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INFLUENCE OF FOLIAR APPLICATION OF ORGANIC GROWTH PROMOTERS ON GROWTH AND YIELD OF GRAPE CV. THOMPSON SEEDLESS

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ABSTRACT

The study entitled "Effect of foliar application of organic growth promoters on growth and yield of grape cv. Thompson Seedless" was conducted during 2024-25 at MHREC, UHS, Bagalkot, to evaluate the impact of organic foliar sprays on vine performance. The experiment comprised twelve treatments arranged in RCBD with three replications, involving individual and combined sprays of moringa leaf extract, humic acid, panchagavya and vermiwash at 30, 60, 90 and 120 days after forward pruning. The combined application (T_{11}) recorded maximum internodal length (5.85 cm), girth (7.28 mm), chlorophyll content (35.93 SPAD) and leaf area (155.45 cm²), indicating superior vegetative growth. Yield parameters were also highest in T_{11}, with berry length (20.64 mm), 100-berry weight (382.13 g), bunch length (25.20 cm) and yield (21.81 kg/vine; 48.49 t/ha), while early maturity (89.60 days) and better bunch compactness (4.68) were achieved. The control (T_{12}) consistently recorded the lowest performance. Overall, the integrated foliar application of organic growth promoters significantly improved growth, yield and earliness in Thompson Seedless grapes.

Keywords **:** Organic Growth Promoters, Growth, Yield, Grape.

Introduction

Grape (*Vitis vinifera* L.) is one of the most commercially important fruit crops in India, cultivated both for table consumption and processing into raisins and wine. Believed to have originated near the Caspian Sea, grape cultivation in India dates back to the 14th century and is now concentrated in Maharashtra, Karnataka Andhra Pradesh, Tamil Nadu and Punjab. According to the National Horticulture Board (2022-23), grapes occupy about 1.76 lakh hectares with an annual production of 34.9 lakh tonnes, of which nearly 74.5 per cent is consumed fresh and 25 per cent processed into raisins. Among cultivars, Thompson Seedless and its clonal derivatives such as Tas-A-Ganesh, Sonaka and Manik Chaman dominate commercial viticulture due to their high yield potential, sweetness and suitability for raisin making.

While intensive fertilizer use has enhanced productivity, it has also caused nutrient imbalances, soil degradation and reduced sustainability. Current global challenges rising food demand, climate change and ecological degradation necessitate eco-friendly alternatives that maintain productivity while conserving natural resources. Organic growth promoters like panchagavya, vermiwash, moringa leaf extract and humic acid offer such potential. These liquid organics, derived from livestock residues and plant extracts, are rich in plant growth-promoting microorganisms and bioactive substances that enhance nutrient uptake, stimulate photosynthesis, improve soil health and strengthen plants against stress.

Foliar application of these organics ensures quick nutrient absorption through leaves, improving vegetative growth and yield attributes. Considering the need for sustainable grape production, the present study entitled "Effect of foliar application of organic growth promoters on growth and yield of grape (*Vitis vinifera* L.) cv. Thompson Seedless" was undertaken to evaluate the influence of different organic liquid formulations on vine performance under the conditions of Bagalkot.

Material and Methods

The current study was conducted during 2024-25 at the grape orchard of the Main Horticultural Research and Extension Centre (MHREC), University of Horticultural Sciences, Bagalkot. The site lies in Karnataka's Northern Dry Zone (Zone-3) at 16°10' N latitude, 75°42' E longitude and an elevation of 542 m above mean sea level. The region experiences a semi-arid tropical climate with moderately high temperatures and variable humidity. During the study period, the minimum temperature ranged from 14.7°C (January 2025) to 23°C (April 2024), while the maximum temperature varied between 27.9°C (June 2025) and 38.9°C (April 2025). Morning relative humidity varied from 37 to 93 per cent, afternoon humidity from 19 to 86.87 per cent and the highest rainfall was recorded in June 2024 (130.3 mm), followed by October (109.7 mm) and May (105.1 mm). The soil was red sandy loam with good drainage, a pH of 8.05 and electrical conductivity of 0.15 dS/m, containing (23.7 % sand, 18 % silt and 52 % clay), with available nitrogen, phosphorus and potassium at 152.6, 21.35 and 386.20 kg/ha, respectively. The experiment was laid out in a Randomized Complete Block Design (RCBD) with twelve treatments and three replications on twelve-year-old Thompson Seedless vines grafted on Dogridge rootstock, spaced at 3 m × 1.5 m and trained on a Y-trellis system. The treatments were: T_1 - Moringa leaf extract (10 %), T_2 - Humic acid (0.3 %), T_3 - Panchagavya (3 %), T_4 - Vermiwash (1.5 %), T_5 - Moringa leaf extract (10 %) + Humic acid (0.3 %), T_6 - Moringa leaf extract (10 %) + Panchagavya (3 %), T_7 - Moringa leaf extract (10 %) + Vermiwash (1.5 %), T_8 - Panchagavya (3 %) + Vermiwash (1.5 %), T_9 - Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %), T_{10} - Moringa leaf extract (10 %) + Humic acid (0.3 %) + Vermiwash (1.5 %), T_{11} - Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %) + Vermiwash (1.5 %) and T_{12} - Control. Foliar sprays were applied at 30, 60, 90 and 120 days after forward pruning. The vines underwent back pruning on 22nd April 2024 and forward pruning on 22nd October 2024.

Spray Solution Preparation

In this experiment, Panchagavya, Moringa leaf extract, Vermiwash and Humic acid were used for foliar application.

Panchagavya was prepared by fermenting a blend of desi cow dung (2.5 kg) and cow ghee (450 g) for three days, followed by the addition of cow urine (3.5 L) and water (3.5 L). After 15 days, cow milk (1 L), curd (750 ml), jaggery (1 kg), tender coconut water (1 L) and four ripe Cavendish bananas were incorporated and the mixture was fermented for another 15 days with twice-daily stirring. The final solution was filtered after 30 days and a 3 % foliar spray was prepared by mixing 3 ml of Panchagavya in 97 ml of water.

Moringa leaf extract was prepared using shade-dried moringa leaves collected from UHS, Bagalkot. One kilogram of fresh leaves yielded about 250 g of dry powder. Two hundred grams of this powder were soaked in four liters of distilled water for 24 hours and filtered to obtain the extract. Working concentrations of (6 %, 8 % and 10 %) were prepared by diluting the extract accordingly for foliar application.

Vermiwash was produced using the Eco-Science Research Foundation (ERF) method in a layered filtration unit comprising gravel, sand and loamy soil. A mixture of partially decomposed cattle dung and straw was inoculated with *Eisenia foetida* or *Perionyx excavatus* earthworms and stabilized for 10-15 days. Water percolating through the system overnight was collected as nutrient-rich vermiwash containing N, P, K, Ca, Mg, Fe, Zn and growth hormones such as IAA, GA and cytokinins. (1.5 %) solution was prepared by mixing 1.5 ml vermiwash in 98.5 ml of water for spraying.

Humic acid (commercial formulation "Super Humic") was diluted to (0.3 %) by mixing 0.3 ml of the solution in 9.7 ml of water for foliar application.

Observations Recorded (Growth Parameters)

Internodal length (cm)

Measured as the distance between the fourth and fifth nodes from the base of fruiting shoots using a 30 cm scale on five randomly selected shoots per vine at 45 and 90 days after forward pruning.

Internodal girth (mm)

Determined between the fourth and fifth nodes of five randomly selected shoots per vine using a vernier caliper at 45 and 90 days after forward pruning.

Chlorophyll content (SPAD)

Recorded using a SPAD-502 (Konica Minolta) on fully expanded leaves opposite to the inflorescence at 45 and 90 days after forward pruning.

Leaf area (cm^2)

Calculated using the linear method (Somkuwar *et al.*, 2024): Leafarea=L×B×K (0.810). where L = maximum leaf length and B = maximum breadth.

Specific Leaf Area (SLA, cm^2/g)

Determined as the ratio of leaf area to leaf dry weight indicating leaf thickness and photosynthetic efficiency.

$$SLA = \frac{\text{Leaf area } (cm^2)}{\text{Leaf dry weight } (g)}$$

Specific Leaf Weight (SLW, mg/cm^2): Calculated as the ratio of leaf dry weight to leaf area reflecting biomass accumulation and potential yield performance.

$$SLW = \frac{\text{Leaf dry weight } (mg)}{\text{Leaf area } (cm^2)}$$

Yield Components

Pedicel thickness (mm)

Measured with a digital vernier caliper to assess berry attachment strength and bunch compactness.

Bunch length and width (cm)

Measured at harvest using a 30 cm scale on three representative bunches per replication; mean values expressed in centimeters.

Bunch weight (g)

Determined using an electronic balance from three representative bunches per vine and expressed as the mean in grams.

Bunch volume (cm^3)

Estimated by the water displacement method using a graduated cylinder, indicating bunch compactness and berry arrangement.

Bunch compactness

Calculated as the ratio of total number of berries per bunch-to-bunch length.

$$\text{Bunch compactness} = \frac{\text{Number of berries per bunch}}{\text{Total length of bunch}}$$

Berry length and diameter (mm)

Measured using a digital vernier caliper on random berries from representative bunches; expressed in millimeters to assess fruit morphology and quality.

100-berry weight (g)

Computed by weighing 100 randomly selected berries from each treatment using a digital balance; expressed in grams.

Days to maturity

Recorded as the duration from flowering to harvest, representing the total time to reach physiological and commercial maturity.

Yield (kg/vine and t/ha)

Yield per vine calculated by multiplying mean bunch weight with number of bunches per vine; yield per hectare estimated by extrapolating vine yield to total vines per hectare.

Result and Discussion

The observations presented in Table 1 indicated that the internodal length and girth of the fruiting shoots differed significantly among the treatments.

At 45 days after forward pruning, the maximum internodal length (4.82 cm) was recorded in T_{11}, while the minimum (3.64 cm) was noted in T_{12}. A similar trend was observed at 90 days, with T_{11} showing 5.85 cm and T_{12} 4.05 cm. The higher internodal length in T_{11} may be attributed to enhanced cell elongation promoted by moringa leaf extract (rich in zeatin and phenolics), improved nutrient uptake through humic acid and increased metabolic activity stimulated by panchagavya and vermiwash (Abubakar *et al*., 2013; Abd El-Rahman *et al*., 2021; Ahmed, 2023; Chandra *et al*., 2019; Mustafa *et al*., 2019). Conversely, the lack of bioactive inputs in T_{12} restricted cell elongation and growth (Amanullah, 2015; Atawia, 2021).

The internodal girth also differed significantly, with T_{11} recording the highest values (7.02 mm at 45 DAFP and 7.28 mm at 90 DAFP), while T_{12} showed the lowest (5.22 mm and 5.95 mm, respectively). The increased girth in T_{11} can be linked to enhanced cambial activity and tissue thickening due to humic acid's role in improving cell wall plasticity and vermiwash-mediated nitrogen metabolism, supported by nutrient- and hormone-rich panchagavya and moringa extract (Elumalai *et al*., 2015). In contrast, limited nutrient availability in T_{12} resulted in reduced radial growth and weaker shoot development (Amanullah, 2015; Atawia, 2021).

The results in (Table 2) showed that chlorophyll content was significantly influenced by organic growth promoters. At 45 days after forward pruning, the highest chlorophyll content (27.32 SPAD units) was recorded in T_{11}, while the lowest (21.95) occurred in T_{12}. Similarly, at 90 days, T_{10} registered the maximum value (35.93 SPAD units), on par with T_{11} (35.60), whereas T_{12} again recorded the minimum (30.27). The superior chlorophyll content in T_{11} and T_{10} may be attributed to the synergistic effects of moringa leaf extract, humic acid, panchagavya and vermiwash. Moringa extract provides zeatin and ascorbic acid that enhance chlorophyll biosynthesis (Nasir *et al*., 2016; Arif *et al*., 2023), while humic acid improves uptake of nitrogen, magnesium and iron essential for chlorophyll formation (Paramasivan, 2015; Rasouli *et al*., 2024). Panchagavya and vermiwash further promote photosynthetic activity and enzymatic efficiency through microbial metabolites and readily available nutrients (Kumar *et al*., 2024; Dwivedi *et al*., 2015). Conversely, the lowest chlorophyll values in T_{12} were due to the lack of bioactive inputs, limiting pigment synthesis and photosynthetic efficiency, as also observed by Abd El-Hamied and El-Amary (2015) and Hasan *et al*. (2022).

The results in (Table 2) showed that leaf area was significantly influenced by organic growth promoters at both intervals. At 45 days after forward pruning, the maximum leaf area (137.82 cm^2) was observed in T_{11}, while the minimum (116.47 cm^2) occurred in T_{12}. A similar pattern was recorded at 90 days, with T_{11} showing the largest leaf area (155.45 cm^2) and T_{12} the smallest (133.55 cm^2). The greater leaf expansion in T_{11} can be attributed to the synergistic action of moringa leaf extract, humic acid, panchagavya and vermiwash. Moringa extract provides zeatin and ascorbic acid that stimulate cell division and chlorophyll biosynthesis (Nasir *et al*., 2016; Arif *et al*., 2023), while humic acid enhances nutrient uptake and enzymatic activity (Paramasivan, 2015; Rasouli *et al*., 2024). Panchagavya and vermiwash further promote nutrient assimilation and leaf expansion through organic acids, enzymes and beneficial microbes (Kumar *et al*., 2024; Elumalai *et al*., 2015). In contrast, T_{12} recorded the lowest leaf area due to the lack of supplemental nutrients and bio-stimulants, as also observed by Abd El-Hamied and El-Amary (2015) and Bakhsh *et al*. (2020).

The data in (Table 3) showed significant variation in specific leaf area (SLA) Specific leaf weight (SLW) and among treatments. At 45 DAFP, the highest SLA (164.63 cm²/g) was recorded in T_1, while the lowest (153.13 cm²/g) occurred in T_{11}; a similar trend was observed at 90 DAFP, with T_1 (187.09 cm²/g) and T_{11} (172.72 cm²/g). The higher SLA in T_1 may be due to moringa leaf extract and humic acid stimulating cell elongation and leaf expansion (Nasir *et al*., 2016; Arif *et al*., 2023; Rasouli *et al*., 2024), while the lower SLA in T_{11} resulted from thicker, denser leaves under combined organic inputs (Amanullah, 2015).

Specific leaf weight (SLW) followed an inverse pattern. At 45 DAFP, the highest SLW (5.93 mg/cm²) was noted in T_{12}, while the lowest (5.37 mg/cm²) was in T_{11}; at 90 DAFP, T_{11} (5.79 mg/cm²) recorded the highest and T_1 (5.35 mg/cm²) the lowest. The higher SLW in T_{11} reflects increased structural metabolites and thicker leaves due to improved nutrient assimilation from combined organic treatments (Belal, 2015; Alghanim *et al*., 2023). This confirms the inverse SLA-SLW relationship, where higher SLA corresponds to thinner leaves and higher SLW to thicker, more efficient photosynthetic tissues (Amanullah, 2015).

The results (Table 4) revealed significant variation in bunch weight, bunch volume and compactness. Bunch weight ranging from 395.00 to 450.00 g. The highest bunch weight was recorded in T_{10} (450.00 g), on par with T_{11} (445.00 g), while the lowest was observed in T_{12} (395.00 g). Treatments T_7-T_9 also showed higher values, reflecting the positive influence of organic foliar applications. The superior bunch weight in T_{10} may be attributed to the combined application of moringa leaf extract, humic acid and vermiwash, which enhanced berry size, nutrient uptake and assimilate translocation (Nasir *et al*., 2016; Paramasivan, 2015; Dwivedi *et al*., 2015). In contrast, the control (T_{12}) showed reduced bunch mass due to limited nutrient assimilation, as also reported by Belal (2015) and Abd El-Rahman *et al*. (2021).

Similarly, bunch volume varied between 400.00 and 452.10 cm³, with T_{10} (452.10 cm³) and T_{11} (447.02 cm³) recording the highest values and T_{12} (400.00 cm³) the lowest. The increase under T_{10} was likely due to better nutrient absorption and berry expansion aided by humic acid and vermiwash (Rasouli *et al*., 2024; Elumalai *et al*., 2015).

Bunch compactness also differed significantly, with T_9 (4.62) and T_{11} (4.68) producing desirable loose bunches, while T_{12} (6.76) showed the most compact clusters. The looser bunches in T_9 and T_{11} may result from improved rachis elongation and uniform berry growth influenced by moringa leaf extract and panchagavya (Kumar *et al*., 2024; Nasir *et al*., 2016), whereas nutrient deficiency in T_{12} led to tighter clusters, as noted by Dimovska *et al*. (2014).

The results (Table 5) showed significant variation in the number of days to berry maturity, ranging from 89.60 to 95.93 days. The earliest maturity was recorded in T_{11} (89.60 days), while T_{12} (95.93 days) and T_5 (95.20 days) exhibited delayed ripening. The early maturity in T_{11} can be attributed to the combined effect of moringa leaf extract, humic acid, panchagavya and vermiwash, which enhanced photosynthesis, nutrient utilization and carbohydrate accumulation, thereby hastening physiological maturity (Nasir *et al*., 2016; Arif *et al*., 2023). Humic acid further improved nutrient translocation, promoting faster ripening (Rasouli *et al*., 2024), while vermiwash and panchagavya enhanced microbial activity and nutrient cycling, supporting early harvest (Dwivedi *et al*., 2015; Kumar *et al*., 2024). Conversely, delayed maturity in T_{12} was likely due to nutrient deficiency and lower metabolic efficiency.

A significant variation in yield per vine was observed among treatments (Table 5), ranging from 18.57 to 21.81 kg/vine. The highest yield was recorded in T_{11} (21.81 kg/vine), followed by T_{10} (21.60 kg/vine), while the lowest was in T_{12} (18.57 kg/vine). The superior yield in T_{11}, which received a combined foliar spray of moringa leaf extract (10 %) + humic acid (0.3 %) + panchagavya (3 %) + vermiwash (3 %), may be attributed to improved nutrient uptake, photosynthetic efficiency and better source-sink relationship. Moringa leaf extract enhances chlorophyll synthesis and carbohydrate accumulation (Nasir *et al*., 2016; Arif *et al*., 2023), while humic acid boosts root activity and uptake of potassium and nitrogen (Paramasivan, 2015; Rasouli *et al*., 2024). Panchagavya and vermiwash enhance microbial activity and hormonal balance, improving fruit set and retention (Kumar *et al*., 2024; Dwivedi *et al*., 2015). In contrast, the lowest yield in T_{12} resulted from the absence of such biostimulants, leading to reduced nutrient translocation, as also reported by Sarkar (2024) in guava and Devi & Singh (2023) in papaya.

The yield per hectare varied significantly among treatments (Table 5), ranging from 41.27 to 48.49 t/ha. The highest yield was obtained in T_{11} (48.49 t/ha), followed by T_{10} (47.99 t/ha), while the lowest was recorded in T_{12} (41.27 t/ha). The superior yield in T_{11}, which received a combined foliar application of moringa leaf extract, humic acid, panchagavya and vermiwash, can be attributed to enhanced vegetative growth, chlorophyll content and reproductive efficiency. Moringa leaf extract supplied natural hormones that stimulated metabolic activity (Mahmoud *et al*., 2024), while humic acid improved nutrient and water uptake (Rasouli *et al*., 2024). The microbial and enzymatic action of panchagavya and vermiwash promoted nutrient cycling and sustained productivity (Kumar *et al*., 2024; Elumalai *et al*., 2015). Conversely, the lower yield in T_{12} resulted from poor nutrient supply and weaker physiological activity, as also observed by Belal (2015) and Abd El-Rahman *et al*. (2021) in grapes under untreated conditions.

Conclusion

The foliar application of organic growth promoters significantly enhanced the vegetative growth, physiological efficiency and yield performance of grape cv. Thompson Seedless. The combined treatment T_{11} (moringa leaf extract 10 % + humic acid 0.3 % + panchagavya 3 % + vermiwash 3 %) was found most effective, recording the highest internodal length (5.85 cm), girth (7.28 mm), chlorophyll content (35.60 SPAD units) and leaf area (155.45 cm²). T_{11}

also produced thicker and more photosynthetically efficient leaves, reflected by the lowest SLA (172.72 cm²/g) and highest SLW (5.79 mg/cm²).

With respect to yield parameters, T_{11} registered the highest bunch weight (445.00 g), bunch volume (447.02 cm³) and desirable bunch compactness (4.68). The yield per vine was maximum in T_{11} (21.81 kg/vine). Similarly, the yield per hectare was highest in T_{11} (48.49 t/ha). Overall, the superior performance of T_{11} can be attributed to improved nutrient uptake, hormonal stimulation and enhanced photosynthetic efficiency resulting from the synergistic action of organic inputs. In contrast, the control (T_{12}) recorded the lowest values across all parameters. Thus, the integrated foliar use of organic growth promoters proved most effective for improving vine vigor, yield and sustainability in grape production.

Table 1 : Internodal length and girth of the fruiting shoot after forward pruning of grape cv. Thompson Seedless as influenced by foliar application of organic growth promoters

Treatment	Internodal length of fruiting shoot (cm)		Internodal girth of fruiting shoot (mm)	
	45 DAFP	90 DAFP	45 DAFP	90 DAFP
T_1	3.80	4.10	5.68	6.42
T_2	3.82	4.25	5.61	6.38
T_3	3.90	4.38	4.38	6.34
T_4	4.14	4.62	5.74	6.48
T_5	4.28	4.85	6.29	6.87
T_6	4.00	4.58	5.99	6.65
T_7	4.22	4.92	6.64	7.12
T_8	4.09	4.76	5.84	6.50
T_9	4.35	5.10	6.86	7.05
T_{10}	4.29	5.28	6.54	6.94
T_{11}	4.82	5.85	7.02	7.28
T_{12}	3.64	4.05	5.22	5.95
S.Em ±	**0.20**	**0.07**	**0.11**	**0.11**
CD at 5 %	**0.57**	**0.21**	**0.33**	**0.32**

DAFP – Days after forward pruning

T_1: Moringa leaf extract (10 %)
T_2: Humic acid (0.3 %)
T_3: Panchagavya (3 %)
T_4: Vermiwash (1.5 %)
T_5: Moringa leaf extract (10 %) + Humic acid (0.3 %)
T_6: Moringa leaf extract (10 %) + Panchagavya (3 %)
T_7: Moringa leaf extract (10 %) + Vermiwash (1.5 %)
T_8: Panchagavya (3 %) + Vermiwash (1.5 %)
T_9: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %)
T_{10}: Moringa leaf extract (10 %) Humic acid (0.3 %) + Vermiwash (1.5 %)
T_{11}: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %) + Vermiwash (3 %)
T_{12}: Control

Table 2 : Chlorophyll content and leaf area after forward pruning of grape cv. Thompson seedless as influenced by foliar application of organic growth promoters

Treatment	Chlorophyll content (SPAD values)		Leaf area (cm^2)	
	45 DAFP	90 DAFP	45 DAFP	90 DAFP
T_1	23.72	32.77	121.83	138.45
T_2	23.25	32.30	120.33	138.25
T_3	22.55	31.40	118.23	135.52
T_4	24.08	33.30	123.33	139.38
T_5	26.18	34.42	128.43	146.72
T_6	24.56	33.93	126.47	144.35
T_7	27.05	35.43	136.21	154.32
T_8	23.91	33.73	124.43	142.92
T_9	26.70	35.13	135.33	151.22
T_{10}	26.35	35.93	131.57	149.48
T_{11}	27.32	35.60	137.82	155.45
T_{12}	21.95	30.27	116.47	133.55
S.Em ±	**0.39**	**0.56**	**1.57**	**2.57**
CD at 5 %	**1.16**	**1.64**	**4.61**	**7.75**

T_1: Moringa leaf extract (10 %) **DAFP - Days after forward pruning**
T_2: Humic acid (0.3 %)
T_3: Panchagavya (3 %)
T_4: Vermiwash (1.5 %)
T_5: Moringa leaf extract (10 %) + Humic acid (0.3 %)
T_6: Moringa leaf extract (10 %) + Panchagavya (3 %)
T_7: Moringa leaf extract (10 %) + Vermiwash (1.5 %)
T_8: Panchagavya (3 %) + Vermiwash (1.5 %)
T_9: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %)
T_{10}: Moringa leaf extract (10 %) Humic acid (0.3 %) + Vermiwash (1.5 %)
T_{11}: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %) + Vermiwash (3 %)
T_{12}: Control

Table 3 : Specific leaf area and specific leaf weight after forward pruning of grape cv. Thompson Seedless as influenced by foliar application of organic growth promoters

Treatment	Specific leaf area (cm^2 /g)		Specific leaf weight (mg/cm^2)	
	45 DAFP	**90 DAFP**	**45 DAFP**	**90 DAFP**
T_1	164.63	187.09	5.91	5.35
T_2	162.60	186.82	5.90	5.36
T_3	157.64	180.69	5.92	5.53
T_4	160.16	181.01	5.75	5.55
T_5	158.55	181.14	5.69	5.52
T_6	158.08	180.44	5.70	5.55
T_7	156.56	177.37	5.44	5.64
T_8	157.50	180.92	5.71	5.52
T_9	159.21	177.91	5.40	5.62
T_{10}	158.51	180.09	5.47	5.55
T_{11}	153.13	172.72	5.37	5.79
T_{12}	159.54	182.27	5.93	5.47
S.Em ±	**0.42**	**2.11**	**0.09**	**0.01**
CD at 5 %	**1.22**	**6.19**	**0.25**	**0.02**

T_1: Moringa leaf extract (10 %)
T_2: Humic acid (0.3 %)
T_3: Panchagavya (3 %)
T_4: Vermiwash (1.5 %)
T_5: Moringa leaf extract (10 %) + Humic acid (0.3 %)
T_6: Moringa leaf extract (10 %) + Panchagavya (3 %)
T_7: Moringa leaf extract (10 %) + Vermiwash (1.5 %)
T_8: Panchagavya (3 %) + Vermiwash (1.5 %)
T_9: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %)
T_{10}: Moringa leaf extract (10 %) Humic acid (0.3 %) + Vermiwash (1.5 %)
T_{11}: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %) + Vermiwash (3 %)
T_{12}: Control

Table 4 : Bunch weight, bunch volume and bunch compactness of grape cv. Thompson Seedless as influenced by foliar application of organic growth promoters

Treatment	Bunch weight (g)	Bunch volume (cm^3)	Bunch compactness (compact/loose)
T_1	420.00	422.00	6.11
T_2	415.00	420.60	6.26
T_3	412.00	420.24	6.67
T_4	405.00	421.00	6.15
T_5	410.00	425.00	5.32
T_6	415.00	423.12	5.62
T_7	425.00	426.00	5.19
T_8	418.00	429.03	5.18
T_9	412.00	433.05	4.62
T_{10}	450.00	452.10	5.20
T_{11}	445.00	447.02	4.68

T_{12}	395.00	400.00	6.76
S.Em ±	**5.81**	**5.14**	**0.08**
CD at 5%	**17.05**	**15.09**	**0.22**

T_1: Moringa leaf extract (10 %)
T_2: Humic acid (0.3 %)
T_3: Panchagavya (3 %)
T_4: Vermiwash (1.5 %)
T_5: Moringa leaf extract (10 %) + Humic acid (0.3 %)
T_6: Moringa leaf extract (10 %) + Panchagavya (3 %)
T_7: Moringa leaf extract (10 %) + Vermiwash (1.5 %)
T_8: Panchagavya (3 %) + Vermiwash (1.5 %)
T_9: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %)
T_{10}: Moringa leaf extract (10 %) Humic acid (0.3 %) + Vermiwash (1.5 %)
T_{11}: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %) + Vermiwash (3 %)
T_{12}: Control

Table 5 : Days taken to maturity, yield (kg/vine) and yield (t/ha) of grape cv. Thompson Seedless as influenced by foliar application of organic growth promoters

Treatment	Days taken to maturity (flowering to harvesting)	Yield (kg/vine)	Yield (t/ha)
T_1	94.60	19.32	42.92
T_2	94.20	19.09	42.43
T_3	94.97	18.95	42.12
T_4	95.00	18.63	41.40
T_5	95.20	19.27	42.83
T_6	94.33	19.51	43.36
T_7	94.80	19.98	44.40
T_8	92.00	19.65	43.66
T_9	92.60	20.19	44.82
T_{10}	91.47	21.60	47.99
T_{11}	89.60	21.81	48.49
T_{12}	95.93	18.57	41.27
S.Em ±	**0.53**	**0.28**	**0.72**
CD at 5%	**1.57**	**0.82**	**2.10**

T_1: Moringa leaf extract (10 %)
T_2: Humic acid (0.3 %)
T_3: Panchagavya (3 %)
T_4: Vermiwash (1.5 %)
T_5: Moringa leaf extract (10 %) + Humic acid (0.3 %) +
T_6: Moringa leaf extract (10 %) + Panchagavya (3 %)
T_7: Moringa leaf extract (10 %) + Vermiwash (1.5 %)
T_8: Panchagavya (3 %) + Vermiwash (1.5 %)
T_9: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %)
T_{10}: Moringa leaf extract (10 %) Humic acid (0.3 %) + Vermiwash (1.5 %)
T_{11}: Moringa leaf extract (10 %) + Humic acid (0.3 %) + Panchagavya (3 %) + Vermiwash (3 %)
T_{12}: Control

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