



Effect of Spraying with Growth Regulator (2, 4-D) and adding Organic Fertilizer on Growth and Yield of Sour Orange (*Citrus aurantium* L.)

Abbas Hadi Hashim, Sahar Hussein Takheal and Majida Mohammed Hasan

Al-Mussaib Technical College, AL-Furat Al-Awsat Technical University, Babylon, 51001, Iraq
E-mail: com.abs@atu.edu.iq

Abstract: The experiment was conducted during 2018-2019 at Al-Hindiya Barrage region in Babylon province to study the effect of adding organic fertilizer (sheep manures) at two levels. (0, 10) kg tree⁻¹ and spraying with a growth regulator 2,4-D with four levels (0, 1, 2, 3) ml L⁻¹ on the vegetative, quantitative and qualitative traits of sour orange. The application of organic fertilizers at 10 kg tree⁻¹ significantly excelled and gave the highest average of growth and yield contributing traits. The spraying with growth regulator 2, 4-D at a concentration 3m L⁻¹ was significantly superior to the rest of the treatments in all traits. The combination organic fertilizer at 10 kg tree⁻¹ + spraying growth regulator at concentration of 3 ml L⁻¹ was significantly superior and gave the highest average of all traits.

Keywords: Sour orange, *Citrus aurantium*, Sheep manures, 2,4-D

Sour orange (*Citrus aurantium* L.) is the second citrus crop in Iraq with 5583591 total number of citrus fruit trees, with 634796 Sour orange trees, whose production is 17393 tons, at a rate of 27.4 kg per tree. The cultivated of sour orange is spread in the central regions of Iraq. In order to increase the productivity, nutrients management play significant role. The provision of nutrients in a ready manner is considered an important factor in ensuring a good yield. The adding of organic fertilizers to the soil has great benefits as they provide the necessary elements to the plant, especially nitrogen, and it is also important in encouraging the growth of microorganisms that play significant role to decompose the organic matter into the nutrients that the plant benefits from, which improves the soil properties and increases its fertility. The advantage of organic fertilizers is to slowly release nutrients depending on the biological activity of their decomposition and conversion into a form that the plant can absorb and benefit from, Organic fertilizers are called safe fertilizers and soluble salts are low and do not harm plants, as it works on nutritional balance. Fadila et al (2008) observed that adding organic fertilizer to grapefruit trees, an increase the weight, size of fruits, juice percentage in fruits and total yield. Auxins have the ability to regulate growth by stimulating cell elongation. It has also been proven that Auxin is one of the natural stimulating hormones for growth. The 2, 4- D is one of the Auxin contained in the phenoxy compound group which are used in low concentrations to regulate branch growth. Awad (2014) observed significant effect on the average of leaf area,

soluble protein and total chlorophyll when spraying seedlings with NAA, maleic hydrazide and salicylic acid at concentration of 100 mg. liters. The present research aimed to study the effect of adding organic fertilizer (sheep manures) and growth regulator spray 2, 4 D on growth, yield and chemical traits of citrus.

MATERIAL AND METHODS

The research was conducted in Hindiya Barrage region of Iraq during 2018-2019 in a factorial experiment according to the randomized complete block design with three replicates on the sour orange, with an age of three years (*Citrus aurantium* L.). The experiment included two factors: the first is organic fertilizer sheep manure at two levels (0, 10 kg .tree⁻¹), and the second factor is four growth regulators 2,4D at four levels (0, 1, 2, and 3 ml L⁻¹). Trees were sprayed early in the morning by adding the spreader Tween-20 (0.01%) volume /volume. The treatment was sprayed on the leaves to the degree of wetness, on February 20, 2018 and the second after a month from the first spraying. The results were analyzed using the GENE STAT program. The effect on following traits was observed on different parameters. The leaf area was calculated on the basis of the dry weight of the leaf., The leave was dried by placing in paper perforated bags in an electric oven at temperature of 70 ° C for a period of 48 hours until the weight become constant The area of the leaf was calculated according to the following equation (Dvorinic 1965):

$$S= G \times s/g$$

Where: S = Leaf area (cm²), G = Leaf weight (g), s = Average square area (cm²), g = Average weight of cut square (g)

Total chlorophyll in leaf (mg /g fresh tissue) was estimated by the Chlorophyll Meter 502 (SPAD) of Japanese company Minolta. The weight of the fruit and fruit pulp was estimated. The percentage of total soluble solids in fruits was determined by taking 20 g of fruit pulp and randomly added to it 30 ml distilled water and pureed with an electric mixer. The juice was filtered, then diluted and measured the percentage of total soluble solids using a hand refractometer, at 20°C temperature (Abbas and Ibrahim 1996). The 10 ml of fruit juice was taken and diluted in 40 ml of distilled water, then in 10 ml added 5 drops of phenolphthalein then wipe it with 0.1N sodium hydroxide. The percentage of total acidity was calculated on the basis that citric acid (Ranganna 1977). The total yield was calculated. The nitrogen in the leaves was estimated using the Microkjedhal device. Phosphorous was also estimated by the method of fresh digestion using ammonium molybdate and ascorbic acid in the Spectrophotometer (John 1970).

RESULTS AND DISCUSSION

The organic fertilizers at 10 kg tree⁻¹ was significantly superior as compared with other treatments and gave the highest average of traits (leaf area 46.1 cm², chlorophyll 42.9

mg g⁻¹, fruit weight 123.3 g, fruit pulp weight 83.2 g, total yield 16.68 kg, TSS 14.48%, nitrogen 2.54% and phosphorus 0.23%). The spraying treatment with a growth regulator 2, 4-D at a concentration 3ml.L⁻¹ significantly excelled on rest treatments and gave the highest average of traits (leaf area 42.4 cm², chlorophyll 49.6 mg g⁻¹, Fruit weight 128.7 g, fruit pulp weight 86.9 g, total yield 15.13 kg, TSS 15.44 %, nitrogen 2.35%, and phosphorous 0.24%). The organic fertilizer (sheep manure) at a concentration of 10 kg.tree⁻¹ + spraying growth regulator at 3 ml L⁻¹, significantly excelled in all studied traits. The increase may be due to the role of organic fertilizer (sheep manures) in providing nutrients for the plant, especially nitrogen and in increasing the chlorophyll, as it includes the synthesis of amino acids and protein that go into building biological parts, including chloroplasts (Cottee et al 2012).

The spraying the growth regulator 2,4-D plays an active and essential role in cell division, expansion and elongation of cells, which increases the leaf area and chlorophyll content which increased the efficiency of photosynthesis which in turn contributes to increase nutrients contents in leaf (Mancuso et al 2006) The transportation of the products of photosynthesis process to the fruits including processed carbohydrates and to leaves and branches, which works to increase the number of fruits and their size (Fadlieh et al 2008).

Table 1. Effect of adding organic fertilizer (sheep manures) and spraying with growth regulator on the growth and yield of sour orange (*Citrus aurantium* L.)

Foliar spray (ml L ⁻¹)	Organic fertilizer (kg)	P (%)	N (%)	Total yield (Kg/plant)	Total acidity	T.S.S	Fruit pulp weight (g)	Fruit weight (g)	Chlorophyll (mg/cm ²)	Leaf area (cm ²)
0	0	0.19	1.86	12.58	0.78	11.50	54.6	80.9	34.4	37.1
	10	0.21	2.43	15.73	0.72	12.62	66.0	98.8	40.1	41.3
1	0	0.20	1.93	13.66	0.74	11.96	62.6	83.0	34.7	38.5
	10	0.22	2.52	16.09	0.70	13.77	78.6	122.2	42.4	41.3
2	0	0.23	1.92	13.69	0.71	14.13	83.2	125.4	39.1	39.5
	10	0.25	2.53	17.67	0.68	15.68	96.3	138.2	49.9	44.3
3	0	0.23	2.01	13.65	0.73	14.41	82.1	123.3	46.8	40.3
	10	0.25	2.70	17.23	0.70	15.85	91.8	134.0	52.1	44.5
L.S.D 0.05		0.03	0.03	0.82	0.02	1.10	3.31	4.72	2.0	1.3
2,4-D (ml L ⁻¹)	0	0.20	2.15	14.16	0.75	12.06	60.3	89.9	37.3	39.2
	1	0.21	2.22	14.88	0.72	12.86	70.6	102.6	38.6	39.9
	2	0.24	2.23	15.68	0.70	14.91	89.8	131.8	44.5	41.9
	3	0.24	2.35	15.44	0.71	15.13	86.9	128.7	49.6	42.4
L.S.D 0.05		0.02	0.02	0.58	0.02	0.78	2.34	3.34	1.41	0.9
Organic fertilizer	0	0.21	1.93	13.40	0.74	13.00	70.6	103.2	38.8	38.9
	10	0.23	2.54	16.68	0.70	14.48	83.2	123.3	46.1	42.9
L.S.D 0.05		0.01	0.02	0.41	0.01	0.55	1.65	2.36	1.0	0.7

CONCLUSIONS

The application of organic fertilizer (sheep manure) and spray with growth regulator 2, 4-D at a concentration of 2 ml L⁻¹ on sour orange trees improve growth and yield contributing parameters.

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