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EFFICACY OF PLANTOZYME ON PHYSIOLOGICAL PARAMETERS AND YIELD COMPONENTS IN THOMPSON SEEDLESS GRAPES UNDER PUNE CONDITION

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ABSTRACT
An investigation was carried out to study the efficacy of Plantozyme on physiological parameters, quality and yield components in Thompson Seedless grapes at NRC Grapes, Pune (latitude 18.31N, longitude 73.55E) during 2012-13, 2013-14 and 2014-15. Eleven treatments were applied in replicated RBD. Morphological, physiological and biochemical parameters were recorded at 90 days after pruning and yield parameters were recorded at harvest. The maximum shoot length and leaf area and physiological parameters like, berry diameter, berry skin thickness, and berry length were recorded with the application fertilizer dose + Planto granules @ 50 g/vine + Spraying of Planto grapes @ 2 ml/lit. Similarly, cane thickness, leaf thickness, biochemical parameters such as reducing sugar, total protein and total phenol were recorded higher in treatment of recommended fertilizer dose + Planto drip @ 2.5 ml/vine + Spraying of Planto grapes @ 2 ml/lit. The maximum yield per vine and the highest BC ratio was recorded with application of recommended fertilizer dose + Planto granules @ 50 g/vine + Planto drip @ 2.5 ml/vine + Spraying of Planto grapes @ 2 ml/lit. From the present study in general, it can be concluded that the application of Plantozyme resulted increasing berry characters, quality parameters, biochemical parameters as compared to control. In brief, the application of Plantozyme as a granule through soil @ 50g/vine, drip @ 2.5 ml/vine and foliar spray @ 2ml/l along with recommended dose of fertilizers found to be best to improve the quality and yield of Thompson Seedless grapes under Pune conditions.

INTRODUCTION

Grape (*Vitis vinifera* L.) is one of the important fruit crops grown in world and cultivated widely in temperate and subtropical climates. Even though their origin was in temperate regions, it perform equally well in a tropical climate in India. Improvement in yield and quality are the most important aspects of grape production. The quality is mainly determined by berry size, color and pulp content in the berries while, yield is governed by number of bunches per vine and bunch weight. The size of the berry should be around 18mm, prerequisite for export in European Union. Hence, many plant growth regulators particular GA3 and Cytokinin like compounds are playing very important role. Likewise the products like plant biostimulants are also play a role to strength the leaf health as well as to increase the size of berry. Plantozyme is one of the bio-stimulant used for increasing yield and quality parameters in grapes. It is derived from natural sources of animals and vegetable origin; it contains T.S.S. 10%, soluble proteins 6% (as source of organic nitrogen), organic carbon 7%, betaines traces, full range of natural mineral elements in traces derived from biological sources and derivative of silixone. Betaine may work as a nitrogen source when provided in low concentration and serve as an osmolyte at higher concentrations (Naidu *et al.,* 1987) also, yield enhancement effects due to improved chlorophyll content in leaves of various crop plants have been attributed due to the betaines present in the seaweed (Genard *et al.,* 1991). It acts as nutritional support during critical stages of plant growth by providing essential nutrients in easily available form. Natural biostimulants such as seaweed extracts are commercially used to improve the quality and yields of table grapes (Lombard and Lourens 2007; Orellana, 2007). Seaweed and seaweed-derived products have been widely used as amendments in crop production systems due to the presence of a number of plant growth-stimulating compounds (Khan *et al.,* 2009). Foliar applications of seaweed extract has been reported to influence growth, productivity and fruit quality of some fruit crops including 'Red Roomy' (Abada, 2002), 'Superior' (Abd El-Wahab, 2007) and 'Thompson Seedless'(Abd El-Ghany *et al*., 2001) grapes, 'Keitte' Mango (Abd El-Motty *et al*., 2010) and Black gram (Dwivedi *et al*., 2014). Ramteke and Somkumar (2005) also reported that use of bio- stimulant to improve berry and yield characters in grapes. Similarly, use of bio stimulants resulted in significantly higher berry length, diameter, weight and volumes in fruits (Abubakar *et al*., 2013). Keeping in view the benefits of the biostimulant the present price of research work was conducted to study the impact of Plantozyme on morphological, biochemical and photosynthetic parameters to evaluate the efficacy of this product to improve berry, bunch and yield parameters.

MATERIALS AND METHODS

The experiment was conducted on Thompson Seedless grafted on Dog Ridge rootstock planted at ICAR-National Research Centre for Grape, Pune (latitude 18.31N, longitude

73.55E) during the year 2012-13, 2013-14 and 2014-15. Standard cultural practices were followed during the experiment. Following treatments were applied and replicated thrice in RBD.

T0 : Recommended fertilizer dose

T1 : Granular application: Planto granules @ 50 g/ vine, immediately after pruning

T2 : Drip application: Planto Drip @ 2.5 ml/ vine at 21 days & 2.5 ml/ vine after 50 days after pruning.

T3 : Spraying of Planto grapes @ 2 ml/ liter, at 30 and 55 days after pruning.

T4 : T0 + T1

T5 : T0 + T2

T6 : T0 + T3

T7 : T0 + T1 + T2

T8 : T0 + T1 + T3

T9 : T0 + T2 + T3

T10 : T0 + T1 + T2 + T3

Note: - The Plantozyme was applied with a handheld sprayer.

Morphological parameters such as shoot length were measured by tailor tape, leaf area was measured by Leaf Area meter, internodal distance and cane diameter were measured by digital Vernier caliper (0-300 mm, RSK™). Berries were harvested at physiological maturity. At harvesting the bunch weight was measured using electronic weighing balance. Total 100 berry weight were taken for the measurement of mean berry weight (g), Berry length, berry diameter and pedicel thickness of 10 berries in each treatment were measured with the help of Vernier caliper (0-300 mm, RSK™) and expressed in millimeter (mm). Total soluble solids (TSS) were measured using hand refractometer and expressed as °Brix. Total acid (grams/liter or %) was measured in grapes juice with phenolphthalein indicator and titrated against 0.1 N NaOH. Chlorophyll content from leaf and berry of Thompson Seedless grapes were estimated by DMSO method (Shoaf and Linus, 1976) and results were calculated by Arnon's equations (Khaleghi *et.al*; 2012). Reducing sugar in leaves and berries of Thompson Seedless grapes were determined by using Dinitro salicylic acid (DNSA). Protein content in leaves and berries of Thompson Seedless grapes were determined by using Lowry's method. Total phenol in leaves and berries of Thompson Seedless grapes were determined by using Folin – Ciocalteau reagent (Sadasivam and Manickam, 1996). Photosynthesis rate, stomatal conductance, vapour pressure deficit, and diffusive resistance were measured using Infra-Red Gas analyzer (IRGA) system (LICOR 6400, USA) at 90 DAP. The data was analyzed by one-way analysis of variance (ANOVA) using SAS software V 9.3 (2004).

RESULTS AND DISCUSSION

Plantozyme significantly increased morphological characters (Table 1). Among the morphological characters, maximum shoot length (138.8 cm) and leaf area (243.8 cm^2) were recorded in T8 (Recommended fertilizer dose + Planto Drip @ 2.5 ml/vine + planto spray @ 2 ml/l) which was significantly higher than control. These studies are also in confirmation with earlier study reported by Seleem and Ahamed (2008),

Table 1: Effects of Plantozyme on Morphological parameters of Thompson Seedless grapes

Treatment	Shoot length(cm)	Internodal Distance(cm)	Cane thickness(mm)	Leaf thickness(mm)	Leaf area(cm^2)
T0	104.2	5.74	6.06	0.18	178.8
T1	116.7	4.28	6.34	0.20	208.
T2	119.7	6.28	6.92	0.20	192.3
T3	105.4	6.12	6.74	0.21	193.5
T4	95.6	4.56	6.96	0.20	201.5
T5	116.6	6.14	7.12	0.20	225.3
T6	124.2	5.80	7.38	0.21	211.2
T7	119.6	5.30	7.47	0.21	210.8
T8	138.8	6.26	7.66	0.21	243.8
T9	132.2	5.34	8.00	0.22	220.5
T10	110.6	3.68	6.82	0.20	243.4
LSD 5%	2.7	0.12	0.14	0.006	4.8

Table 2: Effects of Plantozyme on biochemical parameters of Thompson Seedless grapes

Treatment	Reducing sugar (mg/g)	Proteins (mg/g)	Total Chlorophyll (mg/g)
T0	2.46	1.88	0.87
T1	3.18	1.83	1.05
T2	2.93	2.01	1.12
T3	3.27	1.99	1.15
T4	3.43	1.95	1.19
T5	3.31	2.09	1.20
T6	3.25	2.06	1.15
T7	3.59	1.98	1.17
T8	3.54	2.09	1.14
T9	3.75	2.25	1.23
T10	3.16	2.07	1.16
LSD 5%	0.06	0.03	0.02

Table 3: Effects of Plantozyme on quality parameters of Thompson Seedless grapes

Treatment	Berry Diameter (mm)	Berry skin thickness (µm)	Berry length (mm)	100 berry weight (g)	Average Bunch weight (g)	TSS (ºBrix)	Acidity (%)
T0	16.20	26.00	19.48	316.6	256.8	21.44	0.79
T1	16.42	26.82	20.06	336.2	262.8	22.12	0.78
T2	16.76	25.70	20.30	214.3	276.2	22.50	0.74
T3	17.00	26.50	20.50	284.6	256.7	21.28	0.68
T4	16.76	27.30	20.50	375.5	296.4	21.34	0.74
T5	16.74	28.72	20.46	311.1	254.2	21.00	0.75
T6	16.92	26.40	21.08	333.3	270.5	19.64	0.74
T7	17.24	28.22	20.74	344.2	285.1	21.70	0.74
T8	17.52	27.76	21.40	354.1	283.8	21.62	0.75
T9	17.62	30.94	21.62	369.5	308.4	21.94	0.72
T10	17.12	27.46	21.12	373.9	294.3	19.84	0.77
LSD 5%	0.31	0.58	0.38	10.13	6.18	0.37	0.01

Table 4: Effects of Plantozyme on yield parameters of Thompson Seedless grapes

Treatment	Yield (kg/vine)	Yield /ha(t/ha)	Brix yield(t/ha)	Benefit/cost ratio
T0	10.96	21.37	458.2	2.28
T1	12.26	23.91	528.9	2.52
T2	15.22	29.68	487.5	3.13
T3	12.85	25.06	549.8	2.66
T4	13.15	25.64	547.2	2.71
T5	13.10	25.55	536.6	2.69
T6	14.30	27.89	547.8	2.96
T7	13.09	25.53	554.0	2.66
T8	12.13	23.65	511.3	2.49
T9	16.01	31.22	667.8	3.24
T10	11.75	22.91	619.4	2.40
LSD 5%	0.34	0.56	12.9	0.06

they reported that increase in shoot length and leaf area in Thompson Seedless. Other characters like cane thickness (8 mm) and leaf thickness (0.22 mm) were recorded higher in T9 (Recommended fertilizer dose + Planto-granules @ 50 g/vine + Planto Drip @ 2.5 ml/vine + planto spray @ 2 ml/l) and the maximum intermodal distance (6.28cm) was observed maximum in T2 (Planto Drip @ 2.5 ml/ vine) which was at par with T8 and it was significantly higher than other treatments. Timothy and Holly (2010) also reported that Simplex bio stimulant influencing morphological characters (shoot length, leaf area) in 'Hamlin' sweet orange.

The data on biochemical parameters were presented in Table 2 which indicate that the application of Plantozyme significantly increases the reducing sugar (3.75 mg/g) and total protein (2.25 mg/g) were recorded maximum in treatment T9. Total Chlorophyll content (1.23 mg/g) was recorded highest in treatment T9 which was followed by T5 (1.20 mg/g). The studies are in confirmation with the earlier works by Dubravee *et al.* (1995), they also reported that the increase in chlorophyll content with the application of agrispon and ergostim. Foliar application of 0.5 ml/l mixture of amino acids and seaweed extract at different growth stages significantly improved leaf chlorophyll contents in grapevines (Khan *et al.,* 2012). Similarly, Kok *et al.* (2010) also reported that seaweed treatments contributed to higher total phenolic compound content.

The data on quality parameters were presented in Table 3. The quality parameters such as berry diameter (17.62 mm), berry skin thickness (30.94 µm), and berry length (21.62 mm) was recorded higher in T9, similarly, highest average bunch weight was recorded in T9 (308.4 g) which was at par with T10 (294.3 g). Among the quality parameters, total soluble solid and total acid influenced by application of Plantozyme. The highest TSS (22.50 ^{0}brix) was recorded in T2 and lowest per cent acidity was recorded in T3 (0.68 %). These results are like Kok *et al.,* 2010, who reported that seaweed treatments contributed to higher quality parameters (Berry weight, 100 berry wt. TSS, per cent acidity etc.). Similarly, application of biostimulants results in significantly higher lengths, diameters, weights and volumes in fruits in comparison to the control was reported by Abubkar *et al.,* 2013. Similarly, El-Shazly and Mustafa (2013) also reported that biostimulant had a promotional effect on yield, fruit quality and nutrient status of Washigton Navel Orange. The combined foliar sprays of 2% SOP and 2 PPM Brassinosteroid significantly increased the bunch characteristics and fruit yield in Banana (Mulagund *et al*., 2015).

The data presented in Table 4 indicated that yield of grapes (tones/ha), increased significantly and substantially with the application of bio-stimulant (31.22 t/ha) in T9 which was significantly higher than all other treatments. Similarly, the maximum total yield of Thompson Seedless grapes were obtained in (16.01 kg/Vine) in T9. These results are similar to Dubravee *et al.* (1995) who also reported that increase in the yield due to the application of ergostim and also agrispon

Table 5: Effects of Plantozyme on photosynthetic parameters of Thompson Seedless grapes

Treatment	Photosynthesis rate(µmol/mg/s)	Stomtal conductance (mm/s)	Transpiration rate(mmol H_2O $m^{-2}s^{-1}$)	Vapour pressure Deficit(vpdl)	Diffusive resistance (Mol $m^{-2}s^{-1}$)
T0	13.08	0.22	2.25	1.02	4.67
T1	15.30	0.30	3.05	1.05	3.43
T2	13.48	0.38	3.84	1.06	2.69
T3	14.70	0.32	3.57	1.15	3.19
T4	13.98	0.31	3.20	1.08	3.36
T5	13.34	0.28	2.96	1.05	3.52
T6	14.38	0.16	2.02	1.20	6.36
T7	11.96	0.17	1.93	1.15	7.02
T8	11.10	0.17	1.96	1.16	6.52
T9	15.00	0.33	2.91	0.91	3.12
T10	14.80	0.37	4.01	1.12	2.74
LSD 5%	0.26	0.00	0.07	0.02	0.13

significantly increased the yield and fruit per tree in apple. The maximum benefit cost ratio obtained in T9 which was followed by T2. Application of Plantozyme in various concentrations imposed increment in different physical attributes (photosynthesis rate, stomatal conductance, transpiration rate etc.). Tahira *et al.* (2013) also reported that split application of humic acid at three different growth phases of the kinnow mandarin stimulated the reproductive vigor and physio-biochemical attributes.

Photosynthesis parameters such as photosynthesis rate were recorded maximum in T1 (15.3 µmol/mg/s) which was significantly higher than all other treatments, similarly, stomatal conductance also recorded higher in T2 (0.38 mm/s) which were significantly higher than all other treatments. Transpiration rate, vapour pressure deficit and diffusive resistance was recorded the maximum in T10 (4.0 mmolH_2O $m^{-2}s^{-1}$), T6 (1.2 vpdl) and T7 (7.0 Mol $m^{-2}s^{-1}$), respectively. These results are similar as earlier study of Tahira *et al.* (2013) reported and they observed that significant positive influence on total chlorophyll contents, stomatal conductance, net photosynthesis rate and transpiration rate.

In general, the results obtained revealed that morphological parameters, quality parameters, yield components and biochemical composition of Thompson seedless grapes were influenced with the application of (Recommended fertilizer dose, Planto-granules @ 50 g/ vine, immediately after pruning, Planto Drip @ 2.5 ml/vine at 21 days and 2.5 ml / vine after 50 days after pruning and spraying of Planto-grapes @ 2 ml/ liter at 30 and 55 days after pruning), followed by recommended dose of fertilizer with Planto drip + Planto Spray). Plantozyme is emerging as the most prominent bio-stimulant in enhancing morpho-physiological and biochemical aspects of plant growth. Application of Plantozyme at different growth phases of grapevine after fruit pruning stimulated vigour and physio-biochemical attributes thus proved to be beneficial for substantiating high yields.

Therefore, it can be concluded from this study that the application of Plantozyme (Recommended fertilizer dose, Planto-granules @ 50 g/ vine, immediately after pruning, Planto Drip @ 2.5 ml/vine at 21 days & 2.5 ml / vine after 50 days after pruning and spraying of Planto-grapes @ 2 ml/ liter at 30 and 55 days after pruning) significantly increases morphological characters, quality parameters, yield components and biochemical composition of Thompson Seedless grapes under Pune conditions.

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