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EFFECTS OF BIOFERTILIZERS AND COMPOST APPLICATION ON VEGTATIVE GROWTH OF PLUM TRANSPLANTS

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Abstract

This study was conducted in a lath house, Dept. Of Hort. and Landscape, College of Agricultural Engineering Sciences, Univ. Baghdad, Al- Jadriya during 2018 and 2019 growing seasons to investigate the influence of Biofertilizers and compost on growth of one year's old trees of "Hollywood" plum cultivar. The first factor is the addition of biofertilizers (B) at four types are without addition (B_0) and the addition of *Azospirillum brasilemse* to soil (B_1) , addition of *Bacillus megatherium* to soil (B_2) and the addition of *Azospirillum brasilemse* + *Bacillus megatherium* to soil (B_3). The second factor is the addition of compost, without adding (C_0) and the addition of compost prepared from palm leaves to soil (C_1) and the addition of compost prepared from the residues of wheat to soil (C_2). Treatments were replicated three times (three transplants in experimental unit) at factorial experiment in a RCBD. The results of the study were statistically analyzed and averages were compared according to the (L.S.D) at 0.05 and thus the number of transplants used was 108 transplants. The experimental results showed; The addition of biofertilizers, especially the addition of *Azospirillum brasilemse* + *Bacillus megatherium* to soil (B_3), showed significant superiority in most vegetative growth traits, and gave highest increase in shoot length was 36,72 and 62,72 cm ,the increase in stem diameter was 9,390 and 14,41 mm for the two seasons, respectively, Addition of compost prepared from date palm leaves (C_1) and prepared from wheat residues to soil (C_2) resulted in an increase in most vegetative traits (increase in branch length, increase in transplants height, leaf chlorophyll content and leaves dry weight.

Key words: Plum, Biofertilizers, Compost

Introduction

Plum *Prunus salicina* L. belongs to the Rosacea family and under the Prunoideae sub-family (Al-Essa and Batha, 2012). The history of the Japanese Plum tree dates back to 300 BC in China (Janick, 2005). In 2018, Estimated number of plum fruitful trees growing in Iraq, including nearly 146564 tree produces up to 4464 tons, and the average production per tree about 30.46kg (PCBS, 2018). While the acreage of plum in the world reached about 2619471 hectare, with production of 11758135 tons (FAO, 2017). The main producing countries are China then Romania, Serbia, USA and Iran (FAO, 2017). Perhaps the reason for the decline in the number of trees in Iraq is due to lack of care for trees and disease and insects, as well as the lack of horticultural treatment of trees well, and fertilization with organic fertilizers and mineral fertilizers is very limited and pruning operations are not carried out properly as well as soil service and spraying against diseases and insects it is very few It rarely occurs (Alwan, 2017).

The addition of mineral fertilizers, which provide the needs of any crop accompanied by a number of problems that may arise, especially in Iraqi soils characterized by high content of calcium carbonate and high values of soil pH, These properties expose nutrients to sedimentation and loss, especially nitrogen and phosphorus, leading to environmental pollution, degradation of the biomass of bacteria and fungi that are critical to improving physical and chemical soil properties and facilitating nutrients. This has led to the search for more environmentally friendly alternatives, including a return to the use of organic and biofertilizers or the adoption of organic farming (Alguacil *et al.,* 2005).

Biofertilizers are fertilizers that contain microscopic microorganisms that often increase the biological activity

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of the soil, the most important functions of these plants are to convert atmospheric nitrogen into forms that can be utilized by plants such as nitrates and ammonia, increase soil porosity and defend the plant against pathogens by depriving them of food sources (Ali, 2012). Several studies have been conducted to determine the role of biofertilizers in growth of fruit trees, Al-Hadethi, 2015, studied the effect of biofertilizer on apricot trees and found the biofertilizer (Phosphorene + Nitrobeine) caused significant increases in stem diameter, shoot growth and leaf chlorophyll content compared with control treatment. Al-Hadethi *et al.*, 2017, found that the addition of bio-fertilizers to peach transplants gave the highest leaves area and increase in stem diameter, especially when added *Azotobacter chroococcum* + *Azospirillum brasilense* + *Bacillus megatherium* to the soil. Also Al-Hadethi, 2019 found the added *Azospirillum brasilense* + *Bacillus megatherium* gave the highest leaves number, stem diameter and shoots length when his studied on hawthorn transplants.

Organic fertilization is one of the important ways to supply plants with nutrient requirements without any negative impact on the environment, as the increase does not lead to damage to the plant that occurs when mineral fertilizers in large quantities, and it is not hidden from the workers in the agricultural sector of the organic It has a role in plant growth and yield, whether it is added to the soil or sprayed on the vegetative part (Nardi *et al.,* 2016). Compost is one of the organic fertilizers that provide the plant with its nutrient needs without any negative impact on the environment, in addition to improving the physical, chemical and biological properties of the soil, and can be used at high rates without leading to damage to the roots of the plant, which may occur when fertilization with mineral fertilizers in large quantities, as the addition of organic fertilizers to the soil increases the amount of organic matter and the activity and preparation of microorganisms in it as well as working to add nutrients to the soil, which leads to an increase in plant growth rates and increase in the amount of yield and improve Its quality (Hao *et al.,* 2009; Baldi and Toselli, 2013). Some studies have been conducted on the effect of compost addition on the growth of fruit trees, Al-Hadethi et al. (2015) conducted a study that included the addition of four levels of compost prepared from date palm leaves (DPLC) to find out its effect on the physical and chemical properties of the soil and some vegetative properties of fig transplants, they found that the addition of this compost had a significant effect on the improvement of soil properties and a significant increase in leaf area and leaves chlorophyll content. Al-Rawi *et al.,* (2016) also found that the addition of four levels of compost prepared from palm fronds led to an increase in branches number; stem diameter and fig transplants length.

Due to the lack of studies on the role of organic and biofertilizers in the growth of fruit transplants as well as to move away from fertilizers and chemical growth regulators, the present study aims to know the effect of the addition of biofertilizers and compost on plum transplants growth.

Materials and Methods

This study was conducted in a lath house, Dept. Of Hort. and Landscape , College of Agricultural Engineering Sciences, Univ. Baghdad, Al- Jadriya during 2018 and 2019 growing seasons to investigate the influence of Biofertilizers and compost on growth of one year's old trees of "Hollywood" plum cultivar. The first factor is the addition of biofertilizers (B) at four types are without addition (B_0) and the addition of *Azospirillum brasilemse* to soil (B_1), addition of *Bacillus megatherium* to soil (B_2) and the addition of *Azospirillum brasilemse* + *Bacillus megatherium* to soil (B_3). The second factor is the addition of compost, without adding (C_0) and the addition of compost prepared from palm leaves to soil (C_1) and the addition of compost prepared from the residues of wheat to soil (C_2). Treatments were replicated three times (three transplants in experimental unit) at factorial experiment in a RCBD. The results of the study were statistically analyzed and averages were compared according to the (L.S.D) at 0.05 according to Elsahookie and Wuhaib (1990) and thus the number of transplants used was 108 transplants.

The following parameters were determined in the two successive seasons:

1. Transplant height (cm): The lengths of the plants were measured at the beginning of the experiment using the metric tape and then the lengths were measured at the end of the experiment (mid-October for the first year and mid-September for the second year) and according to the difference between them, which represented an increase in the height of transplants.
2. Shoots length (cm): four branches were measured using metric tape from each experimental unit at the beginning and end of the experiment and calculating the difference between them for both seasons.
3. Stem diameter increase (mm): Stem diameter was measured using a (Vernier) at the beginning and end of the experiment, and calculating the difference

between them for both seasons.

4. Branches number increase (branch.plant^{-1}): Three branches were left for each transplant and then according to the number of branches formed on the transplant at the end of the experiment (mid-October for the first year and mid-September for the second year).
5. Leaf dry weight (%): Various leaves were taken from the transplants was weighing then drained and calculated the percentage of dry matter by dividing weight after drying on weight before drying × 100.

Leaf chlorophyll contents (mg.100gm^{-1}): In the first week of June for both seasons, total chlorophyll was estimated in the plum leaves, according to Mackinney (1941) modified by Arnon (1949).

Results and Discussion

Effect of biofertilizers and compost application on transplants height, shoot length and increased in stem diameter of plum transplants:

The results in Tables 1 showed that the addition of the biofertilizer factor had a significant effect on plant height shoot length and increased in stem diameter. That this effect varied according to the added levels of these fertilizers during the two seasons of the study. The highest plant height reached 94.02 cm in B_3 treatment, but it did not differ significantly from treatment B_2, which gave the highest plant height of 63.71 cm. As for the role of adding compost, the results of the same table indicate that compost significantly affected the plant height where treatment C_1 gave the highest value of 98.91 cm during the first season of the study, while treatment C_2 excelled by giving the highest value was 65.96 cm for the second season. The results indicated in Table 1 showed that the addition of microorganisms significantly affected on shoot length, where treatment B_3 excelled by giving the highest shoot lengths of 36.72 and 62.72 cm for two growing seasons respectively, while giving B_0 treatment (control) is the least increase in shoot length. As for the role of compost, the results showed that the addition of compost significantly affected on shoot length, where C_2 treatment outperformed by giving the highest value of 33.89 cm and 58.24 cm while the lowest value when the control

Table 1: Effect of biofertilizers and compost application on transplants height, shoot length and increased in stem diameter of "Hollywood" plum transplants.

season	2018				2019			
Biofertilizers (B)	Compost (C)				Compost (C)			
	C_0	C_1	C_2	mean	C_0	C_1	C_2	mean
Transplant Height (cm)								
B_0	89.72	91.33	88.26	89.77	54.04	56.98	65.98	59.00
B_1	85.00	101.74	85.93	90.89	57.45	63.37	58.07	59.63
B_2	85.70	101.48	94.48	93.89	54.92	66.41	69.80	63.71
B_3	84.39	101.08	96.59	94.02	52.78	65.70	70.00	62.83
mean	86.20	98.91	91.32		54.80	63.12	65.96	
L.S.D5%	B	C	Inter		B	C	Inter	
	1.432	1.240	2.480		1.280	1.109	2.218	
Shoot length (cm)								
B_0	18.67	27.57	29.15	25.13	43.09	43.79	52.44	46.44
B_1	27.48	23.34	27.09	25.97	36.69	48.66	50.08	45.15
B_2	25.92	30.95	41.41	32.76	50.05	55.00	66.35	57.14
B_3	39.61	32.63	37.92	36.72	62.17	61.92	64.07	62.72
mean	27.92	28.62	33.89		48.00	52.34	58.24	
L.S.D5%	B	C	Inter		B	C	Inter	
	0.591	0.512	1.024		0.640	0.554	1.108	
Increased in stem diameter (mm)								
B_0	8.648	8.276	8.090	8.338	11.69	13.56	13.77	13.01
B_1	8.519	10.46	8.444	9.140	12.49	14.47	14.66	13.87
B_2	8.249	11.06	9.037	9.447	12.45	14.11	14.45	13.67
B_3	8.052	10.55	9.567	9.390	12.59	15.32	15.34	14.41
mean	8.367	10.09	8.784		12.30	14.37	14.56	
L.S.D5%	B	C	Inter		B	C	Inter	
	0.372	0.322	0.644		0.574	0.497	0.995	

Table 2: Effect of biofertilizers and compost application on branches number, leaves dry weight and leaf chlorophyll content of "Hollywood" plum transplants.

season	2018				2019			
Biofertilizers (B)	Compost (C)				Compost (C)			
	C_0	C_1	C_2	mean	C_0	C_1	C_2	mean
Branches number								
B_0	16.19	16.82	16.18	16.40	29.82	34.76	38.96	34.51
B_1	15.74	17.33	15.59	16.22	31.05	41.66	43.05	38.59
B_2	15.11	17.07	15.48	15.89	34.50	39.71	44.33	39.51
B_3	15.81	15.76	16.74	16.11	40.59	49.31	49.08	46.33
mean	15.71	16.75	16.00		33.99	41.36	43.86	
L.S.D5%	B	C	Inter		B	C	Inter	
	0.280	0.250	0.500		1.397	1.210	2.420	
Leaves dry weight (%)								
B_0	56.03	57.58	57.61	57.07	71.97	73.39	73.04	72.80
B_1	57.53	56.49	57.68	57.24	72.78	75.34	71.17	73.10
B_2	57.42	59.35	58.38	58.39	70.67	70.45	73.71	71.61
B_3	56.50	58.43	61.15	58.69	71.07	72.62	73.17	72.29
mean	56.87	57.96	58.71		72.77	72.95	72.77	
L.S.D5%	B	C	Inter		B	C	Inter	
	0.221	0.191	0.383		0.623	0.540	1.079	
Leaf chlorophyll content (mg.100gm^{-1})								
B_0	29.29	37.79	39.60	35.56	29.62	28.84	33.28	30.58
B_1	34.81	36.02	40.99	37.27	29.78	36.26	35.30	33.78
B_2	43.54	39.42	40.58	41.18	24.49	29.82	33.70	29.33
B_3	42.19	50.16	57.75	50.03	36.57	41.76	38.40	38.91
mean	37.46	40.85	44.73		30.11	34.17	35.17	
L.S.D5%	B	C	Inter		B	C	Inter	
	0.340	0.298	0.595		0.332	0.288	0.575	

treatment C_0 was 27.92 cm and 48.00 Cm during the two seasons, respectively.

The results showed in Table 1 that the addition of microorganisms led to a clear increase in the increased in stem diameter, where B_3 treatment gave the highest mean of 9.390 mm and 14.41 mm where it surpassed the control treatment (B_0), which gave the lowest value was 8.338 mm and 13.01 mm for both season, respectively. As for the role of compost, its effect on increased in stem diameter varied during the two seasons.The C_1 treatment gave the highest value of 10.09 mm during the first growing season, while the C_2 treatment gave the highest rate of increase in stem diameter was 14.56 mm for the second growing season, while the control treatment (C_0) gave the lowest value of diameter was 8.367 mm and 12.30 mm and for the two growing seasons, Respectively.

Effect of biofertilizers and compost application on branches number, leaves dry weight and leaf chlorophyll content of plum transplants:

The results shown in Table 2 showed that the addition of microorganisms varied in their effect on increasing of branches number during the growing seasons.It did not significantly affect during the first growing season, In the second growing season, the addition of microorganisms significantly affected the rate of increase in branches number, where B_3treatment gave the highest mean of 46.33 branches. The lowest mean was at B0, which gave a value of 34.51 branches. Plant^{-1}. As for the effect of adding compost, the C_1 treatment exceeded, which gave the highest mean of 16.75 branches. Plant^{-1} during the first growing season and C_2 treatment significantly outperformed, which gave the highest mean of 43.86 branches.Plant^{-1} during the second growing season. The results of Table 2 indicate that adding the microorganism factor may change its effect on leaves dry weight. During the first growing season, treatment B_3 outperformed giving it the highest leaves dry weight reaching 58.69%, while control treatment gave the lowest leaves dry weight of 57.07%. As for the second growing season, it is clear from the results that treatment B_1 exceeded the highest value of 73.10%. As for the effect of compost addition, it may be clear from the results of

the same table that the effect of adding this factor has also varied and during the two seasons of study, in the first season of the study, treatment C_2 may give a clear effect by giving it the highest leaves dry weight of 58.75% While the C_1 treatment gave the highest leaves dry weight it was 72.95%, while the control treatment (C_0) gave the lowest increase in leaves dry weight of 56.87% and 71.62% during the two growing seasons.

Results of Table 2 showed that B_3 treatment gave the highest leaves chlorophyll content of 50.03 and 46.20 mg.100g^{-1} respectively in the two seasons, while control treatment gave the lowest rate as it was 35.56 mg. 100 g^{-1} in the first growing season while B_2 gave the lowest content during the second growing season is 29.33 mg.100g^{-1}. The results showed that the leaves chlorophyll content was affected when adding compost, as C_2 treatment was higher than other treatments and gave the highest leaves chlorophyll content as it reached 44.73 and 35.17 mg.100g^{-1} for two growing seasons respectively, while the C_0 treatment gave the lowest leaves chlorophyll content of 37.46 and 30.11 mg.100 g^{-1} for the two seasons of the study, respectively.

The increase in vegetative traits may be attributed to the effect of biofertilizers on improving the biological and physical characteristics of the soil in addition to the chemical properties that resulted from the release of greater quantities of nutrients available for absorption by the roots and thus influence physiological processes such as increasing the efficiency of photosynthesis in the leaves (Yu *et al.,* 2014) and increased carbohydrate output, thereby increasing vegetative growth. The reason is also due to the increased susceptibility of the microorganisms to produce plant growth regulators such as auxin, cytokines and gibberellins, as they affect growth and increase nutrient uptake from the soil (Bhardwaj *et al.,* 2014). This is consistent with Attay (2015) on pomegranate trees and Al-Hadethi *et al.,* (2017) on peach transplants, when they found that there was a significant increase in most vegetative traits at Add biofertilizers. The reason for the increase in the vegetative traits as a result of adding compost is due to its role in increasing the proportion of organic matter in the soil and then improving the soil composition and increasing the amount of elements available to the plant that are used in the vegetative growth. Also, increasing the proportion of organic matter in the soil increases the activity of soil revival, which increased the mineralization of the organic matter in the soil and thus increased the liberation of the elements, especially nitrogen, which is included in the vegetative growth of transplants (Mosaddeghi *et al.,* 2009). These results agree with Sharaf et al (2015) when adding compost to apricots, Al-Rawi *et al.,* (2016) on fig. seedlings.

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