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Evaluation of Vegetative Characteristics of White Wine Grape Varieties for Growth and Yield Parameters in Semi-arid Conditions of India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted at ICAR- National Research Centre for Grapes, Pune during fruiting season of 2022-2023 and 2023-24. The variety Sauvignon Blanc stood out among white wine varieties, showing superior growth parameters like pruned biomass (0.853 Kg/vine), shoot length (102.56 cm), internodal length (7.89 cm), number of leaves (25.61/fruiting shoot) and yield

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parameter like number of bunches (60.50/vine). Minimum days taken to bud sprout (8.50 days) and higher shoot diameter (7.94 mm) was recorded in Charak-2. Higher leaf area was recorded in Riesling (3532.27 cm^2/fruiting shoot) and Muscat Petit (150.21 cm^2/leaf) varieties. Higher chlorophyll content was recorded in White Muscat (22.28 mg/ml). Higher number of berries (157.56/bunch) recorded in Trebbiano. Yield-related metrics like bunch weight (183.20 g) higher in Muscat Petit, 100 berry weight (186.80 g) in Riesling, yield in Marsanne (8.53 kg/vine and 10.32 MT/acre) for pooled mean basis.

Keywords: White wine varieties; grape; food product; vegetative characteristics.

1. INTRODUCTION

Grape (*Vitis spp*. L.) is considered to be originated about 54 million years ago, but it's only been 6000 years when humans started domesticating and cultivating grapes (McGovern, 2003). Grape occupies an eminent position in fruit industry both in terms of area and economic returns and is grown widely in subtropical and temperate climates. Although grape is basically a crop of temperate origin, it is mainly grown in sub-tropical and tropical agro climatic conditions (Ghule *et. al*., 2021; Somkuwar *et. al*., 2021). In India, about 98% of the total area is covered for table or raisin purpose. Out of total production, only about 2% of the total production of grapes is being used for juice and winemaking (Ausari et al. 2024).

The International Organization of Vine and Wine (OIV) defines wine as a food product made solely through the complete or partial alcoholic fermentation of fresh grapes or their must, whether pressed or unpressed. Chemically, wine is a complex drink composed of water, ethanol, sugars, amino acids, polyphenolic compounds, anthocyanins, and various organic and inorganic substances (Avram et al., 2014; Karataș et al., 2015 and Bora et al., 2016). During 2023, global wine production, excluding juices and musts, was estimated at 237 mhl (OIV, 2024). Wine is one of the most popular beverages prepared from grapes through fermentation under the controlled conditions (Somkuwar et al. 2019). Due to rising worldwide demand and consumption, wine market had quickest rate of growth, and the output increased by more than 40% in the last ten years (OIV, 2024). Berries with a high acidity and low sugar content and pH are advantageous for wines, as their quality is mostly determined by their acid level (Jones et al., 2014). Not only the climate affects and disrupt in grapes composition but also vineyard managements can improve the necessary acidity, sugar, and pH levels (Lavras, 2017).

Grape quality is directly affected by several factors, including the grape variety, eco-climatic conditions, soil properties (both physical and chemical), the winemaking process, transportation and storage of the wine, the extent of applied agro-technical practices, and the vineyard's location (Bora et al., 2015a; Condurso et al., 2015). A favorable climate is essential for stabilizing the productivity, while the inter-annual variability of atmospheric conditions can strongly influence the quality of grapes (Jones and Goodrich, 2008) and consequently the wine quality.

Wineries make wine using over 20 different types of white grapes. Around 90% of wine grapes cultivated in the world trace back to a single group known as *Vitis vinifera*. Among the white grape wine varieties, Sauvignon Blanc, Chenin Blanc, Chardonnay, Riesling, Semillon, Symphony, Gewurztraminer etc. are major varieties utilized for wine making. Quality of wine mainly depends upon grape variety grown in area, the climate available during the cultivation, management practices followed in the vineyard during growth stages and fermentation techniques (Karibasappa, 2013). The micro climates of grape growing regions of Maharashtra specifically Nashik and Pune are suitable to grow wine varieties and produce acceptable quality wine.

2. MATERIALS AND METHODS

Experimental site: In the current study, growth, yield, and berry quality parameters of 17 white grape wine varieties (*V. vinifera* L.) grafted on Dogridge rootstock planted at National Research Centre for Grapes, Pune was undertaken during two seasons (2022-23 and 2023-24). The age of the vineyard was seven years old with good health and regular crop. The vines were trained to a mini-Y trellis system with single cordons trained in the horizontal direction while shoots were placed in a vertical position. The soil in the region is heavy black with pH 7.75 and EC 0.46 dS m^{-1}.

Experimental Design: All the varieties were planted at a spacing of 3 m between the rows and 1.5 m between the vines in a completely randomized setup with three replications and five vines per replication.

Procedure to record observations: Seventeen white wine grape varieties (White Muscat, Muscat Petit, Chenin Blanc, Riesling, Clairette, Charak-1, Charak-2, Charak-3, Charak-4, Vermentino, Viognier, Trebbiano, Marsanne, Colombard, Gewurztraminer, Gros Mesang and Sauvignon Blanc) were used as per the treatments for production and for further use in the study.

2.1 Growth Parameters

Five vines were selected and marked within each replication and means of five vines was calculated for each parameter.

2.1.1 Weight of pruned biomass (kg/vine)

After pruning, pruned material from each vine was collected immediately and weighed using a weighing balance (Param weighing scale). The mean weight of biomass was calculated and expressed in kg/vine.

2.1.2 Days taken to bud sprout

Days to bud sprout were calculated after each pruning (foundation and fruit pruning). The first sprouted bud with fully expanded leaf was taken as an indicator to count the days to bud sprout (Satisha et al*.,* 2010)

2.1.3 Cane length (cm)

Five canes were selected randomly and tagged to measure cane length using measuring tape at 90 days after fruit pruning (DAP) and was expressed in cm.

2.1.4 Cane diameter (mm)

Cane diameter was measured between fifth and sixth node of cane from five different vines and the mean was expressed in millimeters (mm) at 90 days after foundation pruning.

2.1.5 Internodal length (cm)

Internodal length was measured between fifth and sixth nodes of canes using a measuring scale at 90 DAP during the fruit pruning. The mean was calculated and reported in centimeters (cm).

2.1.6 Number of leaves per fruiting shoots

Number of leaves per fruiting shoot was recorded by counting the number of leaves from selected canes at 90^{th} day of fruit pruning. The mean number of shoots was worked out.

Five shoot were selected from each vines and it was measured using BIOVIS, leaf area meter at days after foundation pruning and their mean was expressed in cm^2.

2.1.7 Estimation of chlorophyll

The chlorophyll content in the various parts of vine was estimated using the method of Witham et al. (1971).

2.2 Yield Parameters

After harvesting bunches, five healthy bunches/vine were selected for recording the observations for yield and quality parameters.

2.2.1 No. of bunches per vine

Number of bunches per vine was recorded by counting number of bunches from three different vines and the mean of the three vines was calculated.

2.2.2 No. of berries per bunch

Number of berries was recorded by counting number of berries from five different bunches and mean of the five bunches was calculated.

2.2.3 Average bunch weight (g)

Five healthy bunches per replication were selected randomly at the time of harvesting and their mean weight was recorded using weighing balance. The mean average bunch weight was expressed in grams.

2.2.4 100 berry weight (g)

A hundred berries from five bunches were selected under each replication and their mean weight was recorded using weighing balance. The mean 100 berry weight was expressed in grams.

2.2.5 Yield per vine (kg)

At the time of harvest, five vines were selected and tagged. The harvested grapes from these vines under each treatment were weighed using weighing balance. The mean yield of each vine calculated and was expressed in Kg.

2.2.6 Yield per acre (MT)

The grape yield per acre was calculated by following formula

$$\text{Yield(t/ha)} = \frac{\text{Yield/vine (kg) x Vines/acre}}{\text{1000 kg}}$$

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Among the white wine varieties, Sauvignon Blanc consistently exhibited the highest pruned biomass during both years, indicating robust vine growth. Charak-1 showed the lowest pruning weight across the study period suggesting less vigorous growth compared to other varieties. During 2022-23 season, Sauvignon Blanc showed the highest weight of pruned biomass while during 2023-24 season, Riesling showed the highest weight of pruned biomass followed by Sauvignon Blanc. The difference in pruning weight among the varieties may be attributed to the difference in the vigour of vine resulting from assimilation of carbohydrates due to a greater number of canes, number of leaves produced and other growth parameters resulted in more dry matter production (Somkuwar et al., 2024b). A wide range of pruning weight was reported by several workers as 0.04 to 2.42 kg/vine (Kadu et al., 2007), 0.44 to 2.93 kg/vine (Havinal et al., 2008), 4.6 to 20.4 kg/vine (Shellie, 2007), 2.51 to11.09 t ha^{-1} (Karibasappa and Adsule, 2008), 0.91 to 3.78 kg/vine (Ratnacharyulu, 2010), 1.32 to 4.28 kg/vine (Jayalakshmi et al., 2019).

Charak-2 exhibited the quickest bud sprouting with a pooled mean of 8.50 days. While Muscat Petit, Chenin Blanc and Clairette all showed the slowest bud sprouting taking about 13.00 days on average across both years. This indicated a rapid initiation of growth cycle, which could be advantageous for regions with shorter growing seasons. The slower bud sprouting may suggest a more prolonged dormancy or slower transition into active growth. Bud burst is a varietal character as it marks the beginning of seasonal growth and is strongly influenced by temperature. The data on the growth parameter clearly indicated that prevailing temperature after pruning affects the time required for bud break in the same variety and the influence of temperature is more than that of variety (Somkuwar et al., 2024a). Similar studies were reported by Gupta et al., (2015).

The shoot length of white wine varieties varied from 66.34 cm to 106.66 cm with maximum shoot length in Sauvignon Blanc during 2023-24 and pooled mean while Chenin Blanc recorded maximum shoot length during season 2022-23. Shoot growth is heavily affected by factors such as temperature, soil moisture, the nutrient and reserve status of the grapevine, the level of pruning, the age of the plant, and the genetic traits of the rootstock or scion (Keller *et. al*., 2010 and Jayalakshmi et al., 2019). Similar results were found by Anupama et al., (2016) and Ingole et al., (2018).

Higher shoot diameter reported was recorded in Charak-2 during 2022-23 with highest in White Muscat variety during 2023-24. Differences in cane diameter may be influenced by the vine's vigor as well as its age (Somkuwar et al., 2010). It was obvious that the vigour of the individual shoot increased with the decreased canes per vine which could be attributed to diversion of more metabolites to the canes (Anupama et al., 2016). Similar observations were also reported by Pina and Bautists (2006), Havinal et al., (2008), Soni et al., (2019) and Nidhi et al., (2023). In a well-maintained vineyard, the vines with thicker canes and shorter internodes are known to bear a good crop as it is reflecting optimum vigour in the vines. More photosynthates were partitioned rigorously during peak vegetative phase. This might have deposited more food material (Chalak et al. 2012).

Chenin Blanc showed higher internodal length during season 2022-23 and pooled mean data while during 2nd year maximum internodal length was reported in Charak-2. Higher internodal length in Syrah may be due to more shoot length which increases internodal length in between cane. Mostly shorter internodes accumulate higher carbohydrates food reserves which are pre-requisite for flower bud initiation (Jayalakshmi et al., 2019; Somkuwar and Ramteke, 2008).

Among the white wine varieties, Sauvignon Blanc recorded the highest number of leaves per fruiting shoot during both season (2022-23 and 2023-24) and pooled mean while Marsanne remained the variety with the lowest number of leaves per shoot. Such variation among the white grape wine varieties for leaf number may be attributed to difference in number of canes and vigour of the vine and the inherent varietal character (Veena et al., 2015). Similar results were also reported by Anupama et al., (2016).

Table 1. Pruned biomass, days taken to bud sprout and shoot length data of white grape wine varieties during two growing seasons (2022-23 and 2023-24) and pooled mean data

Varieties	Pruned biomass (Kg)			Days taken to bud sprout			Shoot length (cm)		
	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean
White Muscat	0.478	0.582	0.530	12.67	11.50	12.09	85.44	96.34	90.89
Muscat Petit	0.607	0.602	0.605	13.00	13.00	13.00	94.14	102.98	98.56
Chenin Blanc	0.694	0.721	0.707	13.00	13.00	13.00	99.22	104.33	101.78
Riesling	0.747	0.821	0.784	9.50	10.00	9.75	98.68	105.20	101.94
Clairette	0.540	0.628	0.584	13.00	13.00	13.00	88.67	98.00	93.34
Charak-1	0.384	0.535	0.460	9.67	10.00	9.83	82.77	87.89	85.33
Charak-2	0.379	0.507	0.443	8.00	9.00	8.50	80.11	90.34	85.22
Charak-3	0.300	0.290	0.295	10.67	10.00	10.34	66.34	71.86	69.10
Charak-4	0.346	0.385	0.365	11.33	11.00	11.17	78.70	83.57	81.13
Trebbiano	0.319	0.323	0.321	9.67	10.00	9.83	69.34	79.78	74.56
Marsanne	0.509	0.476	0.493	9.67	10.00	9.84	81.48	90.06	85.77
Viognier	0.470	0.572	0.521	9.33	10.00	9.67	84.80	91.86	88.33
Vermentino	0.503	0.546	0.525	10.67	10.00	10.33	86.20	91.53	88.87
Gros Mesang	0.513	0.549	0.531	9.50	10.00	9.75	89.35	94.88	92.11
Colombard	0.621	0.678	0.650	9.67	10.00	9.83	97.65	103.02	100.33
Gewurztraminer	0.537	0.574	0.555	9.33	10.00	9.67	87.31	98.46	92.89
Sauvignon Blanc	0.939	0.766	0.853	9.67	10.00	9.83	98.45	106.66	102.56
S.Em. (±)	**0.023**	**0.021**	**0.013**	**0.311**	**0.301**	**0.271**	**3.700**	**3.221**	**2.405**
C.D. (0.05)	**0.065**	**0.060**	**0.037**	**0.895**	**0.868**	**0.780**	**10.660**	**9.279**	**6.927**

Table 2. Shoot diameter, internodal length and number of leaves per shoot data of white grape wine varieties during two growing seasons (2022-23 and 2023-24) and pooled mean data

Varieties	Shoot diameter (mm)			Internodal length (cm)			Number of leaves per shoot		
	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean
White Muscat	7.00	7.29	7.14	5.58	6.44	6.01	20.00	20.67	20.33
Muscat Petit	6.89	6.42	6.66	6.09	7.33	6.71	22.00	22.83	22.42
Chenin Blanc	7.33	6.72	7.03	6.58	7.89	7.23	23.00	24.67	23.83
Riesling	6.78	6.58	6.68	6.71	8.00	7.36	23.22	25.83	24.53
Clairette	5.89	5.28	5.59	6.06	6.89	6.47	21.44	21.50	21.47
Charak-1	6.22	5.95	6.09	4.85	6.00	5.42	19.00	19.67	19.34
Charak-2	8.89	7.00	7.94	4.82	5.89	5.36	18.89	19.33	19.11
Charak-3	8.11	6.17	7.14	3.98	5.00	4.49	15.44	18.67	17.06
Charak-4	7.55	6.84	7.20	4.80	5.88	5.34	18.55	19.17	18.86
Trebbiano	6.44	6.09	6.27	4.67	5.80	5.23	17.28	19.00	18.14
Marsanne	7.34	6.93	7.14	5.01	6.00	5.51	19.56	19.86	19.71
Viognier	5.00	5.58	5.29	5.09	6.20	5.64	19.72	20.33	20.03
Vermentino	6.44	5.84	6.14	5.32	6.22	5.77	19.83	20.50	20.17
Gros Mesang	5.80	6.03	5.92	5.93	6.71	6.32	20.33	20.83	20.58
Colombard	6.00	5.80	5.90	6.26	7.80	7.03	22.83	23.50	23.17
Gewurztraminer	5.89	5.49	5.69	6.03	6.78	6.41	21.11	21.18	21.15
Sauvignon Blanc	6.00	5.66	5.83	6.89	8.89	7.89	25.22	26.00	25.61
S.Em. (±)	**0.332**	**0.178**	**0.191**	**0.341**	**0.200**	**0.201**	**0.950**	**0.734**	**0.580**
C.D. (0.05)	**0.957**	**0.513**	**0.551**	**0.983**	**0.575**	**0.580**	**2.738**	**2.115**	**1.672**

Table 3. Leaf area per leaf, leaf area per fruiting shoot and cane chlorophyll content of white grape wine varieties during two growing seasons (2022-23 and 2023-24) and pooled mean data

Varieties	Leaf area per leaf			Leaf area per fruiting shoot			Chlorophyll content (mg/ml)		
	2022-23	**2023-24**	**Pooled Mean**	**2022-23**	**2023-24**	**Pooled Mean**	**2022-23**	**2023-24**	**Pooled Mean**
White Muscat	96.61	83.59	90.10	1953.52	1726.44	1839.98	22.10	23.95	23.03
Muscat Petit	152.91	147.32	150.12	3359.65	3362.01	3360.83	20.72	23.84	22.28
Chenin Blanc	97.55	72.26	84.90	2244.88	1778.29	2011.59	11.66	12.38	12.02
Riesling	137.63	150.28	143.96	3198.63	3865.92	3532.27	8.91	10.05	9.48
Clairette	131.36	120.60	125.98	2817.34	2597.78	2707.56	7.72	8.70	8.21
Charak-1	97.48	95.86	96.67	1854.55	1887.58	1871.06	12.43	13.47	12.95
Charak-2	119.10	104.65	111.87	2248.83	2023.03	2135.93	9.73	11.19	10.46
Charak-3	135.77	148.37	142.07	2096.10	2772.86	2434.48	7.55	8.02	7.79
Charak-4	94.04	109.15	101.60	1745.40	2092.88	1919.14	8.87	9.81	9.34
Trebbiano	137.97	120.06	129.01	2383.30	2287.29	2335.29	7.40	7.86	7.63
Marsanne	87.72	92.42	90.07	1714.97	1835.83	1775.40	8.45	9.53	8.99
Viognier	56.55	66.47	61.51	1116.73	1348.10	1232.41	9.46	10.88	10.17
Vermentino	111.96	92.49	102.23	2223.68	1900.40	2062.04	12.99	14.07	13.53
Gros Mesang	91.28	98.19	94.74	1857.80	2044.07	1950.93	13.41	14.82	14.12
Colombard	107.08	70.43	88.75	2447.63	1661.05	2054.34	17.21	19.80	18.51
Gewurztraminer	57.12	50.77	53.94	1204.52	1073.59	1139.05	14.84	15.76	15.30
Sauvignon Blanc	83.30	81.91	82.60	2101.43	2126.64	2114.03	9.35	10.33	9.84
S.Em. (±)	**2.986**	**3.808**	**2.409**	**142.059**	**92.281**	**86.438**	**0.368**	**0.448**	**0.300**
C.D. (0.05)	**8.603**	**10.970**	**6.940**	**409.225**	**265.831**	**248.997**	**1.061**	**1.291**	**0.864**

Table 4. Number of bunches per vine, number of berries per bunch and Average bunch weight of white grape wine varieties during two growing seasons (2022-23 and 2023-24) and pooled mean data

Varieties	Number of bunches per vine			Number of berries per bunch			Average bunch weight (g)		
	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean
White Muscat	31.83	27.00	29.42	135.33	133.33	134.33	146.49	148.87	147.68
Muscat Petit	21.50	22.67	22.08	134.67	136.50	135.59	225.84	227.12	226.48
Chenin Blanc	51.50	49.30	50.40	134.00	130.00	132.00	156.35	152.81	154.58
Riesling	36.50	40.92	38.71	102.00	97.83	99.92	185.24	186.70	185.97
Clairette	33.00	35.33	34.17	74.67	77.33	76.00	93.06	93.02	93.04
Charak-1	33.50	35.00	34.25	107.00	104.33	105.67	173.06	172.88	172.97
Charak-2	49.50	47.84	48.67	102.33	102.00	102.17	159.49	160.60	160.05
Charak-3	43.33	46.00	44.67	116.67	110.17	113.42	164.42	161.34	162.88
Charak-4	30.50	34.33	32.42	109.89	102.00	105.95	134.16	134.69	134.42
Trebbiano	27.33	27.50	27.42	155.11	160.00	157.56	200.03	202.00	201.02
Marsanne	49.33	43.67	46.50	139.78	135.20	137.49	182.21	184.18	183.20
Viognier	40.83	45.33	43.08	150.22	151.00	150.61	134.63	136.07	135.35
Vermentino	41.17	39.75	40.46	83.84	77.33	80.59	133.04	131.11	132.07
Gros Mesang	19.00	17.33	18.17	122.44	117.67	120.06	152.92	150.72	151.82
Colombard	52.17	49.00	50.58	115.33	113.33	114.33	147.69	150.66	149.18
Gewurztraminer	39.50	38.00	38.75	91.00	89.28	90.14	83.47	84.78	84.13
Sauvignon Blanc	58.67	62.33	60.50	141.67	137.33	139.50	129.83	131.07	130.45
S.Em. (±)	**3.483**	**2.039**	**1.692**	**6.067**	**2.829**	**3.588**	**5.381**	**4.742**	**3.405**
C.D. (0.05)	**7.094**	**4.153**	**3.447**	**17.477**	**8.150**	**10.337**	**15.500**	**13.659**	**9.809**

Table 5.100 berry weight, yield/vine and yield/acre of white grape wine varieties during two growing seasons (2022-23 and 2023-24) and pooled mean data

Varieties	100 berry weight (g)			Yield/vine (Kg)			Yield/acre (MT)		
	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean	2022-23	2023-24	Pooled Mean
White Muscat	108.65	111.69	110.17	4.67	4.02	4.35	5.66	4.87	5.26
Muscat Petit	168.93	166.59	167.76	4.85	5.16	5.00	5.87	6.24	6.06
Chenin Blanc	117.59	117.55	117.57	8.05	7.54	7.80	9.74	9.12	9.43
Riesling	182.43	191.18	186.80	6.76	7.66	7.21	8.18	9.27	8.72
Clairette	124.60	120.96	122.78	3.07	3.29	3.18	3.71	3.98	3.85
Charak-1	161.88	165.92	163.90	5.80	6.04	5.92	7.02	7.31	7.16
Charak-2	156.03	157.53	156.78	7.89	7.66	7.77	9.55	9.27	9.41
Charak-3	141.22	146.27	143.75	7.10	7.44	7.27	8.59	9.00	8.80
Charak-4	123.34	132.05	127.69	4.11	4.63	4.37	4.97	5.61	5.29
Trebbiano	129.06	126.38	127.72	5.41	5.55	5.48	6.55	6.72	6.63
Marsanne	130.38	136.63	133.51	9.02	8.04	8.53	10.92	9.73	10.32
Viognier	90.18	90.17	90.18	5.50	6.16	5.83	6.66	7.46	7.06
Vermentino	158.50	169.62	164.06	5.50	5.21	5.36	6.65	6.31	6.48
Gros Mesang	125.09	128.20	126.65	2.89	2.61	2.75	3.49	3.16	3.33
Colombard	131.09	134.04	132.57	7.72	7.38	7.55	9.35	8.93	9.14
Gewurztraminer	91.86	95.64	93.75	3.29	3.22	3.26	3.98	3.90	3.94
Sauvignon Blanc	91.68	95.51	93.59	7.62	8.16	7.89	9.22	9.88	9.55
S.Em. (±)	**7.841**	**5.075**	**4.081**	**0.449**	**0.307**	**0.242**	**0.543**	**0.371**	**0.293**
C.D. (0.05)	**22.587**	**14.620**	**13.829**	**1.294**	**0.884**	**0.698**	**1.565**	**1.070**	**0.845**

Among the white wine varieties, Muscat Petit had the largest leaf area per fruiting shoot during 2022-23 season. During 2023-24 season and pooled mean data, Riesling led with the highest leaf area per fruiting shoot. The increase in leaf area per shoot and vine with more leaves was due to the direct correlation between the number of leaves and the overall vegetative growth of the vine. However, decrease in leaf area per leaf showed limited resource distribution or reduce efficiency as the leaf number increased (Somkuwar et al., 2024c, 2024d). Leaf area is strongly correlated with the annual shoots and cane growth; the most vigorous varieties usually have the highest annual growth (Borca et al., 2020). The optimum leaf number enhanced the overall leaf area, potentially contributing to higher photosynthetic capacity (source) and resource distribution (sink) for grape development (Somkuwar et al., 2024e and Thoke et al., 2024).

The variety White Muscat had highest average chlorophyll content followed by Muscat Petit. The chlorophyll content in leaf gives an indication of the efficiency of leaf to prepare food through photosynthesis (Somkuwar et al., 2024d). The results of the present study confirm the earlier results of Somkuwar et al., (2024c) that the chlorophyll content in leaf ranged from 29.15 to 25.30 mg/ml among the treatments and 21.35 mg/ml to 19.14 mg/ml. More leaves can increase overall photosynthetic capacity. There may be an optimum leaf number beyond which chlorophyll content per leaf might begin to decrease. Maintaining an appropriate number of leaves can produce maximum chlorophyll content and photosynthetic efficiency without any negative effect (Somkuwar et al., 2024d). Petrie et al., (2000) and Somkuwar et al., (2014b) observed that leaf removal led to an increase of chlorophyll content.

3.2 Yield Parameters

Sauvignon Blanc recorded the highest number of bunches per vine during both seasons (2022-23 and 2023-24). This difference in the number of bunches per vine may be attributed to varietal character due to a greater number of canes or immaturity of canes in different varieties. The increased number of bunches per vine increases the grape yield per vine with an increment in carbohydrate content in the berries to the maximum extent (Somkuwar et al., 2013 and Veena et al., 2015). Similar line of work in grapes was reported by Havinal (2007) and Jayalakshmi et al., (2019) Somkuwar et al., (2024b).

The variety Trebbiano exhibited maximum average number of berries per bunch during both season (2022-23 and 2023-24). With the reduction in number of berries per bunch, there was increased berry length and diameter due to efficient utilization of nutrients into fruiting. Somkuwar et al., (2024b) reported maximum number of berries per bunch in Gross Mesang (127.22). In the present study, minimum number of berries per bunch was recorded in Riesling (71.59). Similar line of findings was earlier reported by Havinal et al., (2008); Tecchio et al., (2022).

The variety Muscat Petit had the highest average bunch weight, making it consistently heavy fruit bearer among the varieties studied. On the lower end, Gewurztraminer reported the lightest bunch. Similar line of work was reported earlier by Havinal et al., (2008); Anupama et al., (2016); Jayalakshmi et al., (2019) and Somkuwar et al., (2024b). Similar line of work was done earlier by Leao et al., (2017); Ingole et al., (2018).

The varietyRiesling consistently had the highest berry weight, making it the variety with the most substantial berries while, Viognier had the lowest berry weight, indicating consistently smaller berries. The variation in the berry weight might be due to the difference in diameter and length of berries as was reported by Richard et al. (1999).The variation in berry weight may arise from differences in both the diameter of the berries and the number of berries/bunch (Thakur et al., 2008).

The maximum yield was recorded in variety Marsanne (8.53 kg/vine) while minimum in Gros Mesang (2.75 kg/vine). Wide range of yield among different varieties of grape screened at different location has been reported from India and abroad (Shellie 2007; Ghosh et al. 2008; Karibasappa and Adsule 2008; Havinal et al. 2008 and Ratnacharyulu 2010) which support the results of the present study. Similar line of work is reported by Somkuwar et al. (2024a, 2024b), Tecchio et al., (2022); Anjanawe et al., (2020); Ingole et al. (2018); Vijaya et al., (2018); Leao et al., (2017); Veena et al. (2015). In contrast, Anupama et al., (2016) found that the maximum yield was recorded in Tempranillo (27.40 kg/vine), followed by Grenache Blanc (24.33 kg/vine) while the minimum yield was recorded in Tsimlyansk Charny (7.50 kg/vine) which was on par with Sauvignon Blanc (8.03 kg/vine).

4. CONCLUSION

The evaluation of growth and yield parameters of different white wine grape varieties over the 2022-23 and 2023-24 seasons revealed significant varietal differences. Sauvignon Blanc stood out among white wine varieties, showing superior growth parameters like pruned biomass, shoot length, number of leaves and yield parameter like number of bunches per vine. Minimum days taken to bud sprout; higher shoot diameter was recorded in Charak-2. Higher internodal length was observed in Chenin Blanc. Higher leaf area recorded in Riesling and Muscat Petit varieties. Higher number of berries per bunch recorded in Trebbiano. Varieties such as Muscat Petit excelled in yield-related metrics like bunch weight and 100 berry weight. Higher yield was observed in Marsanne. These findings underscore the varietal adaptability and potential for different wine profiles based on growth conditions and seasons, providing valuable insights for viticulture practices aimed at optimizing grape yield and wine quality.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Anjanawe, S. R., Naruka, I. S., Sharma, A., & Mishra, P. (2020). Evaluation of wine purpose varieties of grapes under the environmental condition of Malwa Plateau. *Current Journal of Applied Science and Technology, 39*(43), 98-107.

Anupama, H., Hipparagi, K., Rani, S., Ravindranath, & Balesh G. (2016). Evaluation of wine grape varieties for growth and yield under northern dry zone of Karnataka. *International Journal of Scientific Research, 5*(2), 409-411.

Ausari, P. K., Gurjar, P. K. S., Somkuwar, R. G., Naruka, I. S., Sharma, A. K., & Gharate, P. S. (2024). Effect of rootstocks on yield and wine quality of *Sauvignon Blanc* variety. *Plant Archives, 24*(1), 1477-1482.

Avram, V., Voica, C., Hosu, A., Cimpoiu, C., & Marutoiu, C. (2014). ICP-MS characterization of some Romanian white wines by their mineral content. *Revue Roumaine de Chimie, 59*(11-12), 1009-1019.

Bora, F. D., Bunea, C. I., Rusu, T., & Pop, N. (2015). Vertical distribution and analysis of micro, macroelements and heavy metals in the system soil-grapevine-wine in vineyard from North-West Romania. *Chemistry Central Journal, 9*(1), 19.

Bora, F. D., Donici, A., Oslobanu, A., Fitiu, A., Babes, A. C., & Bunea, C. I. (2016). Qualitative assessment of the white wine varieties grown in Dealu Bujorului vineyards, Romania. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 44*(2), 593-602.

Borca, F., Roxana, N., Alina, D., Eleonora, N., & Dobrei, A. (2020). The anthropogenic influence of soil management on grape yield and economic parameters in grapevine growing. *Journal of Horticulture, Forestry and Biotechnology, 24*(4), 58-65.

Burg, P., Burgova, J., Masan, V., & Vachun, M. (2017). Leaf surface area estimation in different grape varieties using an AM-300 leaf area meter. In *International scientific conference Rural Development 2017* (pp. 24-30).

Chalak, S. U., Kulkarn, S. S., Kishrsagar, A. V., & Nimbalkar, C. A. (2012). Pruning studies in some white wine grape varieties for yield and yield contributing parameters under Western Maharashtra conditions. *Asian Journal of Horticulture, 7*(2), 1468-1472.

Condurso, C., Cioncatta, F., Tripodi, G., Sparacio, A., Giglio, D. M. F., Sparla, S., & Verzera, A. (2015). Effects of cluster thinning on wine quality of *Syrah* cultivar (*Vitis vinifera* L.). *European Food Research and Technology, 246*(10), 1719-1726.

Ghosh, S. N., Bera, B., Roy, S., & Kundu, A. (2012). Adaptation and commercialization of viticulture in West Bengal - a new area in India. *Acta Horticulturae, 931*, 389-399.

Ghule, V. S., Ranpise, S. A., Somkuwar, R. G., Kulkarni, S. S., Wagh, R. S., Naik, R. M., &

Nimbalkar, C. A. (2021). Effect of rootstocks on growth parameters of *red globe* grapevines (*Vitis vinifera* L.). *International Journal of Chemical Studies, 9*(1), 3483-3487.

Gupta, N., Gill, K. K., Babuta, R., Gill, M., & Arora, N. K. (2015). Thermal requirement and phenological development of different grape varieties under South Western Punjab. *Annals of Agricultural Research, 36*(4), 377-383.

Havinal, M. N., Tambe, T. B., & Patil, S. P. (2008). Comparative studies on vine vigour and fruitfulness of grape wine varieties. *Asian Journal of Horticulture, 3*(1), 180-182.

Huang, H., & Lu, J. (2000). Variation and correlation of bud breaking, flower opening and fruit ripening in Muscadine grape cultivars. *Proceedings of the Florida State Horticultural Society, 113*, 46-47.

Ingole, R. H., Tambe, T. B., & Bobade, D. H. (2018). Influences of various rootstocks on yield and quality of wine grape varieties (*Vitis vinifera* L). *Journal of Pharmacognosy and Phytochemistry, 7*(2), 2466-2468.

International Organisation of Vine and Wine - OIV. (2023). Standards and technical documents. Available at: https://www.oiv.int/what-we-do/standards (Accessed April 20, 2024).

Jayalakshmi, C., Saraswathy, S., Subbiah, A., Ilamurugu, K., & Balachandar, D. (2019). Evaluation of wine varieties of grapes (*Vitis vinifera* L.) during winter pruning under Cumbum valley condition of Tamil Nadu. *Journal of Pharmacognosy and Phytochemistry, 8*(3), 3770-3773.

Jones, G. V., & Goodrich, G. B. (2008). Influence of climate variability on wine regions in the western USA and on wine quality in the Napa Valley. *Climate Research, 35*(3), 241-254.

Jones, J. E., Kerslake, F. L., Close, D. C., & Dambergs, R. G. (2014). Viticulture for sparkling wine production: A review. *American Journal of Enology and Viticulture, 65*, 407-416.

Kadu, S. Y., Tambe, T. B., & Patil, S. P. (2007). Studies on leaf morphology and vine vigour of various grape wine varieties. *Asian Journal of Horticulture, 2*(1), 131-134.

Karatas, D., Aydin, F., Aydin, I., & Karatas, H. (2015). Elemental composition of red wines in Southern Turkey. *Czech Journal of Food Sciences, 33*(3), 228-236.

Karibasappa, G. S. (2013). Manual and good agricultural practices for quality wine production. *Indian Council of Agricultural Research*, 5-16.

Karibasappa, G. S., & Adsule, P. G. (2008). Evaluation of wine grape genotypes by National Research Center for Grapes at their farm at Pune, Maharashtra (India). *Acta Horticulturae, 785*, 497-504.

Keller, M. (2010). *The science of grapevines: Anatomy and physiology*.

Lavras, M. G. (2017). *Planting density for Chardonnay grapevines in the South of Minas Gerais* (M.Sc. Thesis). Luciana Wilhelm De Almeida.

Leao, P. C. de Souza, Nunes, B. T. G., Carvalho de Souza, E. M., Rego, J. I. de Souza, & Bernardino do Nascimento, J. H. (2017). Evaluation of some new wine grape cultivars under Sao Francisco Valley conditions. *Journal of Agricultural Science and Technology, B(7)*, 320-325.

McGovern, P. E. (2003). *Ancient wine: The search for the origins of viniculture* (PDF). Princeton University Press.

Myers, J. K., Wolpert, J. A., & Howell, G. S. (2008). Effect of shoot number on the leaf area and crop weight relationship of young *Sangiovese* grapevines. *American Journal of Enology and Viticulture, 59*(4), 422-424. https://doi.org/10.5344/ajev.2008.59.4.422

Patel, N., Soni, N., Ausari, P. K., Meena, K. C., Patidar, B. K., Patidar, D., Haldar, A., & Thakur, R. (2023). Evaluation of different wine varieties of grapes grafted on *Dogridge* rootstocks. *Biological Forum - An International Journal, 15*(8a), 521-525.

Petrie, P. R., Trought, M. T., & Howell, G. S. (2000). Influence of leaf ageing, leaf area and crop load on photosynthesis, stomatal conductance and senescence of grapevine (*Vitis vinifera* L. cv. Pinot noir) leaves. *Vitis*, 39(1), 31-36.

Pina, S., & Bautista, D. (2006). Evaluation of vegetative growth on several table grape cultivars under semiarid tropic conditions in Venezuela. *Magazine of the Faculty of Agronomy of the University of Zulia*, 23, 402-413.

Ratnacharyulu, S. V. (2010). *Evaluation of coloured grapes varieties for yield, juice recovery and quality* (M.Sc. thesis). Grapes Research Station, Andhra Pradesh Horticultural University, Rajendranagar, Hyderabad, A. P.

Satisha, J., Somkuwar, R. G., Sharma, J., Upadhyay, A. K., & Adsule, P. G. (2010). Influence of rootstocks on growth yield and fruit composition of Thompson Seedless grapes grown in the Pune region of India. *South African Journal of Enology and Viticulture*, 31, 1-8.

Shellie, K. C. (2007). Viticultural performance of red and white wine grape cultivars in Southwest Idaho. *HortTechnology*, 17(4), 595-603.

Somkuwar, R. G., & Ramteke, S. D. (2008). Effect of shoot orientation on growth, biochemical changes and fruitfulness in grape (*Vitis vinifera* L.) variety Thompson Seedless. *Journal of Plant Sciences*, 3(2), 182-187.

Somkuwar, R. G., Bahetwar, A., Khan, I., Satisha, J., Ramteke, S. D., Itroutwar, P., Bhongale, A., & Oulkar, D. (2014b). Changes in growth, photosynthetic activities, biochemical parameters and amino acid profile of Thompson Seedless grapes (*Vitis vinifera* L.). *Journal of Environmental Biology*, 35(6), 1157.

Somkuwar, R. G., Bhor, V. A., Ghule, V. S., Hakale, D. P., Shabeer, A., & Sharma, A. K. (2021). Rootstock affects stress relieving enzymatic activity during bud break in 'Red Globe' grapevine under semi-arid condition. *Vitis*, 60, 93-99.

Somkuwar, R. G., Hakale, D. P., & Sharma, A. K. (2019). Studies on biochemical composition of different parts of berries and wine quality of wine grape varieties (*Vitis vinifera* L.). *International Journal of Current Microbiology and Applied Sciences*, 8(3), 155-164. https://doi.org/10.20546/ijcmas.2019.803.022

Somkuwar, R. G., Kakade, P. B., Dhemre, J. K., Gharate, P. S., Deshmukh, N. A., & Nikumbhe, P. H. (2024c). Leaf area influences photosynthetic activities, raisin yield and quality in Manjari Kishmish grape variety. *Archives of Current Research International*, 24(6), 613-622.

Somkuwar, R. G., Kakade, P. B., Dhemre, J. K., Thutte, A. S., Nikumbhe, P. H., & Deshmukh, N. A. (2024d). Leaf retention affects photosynthetic activity, leaf area index, yield and quality of Crimson Seedless grapes. *Journal of Advances in Biology & Biotechnology*, 27(9), 123-130.

Somkuwar, R. G., Kakade, P. B., Jadhav, A. S., Ausari, P. K., Nikumbhe, P. H., & Deshmukh, N. A. (2024e). Leaf area index, photosynthesis and chlorophyll content influences yield and quality of Nanasaheb Purple Seedless grapes under semi-arid condition. *Journal of Scientific Research and Reports*, 30(9), 750-758.

Somkuwar, R. G., Satisha, J., & Ramteke, S. D. (2013). Berry weight, quality and cane biochemistry changes in relation to cane thickness of own-rooted and grafted 'Tas-A-Ganesh' grape. *Journal of Horticultural Science*, 8(1), 30-34.

Somkuwar, R. G., Satisha, J., Bondge, D. D., & Itroutwar, P. (2013). Effect of bunch load on yield, quality and biochemical changes in Sharad Seedless grapes grafted on Dogridge rootstock. *International Journal of Biology, Pharmacy and Allied Sciences*, 2(6), 1226-1236.

Somkuwar, R. G., Sharma, A. K., Nilima, G., & Ausari, P. K. (2024a). Performance of red wine varieties under Pune region of Maharashtra. *International Journal of Advanced Biochemistry Research*, 8(5), 981-988.

Somkuwar, R. G., Sharma, A. K., Nilima, G., & Ausari, P. K. (2024b). Evaluation of white wine varieties for growth, yield, berry and wine quality under Pune region of Maharashtra, India. *Pant Archives*, 24(2), XX-XX.

Soni, N., Patil, P., Meena, K. C., Haldar, A., Patidar, D. K., & Tiwari, R. (2019). Evaluation of different colored varieties of grapes under nontraditional area of Malwa Plateau: A thin line tool for doubling the farmer income. *International Journal of Current Microbiology and Applied Sciences*, 8(3), 1968-1976. https://doi.org/10.20546/ijcmas.2019.803.234

Tecchio, M. A., Silva, M. J. R., Sanchez, C. A. P. C., Callili, D., Vedoato, B. T. F., Hernandes, J. L., & Moura, M. F. (2022). Yield performance and quality of wine grapes (*Vitis vinifera*) grafted onto different rootstocks under subtropical conditions. *Bragantia*, 81, e1622. https://doi.org/10.1590/1678-4499.20210214

Thakur, A., Arora, N. K., & Singh, S. P. (2008). Evaluation of some grape varieties in the arid irrigated region of North West India. *Acta Horticulturae*, 785, 79-83.

Thoke, S., Patil, S. N., Gollagi, S. G., Hipparagi, K., Hiremath, V., Peerajade, D., & Kore, D. (2024). Evaluation of different table grape varieties in response to growth and physiological traits during foundation bud pruning. *Journal of Agriculture of Experimental International*, 46(2), 126-140.

Veena, J., Kumar, V., Debnath, M., Pattanashetti, S., Variath, M. T., & Khadakabhavi, S. (2015). Multivariate analysis of colored and white grape grown under semi-arid tropical conditions of Peninsular India. *International Journal of Agriculture and Crop Sciences*, 8(3), 350-365.

Vijaya, D., Reddy, G. R., Joshi, V., Mamatha, & Kumari, D. A. (2018). Evaluation of juice and wine varieties of grapes (*Vitis* spp) for petiole nutrient content, bud break, yield and yield components. *International Journal of Chemical Studies*, 6(6), 2739-2745.

Witham, F. H., Blaydes, D. F., & Devlin, R. M. (1971). *Experiments in plant physiology*. Litton Educational Publishing Inc. D. Van Nostrand Company. New York.

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