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ROLE OF BIO FERTILIZERS AND PHOSPHATE LEVELS ON SOME GROWTH AND YIELD PROPERTIES OF BROCCOLI (*BRASSICA OLERACEA VAR. ITALICA*)

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Abstract

An experiment was carried out in agriculture college of Karbala University, on role of bio fertilizers and phosphate levels on some growth and yield properties of Broccoli (*Brassica oleracea* var. italica) duringwinterseason 2017 -2018.The experimentwas laid out in split plot design with three replications. Whereitrepresented the factors of bio-fertilization (contrpl, Azotovit, Phosphavit and Azotovit+Phosphovit) the main plots,While phosphate fertilization treatments were represented (0,30,60 and 90 Kg P ha^{-1}) the subplots. Results of the study showed the bio fertilizer (A+B) give highest value in all characters under study. The interaction 90 and 60 Kg P.ha^{-1} with (A+B) treatment give high value in plant height (67.00 and 61.70) cm, Branchnumber per plant (12.00 and 11.00), Leavesnumber per Plant (52.50 and 51.00), Chlorophyll Content (83.80 and 82.90) spad, Leaf Area (91.97 and 90.80)dcm2, TSS(15.00 and 13.50)%, Plant Weight (619.8 and 611.5) gm and curd weight (1685 and 1484) gm respectively.

Keywords **:** Broccoli, Bio fertilizer, Phosphate levels, Growth and yield.

Introduction

Broccoliis one of the cropsthatbelong to the Brassiaceae family. This plant ischaracterized by its high nutritional value to contain itsInflorescences, which are eaten in the vegetative floral shoots on many compounds such as carotenoids, folicacid and riboflavin as well as vitamins, especially vitamin A and C (Decoteau, 2000; Hassan, 2004). Broccoliisrich in manymineralelementssuch as phosphorus, potassium, iron and calcium (Beecher, 1994; Michaud *et al*., 2002). Broccoli can be used as a treatment, regulator and antibiotic for many diseases such as hypertension and diabetes, as well as itsrole in heart rhythm regulation, as well as its importance in processing of urinary tract infections alsois an anticancer (Kirsh *et al*., 2007; Zhao *et al.*, 2007).

The fertilization processis one of the most important agricultural techniques in increasing production and improving its quality (Almosawy *et al*., 2018) . However, the excessive use of chemical fertilizer causes many environmental problems such as water and soil pollution as well as the harmful effects of health (López-Valdez, and Fernández-Luqueño.2014; Abu-Rayyan, A.2010;Almosawy *et al*., 2018) Therefore, there is a tendency by many countries to search for alternative methods or reduce the use of chemical fertilizers Among these techniques are the use of bio-fertilizers, which are environmentally friendly, as well as being in expensive and have an important role in increasing production and improving its quality (Khalaf, 2015). The use of levels of bio-fertilization has led to an increase in some growth characteristics Corn of Shamia. Taha (2007) showed that the use of biological fertilizersis not a substitute for chemical fertilizers but rather a complement to them. In view of the lack of studies that concern With the subject of pollution caused by the high quantities of chemical fertilizers in addition to increasing the production and improvement of the quality of broccoli plant This study was to demonstrate the importance of adding bio fertilization with phosphorus fertilizers in the growth and yield broccoli.

Materials and Methods

This research was conducted during Winter season 2017-2018 at agriculture college of karbala university, Indicating its physical and chemical properties in a table (1), In order to study the effect of bio-fertilization Azotovit and Phosphatovit In increasing the efficiency of the use of phosphate fertilizer for some growth and yield broccoli plant. Broccoli seeds were planted in corks in the canopy of the Department of Horticulture and Garden Engineeringat 7 /8/2017. The broccoli seeds were planted in corks in the Horticulture and Garden Engineering Department with appropriate conditions and service processes). Experiment was laid out in split plot design with three replication, Where it represented the factors of bio-fertilization (contrpl, Azotovit , Phosphavit and Azotovit+Phosphovit) the main plots,While phosphate fertilization treatments were represented (0, 30, 60 and 90 Kg P ha^{-1}) the subplots. The plants were transferred to the soil of the field at 9/10/2017. Five Plants were selected randomly from each experimental unit for field measurements which included : plant height (cm), branch number per plant, Leaves number per Plant, Chlorophyll Content(SPAD), Leaf Area (dcm2), Total Soluble Solids (TSS), Plant Weight and Curd Weight according to Watson and Watson (1953).Data analyzed using the Genest at program and means were compared using LSD at a probability level of 5% (Steel and Torri,1960).

Table 1 : Physical and chemical soil characteristics

Property		Value	Unit			
PH		7.3		Available N	0.08	gm Kg^{-1}
EC		2.1	ds m^{-1}	Available P	62.8	gm Kg^{-1}
Ca^{+2}	Soluble ions	21.32	Cmol Kg $Soil^{-1}$	Sand	684	gm Kg^{-1}
Mg^{+2}		12.24	Cmol Kg $Soil^{-1}$	Silt	174	gm Kg^{-1}
Na^{+}		10.39	Cmol Kg $Soil^{-1}$	Clay	142	gm Kg^{-1}
K^{+}		1.89	Cmol Kg $Soil^{-1}$	Texture	Sandy loam	
SO_4^{-2}		14.12	Cmol Kg $Soil^{-1}$			
HCO_3^{-}		2.82	Cmol Kg $Soil^{-1}$			
$CO3^{-2}$		Nil	Cmol Kg $Soil^{-1}$			
CL^{-}		28.90	Cmol Kg $Soil^{-1}$			

Results and Discussions

Plant Height

Table (2) show that Bio fertilizer play significant role in affecting Plant height, the maximum Plant height (60.05) cm recorded at (A+B) treatment. The minimum value was recorded with control (39.14) cm. Plant height was significantly affected by Phosphate levels factor, The maximum value was recorded in 90 kg.ha^{-1} which were recorded (54.33) cm. The increase did not rise to significant with 60Kg Pha^{-1} treatmeant which was recorded (50.63) cm. The minimum plant height was noticed with control treatment which was recorded (38.96) cm.

The interaction effects on plant height was significantly affected, where the maximum value of interaction noticed at Bio fertilizer (A+B) and 90 kg P.ha^{-1} treatment which was recorded (67.00) cm significantly higher on other interaction except 30 and 60 kg P.ha^{-1} with bio fertilizer treatments. The minimum plant height was noticed with control treatment which was recorded (27.67) cm.

Branch number per plant

Table (3) show that Bio fertilizer was affected on Branch number per plant of Broccoli plant. The maximum value was noticed in (A+B) treatment which was recorded (10.75), superior significant over (out bio fertilizer) which was recorded (5.50). Branch number per plant was a significant role. The maximum Branch number per plant was noticed in 90 kg P.ha^{-1} which was recorded (10.38) The increase did not rise to significant with 60Kg P ha^{-1} treatmeant which was recorded (8.63).The minimum value was recorded in control (6.62). interaction between Bio fertilizer and Phosphate levels played significant role in affecting of Branch number per plant, where maximum value recorded in (A+B) Bio fertilizer and 90 kg P.ha^{-1} (12.00). The minimum value was recorded in control treatment (3.50).

Leaves number per Plant

The leaves number per Plant of broccoli significantly increased due to Phosphate levels treatments Table (4).where Phosphate level 90 kg P.ha^{-1} gave highest leaves number per Plant (46.13), followed by level 60 kgP.ha^{-1} which was recorded (43.88), there is no significant effect between them. The minimum value was noticed with control treatment (32.50). Leaves Number per Plant was significant affected by bio fertilizers factor so that (A+B) treatment recorded high value in this character (46.38) superior over other treatments .The minimum value noticed with control treatment (33.38). interaction between Bio fertilizer and Phosphate levels played significant affected on leaves number per plant where superior interaction noticed with 90kg P.ha^{-1} and (A+B) treatment which was recorded (52.50), But did not differ significantly compared with 60Kg P ha^{-1} treatmeant which was recorded (51.00), While the minimum value was recorded with control treatment (28.00).

Leaf Area

Table (5) indicated that leaf area was significantly increased with phosphorus levels, where the highest value of this character was recorded at 90kg P.ha^{-1}(80.18) dcm^2, followed by level 60 kg P.ha^{-1} which was recorded (71.79) dcm^2, there is no significant effect between them. The minimum value was noticed with control (50.27) dcm^2. Result showed that the bio fertilizer played significant role on leaf area. The maximum value was recorded statistically significant in (A+P) treatment (82.10) dcm^2, while the minimum value was recorded at control treatment (47.00) dcm^2. The interaction effects on leaf area of broccoli plant, where superior interaction noticed at 90 kg P.ha^{-1} and (A+P) treatment which was recorded (91.97) dcm^2, significantly higher on other interaction except 30 and 60 kg P .ha^{-1} with bio fertilizer treatments. While control treatment was recorded less value of interaction (30.97) dcm^2.

Total Soluble Solids (TSS)

Table (5) illustrated that phosphorus levels play significant role on TSS character. The maximum TSS(13.13)% was recorded with 90 kg P.ha^{-1}, followed by level 60 kg P.ha^{-1} which was recorded (12.38)%, there is no significant effect between them. The minimum value was recorded with control treatment (8.75)%. Bio fertilizer where effected on TSS character the highest TSS was obtained from (A+P) treatment which was recorded (12.50)%, while the lowest value produced under control treatment which was recorded (10.00)%.

The interaction between phosphorus levels and bio-fertilizer played significantly affected on TSS, where superior interaction noticed at 90 kg P.ha^{-1} and (A+P) treatment which was recorded (15.00)% significantly higher on other interaction except 60 kg P .ha^{-1} with bio fertilizer treatment. The minimum TSS was noticed with control treatment which was recorded (7.00)%.

Chlorophyll Content

Table (6) indicated that Chlorophyll Content was a significantly increased with phosphorus levels, where the highest value was recorded at 90 kg P.ha^{-1} (68.10) spad. The minimum value was noticed with control (45.10) spad. The response of Bio fertilizers were a significant. The maximum

chlorophyll was recorded statistically significant in A+B which was recorded (69.10) spad. The minimum value in this character was noticed with control which was recorded (43.00) spad. The interaction between phosphorus levels and bio fertilizer played significantly affected on Chlorophyll Content ,where superior interaction noticed at 90 kg P.ha^{-1} and (A+P) treatment which was recorded (83.80) spad. While the minimum value was noticed with control treatment which recorded (28.90) spad.

Plant Weight

According to analysis of variance (Table 7), phosphorus levels had significant influence on plant weight. The maximum value was recorded at 90 kg P.ha^{-1} (526.5) gm, followed by level 60 kg P.ha^{-1} which was recorded (470.0)gm, there is no significant effect between them. While the minimum value was recorded in control treatment (386.7) gm. Result in this table showed that the bio fertilizer played a significant role in affecting. The maximum value was recorded (576.5)g min (A+B) treatment. The minimum value was noticed with control which was recorded (380.3) gm. The interaction between phosphorus levels and bio fertilizer played significantly affected on plant weight, where superior interaction noticed at 90 kg P.ha^{-1} and (A+P) treatment which was recorded (619.8) gm. The minimum value in this character was noticed with control treatment (288.6) gm.

Curd Weight

Table (8) illustrated that phosphorus levels play significant on curd weight character, where the highest value was recorded at 90 kg P.ha^{-1} (1423) gm, followed by level 60 kg P.ha^{-1} which was recorded (1306) gm, there is no significant effect between them. The minimum value was noticed with control (957)gm. a response of bio fertilizers were a significant .The maximum Curd Weight was recorded statistically significant in (A+B) treatment which was recorded (1440) gm. The minimum value in this character was noticed with control which was recorded (944)gm. The interaction between phosphorus levels and bio fertilizer played a significant role in affecting Curd Weight compare with control treatment where superior interaction noticed at 90 kgp.ha^{-1} and (A+P) treatment which was recorded (1685)gm. While the minimum value was noticed with control treatment which recorded (569) gm.

Table 2 : Role of Bio Fertilizers and Phosphate levels on plant height(cm).

Phosphorus Levels / Bio Fertilizers	0	30	60	90	Mean
	Kg P.ha^{-1}				
0	27.67	37.70	44.20	47.00	39.14
A	38.97	52.00	46.77	51.00	47.18
B	38.00	44.67	49.87	52.30	46.21
A+B	51.20	60.30	61.70	67.00	60.05
Mean	38.96	48.67	50.63	54.33	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	4.123	4.123		8.246	

Table 3 : Role of Bio Fertilizers and Phosphate levels on Branch number per plant.

Phosphorus Levels / Bio Fertilizers	0	30	60	90	Mean
	Kg P.ha^{-1}				
0	3.50	4.50	6.00	8.00	5.50
A	6.50	8.00	8.50	10.50	8.38
B	7.00	8.50	9.00	11.00	8.88
A+B	9.50	10.50	11.00	12.00	10.75
Mean	6.62	7.87	8.63	10.38	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	1.886	1.886		3.772	

Table 4 : Role of Bio Fertilizers and Phosphate levels onLeaves number per Plant.

Phosphorus Levels / Bio Fertilizers	0	30	60	90	Mean
	Kg P.ha^{-1}				
0	28.00	32.00	35.00	38.50	33.38
A	32.00	37.00	45.00	47.50	40.38
B	33.00	34.00	44.50	46.00	39.38
A+B	37.00	45.00	51.00	52.50	46.38
Mean	32.50	37.00	43.88	46.13	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	2.471	2.471		4.843	

Table 5 : Role of Bio Fertilizers and Phosphate levels on Leaf Area.

Phosphorus Levels / Bio Fertilizers	0	30	60	90	Mean
	Kg P.ha^{-1}				
0	30.97	42.87	51.20	62.97	47.00
A	59.17	64.07	67.47	80.87	67.89
B	49.07	68.67	77.70	84.90	70.08
A+B	61.87	83.77	90.80	91.97	82.10
Mean	50.27	64.84	71.79	80.18	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	8.954	8.954		17.908	

Table 5 : Role of Bio Fertilizers and Phosphate levels onTotal Soluble Solids (TSS):.

Phosphorus Levels / Bio Fertilizers	0	30	60	90	Mean
	Kg P.ha^{-1}				
0	7.00	9.50	11.50	12.00	10.00
A	9.50	9.50	12.50	13.00	11.13
B	9.00	10.50	12.00	12.50	11.00
A+B	9.50	12.00	13.50	15.00	12.50
Mean	8.75	10.38	12.38	13.13	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	0.963	0.963		1.926	

Table 6 : Role of Bio Fertilizers and Phosphate levels on Chlorophyll Content.

Phosphorus Levels / Bio Fertilizers	0	30	60	90	Mean
	Kg P.ha^{-1}				
0	28.90	39.90	46.00	57.10	43.00
A	52.10	45.40	49.10	67.50	53.50
B	40.80	43.60	47.20	64.10	48.90
A+B	58.70	50.90	82.90	83.80	69.10
Mean	45.10	44.90	56.30	68.10	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	8.57	8.57		17.14	

Table 7 : Role of Bio Fertilizers and Phosphate levels onPlant Weight.

Phosphorus Levels / Bio Fertilizers	0	30	60	90	Mean
	Kg P.ha^{-1}				
0	288.6	375.4	401.1	456.2	380.3
A	354.1	398.6	426.3	503.7	420.6
B	368.5	404.0	441.2	526.2	435.0
A+B	535.6	539.2	611.5	619.8	576.5
Mean	386.7	429.3	470.0	526.5	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	57.99	57.99		115.98	

Table 8 : Role of Bio Fertilizers and Phosphate levels on Curd Weight.

Phosphorus levels / Bio Fertilizers	0	30	60	90	Mean
	kgp.ha^{-1}				
0	569	930	1068	1207	944
A	1030	1151	1301	1384	1217
B	1040	1224	1372	1416	1263
A+B	1187	1402	1484	1685	1440
Mean	957	1177	1306	1423	
	Bio Fertilizer	Phosphorus Levels		Interaction	
F-Test	S	S		S	
CD at 5%	122.3	122.3		244.6	

Discussion

The results showed that the biological fertilizers used in the study played a significant role in all the studied traits. This confirms the role of bio fertilizers in increasing the efficiency of the use of chemical fertilizers in nutrient-poorsoils (Alwan *et al*., 2009; Brunner *et al*., 2015; Taha *et al*., 2016). The interaction treatment 90 kg $P.ha^{-1}$ with (A+B) treatment and did not differ significantly 60 kg P ha^{-1} treatment in most studied traits. This illustrates the role of bio fertilizers in increasing the efficiency of the use of chemical fertilizers, thus reducing the use of high levels of chemical fertilizers as well as reducing environmental pollution.

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