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Assessing the effect of application of organic manures and grapevine pruned biomass on Thompson Seedless

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Abstract

Our soil continues to grapple with a number of familiar challenges like soil infertility, unfavourable soil conditions, and declining soil health as well as quality. These issues are caused by the ongoing crises of climate change, biodiversity loss, pollution, and excessive fertilizer usage alone in intensive cropping. Deterioration of soil health can be alleviated by application of organic fertilizers. With this background, the current experiment was conducted during 2013- 2016 to evaluate the effect of different organic sources *viz.* farm yard manure (FYM), green manure, press mud compost and grapevine pruning residue on Thompson Seedless and soil organic carbon content. Results indicated that maximum yield of 19.50 t/ha was obtained in T_3 (press mud @15ton/ha). The increase in yield was +10.36% and +4.62% over T_1 (only Fertigation schedule) and T_2 (FYM), respectively. Maximum petiole potassium concentration (1.63%) was recorded in T_3 at fruit bud differentiation stage. The soil organic carbon was highest in T_4 (FYM @7.5 ton/ha and Press mud @ 7.5 ton/ha) among all the treatments. The increase was +5.6%, +66.66% and +63.56% over T_1 in first, second and third year respectively. The gross returns (Rs. 319945/-), net profit (Rs. 121170/-) as well as cost benefit ratio (0.61) was maximum in case of press mud among all the organic sources. On the basis of obtained results, it can be concluded that use of press mud compost or press mud and FYM may be recommended as an organic fertilizer to improve yield and petiole nutrient content of Thompson Seedless as well as soil organic carbon content.

Keywords: Farm yard manure, press mud compost, green manure, petiole, grapes.

Introduction

The emblematic maternal relationship of human beings with fertile soil is intense, as 95 percent of global food production is supported by soil. The statistical figure anticipates a worldwide population of 9.6 billion people by the year 2050. Nourishing the burgeoning population with nutritious food will not only put an immense pressure on the present condition of soil but will also demand a healthy and fertile soil for healthy food (Euronews, 2022). Climate change, excessive usage of chemicals and fertilizers as well as desertification accentuates soil impoverishment, resulting into degraded soil health and declining soil quality (Pinamonti and Sicher, 2001; Belletti, 2002). Due to continuous soil degradation, in the present scenario, it is left with a very lesser amount of organic matter, which is almost eight times lesser than what is required for its health and proper functioning. According to FAO (2022) if the present situation persists, entire global population will be deprived of topsoil in the coming 60 years and according to the GBD (2017) *humans are not happy either.* At least, one in five early deaths occurs due to poor diet globally. The quality of food, water as well as air is very much affected by our soils. Intensive cultivation and unsustainable use of soil as well as water has led to

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productivity losses of $400 billion per year. As a result of this, we may expect an increase of 30% in food-price by 2035. Nowadays, about half of the populations rely on fertilizers for their alimentation. Farmers have been affected by the volatility of fertilizer purchase prices as well as high transportation costs in the last decades. It directly decreases profitability, strongly for productions where fertilizer account for a large part of production costs (Huang et al., 2009). Facing these challenges, other approaches for fertilization would benefit from being better known in order to feed a growing population.

The benefits of using farm yard manure (FYM) or press mud compost, green manuring, pruning residue in perennial crops such as grapevine has been demonstrated by several research reports (Garcia et al., 2018; Atwood and Wood, 2021). Viticulture is the study and practice of cultivating grapevines that produce grapes (Vitis vinifera *L.*). Variability in vineyards which is universal across the vine growing areas of the globe poses several challenges for grape growers (Delay et al., 2015). Therefore, it becomes essential for the growers to choose efficient practices aimed towards enhancing the yield of poor performing sections within vineyards, while maintaining soil health and economic sustainability. Balanced nutrition is one of the most important aspects for improving the vine productivity and nutrient content (Lester et al., 2007). Along with considering vine nutrient content, maintaining soil health as well as quality and increasing soil organic carbon content can considerably contribute to combat climate change. A good soil health is an essential pre-requisite to sustain plants, animals as well as human beings (Lehmann et al., 2020). In this context, combined application of organic manures *viz.* FYM, press mud compost, green manure which can improve soil physical, chemical as well as biological properties and grapevine pruning residue, which targets soil physical limitations, can be significant.

Organic fertilizers are plant and animal derived products that provide vital nutrients for the growth and development of crops. Organic manure plays an important role in soil through its active groups which have the ability to retain the inorganic elements in complex and chelated forms. The beneficial effects of organic fertilizers are involved in improving physical, chemical and biological characteristics of soil *viz.* increase in water holding capacity, improved soil structure, reduced bulk density, improved drainage, decrease in soil pH, increase in bacterial and fungal population as well as enzymatic activities (Mills and Fey, 2003). Organic matter on decomposition release organic acids that aid in dissolving essential nutrients and ensure their adequate supply to plants as well as improve the stability of soil aggregates (Cass and McGrath, 2004; Farooq et al., 2021). Therefore, soil organic matter is considered as the key to soil health and quality. There are a variety of organic fertilizers like FYM, dry leaf manure, press mud compost, green manure etc. (Joshi et al., 2010). Press mud, a soft, spongy, dark brown substance that helps preserve soil fertility and crop production, contains fibre, sucrose, coagulated colloids, and other biological substances. Use of green manures like sun hemp is a low cost effective technology which also conserves soil productivity (Korwa et al., 2006). The green manure crops provide a protective action against soil erosion and leaching. A large amount of grapevine pruning residue are generated by viticultural practices which is a serious concern regarding environmental as well as economic sustainability. (Liguori et al., 2013; Rondeau et al., 2013; Teixeira et al., 2014; Kammerer et al., 2014; Colantuono et al., 2017; Jesus et al., 2017). Several regulatory organisations have recently focused on the "waste" problem related to environmental sustainability (examples include European Commission Directives 1999/31/EC and 2008/98/EC).As a result, there is currently significant interest in using wine industry byproducts to satisfy the growing demand for environmentally friendly materials that can serve as vital sources of nutrients and bioactive chemicals for the food industries.

For various soil types and fruit crops, FYM has long been a crucial supply of organic matter in Indian agriculture. Grape vineyards were no exception. However, an attempt was made to partially or completely replace FYM with alternative cheaper sources of organic matter, such as press mud compost, green manure, and grapevine pruning residue in different treatment combinations, due to the higher cost and limited availability of FYM in the grape-growing regions. A better knowledge and understanding of whether or not, combined application of compost and grapevine pruning residue proves to have substantial benefits to the grape industry, would be of great significance to the farmers as well as researchers. If this practice proves to be economically sustainable, it would establish the ground work for application of organic manures into the vineyards. With this background, field experiments were carried out to see the effect of using various organic sources and pruned biomass on Thompson Seedless grapevine and soil health.

Material and Methods

Due to lesser availability of FYM in grape growing regions and its higher cost, an experiment was conducted for three successive years (2013-14 to 2015-16). The major objective was to replace FYM with other organic sources, such as press mud compost, green manure, and grapevine pruned biomass, either completely or partially. Recommended fertigation schedule was applied in all the treatments.

Vineyard site and plant material

The experiment was conducted in a vineyard situated in (40°58' N; 27°28' E; elevation 4 m a.s.l.) that was five years old. For carrying out the experiment, Thompson Seedless grafted on Dogridge rootstock was used. The rootstock was collected from nursery and the scion material was collected from vineyard blocks of ICAR-National Research Centre for Grapes, Pune.

Climate

The maximum as well as minimum temperature was 35.89 and 8.6°C during the experiment. Total rainfall was 512 mm and total pan evaporation was 1302 mm.

Soil

The soil of the experimental site was clayey (40% clay content). Recommended fertigation schedule *i.e.* 160 kg N, 50 kg P_2O_5 and 160 kg K_2O was followed in vineyard during the study period. Some of the important physico-chemical properties of initial experimental soil have been presented in Table 1.

Table 1. Some important physico-chemical properties of the initial experimental soils

Parameter	NRC for Grapes, Pune	Reference
Soil pH	8.13	Jackson (1967)
Soil EC (dS m^{-1})	0.65	Jackson (1967)
Soil texture	Clay loam	Bouyoucos (1962)
$CaCO_3$ (%)	2.74	Puri (1930)
Organic carbon (%)	1.11	Walkley and Black (1934)
Soil Available N (ppm)	179	Subbiah and Asija (1956)
Soil Available P (ppm)	32.83	Olsen (1954)
Soil Available K (ppm)	865.5	Hanway and Heidel (1952)
Soil Available Na (ppm)	1025	Hanway and Heidel (1952)
Soil Available Ca(ppm)	7884	Hanway and Heidel (1952)
Soil Available Mg (ppm)	2309	Hanway and Heidel (1952)

Treatments

The treatment details are as follows:

T_1: Control (no organic manure)

T_2: T_1+ Farm yard manure @ 15 ton/ha

T_3: T_1+ Press mud @ 15 ton/ha

T_4: T_1+ Farm yard manure @ 7.5 ton/ha+ Press mud @ 7.5 ton/ha

T_5: T_1+ Press mud @ 8.5 ton/ha + Pruned biomass @ 4 ton/ha + Green manure @ 2.5 ton/ha

The percent nutrient content in different sources of organic matter (Press mud, FYM, Green manure) has been presented in Table 2.

Table 2.Nutrient content in different sources of organic matter used

Sample	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (%)	Cu (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)
Press mud	1.96	1.82	2.46	2.02	0.74	0.37	37.33	48.00	260.33	5846.00
FYM	1.50	0.57	0.92	1.27	0.71	0.22	33.67	85.33	271.00	11211.33
Green manure	40.15	0.47	3.35	1.89	1.88	0.32	17.25	74.10	7.25	178.95

Statistical analysis

Analysis of variance (ANOVA) was used for the statistical analysis. The statistical design used was randomized block design (Snedecor and Conchran, 1980). SPSS statistical software was used for the analysis (version 9.2; SAS Institute, Cary, NC). To distinguish between means from various treatments, the standard error of the mean was employed.

Results and Discussion

Effect of Organic sources on yield

Significantly highest yield of 19.50 t/ha was recorded in T_3 treatment (Press mud) over T_1 (only Fertigation schedule), however, it was on par with other treatments (Figure 1 and Table 3, 4 and 5). The increase was

+10.36% and +4.62% over T_1 (control) and T_2 (FYM) respectively. Similarly, an increase in +10.05 and +2.55 % was recorded in bunch weight in T_3 over T_1 and T_2 respectively. This may be ascribed to high sugar content and significant amount of organic carbon, macronutrients as well as micronutrients in press mud resulting into improved soil fertility and crop productivity (Liard et al., 2001; Abd El Hady et al., 2003; Banulekha, 2007; Joshi et al., 2010; Myburgh, 2013). An increase in yield was observed in first, second and third year as a result of compost application. It may be attributed to higher 100-berry weight and more bunch weight (Ahmed et al., 2000; Harhash and Abd EL-Nasser, 2000; Kassem and Marzouk, 2002). Various research reports revealed an increase in vine growth and yield per hectare due to addition of compost in vineyards (Rubio et al., 2013; Gaiotti et al., 2017; Ramos, 2017; Brunetto et al., 2018). Because compost has a narrow area of contact with the soil surface, it releases nitrogen slowly into the soil, allowing the grapevine to use more of the organic compost's nitrogen. (Korboulewsky et al., 2002; Morlat and Chassod, 2008; Bustamante et al., 2011). Since, nitrogen is considered essential for vegetative growth of plant, incorporation of compost results into higher yield of grapes. Addition of organic manures into the soil improves the microbiological activity in the root zone. It also aids to an increase in soil porosity, soil aggregates, water holding capacity, thereby contributing to vineyard health and productivity. Continuous and sustained supply of nutrients due to application of compost also contributes towards higher yield.

Among all the organic treatments, the maximum total soluble solids (TSS) was found in T_5 (FYM + Press mud + Pruned biomass + Green manuring) in pooled analysis which was 21.43°B (Figure 1). The increase was +1.18%, +3.38% and +1.99% over T_2, T_3 and T_4 respectively. High TSS in the present study was due to more release of nutrients which is involved in synthesis of carbohydrate and proteins as well as breakdown and transloaction of photosynthetic products (starch) from leaves to developing fruits and thereby increasing the total sugars. Also, press mud compost is rich in sugar resulting into more TSS. This may also be credited to increased population of microorganisms who might have contributed in the release of phytohormones *viz.* auxins, gibberellins and cytokinins due to their increased metabolic activity. The beneficial properties of grapevine leaves may be attributed to the phenolic compounds (phenolic acids, flavonols, mainly in the form of O-glycosides of quercetin and kaempferol and, to a lesser extent, by stilbenes (resveratrol), flavan-3-ols, and anthocyanins and secondary metabolites, correlated with antioxidant activity (Doshi et al., 2006; Monagas et al., 2006; Fernandes et al., 2013; Katalinic et al., 2013; Krol et al., 2014; Fontana et al., 2017; Barreales et al., 2019). Among all the organic treatments, the minimum acidity (6.56%) was recorded in T_3 (Press mud) followed by T_4 (FYM + press mud) in which it was 6.58%. The decrease was -2.6% and -2.4% over control (T_1) in which the acidity was 6.74% (Figure 1).

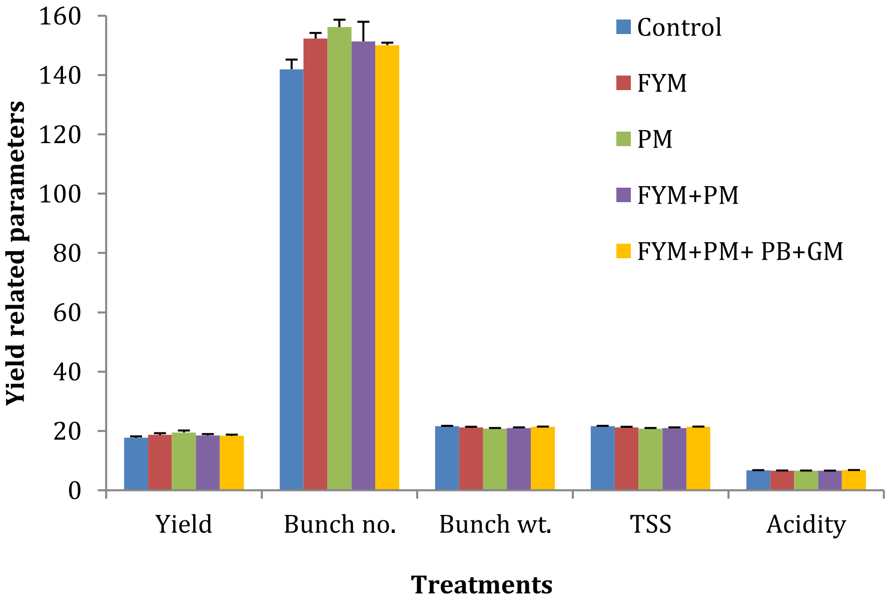

Figure 1. Effect of treatments on yield and yield related parameters (pooled data)

Table 3. Effect of treatments on yield and yield related parameters (First year)

Treatments	Yield (t/ha)	Bunch no.	Bunch wt.(g)	TSS (°B)	Acidity (%)
T1	17.65±0.41a	127.90±3.64a	20.43±0.41a	20.43±0.41a	6.73±0.05a
T2	18.80±0.68a	135.73±5.09a	20.48±0.12a	20.48±0.12a	6.63±0.05a
T3	19.05±0.59a	140.86±5.49a	20.30±0.34a	20.30±0.34a	6.65±0.12a
T4	18.97±0.75a	137.40±5.27a	20.95±0.32a	20.95±0.32a	6.60±0.04a
T5	17.90±0.38a	132.23±2.79a	20.55±0.23a	20.55±0.23a	6.88±0.13a

Table 4. Effect of treatments on yield and yield related parameters (Second year)

Treatments	Yield (t/ha)	Bunch no.	Bunch wt.(g)	TSS (°B)	Acidity (%)
T1	16.98±0.53a	13.02±6.56a	22.20±0.18b	22.20±0.19b	7.23±0.05a
T2	18.23±0.87a	137.52±8.95a	21.05±0.66ab	21.05±0.67ab	7.00±0.41a
T3	18.82±1.32a	140.35±9.15a	19.80±0.58a	19.80±0.58a	7.00±0.07a
T4	17.87±0.49a	131.23±12.48a	19.78±0.44a	19.78±0.44a	7.00±0.11a
T5	18.27±0.67a	137.19±2.47a	21.63±0.24b	21.63±0.24b	7.23±0.09a

Table 5. Effect of treatments on yield and yield related parameters (Third year)

Treatments	Yield(t/ha)	Bunch no.	Bunch wt.(g)	TSS (°B)	Acidity (%)
T1	18.38±1.24a	183.90±4.89a	22.15±0.19a	22.15±0.19a	6.28±0.11a
T2	18.88±1.24a	195.97±11.63a	22.00±14.72a	22.00±0.15a	6.23±0.10a
T3	20.63±1.62a	199.83±19.97a	22.08±0.08a	22.08±0.75a	6.03±0.08a
T4	18.58±0.89a	205.71±5.75a	22.30±0.07a	22.30±0.07a	6.13±0.05a
T5	18.79±1.31a	193.34±7.36a	22.13±0.15a	22.13±0.15a	6.25±0.06a

Effect of organic sources on petiole nutrient content

Maximum nitrogen (1.06%), phosphorus (0.46%), potassium (2.52%), and calcium (0.96%) concentration in petiole was obtained in T_5 at flowering stage whereas maximum potassium content (1.63%) at fruit bud differentiation was found in T_3 (Figure 2, 3 and Table 6, 7, 8, 9 and 10). The petiole potassium concentration was higher in those treatments where press mud compost was used either alone or with other organic sources. Exchangeable Ca^{2+} and Mg^{2+} also increased due to organic sources. These findings were in accordance with Ahmed et al. (2000); Morlat and Chassod (2008); Chan et al. (2010); Bustamante et al. (2011) and Rubio et al. (2013). This suggests that compost application can result in improved vine nutritional status. In vineyards, green manure can also be used as a nutrient source to restore nitrogen to grape (Cherr et al., 2006; Scneider and Huyghe, 2015; Garcia et al., 2018). Soil nitrogen absorption is greatly enhanced from blooming to veraison stages (Conradie, 1986). As grape nitrogen needs are the most important from bud burst to veraison and reach a peak at blooming, soil fertility here consists in a good availability of nutrients near blooming. Green manures including leguminous have already proved itself to provide nitrogen to grapes (Gontier, 2013). An increase in available phosphorus was observed due to organic manures incorporation. It may be attributed to competitive inhibition of phosphorus sorption due to the organic acids and anions released as a result of decomposition of organic matter (Korboulewsky et al., 2002; Calleja-Cervantes et al., 2015a, Wilson et al., 2016).

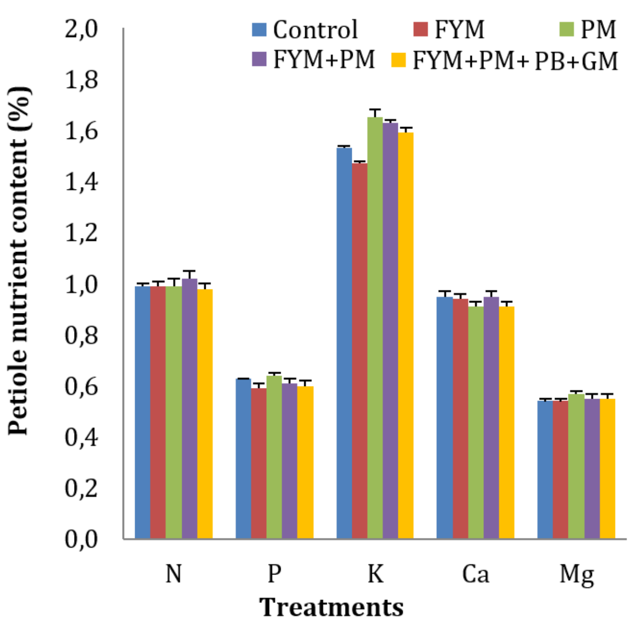

Figure 2. Effect of treatments on petiole nutrient content (%) at fruit bud differentiation stage (pooled data)

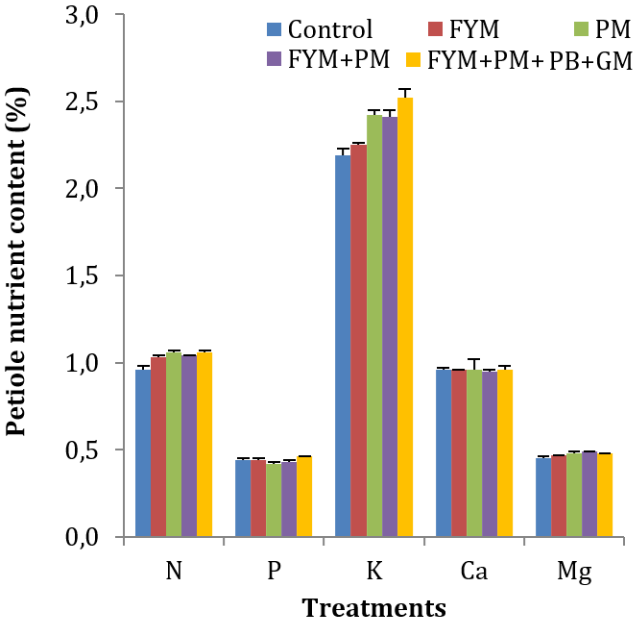

Figure 3. Effect of treatments on petiole nutrient content (%) at flowering stage (pooled data)

Table 6. Effect of treatments on petiole nutrient content (%) at fruit bud differentiation stage (First year)

Treatments	N	P	K	Ca	Mg
T1	0.87± 0.01a	0.69±0.02b	1.88±0.01a	0.78±0.00b	0.55±0.02c
T2	0.89± 0.03ab	0.63±0.02a	1.83±0.01a	0.75±0.00a	0.55±0.02b
T3	0.87± 0.02a	0.69±0.02b	2.05±0.07b	0.74±0.00a	0.62±0.02b
T4	0.95± 0.02b	0.64±0.02ab	2.07±0.01b	0.77±0.01b	0.60±0.05d
T5	0.88±0.02a	0.63±0.02ab	2.18±0.02c	0.75±0.01a	0.61±0.04a

Table 7. Effect of treatments on petiole nutrient content (%) at fruit bud differentiation stage (Second year)

Treatments	N	P	K	Ca	Mg
T1	1.09±0.04a	0.57±0.01a	1.19±0.02ab	1.13±0.04a	0.55±0.02a
T2	1.09±0.03a	0.57±0.02a	1.12±0.02a	1.12±0.04a	0.55±0.02a
T3	1.11±0.04a	0.59±0.03a	1.24±0.03b	1.08±0.03a	0.62±0.02a
T4	1.09±0.04a	0.59±0.24a	1.19±0.03ab	1.13±0.05a	0.60±0.46a
T5	1.08±0.02a	0.57±0.02a	1.18±0.04ab	1.07±0.04a	0.61±0.04a

Table 8. Effect of treatments on petiole nutrient content (%) at flowering stage (First year)

Treatments	N	P	K	Ca	Mg
T1	1.07±0.06a	0.45±0.01a	2.15±0.03a	1.38±0.03a	0.59±0.01a
T2	1.20±0.04b	0.44±0.01a	2.28±0.03b	1.39±0.01a	0.59±0.01a
T3	1.24±0.02b	0.44±0.01a	2.43±0.04b	1.40±0.01a	0.61±0.02ab
T4	1.24±0.01b	0.45±0.01a	2.37±0.08b	1.39±0.01a	0.63±0.01b
T5	1.26±0.01b	0.45±0.01a	2.32±0.05b	1.39±0.01a	0.63±0.01b

Table 9. Effect of treatments on petiole nutrient content (%) at flowering stage (Second year)

Treatments	N	P	K	Ca	Mg
T1	0.90±0.01a	0.32±0.01ab	2.52±0.08ab	0.76±0.01a	0.37±0.01a
T2	0.94±0.01ab	0.31±0.00a	2.50±0.01a	0.79±0.00b	0.39±0.01a
T3	0.97±0.01c	0.32±0.00b	2.67±0.03bc	0.76±0.01a	0.38±0.00a
T4	0.92±0.01ab	0.34±0.00c	2.73±0.02c	0.76±0.01a	0.39±0.01a
T5	0.94±0.02bc	0.35±0.01d	2.92±0.07d	0.76±0.01a	0.36±0.01a

Table 10. Effect of treatments on petiole nutrient content (%) at flowering stage (Third year)

Treatments	N	P	K	Ca	Mg
T1	0.91±0.01a	0.56±0.15ab	1.91± 0.03a	0.75±0.00a	0.38±0.08a
T2	0.95±0.01ab	0.57±0.03ab	1.96± 0.01ab	0.71±0.02a	0.43±0.01b
T3	0.98±0.02b	0.51±0.01a	2.16±0.06bc	0.72±0.01a	0.44±0.01b
T4	0.95±0.01ab	0.52±0.01ab	2.14± 0.08bc	0.71±0.01a	0.44±0.01b
T5	0.99±0.02b	0.57±0.01b	2.31± 0.12c	0.74±0.04a	0.43±0.01b

Effect of organic sources on soil organic carbon

The soil organic carbon was highest in T_4 (FYM @7.5 ton/ha plus Press mud @ 7.5 ton/ha) among all the treatments. The increase was +5.6%, +66.66% and +63.56% over T_1, +4.16%, +19.46% and +34.39% over T_2 (FYM) and +2.74%, +7.14%, +3.43% over T_3 (Press mud compost) in first, second and third year respectively (Figure 4).

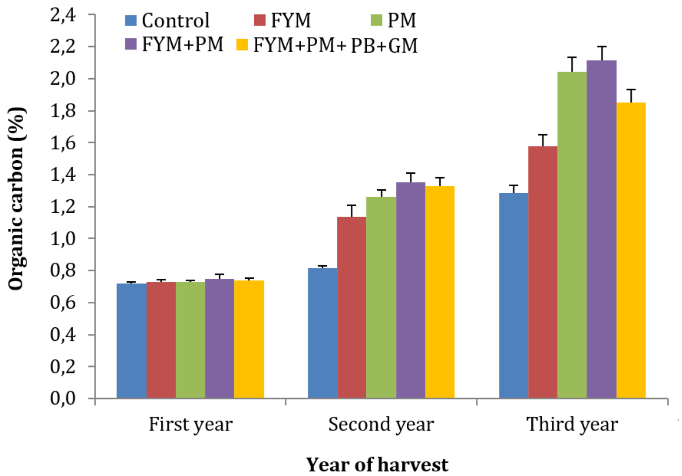

Figure 4. Effect of treatments on soil organic carbon (%)

In the treatments that supplied organic sources, the soil organic carbon accumulated significantly over T_1 (control). Similar results have been reported by Biala (2000); Pinamonti and Sicher (2001) and Martinez et al. (2018). Increased soil organic carbon content may result in improved soil aggregation, improved water holding capacity of soil as well as infilteration, reduced bulk density, improved porosity, increased microbial activity and potential soil carbon sequestration (Morlat and Chassod, 2008; Bustamante et al., 2011; Ramos, 2017, Martinez et al., 2018). More research is needed to have a better understanding about the effect of compost additions on soil carbon content in vineyards (Lazcano et al., 2020).

Effect of organic sources on cost benefit ratio

Form Table 11, it is clear that amongst all the organic sources, the gross returns (Rs.319945), net profit (Rs. 121170) and the cost-benefit ratio (0.611) was highest in T_3 (Press mud compost).These results obtained revealed that press mud compost or press mud compost plus other organic sources like FYM, green manure and pruned biomass can be used as one of the most economic sources of plant essential nutrients as well as soil organic carbon for sustainable grape production (Elsayed et al., 2008).

Table 11. Cost benefit ratio of the treatments

Treatments	Yield (t/acre)	Gross returns** (Rs)	Gross returns*** ($)	Recurring cost (Rs)	Recurring cost ($)	Net profit (Rs)	Net profit ($)	Cost benefit ratio (Net profit/ Recurring cost)
T1	7.16	286350.0	3722.55	164675	2140.78	121675.0	1581.78	0.739
T2	7.51	300488.2	3906.35	190775	2480.08	109713.2	1426.27	0.575
T3	7.99	319445.0	4152.79	198275	2577.58	121170.0	1575.21	0.611
T4	7.38	295141.4	3836.84	205775	2675.08	89366.4	1161.76	0.434
T5	7.50	300146.6	3901.91	205775	2675.08	94371.65	1226.83	0.459

** Sale price of produce @Rs 40 /kg

*** Sale price of produce @ $ 0.52/kg

Conclusion

From this study it is clear that adding press mud compost or press mud plus other organic manures in Thompson Seedless increased yield, bunch number, vine nutritional status and soil organic carbon content. The use of these organic sources is particularly complementary to the goals of organic viticulture. We need to implement good practices that are a combination of scientific and local knowledge for re-setting the balance and harmony of our soils. A balance should be maintained between organic matter accumulation and utilization to maintain soil fertility and to feed the global population. While compost application may demand immediate costs, the long-term financial benefits can be significant, as well as the benefits to the soil environment. Therefore, press mud compost alone or in combination with other organic amendments can be used as a cheaper source of organic fertilizer.

Future prospects: Despite having a lower concentration of nutrients, organic manures nevertheless contain many of the necessary elements for plant growth and release them over a longer time period. Therefore, they are advantageous over chemical fertilizers, which only provide plants with a limited number of nutrients for a short time. Additionally, the country's soil quality is declining as a result of the unbalanced use of fertilizers. These facts led the Ministry of Agriculture Development (MoAD) to introduce a number of organic intervention initiatives designed to improve soil health, reduce reliance on chemical fertilizers, and lower crop production costs. Vermi-composting, cattle shed development and the establishment of organic fertilizer plants, are a few of these that the nation has implemented in various Financial Years (FYs).These programmes are currently in the implementation phase. Although these initiatives have been found to be successful in educating farmers on the value of organic manure in improving soil health. The demonstration effect that these initiatives have had on the village level has motivated farmers who are not a part of the programmes to properly manage the organic manure produced at the home level. Some of the issues preventing the proper execution of programmes include harsh topography in hilly and mountainous areas, lack of availability in a timely manner, and installation of production plants far from the demand centres. Instead of constructing production facilities in dense metropolitan regions, it is preferable to encourage their establishment in and around demand centres, hilly areas, and mountainous locations.

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References

Abd El-Hady, A. M., Aly, A.M., El-Mogy, M.M., 2003. Effect of some soil conditioners on counteracting the adverse effects of salinity on growth and fruiting of Flame. *Minia Journal of Agricultural Research Development* 4(23): 699-726.

Ahmed, F. F., Abd Elaal, A.H., Ali-Mervet, A., 2000. A comparative study for using farmyard manure and filter mud on flame seedless grapevines growing in sandy soil. The 2nd Scientific Conference of Agricultural Sciences, Assiut University, Assiut, Eygpt. 28-30 October 2000, Vol.1, pp.277-284.

Atwood, L.W., Wood, S.A., 2020. AgEvidence: Agro-Environmental Responses of Conservation Agricultural Practices in the US Midwest Published from 1980 to 2020. Knowledge Network for Biocomplexity.

Banulekha, C., 2007. Eco-friendly utilization of organic rich bio-methanated distillery spentwash and biocompost for maximizing the biomass and quality of cumbunapier hybrid fodder (CO3). M.Sc. (Environmental Science) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Barreales, D., Malheiro, R., Pereira, J.A., Verdial, J., Bento, A., Casquero, P.A., Ribeiro, A.C., 2019. Effects of irrigation and collection period on grapevine leaf (Vitis vinifera L. var. Touriga Nacional): Evaluation of the phytochemical composition and antioxidant properties. *Scientia Horticulturae* 245: 74-81.

Belletti, G., 2003. Le denominazioni geografiche nel supporto all'agricoltura multifunzionale. *Politica Agricola Internazionale* 4: 81-102.

Biala, J., 2000. The use of recycled organics compost in viticulture - a review of the international literature and experience. Proceedings of the 6th International Congress on Organic Viticulture, 25-26 August 2000, Basel, Switzerland. pp. 130-134.

Bouyoucos, G.J., 1962. Hydrometer method improved for making particle size analyses of soils. *Agronomy Journal* 54: 464-465.

Brunetto, G., Ceretta, C.A., Melo, G.W.B., Miotto, A., Ferreira, P.A.A., Couto, R.R., Silva, L.O.S., Garlet, L.P., Somavilla, L.M., Cancian, A., Ambrosini, V.G., 2018. Grape yield and must composition of 'Cabernet Sauvignon' grapevines with organic compost and urea fertilization. *Revista de Ciências Agroveterinárias* 17(2): 212-218.

Bustamante, M.A., Said-Pullicino, D., Agulló, E., Andreu, J., Paredes, C., Moral, R., 2011. Application of winery and distillery waste composts to a Jumilla (SE Spain) vineyard: effects on the characteristics of a calcareous sandy-loam soil. *Agriculture, Ecosystems and Environment* 140: 80-87.

Cass, A., McGrath, M., 2004. Compost benefits and quality for viticultural soils. Proceedings of the Soil Environment and Vine Mineral Nutrition Symposium. Christensen, L.P., Smart, D.R. (Eds.). 29-30 June 2004. San Diego, California, USA. pp. 135-143.

Chan, K.Y., Fahey, D.J., 2011. Effect of composted mulch application on soil and wine grape potassium status. *Soil Research* 49(5): 455-461.

Cherr, C.M., Scholberg, J.M.S., Mc Sorley, R., 2006. Green manure approaches to crop production. *Agronomy Journal* 98(2): 302-319.

Colantuono, A., Vitaglione, P., Ferracane, R., Campanella, O.H., Hamaker, B.R., 2017. Development and functional characterization of new antioxidant dietary fibers from pomegranate, olive and artichoke by-products. *Food Research International* 101: 155-164.

Conradie, W.J., 1986. Utilisation of nitrogen by the grape-vine as affected by time of application and soil type. *South African Journal of Enology and Viticulture* 7(2): 76-83.

Delay, E., Piou C., Quenol H., 2015. The mountain environment, a driver for adaptation to climate change. Land Use Policy 48: 51-62.

Doshi, P., Adsule, P., Banerjee, K., 2006. Phenolic composition and antioxidant activity in grapevine parts and berries (Vitis vinifera L.) cv. Kishmish Chornyi (Sharad Seedless) during maturation. *International Journal of Food Science and Technology* 41(s1): 1-9.

Elsayed, M.T., Babiker, M.H., Abdelmalik, M.E., Mukhtar, O.N., Montange, D., 2008. Impact of filter mud applications on the germination of sugarcane and small-seeded plants and on soil and sugarcane nitrogen contents. *Bioresource Technology* 99(10): 4164-4168.

Euronews, 2022. The fate of our planet hinges on soil, our 'silent ally', says UN scientist. Available at [Access date : 02.06.2022]: https://www.euronews.com/green/2022/02/12/the-fate-of-our-planet-hinges-on-soil-our-silent-ally-says-un-scientist

FAO, 2022. Land & Water. Food and Agriculture Organization of the United States. Available at [Access date : 02.06.2022]: http://www.fao.org/land-water/databases-and-software/crop information/tomato/en

Farooq, T.H., Kumar, U., Shakoor, A., 2021. Influence of intraspecific competition stress on soil fungal diversity and composition in relation to tree growth and soil fertility in sub-tropical soils under Chinese fir monoculture. *Sustainability* 13(19):10688.

Fernandes, F., Ramalhosa, E., Pires, P., Verdial, J., Valentão, P., Andrade, P., Bento, A., Pereira, J.A., 2013. Vitis vinifera leaves towards bioactivity. *Industrial Crops and Products* 43: 434-440.

Fontana, A.R., Antoniolli, A., Bottini, R., 2017. Utilisation of Bioactive Compounds from Agricultural and Food Production Waste. CRC Press. Boca Raton, FL, USA. 414p.

Gaiotti, F., Marcuzzo, P., Battista, F., Belfiore, N., Petoumenou, D. Tomasi, D., 2016. Compost amendment effects on grapevine root density and distribution. *ISHS Acta Horticulturae* 1136: 115-120.

Garcia, L., Celette, F., Gary, C., Ripoche, A., Valdés-Gómez, H., Metay, A., 2018. Management of service crops for the provision of ecosystem services in vineyards: A review. *Agriculture, Ecosystems and Environment* 251: 158-170.

GBD, 2017. Findings from the Global Burden of Disease Study 2017. Institute for Health Metrics and Evaluation (IHME), Seattle, WA: IHME, USA. 25p. Available at [Access date: 02.06.2022]: https://www.healthdata.org/sites/default/files/files/policy_report/2019/GBD_2017_Booklet.pdf

Gontier, L., 2013. Green manuring in viticulture: impact of cover crop species and way of destruction on nitrogen supply of the grapevine. 18th International Symposium GiESCO, Porto, Portugal. 7-11 July 2013, pp. 299-304. [in Portuguese]

Hanway, J.J., Heidal, H., 1952. Soil analysis methods as used in Iowa State College Soil Testing Laboratory. *Iowa State College of Agriculture Bulletin* 57: 1-31.

Harhash, M. M., Abd El-Nasser, G., 2000. Effect of organic manures in combination with elemental sulphur on soil physical and chemical characteristics, yield, fruit quality, leaf water content and nutritional status of Flame Seedless grapevines*. Journal of Agricultural Science, Mansoura University* 25(5):2819-2837.

Huang, W., McBride, W., Vasavada, U., 2009. Factors Contributing to the Recent Increase in U.S. Fertilizer Prices Horticultural Cropping Systems. Lewis Publishers, New York. USA.

Jackson, M.L., 1967. Soil Chemical Analysis, Prentice Hall of India Private Limited, New Delhi, India. 498p.

Jesus, M.S., Romaní, A., Genisheva, Z., Teixeira, J.A., Domingues, L., 2017. Integral valorization of vine pruning residue by sequential autohydrolysis stages. *Journal of Cleaner Production* 168:74-86.

Joshi, N., Sharma, S., 2010. Physico-chemical characterization of sulphidation press mud composted press mud and vermicompost press mud. Department of Environmental Sciences, Kanya Gurukul Mahavidyalaya, Gurukul Kangri, Harudwar, Uttarankhand, India. 2(3).

Kammerer, D.R., Kammerer, J., Valet, R., Carle, R., 2014. Recovery of polyphenols from the by-products of plant food processing and application as valuable food ingredients. *Food Research International* 265: 2-12.

Kassem, H. A., Marzouk, H.A., 2002. Effect of organic and / or mineral nitrogen fertilization on the nutritional status, yield and fruit quality of Flame Seedless grapevines grown in calcareous soil. *Journal of Advances in Agricultural Research* 7: 117-126.

Katalinic, V., Mozina, S.S., Generalic, I., Skroza, D., Ljubenkov, I., Klancnik, A., 2013. Phenolic profile, antioxidant capacity, and antimicrobial activity of leaf extracts from six Vitis vinifera L. varieties. *International Journal of Food Properties* 16(1): 45-60.

Korboulewsky, N., Dupouyet, S., Bonin, G., 2002. Environmental risks of applying sewage sludge compost to vineyards: carbon, heavy metals, nitrogen, and phosphorus accumulation. *Journal of Environmental Quality* 31(5):1522-1527.

Korwar, G, R., Pratibha, G., Ravi, V., Palanikumar, D., 2006. Influence of organics and inorganics on growth, yield of aonla (Emblica officinalis) and soil quality in semi-arid tropics. *Indian Journal of Agricultural Sciences* 76(8):457-461.

Król, A., Amarowicz, R., Weidner, S., 2014. Changes in the composition of phenolic compounds and antioxidant properties of grapevine roots and leaves (Vitis vinifera L.) under continuous of long-term drought stress. *Acta Physiologiae Plantarum* 36:1491-1499.

Laird, D.A., Martens, D.A., Kingery, W.L., 2001. Nature of clay-humic complexes in an agricultural soil: I. Chemical, biological and spectroscopic analysis. *Soil Science Society of America Journal* 65(5): 1413-1418.

Lazcano, C., Decock, C., Wilson S., 2020. Defining and managing for healthy vineyard soils, intersections with the concept of terroir. *Frontiers in Environmental Science* 8:68.

Lehmann, J., Bossio, D. A., Kögel-Knabner, I., Rillig, M. C., 2020. The concept and future prospects of soil health. *Nature Reviews Earth and Environment* 1: 544-553.

Lester, G.E., Jifon, J.L., Makus, D.J., 2007. Impact of potassium nutrition on food quality of fruits and vegetables: A condensed and concise review of the literature. *Better Crops* 94(1): 18-21. Available at [Access date: 02.06.2022]: http://eeca-en.ipni.net/ipniweb/region/eecaen.nsf/0/69F4F2205C1B59EE8525803E0031DF67/$FILE/K_booklet_ENG_site.pdf#page=12

Liguori, R., Amore, A., Faraco, V., 2013. Waste valorization by biotechnological conversion into added value products. *Applied Microbiology and Biotechnology* 97: 6129-6147.

Martinez, M.M., Ortega, R., Janssens, M., Fincheira, P., 2018. Use of organic amendments in table grape: Effect on plant root system and soil quality indicators *Journal of Soil Science and Plant Nutrition* 18(1):100-112.

Mills, A., Fey, M.V., 2004. Declining soil quality in South Africa: effects of land use on soil organic matter and surface crusting. *South African Journal of Plant and Soil* 21 (5): 388-398.

Monagas, M., Hernández-Ledesma, B., Gómez-Cordovés, C., Bartolomé, B., 2006. Commercial dietary ingredients from Vitis vinifera L. leaves and grape skins: Antioxidant and chemical characterization. *Journal of Agricultural and Food Chemistry* 54: 319-327.

Morlat, R., Chassod, R., 2008. Long-term additions of organic amendments in a Loire Valley vineyard. I.Effect on properties of a calcareous sandy soil. *American Journal of Enology and Viticulture* 59(4): 353-363.

Myburgh, P.A., 2013. Effect of shallow tillage and straw mulching on soil water conservation and grapevine response. *South African Journal of Plant and Soil* 30(4): 219-225.

Olsen, S.R., Cole, C.V., Watanabe, F.S., Dean, L.A., 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. U.S. Department of Agriculture, Circular No 939, USA, 19p.

Pinamonti, F., Sicher, L., 2001. Compost Utilization in Fruit Production Systems. In: Compost Utilization in Horticultural Cropping Systems. Stoffella, P.J., Kahn, B.A. (Eds.). Lewis Publishers, Boca Raton, FL, USA. pp.177-200.

Puri, A.N., 1930. A new method for estimating total carbonates in soils. Important Agriculture Research. Pusa Bulletin 7p.
Ramos, M., 2017. Effects of compost amendment on the available soil water and grape yield in vineyards planted after land levelling. *Agricultural Water Management* 191: 67-76.
Rondeau, P., Gambier, F., Jolibert, F., Brosse, N., 2013. Compositions and chemical variability of grape pomaces from French vineyard. *Industrial Crops and Products* 43: 251-254.
Rubio, R., Pérez-Murcia, M. D., Agulló, E., Bustamante, M. A., Sánchez, C., Paredes, C., 2013. Recycling of agro-food wastes into vineyards by composting: agronomic validation in field conditions. *Communications in Soil Science and Plant Analysis* 44(1-4): 502-516.
Schneider, A., Huyghe, C., 2015. Les légumineuses pour des systèmes agricoles et alimentaires durables. Éditions Quæ, Cedex, France. 475p. [in French].
Snedecor, G.W., Cochran, W.G., 1980. Statistical Methods. 7th Edition. The Iowa State University Press. Iowa, USA. 507p.
Subbiah, B.V., Asija, G.L., 1956. A rapid procedure for the determination of available nitrogen in soils. *Current Science* 25: 259-260.
Teixeira, A., Baenas, N., Dominguez-Perles, R., Barros, A., Rosa, E., Moreno, D., Garcia-Viguera, C., 2014. Natural bioactive compounds from winery by-products as health promoters: A Review. *International Journal of Molecular Sciences* 15(9):15638-15678.
Tester, F.C., 1990. Organic amendment effects on physical and chemical properties of a sandy soil. *Soil Science Society of America Journal* 54(3): 927-931.
Walkley, A., Black, I.A., 1934. An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil Science* 37(1): 29-38.
Wilson, S.G., Lambert, J.J., Dahlgren, R.A., 2016. Seasonal phosphorus dynamics in a volcanic soil of Northern California. *Soil Science Society of America Journal* 80(5): 1222-1230.