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Effect of Organic Residues and Boric acid on Growth and Flowering Parameters of Rocket Larkspur *Delphinium ajacis* L.

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Abstract: A pot trial was conducted to investigate the impact of adding organic residues (fermented powder of date palm leaves) and spraying boric acid on growth and flowering of Larkspur planting randomized complete block design with two factors, three applications of organic fertilizer were mixed with the growing media at different ratios (0:4, 1:4 and 2:4 organic fertilizer: soil) and spraying boric acid (17% B) at three concentrations (0, 10 and 20 mg l^{-1}) were used. There was a significant increase in plant height, number of leaves $plant^{-1}$, stem diameter, leaf dry matter, total chlorophyll content, total soluble carbohydrates, protein content in leaves and C/N ratio as a result of adding organic residues or spraying boric acid, where the highest values observed when adding organic residues at ratio 2:4 and spraying boric acid at 20 mg L^{-1}, also flowering parameters were increased significantly by adding organic residues at 2:4 ratio + 20 mgL^{-1} boric acid, recording 13.05 inflorescence $plant^{-1}$, 3.16 g for inflorescence dry weight and 4.60 days $^{-1}$ for vase life. Likewise early flowering (94.96 day) took part in plants of these treatments. The greatest value in inflorescences diameter (4.42 cm) was recorded in the F2 and B1 treatment.

Keywords: Organic Residues, Rocket Larkspur, *Delphinium ajacis,* Boric acid

Delphinium ajacis L. (Rocket Larkspur) is a traditional English garden plant which has tall Inflorescences with much color that adds beautiful views to the public and private garden, as well as its cut flowers. It's an annual flowering plant of the family Ranunculaceae native to Eurasia. There are several new cultivars of *Delphinium* suitable to grow as cut flowers or for garden planting. Many organic can be obtained at little or no cost from collecting plant wastes and leaves, and important nutrients which have role these decomposing organic residues are important in plant nutrition when mixing it or adding it to the potting soil. In addition In addition to the environment safety and reducing chemical products, also improves the growth and development of the plant because it contains many plant nutrients which have role in the growth, flowering and metabolism processes inside the plant like photosynthesis, as well as it works to improve the characteristics of the soil (Rosen and Bierman 2005). Muslat and Muslh (2012) mentioned that organic matter is rich in nutrients and hormones and also adjusts the pH of the soil as a result of the release of CO_2 gas when dissolved and improves soil properties. Rajvanshi and Dwivedi (2014) noted that the addition of compost to soil planted with *Zinnia elegans* L. resulted in a significant increase in plant height, number of leaves, number of flowers and flower diameter. Husien and Abbass (2017) concluded that adding of residues of date palm fronds increased significantly leaf area. Boron is an important nutrient in the activation of vital processes, especially in relation to fruit nodes by stimulating physiological processes during the flowering phase and this leads to an increase in pollen. Boron also plays an important role in the division and elongation of growing peak cells and its role in promoting pollen germination as a result of the manufacture of gibberellic acid (GA) in those seeds. The essential physiological activities of boron linked to strength of cell wall and development, RNA metabolism, sugar transport, hormones development, respiration, cell division, indole acetic acid (IAA) metabolism and as a part of the cell membranes (Marchner 1995). Fahad et al (2014) mentioned that spraying boric acid to *Gladiolus grandiflorus* L. significantly increased plant height, leaf total chlorophyll content, flower stalk length, floret fresh weight, number of florets per inflorescence, floret diameter, inflorescence vase life. AL-Atrakchii et al (2017) observed that spraying plants with boric acid gave a significant increasing in leave number, plant dry weight, inflorescence length and floret number $inflorescence^{-1}$ of Snapdragon plant *Antirrhinum magus* L. The present study was carried out to study the effect of adding organic residues and spraying boric acid on growth and flowering parameters of Rocket Larkspur grown in pots.

MATERIAL AND METHODS

This study was done during autumn, winter and spring seasons of 2017-2018 at Basrah governorate to investigate the effect of organic residues (fermented powder of date palm -*Phoenix dactylifera* L. leaves), as date palm leaves

were collected, chopped and soaked in water (7–10 days) then dried and mixed with cow manure in a 3:1 ratio and boric acid on growth and flowering parameters of Rocket Larkspur plant. The experiment was designed in a factorial experiment according to randomized completely block design. The organic residues (fermented powder of date palm leaves) were mixed with soil at three ratio *i.e.* 0:4 (2kg soil only), 1:4 (200 gm fermented powder: 4 soil) and 2:4 (400 gm fermented powder: 4soil) as F0, F1 and F2, in pots (20 cm height and 20 cm diameter) and harmonized seedlings of 12 ± 2 cm length developed two to three true leaves were transplanted in it. Boric acid H_3BO_3 (17% B) was sprayed at three concentrations *i.e.*(0, 10 and 20 mg L^{-1}) at two times, the first one was after 15 days form planting (Nov 14, 2017), and second after two weeks of the first spraying. Control treatment was sprayed with distilled water. Parameters were taken at April 15, 2018 which included:

Plant height (cm), number of leaves $plant^{-1}$, leaves dry mater (%): fresh weight was measured, then they were dried in an aerated oven at 70ºC for each plant, then dry matter in leaves was estimated stem diameter (mm), total chlorophyll content of leaves (mg g^{-1} fresh wt.) was estimated according to (Goodwin 1976), total soluble carbohydrate in leaves (mg g dry wt^{-1}) according to (Dobois et al 1956).

Protein content in leaves (%): Protein was estimated according to the procedures reported in Association of Analytical Communities (AOAC 1970) by the equation: Protein = N % X 6.25, as nitrogen was estimated as described by Jackson (1958).

C/N ratio was calculated as C/N = total soluble carbohydrate / nitrogen content.

Days to flowering and number of inflorescence $plant^{-1}$ was calculated. The inflorescence dry weight (g) as they were dried in an aerated oven at 70 º C for each plant and dry weight was calculated. Three to one-half florets opened inflorescence were randomly taken from each treatment and vase life was calculated as described by (Al-Abbasi et al 2015). Al-Abbasi et al (2015) as vase life included days from the first flower opened until the floret become wilted. The data were statistically analyzed by using Gnestat program and least significant difference (LSD) test at 0.05 probability level.

RESULTS AND DISCUSSION

Adding organic residues at ratio 2:4 and spraying boric acid at 20mg L^{-1} had significant effects on growth parameters and gave the highest plant height, leaves number per plant and stem diameter that reached (60.09 cm, 43 and 2.03 mm, respectively) compared to control treatment which gave the least values (Table 1). Organic residues can improve soil fertility, as they may improve physical properties and increase

Table 1. Effect of adding organic residues and spraying boric acid on vegetative growth parameters of Rocket Larkspur plant

Treatment			Leaves $plant^{-1}$	Leaves dry matter (%)	Plant height (cm)	Stem diameter (mm)
Organic residues ratio		F0	23.69	12.59	46.68	1.786
		F1	36.43	13.18	54.09	1.930
		F2	41.38	14.63	57.19	1.933
LSD (p=0.05)			0.745	0.309	0.972	0.045
Boric acid (mg l^{-1})		B0	30.38	13.09	49.70	1.746
		B1	33.84	13.50	52.14	1.923
		B2	37.28	13.80	56.13	1.980
LSD (p=0.05)			0.745	0.309	0.972	0.045
Organic residuesX Boric acid	F0	B0	19.95	12.37	43.97	1.610
		B1	23.42	12.54	46.18	1.850
		B2	27.71	12.86	49.90	1.900
	F1	B0	32.03	12.89	51.39	1.800
		B1	36.11	13.12	52.47	1.960
		B2	41.14	13.53	58.40	2.010
	F2	B0	39.15	14.01	53.73	1.830
		B1	41.99	14.86	57.76	1.960
		B2	43.00	15.02	60.09	2.010
LSD (p=0.05)			1.291	0.536	1.683	0.078

NS = No significant differences among the means (P < 0.05)

nutrients availability and supplying soil with humus that improves physical properties and increases ability to hold water, reduces nutrient loss and increase the availability of the essential nutritional elements necessary for plant growth for the purpose of carrying out biological processes, like photosynthetic, protein formulation and carbohydrates manufacturing and stimulate the cell division (Grandy et al 2002, Rosen and Bierman 2007). The organic fertilizer also supplies with some nutrients like nitrogen potassium and phosphorus that is important role in the growth and development of the plant growth and chlorophyll synthesis and increase in the number of leaves and leaves area (Abdelrazzag 2002). The boron plays roles in cell division, metabolism of nitrogen, formation of proteins, formation of nucleic acids and systems antioxidants (Johnson et al 2005, Koshiba et al (2009). Rajput et al (2003) also indicated an increase in the number of lateral shoots of African marigold (*Tagetes minuta* L.) occurred when treating with boron as boron performs an important role in the biosynthesis of auxins within the plants leading to an increase in leaves number and shoot dry weight.

The total chlorophyll content in leaves, percentage of total soluble carbohydrates in leaves protein content in leaves were significantly increased in plants treated with F2 ration of organic residues and spraying with concentration 20 mg L^{-1} boric acid than control plants which gave the lowest values (Table 2). This may be due to the role of fertilizers in improving some of the characteristics of and increasing the availability of nutrient elements in the soil and increasing the efficiency of the root system to absorb more nutrients, which led to improving the efficiency of photosynthesis and increasing the manufacturing of carbohydrates, also increase the absorbed quantities of nitrogen element) which finally led to an improvement in the growth parameters of the plant (Muslat and Muslh 2012).

These results are in agreement with the suggestions that boron element had an important role in the metabolism of nitrogen and proteins formation, translocation of sugars which finally increase growth parameters (Johnson et al 2005, Koshiba et al 2009). It is evident from the results obtained as illustrated in Table 3 that treatments had the same effect on flowering parameters. Therefore, findings showed that number of inflorescences $plant^{-1}$, inflorescences dry weight and vase life were significantly increased in the F2 and B2 treatment (13.05, 3.16 gm and 4.60 day, respectively), On the other hand early flowering (4.42 day) took part in plants of these treatments as well. While, the greatest value in inflorescences diameter was

Table 2. Effect of adding organic residues and spraying boric acid on chemical composition of Rocket Larkspur plant

Treatments			Total chlorophyll content in leaves (mg kg^{-1} f. wt.)	Leaves dry matter (%)	Total soluble Carbohydrates in leaves (%)	Protein content in leaves (%)	C/N ratio
Organic residues ratio		F0	1.37	12.59	19.47	12.39	9.76
		F1	1.41	13.18	20.63	13.35	12.26
		F2	1.416	14.63	29.67	14.06	13.47
LSD (p=0.05)			0.011	0.309	0.869	0.34	0.830
Boric acid (mg l^{-1})		B0	1.3767	13.09	21.93	12.83	11.19
		B1	1.4100	13.50	23.27	13.37	11.93
		B2	1.4133	13.80	24.57	13.60	12.36
LSD (p=0.05)			0.011	0.309	0.869	0.34	0.830
Organic residue X Boric acid	F0	B0	1.36	12.37	17.30	12.18	9.03
		B1	1.38	12.54	19.60	12.43	9.56
		B2	1.37	12.86	21.50	12.56	10.70
	F1	B0	1.38	12.89	19.70	12.68	11.38
		B1	1.43	13.12	20.00	13.50	12.78
		B2	1.43	13.53	22.20	13.87	12.62
	F2	B0	1.39	14.01	28.80	13.62	13.17
		B1	1.42	14.86	30.20	14.18	13.47
		B2	1.44	15.02	30.00	14.37	13.77
LSD (p=0.05)			0.0198	0.536	1.505	0.595	1.437

NS = No significant differences among the means (P < 0.05)

Table 3. Effect of adding organic residues and spraying boric acid on flowering parameters of Rocket Larkspur plant

Treatments			Inflorescence diameter (cm)	Days to first flowering	No. of Inflorescence plant^{-1}	Inflorescence Dry wt. (gm)	Vase life (day)
Organic residues ratio		F0	3.66	110.65	10.62	1.94	3.55
		F1	3.89	105.74	12.29	2.62	3.83
		F2	4.28	97.590	12.55	3.03	4.23
LSD (p=0.05)			0.108	00.831	0.370	0.156	0.382
Boric acid (mg l^{-1})		B0	3.78	108.12	11.17	2.31	3.68
		B1	3.97	106.17	11.76	2.57	3.99
		B2	4.07	99.70	12.53	2.70	3.94
LSD (p=0.05)			0.108	0.831	0.370	0.156	0.382
Organic residues X Boric acid	F0	B0	3.53	113.16	9.81	1.76	3.21
		B1	3.71	110.80	10.45	1.90	3.68
		B2	3.75	108.00	11.60	2.15	3.78
	F1	B0	3.71	111.10	11.84	2.31	3.50
		B1	3.79	109.98	12.11	2.76	4.00
		B2	4.17	96.14	12.93	2.80	4.00
	F2	B0	4.12	100.10	11.87	2.87	4.35
		B1	4.42	97.72	12.73	3.06	4.29
		B2	4.30	94.96	13.05	3.16	4.06
LSD (p=0.05)			0.187	1.440	0.641	0.271	0.661

NS = No significant differences among the means (P < 0.05)

recorded in the F2 and B1 treatment. The added organic residues caused. The added organic residues caused an significant increases in the flowering parameters and that may be due to the organic residues that contain many nutrients necessary for growth when disintegrate into nitrogen, potassium and phosphorus, which stimulates the process of photosynthesis and the increase of processed substances such as carbohydrates (Table 2) and thus their transfer from the source (leaves) to places stored in flowers (sink) ultimately improvement flowering parameters(Muslat and Muslh 2012).

Because boron is passively absorbed and transported through the transpiration stream, deficiencies of Boron may be transitory. Such deficiencies commonly occur during periods of rapid plant growth, especially during flowering and seed set, furthermore, premature flower and fruit drop of plant has been attributed to B deficiency, suggesting that B movement to reproductive structures is restricted or that growth and development of floral structures have a higher demand for B than do vegetative structures do (Dell and Huang 1997). The increase indicated that foliar B had positive effects by increasing weight; this may be due to its positive effects on and higher nitrogen fixation rate. This could be resulted from the improvement took part in vegetative growth especially numbers leaves (Table 1). These results are in agreement with previous reports that B has indirect effects on nitrogen metabolism by increasing nitro- gen demand (Rosen and Bierman 2005).

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