Original Article

Effect Of Adding Polymer (SAP) And Spraying Anti-Transpiration Kaolin And Yeast On Some Indicators Of Vegetative Growth And Some Chemical Traits Of Leaves Of Carica Papaya L

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Abstract

During the growing season of 2021, an experiment was conducted on a papaya plant at the research station of the College of Agriculture and Marshlands, Dhi Qar University, to determine the impact of adding various levels of SAP agricultural polymer (0, 50, 100) g. m-2, anti-transpiration kaolin at levels (0, 1, 3) g.L-1, and baking yeast at two levels (0, 20) g.L-1. In terms of several chemical properties and characteristics of vegetative development, The results showed that the yeast spray (20 g.L-1), the anti-transpiration therapy (3 g.L-1), and the polymer addition treatment (100 g.m-2) were the most effective treatments. The complete random block design was utilized with three replicates. In comparison to the other treatments, they produced plants with the maximum height, leaf area, stem diameter, number of leaves, chlorophyll content, and leaf carbohydrate content.

Keywords: polymer, anti-transpiration, papaya, leaf area, root dry weight.

Introduction:

Papaya plant Carica papaya L. of tropical evergreen fruit plants, the origin country of this plant tropical regions of America and possibly southern Mexico, Costa Rica or Central America, successful growth in tropical and temperate regions. The papaya plant is a fast-growing, vigorous plant whose fruits are eaten fresh or preserved or used in making juice, jams or sauces and are used in the manufacture of many pharmaceutical and cosmetic preparations. .As well as the papaya plant has a role in treating many diseases that affect humans and for different age groups by using different parts of the papaya plant (Ramal, 2005 and Al-Saadi, 2003; Kala, 2012). Perhaps one of the most important reasons that lead to the deterioration of agricultural production is the problem of drought and water scarcity, which is one of the most important factors affecting the growth and production of plants. Therefore, most physiological processes are directly related to the availability of water. Therefore, water is the first limiting factor for production, and it is the main reason for the decrease in production by 18-10% in arid and semi-arid areas (Chaves, et.al, 2002). SAPs (Superabsorbent Polymers), which are defined as 3D hydrophilic polymeric networks, are lightly cross-linked and ductile in water. These materials can absorb large quantities of water that may reach 1000 times or more of their net mass, and they can retain water even if they are subjected to a certain pressure effect on them. (ZOHOURIAN, et.al, 2008). The use of safe and environmentally friendly anti-transpirants is an effective methods to reduce water loss from the plant and increase the productivity of the crop and its components. A group of researchers showed that the use of anti-transpiration had a positive effect on increasing the growth and yield of different plant species (IISR, 2012, Iriti, et.al 2009, and Ouda, et.al 2007). Since the amount of water actually consumed by the plant is less than 10% of the irrigation water and 90% of the water is lost through transpiration (Mackay et.al, 2003). Especially what happens in areas with high temperatures that cause stress to the plant, resulting in many physiological damages that lead to a decrease in the size of the plant and its leaf area and yield (Gu, 1998) Regarding the impact of organic fertilizers, we discover that they serve as a crucial and fundamental source of the macro- and microelements that all plants require. They also play a crucial role in enhancing the physical, chemical, and biological qualities of soil, and in recent years, they have become increasingly popular. Because they contain organic acids like humic and folic acids, amino acids, and other substances and are easy to use, cheap, and low-polluting to the environment and agricultural products, liquid organic fertilizers have become one of the most important clean alternatives to the nutrients needed by fruit seedlings. They also contribute to improving the physical, chemical, and biological properties of the soil. (Al-Araji, 2010) In addition, these substances are characterized by being absorbed by the root system of plants and releasing ions in an easy way, and also moving quickly to be used by the plant by participating in physiological processes, which provides the plant with the energy needed to absorb it, especially in the critical stages of its growth. (Al Allaf, 2014, 2018).For the purpose of knowing the extent of the effect of adding the super absorbent polymer, concentrations of anti-transpiration spray and organic fertilizer on the success of papaya fruit cultivation under the environmental conditions of southern Iraq, as well as identifying the most important traits of vegetative growth.

Materials and methods:

The current study was conducted at the research station of the College of Agriculture and Marshes, Dhi Qar University, on papaya plant during the 2021 growing season for the purpose of knowing the effect of adding different levels of agricultural polymer SAP, anti-transpiration kaolin and bread yeast on vegetative growth traits, quantitative and qualitative yield traits. Fifty-four papaya bushes were selected and weeds were marked by digital marking, and they were planted in pots with dimensions of 50 cm x 50 cm and grown in soil (Table 1). Field soil and irrigation water were analyzed in the laboratories of the Research Center of the College of Agriculture and the Marshes of Dhi Qar University. Table (1) shows some physical and chemical properties of field soil. All service operations were conducted for the papaya weeds , including hoeing and weeding, as well as adding decomposed organic fertilizer to the trees at the beginning of the winter season. Then, the process of adding chemical fertilizer to weeds, which is the compound fertilizer NPK, and the amount added according to the age stage.

Table (1) Some of the primary properties of soil and irrigation water used in the study.

Soil layer depth (cm)	particle size			texture	BD	Porosity	pH	EC	O**M**	Na	Ca
	Clay (%)	Silt (%)	Sand (%)		g cm^{-3}	%		dsm^{-1}	%	meq l^{-1}	
0 - 30	20.8	23.6	55.6	Loam	1.28	50.76	8.20	3.64	2.43	24.17	3.76

Studied traits:

1- Plant height (cm):

2- leaf area (cm^2):

3- stem diameter (cm):

4- Number of leaves ($leaf.plant^{-1}$):

5- Estimation of the total soluble carbohydrates in the leaves:

This trait was determined by the modification of phenol sulfuric acid colorimetric method (PSACM) mentioned by (Dubois et al., 1956).

6- Determination of total chlorophyll pigment in leaves:

The total chlorophyll pigment in grape leaf samples was estimated according to Goodwin (1976) method, during the month of April 2016. Where 0.5 gm of fresh leaves was taken, the pigments were extracted by 80% acetone, and the pigments were estimated in a spectrophotometer. Chlorophyll pigment(a) was measured at a wavelength of 663 nm and chlorophyll (b) at a wavelength of 645 nm, while the total chlorophyll pigment was estimated by calculating the concentration of dyes as in the following equations:

Total chlorophyll mg/L = 20.2×O.D. (645) - 8.02×O.D.(663)

The results were then converted to units of (mg/100) g of fresh weight.

O.D. : Represents the device reading.

statistical analysis:

The experiment was conducted according to a Randomized Complete Block Design (R.C.B.D) and in a Factorial Experiment with three factors, the first factor represented the addition of polymer and it was at three levels (0, 50, 100) g.m^{-2} and the second factor represented anti-transpiration spraying with three levels (3 levels). 1,0) g.L^{-1}.The third factor is two levels of yeast spray (20,0) g. L^{-1}, and the number of experimental treatments was (18) factorial and the number of replicates for each treatment was 3, and the total experimental units were (54) experimental units.As for the statistical analysis of the experimental data, it was done using the statistical program Genestat, and the Least Significant Differences (L.S.D) test was used at the probability level of 0.05 to compare the means of treatments.

Results:

vegetative growth traits:

When comparing the averages of treatments, significant differences were found between all treatments. The results of the statistical analysis of the F-test (Table 2) demonstrate that the polymer addition factor has a significant impact on the values of plant height, leaf area, stem diameter, and number of leaves (Table 2). The greatest values were obtained with the 100 g. m-2 treatment and were 183.89 cm, 179.73 cm2, 8.91 cm, and 22.72 leaf. plant-1, respectively. The lowest values were produced by the control treatment and were, in order, 158.17 cm, 169.02 cm2, 4.81 cm, and 10.56 leaf.plant-1. Additionally, Table 2's treatment with anti-transpiration spray at a 3 g concentration is noted. L-1 outperformed the other treatments and produced a plant with the largest height (177.00 cm), leaf area (179.42 cm2), stem diameter (7.60 cm), and leaf count (18.44 leaf.plant-1). The lowest results were obtained when the control treatment did not involve spraying; they were, respectively, 164.67 cm, 171.48 cm2, 5.83 cm, and 15.82 leaf.plant-1. Table 2's results on the influence of yeast spray on vegetative development traits show a highly significant effect, The treatment of 20 g.L^{-1} was excelled and gave the highest values for plant height, leaf area, stem diameter and number of leaves with an increase of 7.90%, 5.11%, 54.99%, 24.81%, respectively compared with the control treatment without spraying.

Table (2) Effect of SAP, Kaolin Anti-transpiration and Bread Yeast on some vegetative growth traits of papaya plant

Treatments	levels	plant height ((cm	Leaf area ((cm2	stem diameter (cm)	number of leaves (leaf.plant^{-1})
add polymer	0	158.17 c	169.02 b	4.81 c	10.56 c
	50	169.06 b	178.71 a	6.59 b	17.94 b
	100	183.89 a	179.74 a	8.91 a	22.72 a
	LSD	**2.056**	**1.535**	**0.367**	**1.052**
anti transpiration spray	0	164.67 c	171.48 c	5.83 c	15.72 c
	1	169.44 b	176.57 b	6.87 b	17.06 b
	3	177.00 a	179.42 a	7.60 a	18.44 a
	LSD	**2.056**	**1.535**	**0.367**	**1.052**

Yeast spray	0	163.89 b	171.44 b	5.31 b	15.19 b
	20	176.85 a	180.21 a	8.23 a	18.96 a
	LSD	**1.679**	**1.253**	**0.300**	**0.859**

Chemical traits:

The results of the statistical analysis of the F-test (Table 3) show that there is a significant effect of the polymer addition factor on the values of chlorophyll and carbohydrates in the leaves. When comparing the averages of the transactions, significant differences appeared between all the treatments (Table 3). The 100 g. m^{-2} treatment recorded the highest values with 16.22 mg 100 g^{-1} and 15.18% respectively, while the control treatment gave the lowest values 9.94 mg 100 g^{-1} and 11.52%, respectively.As we notice from Table 3, the treatment of spraying anti-transpiration at a concentration of 3 $g.L^{-1}$ was excelled, with a significant difference from the rest of the treatments, and it gave the highest chlorophyll in the leaves amounted to 14.35 mg 100 g^{-1} and carbohydrates in the leaves amounted to 14.41%, while the lowest values were in the control treatment without spraying by 11.39 mg 100 g^{-1}, 12.79%, respectively. As for the effect of yeast spray on vegetative growth characteristics, we note from Table 2 that there is a highly significant effect, The treatment of 20 $g.L^{-1}$ excelled and gave the highest values of chlorophyll and carbohydrates in the leaves with an increase of 26.87% and 16.57%, respectively, compared to the control treatment without spraying.

Table (3) Effect of SAP, Kaolin Anti-transpiration and Bread Yeast on some chemical properties of papaya leaves

Treatments	levels	Total chlorophyll (mg.100g-1(	total soluble carbohydrates (%)
add polymer	0	9.94	11.52
	50	13.35	14.06
	100	16.22	15.18
	LSD	**0.450**	**0.171**
anti transpiration spray	0	11.39	12.79
	1	13.77	13.57
	3	14.35	14.41
	LSD	**0.450**	**0.171**
Yeast spray	0	11.61	12.55
	20	14.73	14.63
	LSD	**0.368**	**0.140**

Discussion:

The addition of the polymer helps the soil to retain water, and thus the soil retains sufficient quantities of water, which helps the roots to absorb it and benefit from it in the vital processes inside the plant, which increases the plant height (El-Shahorey et al., 2010).Super absorbent polymers also play an important role in increasing the ability of the soil to absorb a large amount, store it and regulate its release to plants. As well as improving some important physical properties of the soil, such as increasing the weighted diameter rate, the total porosity and the decrease in the bulk density of the soil, which helped the roots absorb large amounts of water and nutrients, which was positively reflected in improving the vegetative growth of the plant (Al-Halafi, 2016).The addition of the polymer and its mixture with the surface layer works to reorganize the interracial pores in the soil and maintain a good structure, which works to provide moisture well for the plant and thus is reflected in the activation of vegetative growth indicators. This is in agreement with the findings of Oraee and Moghadam (2013) and Khaleghi and Moallemi (2018) who observed the improvement of the vegetative growth traits of fruit trees when the polymer was added.As for anti-transpiration, it works to prevent stem stunting by preserving the water content of plant tissues, where the increase in plant height occurs through the process of cell division and expansion represented by the growth process, which means the availability of building materials for cells and pressure of filling.Regulating membrane permeability and internal hormonal balances, all of which are related to plant water content and consequently water conservation in sandy soils (Nehad, 2015). The increase in the leaf area may be due to achieving some balance between reducing transpiration at times of peak transpiration and allowing gas exchange at moderate transpiration times, by liquefying these compounds at high transpiration intensity and then releasing the anti-transpiration layer when transpiration is lacking or absent. Thus, its action is regulatory and not completely inhibiting transpiration, which allows the growth and increase of leaf area through increasing the efficiency of photosynthesis (Quanzhi and Erming, 1998). Silicates build up in the leaf to form a double layer, which encourages less transpiration and less water loss (De Freitas et al., 2011). This outcome is caused by silicon, which improves hydration levels and subsequently makes it easier for plant cells to conduct photosynthesis (Crusciol et al., 2009). As indicated in Table 2, anti-transpiration promotion of papaya plant vegetative growth can be used to explain this increase in output. This is consistent with what Cirillo et al., (2021) found through their study on olive seedlings sprayed with 2% anti-transpiration agent, which was added five times during the season. As for yeast, it contains large amounts of mineral elements, proteins, carbohydrates and vitamins, which contribute to an increase in physiological processes within the plant, this has a good impact on the papaya trees' vegetative growth. Yeast is also a natural source of cytokinins, which contribute to stimulating cell division and widening, and thus the number of leaves (Ezz El-Din and Hendway, 2010). This result is in line with what was found by Faten et al., (2004) in his study on papaya trees, where it was found that the treatment of 500 ml L-1 gave the highest number of leaves amounting to 24.67 and 20.00 leaves of a plant-1, while the control treatment gave the lowest values by 17.67 and 19.67 leaves-1 for both seasons 2003 and 2004, respectively .Yeast also contains amino acids, proteins and mineral nutrients, which in turn enter into the synthesis of organic bases, which lead to the formation of nucleic acids, DNA and RNA, and the synthesis of growth hormones such as auxins. Especially IAA, it plays a part in improving the primary cambium's efficiency, which in turn has an impact on how well wood and bark are produced, the thickness of the stem, and the diameter of the stem (Mohammed, 1985).

Conclusions:

In the light of the field experiment, the addition of the polymer improved the traits of vegetative growth, such as increasing plant height, area, leaf area, stem diameter and number of leaves, which was positively reflected on the content of chlorophyll and carbohydrates in the leaves. Spraying papaya plants with anti-transpiration and yeast also led to positive results in improving the traits of vegetative growth through a significantly positive relationship and affecting the photosynthesis process, growth and nutritional content in plants under different treatment conditions, which led to improving the cultivation of the papaya crop and its tolerance to climatic conditions in the southern region of Iraq.

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