع الرئيسية كانت صنفى البطاطا. والقطع الثانوية تكونت من أربع معاملات هي: تركيز واحد من بيروكسيد الهيدروجين (H_2O_2) 60 ملى مولار، تركيز واحد من مستخلص الخميرة الجافة النشطة ٨ جم/ لتر، ومزيج من بيروكسيد الهيدروجين + مستخلص الخميرة النشطة والكنترول (الرش بماء الصنبور).

أشارت النتائج إلى أن الصنف أبيس سجل أعلى القيم لكل من عدد الأفرع/ النبات، طول النبات، الوزن الكلي للجذور/ النبات، وزن الجذور القابلة للتسويق/ النبات، محتوى الجذور من السكريات الكلية، السكريات المختزلة، الكاروتين، المادة الجافة والنشا، بينما أعطى الصنف مبروكة أعلى القيم لعدد الجذور/ النبات وعدد الجذور القابلة للتسويق / النبات في كلا الموسمين.

وقد أوضحت الدراسة أن تأثير الرش بمستخلص الخميرة أعطى أعلى قيم لجميع الصفات المدروسة للصفات الخضرية على صنفى البطاطا في كلا الموسمين. كما أعطى رش مستخلص الخميرة أعلى قيم معنوية للمحصول الكلي للجذور /نبات ووزن الجذور القابلة للتسويق وعدد الجذور /نبات ومحتوى الجذور من السكريات الكلية والمختزلة والكاروتين والمادة الجافة للجذور والنشا بالمقارنة بالمعاملات الأخرى في كلا الموسمين.

وبصفه عامه سجل الصنف أبيس والصنف مبروكة مع الرش بمستخلص الخميرة أعلى القيم لكل من عدد الفروع للنبات والمحصول الكلى للجذور بالنسبة للنبات ووزن الجذور الصالحة للتسويق وعدد الجذور الكلية للنبات والمادة الجافة للجذور بالنسبة للمعاملات الأخرى.