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Pre-Harvest Treatment of Chitosan and Potassium Schoenite on Yield, Quality, Biochemical Changes and Shelf Life in Manjri Shyama Grapes (*Vitis vinifera* L.)

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Abstract

An investigation was carried out to know the effect of foliar application of Chitosan and Potassium Schoenite with different concentration on Manjri Shyama grape (*Vitis. Vinifera. L.*) at ICAR-NRCG Pune, during 2021-2022. The experiment was carried out in Randomized Block Design with five treatments and four replications. The application of Potassium Schoenite @ 2.5g/l , 5 g/l and Chitosan @ 0.2% and 0.4 % along with control vines was carried out at veraison stage. The effect of Potassium Schoenite and Chitosan were studied on bunch, berry characters, yield and quality parameters. The results revealed that the vines treated with chitosan 0.2 % recorded higher bunch weight (493.5 g) and yield/vine (38.42 kg).In terms of quality parameters i.e. TSS (21.98^0 Brix), Acidity (0.60%) were recorded in vine treated with Chitosan @ 0.2%. The Potassium Schoenite @ 5 g/l recorded higher phenol, tannin and flavonoids content. Among these treatment anthocyanin content was increased due to application of Potassium Schoenite, which is important for colour development of berry. From this investigation the foliar application of 0.2% of Chitosan and 5g/l of Potassium Schoenite reported higher yield, quality and improve shelf life of grapes.

Key words : *Chitosan, potassium schoenite, yield, quality, physiological loss in weight.*

Introduction

Grape *(Vitis vinifera L.)* is the most important commercial crop grown in India, especially in Maharashtra. The fruit of grapes is like by consumers worldwide for its taste and is blessed with a bundle of nutritional property. Sugar, minerals, enzymes, vitamin and acids are nutritive for our human health that contain in table grapes. Grapes production contributes about 16 per cent of the total fruit production. Archeological evidence suggest human began to growing grapes as early as 6500 BC during the Neolithic era B.C (1). China rank 1st country in world in grapes production, while India is ranked 7th in world. Major grapes growing state in India is Maharashtra, Tamil Nadu, Karnataka, Andrapradesh. Maharasthra state reported 62.7% production from out of total production of grapes in India. The popular cultivars of grapes grown are Thompson Seedless and its mutant like Tas-A-Ganesh, Sonaka, Manik Chaman, Kismish Charni and Flame Seedless, Clone-2. (2).

Manjari Shyama grapes formed by cross between Black Champa and Thompson Seedless. It is table grapes variety. Which is black in color, bold and seedless. Its average yield of 12 to 14 tones/ acre and no berry cracking recorded till now. After pruning it matures between 125 to 135 days. It give better economic return due to high yield potential and uniform berry color. Now this variety evaluated at many locations of India i.e. Tamil Nadu, Karnataka and Madhya Pradesh. This variety reported yield 16-18 kg/vine, average bunch weight 350-450 g, TSS 18-20^0 brix and 4.5-5.5 g/l acidity. It is moderately resistance to downy mildew disease. Adequate supply of nutrient required for proper reproductive growth and vegetative growth of grapevine. Mineral nutrition and balance between macro and micro nutrients in different parts of vine leads to good quality and yield of grapes. (3).

Nitrogen, Phosphorus, Potassium, Sulphur, Calcium and Magnesium are most important macro nutrient among them Potassium are used to increase the shelf life and yield. Uptake of Potassium is related to vegetative growth and it accumulates subsequently in fruit cell. It plays significant role in physiological and biochemical activity of plant like photosynthesis, PH stabilization, stomata function, activation of protein, maintain salt balance, transport of metabolite and extensibility that leads to increase in fruit size (4). High supply of Potassium increases total soluble solid and reduction in acidity. In biotic and abiotic stress condition it involve in plant adaptation. Which is necessary to translocate sugar to berry. Adequate amount of Potassium is required at harvesting time for to provide attractive look and long shelf life of grapes (2). Foliar application of Potassium fertilizer accelerate anthocyanin accumulation by altering the transcript levels of PAL,CYP73A,4CL,CHS,F3H and UFGT of flavonoids biosynthesis. Potassium Schoenite is good source of Potassium, Magnesium and Sulphur. It influence fruit size, appearance, colour, total soluble solid,

acidity, vitamin, taste as well as shelf-life (5). High supply of Potassium increasing total soluble solid and reduction in acidity of berry.

Potassium Schoenite is useful in acidic and alluvial soil. It protect soil from leaching (3). It is useful in promoting healthy roots system, increase plant vigour and resistance to disease and act as enzyme activator. It has low salt index and it is chloride free so it is ideal for crop who are sensitive to chloride and salt. It does not change the PH of soil (Titan biotech Ltd. Group) it is an alternate form of Potassium fertilizer for enhancing growth, yield and quality of many crops. Not only for better productivity but also good quality of fruit, farmer have started to use biopolymer like Chitosan for plant defence mechanism.

Chitosan is polysaccharide resulting from the De-acetylation of chitin. This natural polymer is convenient and largely available as waste from shell of shrimps and crabs processed by the seafood industry. It is nontoxic, biocompatible, biodegradable, antimicrobial and antioxidant properties, due to presence of free amine group and hydroxyl groups to scavenge free radicles to form stable micro molecular radicle (6). The positive effect of Chitosan on metabolism and increased photosynthesis which enhanced the plant growth (7), (8). Plant growth may be attributed to an increase in the key enzyme activities of nitrogen). Chitosan nanoparticle used as carrier system for plant growth hormones. Therefore the aim of Present study is to determine the effect of pre harvest application of Potassium Schoenite and Chitosan on yield, quality, biochemical changes and shelf life of Manjari Shyama grapes *(Vitis Vinifera L.)*.

Materials and Methods

The experiment was conducted at ICAR-National Research Center for Grapes during the fruiting season of 2021-2022. Geographically Pune is located at latitude 18.32 °N and longitude 73.51°E. The experiment carried out in randomized block design with five treatments and four replications. All the treatments application was made with a high-volume pneumatic knapsack sprayer fitted with a hollow cone nozzle using spray fluid @ 500 liters/ha.

Table-1 : Treatment details :

Treatment	Details	Time
T1	P. Schoenite @ 2.5 g/Lit	The vine received the treatment at veraison, (15-20% berries coloration)
T2	P. Schoenite @ 5 g/Lit	
T3	Chitosan @ 0.2% (20g/10L)	
T4	Chitosan @ 0.4 % (40g/ 10 L)	
T5	Control	

Observations recorded

Yield per vine (Kg) : The observations recorded on average bunch weight, 10 berry weight were taken by using an electronic balance and Pedicel thickness, Berry diameter and Berry length were measured by using digital vernier caliper 0- 300 mm.). Average berry weight bunch weight and yield per vine were recorded. Hundred berry samples were randomly selected from each replicate, processed in a blender and strained through two layers of muslin cloth. Total soluble solids concentration was determined from the juice using a digital refractometer (model ERMA of Japan). The titratable acidity was calculated by using the titration method. The 5 ml of fruit juice from each replications was titrated with sodium hydroxide solution of known normality (NaOH N =0.1N) using phenolphthalein indicator as an suggested by (A.O.A.C) (9). The results of these titrations were converted to percent of titratable acidity using the following equation;

Percent of titratable acidity = (N.NaOH × ml.NaOH × 0.075* × 100) (Juice in ml)

*0.075 = Equivalent weight of tartaric acid.

Biochemicals study : The total phenol, tannin contents of the fruit extract was determined using the Folin-Ciocalteu method (Singleton and Rossi 1965(10) using gallic acid as the standard. Total anthocyanins were estimated as suggested by (11) and total flavonoids by (12). All bio chemicals were estimated by using UV spectrometer. The standard reference chemicals were obtained from the O.K chemicals Ltd., Mumbai (India). All other buffers and chemicals were of AR grade and obtained from Merck Pvt. Ltd., Mumbai.

Physiological loss in weight (PLW) : The PLW was calculated on an initial weight basis. The physiological loss in weight of grape bunches was recorded based on the initial fresh weight of the fruit and subsequent loss in weight which occurred during post-harvest storage and was expressed as a percentage value.

PLW (%) = Initial weight of fruit – Finial weight of fruit / Initial weight *100

Statistical analysis : The various data collected were subjected to analysis of variance in randomized block design (RBD) using SAS software version 9.2 (13) with a generalized linear model (GLM) procedure. Means were separated using least significant differences (LSD) test at 5% level of significance.

Results and Discussion

Yield and quality Parameters : The significant differences were recorded on yield and yield attributing

Table-2 : Effect of Chitosan and Potassium Schoenite on yield and quality parameters in Manjri Shyama Grapes.

Treatments	Bunch weight(g)	Yield kg/vine	50 Berry weight (g)	Berry length (cm)	Berry diameter (mm)	TSS (°Brix)	Acidity (%)	TSS/ Acidity ratio
T1	387.50	30.23	162.43	22.50	16.00	18.68	0.67	27.90
T2	428.25	33.40	174.53	21.00	16.50	18.70	0.65	29.04
T3	492.50	38.42	183.38	23.30	17.30	21.98	0.60	36.94
T4	429.00	33.46	173.65	21.30	16.30	18.20	0.71	25.73
T5	336.00	26.21	150.98	19.30	15.30	17.13	0.75	22.74
SEm(±)	12.65	0.99	1.52	0.08	0.08	0.3	0.01	0.77
C.D. @ 5%	39.42	3.08	4.73	0.25	NS	0.92	0.04	2.4

Table-3 : Effect of Chitosan and Potassium Schoenite on Skin Thickness, Pedicel Thickness and PLW (%) in Manjri Shyama Grapes.

Treatments	Skin Thickness (mm)	Pedicel Thickness (mm)	PLW (%)
T1	32.25	1.28	8.25
T2	25.50	1.28	8.13
T3	35.25	1.33	7.74
T4	31.75	1.28	9.75
T5	27.25	1.13	8.35
SEm(±)	1.97	0.04	0.82
C.D. @ 5%	6.14	0.12	NS

Table-4 : Effect of Chitosan and Potassium Schoenite on Biochemical parameter in Manjri Shyama Grapes.

Treatments	Phenol (mg/g)	Tannin (mg/g)	Reducing sugar (mg/g)	Anthocyanin (mg/L)	Flavonoids (mg/g)
T1	1.58	1.82	321.66	25.16	33.00
T2	2.86	3.53	302.56	54.96	60.57
T3	2.15	2.58	323.87	41.32	48.40
T4	1.4	1.55	314.26	41.01	33.69
T5	1.32	1.44	258.37	22.46	29.22
SEm(±)	0.05	0.05	11.5	2.94	1.69
C.D. @ 5%	0.15	0.17	38.07	9.15	5.24

characters in Manjri Shyama and depicted in Table No. 2. Present data illustrate that foliar application of Chitosan at 0.2% and 0.4% at veraison stage leads to increase in yield as compared to treatment treated with Potassium Schoenite. The highest yield/vine (38.42 Kg), bunch weight (493.5 g), 50 berry weight (183.38 g) were recorded in Chitosan @ 0.2%, followed by Potassium Schoenite at 2.5 g/lit. While the minimum yield /vine (26.21 kg) and bunch weight (336 g) were recorded in untreated control. (14) while working on strawberry (*var.* winter dawn), they reported that Chitosan significantly increase in vegetative growth parameter due to availability and uptake of water and essential nutrients through adjusting cell osmotic pressure and reducing the accumulation of harmful free radicals by increasing antioxidants and enzyme activities. The result of present investigation is similar with study of (15), (3), they reported that the Lower doses of Chitosan could have an effective for increment in crop growth and yield and higher doses decreases crop growth and yield. The Maximum berry diameter (17.30 mm) and Berry length (23.30 mm) were reported in Chitosan at 0.2%, followed by Potassium Schoenite (8), they found that okra fruit size increased on application of Chitosan as compared with other treatment.

Chitosan is the N-deactivated derivate of chitin. Chitosan is commercial interest because of it high percent of nitrogen. In this study maximum TSS (21.98° brix) reported in treatment treated with 0.2% of Chitosan, followed by Potassium Schoenite @ 5g/lit (18.700 brix) as compared to untreated control (17.130 brix). Acidity (0.60%) reported lowest in Chitosan @ 0.2% and higher (0.75%) in untreated control. This study is correlate with (16) and (17), According to (17) they found that Chitosan increases the total soluble solids (TSS) and decreases titratable acidity during storage. The TSS/Acidity ratio was recorded higher (36.94) in Chitosan @ 0.2% followed by treatment treated with 5g/lit of Potassium Scheonite (29.04).

Skin Thickness, Pedicel Thickness and PLW (%) : Data recorded on Skin Thickness, Pedicel Thickness and PLW (%) were recorded and depicted in Table-3. Skin Thickness (35.25 mm) and Pedicel Thickness (1.33 mm) were recorded higher in Chitosan @ 0.2%, followed by

Table-5 : Correlation between different parameters in relation to yield in Manjri Shyama Grapes.

	50 berry weight (g)	Berry length (mm)	Berry diameter (mm)	Pedicel Thick-ness (mm)	Skin Thick-ness (mm)	TSS (°Brix)	Acidity (%)	TSS/ Acidity ratio	Yield kg/ vine	Bunch weight (g)	Phenol (mg/g)	Tannin (mg/g)	Reduc-ing sugar ((mg/g)	Anthocy anin (mg/L)	Flavo-noids (mg/g)
50 berry weight (g)	1.00														
Berry length (mm)	0.72	1.00													
Berry diameter(mm)	0.97	0.81	1.00												
Pedicel Thickness (mm)	0.77	0.69	0.67	1.00											
Skin Thickness (mm)	0.47	0.81	0.56	0.45	1.00										
TSS (°Brix)	0.81	0.85	0.92	0.43	0.70	1.00									
Acidity (%)	-0.83	-0.85	-0.92	-0.54	-0.48	-0.92	1.00								
TSS/Acidity ratio	0.82	0.85	0.94	0.45	0.61	0.99	-0.96	1.00							
Yield (kg)/vine	0.99	0.78	0.99	0.71	0.58	0.89	-0.86	0.89	1.00						
Bunch weight (g)	0.99	0.78	0.99	0.71	0.58	0.89	-0.86	0.89	1.00	1.00					
Phenol (mg/g)	0.59	0.26	0.59	0.30	-0.29	0.43	-0.69	0.55	0.53	0.53	1.00				
Tannin (mg/g)	0.59	0.27	0.60	0.30	-0.28	0.44	-0.70	0.56	0.54	0.54	1.00	1.00			
Reducing sugar (mg/g)	0.77	0.93	0.76	0.90	0.69	0.67	-0.75	0.68	0.77	0.77	0.28	0.29	1.00		
Anthocya Nine (mg/L)	0.78	0.22	0.67	0.59	-0.18	0.36	-0.55	0.45	0.68	0.68	0.83	0.83	0.39	1.00	
Flavonoids (mg/g)	0.68	0.28	0.66	0.35	-0.23	0.49	-0.71	0.59	0.62	0.62	0.99	0.99	0.31	0.88	1.00

similar to (18), they reported that the pre-harvest spray of Chitosan on orange increases in fruit peel thickness. This data revealed that there is significant interaction between storage intervals and treatment for the percentage PLW. The physiological loss in weight was recorded in 8th days of storage. The minimum weight loss (7.74%) is recorded in grapes bunch treated with Chitosan @ 0.2%, followed Potassium Schoenite @ 5g/lit (8.13%). According to (19), reported that the chitosan decreases weight loss due to covering of Chitosan protect berry against bacterial contamination and also moisture transfer to extend shelf life.

Biochemical parameter : The data recorded on biochemical changes of Manjri Shyama and presented in Table-4. The significant differences were recorded in phenol, Tannin, Anthocyanin and Flavonoid, content. Treatment treated with Potassium Scheonite @ 5 g/lit were recorded maximum phenol (2.86 mg/g) and Flavonoid (60.57 mg/g) contents, followed by chitosan @ 0.2% as compared with untreated control (29.22 mg/g).The higher concentration of Anthocyanin (54.96) were recorded in Potassium Schoenite @5g/lit, followed by chitosan @0.2% (41.32 mg/g). While control treatment reported very low concentration of anthocyanin (22.46 mg/g). Magnesium is present in Potassium Schoenite, According to (20), they reported that the higher level of magnesium increases anthocyanin accumulation. Tannins and anthocyanin are most concentrated natural antioxidant in grapes. Maximum concentration of tannin (3.53 mg/g) found in treatment treated with Potassium Schoenite @5g/lit, followed by treatment treated with chitosan @ 0.2% (2.58 mg/g). Similar result found by (21), they reported that higher concentration of Potassium source increase tannins in Date Palm. Reducing sugar content is higher (323.87 mg/g) in treatment treated with Chitosan 0.2%, followed by Potassium Schoenite @5g/lit (321.66 mg/g). This study is correlate with (22), they found that application of Chitosan increase osmo protectants compound such as sugar, free amino acid and soluble phenols. According to (16) reported that the lower concentration of chitosan (50% mineral + 250 ppm Nano K) improved the berry quality of 'Flame seedless' grapevines. Lower doses of chitosan could have an effective for increase in crop growth and yield, whereas higher doses decrease this benefit.

Correlation between different parameters : The correlation between different parameter are studied and present in Table No. 5. The positive and negative correlation between different morphological parameter showed due to use of different concentration of Chitosan and Potassium Schoenite. Among all parameter 50 berry weight high positive relationship with yield bunch weight. TSS show negative relationship with Acidity. Phenol show positive relationship with tannin and reducing sugar.

Conclusion

From this study it is revealed that the application of chitosan, Potassium Schoenite increases the bunch weight, berry weight and yield /vine, reduces PLW % in this study. However it increases the Phenol, Tannin, Anthocyanin by application of Potassium Schoenite @5 g/l. The application of Chitosan @ 0.2% were reported higher Pedicel thickness and reducing sugar. The Potassium Schoenite and chitosan were beneficial for increasing berry quality, yield and biochemical changes and recorded good shelf life in Manjari Shyama grapes.

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