Plant Archives Vol. 24, No. 1, 2024 pp. 779-786 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.1.107

PERFORMANCE OF DIFFERENT TABLE GRAPE VARIETIES FOR YIELD AND YIELD ATTRIBUTING TRAITS

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(Date of Receiving-16-12-2023; Date of Acceptance-25-02-2024)

ABSTRACT

Grape (*Vitis vinifera* L.) is traditionally, a temperate region crop and in India it is mainly grown in tropical belts, which face many challenges related to varietal adaptability, climate resilience, water scarcity, incidence of insect/diseases, implementation of good agricultural practices in line of international trade and phytosanitary issues etc. The present study 'Performance of different table grape varieties for yield and yield attributing traits' emphasized important traits of yieldin different table grape varieties over a two year of experimentation (2021-22 and 2022-23) at Horticulture Research and Extension Centre, Tidagundi (Vijayapur), Karnataka, India. The experiment consisted of 10 treatments laid out in randomized block design with 4 replications. The results depicted the variety 2A-Clone recorded the maximum number of panicles per cane (1.18). Fantasy Seedless (87.72) took the minimum number days for veraison and highest bunch length (20.68 cm). Nanasaheb Purple Seedless took the minimum number days from pruning to harvest (116.85) and minimum number of days taken to achieve18^0 brix (112.29). The highest 100 berries weight (491.82 g), maximum berry length (21.07 mm), highest bunch width (14.89 cm), maximum berry diameter (24.41 mm), highest bunch weight (469.47 g) and highest B: C ratio (3.91) was obtained in Red Globe. The maximum number of berries per bunch (150.65) was noted in Merbein Seedless. Thompson Seedless recorded the maximum number of bunches (51.19) and the highest yield (14.80 kg/vine and 32.22 t/ha).

Key words : Table grapes, Number of bunches per vine, Bunch weight, Yield.

Introduction

Due to change in the consumption pattern of the people resulted in the reduced per capita demand for food grains. Hence, there is an increased demand for consumption of fresh fruits is being popular. Grape L (*Vitis vinifera*) is one of the most delicious and refreshing fruit among the different commercial fruits, which is good source of vitamins, minerals and antioxidants. Grape is consumed as a table, raisin and processed in to wines and juices. In India, grape cultivation increasing yearly due to great demand in the domestic as well as in the international market, at present grape is cultivated with an area of 139 thousand ha with production of 2920 thousand MT (Anon., 2018). Among the white seedless varieties, Thompson Seedless and its clones (Tas- A-Ganesh, Sonaka Seedless, Manik Chaman and 2A Clone)

are being cultivated in more than 60 per cent of the area whereas, there is increasing demand for coloured varieties too. About 65% of the European market demand is for coloured grapes, while more than 90% of India's grape export constitutes white grapes. Getting good coloured varieties can help India to get a bigger share of the international market. Maharashtra is the leading state for grape cultivation followed by Karnataka.

Grape cultivation is one of the remunerative enterprises in horticulture sector. Large number of varieties are grown from tropical to temperate region. However, the yield may differ with variety and location, but there is huge domestic and international demand for grapes and its byproducts. The increasing exports also boosting the grape economy in India. Therefore, there is need to make a rational structure in right direction, which can help grape growers by giving inputs in the form of new varieties and technologies, which will make grape farming a profitable venture.There is a lot of scope for high yielding table grape varieties. Hence, the present study was conducted to evaluate 10 table grape varieties to identify suitable high yielding table grape variety for Northern dry zone of Karnataka.

Materials and Methods

The present investigation on "Performance of different table grape varieties for yield and yield attributing traits" was carried out during 2021-22 and 2022-2023 in the grape vineyard, Horticultural Research and Extension Centre, Tidagundi, Vijayapur district. The research centre is situated at Vijayapur (Tidagundi), which comes under Northern dry zone of Karnataka. It is geographically located at a latitude of 16^0 49′ North and longitude 75^0 43′ East. Soils are medium black colour and shallow in depth. The pH of the soil range between 7.5 to 8.5. The average annual temperature is 26.5°C and an average rainfall is 590 mm.

No. of treatments	:	10
No. of replications	:	4
No. of vines/ treatment	:	6
Spacing	:	2.74m × 1.52m
Design	:	RBD

Treatment details

Number of varieties: 10

V_1 : Red Globe
V_2 : Fantasy Seedless
V_3 : Crimson Seedless
V_4 : Manjari Shyama (A-18/3)
V_5 : Nanasaheb Purple Seedless
V_6 : Sharad Seedless (Check)
V_7 : Merbein Seedless
V_8 : 2A-Clone
V_9 : Manjari Kishmish (Kishmish Rozavis White)
V_{10} : Thompson Seedless (Check)

Gas exchange parameters

Using an Infrared gas analyzer (IRGA-LICOR6400; LI-6400) instrument, various parameters such as photosynthetic rate (µmol m^{-2} s^{-1}), transpiration rate (mmol m^{-2} s^{-1}), stomatal conductance (mmol m^{-2} s^{-1}) and leaf temperature (°C) were measured.

Number of panicles/vine

In each treatment, the number of panicles per vine was counted and expressed in number.

Days taken to veraison (Number)

Number of days taken for veraison was determined by counting the total number days from fore pruning to veraison stage.

Days taken from pruning to harvest of the bunches

The total number of days taken were counted from fore pruning to harvesting of the bunches and expressed as average number of days.

Days taken to achieve 18 °B

Counting the days taken from fore pruning to berries achieving 18ºB was recorded.

Number of bunches per vine

The number of bunches per vine was counted and recorded as average number of bunches.

Berry weight (g)

The 100 berries weight was measured by randomly selecting the 100 berries from each of the five bunches from each replication in a treatment were weighed and their mean weight is expressed in terms of gram.

Number of berries/ bunch

By counting all the berries in each randomly chosen bunch for each treatment, the average number of berries was calculated.

Bunch length (cm)

From the bunch's base to its tip, the bunch's length was measured. In order to calculate the mean bunch length, the length of five bunches was averaged at harvest. The resultant mean bunch length was stated in centimeters (cm).

Bunch width (cm)

The width of bunch was measured from left end of the bunch to right side end of the bunch. The mean width of bunch was obtained by averaging the width of five bunches at harvest and used for determining the mean of bunch width and was expressed in centimetre (cm).

Bunch weight (g)

Five bunches were summed up in weight during harvest to determine the mean weight of the bunch, which was then expressed in grams.

Berry length (mm)

From each replication in a treatment, the randomly chosen berries from five different bunches are scaled using digital vernier callipers and there mean is depicted in millimeters (mm) as berry length.

Berry diameter (mm)

Using digital vernier callipers the same berries which were used for measuring length at its maximum width, the mean berry diameter was expressed in terms of millimetre (mm).

Yield (kg/vine)

To calculate the yield per vine, the mean bunch weight was multiplied by the average number of bunches per vine. Which was expressed in kilogram (kg).

Yield (t/ha)

The estimated yield/ha was calculated by multiplying the total number of vines per hectare by the yield (kg/ vine) and the result was expressed in tones.

Results and Discussion

The maximum photosynthetic rate (15.92 µmol m^{-2} s^{-1}), transpiration rate (6.08 m mol m^{-2} s^{-1}) stomatal conductance (253.47 m mol m^{-2} s^{-1}) was recorded in Manjari Kishmish and the minimum photosynthetic rate (10.81 µmol m^{-2} s^{-1}), transpiration rate (3.80 m mol m^{-2} s^{-1}) and stomatal conductance (130.47 m mol m^{-2} s^{-1}) was exhibited in Nanasaheb Purple Seedless (Table 1). Whereas, Thompson Seedless (33.47°C) recorded maximum leaf temperature and the minimum leaf temperature (32.18°C) was recorded in Red Globe. In essence, these gas exchange parameters are basically Physiological, genetically and environment dependent. Different table grape varieties possess distinct genetic traits which support their photosynthetic and transpiration process, which further these traits also contribute to variation in the chlorophyll content, stomatal density and leaf structure which impact on photosynthetic and transpiration rate. In addition to this some varieties like Thompson Seedless which is having flexible stomata allowing higher conductance and elevated transpiration rate, again this variation is largely environment dependent, Leaf characteristics and water use efficiency of the variety. These results are in close conformity with the findings of Bota *et al*. (2001), Kellar (2010), Schultz and Stoll (2010).

2A-Clone exhibited the maximum number of panicles per cane (1.18). Whereas, Nanasaheb Purple Seedless had less number of panicles per cane (0.50). Fantasy Seedless took the minimum number of days for veraison

Table 1 : Photosynthetic rate, transpiration rate, stomatal conductance and leaf temperature in different table grape varieties.

Treatment	Photosynthetic rate (µmol m^{-2} s^{-1})	Transpiration Rate (m mol m^{-2} s^{-1})	Stomatal Conductance (m mol m^{-2} s^{-1})	Leaf temperature (°C)
V_1	12.43	4.21	155.19	32.18
V_2	12.58	4.28	147.10	32.53
V_3	11.17	4.23	150.35	32.65
V_4	11.52	4.51	159.97	32.73
V_5	10.81	3.80	130.47	33.14
V_6	13.77	5.13	185.78	32.89
V_7	11.60	4.95	183.62	33.33
V_8	14.28	5.63	229.21	33.04
V_9	15.92	6.08	253.47	32.85
V_{10}	11.75	4.66	169.45	33.47
S.Em ±	0.55	0.29	13.37	0.09
CD at 5%	1.61	0.85	38.79	0.27

V_1 - Red Globe
V_2 - Fantasy Seedless
V_3 - Crimson Seedless
V_4 - Manjari Shyama (A-18/3)
V_5 - Nanasaheb Purple Seedless
V_6 - Sharad Seedless (Check)
V_7 - Merbein Seedless
V_8 - 2A-Clone
V_9–Manjari Kishmish (Kishmish Rozavis White)
V_{10} - Thompson Seedless (Check)

Table 2 : Number of panicles per cane, days to veraison, days taken from pruning to harvest and days taken to achieve 18°brix in different table grape varieties.

Treatment	No of panicles/cane			Days to veraison			Days taken from pruning to harvest			Days taken to achieve 18°brix		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_1	0.70	0.89	0.79	94.79	95.29	95.04	134.75	137.79	136.27	129.38	133.33	131.35
V_2	1.02	0.81	0.92	86.31	89.13	87.72	123.04	124.08	123.56	115.29	118.04	116.67
V_3	0.88	0.91	0.90	88.81	92.50	90.66	133.29	135.92	134.61	127.17	128.79	127.98
V_4	0.99	1.06	1.02	90.31	88.38	89.34	119.25	119.63	119.44	112.08	113.71	112.90
V_5	0.50	0.51	0.50	86.88	90.04	88.46	118.33	115.38	116.85	111.96	112.63	112.29
V_6	0.88	0.94	0.91	94.06	92.29	93.18	122.00	125.08	123.54	116.25	116.54	116.40
V_7	1.19	1.12	1.16	92.08	94.04	93.06	123.04	123.79	123.42	116.38	116.92	116.65
V_8	1.25	1.11	1.18	93.92	91.79	92.85	123.83	123.58	123.71	117.17	116.67	116.92
V_9	1.19	1.01	1.10	93.75	95.08	94.42	123.58	122.79	123.19	115.17	114.58	114.87
V_{10}	1.14	1.00	1.07	95.54	95.69	95.61	123.50	125.13	124.31	117.67	119.04	118.36
S.Em ±	0.11	0.10	0.10	1.64	1.46	1.33	1.64	1.74	1.29	1.88	1.74	1.72
CD at 5%	0.32	0.31	0.30	4.92	4.38	3.99	4.92	5.24	3.88	5.64	5.22	5.16

NS: Non significant

V_1 - Red Globe
V_2 - Fantasy Seedless
V_3 - Crimson Seedless
V_4 - Manjari Shyama (A-18/3)
V_5 - Nanasaheb Purple Seedless
V_6 - Sharad Seedless (Check)
V_7 - Merbein Seedless
V_8 - 2A-Clone
V_9–Manjari Kishmish (KishmishRozavis White)
V_{10} - Thompson Seedless (Check)

(87.72) and Thompson Seedless took the maximum number of days for veraison (95.61). This variation may be because of climatic factors like high temperature influenced the grape phenology, which leads to early bud burst resulting in early panicle initiation and earliest to veraison stage. It is possible that the variation was attributed to the variety's genotypic characteristics. Similar results are in accordance with the findings of Eliana *et al*. (2010) and Saniya *et al*. (2018).

Nanasaheb Purple Seedless took the minimum number days from pruning to harvest (116.85) and to achieve18^0 brix (112.29) whereas, Red Globe took the maximum number of days from pruning to harvest (136.27) and to achieve 18^0 brix (131.35). The earliness to harvesting is purely a genotypic character of the variety (Table 2). However, light plays an important role in penetration of deep inside the canopy which helps in early flowering. Further, Nanasaheb Purple Seedless, Manjari Shyama, Fantasy Seedless and Manjari Kishmish are early to mid-maturing varieties, while Thompson Seedless, Crimson Seedless, Red Globe and Merbein Seedless fall into the mid to late maturing category. This distinction highlights the impact of their genetic traits on the time taken for bunches to be ready for harvesting. The present findings are in consonance with the findings of Porika *et al*. (2015), Shubhangini (2016), Pal *et al*. (2018) and Soni *et al*. (2019).

As the number of canes per vine increased, the number of bunches also increased. Thompson Seedless recorded the maximum number of bunches per vine (51.19) and the minimum number of bunches per vine (17.25) was recorded in Nanasaheb Purple Seedless (Table 3 and Fig. 1). The number of bunches per vine is a genetic and phenotypic expression of the variety in a given environmental conditions. The prevailing weather conditions plays crucial role in bearing maximum number of bunches per vine, but it is most likely dependent on fruitfulness of the variety. The results are in close conformity with the findings of Soni *et al*. (2019), Anand *et al*. (2021), Pavithra (2022) and Shruti (2022).

The vine which had more number of bunches reduced individual bunch weight. The difference in the bunch weight in different table grape varieties might be due to inherent genetic character of the variety and difference in the number of canes per vine. The difference in the number of berries in a bunch is due to difference in the size of the berry and diameter of the berry. As the number of berries in a bunch increases the diameter of the berry reduces and vice versa. The highest berry weight in Red Globe was due to less number of berries in a bunch and genetic makeup of the variety. The maximum individual berry weight and berry diameter helps in increased bunch weight (Fig. 2) in Red Globe (469.47 g). On the other hand, Red Globe is a seeded variety, which acts as a

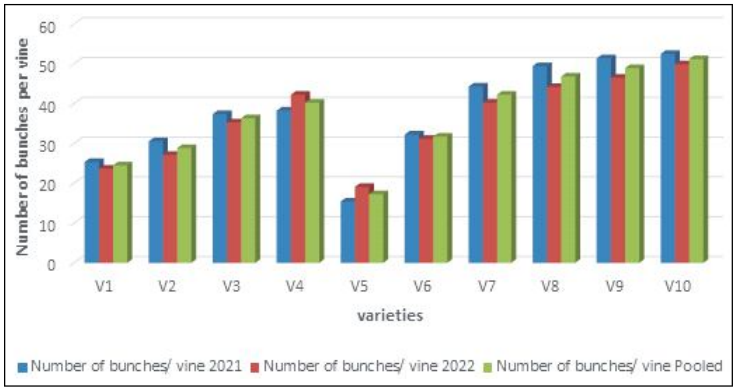

Fig. 1 : Number of bunches per vine in different table grape varieties.

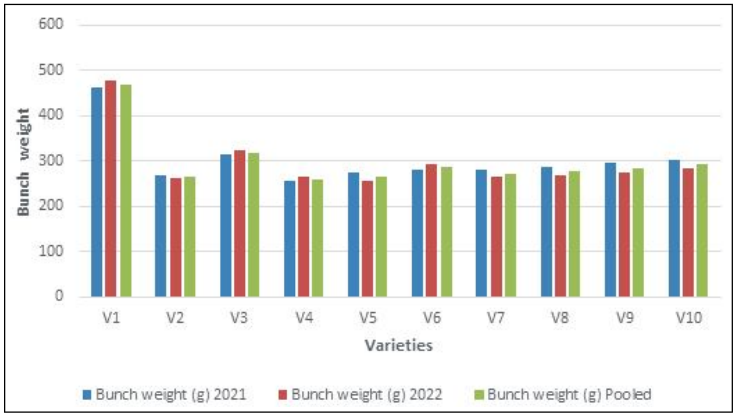

Fig. 2 : Bunch weight (g) in different table grape varieties.

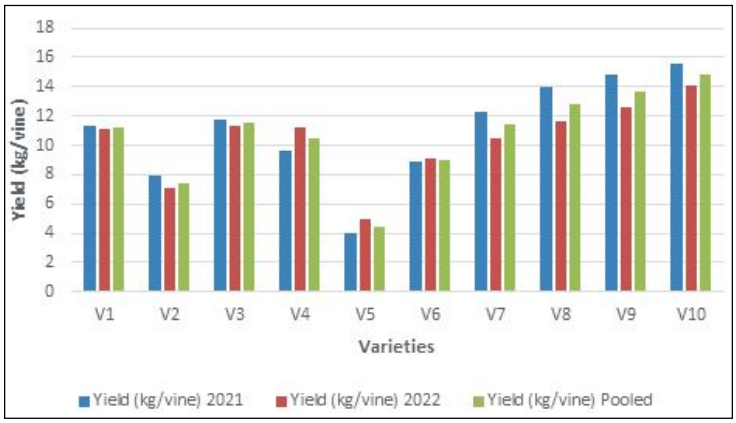

Fig. 3 : Yield (kg/vine) of different table grape varieties.

strong sink during grand growth period which in turn helps in large bunch development. These results are in line with the findings of Kadu *et al*. (2007) and Ratnacharyulu (2010).

The maximum 100 berry weight was recorded in Red Globe (491.82g) and the minimum 100 berry weight (209.59 g) was recorded in Merbein Seedless. The maximum 100 berry weight in Red Globe might be due to presence of less number of berries in a bunch wherein, maximum supply of carbohydrate to the growing berries. On the other hand, lesser 100 berry weight in Merbein Seedless was due to maximum number of berries in bunch create competition for food material leads to smaller in berry size and less in weight. The variation in the berry weight was due to genotypic character of the variety. The results are in consonance with the findings of Soni *et al*. (2019), Anand (2021), Pavithra (2022), Shruti (2022) and Priyadharshini *et al*. (2023).

In table grapes, appearance of the bunches plays an important role which fetches good price in the international market especially shape of the bunch, bunch length and bunch width. The maximum bunch length (20.68 cm) in Fantasy Seedless and the maximum bunch width (14.89 cm) was recorded in Red Globe, which may be attributed to genetic makeup of the variety, where in, the number of berries and weight of the berries in a bunch and environmental conditions. These findings are in agreement with supporting reference of Hachcholli *et al*. (2016), Roberto *et al*. (2017), Pal *et al*. (2018) and Ingole *et al*. (2018).

The maximum berry length (21.07 mm) and berry diameter (24.41 mm) exhibited in Red Globe whereas, the lowest berry length (12.55 mm) and berry diameter (16.08 mm) was recorded in 2A-Clone (Table 4). The increased berry length and

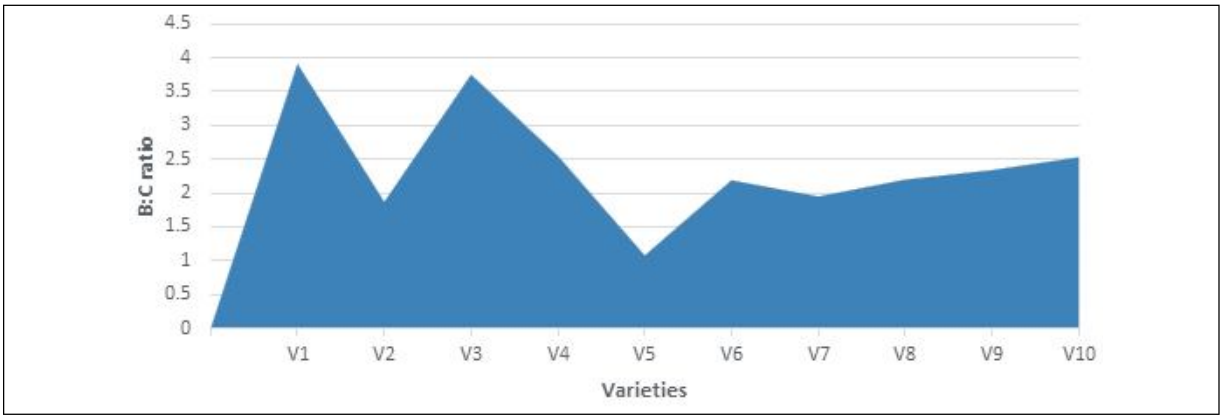

Fig. 4 : Economics of different table grape varieties.

Table 3 : Number of bunches per vine, weight of 100 berries, number of berries per bunch and bunch length in different table grape varieties.

Treatment	Number of bunches/ vine			Weight of 100 berries (g)			No of berries / bunch			Bunch length (cm)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_1	25.33	23.67	24.50	501.05	482.59	491.82	89.38	84.96	87.17	19.32	18.67	18.99
V_2	30.54	27.13	28.83	249.72	231.07	240.39	107.29	101.42	104.36	21.27	20.08	20.68
V_3	37.38	35.29	36.33	274.21	261.69	267.95	114.79	119.46	117.13	19.53	19.24	19.38
V_4	38.25	42.25	40.25	216.55	206.48	211.52	105.00	111.34	108.17	16.84	17.65	17.24
V_5	15.42	19.08	17.25	242.04	236.29	239.17	92.08	96.25	94.17	16.81	17.52	17.17
V_6	32.25	31.17	31.71	218.22	231.61	224.92	122.17	115.71	118.94	18.34	19.09	18.71
V_7	44.29	40.25	42.27	213.59	205.59	209.59	148.29	153.00	150.65	19.47	19.25	19.36
V_8	49.42	44.21	46.81	221.31	209.83	215.57	142.34	140.42	141.38	18.62	19.52	19.07
V_9	51.38	46.50	48.94	236.68	223.63	230.15	135.21	131.21	133.21	19.12	20.23	19.67
V_{10}	52.50	49.88	51.19	228.17	215.13	221.65	131.75	134.75	133.25	19.81	20.13	19.97
S.Em ±	3.11	3.08	2.86	6.96	7.85	5.91	3.09	4.02	2.65	0.50	0.38	0.40
CD at 5%	9.34	9.24	8.58	20.88	23.55	17.73	9.28	12.06	7.95	1.51	1.14	1.21

V_1 - Red Globe
V_2 - Fantasy Seedless
V_3 - Crimson Seedless
V_4 - Manjari Shyama (A-18/3)
V_5 - Nanasaheb Purple Seedless
V_6 - Sharad Seedless (Check)
V_7 - Merbein Seedless
V_8 - 2A-Clone
V_9–Manjari Kishmish (KishmishRozavis White)
V_{10} - Thompson Seedless (Check)

Table 4 : Bunch width, berry length, berry diameter and bunch weight in different table grape varieties.

Treatment	Bunch width (cm)			Berry length (mm)			Berry diameter (mm)			Bunch weight (g)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_1	14.31	15.46	14.89	20.63	21.51	21.07	24.61	24.20	24.41	462.21	476.74	469.47
V_2	9.84	10.50	10.17	18.28	19.54	18.91	16.85	16.37	16.61	268.31	262.56	265.43
V_3	11.52	10.43	10.97	20.32	19.62	19.97	17.02	18.11	17.57	315.47	322.05	318.76
V_4	10.69	9.83	10.26	14.51	13.46	13.98	16.33	16.21	16.27	255.71	264.23	259.97
V_5	8.23	8.97	8.60	13.18	14.43	13.80	16.38	16.01	16.20	275.20	255.81	265.51
V_6	9.47	11.28	10.37	16.23	15.35	15.79	16.45	17.09	16.77	281.48	294.09	287.79
V_7	11.26	11.49	11.38	12.94	13.83	13.39	16.40	16.10	16.25	279.83	264.89	272.36
V_8	9.67	9.09	9.38	12.26	12.84	12.55	16.20	15.95	16.08	285.50	267.81	276.65
V_9	10.24	10.81	10.52	15.19	14.61	14.90	16.83	16.50	16.66	294.67	274.77	284.72
V_{10}	11.24	10.52	10.88	13.93	13.58	13.76	16.98	16.65	16.81	300.79	283.52	292.16
S.Em ±	0.37	0.34	0.30	0.42	0.44	0.37	0.69	0.40	0.51	11.97	13.46	11.70
CD at 5%	1.12	1.02	0.91	1.26	1.32	1.12	2.08	1.21	1.53	35.92	40.42	35.12

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V_{10} - Thompson Seedless (Check).

diameter might be due to less number of berries in a bunch helps in translocation of more nutrients and efficient utilization of these nutrients for berry development. On the other hand, the maximum number of berries per bunch leads to reduction in berry diameter. These results are in consonance with the findings of Goswami *et al*. (2013), Sharma *et al*. (2017), Soni *et al*. (2019), Shruti (2022), Pavitra (2022), Priyadharshini *et al*. (2023) and Somkuwar *et al*. (2023).

The highest yield was recorded in Thompson Seedless (14.80 kg/vine and 32.22 t/ha) and the lowest in Nanasaheb Purple Seedless (4.46 kg/vine and 9.78 t/ha).

Table 5 : Yieldof different table grape varieties.

Treatment	Yield (kg/vine)			Yield (t/ha)			B: C ratio
	2021	2022	Pooled	2021	2022	Pooled	
V_1	11.33	11.07	11.18	24.67	24.12	24.39	3.91:1
V_2	7.89	7.06	7.45	17.17	15.37	16.27	1.87:1
V_3	11.72	11.32	11.54	25.52	24.66	25.09	3.75:1
V_4	9.63	11.27	10.44	20.97	24.55	22.76	2.55:1
V_5	4.06	4.92	4.46	8.84	10.72	9.78	1.08:1
V_6	8.87	9.12	8.98	19.31	19.86	19.59	2.19:1
V_7	12.30	10.51	11.40	26.78	22.89	24.83	1.95:1
V_8	13.97	11.67	12.82	30.42	25.41	27.91	2.20:1
V_9	14.79	12.58	13.68	32.21	27.39	29.80	2.34:1
V_{10}	15.54	14.05	14.80	33.85	30.60	32.22	2.53:1
S.Em ±	0.93	0.94	0.88	2.03	2.04	1.91	-
CD at 5%	2.80	2.82	2.64	6.09	6.12	5.74	-

V_1 - Red Globe
V_2 - Fantasy Seedless
V_3 - Crimson Seedless
V_4 - Manjari Shyama (A-18/3)
V_5 - Nanasaheb Purple Seedless
V_6 - Sharad Seedless (Check)
V_7 - Merbein Seedless
V_8 - 2A-Clone
V_9–ManjariKishmish (KishmishRozavis White)
V_{10} - Thompson Seedless (Check).

The highest yield (Table 5 and Fig. 3) was due to internal and external factors. The internal factors like genetic makeup of the variety, which has interacted with external environmental growing conditions and also their adoption to agro climatic situations where they have grown. The difference in the yield in different varieties may be due to variation in the number of bunches per vine, bunch weight and individual berry weight. The highest yield in Thompson Seedless might be due to increased leaf area, LAI, photosynthetic rate, stomatal conductance, specific leaf area and maximum pruned biomass helps in overall increased yield. The results are in accordance with the findings of Jugati *et al*. (2022), Priyadharshini *et al*. (2023) and Somkuwar *et al*. (2023).

As the bunches are uniform in size, colour, bold berries with attractive bunch appearance which fetches better price in the market as a consequence of which the highest B: C ratio (Fig. 4) was obtained in Red Globe (3.91) and Crimson Seedless (3.75) followed by Manjari Shyama (2.55). On the other hand, even having high TSS, better eating quality of the fruits Nanasaheb Purple Seedless recorded lowest B: C ratio (1.08) due to less fruitfulness of the variety results in the reduced yield and lower returns. These results are in line with the findings of Pavithra (2022) and Shruti (2022).

Conclusion

Based on the findings, the highest yield andyield attributing characters were recorded in Thompson Seedless and Red Globe Whereas, the highest B: C ratio was obtained in Red Globe (3.91) and Crimson Seedless (3.75) followed by Manjari Shyama (2.55). So these four varieties Thompson Seedless, Red Globe, Crimson Seedless and Manjari Shyama can be grown in Northern dry zone of Karnataka for getting highest yield and better returns.

Acknowledgement

The authors are grateful to AICRP Fruits (Arabhavi and Vijayapur centre) and HREC Tidagundi (Vijayapur) for providing the research material to carry out the experiment.

Competing interests : Authors have declared that no competing interests exists.

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