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Effect of spraying seaweed extract on the yield of different varieties of potatoes (Solanum tuberosum L.)

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Abstract: The experiment was conducted during the 2017 spring season planting in Baquba nursery of Diyala Agriculture Directorate- Diyala Governorate. The study included three varieties of potatoes (AXENIA, OSIRIS and HERMES), sprayed four concentrations of seaweed extract (APPETIZER) (0, 0.75, 1.50 and 2.25 ml.l^{-1}water), with three sprays. In order to study the effect of the variety and the concentration of seaweed extract in the growth and yield of potatoes. The trial included 12 treatments resulting from the combination of the study factors above mentioned. applied Randomized complete Block Design (R.C.B.D) With three replicates, were statistical analysis using a program (SAS) The averages were compared using the Dunkin multiple rang test at 5% . The results showed that OSIRIS variety gave significantly in the total number of tubers per plant (tuber. Plant-1), tuber yield per plant (kg), Marketable yield of tubers(ton.donum^{-1}), unmarketable yield of tubers(ton.donum^{-1}), Total tuber yield (ton.donum^{-1}), While AXENIA significantly the average wight of tuber marketable(gm.tuber^{-1}). The spray seaweed extract at a concentration of 1.50 ml. l^{-1} was significantly in most of the studied traits, addition to a significant in the treatments of overlap between the study factors.

Keywords: potatoes, varieties, seaweed extrac.

Introduction:

Potato is a tuberous crop belonging to the family of solanaceae, ranks fourth in economic importance after the wheat, rice and yellow maize ((Bowen, 2003). Potato tuber, easy to digest and absorption the body, it is consider an important source of energy for containment of carbohydrates, vitamins, proteins, salts, add to containing 18 amino acids essential for the human body (NAPC, 2005). It is also including sugar reduction, Cholesterol reduction, microorganism resistance that cause disease and prevent cancer growth (Camire et.al, 2009). The increase in the world's population has led to increased demand for nutriment, Forecasts indicate to raise average consumption human for potatoes in Iraq 2022 to 32.51 kg to each year (Al-Bayaty and Al-Douri, 2015). Therefore, the goal of most researchers to raise production rates in the unit area to coverage the needs of the population of food products, The selection of the appropriate variety is one of the most important determinants of production because of the effect of the nature genetic of the variety and its interaction with the environmental Circumstances in the growth, yield and quality of the Most agricultural crops (Kumar and Ezekiel, 2006; Patel, et. al., 2008).

With increased level awareness to environmental problems because of the excessive useing of chemical fertilizers and pesticides that cause danger to human. It is therefore necessary to obtain alternative ways to improve plant traits in growth and production (Metting, et.al, 1990). Different studies have been carried out by researchers on the use of seaweed for its contents complex group of carbohydrates, biological stimulants, regulating hormones for growth (jibrelins, cytokines and oxins), abyssic acid, similar substances whence of the effect of hormones, vitamins, antibiotics, antioxidants and other important and effective material that enter the vital processes of the plant cell, which lead to improve indicators of growth and production (Jothinayagi and Anbazhagan, 2009; Spinelli, et.al., 2009), In addition to increasing the resistance of the plant to the frozen, stress conditions, reduce incidence of fungus and insects(Jolivet, et.al., 1991; Sultana, et.al., 2011) .

The method of paper fertilization gave the plant with nutrients necessary for its growth and development in a short time compared to soil fertilization, as well as a good way in the transfer of nutrients within the plant in form homogeneous if used according to the requirements of the crop with taking considering (type of crop, the number of sprinkles, the nature of Fertilizer, concentration of the active ingredient and the time of addition), but this does not mean to eliminate the importance of roots in the absorption of nutrients from the soil (kuepper, 2003).

The research aims to:

- Determine the best varieties used in the study whence of production.
- Know the optimal level of spray the seaweed extract (APPETIZER) on the potato, which gives the best results desired for farmers.
- Choose the better treatment between the varieties and spraying fertilizer, which gives the best production.

MATERIALS AND METHOD:

The experiment was carried out in Baquba nursery of Diyala Agriculture Directorate - Diyala Governorate for the spring season 2017, The tubers were planted in 2017/2/5 in the soil at a distance of 0.25 m between tubers and others after the land was prepared for agriculture, and the work of three sectors width of 0.80 m and two irrigation lines and the distance between the sector and other 0.50m. Added Poultry fertilizer was by 5% of the soil volume calculated on the basis of the area of the experimental unit at a depth of 0.30 m (Al-Azzawi, 2016), Tilled soil and fulfills operation service from fertilization, irrigation and other agricultural work (potato cultivation technology, 2005). The experiment consisted of 12 treatments from three varieties of potatoes (AXENIA, OSIRIS, HERMES), Its symbol (V1, V2 and V3) respectively and four

concentrations of the seaweed extract (APPETIZER) 0, 0.75, 1.50 and 2.25 ml. L-1, Its symbol (F0, F1, F2 and F3) respectively . It is a paper fertilizer emulsion from French company(GOËMAR), containing seaweed (Ascophyllum nodosum) rich in nutrients especially Micro nutrients (www.goemar.com). The plants were sprayed until complete wet by a hand spray with three dates at a rate of one spray every 15 days, the first date of spraying was on 8/4/2017. The treatments were organized by Randomized complete Block Design, Statistical analysis of the studied traits was performed using the (SAS) program, and the rates were compared using the Dunkin test multidisciplinary test and below the 0.05(Al-rawy and kalafullah, 1980).

studied the following qualities:

1- **Total number of tubers per plant (tuber. Plant^{-1}):-** Was calculated the number of tubers per plant of dividing the number of Total tubers per seven plants selected randomly from each unit experimental on the number.

2- **Average wight of tuber marketable (gm) :-** The specifications of the tuber marketable are free of defects, deformities, not less than 35 mm diameter, calculated the average by dividing the marketable yield on the number of tubers marketable for seven plants per unit experimental.

3- **tuber yield per plant (kg) :-** was Calculate the average from the total yield of the seven plants for per unit experimental divided by their number.

4- **Marketable yield of tubers (ton.donum^{-1}) :-** The tubers was excluded Distorted, sick, the diameter of don't less than 35 mm of the seven plants that selected from per unit experimental and the weight of the residue and change to the dunum (2500 m^2) .

5- **Unmarketable yield of tubers (ton.donum^{-1}) :-** weight distorted tubers, sick, the diameter of less than 35 mm of the seven plants selected per unit experimental and change to the dunum.

6- **Total tuber yield (ton.donum^{-1}) :-** was calculated average from the Total tuber yield seven plants selected per unit experimental and and change to the dunum.

RESULTS AND DISCUSSIONS:

Total number of tubers per plant (tuber. Plant^{-1})

the results of Table (1) indicate that there is a significant effect between the varieties in the total number of tubers per plant. OSIRIS was significantly (12.26 tuber.plant^{-1}), compared to AXENIA, which recorded the lowest average (7.19 tuber.plant^{-1}). The results of the same table showed a significant effect when using seaweed extract at 1.50 ml.l^{-1}concentration, which recorded the highest average (11.46 tuber. plant^{-1}) compared to the spray treatment at 0 ml.l^{-1}, which gave the lowest average (9.58 tuber. plant^{-1}). as

overlap between the varieties and the fertilization had a significant effect on the total number of tubers per plant, the treatment OSIRIS×1.50 ml.l^{-1} Have a significant effect on recording the highest average (13.19 tuber. plant^{-1}) while the treatment AXENIA ×0 ml.l^{-1}recorded the lowest average (5.85 tuber. plant^{-1}) .

Table (1) Effect of spraying seaweed extract and varieties of potatoes in the Total number of tubers per plant (tuber. Plant^{-1}).

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
7.19 B	7.03 de	8.72 cd	7.14 de	5.85 e	**(v1) AXENIA**
12.26 A	11.85 ab	13.19 a	11.66 ab	12.33 ab	**(v2) OSIRIS**
11.45 A	12.69 ab	12.47 ab	10.09 bc	10.57 abc	**(v3) HERMES**
	10.52 AB	11.46 A	9.63 B	9.58 B	**Average effect of concentrations**

*Notice:- Values followed by the same letter are not significant differences according to Duncan test polynomial

Average wight of tuber marketable (gm)

Table (2) shows that AXENIA was significantly (88.76 gm) while there was no significantly effect between OSIRIS and HERMES in the average (71.91 and 59.41 gm) respectively. The results of the same table indicate that there is no significant effect on the average of weight of the marketable tuberes when spraying seaweed extract at different concentrations. The highest reading was recorded for spraying with a of 1.50 ml.l^{-1} concentration (80.74 gm) while the lowest reading average was recorded for spray concentration at 0 ml.l^{-1} (66.22 gm). In the case of the overlap between the experimental treatments, the AXENIA × 1.50 ml.l^{-1} was significantly to the average (105.22 gm) compared to thtreatmente HERMES × 2.25 ml.l^{-1} gave the lowest average (56.99 gm) .

Table (2) Effect of spraying seaweed extract and varieties of potatoes in the average wight of tuber marketable (gm).

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
88.76 A	92.94 ab	105.22 a	78.94 abc	77.97 abc	**(v1) AXENIA**
71.92 B	76.28 abc	72.40 bc	76.05 abc	62.95 bc	**(v2) OSIRIS**
59.41 B	56.99 c	64.61 bc	58.29 c	57.76 c	**(v3) HERMES**
	75.40 A	80.74 A	71.09 A	66.22 A	**Average effect of concentrations**

*Notice:- Values followed by the same letter are not significant differences according to Duncan test polynomial

tuber yield per plant (kg. Plant^{-1})

Table (3) shows that OSIRIS is significant (0.824 kg. Plant^{-1}), while AXENIA has the lowest average (0.590 kg. Plant^{-1}). The seaweed extract spray treatment 1.50 ml.l^{-1} was significant in tuber yield per plant (0.759 kg. Plant^{-1}) compared to the spray treatment 0 ml.l^{-1} (0.588 kg. Plant^{-1}). And through results of the same table note significant effect between overlap varieties and seaweed extract in the tuber yield per plant. The OSIRIS×1.50 ml.l^{-1} was significant (0.884 kg. Plant^{-1}) while treatment the AXENIA× 0 ml.l^{-1} gave lowest average (0.417 kg. Plant^{-1}).

Table (3) Effect of spraying seaweed extract and varieties of potatoes in the tuber yield per plant (kg. Plant^{-1}) .

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
0.590 B	0.626 bcd	0.716 abc	0.599 bcd	0.417 d	**(v1) AXENIA**

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
0.824 A	0.804 ab	0.884 a	0.790 ab	0.820 ab	(v2) OSIRIS
0.596 B	0.650 abcd	0.677 abc	0.531 cd	0.528 cd	(v3) HERMES
	0.693 AB	0.759 A	0.640 AB	0.588 B	Average effect of concentrations

*Notice:- Values followed by the same letter are not significant differences according to Duncan test polynomial

Marketable yield of tubers (ton.donum^{-1})

Table (4) shows the significantly OSIRIS and gave the highest average (12.80 ton.donum^{-1}) in the Marketable yield of tubers, compared to HERMES which recorded the lowest average (9.24 ton.donum^{-1}) . The results of the same table show that the spray treatment at 1.50 ml.l^{-1} has a significant on the average (12.53 ton.donum^{-1}) compared to the spray treatment at 0 ml.l^{-1} concentration which recorded the lowest average (8.51 ton.donum^{-1}). As for the treatment overlap between OSIRIS x 1.50 and 2.25 ml.l^{-1} was significant in recording the Marketable yield of tubers (14.20 and 13.79 ton.donum^{-1}) Respectively. While gave the treatment overlap AXENIA × 0 ml.l^{-1} the lowest average (6.14 ton.donum^{-1}).

Table (4) Effect of spraying seaweed extract and varieties of potatoes in Marketable yield of tubers (ton.donum^{-1}).

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
10.11 B	11.38 ab	12.95 ab	9.94 abc	6.14 c	(v1) AXENIA
12.80 A	13.79 a	14.20 a	12.00 ab	11.22 ab	(v2) OSIRIS
9.24 B	9.48 abc	10.46 ab	8.85 bc	8.19 bc	(v3) HERMES

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
	11.55 AB	12.53 A	10.26 AB	8.51 B	**Average effect of concentrations**

*Notice:- Values followed by the same letter are not significant differences according to Duncan test polynomial

unmarketable yield of tubers (ton.donum^{-1})

Table (5) shows the significantly of OSIRIS in the recording of the highest average (6.22 ton.donum^{-1}) in the unmarketable tuber yield compared to the AXENIA, which recorded the lowest average (3.49 ton.donum^{-1}). As for the effect of fertilizer treatments, there was not significant difference between the concentrations used in fertilizer on unmarketable tuber yield. The same table showed the significantly of the treatment of OSIRIS × 0 ml.l^{-1}, which gave highest average (7.70 ton.donum^{-1}) compared to the treatment AXENIA × 2.25 ml.l^{-1}, which gave the lowest average (3.06 ton.donum^{-1}) in the unmarketable tuber yield.

Table (5) Effect of spraying seaweed extract and varieties of potatoes in unmarketable yield of tubers (ton.donum^{-1}).

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of Varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
3.49 C	3.06 c	3.56 bc	3.87 bc	3.48 c	**(v1) AXENIA**
6.22 A	4.76 bc	6.20 abc	6.23 abc	7.70 a	**(v2) OSIRIS**
4.52 B	5.52 abc	5.16 abc	3.41 c	4.00 bc	**(v3) HERMES**
	4.44 A	4.97 A	4.50 A	5.06 A	**Average effect of concentrations**

*Notice:- Values followed by the same letter are not significant differences according to Duncan test polynomial

Total tuber yield (ton.donum^{-1})

The results of Table (6), OSIRIS was significantly (19.02 ton.donum^{-1}) than the AXENIA, which recorded the lowest average (13. ton.donum^{-1}). As for the effect of the fertilization factors, the spraying treatment was significantly with 1.50 ml.l^{-1} concentration (17.50 ton.donum^{-1}) while the spray treatment at 0 ml.l^{-1} was the lowest average (13.57 ton.donum^{-1}). The results of the same table show that treatment OSIRIS × 1.50 was significantly (20.39 ton.donum^{-1}) compared with the treatment of AXENIA × 0, which gave the lowest average (9.62 ton.donum^{-1}).

Table (6) Effect of spraying seaweed extract and varieties of potatoes in Total tuber yield (ton.donum^{-1}).

Average effect of varieties	Effect of fertilizer concentration (ML.L^{-1}((APPETIZER)				Effect of Varieties
	F3 (2.25)	F2 (1.50)	F1 (0.75)	F0 (0)	
13.60 B	14.44 bcd	16.51 abc	13.81 bcd	9.62 d	**(v1) AXENIA**
19.02 A	18.54 ab	20.39 a	18.22 ab	18.91 ab	**(v2) OSIRIS**
13.76 B	14.99 abcd	15.61 abc	12.25 cd	12.18 cd	**(v3) HERMES**
	15.99 AB	17.50 A	14.76 AB	13.57 B	**Average effect of concentrations**

The results of the tables (1, 2, 3, 4, 5 and 6) show that there is a significant difference between the varieties in the average of most of the traits studied in the experiment. This significant may be due to the different genetic factors controlling each type of superior varieties, also the reason may be due to the suitability of the environmental conditions With the varieties. This is in line with the results of Dawood (2013), with Kahlel and Al-Othman (2014), with Al-Shammaryet.al (2016) and with Zewdu et.al (2017) when comparing different potato varieties.

As for the effect spray of seaweed extract (APPETIZER) on the yield of tubers. It was found that when the concentration increased to a certain extent led to significant in most of the qualities of the yield studied, this superiority may be linked to the contents of this extract of important nutrients, Natural growth regulators, Amino acids and sugars (Stevenson, 1968;O'Dell, 2003; Jensen, 2004 and Stępowska, 2008), which increase the efficiency of photosynthesis processes and thus these factors are reflected in the increase the quantitative

traits of tubers. This corresponds to the results of Gharakhani et. al ., (2016), Prajapati et. al., (2016) and with Pramanick et. al., (2017). when spraying potato plants with seaweed extracts.

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تأثير رش مستخلص الطحالب البحرية في حاصل أصناف مختلفة من البطاطا (Solanum tuberosum L.)

الملخص: نفذت التجربة خلال الموسم الزراعي الربيعي 2017 في مشتل بعقوبة التابع لمديرية زراعة ديالى– محافظة ديالى وشملت الدراسة ثلاثة أصناف من البطاطا (AXENIA وOSIRIS وHERMES) وأربعة تراكيز من مستخلص الطحالب البحرية (APPETIZER) (0 و0.75 و1.5 و2.25 مل. لتر$^{-1}$ ماء) وبمعدل ثلاث رشات. بهدف دراسة تأثير التركيب الوراثي للأصناف وتركيز السماد في حاصل البطاطا. تضمنت التجربة 12 معاملة ناتجة من التوافيق ما بين عوامل الدراسة المذكورة أنفاً. وطبقت تجربة عاملية بتصميم القطاعات العشوائية الكاملة Randomized complete Block Design (R.C.B.D) وبثلاث مكررات وكان التحليل الإحصائي باستخدام برنامج (SAS) وتم مقارنة المتوسطات باستخدام اختبار دنكن متعدد الحدود وتحت مستوى احتمال 5%. أوضحت النتائج تفوق الصنف OSIRIS معنوياً بتسجيل أعلى معدل في صفة عدد درنات النبات الواحد وحاصل النبات الواحد والحاصل القابل للتسويق والحاصل الغير قابل للتسويق والحاصل الكلي، بينما تفوق الصنف AXENIA في معدل وزن الدرنة القابل للتسويق وتفوق الرش بمستخلص الطحالب البحرية بتركيز 1.50 مل. لتر$^{-1}$ بشكل معنوي في معظم الصفات المدروسة إضافة إلى وجود تفوق معنوي عند تداخل ما بين عوامل الدراسة.

الكلمات المفتاحية: البطاطا، أصناف، مستخلص الطحالب البحرية.