Original Article

The effect of pinching and spraying with zinc on the yield of seeds and oil of castor plant (Ricinus communis L.)

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Abstract

A factorial experiment was conducted at the Agriculture fields of Diyala University on alluvial mixed soils in spring 2021 according to the complete random sector (R.C.B.D.) design to study the effects of two dates of pinching as well as the comparative treatments(without pinching, 15 and 40) days, after planting and spraying with zinc by two concentrations with non –spraying treatment (300, 150 and 0). Ppm. On castor plant (Ricinus communis L.).The results obtained revealed the following :the process of developing apex pinching of the plant (first pinching) significantly exceeded In the average quality of the seed yield in plant and hectare and the ratio and yield of oil amounted to 53.55 g, 1115.0 kg.h^{-1}, 36.1%, 402.7 kg.h^{-1} respectively, In addition, it increased the average total percentage of unsaturated fatty acids in the oil to 37.73%. treatment of spraying with zinc at a concentration of 300 ppm showed significant superiority of the average seed yield, characteristic of plant, hectare and oil yields, reaching 52.93 g and 1102.6 kg. h^{-1}, 388.3 kg. h^{-1}-, respectively, increasing the average oil and total percentage of unsaturated fatty acids to 35.5% and 32.72%, respectively. In addition to the role of zinc application at 150 ppm concentration. The overlap of the two test factors (first pinching with spraying with zinc at 300 ppm concentration) had a significant impact on the quality of seed yield in plants, hectares, and oil yield, 56.89 g, 1184.8 kg.h^{-1}, 427.2 kg.h^{-1}. continuous.

Keywords: foliar feeding, ear fertilizer, zinc, oil index, castor bean.

INTRODUCTION

Castor (Ricinus communis L.) belongs to the family Euphorbiaceae and is a perennial crop of industrial importance for oilseed production and is grown in warm tropical and temperate environments (Bisht and Bhattacharaya, Anjani; 2011, 2012), and studies have shown that It is well adapted to various climatic conditions in many regions of the world, but its origins are in Africa (Vasconcelos et al, 2010). India, China, Brazil, Russia, Thailand, Ethiopia, and the Philippines are the world's leading castor producers (Damodaram and Hegde, 2011). India is the world's largest exporter of castor oil, while the other two largest producers are China and Brazil (Ramos et al.)

Its seeds are found in different regions of Iraq as an oil plant or windbreak (Ogunniyi, 2006). Sunflower is a durable and drought-tolerant crop that grows on the sides of roads and fields because it tolerates different types of soil and has strong seed germination despite the surrounding conditions (Canoira et al., 2010; Hincapie et al., 2011). Studies show that the plant occupies 1,525,000 hectares in 30 countries, with India ranking first with about (65%) of the world's total production and meeting 80-90% of the world's demand for castor oil (Baldwin and Cossar, 2009.(

Several mechanical operations, including ,pinching of growth tip have been used as an important method to obtain more major plant branches (Abbas and Jurani, 2006). This is one of the agricultural methods used to promote plant growth and productivity, as it removes the apical dominance source (auxins) of the apical buds by removing the apical buds of the stem at the growing tip, and converts the material to lateral buds to stimulate the growth of buds and lateral branches (Lowes, 2009). Thus increasing total vegetation volume, vegetation area, rate, and efficiency of photosynthetic processes, which is reflected in increased seed and oil yields (Lakshmi et al., 2015). Foliar feeding is also an important method in modern agriculture, and studies have shown that when nutrients are scarce, especially in limestone or saline lands, the application of diluted solutions on vegetation areas as a complementary and therapeutic nutrient can provide various nutrients faster and more efficiently (Wittner, 1999(.

This is because zinc is an important micronutrient and is poorly prepared in limestone soils (Ojeda-Barrios et al., 2014). Intensive cultivation and the increased use of highly degradable soil fertilizers such as di-ammonium phosphate and triple superphosphate fertilizers have depleted and deficient this element, which is essential for plant nutrition, in those soils (Graham and Rengel, 1993). Its deficiency and lack of availability at levels required by the plant environment leads to reduced productivity of many crops (Mengel and Kirkby, 2001). It is also an essential element for plants because of its important role in the formation of chlorophyll, the building of carbohydrates and proteins, and the activation of enzymes in plants (Al-Sahaf, 1989). It is also involved in cell division and elongation, maintenance of cell structure, and the formation of the amino acid tryptophan, which makes up the hormone (indoleacetic acid) IAA, responsible for photosynthesis (Hassan et al., 1990 and Marschner, 2012). Due to the paucity of studies on castor in Iraq, this study was undertaken to determine the effects of pinching and spraying with zinc on castor seed and oil yields.

Materials and working methods:-

A field experiment was conducted in the spring season of 2021 in one of the plots of the Faculty of Agriculture of Diyala University in alluvial mixed soil (silt loam).The area of the experimental unit was 3.8 m x 3.2 m, with an area of 3.8 m x 3.2 m. Pinching of growth tip. and foliar of zinc sulfate at a vegetation density of 20833 plants of hectares with a distance of 80 cm between one pinching and another and a distance of 60 cm between one hole and another inside it, the development of pinching apex and foliar spraying of zinc sulfate on castor plants (Indian species) to study the impact on seed and oil yields.h-1, the crop was irrigated by opening the drive with a 1 m spacing between the replicators and the experimental unit.

Seeds were hand-planted on May 3, 2021, with 3 seeds per hole irrigated to the experimental site 13 times, the date of plant emergence was 7 to 9 days after planting, and then diluted to the number of plants per gorilla when plant growth reached the stage of holding 2 true leaves and before pinching process . The fruit of the plants was harvested on July 31, 2021, in the first batch, with the second batch 15 days later when the fruit turns brown and the seeds ripen in it. The following study traits were calculated on a per plant basis, at a rate of 7 plants taken randomly from an average lineage per experimental unit.

1. Seed yield/plant (g): was calculated by taking the average seed yield of one plant, randomly taking the seed yield of seven plants from the center line of each experimental unit, weighing them using a sensitivity scale, and calculating according to the mean.

2. Total seed yield (kg/h^{-1}): Calculated from (average yield of 7 plants in each experimental unit) x plant density / h^{-1}after weighting based on 8% humidity and converting the weight to kg / h^{-1}units.

3. Oil rate: The rate of oil in the seeds was calculated by Soxhlet Oil rate % = (castor seed weight of oil extract) / (sample seed weight) x 100 (A.O.A.C., 1980)

4. Oil yield (kg/h^{-1}): Calculated by oil rate x seed yield per hectare

5. Estimated unsaturated fatty acids in oil by equipment (Gc-MS)

First: oil was extracted from the seeds by taking 10 g of seeds and placing them in (OVEN) for 1 hour at a temperature of 105 °C to adjust the constant weight of the seeds for later extraction purposes.

Second: 10 g of dried seeds were crushed and placed in a Soxhlet succulent apparatus with hexane alcohol solvent at a temperature of 55 -60°C for 6 hours, then the oil was evaporated (oil with alcohol) in a rotary evaporator apparatus to remove the alcohol in the oil, placed in a glass beaker and placed in an oven electric oven at a temperature of 60°C and stabilized for 30 minutes to weigh accurately. The oil extracted from the seeds was stored in sealed opaque cans away from lighting and at a temperature of 4 ° C for property diagnosis and estimation. (Salimon et al., 2010).

Fatty acids in the oil were identified using a Gc-17A gas chromatograph of Shimaza type from Japan equipped with a capillary shaft (Restek Stabilwax-DA) (m0.25µ × m0.25 × m30) 70×BP, using helium holder gas at a constant shaft flow rate of 3 ml/min. The injector and detector temperatures were set to 260-280°C, respectively, for identification. The oil was limited according to the methods contained in the Official Test Method (1995) PORIM, with some modifications to my institution.

Dissolve 11 g KOH in 100 ml methanol alcohol to prepare a KOH solution in methanol alcohol, then take 0.5 ml of oil sample to complete 5 ml of solution (KOH methyl) and shake the final solution by vortex device for homogenization with oil and preparation for injection into the GC-MS .system The pact is then estimated and the solution is added to the GC-MS apparatus.

Next, the pact is estimated, F-A fatty acid methyl esters are separated at a constant pressure of 100 kPa, retention times of fatty acid samples are compared, and then 1 µL is injected, at a 10:1 Split Ratio separation ratio, and the data are processed according to specific software (IST-Crom) to obtain a per 100 g oil Calculate the amount and concentration of fatty acids in grams as stearic acid.

Results and Discussion

1: Seed yield (g/plant^{-1})

The results in Table (1) show significant differences between the mean coefficients of the pinching growth tip of the plants, but if (the first pinching) gives the highest mean of seed yield, which is characteristic of the plants, reaching 53.55 g. Plant^{-1} and is not significantly different from the treatment (second pinching) No. Compared to the comparison treatment (no pinching) which gave the lowest mean, 47.19 g. Plant^{-1}, which is credited to the pinching treatment's cytokines in lateral shoot growth, increased vegetative area in the plant, and ability to produce carbohydrate compounds and transfer to the quotient component and photosynthetic efficiency (Shin et al., 2013 and Lakshmi et al. 2015) to encourage The data in the same table for the treatment of paper spraying with zinc showed a significant difference in the spraying coefficient, as the spraying at a concentration of 300 ppm gave the highest seed yield characteristics with 52.93 g. Plant-1, although not significantly different from the spraying treatment at a concentration of 150 ppm compared to the comparison treatment (non-spraying) that gave the lowest mean value for the adjective47 .41 g. Plant^{-1}

This is because zinc plays an important role in reducing the number of sterile flowers and activating and forming pollen (Abu Dahi and Younis, 1988). This is also consistent with the findings of Nofal et al. (2011), as well as the role of the element zinc in increasing the efficiency of the photosynthetic process and vegetative area, and increasing carbohydrate compounds that stimulate flower bud growth and fruit number, and hence plant yield. It is significant There was an overlap, with the interference treatment (first pinching disbursement and zinc spray at a concentration of 300 ppm) giving the highest rate of seed yield characteristic of the plant at 56.89 g. Plant^{-1} and the lowest rate of adjective Plant^{-1}, which was 44.68 g. Plant^{-1} when measured in the comparison treatment of interference (no spray, no pinching disbursement).

Table (1) Effect of earrings and spraying with zinc on the quality of the seed yield (g. plant^{-1})

Spraying with zinc treatment **Pinching treatment**	**Non-spraying**	**ppm150**	**ppm 300**	**Average**
Non-pinching	**44.68** **D**	**48.58** **CD**	**48.31** **CD**	**47.19** **B**
First pinching	**48.59** **CD**	**55.16** **AB**	**56.89** **A**	**53.55** **A**
Second pinching	**48.95** **C**	**52.88** **B**	**53.60** **AB**	**51.81** **A**
Average	**47.41** **B**	**52.21** **A**	**52.93** **A**	

2. Seed yield (kg.h^{-1})

The results in Table (2) point out that there is a significant difference between the mean coefficients of pinching of growth tip at the apex of plant development in the given case (first pinching) (the highest mean of the attribute of seed yield per hectare was 1115.0 kg. h^{-1} it was the same as the treatment (second pinching) and 982.4 kg. h^{-1} compared to the comparison treatment (no pinching), which was not significantly different, but recorded the lowest average of the attribute. because the increased yield of seeds in the plant body Table (1) led to an increase in seed yield per hectare. The results of the same table show that the application coefficient due to zinc was significantly different when the application treatment exceeded a concentration of 300 ppm, giving the highest average seed yield per hectare of 1102.6 kg. h^{-1} which was not significantly different from the application treatment with a concentration of 150 ppm, and the comparison treatment (no spraying) gave the lowest average of 986.9 kg. h^{-1}.

This is due to the increase in the yield of seeds in the plant Table (1) which led to an increase in the yield of seeds per hectare. There was a significant overlap between the two factors (pinching and spraying with zinc), and the interference treatment (first pinching and spraying with zinc at a concentration of 300ppm) gave the highest rate of seed yield trait per hectare of 1184.8 kg. h^{-1}, compared to the comparison treatment of interference (no spraying and without pinching) which gave the lowest rate of the attribute was 929.8 kg. h^{-1}.

Table (2) Effect of earrings and spraying with zinc on the quality of the seed yield (kg.h^{-1})

Spraying with zinc treatment Pinching treatment	Non-spraying	ppm150	ppm 300	Average
Non-pinching	**929.8** **D**	**1011.0** **C**	**1006.4** **C**	**982.4** **B**
First pinching	**1011.7** **C**	**1148.6** **AB**	**1184.8** **A**	**1115.0** **A**
Second pinching	**1019.3** **C**	**1101.6** **B**	**1116.7** **AB**	**1079.2** **A**
Average	**986.9** **B**	**1087.1** **A**	**1102.6** **A**	

3. oil rate%

The results in Table (3) shows that there is a significant difference between the coefficients of the developed apical pinching. If the treatment (first pinching) gave the highest mean for the quality of oil rate value 36.1%, although not significantly different from the treatment (second pinching), the lowest mean value was 34.1% compared to the comparison treatment (non-pinching). 3%, which is attributed to the fact that the developed top earring increases lateral branches, increasing the leaf area of the plant, and the accumulation of compounds (carbohydrates) increases seed size, which is reflected in the percentage of oil in the seeds (Lakshmi et al, 2015). The same data in the table below shows that the zinc application coefficient does not significantly differ in the quality of oil percentage: there is a significant overlap between the two factors (pinching and spraying with zinc), with the interference treatment (the first pinching and spraying with zinc at 150 ppm) concentration having the highest characteristic rate of oil rate value 36.5%, while The comparison treatment (no spray and without pinching) had the lowest characteristic rate of 33.7%.

Table (3) Effect of earrings and spraying with zinc on the quality of the oil rate%

Spraying with zinc treatment Pinching treatment	Non-spraying	ppm150	ppm 300	Average
Non-pinching	**33.7** **A**	**34.8** **A**	**34.5** **A**	**34.3** **B**
First pinching	**35.7** **A**	**36.5** **A**	**36.1** **A**	**36.1** **A**
Second pinching	**34.5** **A**	**35.2** **A**	**34.9** **A**	**34.9** **AB**
Average	**34.6** **A**	**35.5** **A**	**35.1** **A**	

4-Oil yield (kg.h^{-1})

The results in Table (4) indicate that compared to the comparison treatment pinching, which had the lowest mean value (first pinching) the highest mean value of 402.7 Kg.h^{-1}of oil quotient per hectare, was not significantly different from the treatment (second pinching), but there is a significant difference (no-pinching) was 338.1 Kg.h^{-1}, because the process of pinching of growth tip of plant has the effect of increasing seed yield and oil quotient, as shown in Tables (2, 3), respectively, and the earring on the medicinal pumpkin plant (Cucurbita pepo) led to increased seed oil yield This is also consistent with the results of Zarei et al. (2016). The results in the same table also show significant differences between plants sprayed with zinc, where plants sprayed at 300 ppm gave the highest average oil yield characteristics of 388.3 Kg.h^{-1} was not significantly different from the treatment sprayed at 150 ppm, but compared to the comparison treatment (no spray), the lowest average value of the adjective given was 342.18 Kg.h^{-1} , which may be due to the effect of zinc application on increasing seed yield in the plant Table (1).

There was a significant overlap between the two factors (pinching and spraying zinc), with the interference treatment (first pinching and spraying zinc concentration 300 ppm) having the highest rate of oil yield traits per hectare value 427.2 Kg.h^{-1} comparison treatment interference (non- spraying, without pinching) give the lowest rate was 314.1 Kg.h^{-1} .

Table (4) Effect of earrings and spraying with zinc on the quality of the Oil yield (kg.h^{-1})

Spraying with zinc treatment / **Pinching treatment**	**Non-spraying**	**ppm150**	**ppm 300**	**Average**
Non-pinching	**314.1** **C**	**352.3** **BC**	**348.0** **BC**	**338.1** **B**
First pinching	**361.5** **BC**	**419.4** **A**	**427.2** **A**	**402.7** **A**
Second pinching	**352.9** **BC**	**388.2** **AB**	**389.9** **AB**	**377.0** **A**
Average	**342.8** **B**	**386.6** **A**	**388.3** **A**	

5: rate of unsaturated fatty acids in castor oil %.

Table (5) shows the presence of the effect of spraying the element of zinc on the percentage of total unsaturated fatty acids, compared to the treatment that gave the lowest average percentage of total unsaturated fatty acids (non-spraying), by giving it the treatment spraying zinc at a concentration of 150 ppm, reached 32.72%, the percentage of total unsaturated fatty acids that was 25.04%. This is due to the role of zinc as a direct element in increasing the percentage in the oil by stimulating enzymes such as dehydrogenase, which is involved in transporting hydrogen from reactants to enzymatic accompaniments such as NAD and NAP and in forming the energy needed to oxidize fatty acids and convert them to unsaturated fatty acids (Yassin, 2001). This finding is consistent with that of Dehnavi et al. (2008) on safflower crops.

Table (5) Effect of pinching and spraying with zinc on the rate of total unsaturated fatty acids%

Name of treatment	**Compound name**	**R.t**	**Fatty acid ratio**	**The total percentage of fatty acids in the oil**
Non- pinching / **Non-spray**	**9,12- Octadecadienoic acid** **(E)-9- Octadecanoic acid ethyl ester** **9- Octadecanoic acid** **Ricinoleic acid**	**7.74** **10.05** **10.46** **10.63**	**3.76** **2.60** **1.19** **3.94**	**11.49**
Non- pinching / **spray 150**	**Ricinoleic acid** **9- Octadecanoic acid** **(E)-9- Octadecanoic acid ethyl ester**	**8.68** **8.92** **9.72**	**13.09** **8.05** **1.71**	**22.85**

Non- pinching spray 300	9- Octadecanoic acid	8.17	0.17	21.99
	9,12- Octadecadienoic acid	10.27	2.21	
	(E)-9- Octadecanoic acid ethyl ester	10.81	19.61	
First pinching Non-spray	9- Octadecanoic acid	8.90	0.02	36.72
	9,12- Octadecadienoic acid	8.80	7.27	
	(E)-9- Octadecanoic acid ethyl ester	10.81	29.43	
First pinching spray 150	9- Octadecanoic acid	9.38	1.48	40.08
	9,12- Octadecadienoic acid	9.80	17.34	
	Ricinoleic acid	9.86	4.56	
	(E)-9- Octadecanoic acid ethyl ester	10.98	16.70	
First pinching spray 300	9,12- Octadecadienoic acid	9.78	6.75	36.39
	(E)-9- Octadecanoic acid ethyl ester	10.97	29.39	
	9- Octadecanoic acid	11.32	0.25	
Second pinching Non-spray	9,12- Octadecadienoic acid	7.28	3.28	26.22
	Ricinoleic acid	7.77	9.17	
	9- Octadecanoic acid	8.06	0.54	
	(E)-9- Octadecanoic acid ethyl ester	9.07	13.93	
Second pinching spray 150	9,12- Octadecadienoic acid	9.78	10.85	35.24
	9- Octadecanoic acid	10.69	9.58	
	(E)-9- Octadecanoic acid ethyl ester	10.88	14.81	
Second pinching spray 300	Ricinoleic acid	9.06	2.88	24.99
	9,12- Octadecadienoic acid	9.78	3.89	
	(E)-9- Octadecanoic acid ethyl ester	10.96	18.22	

The average effect of pinching treatments on the percentage of total fatty acids %	
No pinching	**18.77**
First pinching	**37.73**
Second pinching	**29.05**
Average effect of zinc spraying treatments %	
No spray 0ppm	**25.04**
Spraying at 150 ppm	**32.72**
Spraying at 300 ppm	**27.79**

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