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Original Article:

Evaluation of the Effects of Amino Acid and Mother Corm Weight on Antioxidant Activity and Stigma Quality of Saffron (*Crocus sativus* L.)

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Extended Abstract

Introduction: Amino acids are organic fertilizers. Adding these organic fertilizers to the soil improves the condition of microorganisms in the soil, which their activity facilitates the absorption of some nutrients and ultimately increases the growth and performance of the plant. To investigate the effect of amino acid and mother corm weight on qualitative parameters in petals and stigmas of saffron (*Crocus sativus* L.), an experiment was conducted at the Research Field of College of Agricultural, University of Birjand, in 2017.

Materials and Methods: The experimental factors included amino acid (0, 2, and 4 $L.ha^{-1}$) and corm weight [0.1-4 (small), 4.1-8 (medium), and 8.1-12 g (large-sized)] which were tested in an RCBD with three replications. After the land preparation operations including initial plowing, disk, and land leveling, plots of 2 × 2 meters were created. Irrigation was done by siphoning. The saffron corms were planted in grooves with a depth of 20 cm, the distance between the rows was 20 cm, and the distance between the corms was 10 cm. The amino acid was consumed before planting by submerging the corms and with the first irrigation when the plots were flooded uniformly. Harvesting of saffron flowers was done daily for about three weeks in the first hours of the morning, taking into account the marginal effect of the remaining surface of the plots. After weighing the flower yield in each plot, the different parts of the flower (petal and stigma)

were dried in an electric oven at 45 °C for 24 hours and then used to measure the quality indicators.

Results and Discussion: The use of amino acids had a significant effect on the carotenoid content and anthocyanin of petals and stigma crocin. The highest amounts of carotenoid content (0.95 $mg.g^{-1}$ FW), anthocyanin (26.28 $mg.100g^{-1}$ DW), and crocin (270.4% Absorbance of 1% aqueous saffron extract at 440 nm) were obtained when amino acid was used at the rate of 4 $L.ha^{-1}$. However, no significant difference was found between the two levels of amino acid in terms of all the mentioned parameters. The lowest values of carotenoid (0.71 $mg.g^{-1}$FW) anthocyanin (24.23 $mg.100g^{-1}$DW), and crocin (230.5) were obtained from the control treatment. Mother corm weight also exerted a significant effect on picrocrocin content. The lowest content of picrocrocin was obtained in the amount of 100.7 (Absorbance of 1% aqueous saffron extract at 257 nm) of small-sized mother corms (0.1- 0.4 g) and the highest of 108.5 of large-sized mother corms (8.1-12 g). The interaction of these two factors (amino acid and mother corm weight) had also a significant effect on the safranal of stigma, and antioxidant activity of saffron petals. The highest content of safranal (36.82, Absorbance of 1% aqueous saffron extract at 330 nm), and antioxidant (31.26%) were obtained from corm 8.1-12 g and 2 or 4 $L.ha^{-1}$ of amino acid.

Conclusion: The results of this research showed that the planting of larger mother corms and the use of amino acids can be useful in improving the quality characteristics of petals and effective substances of saffron stigma. Since no statistically significant difference was observed between the consumption levels of two and four liters per hectare of amino acids in most of the studied traits, to reduce production costs, two liters per hectare of organic input of amino acids can be suggested. This amount can vary depending on the characteristics of the soil in each region. The results of this study indicated the beneficial effects of amino acid on improving biochemical traits and effective ingredients which is appropriate for the organic production of saffron.

Conflict of Interest: The authors declare no potential conflict of interest related to the work.

Keywords: Anthocyanin, Picrocrocin, Safranal, Carotenoid, Crocin.

Five Important References

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Table 1. Physical and chemical characteristics of the soil at the experiment site

Texture	pH	EC ($ds.m^{-1}$)	Organic matter (%)	Total nitrogen (%)	Absorbable potassium (ppm)	Absorbable phosphorus (ppm)
Loam	7.76	3.4	0.68	0.06	230	40

Table 2. Chemical properties of amino acids

Amino acid (%)	Organic carbon (%)	Total nitrogen (%)	EC ($ds.m^{-1}$)	pH
28	19	5	3.2	5.8

Table 3. The results of analysis of variance (mean square) for the studied characteristics

Cartenoid leaves	Petal anthocyanin	Antioxidant activity of petals	Petal phenol	Stigma safranal	Stigma crocin	Stigma picrocrocin	df	S.O.V
0.0021^{ns}	0.123^{ns}	0.44^{ns}	1.08^{ns}	0.55^{ns}	575.2^{ns}	498.4^{*}	2	Block
0.13^{**}	12.20^{**}	10.37^{**}	1.94^{ns}	14.25^{**}	3717.8^{**}	1117.9^{**}	2	Amino acid
0.078^{*}	6.84^{*}	10.85^{**}	1.72^{ns}	2.56^{*}	290.9^{ns}	282.3^{*}	2	Weight of corm
0.0057^{ns}	3.50^{ns}	2.60^{*}	0.40^{ns}	2.57^{*}	233.4^{ns}	148.9^{ns}	4	Weight of corm×Amino acid
0.015	1.31	0.56	0.7	0.75	267.9	84.7		Error

ns, ** and *are nonsignificant and significant at the 0.01 and 0.05, -, respectively.

Table 4. Comparison of the simple effect of corm weight on quality traits of saffron

Cartenoid leaves ($mg.g^{-1}f.w$)	Petal anthocyanin ($mg.100\ g\ dry\ weight^{-1}$)	Antioxidant activity of petals (%)	Petal phenol ($mg.100g\ dry\ weight^{-1}$)	Stigma safranal (Absorbance of 1% aqueous saffron extract at 330 nm)	Stigma crocin (Absorbance of 1% aqueous saffron extract at 440 nm)	Stigma picrocrocin (Absorbance of 1% aqueous saffron extract at 257 nm)	Weight of corm (g)
0.74^{b}	24.86^{b}	27.28^{c}	62.66^{a}	34.22^{b}	242.9^{a}	100.7^{b}	0.1-4
0.84^{a}	25.31^{b}	28.40^{b}	62.83^{a}	34.68^{ab}	247.7^{a}	103.0^{ab}	4.1-8
0.93^{a}	26.54^{a}	29.48^{a}	63.49^{a}	35.28^{a}	254.2^{a}	108.5^{a}	8.1-12

In each column, means with the same letter are not different significantly at 5% probability level.

Table 5. Comparison of the average effect of simple amino acid on quality traits of saffron

Cartenoid leaves ($mg.g^{-1}f.w$)	Petal anthocyanin ($mg.100\ g\ dry\ weight^{-1}$)	Antioxidant activity of petals (%)	Petal phenol ($mg.100g\ dry\ weight^{-1}$)	Stigma safranal (Absorbance of 1% aqueous saffron extract at 330 nm)	Stigma crocin (Absorbance of 1% aqueous saffron extract at 440 nm)	Stigma picrocrocin (Absorbance of 1% aqueous saffron extract at 257 nm)	Amino acid ($L.ha^{-1}$)
0.71^{b}	24.23^{b}	27.25^{c}	62.54^{a}	33.27^{b}	230.5^{b}	94.8^{b}	0
0.85^{a}	26.20^{a}	28.52^{b}	62.83^{a}	35.44^{a}	244.0^{b}	108.6^{a}	2
0.95^{a}	26.28^{a}	29.39^{a}	63.49^{a}	35.47^{a}	270.4^{a}	108.7^{a}	4

In each column, means with the same letter are not different significantly at 5% probability level.

Table 6. Comparison of the average interaction effect of corm weight and amino acid on the studied characteristics

Antioxidant activity of petals (%)	Stigma safranal (Absorbance of 1% aqueous saffron extract at 330 nm)	Weight of corm (g)	Amino acid ($L.ha^{-1}$)
26.64^{d}	33.79^{cd}	0.1-4	0
27.19^{d}	33.03^{d}	4.1-8	0
27.94^{cd}	33.00^{d}	8.1-12	0
27.25^{d}	33.86^{cd}	0.1-4	2
29.06^{bc}	35.63^{ab}	4.1-8	2
29.24^{bc}	36.82^{a}	8.1-12	2
27.41^{d}	35.01^{bc}	0.1-4	4
29.50^{b}	35.37^{ab}	4.1-8	4
31.26^{a}	36.03^{ab}	8.1-12	4

In each column, means with the same letter are not different significantly at 5% probability level.

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