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EFFECT OF FOLIAR APPLICATION OF SIDA COMPOUND FERTILIZER ON GROWTH, YIELD, AND FRUIT CHEMICAL COMPOSITION OF 'EARLY SUPERIOR' GRAPEVINE

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ABSTRACT

This experiment aimed at studying the effect of Sida Compound fertilizer containing seaweed extract, natural fertilizers, growth promoters and micronutrients in chelated form on growth, yield and berry quality of table grape 'Early Superior'. Foliar application of Sida Compound at concentration 0.05 to 0.20%, three times in a season increased shoot length, leaf area and content of N, P and K in the leaves as well as total soluble solids and total sugar contents in fruits. Yield of fruits increased by 29 and 14%, depending on the season.

Key words: Sida Compound, seaweed, 'Early Superior' cv., grapevines, berry quality

INTRODUCTION

In Egypt, grape is considered the second major fruit crop after citrus owing to its acreage and fruit production, which reached 64 835 hectares and 1 320 800 MT (metric tonnes), respectively, giving Egypt the 12th position in grape production all over the world according to FAO (2011). The key for increasing the quality of Egyptian grapes exported to the European markets and reducing the competition with other producers is optimizing the berry quality.

'Early Superior' grapevine is the most popular grape cultivar successfully grown under Egyptian conditions. This cultivar ripens early in June and sometimes in the last week of May when grown in sandy soils. It has a great potential for export to foreign markets due to its early ripening.

Intensive crop cultivation mostly leads to nutrient depletion from the soil. Soil application of nutrients may not meet the nutritional crop requirements for growth and nutrient balance within the plant tissue. Thus, an alternative approach is to apply nutrients as foliar sprays (Arif *et al*. 2006). Some fertilizers contain algae extracts, rich in micro- and macroelements, amino acids, vitamins and plant growth regulators, affecting cellular metabolism of treated plants and enhancing plant growth (Durand *et al*. 2003; Strik *et al*. 2003). This experiment aimed to study the effect of Sida Compound complex fertilizer containing algae extract, natural fertilizers, growth promoters, and micronutrients in chelated form, on vegetative growth, yield, and fruit quality of 'Early Superior' grapevine.

MATERIALS AND METHODS

The study was carried out during 2005 and 2006 seasons on uniform-in-vigour, 5-year-old 'Early Superior' grapevine plants, in a private vineyard located at Beni-Mazar District, Minia Governorate, where the soil is silty loam, well drained with 2-m-deep water table. Experimental plants received agricultural practices typical of vineyard. The plants were trained according to cane pruning system using modified Y shape supporting system. Pruning was carried out in the second week of December in both seasons. Vine load was 84 flower buds per vine (six canes, each having 12 buds plus six renewal spurs, each having 2 buds). The uniform in vigour vine bushes were

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spaced at 1.75 m between bushes and 2.5 m between rows.

Sida Compound, a product of Sidasa Egypt Co., accounted to "Growth Media Fertilizers", contains plant and seaweed extracts, natural fertilizers and growth promoters, and micronutrients in chelated form (www.Sidasa-egypt.com). More detailed composition of the above fertilizer, available in Arabic (http://www.sidasaegypt.com/arabic/pro1.htm), declares the presence of nitrogen, phosphor, potassium, magnesium, calcium, sulphur, chelates of Fe, Zn, Mn, Cu, Mo and B, auxins, cytokinins, abscisic acid, gibberellins, vitamins, organic and amino acids, alginic acid, proteins, and carbohydrates. Sida Compound was applied as foliar sprays in two subsequent seasons in the following concentrations: 0.00% (control), 0.05%, 0.10%, 0.15% and 0.20%, with 0.05% Triton B added as a wetting agent. Fertilizer was dissolved in tap water to the proper concentration and applied three times – 10 days before full blooming (first week of March), after berry setting (first week of April) and 21 days later (the last week of April). The vines were covered with abundant amount of the solution (about 1 L per vine).

Measurements of vegetative growth parameters

At the end of growth seasons, shoot length (cm) and number of leaves per shoot were recorded. Using the equation by Ahmed and Morsy (1999), average leaf area (in cm^2) was estimated during the second week of May in both seasons on 20 mature leaves growing below basal clusters.

Evaluation of NPK contents in leaves

Twenty petioles of the same leaves picked for measuring leaf area (according to Kavanci & Ataly 1987; Balo *et al*. 1988) were taken in the second week of May. Samples were washed with tap water, and twice with distilled water followed by oven drying at 70 °C. Nitrogen (%) was determined by the modified micro-Kjeldahl method described by Wilde *et al*. (1985). Phosphorus (%) was determined using the Olsen method, and potassium (%) with flame photometer method outlined by Chapman and Pratt (1965).

Yield evaluation

Harvesting was carried out at the time of commercial maturity typical for this cultivar in the experimental region when total soluble solids content reached about 16% for the berries of control vines, in the last week of May 2005 and 2006. The number of clusters per plant was recorded. The weight of each individual cluster was estimated in grams and the total yield per plant in kilograms.

Measurements of berry chemical constituents

Five clusters were picked at random from the yield of each replicate as a representative sample for juice chemical analysis. The following constituents were estimated, using the corresponding methods: total soluble solids content (TSS in %) by hand refractometer; total acidity (in g of tartaric acid/ 100 mL of juice) by titration against 0.1N NaOH, using phenolphthalein as an indicator outlined by Association of Official Agricultural Chemists (AOAC); total sugars (%) according to Lane and Eynon volumetric method, as described in AOAC (1985).

Statistical analysis

The experiment was set up in a complete randomized block design with three replicates (plants), where five concentrations of Sida Compound were applied. All the obtained data were statistically elaborated using the MSTAT package on PC, then Least Significant Difference (LSD) test was used to recognize the significance between the treatment means.

RESULTS AND DISCUSSION

Influence of Sida Compound on growth parameters

Shoot length and number of leaves per shoot were positively affected by Sida Compound (Table 1). Foliar application of Sida Compound at 0.20% increased shoot length by 20 cm in the first and by 10 cm in the second season in comparison with control. Similarly, the leaves number increased by about 3.5 in both years and leaf area by 10 and 13 cm^2 in the first and the second season in comparison to control. All three parameters increased with concentration of applied Sida Compound. Similar results were obtained by Mahran (2005). Increase in vegetative parameters may be caused by the positive influence of endogenous hormones present in Sida Compound. Recently, Khan *et al*.

(2012) observed that foliar application of a mixture of amino acids and seaweed (*Ascophyllum nodosum*) significantly increased the leaf size of 'Perlette' grapevine.

Influence of Sida Compound on content of NPK in leaves

Spraying grapevine plants three times per season with 0.20% of Sida Compound increased content of N by 13 and 11%, P by 35 and 35% and K by10 and 12% in the leaves, depending on the season (Table 2). Contents of NPK increased together with Sida Compound concentration. This effect may be attributed to the availability of high level of NPK in Sida Compound, which increased the mineral content of the leaves (Durand *et al*. 2003; Strik *et al*. 2003). These results confirmed the findings of Abd El Moniem and Abd-Allah (2008), who obtained positive influence of Sida Compound on NPK content in the leaves of 'Superior' grapevine cultivar.

Influence of Sida Compound on fruit yield

Only in the first year of application of Sida Compound did it not have any influence on number of fruit clusters per plant. In the next year, even application this fertilizer at 0.05% increased this parameter (Table 3). Increase in cluster weight grew with the fertilizer concentration. The same effect of foliar application was observed for fruit yield, which increased with the fertilizer concentration by 13 or 30%, depending on the year. The weaker result in the first year might be related to the formation of flower buds in the season of 2004, when Sida Compound was not applied. The increase in the number of clusters in 2006 season may be due to the increased rate of photosynthesis in the treated grapevines, which was reported for squash plants by Abd El-Aal *et al*. (2010). The obtained results are in the line with those of Norrie and Keathley (2006), who also reported that the application of marine-plant extract on 'Thompson Seedless' grapes increases the number of clusters per vine. The increase of cluster weight may be related to the availability of iron and manganese in Sida Compound; both elements are known to enhance chlorophyll content and photosynthesis rate. Khan *et al*. (2012), who sprayed 'Perlette' grapevine with a fertilizer containing mixture of amino acids and seaweed extract, recorded similar results. The most significant increase in average weight of yield per vine was obtained when the vines were treated with 0.10% of Sida Compound, which gave 16.0 kg and 30.1 kg of fruits in comparison to 11.7 and 26.5 kg per vine in the seasons of 2005 and 2006, respectively. The significant yield increase may be related to the enhancement of number of clusters per vine and cluster weight. In addition, the yield enhancement was caused by improvement of vegetative vine growth and higher nutritional status of the plants. Our results are in agreement with those obtained by Abd El Moniem and Abd-Allah (2008), in which 'Superior' grapevine plants were sprayed with Sida Compound.

Influence of Sida Compound on berry chemical constituents

Spraying of vines with Sida Compound at 0.05 to 0.20% significantly enhanced the contents of TSS and total sugars in the berries. The percentage of total soluble solids was positively affected by increasing the Sida Compound concentration, whereas the content of total sugars did not increase at concentrations higher than 0.10%. The highest contents of TSS (19.3 and 21.2%) were recorded in the grapevines treated with 0.20% of Sida Compound concentration. Grape ripening is not only determined by the rate of TSS accumulation, but also characterized by the rate of decline in organic acids. Table grapes for fresh consumption require lower acidity than wine grapes, and an appropriate balance between TSS and acid content around 25:1 should be carefully observed. Total acidity in berry juice was remarkably decreased (0.658%, 0.651%, 0.577%, 0.574% and 0.572%) with increasing concentration of the Sida Compound in both seasons (Table 4). The increase of the total sugars content might be due to the availability of iron and manganese in Sida Compound, which may enhance chlorophyll level and photosynthesis rate. Similarly, the significant increase in the content of total sugars has been reported in 'Red Roomy' grapes after foliar application of yeast extract and some micronutrients (Abada 2002).

Table 1. The effect of Sida Compound on the vegetative growth of 'Early Superior' grapevine

Sida Compound concentration (%)	Shoot length (cm)		No. of leaves per shoot		Average leaf area (cm^2)	
	2005	2006	2005	2006	2005	2006
0.00	166	182	24	27	164	181
0.05	169	186	25	28	167	183
0.10	174	191	27	30	174	192
0.15	175	192	28	31	175	192
0.20	175	193	29	31	175	193
LSD at 5%	1.5	1.8	0.7	0.8	2.3	2.6

Table 2. Effect of Sida Compound on leaf chemical constituents of 'Early Superior' grapevine

Sida Compound concentration (%)	Nitrogen content (%)		Phosphorus content (%)		Potassium content (%)	
	2005	2006	2005	2006	2005	2006
0.00	1.22	1.19	0.15	0.17	1.09	1.07
0.05	1.30	1.26	0.19	0.20	1.15	1.12
0.10	1.38	1.31	0.21	0.24	1.22	1.18
0.15	1.39	1.37	0.22	0.25	1.23	1.19
0.20	1.40	1.33	0.23	0.26	1.24	1.19
LSD at 5%	0.03	0.05	0.02	0.03	0.06	0.05

Table 3. The effect of Sida Compound on fruit yield of 'Early Superior' grapevine

Sida Compound concentration (%)	No. clusters/vine		Average cluster weight (g)		Yield/vine (kg)	
	2005	2006	2005	2006	2005	2006
0.00	34.3	38.8	164.4	180.8	11.7	26.5
0.05	34.5	43.1	166.7	183.4	12.9	27.6
0.10	34.5	48.9	174.4	191.8	16.0	30.1
0.15	34.8	49.4	174.9	192.4	16.2	30.5
0.20	34.9	49.7	175.4	193.0	16.5	30.7
LSD at 5%	NS	1.6	2.3	2.6	1.4	0.8

Table 4. The effect of Sida Compound on chemical content of the berries of 'Early Superior' grapevine

Sida Compound concentration (%)	TSS content (%)		Total acidity (%)		Total sugars content (%)	
	2005	2006	2005	2006	2005	2006
0.00	17.0	18.7	0.658	0.598	15.3	17.0
0.05	18.0	19.8	0.651	0.591	15.9	17.7
0.10	19.0	20.9	0.577	0.524	16.6	18.4
0.15	19.2	21.1	0.574	0.522	16.7	18.5
0.20	19.3	21.2	0.572	0.520	16.7	18.5
LSD at 5%	0.4	0.5	0.027	0.016	0.2	0.2

CONCLUSIONS

Foliar application of Sida Compound fertilizer in both years of the study had a positive effect on vegetative growth, leaf mineral content, yield and chemical content of the berries. Application of the Sida Compound at the concentration of 0.10% is quite effective to enhance growth, yield and berry chemical characteristics of 'Early Superior' grape although some parameters increase at concentrations 0.15 and 0.20%.

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