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Effect of *Azotobacter* Inoculation, Dry Bread Yeast Suspension and Varying Levels of Urea on Growth of Potato cv. Desiree

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important vegetable crops in Iraq and in the world. It belongs to the *Solanaceae* family. It is rich of nutrients but its production in Iraq is still very low. The last recorded statistical productivity revealed that potato production was only 3.992 tons/ donum (1 donum equals 2500m^2) (Annual Iraqi Statistical Group, FAO, 1997). Yield quantity and quality is usually affected by several factors like agricultural service operations especially fertilization. The fertilizers use technique is an important tool throughout the minimum and complete use of chemical and biofertilizers. It has been proved that the excessive use of mineral fertilizers causes many negative results, so and from this prospective the concept of complete fertilization come truth by combining the chemical and biological fertilization to preserve soil fertility. This is because the most Iraqi soils are alkaline and lacked the organic matter and the biological activity in which represent together one of the three main components of soil fertility system (Physical, chemical and biological) (The national training course on the use of biofertilizers, 1998). So, it was necessary to conduct many experiments on the complete fertilization between the both of chemical and biological fertilizers. The genus *Azotobacter* is one of the important non symbiotic bacterial genera that has the ability to fix the atmospheric nitrogen as well as, to release several compounds like auxins, gibberellins, cytokinins and fungi antibiotics that can improve soil fertility and the growth and productivity of agricultural crops (Forlain *et al*., 1995). *Azotobater* has been used as biofertilizer or as bacterial inoculums for potato (Sidarenko *et al*., 1996; Vivek Kumar *et al*., 2001 and Shafeek*etal*., 2004).

The dry 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). This is because its content of many nutrient elements and being productive compounds of semi growth regulator compounds like auxins, gibberellins and cytokinins (Glick, 1995). As Iraq and the northern area of Iraq lack such investigations about minerals and biofertilizers on potato growth and yield, the current investigation was carried out to try to obtain the best growth and yield by combining the biofertilizing by the bacterial inoculums and the addition of yeast suspension with different levels of the nitrogenous fertilizer under the conditions of Zakho province in Iraqi Kurdistan Region.

MATERIALS AND METHODS

This experiment was carried out during spring seasons of 2005 and 2006 in the fields of the agricultural research center, Zakho/ Iraqi Kurdistan Region. The aim of the study was to test the effects of biofertilizers by the inoculation with *Azotobacter chroococum*, the addition of bread yeast suspension and nitrogenous mineral fertilizer (Urea, 46% N) on shoots characteristics of potato Desiree cultivar. The pre-sprouted tuber seeds (sprouts of 1-3 cm), originated from Holland class E, were sown on March 10^{th} 1^{st} and in 2005 and 2006 respectively. *Azotobacter* suspension was added to roots area by inoculating the tubers by 1 ml of the medium for each plant similarly. The solution was diluted by adding 2 liters for each row (200 ml/ plant) in April 10^{th} and 1^{st} respectively. The dry bread yeast suspension was added around the roots 5 days after germination in April 25^{th} and 15^{th} for 2005 and 2006 respectively. This operation was repeated three times at a level of 1 liter/ m^2 ten days intervals (Hegazi and Awad, 2002). Urea was added in three different levels (0, 25 and 50 kg/donum) in two dozes, the first after the full germination including the half of the fertilizer amount while the second doze was after two weeks from the first one. The experiment was designed according to RCBD in three replicates. The shoot growth measurements were recorded two weeks before the harvest by taking ten plants from each experimental unit. The following traits were studied: plant height (cm), number of areal stems, plant leaves area (cm^2), total chlorophyll in leaves and shoots dry matter percentage.

RESULTS AND DISCUSSION

Data in tables 1 to 5 (Table, 3 is shown only on this paper) reveal significant increase in plant height, number of areal stems per plant, total chlorophyll and dry matter percentage in both seasons 2005 and 2006 as results of inoculations with *Azotobacter* bacteria. Whereas for leaves area, the bacterial inoculation caused significant increase in only the second season (2006) which gave 15.36% increase as compared with control. The treatments of yeast suspension caused gradual significant increase in plant height, number of areal stem per plant, leaves area, total chlorophyll and dry matter percentage. These increases were accompanied with the gradual increase in yeast suspension concentration. The highest values were obtained from the use of 6 g/l yeast suspension (3394.70 and 4128.40 cm^2) for both growing seasons respectively. As well as, the addition of the mineral fertilizer was significantly affective in improving the studied shoots characteristics. The increases were raised as the levels of the fertilizer were raised. The addition of 50 kg/donum Urea gave the highest plant height, number of areal stems per plant, leaves area, total chlorophyll and dry matter percentage in both growing seasons causing a percentage of 22.93 and 28.77% increases in both seasons respectively as compared with the control treatment. The same tables show that the dual interaction treatments between yeast suspension and mineral fertilizer levels caused significant increase in these characteristics. The treatment of the interaction between 6 g/l yeast suspension and 50 kg/donum Urea gave the highest values (3448.70 and 5226.80 cm^2) for both growing seasons respectively.

The dual interaction between the bacterial inoculation and the mineral fertilizer was significantly effective as well by the superiority of the treatment of the bacterial inoculation with the addition of 50 kg/donum Urea by giving the highest values of plant height, number of areal stems per plant, leaves area (3318.50 and 5080.10 cm^2/ plant), dry matter percentage and the total chlorophyll for both growing seasons respectively as compared with the least values recorded for the treatment of control. The trial interaction treatments caused significant differences in plant height, number of stems per plant, leaves area, dry matter percentage and total chlorophyll. The highest values of these characteristics (3680.70 and 5597.70 cm^2) for both growing seasons respectively were recorded for the treatment of bacterial inoculation, 6 g/l yeast suspension and 50 kg/donum Urea.

These results indicate that the shoots characteristics were significantly improved by the bacterial inoculation, yeast suspension and mineral fertilizer lonely or in combination. This might

be due to the ability of this bacteria to fix nitrogen as well as its role in increasing the surface area of the roots hairs which increase the levels of nutrients absorption. *Azotobacter* bacteria has the ability to release some chemical compounds that stimulate growth hormones like cytokinins, indoleacetic acid and gibberellins (Marha *et al.*, 2000) and release siderophores compounds wihc act as chelate agents for iron that increase the availability of this element in soil (Marin *et al*., 2001). 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 and Rao (1984) mentioned that the yeast induce the absorption of nutrient elements by improving the soil pH into acidity. Ahmed *et al*. (1995) and Glick (1995) recorded that the yeast is capable of increasing the stimulative growth compounds like gibberellins, auxins and cytokinins that act in improving plant cell division and growth.

Table (3): the effect of Azotobacter inoculation, dry bread yeast suspension and varying levels of Urea on leave area/plant cm2 during both growing season 2005and 2006

2005

Bacteria	Mineral Fertilizer/Urea kg/do.	Yeast gm/L.				Fertilizer × Bacteria	Bacteria
		00	2	4	6		
+Bacteria	00	d -a 2972. 80	c -a 3379. 30	c -a 3264. 60	c -a 3419. 50	a 3259. 10	a 3193. 27
	25	d - b2814. 60	d -a 3225. 90	d 2458. 40	ab 3510. 20	a 3002. 30	
	50	d -a 2938. 30	d -a 3248. 40	c -a 3406. 40	a 3680. 70	a 3318. 50	
Bacteria–	00	cd 2667. 40	d -a 2926. 10	d -a 3116. 00	d -a 3229. 90	a 2984. 80	a 3032. 24
	25	d - b2709. 10	d -a 3015. 90	d -a 3137. 60	c -a 3311. 10	a 3043. 40	
	50	d - b2791. 00	d -a 3166. 50	d -a 3099. 60	d -a 3216. 70	a 3068. 50	
yeast		c 2815. 50	ab 3160. 40	c b3080. 40	a 3394. 70	fertilizer	
Bacteria *yeast	+Bacteria	c b2908. 60	ab 3284. 60	c b3043. 10	a 3536. 80		
	Bacteria-	c 2722. 50	c b3036. 20	c b3117. 70	ab 3252. 60		
Fertilizer *yeast	00	c b2820. 10	c -a 3152. 70	c -a 3190. 30	ab 3324. 70	a 3121. 90	
	25	c 2761. 90	c -a 3120. 90	c b2798. 00	a 3410. 60	a 3022. 90	
	50	c 2761. 90	c -a 3120. 90	c b2798. 00	a 3410. 60	a 3259. 10	

2006

Bacteria	Mineral Fertilizer/Urea kg/hec.	Yeast gm/L.				Fertilizer × Bacteria	Bacteria
		00	2	4	6		
+Bacteria	00	i - b2379. 20	i -f 2588. 80	i -f 2622. 90	i - b3654. 60	-e d 2811. 40	3927. 30 a
	25	i - b3720. 10	g - b3902. 70	f - b4006. 80	g - b3931. 90	c b3890. 40	
	50	-e -a 4553. 90	c -a 4976. 80	ab 5192. 10	a 5597. 70	a 5080. 10	
Bacteria–	00	i 2134. 30	i h 2269. 20	i -f 2564. 90	i - -e 2977. 10	-e 2486. 40	b3404. 30
	25	i - -e 3132. 60	i -d 4264. 00	i -c 3506. 30	h - b3755. 10	cd 3414. 50	
	50	g -d 3900. 50	f -a 4112. 80	-e -a 3481. 50	d -a 4853. 80	b4312. 20	
yeast		b3303. 50	b3519. 10	ab 3712. 40	a 4128. 40	fertilizer	
Bacteria *yeast	+Bacteria	ab 3551. 10	ab 3822. 80	ab 3940. 60	a 4394. 70		
	Bacteria-	b3055. 80	b3215. 30	b3484. 20	ab 3862. 00		
Fertilizer *yeast	00	g 2256. 80	g f 2429. 00	g - -e 2593. 90	f -d 3315. 80	c 2648. 90	
	25	f -d 3426. 40	-e -c 3583. 40	d - b3756. 60	d - b3843. 50	b3652. 40	
	50	d -a 4227. 20	c -a 4544. 80	ab 4786. 80	a 5225. 80	a 4696. 10	

Means within a column, row and there interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

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