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EFFECT OF FOLIAR SPRAY WITH UREA AND DRY YEAST EXTRACT ON HEAD LETTUCE PRODUCTION

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ABSTRACT

The present investigation was carried out during the two successive seasons of 2018/2019 and 2019/2020 at Abo El-Matameer, Behairah Governorate, Egypt to study the effect of seven treatments a foliar application, i.e. control (spray with water only), dry yeast at 2g/L, dry yeast at 4 g/L, urea at 0.5%, urea at 1.0%, urea at 1.5%, and urea at 2% on growth, yield and chemical content of lettuce plants.

The experiment was arranged in a randomized complete blocks design in three replications.

The obtained results are summarized as follows:

Using urea and dry yeast extract levels as a foliar spray on vegetative growth characters, i.e. root length, head length, number of leaves/head, length and width of leaf, diameter of head , fresh and dry weight of head, pigments content ,chemical contents and head yield of lettuce and its components were significantly increased compared to the control treatment. The highest values of these characters of lettuce were recorded by using 1% urea, in both growing seasons. This treatment was followed by the treatments of dry yeast extract at 4 g/L, dry yeast extract at 2 g/L, and urea at 0.5%, respectively.

***Conclusively**: It can be concluded that the treatment of 1% urea gave the best results on all characters of head lettuce.*

Key words: Head lettuce – foliar spray with urea and dry yeast extract

INTRODUCTION:

Head lettuce (*Lactuce sativa* L.) is the world's most used salad crop. It is one the important leafy vegetable crops which are eaten fresh and is a major and extensively grown cool season vegetable best adapted to temperate locations (Rubatzky and Tamaguchi, 1997). It is taken as synonym of salads and contains about 6 – 19% mineral elements on the dry weight basis. It is

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the richest source of calcium among other vegetables and is the second richest source of minerals after spinach.

The milky liquid substance, latex present in lettuce contains Lactucin and lactucopicrin, which helps to regulate nervous system, improves sleepiness, appetite and digestion and reduces high blood pressure, lowers high cholesterol levels, lower inflammation and provides a supply of antioxidants (Sharma, 2005 and Masarirambi *et al*., 2012). It is contains a lot of cellulose, which is highty important and required for human health and it facilitates digestion (Chaudhury, 1967).

Plants, need all nutrients in different ratios for their germination, growth and development stages, and get them from soil, water or air by their roots or leaves. Some of these nutrients require in a large amounts, whereas, others are less quantities. Nutrients such as nitrogen is an important nutrient and contribute to increase yield and plant nutrition (Wang *et al*., 2008). Nitrogen is the most important essential macronutrient for production of leafy vegetables, required by plants in the largest proportion (Broadley *et al*., 2000).

Foliar application is one of the techniques of fertilization. Nutrients can be effectively taken up by plants when they are used as foliar fertilizer. Different studies have been done on foliar application of vegetable crops. The response to foliar application of urea as N source has been reported in lettuce, that increased vegetative growth and yield, as well as decreased No_3 level in leaves (Wojciechowska, 2004 and Yucel *et al*., 2013).

Bio-stimulants are biologically active compounds that enhance metabolism and promote plant development when applied in small quantities. Bio-stimulants contain microelements, hormones, enzymes, proteins, vitamins, amino acids, and other compounds (Edmeades, 2002). It is an environmental friendly method for improving plant development that reduces fertilizer and pesticide consumption and optaining high yield of nutritionally valuable vegetables (Paradikovic *et al*., 2011).

Dry yeast is a natural bio-substance suggested to be useful stimulatory, nutritional and protective functions. Many investigators cleared out that application of dry yeast as foliar spray was found to increase growth, yield and quality of some vegetable crops (Fathy and Farid, 2000, and Abou El. Nasr *et al*., 2001, Mona *et al*., 2005 and Fawzy, 2010 a & b).

This work was carried out to study the effect of urea and dry yeast as foliar spray on growth, yield and chemical content of head lettuce plants.

MATERIALS AND METHODS

The present investigation was carried out during the two successive seasons of 2018/2019 and 2019/2020 at Abo El-Matameer, Behairah Governorate, Egypt to study the effect of seven treatments of foliar application, i.e. control (spray with water only), dry yeast at 2g/L, dry yeast at 4 g/L, urea at 0.5%, 1.0%, 1.5%, and 2% on growth, yield and chemical content of lettuce plants.

Seeds of head lettuce (*Lactuca sativa* L.) cv. Lymar (9283) were drilled in foam trays of 209 holes in a media consisting of peat moss and vermiculate 1:1 trays were wetted and warmed under plastic sheet for three days, then kept under plastic tunel. Normal nursery treatments were followed till seedlings become suitable for transplanting. The time of transplanting took place after one month at 11^{th} and 15^{th} of November in both growing seasons of the experiment, respectively. The seeds of head lettuce was sown in 10 of November in both growing seasons in foam trays .

Plants were sprayed with dry yeast extract and urea 6 weeks after transplanting four times every week intervals. Pest control and other agriculture practices, *i.e.* cultivation irrigation and fertilization with phosphorus (calcium super phosphate,16.6 P2O5, 200 kg / feddan) , and potassium (potassium chloride ,48 % K2 O, 100kg/feddan) were applied wherever it was necessary and as commonly recommended in the commercial head lettuce production. Harvesting time was carried out 81 and 87 days after transplanting in the first and second seasons, respectively. The experiment was arranged in a complete randomized blocks design in three replications.

Data recorded:

Five plants of each plot were randomly chosen at 75 days after transplanting and the following data were recorded:

a) Vegetative growth parameters:

1 .Root length (cm)
2. Head height (cm).
3. Number of leaves.
4. Leaf length (cm).
5. Leaf width (cm).
6. Fresh weight of plant (g)
7. Dry weight of plant (g).

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b) Yield:

1. Diameter of head (cm)
2. Average head weight (g)

c) Pigments content:

1. Chlorophyll a
2. Chlorophyll b
3. Total chlorophyll (a +b)
4. Total carotenoids

d) *Chemical content:*

At harvesting time, three samples of heads were randomly taken at the second season, Nitrate – N content in the fresh head lettuce leaves were determined using the method described by A. O. A. C. (2000).

. Samples of leaves were oven dried at 70°c then fine grounded and wet digested, total nitrogen, phosphorus and potassium concentration in leaves were determined according to the methods described by A. O. A. C. (2000).

Statistical analysis:

The obtained data were subjected to the statistical analysis according to the method of **Snedecor and Cochran (1980)**. The treatments means were compared by used SAS program **(SAS, 2004)**.

RESULTS AND DISCUSSION

Vegetative growth parameters:

Data in Tables (1- 2) show clearly that using urea and dry yeast extract levels as a foliar spray on vegetative growth characters, i.e. root length , head length, number of leaves/ head, length and width of leaf, diameter of head, and fresh and dry weight of plant were increased of these vegetative growth characters of lettuce plants compared with the control treatment. The highest values of vegetative growth characters of head lettuce were recorded by using 1% urea, in both growing seasons. This treatment was followed by the treatments of dry yeast extract at 4 g/L, dry yeast extract at 2 g/L and urea at 0.5%, respectively. There are no differences between urea at 1.5% and 2.0%. On the contrary, the lowest value of all the vegetative growth characters of head lettuce was found in case of the control treatment. These findings were true in both growing seasons.

Regarding the effect of urea as a source of nitrogen where it's a vital role on plants, Edmond *et al.* (1981) illustrated that nitrogen is an indispensable elementary constituent of numerous organic compounds of general importance (amino acids, protein, nucleic acids) and it is needed in the formation of protoplasm and new cells, consequently increased the number of leaves and in chancing the biosynthesis in plant. Moreover, Broadley *et al.* (2000) demonstrated that nitrogen is the most important essential macronutrient for production of leafy vegetables, it required by plants in the largest proportion when applied at the soil while, it was lowest quantities when applied as foliar application.

Respecting the role of dry yeast extract in plants, Ahmed *et al.* (1997) and Abou El. Nasr et al. (2001) stated that the positive effect of applying active dry yeast was attributed to its own content of different nutrients, high percentage of protein, large amounts of vitamin B and natural growth regulators such as cytokinins. In addition, Amer (2004) noticed that yeast extract is a natural bio-substance used as foliar application, it is contain high levels of nutrient elements and existence of stimulative growth regulators compounds like auxins, gibberllins, and cytokinins that stimulates cell division and enlargement, as well as, the synthesis of protein, nucleic acid and chlorophyll.

The obtained results are in accordance with these mentioned by Guvenc *et al.* (2006), Yildirim *et al.* (2007). Younis *et al.* (2008), Wojciechowska and Kowalska (2011), Yucel *et al.* (2013) and Abdel-salam (2018), who working on different organic manure. As well as, Fawzy (2010-a and b), Saleh *et al*. (2010), Shehata *et al*. (2012), Marzauk *et al*. (2014), Farrag *et al* (2016), Fouda and Abd- El hamid (2017) and Alsaady *et al.* (2020), who working on yeast. All researchers concluded that organic manure or dry yeast extract were significantly increased vegetative growth parameters of legumes plants.

Head yield and its components:

Data in Tables (3 and 4) indicated that all treatment of urea and dry yeast extract levels had a significantly effect on head yield of lettuce plants, *i.e*. average weight of head, three head weight(kg) and ten head weight (kg) , as well as , head quality ,*i. e.* leaf length width and head diameter . The treatment of 1% urea appeared superiority in fresh yield of head lettuce and quality, followed by the treatment of dry yeast extract at the level of 4 g/L.

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On the other hand, the lowest values of head yield and quality of head lettuce were recorded as a result from the control treatment.

The increase in fresh weight of head lettuce and its components as a result of urea and dry yeast extract might be attributed to the increase in its vegetative growth and dry matter accumulation (Tables,1 and 2), pigments

Table (1): Effect of foliar spray with urea fertilizer levels and dry yeast extract on vegetative growth of lettuce plant during 2018 /2019 and 2019 / 2020 seasons

Treatments	**Root length (cm)**		**Head height (cm)**		**Number of leaves**	
	2018 season	**2019 season**	**2018 season**	**2019 season**	**2018 season**	**2019 season**
Control	3.1	9.33	13.61	21.66	29.66	23.00
Dry yeast at 2g/L	4.66	13.00	14.00	22.33	27.66	25.33
Dry yeast at 4 g/L	5.00	13.00	14.00	23.33	25.00	26.00
Urea at 0.5%	4.33	11.33	14.00	21.00	23.00	23.00
Urea at 1.0%	5.33	15.33	14.66	24.66	38.00	26.33
Urea at 1.5%	3.66	12.00	14.33	21.33	24.00	24.33
Urea at 2%	3.00	10.00	13.66	21.66	23.66	24.33
LSD (5 %)	**0.43**	**1.23**	**0.28**	**5.08**	**5.67**	**4.68**

Table (2): Effect of foliar spray with urea fertilizer levels and dry yeast extract on fresh and dry weight of lettuce plant during 2018/2019 and 2019/2020 seasons

Treatments	**Plant fresh weight (g)**		**Plant dry weight (g)**	
	2018 season	**2019 season**	**2018 season**	**2019 season**
Control	575.1	686.00	25.41	26.23
Dry yeast at 2g/L	741.5	674.30	25.91	26.93
Dry yeast at 4 g/L	881.7	697.70	34.11	33.33
Urea at 0.5%	847.1	843.70	32.75	33.00
Urea at 1.0%	891.1	899.70	34.15	33.33
Urea at 1.5%	698.9	748.30	28.30	29.33
Urea at 2%	663.2	892.30	28.17	29.00

LSD (5 %)	**5.7**	**8.68**	**0.71**	**0.49**

contents, (Tables 5 and 6), chemical content (Table, 7) and then increased the fresh head yield and its components.

These results are in concurrence with those listed by Guvenc *et al.* (2006), Yildirim *et al.* (2007), Abdel-Salam (2018), and Ghimire *et al.*

Table (3): Effect of foliar spray with urea fertilizer levels and dry yeast extract on head yield of lettuce plant during 2018/2019 and 2019/2020 seasons

Treatments	**Head weight (g)**		**Three head weight (g)**		**Ten head weight (g)**	
	2018 season	**2019 season**	**2018 season**	**2019 season**	**2018 season**	**2019 season**
Control	0.70	0.90	2.10	2.25	7.44	7.50
Dry yeast at 2g/L	0.89	0.85	2.69	2.65	7.76	8.83
Dry yeast at 4 g/L	0.96	0.88	2.89	2.70	8.77	9.00
Urea at 0.5%	0.72	0.83	2.56	2.35	8.41	8.33
Urea at 1.0%	1.12	0.91	3.37	2.75	9.25	9.16
Urea at 1.5%	0.85	0.78	2.18	2.55	8.71	8.50
Urea at 2%	0.70	0.75	2.12	2.50	8.30	7.80
LSD (5 %)	**0.18**	**0.13**	**0.24**	**0.09**	**0.10**	**0.12**

Table (4): Effect of foliar spray with urea fertilizer levels and dry yeast extract on yield quality of lettuce plant during 2018/2019 and 2019/2020 seasons

Treatments	**Leaf length (cm)**		**Leaf width (cm)**		**Head diameter (cm)**	
	2018 season	**2019 season**	**2018 season**	**2019 season**	**2018 season**	**2019 season**
Control	25.66	27.00	24.00	23.00	22.00	25.33
Dry yeast at 2g/L	27.66	28.00	27.66	25.33	24.33	29.00
Dry yeast at 4 g/L	28.33	29.33	29.00	26.00	24.66	30.33
Urea at 0.5%	27.66	29.33	27.33	23.00	24.33	26.33
Urea at 1.0%	29.33	30.66	29.33	26.33	25.66	31.33
Urea at 1.5%	25.66	28.00	27.66	24.33	24.00	26.33
Urea at 2%	27.33	27.66	24.33	24.33	23.33	25.66
LSD (5 %)	**1.61**	**1.33**	**1.02**	**1.08**	**0.12**	**0.17**

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(2019) who working with urea as foliar spray on lettuce plants, as well as, Fawzy (2010a), Farrag *et al.* (2016), and Kanimarani (2020) who working with foliar dry yeast extract on lettuce plants.

They concluded that foliar spray with urea or dry yeast extract significantly increased the productivity of lettuce plants.

Leaves pigments content:

Data in Tables (5-6) indicated that all the studied treatments had different significant effect on leaves pigments content of head lettuce, *i.e* chlorophyll a, chlorophyll b, total chlorophyll (a + b) and carotenoids.

The foliar application of 1% urea and dry yeast extract at the level of 4 g/L, being the most effective treatments on the values of pigments content of head lettuce. These treatments were followed by the treatments of dry yeast extract at 2 g/L, and urea at 0.5% on pigments content. These results are true in both growing seasons.

In this respect, as the important role of urea as a source of nitrogen and dry yeast in leafy vegetables, Ivanova and vassilev (2003) illustrated that the influence of N on plant growth and development, as well as, photothynthetic pigments is often connected with the process of photosynthesis, because the suitable quantity of N in the medium degree (1%), determines the formation and the functional state assimilation apparatus of plants including the content of photosynthetic pigments, the synthesis of the enzymes taking part in the carbon reduction and the formation of the membrane system of chloroplasts. Regarding the important role of dry yeast, Taha *et al.* (2016) concluded that the enhancement effect of yeast extract might be attributed to its influence on metabolism, biological activity, photosynthetic pigments and enzyme activity which in turn encourage vegetative growth and increasing the photosynthetic pigments. Similar trends were also registered by Younis *et al.* (2008), who found that urea as foliar spray on lettuce plants caused an increases in pigments content.

Moreover, El-Sherbeny *et al*. (2007), Saleh *et al*. (2010), Abbas (2013), Fouda *et al*. (2017) and Alsaady *et al*. (2020), who sprayed plants with yeast extracts showed that yeast extract significantly increased the pigments content of plants.

N , P and K contents and accumulation of nitrate:

Data in Table (7) revealed that the studied treatments of urea levels and dry yeast extracts caused a significantly different in chemical contents of head lettuce leaves and the nitrate accumulation. The suitable urea as foliar spray, i.e. 1% recorded a highest values on N, P and K contents of leaves, and medium level of nitrate accumulation, as well as, dry yeast extract at the level of 4 g/L gave the highest values on N, P and K content in head lettuce leaves and suitable level of nitrate with any harmful to human race. These results were followed by dry yeast extract at the rate of 2 g/L, and 0.5% urea, respectively.

Table (5): Effect of foliar spray with urea fertilizer levels and dry yeast extract on pigments content; chlorophyll A and chlorophyll B (mg/g f. w.)

Treatments	**Chlorophyll (A)**		**Chlorophyll (B)**	
	2018 season	**2019 season**	**2018 season**	**2019 season**
Control	0.05	0.19	0.02	0.35
Dry yeast at 2g/L	0.03	0.21	0.04	0.42
Dry yeast at 4 g/L	0.04	0.17	0.04	0.30
Urea at 0.5%	0.03	0.26	0.01	0.35
Urea at 1.0%	0.07	0.25	0.04	0.45
Urea at 1.5%	0.03	0.24	0.03	0.36
Urea at 2%	0.01	0.25	0.03	0.44
LSD (5 %)	**0.01**	**0.02**	**0.01**	**0.03**

Table (6): Effect of foliar spray with urea fertilizer levels and dry yeast extract on total chlorophyll (A+B) and carotenoids

Treatments	**Total Chlorophyll (A+B)**		**Carotenoids (mg/100f.w.)**	
	2018 season	**2019 season**	**2018 season**	**2019 season**
Control	0.10	0.30	0.03	0.25
Dry yeast at 2g/L	0.08	0.35	0.09	0.40
Dry yeast at 4 g/L	0.07	0.42	0.08	0.29
Urea at 0.5%	0.04	0.45	0.08	0.38
Urea at 1.0%	0.11	0.44	0.10	0.45
Urea at 1.5%	0.04	0.36	0.08	0.38
Urea at 2%	0.07	0.35	0.06	0.27
LSD (5 %)	**0.01**	**0.02**	**0.01**	**0.04**

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Respecting the role of urea as a source of nitrogen and dry yeast extract on leafy crops, Yildirim *et al.*(2007) stated that foliar spray with urea to plants during crop growth can improve the mineral status and increase nutrient in different tissues of these plants. Moreover, Taha *et al.* (2016) pointed out that the enhancement effect of yeast extract might be attributed to its influence on acting as a source of plant growth hormones and macro nutrients and vitamins which in turn increasing the chemical content of leaves.

Table (7): Effect of foliar spray with urea fertilizer levels and dry yeast extract on N, P, K and NO_3

Treatments	**Percentages**			
	N	**P**	**K**	**NO_3**
Control	1.52	0.22	1.24	0.045
Dry yeast at 2g/L	2.68	0.23	2.23	0.029
Dry yeast at 4 g/ L	2.82	0.25	2.37	0.027
Urea at 0.5%	1.52	0.24	2.19	0.038
Urea at 1.0%	2.88	0.26	2.41	0.025
Urea at 1.5%	2.63	0.26	2.21	0.040
Urea at 2%	2.24	0.22	1.25	0.038
LSD (5 %)	0.01	0.03	0.02	0.014

The present results resemble with those noticed by Yildirim *et al.* (2007), Wojciechowska and Kowalska (2011), Yucel *et al.* (2013), Abdel-Salam (2018), and Ghimire et al. (2019), who sprayed plants with urea and improved that urea as foliar spray significantly increased the chemical content of plant leaves Moreover, Fawzy (2010 a), Shehata *et al.* (2012), Marzouk *et al.*(2014), Farrag *et al.* (2016), who spraying plant with yeast extract noticed that foliar spray of yeast significantly increased the chemical content of plant leaves.

Conclusively: it can be concluded that the treatment of 1% urea gave the best results on all characters of head lettuce.

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تأثير الرش الورقي باليوريا ومستخلص الخميرة الجافة علي انتاج خس الرؤوس

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أجرى البحث خلال موسمين ناجحين لعامي 2019/2018، 2020/2019 فى قرية البرعصي – مركز أبو المطامير – محافظة البحيرة لدراسة تأثير 7 معاملات وهى الكنترول (الرش بالماء فقط)، الخميرة الجافة بمعدل 2 جرام لكل لتر، وخميرة

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جافة 4 جرام لكل لتر، واليوريا 0.5% ويوريا 1% ويوريا 1.5% ، يوريا 2% على النمو والمحصول والمحتوى الكيماوي فى نبات الخس.

كان تصميم التجربة بنظام القطاعات كاملة العشوائية فى ثلاث مقررات ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

استخدام اليوريا ومستخلص الخميرة الجافة كإضافة ورقية على صفات النمو الخضري وهى طول الرأس وعدد الأوراق بكل رأس وطول الورقة وعرضها وقطر الرأس والوزن الطازج للرأس قد زاد زيادة معنوية بالمقارنة للمعاملات الكنترول تم الحصول على أعلى القيمة للصفات النمو الخضري باستخدام الرش باليوريا بتركيز 1% فى كلا موسمين النمو.

هذه المعاملات متبوعة بها المعاملات مستخلص الخميرة الجافة عند 4 جرام فى اللتر ومستخلص الخميرة الجافة بمعدل 2 جرام فى اللتر ومعدل 0.5% من اليوريا على التوالي المحتوى الصباغي.

أثرت معنوي كل المعاملات المدروسة على محتوى الصبغات لأوراق الخس الرؤس وهى كلوروفيل أ كلوروفيل ب والكلورفيل الكلي (أ + ب) ، الكاروتين وكانت المعاملتين 1% يوريا ومستخلص الخميرة بمعدل 4 جرام فى اللتر هما المعاملات الأكثر فاعلية فى قيمة المحتوى الصبغي.

سببت المعاملات المدروسة من اليوريا ومستخلص الخميرة الجافة اختلافات معنوية فى المحتوى الكيماوي من النتروجين والفسفور والبوتاسيوم وتراكم النترات فى أوراق الخس.

كان الرش الورقي باليوريا بمعدل 1% قد سجل أعلى قيمة فى محتوى النتروجين والفسفور والبوتاسيوم فى الأوراق ومعدل متوسط من تراكم النيترات ، وكذلك مستخلص الخميرة الجافة عند معدل 4 جرام فى اللتر،وقد كان معدل 4 جرام فى اللتر قد أعطى قيمة فى المحتوى الكيماوي ومعدل نترات مناسب بدون أى أضرار للجنس البشري.

جميع المعاملات سببت زيادة معنوية فى محصول الرؤوس وهى متوسطة وزن الرأس ومحصول الرأس للقطعة التجريبية للكيلو جرام ومحصول الرأس / فدان بالطن. تفوقت المعاملة باليوريا بتركيز 1% فى محصول رؤوس الخس ، متبوعة بمستخلص الخميرة الجافة بمعدل 4 جرام لكل لتر . ومن ناحية أخرى سجلت معاملات الكنترول أقل القيمة.

التوصية : يمكن أن نوصي بالرش باليوريا 1 % والخميرة الجافة بمعدل 4 جم / لتر للحصول علي صفات رؤوس جيدة لخس الرؤوس .