Plant Cell Biotechnology and Molecular Biology 22(41&42):165-173; 2021 ISSN: 0972-2025

THE EFFECT OF YEAST EXTRACT AND ORGANIC FERTILIZER ALGIDEX SPRAY ON THE VEGETATIVE, ROOT AND FLORAL GROWTH OF THE CHINESE CARNATION

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Article Information

Editor(s):
(1) Dr. Hon H. Ho, Professor, State University of New York, USA.
Reviewers:
(1) Basel Natsheh, Palestine Technical University- Kadoorie (PTUK), Palestine.
(2) Charles Nyambane Onyari, University of Embu, Kenya.

Received: 01 May 2021
Accepted: 06 July 2021
Published: 19 July 2021

Original Research Article

ABSTRACT

The study was conducted during the winter season 2018-2019 in the lethal canopy of the College of Agriculture, University of Basrah to find out the effect of spraying with yeast extract and organic fertilizer Algidex on the growth and flowering of the Chinese carnation plant. The factorial experiments were carried out according to the Randomized Complete Block Design (RCBD) with three replicates and two factors, the first three concentrations of yeast extract were 0, 1 and 2 ml L^{-1} and the second three concentrations of organic fertilizer were 0, 2 and 4 ml L^{-1}, and the interaction between them. The means of the treatments were compared according to the revised least significant difference test (R-L.S.D) at the level of probability (5%). The results showed the significant superiority of the treatment of spraying with yeast extract at a concentration of 2 ml L^{-1} in the vegetative growth characteristics as the height of the plant, the number of leaves and the dry weight of the vegetative growth were increased, while the rate of root length, fresh, and dry weight of the roots were increased at concentrations 1 and 2 ml L^{-1}. The treatment with a concentration of 2 ml L^{-1} increased the fresh and dry weight of the flowers, while the fresh weight of the shoot increased at a concentration of 1 ml L^{-1}. On the other hand, spraying with an organic fertilizer at concentrations 2 and 4 ml L^{-1} improved the vegetative, root, and flower characteristics of the plant. The interaction between yeast extract at a concentration of 2 ml L^{-1} and organic fertilizer at a concentration of 2 or 4 ml L^{-1} had a significant effect in improving most vegetative, flower, and root characteristics.

Keywords: Dry weight; fertilizer; flowering; foliar application; ornamental plant.

INTRODUCTION

The Chinese carnation (*Dianthus chinensis* L.) is called China pink [1] and the plant is also called Rainbow pink [2]. It is one of the plant species that can be grown in gardens and its flowers are used as picking flowers, especially at a time when there is less flowering than other species in early spring and autumn [3]. The original home of this plant is China; this plant has solid branched stems with clear nodes, and the height of the plant reaches 40 cm. Its flowers are used as picking flowers and the plant is grown in gardens and is also used as a potted plant. Chinese carnation flowers form on the lateral branches and the main stem, and one terminal flower usually forms and rarely two or three flowers form in one branch. Its flowers may have fringed petals that are red, pink, white, purple, or bicolor [4]. This plant propagates by seeds. The plant is best grown in well-drained soils with a low alkaloid, and it is preferable to grow it in sunny or partial shade places. Annual carnations produce large double flowers. This type has been used for more than 3000 years in Chinese herbal medicines, where dried aerial parts are used to increase diuresis, reduce blood viscosity, and treat inflammation, swelling and redness of the eyes [5]. Plant flowers are used as an ingredient in some pastries and to decorate them [6-8]. In Korea, the plant is used to treat fatigue and cough, it is a diuretic, and it is also used to reduce blood pressure and is an antioxidant [2].

Foliar fertilization is one of the successful scientific methods for treating nutrient deficiency [9]. Foliar application can also meet 85% of the nutrient needs to plants [10]. However, foliar fertilization is not a substitute for soil application but rather a supplement to it [11]. Biofertilizers have gained much attention in recent years [12]. The yeast is one of these fertilizers and many studies have indicated that yeast is one of the richest sources of protein, and it contains essential amino acids such as lysine and tryptophan among others. It contains many mineral elements such as calcium, cobalt, iron, and others, and it also contains vitamin B groups such as B1, B2, B6, and B12. Yeast extract is a valuable source of vital ingredients, especially cytokinins [13], which act as a readily available growth supplement for plants that ultimately improve plant production [14]. However, it is a source of cytokinin and protein that promotes cell division and expansion, and the dry yeast extract has roles during the vegetative and reproductive growth stages as it works to increase the formation of flowers in plants due to its high content of auxins and cytokinins [15].

Studies have indicated that the use of seaweed extracts as nutrients and fertilizers is common among the inhabitants of coastal areas in many countries [16]. The use of seaweed extracts has spread, as it is characterized by its effectiveness as a fertilizer for many horticultural crops due to the stimulators and plant hormones they contain necessary for growth. These in turn cause an increase in plant growth strength, increase the absorption of nutrients, and resistance to freezing and diseases [17]. The extract of seaweed is rich in macro and micronutrients needed by the plant and contains many substances such as amino acids and growth regulators such as auxins, cytokinins, and gibberellins. The use of marine algae promotes growth in plants due to the presence of cytokinin, auxin, gibberellin, abscisic acid, ethylene, polyamine, and betaine [18-23].

For the aesthetical, coordination and medicinal importance of the Chinese carnation plant, and to improve the vegetative and floral properties of the plant, this study was conducted to demonstrate the effect of spraying the different concentrations of dry yeast extract and ALGIDEX organic fertilizer on the growth indicators and flowers of the Chinese carnation plant.

MATERIALS AND METHODS

The study was carried out on the Chinese carnation plant in the lethal canopy of the College of Agriculture, the University of Basrah during the 2018-2019 seasons. Seedlings were brought from a nursery in Basrah province. Seedlings were planted in pots at the experiment site. The experiment included a study of the effect of two factors, yeast extract (Table 1), and organic fertilizer ALGIDEX (Table 2), and their interactions on the vegetative and floral growth of the Chinese carnation plant. The plants were sprayed at the rate of two sprayings, the first on 28/11/2018 and the second two weeks after the

first spray. The plants were treated with yeast extract after two days of treatment with organic fertilizer, and the experiment included the following treatments:

First: spraying with yeast extract

1- (0) control treatment (sprayed with distilled water)
2- The one ml of yeast extract per one liter of distilled water (1 ml L^{-1})
3- The two ml of yeast extract per one liter of distilled water (2 ml L^{-1})

Second: spraying with organic fertilizer (ALGIDEX)

1- (0) control treatment (sprayed with distilled water)
2- The two ml of organic fertilizer per one liter of distilled water (2 ml L^{-1})
3- The four ml of organic fertilizer per one liter of distilled water (4 ml L^{-1})

The Experimental Design and Statistical Analysis

The experiment was carried out according to a randomized complete block design (RCBD) with a factorial experiment that included 9 treatments, which are combinations between spraying with yeast extract that was prepared by adding 1 g L^{-1} by dissolving 1 gram of dry bread yeast in a little warm water at 35°C added to sugar at a concentration of 0.5 g L^{-1} and left for 12 hours and then completed the volume to one liter. Then the three concentrations 0, 1 and 2 ml L^{-1} were prepared from it and organic fertilizer ALGIDEX in three concentrations 0, 2 and 4 ml L^{-1}. Each treatment was repeated three times. The result data were then analyzed using the analysis of variance by statistical program, Genstat Ver. 16. The means of treatments were compared according to the test of the revised least significant difference and a probability level at 5% [24].

The experiment included the following measurements: -

First: The vegetative growth indicators

1- Plant height (cm)
2- Number of leaves (leaves $plant^{-1}$)
3- Fresh weight of the shoots (g $plant^{-1}$)
4- Dry weight of the vegetative system (g $plant^{-1}$)

Second: The root growth indicators

1- The length of the root system (cm)
2- Fresh weight of the root system (g $plant^{-1}$)
3- Dry weight of the root system (g $plant^{-1}$)

Third: The floral growth indicators

1- Fresh weight of flowers (g $flower^{-1}$)
2- Dry weight of flowers (g $flower^{-1}$)

Table 1. The chemical components of yeast extract (mg per 100 g dry weight)

Mineral elements		Amino acids		Vitamins	
Total N	7.23	Arginine	1.99	Thiamin	2.71
P2O5	51.68	Histidine	2.63	Riboflavin	4.96
K2O	34.39	Isoleucine	2.31	Nicotinic acid	39.88
MgO	5.76	Lucien	3.09	Pantothenic acid	19.56
CaO	3.05	Lysine	2.95	Biotin	0.09
SiO2	1.55	Methionine	0.72	Pyridoxine	2.90
SO2	0.49	Phenylalanine	2.01	Folic acid	4.36
NaCl	0.30	Threonine	2.09	Coalmine	153 µg
Fe	0.92	Tryptophan	0.45	Enzymes	
Ba	157.60	Valine	2.19	Oxidase	0.350
Co	67.80	Glutamic acid	2.00	Peroxidase	0.290
Pb	438.60	Serine	1.59	Catalase	0.063
Mn	81.30	Aspartic acid	1.33		
Sn	223.90	Proline	1.53	Carbohydrates	23.20
Zn	335.60	Tyrosine	1.49		

Table 2. The components for the organic fertilizer algidex produced by trichodex company

No.	Component	Amount
1	Organic matter	45 g L^{-1}
2	Proteins	15 g L^{-1}
3	Crude fibers	5.8 g L^{-1}
4	Sugars	1.2 g L^{-1}
5	Fats	0.4 g L^{-1}
6	Nitrogen	80 g L^{-1}
7	Phosphorus	80 g L^{-1}
8	Potassium	80 g L^{-1}
9	Iron	550 mg L^{-1}
10	Zinc	450 mg L^{-1}
11	Manganese	160 mg L^{-1}
12	Cobalt	15 mg L^{-1}
13	Molybdenum	120 mg L^{-1}
14	Magnesium	540 mg L^{-1}
15	Boron	150 mg L^{-1}
16	Calcium	100 mg L^{-1}
17	Cupper	60 mg L^{-1}

RESULTS AND DISCUSSION

Indicators of Vegetative Growth

The results recorded in Table 3 showed that the treatment of the Chinese carnation plant with different concentrations of yeast extract led to a significant increase in the vegetative growth characteristics compared to the control treatment. The concentration of 2 ml L^{-1} yeast extract led to the highest rate of plant height, which reached 17.83 cm, which was significantly different from the other two treatments. The treatment with yeast extract did not have a significant effect on the characteristic of the number of leaves per plant. The fresh weight of the vegetative system increased upon treatment 1 ml L^{-1}, which reached 7.55 g, which differed significantly from the other two concentrations. As for the dry weight characteristic of the vegetative system, the concentrations 1 and 2 ml L^{-1} were recorded the highest rate for this characteristic, and they reached 1.24 and 1.28 g, respectively, and they differed from the control treatment only.

This is in agreement with what Al-Sahaf et al. [25], Al-Doghachi et al. [26] and Nassar et al. [27] found on hoary stock, cumin, and kidney bean plants, respectively. The increase in vegetative growth indicators may be due to the fact that the yeast extract contains growth-promoting substances such as vitamins, amino acids, carbohydrates and mineral elements [28]. It is also due to its appropriate effect on the metabolic and biological activities and their stimulating effects to increase the photosynthetic pigments and the activity of photosynthesis enzymes, which in turn encouraged the growth of plants [29].

The results of the same table also showed that the treatment with organic fertilizers improved the characteristics of plant height, number of leaves, and the fresh and dry weight of the vegetative parts. The highest mean of plant height and number of leaves at concentration was 4 ml L^{-1} which was 17.03 cm and 41.31 leaves $plant^{-1}$, respectively, that differed significantly from the control treatment. As for the fresh weight characteristic of the vegetative parts, it was the highest in the treatment of 2 ml L^{-1}, which was 7.98 g, which was significantly different from the control treatment only. The highest mean dry weight was 1.29 and 1.28 g at concentrations 2 and 4 ml L^{-1}, respectively, which differed from the control treatment.

This is in agreement with what Sarhan [30] found on cucumber and Al-Doghachi [26] on cumin. The reason for improving vegetative characteristics using organic fertilizer may be due to its high content of auxins that stimulate cell division and expansion [31] or to its content of cytokinins that stimulate physiological activities and the increase of total chlorophyll in the plant, which reflects positively on the photosynthesis process, which leads to an increase In growth [32], or this may be

due to its high content of macro elements such as nitrogen, phosphorous and potassium, which have a great role in plant nutrition and which are essential for plant growth and development [33].

Table 3. Effect of spraying with the yeast extract and organic fertilizer on vegetative growth of Chinese carnation plant

Property	Yeast extract (ml L^{-1})	Algidex fertilizer (ml L^{-1})			Yeast extract mean
		0	2	4	
Plant height (cm)	0	14.61	15.44	15.19	15.08
	1	15.78	15.08	16.08	15.65
	2	17.33	16.33	19.83	17.83
	Algidex mean	15.90	15.61	17.03	
		Algidex	interaction		Yeast extract
	LSD at 5%	1.77	3.07		1.77
Number of Leaves (Leaves $Plant^{-1}$)	0	21.70	35.00	34.40	30.37
	1	32.00	38.00	41.00	37.00
	2	37.00	32.00	48.00	39.00
	Algidex mean	30.23	35.00	41.31	
		Algidex	interaction		Yeast extract
	LSD at 5%	10.29	17.82		Non-significant
Fresh weight of vegetative parts (g)	0	5.16	7.58	6.23	6.32
	1	6.76	9.60	6.30	7.55
	2	6.42	6.76	7.03	6.74
	Algidex mean	6.11	7.98	6.52	
		Algidex	interaction		Yeast extract
	LSD at 5%	0.60	1.05		0.60
Dry weight of vegetative parts (g)	0	0.83	1.24	1.23	1.10
	1	1.04	1.46	1.22	1.24
	2	1.28	1.17	1.40	1.28
	Algidex mean	1.05	1.29	1.28	
		Algidex	interaction		Yeast extract
	LSD at 5%	0.12	0.21		0.12

Table 4. Effect of spraying with the yeast extract and organic fertilizer on the root growth of chinese carnation plant

Property	Yeast extract (ml L^{-1})	Algidex fertilizer (ml L^{-1})			Yeast extract mean
		0	2	4	
Length of root parts (cm)	0	15.17	16.17	18.50	16.61
	1	18.28	19.17	19.30	18.92
	2	20.27	18.78	17.06	18.70
	Algidex mean	17.91	18.04	18.29	
		Algidex	interaction		Yeast extract
	LSD at 5%	Non-significant	3.55		2.05
Fresh weight of root parts (g)	0	3.86	5.05	5.35	4.75
	1	6.76	9.60	6.30	7.55
	2	6.42	6.76	7.03	6.74
	Algidex mean	5.68	7.14	6.23	
		Algidex	interaction		Yeast extract
	LSD at 5%	0.66	1.15		0.66
Dry weight of root parts (g)	0	0.77	0.87	0.96	0.86
	1	0.81	1.08	1.14	1.01
	2	1.04	0.99	0.88	0.97
	Algidex mean	0.87	0.98	0.99	
		Algidex	interaction		Yeast extract
	LSD at 5%	Non-significant	Non-significant		Non-significant

Table 5. Effect of spraying with the yeast extract and organic fertilizer on floral growth of chinese carnation plant

Property	Yeast extract (ml L^{-1})	Algidex fertilizer (ml L^{-1})			Yeast extract mean
		0	2	4	
Fresh weight of flower (g)	0	0.77	1.14	1.05	0.99
	1	0.90	1.08	1.14	1.04
	2	1.24	1.53	1.87	1.55
	Algidex mean	0.97	1.25	1.35	
		Algidex	interaction		Yeast extract
	LSD at 5%	0.19	0.34		0.19
Dry weight of flower (g)	0	0.032	0.042	0.045	0.040
	1	0.040	0.038	0.041	0.040
	2	0.045	0.045	0.047	0.046
	Algidex mean	0.039	0.042	0.044	
		Algidex	interaction		Yeast extract
	LSD at 5%	0.004	0.008		0.004

It was found from the results of Table 3 that spraying with yeast extract at a concentration of 2 ml L^{-1} and organic fertilizer at a concentration of 4 ml $L^{-1}$was recorded the highest rate of plant height and number of leaves in the plant, reaching 19.83 cm and 48.00 leaves $plant^{-1}$, respectively. As for the fresh and dry weight characteristics, the treatment at a concentration of 1 ml L^{-1} yeast extract with 2 ml L^{-1} organic fertilizer was recorded the highest rate for these two characteristics, reaching 9.60 and 1.46 g, respectively.

The Root Growth Indicators

The results of Table 4 showed that spraying with yeast extract had a positive effect on the characteristics of root length, fresh and dry weight of the root system. The concentrations 1 and 2 ml L^{-1} were recorded the highest rates for the length of root parts and dry weight of roots, which were 18.92, 18.70 cm and 1.24, 1.28 g, respectively, which differed with the control treatment that recorded the lowest rates that were 16.61 cm and 1.10 g, respectively. This is consistent with what [25] found, when spraying the hoary stock plant with yeast extract at a concentration of 6 ml L^{-1} recorded the highest average root length and dry weight compared to the lowest concentrations. The reason may be due to the dry yeast extract containing vitamins, mineral elements and some growth hormones such as auxins, which have a known role in forming lateral roots [34], and also because it contains mineral elements, including potassium, which increases plant cell division and promotes the growth of meristematic tissues, and it contains an element potassium, which stimulates the growth and development of roots [35].

The same table also showed that spraying with organic fertilizer had no significant effect on the characteristic of root length. While the dry and dry weight of the root system increased, concentrations 2 and 4 ml L^{-1}. The highest average of fresh weight was at a concentration of 2 ml L^{-1} which was 17.14 g, which differed significantly from the lower and higher concentrations. The highest average dry weight of the vegetative parts was at 2 and 4 ml L^{-1} of organic fertilizer, reaching 1.29 and 1.28 g, respectively, and they differed from the control treatment.

This is in agreement with what Alwan and Al-Masaudi [36] found when spraying wheat plants at a concentration of 0.5 g L-1 with organic fertilizer Algidex resulted in a significant increase in the average length, size, and diameter of the roots and the dry weight of the root system. The reason for the improvement of the properties of the root system by using organic fertilizer may be due to the organic fertilizer containing growth regulators and gibberellin, which has a role in stimulating the process of root growth [37] through its effect on growth processes such as the cell division and expansion, but the processes of cell division It alone does not lead to the growth of the organism, so the cells must expand after their division, as the gibberellin increases the size of the meristematic area with an increase in the percentage of cells that divide [38].

The results of Table 4 also showed that spraying with yeast extract with two concentrations 1 ml L^{-1} and concentration 2 or 4 ml L^{-1} organic fertilizer led to an increase in the length of the root system, reaching 19.17 and 19.30 cm, respectively, which differed significantly from the control treatment, which amounted to 15.17 cm. The spraying with yeast at a concentration of 1 ml L^{-1} with 2 ml L^{-1} organic fertilizer was recorded the highest effect of the fresh and dry weight characteristics of the root system, which was 9.60 and 1.46 g, respectively, while the lowest rate for this characteristic was when the control treatment was 0.83 g.

Floral Growth Indicators

Table 5 results showed that spraying with yeast extract at a concentration of 2 ml L^{-1} was increased the fresh weight of the flower, reaching 1.55 g, which differed significantly from the two treatments, control and 1 ml L^{-1}, which were 0.99 and 1.04 g, respectively. This is consistent with what Nofal [39] found that the fresh and dry weight of the flowers of the marigold plant was affected by spraying with different concentrations of yeast extract during the two seasons of the experiment. The two treatments differed from the control treatment, and this is consistent with Sridhar and Rengasamy [40] found that the fresh weight of the flowers of Mexican marigold plant increased with increasing concentrations of seaweed extract. It was an interaction between yeast extract and fertilizer organic had a significant effect on this characteristic, as the highest rate of fresh weight of the flowers was when sprayed with yeast extract at a concentration of 2 ml L^{-1} and a treatment of 4 ml L^{-1} of organic fertilizer, which reached 1.87 g.

The results of the same table showed that spraying with yeast extract increased the dry weight of the flowers, and the concentration 2 ml L^{-1} was recorded the highest rate, which was 0.046 g, which differed significantly from the 1 ml L^{-1} and the control treatments, which did not differ significantly between them, and the dry weight increased. The flowers were treated with organic fertilizers at concentrations of 2 and 4 ml L^{-1} which were 0.042 and 0.044 g, respectively, which differed from the control treatment. These results are consistent with results of Nofal (2016) found on marigold plant. The interaction between the yeast extract and organic fertilizers had an effect on increasing the dry weight of the flowers. The highest rate was at a concentration of 2 ml L^{-1} yeast extract and 4 ml L^{-1} organic fertilizer, which the dry weight reached 0.047 g.

CONCLUSION

Combining 4 ml L^{-1} organic fertilizer, Algedx, and 2 ml L^{-1} yeast extract is the best to enhance the vegetative, root, and floral growth of the Chinese carnation plant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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