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# Effect of pre-harvest foliar spray of potassium schoenite and chitosan oligo saccharide on yield and quality of grapes var. Muscat Hamburg

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**Abstract**
The study was conducted to investigate the effect of potassium schoenite and chitosan oligo saccharide on yield and quality of grapes var. Muscat Hamburg during July, 2018-September, 2018 at Grapes Research Station, Anaimalayanpatty, Theni, Tamil Nadu, India. The grapevines were planted by adapting a spacing of 3.3m × 1.6m and trained on bower system. Pre-harvest spray of potassium scheonite (0.2% & 0.4%) and chitosan oligosaccharide (0.2% & 0.4%) was carried out at pea stage (65 days after forward pruning) and again at veraison stage (80 days after forward pruning).The grapes bunches were harvested after attaining harvestable maturity with TSS of 17.5° Brix. The highest number of bunches (21) and yield per vine (4.85 kg/vine) was recorded in treatment with 0.4 per cent potassium schoenite. In terms of quality parameters viz., TSS (22.07° Brix), juice recovery (63.37%) and less berry shattering (0.01%) were recorded with the pre harvest spray of 0.2 per cent potassium schoenite. No significant differences were observed regarding the bunch length, bunch width and bunch weight.

**Keywords:** potassium schoenite, chitosan oligo, Hamburg

## Introduction
Grapes (*Vitis vinifera* L.) is one of the major commercial fruit crops with high export potential. Globally, grapes production contributes to about 16 per cent of the total fruit production. In India, remarkable success has been achieved in table grapes production and it is grown in an area of 0.14 lakh ha with an annual production of 2.92 lakh MT. Muscat Hamburg (Panneer) is the most popular and commercial cultivar in Tamil Nadu. This variety is consumed as table and wine making purpose. Grapevines require adequate supply of nutrients for proper vegetative and reproductive growth. Grapes yield and quality depends on mineral nutrition and balance between macro and micronutrients in different parts of the vine. According to Mitra *et al*. (1991) [18], nutrients in soil and foliage have role in plant metabolism and considerable effect on yield and quality of fruits. Grapevines easily absorb the nutrients through green tissues like leaves, buds and berries. Foliar applied nutrients are absorbed by leaves and clusters within two days and transported as chelates (with organic compounds) using proteins, acids and sugars. Anatomical structure and frequent stomatal opening favours the absorption of nutrients applied through foliar application.

Potassium, a well-known plant macronutrient that regulates various enzyme activities in plants, increases the photosynthetic rate of chloroplasts and photosynthates translocation from leaves through phloem to storage tissue which improves fruit yield and quality. There was an intense mobilization of potassium from leaf to fruit during fruit growth period. Insufficient or excessive level of potassium adversely affects the grapes quality. In grape berries, potassium is the most abundant cation which contributes to charge balance and sugar transport (Spayd *et al*. 1993) [25]. Potassium accumulates primarily in the berry skin tissues during ripening as a result of K remobilization from mature leaves (Coombe, 1992) [6]. Grapes berries are a strong sink for K, particularly during ripening (Mpelasoka *et al*. 2003) [20]. Increased potassium supply favours accumulation of total soluble solids content and reduction in total acidity of berries. Further potassium also involved in plant adaptation against biotic and abiotic stress. Compare to other potassic fertilizers like Muriate of potash and Sulphate of potash indigenously produces double salts of potassium, *i.e.*, potassium schoenite (molar mass 415 g/mol) have been found to be beneficial on acidic and alluvial soils and also improves the yield and quality of fruits. It contains 23 per cent potassium and 11 per cent magnesium.

It provides a readily available form of potassium, magnesium and sulfur to the growing plants in an ideal ratio. Very little work on potassium schoenite spray has been reported so far in the fruit crops (Sharma *et al.*, 1998) [23].

Chitin is an important structural component in fungal cell walls and can be degraded by plant chitinases to alleviate fungal infection (Grover, 2012) [11]. Plant cells can recognize chitin and chitin-derived molecules to elicit immune response. Since 1980s, chitin and its deacetylation product chitosan have been used as bio pesticides, bio fertilizers and also as seed coating formulations. In order to overcome the poor solubility obstacle to chitin and chitosan application, soluble chitin oligosaccharides (CTOS) and chitosan oligosaccharides (CSOS) are prepared from these polysaccharides. Chitosan oligosaccharides (COS) are obtained by hydrolysis or degradation of chitosan (Yin *et al.*, 2010) [29]. Oligochitosan has better plant growth promotion and elicitation effect than chitosan. It has shown a wide range of biological applications including health food, plant growth stimulator, feed additive, antimicrobial agent, etc. In addition, oligochitosan is effective at eliciting plant innate immunity against plant diseases in plants such as tobacco, rapeseed, rice, grapevines, etc. (Chen *et al.*, 2009) [4]. Italso exhibits growth promotion effect for plants such as rice, soybean, etc., in previous studies, chitosan and their derivatives were used mostly as post-harvest application to overcome disease problems. With this background, the present work has been envisaged to study the effect of foliar application of potassium scheonite and chitosan oligosaccharide on yield and quality of the grapes.

## Materials and Methods

The present investigation was conducted during July, 2018 - September, 2018 at Grapes Research Station, Anaimalayanpatty, Theni, Tamil Nadu, India. Pre-harvest spray treatments were imposed on five year old Muscat Hamburg grapes variety grown at latitude of 9.7344° N, and longitude of 77.2807° E. The grapevines were planted by adapting a spacing of 3.3m × 1.6m and trained on bower system. The viticultural operations were followed as per standard package of practices irrespective of treatments. The treatments were imposed by Randomized Block Design with five treatments and four replications. Five randomly selected vines were observed per replication.

1. $T_1$ -Potassium schoenite @ 0.2% (20g/10 L of water)
2. $T_2$ -Potassium schoenite @ 0.4% (40g/10 L of water)
3. $T_3$ -Chitosan oligo saccharide@ 0.2% (20g/10 L of water)
4. $T_4$ -Chitosan oligo saccharide @0.4% (40g/10 L of water)
5. $T_5$ -Control (Water spray)

Pre-harvest spray was carried out at pea stage (65 days after forward pruning) and again at veraison stage (80 days after forward pruning-color development stage). The grape bunches were harvested after (proper ripening) attaining harvestable maturity with TSS of 17.5° Brix. The yield and quality characters viz., Average bunch length (cm) and bunch width (cm), bunch weight (g), number of bunches vine$^{-1}$, number of berries bunch$^{-1}$ and yield vine$^{-1}$were recorded. Total soluble solids (°Brix) and titrable acidity (%) were recorded. The juice recovery (%) was calculated by using the following formula.

$$\text{Juice recovery per cent} = \frac{\text{Juice volume}}{\text{Weight of the sample}} \times 100$$

The shelf life of grapes bunches was recorded after 15 days of storage under ambient storage condition at 24 ± 2 °C and 70 to 90 per cent RH. During storage, physiological loss in weight (%) and berry shattering (%) were calculated by using following formula.

$$\text{Physiological loss in weight} = \frac{\text{Initial bunch weight} - \text{Final bunch weight}}{\text{Initial bunch weight}} \times 100$$

$$\text{Berry shattering (percent)} = \frac{\text{Weight of free brries inside each box}}{\text{Total bunch weight}} \times 100$$

## Results

The observations on bunch length (cm), bunch width (cm) and bunch weight (kg) were found to be non-significant among different treatments. The mean values for bunch length, bunch width and bunch weight were ranged from 16.00 cm to 19.90 cm, 9.57 cm to 11.27 cm and 209 g to 266 g respectively. The number of bunches vine$^{-1}$, number of berries bunch$^{-1}$ and average yield vine$^{-1}$ were observed to be significant among different treatments (Table 1). The maximum number of bunches vine$^{-1}$ (21) and the highest average yield vine$^{-1}$ (4.85 kg/vine) was recorded in the pre-harvest spray of 0.4 per cent potassium schoenite. But the maximum number of berries bunch$^{-1}$ (94) was observed in the treatment of 0.4 per cent chitin oligosaccharide. The total soluble solid content (TSS), juice recovery and per cent marketable berries were observed to be significant among different treatments. The highest values for TSS (22.07° Brix), juice recovery (63.37%) and the lowest berry shattering (0.01%) were noticed in the application of 0.2 per cent potassium schoenite. whereas the maximum number of marketable berries was found in the treatment with 0.4 per cent chitin oligosaccharide. The observations on acidity and physiological loss in weight (per cent) were found to be non-significant among treatments. Both the titrable acidity and physiological loss in weight were not much affected by the spray of substances other than chitin. Chitin oligosaccharide at 0.2 per cent has surely increased the titrable acidity and gave the minimum physiological loss in weight as compared to other treatments.

**Table 1:** Effect of pre-harvest foliar spray of potassium schoenite and chitosan oligosaccharide on yield and quality of grapes var. Muscat Hamburg

| Treatment | Bunch weight (kg) | Bunches vine$^{-1}$ (Nos.) | Berries bunches$^{-1}$ (Nos.) | Average yield vine$^{-1}$ (kg) | Bunch length (cm) | Bunch width (cm) | TSS (°Brix) | Titrable Acidity (%) | Juice recover (%) | Marketable berries (%) | PLW (%) | Berry shattering (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 0.248 | 16.00 | 69.00 | 3.96 | 18.93 | 9.57 | 22.07 | 0.87 | 63.37 | 98.13 | 23.71 | 0.01 |
| $T_2$ | 0.241 | 20.67 | 88.00 | 4.85 | 16.00 | 10.93 | 18.93 | 0.91 | 50.47 | 95.58 | 41.68 | 21.03 |
| $T_3$ | 0.246 | 13.67 | 83.00 | 3.39 | 19.73 | 11.13 | 17.53 | 1.03 | 58.36 | 82.54 | 14.98 | 5.54 |
| $T_4$ | 0.266 | 12.33 | 94.33 | 3.25 | 19.90 | 11.27 | 19.80 | 0.74 | 61.58 | 98.62 | 22.51 | 6.13 |
| $T_5$ | 0.209 | 11.67 | 79.66 | 2.44 | 16.87 | 9.80 | 18.17 | 0.99 | 55.42 | 92.15 | 31.31 | 15.43 |
| SE (d) | 0.034 | 1.88 | 6.43 | 0.54 | 2.47 | 1.09 | 0.83 | 0.15 | 2.13 | 3.85 | 8.8 | 1.97 |
| CD (0.05%) | NS | 4.34* | 14.83* | 1.24* | NS | NS | 1.92* | NS | 4.92* | 8.8* | NS | 4.54* |

$T_1$ -Potassium schoenite @ 0.2% (20g/10 L of water),
$T_2$ -Potassium schoenite @ 0.4% (40g/10 L of water),
$T_3$ -Chitosan oligo saccharide@ 0.2% (20g/10 L of water),
$T_4$ -Chitosan oligo saccharide @0.4% (40g/10 L of water)
$T_5$ -Control (Water spray)
NS - Non-significant *Significance at 5 percent level, TSS-Total soluble solids, PLW-Physiological loss in weight

## Discussion

Photosynthates were translocated to fruits from leaves on account of K-fertilization (Hansen, 1970) [12]. Potassium may be involved in the translocation of solutes into the berry through its roles in phloem loading and unloading (Lang 1983) [15]. The maximum number of bunches vine$^{-1}$ (21) and the highest average yield (4.85 kg/vine) were recorded with 0.4% Potassium schoenite. The result is in accordance with the reports of Samra *et al*. (2007) [22] as they had found that yield vine$^{-1}$ (kg) could be significantly increased by increasing the amount of potassium fertilization. Studies on the effect of foliar application of potassium, on the increase of the berry weight of Crimson Seedless are supported by (Mohsen, 2011) [19] and Perlette (Thakur *et al*., 2008) [26]. The increase in fruit weight, length as well as diameter may be attributed to higher cell division and photosynthetic activities. The results of EL-Baz *et al*. (2003) [9] in the application potassium sulphate at 50-350 g/vine on the increase of cluster and berry weight were in concurrence with the present results. Higher amount of total soluble solids (22.07) and juice recovery per cent (63.37%) and minimum berry shattering per cent (0.01%) were recorded in 0.2 per cent potassium schoenite treatment. The increase in TSS might be due to the hydrolyzation of starch into simple sugars with the role of potassium in translocation of sugar from leaves to fruits. The current results are also supported by Shirzadeh and Kazemi (2011) [24] in Apple, Dhatt and Mahajan (2005) [7] in Pear cv. Pathernakh and Mahajan *et al*. (2008) [16] in plum cv. Satluj Purple. Titratable acidity is directly related to the concentration of organic acids present in the fruit, which are an important parameter in determining the fruit quality. Potassium promotes fruitfulness through its enzyme activating property. It must be activating the enzymes involved in the conversion of carbohydrates to ribose sugar, which is a component of RNA (Gopalswamy, 1969) [10] thus increase the juice per cent significantly.

Chitosan oligo saccharide (COS) was obtained by hydrolysis or degradation of chitosan and was used as a plant regulator in a number of plants (Yin *et al*., 2010) [29]. Oligochitosan is used as bio pesticide in many grapes producing countries as plant elicitors. It also used for plant growth substances which increasing yield and quality of grapevine. Studies have suggested that chitosan improves crop yield or harvest qualities (Cabrera *et al*., 2013) [3] which are correlated with the present investigation. Utsunomiya and Kinai (1994) [27] reported that the soil application of chitosan-oligosaccharides advanced the flowering time and increased the flower numbers in Passion fruit (*Passiflora edulis* Sims) thereby increased the yield. In the present study, COS had similar effects on the yield components of the crop. The maximum number of berries bunch$^{-1}$ (94) and marketable berries (98.62%) was observed in the grapevines spray with 0.4 per cent Chitin oligosaccharide and these observations are comparable with the early findings. Lower doses of chitosan could have an effective increment in crop growth and yield; whereas higher doses decrease this benefit (Maksimov *et al*., 2014) [17]. Similar results were observed in this study. Thus, the lower concentration of chitosan oligosaccharide (0.2% and 0.4%) improved the yield and quality of grapes.

## Conclusion

Potassium scheonite is an alternate form of potassium fertilizer for enhancing growth, yield and quality of many crops. Chitosan oligosaccharide (COS) is the degradation product of chitosan, which is widely distributed throughout nature. The findings of this revealed study showed that potassium scheonite and COS could influence grapes production in the field by improving the yield and quality components. It is economical to apply COS and potassium scheonite as a foliar spraying agent in grapes cultivation. It could be concluded that pre harvest application of COS and potassium scheonite in grapes at pea and veraison stage would be highly useful for improving yield and quality of grapes var. Muscat Hamburg.

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