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# Effect of Adding SAPs Polymers and Spraying With Organic Fertilizer on The Vegetative and Root Growth Characteristics of Lawns

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## Abstract

The experiment was carried out in the fields of the Department of Horticulture and Landscaping, College of Agriculture - Anbar University for the period from 1/4/2020 to 31/1/ 2021 to experience the effectiveness of adding SAPs, spraying with organic fertilizers and the interaction between them in the vegetative and root growth characteristics of the lawn. The polymers were used in three concentrations (0, 20, 40) g kg<sup>-1</sup> soil, while the organic fertilizer was in four concentrations (0, 0.5, 1, 1.5) mL.L<sup>-1</sup>. A factorial experiment was carried out according to a randomized complete block design (RCBD) with three replications. The results showed that the addition of polymers at the level of 40 g kg<sup>-1</sup> soil had significant differences in the average plant density, root length, dry matter percentage and chlorophyll content in the vegetative group was 47.83 plant 100 cm<sup>-2</sup>, 25.20 cm, 36.85% and 89.36 mg g<sup>-1</sup> for hot season and 29.17%, 36.19 mg g<sup>-1</sup> for cold season. The high concentration of organic fertilizer 1.5 mL L<sup>-1</sup> showed significant differences in plant density, number of branches in the crown area, root length, dry matter percentage and chlorophyll content in the vegetative group was 46.00 plant 100 cm<sup>-2</sup>, 9.10 branch plant<sup>-1</sup>, 25.14 cm and 36.41%, 87.80 mg g<sup>-1</sup> for hot season and 29.04%, 33.99 mg g<sup>-1</sup> for cold season. The interaction treatment between the level of application of polymers 40 g kg<sup>-1</sup> soil and the treatment of adding organic fertilizer 1.5 mL L<sup>-1</sup> showed significant differences in the number of branches, root length, dry matter percentage and chlorophyll content in the vegetative group was 9.83 branch plant<sup>-1</sup>, 27.36 cm and 39.65%, 99.31 mg g<sup>-1</sup> for hot season and 33.44%, 42.10 mg g<sup>-1</sup> for cold season.

Keywords: Lawn, Polymers, Organic fertilizer.

## 1. Introduction

Lawns are large areas of land covered by a layer of short herbaceous plants that grow thickly and cover the cultivated area, which can be cut to give a beautiful green carpet [1]. Lawns occupy a major part (70% - 80%) of the area of most public and private gardens and parks. In the art of landscaping, they are considered as the main and central corner of the garden, being the largest mass in a green color that is comfortable to look at, in addition, it is considered as an important factor in softening the atmosphere, reducing the sun's heat and increasing the relative humidity through the transpiration process[2]. The cultivation of one type of green flat plants cannot retain its distinctive color throughout the year, as there are types that live and became yellow in winter, while others do not grow in high temperatures [3]. Accordingly, it is possible to address this problem through the process of over seeding by mixing the cold season seeds with the warm season seeds, and the choice of the type of grass plays a major role in performing the function of mixing between plant species [4]. The rainfall rates in Iraq are less than 250 mm per year, so it falls within the arid and semi-arid regions, and the water shortage is the biggest challenge facing agriculture today, as 70% of the total water use is in agriculture [5]. Therefore, it has become necessary to encourage water-saving agriculture through an integrated system of techniques and appropriate management [6]. In recent years, some chemicals are being applied in agriculture as additives to improve the ability of soil to retain water, one of these materials is a super absorbent polymer (SAP), which is a type of water-saving chemical, they are molecules that have the ability to absorb and retain fluids [7]. Aqueous extracts of organic matter contain major and minor elements at different levels according to the source of the organic matter used. In addition, these materials are easily absorbed by the plant and move quickly to be used [8]. Adding organic fertilizers by foliar feeding method works to distribute nutrients homogeneously on the plant, and since plants respond and absorb foliar nutrients faster and their costs are lower, they are preferred over ground fertilization [9]. Therefore, the study aims to increase the tolerance of the lawn and the effect of some factors that act as growth enhancers in increasing the survival of the lawn and increasing its homogeneous appearance for the longest possible period and retaining moisture through these improvements.



## 2. Materials and Methods

The experiment was carried out in the fields of the Department of Horticulture and Landscaping, College of Agriculture - Anbar University for the period from 1/4/2020. The soil was prepared by cleaning, leveling and making a fence surrounding the field, and then building square basins of bricks (1 x 1 )m with a depth of 30 cm, separated by 20 cm intervals for each experimental unit. The basins were covered with a soil of a clay mixture texture (Table 1), with the addition of polymers to the soil before planting, at the concentrations mentioned previously, Then sown a mixture of seeds consisting of warm and cold season plants at a rate of 25g m<sup>-2</sup> (Table 2). The cutting process is carried out whenever the plant reaches 10 cm in length, it is cut to 4 cm, in addition to fertilizing in three batches, summer, autumn and winter, with NPK fertilizer and urea at a rate of 15 g for each experimental unit for each type of fertilizer. The concentrations of polymers were 0, 20, and 40 g kg<sup>-1</sup> soil, while the concentrations of organic fertilizer were 0, 0.5, 1.5, 1 ml L<sup>-1</sup>, spraying on the foliage at a rate of four sprays per season.. The factorial experiment was carried out according to the Randomized Complete Block Design (RCBD) with an average of 12 treatments for each block using three replications with a total number of 36 experimental units. The averages were compared according to the L.S.D test at a probability level of 5%. The chemical and physical analysis of the study soil was carried out in the laboratory of the Anbar Agriculture Directorate.

**Table 1.** Some physical and chemical properties of the study soil.

Properties	Units	Quantity and symbol
sand		545
clay		264
Silt	g kg <sup>-1</sup>	191
Texture		Clay loam
PH	-	7.1
electrical conductivity	dS m <sup>-1</sup>	2.7
bulk density	Mg m <sup>-3</sup>	1.33

**Table 2.** Types of seeds used.

Percentage	English name	Scientific name
%50	Bermuda grass -	<i>Cynodon dactylon</i>
30%	Tall Fescue-	<i>Festuca arundinacea</i>
10%	Perennial rye grass-	<i>Lolium perenne</i>
10%	Kentucky blue grass-	<i>Poa pratensis</i>

### 2.1 Studied traits

#### 2.1.1 Plant density (100 cm<sup>2</sup>)

The plant density was calculated in 100 cm<sup>2</sup> of each experimental unit at the end of the experiment by randomly plucking the plants in the mentioned area and counting their numbers manually after washing them well with water [10].

#### 2.1.2 Number of branches in the crown area (branch plant<sup>-1</sup>)

After the plants were extracted in the previous measurement, a random sample of 10 plants was taken and the number of branches in the crown area was calculated and the average was calculated [11].

#### 2.1.3 Root length (cm)

The root length was measured at the end of the experiment after selecting samples randomly, and the usual ruler was used to measure the length of the roots, then extract the average [12].

### 2.1.4 Percentage of dry matter in the vegetative group (%)

The percentage of dry matter was estimated according to the following equation:

$$\text{Dry matter percentage} = \text{dry weight} / \text{wet weight} \times 100 \text{ [13].}$$

The estimation of total chlorophyll in vegetative growth ( $\text{mg g}^{-1}$  wet weight)

The chlorophyll content was estimated according to method [14].

$$\text{Total chlorophyll ( mg/L)} = (20.20) ( A_{645\text{nm}}) + (8.02) (A_{663\text{nm}})$$

Estimate of proline in vegetative growth ( $\text{micro mg}^{-1}$  wet weight). The proline content was estimated by method [15].

## 3. Results and Discussion

It is noticed from Table (3) that there is a significant difference in the rate of plant density when treated with polymer, as treatment P2 gave the highest value of 47.83 (plant  $100 \text{ cm}^2$ ) compared to treatment P0, which amounted to 39.16 (plant  $100 \text{ cm}^2$ ). Also, spraying with organic fertilizer caused significant superiority, as treatment L3 gave the highest values 46.00 (plant  $100 \text{ cm}^2$ ) compared to treatment L0, which recorded the lowest values of 41.44 (plant  $100 \text{ cm}^2$ ). While the results of the interaction between the two factors of the study did not show any significant differences in this trait. The reason for the increase in the rate of plant density when treated with polymer may be due to the improvement in soil structure when treated with polymers, which led to an increase in the percentage of available water and this increased the percentage of elements ready for absorption in addition to improving soil aeration, increasing the microbial activities in the soil and promoting germination [16], which increased the plant growth and density, and this agreed with the results reached by [17]. It was mentioned that the polymers improved the plant density of five types of lawn plants even at low seeding rates. As for the reason for the increase in plant density when spraying with organic fertilizer, it is due to its role in improving the vegetative and root characteristics in addition to the abundance of the necessary nutrients in it, whether they are major or minor elements, and their effects on the process of respiration and photosynthesis, as some of them, such as nitrogen and phosphorus, are included in the composition of DNA and RNA necessary for cell division and increasing the number of internodes, and then increasing plant height and plant thickness [18].

**Table 3.** Effect of polymers and organic fertilizer and the interaction between them on plant density (plant  $100 \text{ cm}^2$ )

organic fertilizer (L)	Polymers (p)			Average L
	P0	P1	P2	
L0	35.00	43.00	46.33	41.44
L1	38.66	45.00	47.00	43.55
L2	40.33	43.33	48.33	44.00
L3	42.66	45.66	49.66	46.00
Average P	39.16	44.25	47.83	
(0.05) LSD P			1.59	
(0.05) LSD L			1.84	
(0.05) LSD PL			N.S	

As for the results of Table (4), there were significant differences in the number of branches of the crown area between the concentrations of organic fertilizer, as the L3 treatment was significantly superior by giving the highest value of 9.10 branch  $\text{plant}^{-1}$  compared with the control treatment L0 which recorded the lowest value of 6.18 branch  $\text{plant}^{-1}$ . As for the interaction between the two factors of the study, P2L3 treatment outperformed the rest of the treatments with an average of 9.83 branch  $\text{plant}^{-1}$ , compared to treatment P0L0, which recorded the lowest branching of 5.93 branch  $\text{plant}^{-1}$ . While the results did not show significant differences in the number of branches when treated with polymers. The reason for the increase in the number of branches when treated with organic fertilizer may be attributed to the humic and fulvic acids present in the organic fertilizer, which increase the vital activity of the plant through the preparation of enzymatic systems and increase the formation of DNA, RNA and tRNA, which stimulate the formation of cytokines, which in turn stimulate the rapid division of cells. Thus, encouraging lateral growths [19], and this is in agreement with the findings of [20]. It was mentioned that spraying with Humic increased the number of branches in the crown area of lawn plants.

**Table 4.** Effect of polymers and organic fertilizers and the interaction between them on the number of branches (branch.Plant<sup>-1</sup>).

Organic fertilizer (L)	Polymers (p)			Average L
	P0	P1	P2	
L0	5.93	6.60	6.00	6.18
L1	7.83	7.33	8.86	8.01
L2	8.13	8.90	8.16	8.40
L3	8.53	8.93	9.83	9.10
Average P	7.61	7.94	8.21	
(0.05) LSD P			N.S	
(0.05) LSD L			0.61	
(0.05) LSD PL			1.05	

It also appeared through the results indicated in Table (5) that there were significant differences in the length of the roots when treated with polymers, as treatment P2 gave the highest length of 25.21 cm compared to treatment P0, which gave the lowest length of 21.33 cm. Also, spraying with organic fertilizer achieved significant differences in root length, as treatment L3 was significantly superior at a rate of 25.14 compared to treatment L0, which recorded the lowest value of 21.37 cm, as for the interaction between the two factors of the study, treatment P2L3 was significantly superior with the highest root length of 27.36 cm compared with treatment P0L0, which recorded the lowest value of 18.43 cm. The reason for the increase in the roots length when treated with polymers, it is due to its ability to absorb water and give it to the plant when needed, which results in an improvement in plant growth, an increase in microbial activities and an improvement in soil aeration, which improves the growth of the root system [21], and this is in agreement with what was mentioned [22]. The reason for the increase in the roots length when spraying with organic fertilizer may be due to the fact that it contains nutrients necessary for permanence of the division and growth of plant cells, including nitrogen, potassium and phosphorous, as well as micro-nutrients, including iron and zinc, which have a role in activating many enzymatic reactions within the plant in addition to providing Humic acids (Humic, Fulvic), which improves the permeability of the cell membranes of root hairs and facilitates the absorption of nutrients into the cytoplasm of root cells, which leads to an increase in both the roots length and diameters [23].

**Table 5.** Effect of polymers and organic fertilizer and the interaction between them on root length (cm).

Organic fertilizer (L)	Polymers (p)			Average L
	P0	P1	P2	
L0	18.43	22.27	23.41	21.37
L1	20.91	23.10	24.22	22.74
L2	22.53	22.30	25.83	23.55
L3	23.44	24.63	27.36	25.14
Average P	21.33	23.08	25.21	
(0.05) LSD P			0.81	
(0.05) LSD L			0.94	
(0.05) LSD PL			1.63	

The results of Table (6) showed that there was a significant difference in the percentage of dry matter in the vegetative when treated with polymers for the hot and cold months. The treatment P2 excelled with the highest value of 36.85% and 29.17%, respectively, compared to the control treatment P0, which recorded the lowest results for the hot and cold months. amounted to 28.54% and 22.80%, respectively, Spraying with organic fertilizer also achieved significant differences in the percentage of dry matter, as the L3 treatment was significantly superior to the hot and cold months, recording the highest percentage of 36.41% and 29.04%, respectively, compared to the control treatment L0, which recorded the lowest percentage of dry matter amounted to 30.33% and 23.51% for the hot and cold months, respectively, it was also found that there were significant differences for the interaction between the two factors of the study for the hot and cold months, as the treatment P2L3 excelled with the highest percentage of dry matter, which amounted to 39.65% and 33.44%, respectively, compared with the control treatment P0L0, which gave the lowest percentage of dry matter for the hot and cold months amounted to 25.76% and 21.54%, respectively. The rest of the treatments ranged between them for the hot and cold months. The reason for the increase in the percentage of dry matter when treated with polymers may be due to its role in maintaining moisture and preventing water penetration into the depths of the soil away from the root system and thus maintaining the readiness of water and nutrients when the plant is exposed to water shortage, which allows the plant to grow and divide, which leads to an increase in the dry weight [24] and this is in agreement with what was mentioned [25]. The reason for the increase in the

percentage of dry matter when treated with organic fertilizer is due to the provision of these nutrients, including nitrogen, phosphorous, potassium and microelements, which leads to good growth of the vegetative system by increasing the number of leaves, leaf area and increasing the products of photosynthesis, which is positively reflected in the accumulation of carbohydrates and the provision of Nuclear acids needed to build proteins, which leads to the increase in the dry weight [26].

**Table 6.** Effect of polymers and organic fertilizers and the interaction between them on the percentage of dry matter in vegetative group (%).

organic fertilizer (L)	hot months period (1)			cold months period (2)		
	Polymers (P)			Polymers (P)		
	P0	P1	P2	P0	P1	P2
L0	25.7629	28.8735	30.36	21.5424	22.2524	23.75
L1	26.5034	26.5335	32.05	22.2326	22.7827	25.96
L2	29.5636	26.2637	33.33	22.7025	25.5330	26.53
L3	32.3337	25.2539	36.65	24.7128	28.9833	33.44
Average P	28.5434	28.4836	30.85	22.8026	23.3929	25.17
(0.05) LSD P	1.05			1.28		
(0.05) LSD L	1.22			1.48		
(0.05) LSD PL	2.11			2.56		

- hot months period (June - July - August -September)
- cold months period (October-November-December-January)

The results of Table (7) showed that there were significant differences between the concentrations of polymers in the content of chlorophyll in the vegetative group, as the treatment P2 was significantly superior to the hot and cold months with the highest value amounting to 89.36 mg g<sup>-1</sup> and 36.19 mg g<sup>-1</sup> sequentially compared with P0, which gave the lowest value reached 67.62 mg g<sup>-1</sup> and 23.62 mg g<sup>-1</sup> for the hot and cold months, respectively, the spraying with organic manure also achieved significant differences, as the treatment L3 excelled for the hot and cold months, recording the highest value of 87.80 mg g<sup>-1</sup> and 33.99 mg g<sup>-1</sup> compared to treatment L0, which gave the lowest results, amounting to 68.63 mg g<sup>-1</sup> and 25.01 mg g<sup>-1</sup>, for the hot and cold months, respectively. The results also showed that there were significant differences between the two studied factors in the chlorophyll content in the vegetative group, as the treatment P2L3 excelled for the hot and cold months with the highest rates amounting to 99.31 mg g<sup>-1</sup> and 42.10 mg g<sup>-1</sup> compared to treatment P0L0, in which the percentage of the dry matter reached 48.30 mg g<sup>-1</sup> and 20.60 mg g<sup>-1</sup> for the hot and cold months, respectively. and the other treatments ranged between them for the hot and cold months. The reason for the increase in chlorophyll content when treated with polymers may be due to its ability to hold water in very large quantities that exceed its weight and re-release it when the plant needs it, which reduces the effect of drought and increases the efficiency of the photosynthesis process, which leads to an increase in the content of chlorophyll [27], and this agreed with What was mentioned by [1]. It may be due to humic and fulvic acids and their role in increasing the permeability of nutrients, including nitrogen, which participates in the formation of the four porphyrins groups involved in the synthesis of chlorophyll [5].

**Table 7.** Effect of polymers and organic fertilizers and the interaction between them on the estimation of total chlorophyll on vegetative growth (mg g<sup>-1</sup> fresh weight).

organic fertilizer (L)	hot months period (1)			cold months period (2)		
	Polymers (P)			Polymers (P)		
	P0	P1	P2	P0	P1	P2
L0	48.3077	48.4880	68.12	20.6024	23.3230	25.12
L1	66.6678	67.7384	76.69	21.4726	22.7340	27.09
L2	75.9180	70.9333	83.33	24.3636	14.3843	32.98
L3	79.6084	50.9931	87.80	28.0631	8.2421	33.10
Average P	67.6280	67.3589	76.36	23.6229	23.6436	25.19
(0.05) LSD P	3.45			1.69		
(0.05) LSD L	3.99			1.96		
(0.05) LSD PL	6.91			3.39		

- hot months period (June - July - August -September)
- cold months period (October-November-December-January)

The results in Table (8) also show that the increase in the concentration of polymers decreased the content of proline for the hot and cold months, as the treatment P2 significantly decreased the proline content, amounting to  $28.73 \mu \text{mg}^{-1}$  and  $14.93 \mu \text{mg}^{-1}$ , respectively, compared with the control treatment P0, in which The highest value was recorded for the hot months and the cold months, ( $56.37 \mu \text{mg}^{-1}$  and  $26.57 \mu \text{mg}^{-1}$ , respectively), the spraying with organic fertilizer also achieved significant differences in the content of proline in the vegetative group, as the L3 treatment decreased significantly in the proline content of the hot and cold months amounted to  $36.44 \mu \text{mg}^{-1}$  and  $18.13 \mu \text{mg}^{-1}$ , respectively, compared with the control treatment L0, which amounted to  $46.07 \mu \text{mg}^{-1}$  and  $23.21 \mu \text{mg}^{-1}$  for the hot and cold months, respectively, as for the interaction between the two study factors, the results showed significant differences, as the treatment P2L2 decreased significantly on the rest of the treatments for the hot and cold months and amounted to  $27.38 \mu \text{mg}^{-1}$  and  $13.85 \mu \text{mg}^{-1}$ , respectively, compared to the treatment P0L0, in which the value of proline reached  $64.80 \mu \text{mg}^{-1}$  and  $34.78 \mu \text{mg}^{-1}$  for the hot months and cold months, respectively. The reason for the low levels of proline when treated with polymers is the ability of the polymers to retain water and prevent its infiltration into the depths of the soil and thus maintain the appropriate moisture in the root area and this reduces or eliminates the effect of water stress and thus reduces levels of proline acid, which increases mainly in conditions of water in salt stress [24] and this agrees with what was mentioned [11], it was mentioned that the treatment with polymers reduced the levels of proline in the American grass *Cynodon dactylon*, as for the reason for the low levels of proline when spraying with organic fertilizers, it is due to the effect of humic acid, which increases the permeability of cell membranes and the absorption of nutrients, which leads to an increase in photosynthesis and the formation of carbohydrates and proteins, which are the basic building blocks of enzymes and chromosomes, and therefore it reduces the decomposing amino acids, including proline, and that By reducing water stress because proline is multiplied about 12 times in plants exposed to stress [17].

**Table 8.** Effect of polymers and organic fertilizers and the interaction between them on the estimation of proline on vegetative growth ( $\mu \text{mg}^{-1}$  fresh weight).

organic fertilizer (L)	hot months period (1)			cold months period (2)		
	Polymers (P)			Polymers (P)		
	P0	P1	P2	P0	P1	P2
L0	64.80	44.70	28.70	46.07	34.78	20.44
L1	61.47	41.59	29.65	44.24	26.52	18.57
L2	53.06	36.50	27.38	38.98	23.67	19.73
L3	46.14	34.00	29.19	36.44	21.31	17.66
Average P	56.37	39.20	28.73	26.57	19.03	14.93
(0.05) LSD P	2.47			2.09		
(0.05) LSD L	2.85			2.42		
(0.05) LSD PL	4.94			4.19		

- hot months period (June - July - August -September)
- cold months period (October-November-December-January)

## Conclusion

The addition of polymers to the soil positively affected the characteristics of the vegetative and root growth of the lawn due to the improvement of the physical properties of the soil and the increase in its ability to hold water and thus increase the plant's tolerance to drought conditions, as there was an increase in the rate of plant density, root length, percentage of dry matter and chlorophyll content in the vegetative group. Also, spraying with organic fertilizer had a positive effect on the vegetative and root growth of the lawn due to its high content of nutrients and organic acids such as humic and fulvic, as there was an increase in the rate of plant density, number of branches, root length, dry matter percentage and chlorophyll content in the vegetative group.

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