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QUALITY TRAITS AND STORAGE FOR PHYSIOLOGICAL LOSS IN WEIGHT OF DIFFERENT TABLE GRAPE VARIETIES

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ABSTRACT

Grape (*Vitis vinifera* L.) is one of the ancient fruit crops known to man. Due to its wider adaptability, it is being well adapted to tropical regions of India. The present investigation 'Quality traits and storage for physiological loss in weight of the different table grape varieties'recorded important traits of bunch and berry characteristics of 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 highlight the variety Nanasaheb Purple Seedless recorded the highest TSS (21.80 ºB), lowest titratable acidity (0.51%), maximum reducing sugars (16.81%) and maximum total sugars (18.75%). The lowest TSS of the berry (18.81ºB), the highest titratable acidity of the berry (0.60%), lowest TSS: acid ratio of the berry (31.23 %), maximum non reducing sugars (2.06%), the highest value for berry firmness (6.71 N) and maximum number of days of storage (18.04 days) for loss of 5% physiological weight was recorded in Red Globe. Thompson Seedless (56.46%) exhibited the maximum TSS: acid ratio of the berry. Sharad Seedless recorded the maximum pH (3.80) of the juice. The minimum pH of the juice (3.18), lowest non reducing sugars (1.85%) and lowest values for berry firmness (3.22 N) was recorded in Manjari Shyama. The minimum reducing sugars (13.54%) and lowest total sugars (15.59%) was recorded in Crimson Seedless. The minimum number of days (8.83 days) of storage was recorded in Merbein Seedless for loss of 5% physiological weight.

Key words : Table grapes, Quality, TSS, Sugars, Physiological weight.

Introduction

Grape is one of the important commercial fruit crop in the world being originated in the temperate region but well acclimatized in both the tropical and subtropical conditions. India's viticulture industry is a highly profitable farming enterprise, with 72 per cent of production used for table purposes, 22 per cent for raisin, 3.50 per cent for wine and 0.50 per cent for juice. In recent years, viticulture has become one of the India's most profitable farming enterprises per unit area of land. Commercially, cultivated grapes can be classified as table or wine purposes, depending on their intended consumption method. Most types belong to the same species, *Vitis vinifera* L.

In peninsular India, more than 70 per cent of fresh grapes are converted to raisin making, hardly 25- 30 per cent is used for table purpose. The area is mainly dominated by green seedless types rather than coloured grapes. Table grapes are meant for consumption while they are in fresh, they should be attractive appearance,

bold and elongated berries, crisp pulp, conical shaped bunches, medium sugar and seedlessnes is another desirable character. Green seedless varieties are being grown in major part of the India. Whereas, there is increasing demand for coloured seedless varieties in domestic as well as in international market. There is an urgent need to identify the varieties with good quality bunches with better shelf life. The main objective of the research is to identify suitable variety with respect to quality traits under Northern dry zone of Karnataka.

Materials and Methods

The present investigation on "Quality traits and storage for physiological loss in weight of the different table grape varieties" 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 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

Spacing : 2.74m × 1.52m

No. of vines/ treatment : 6

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)

TSS (^{0}Brix)

The total soluble solids were calculated using a digital hand refractometer Erma (0 to 32%), after which the juice of a fruit that was randomly chosen for each replication was removed and filtered through muslin fabric. After the strained juice had been well cleaned, a drop of it was placed on the digital hand refractometer's prism, allowing a direct read-out of the percentage of total soluble solids. Degree Brix was used to express the readings.

Titratable acidity (%)

By diluting the juice taken from five grams of sample, filtering it through muslin cloth and then adding distilled water (100 ml) to a specified volume, the acidity was measured in terms of tartaric acid. Using phenolphthalein as an indicator, 5ml of an aliquot was extracted from this and titrated against standard NaOH (0.1 N). The end point was noted as the appearance of light pink colour. The results were stated as tartaric acid as a percentage of the fruits' titratable acidity.

$$\text{Acidity \%} = \frac{\text{Titrable value} \times \text{Normality of NaOH} \times \text{Volume made up} \times \text{Equivalent weight of acid}}{\text{Volume of sample for estimation} \times \text{Weight or volume of sample taken} \times 1000}$$

TSS to acid ratio

The TSS to acid ratio, which is expressed as a ratio calculated by dividing the TSS (^{o}Brix) by the corresponding fruit's titratable acidity (%).

Reducing sugars (%)

Miller (1972) analysed the reduction of sugars in the berries stored in 80% alcohol using the Dintrosalicyclic acid (DNSA) technique. Measure out a known amount of alcohol and let it evaporate entirely. Using the above procedure, a clear solution was obtained for the DNSA-reagent calculation of sugar reduction. The results were represented as a percentage based on fresh weight.

Non-reducing sugars (%)

By deducting the percentage of reducing sugar from the percentage of total sugar and multiplying the result by 0.95 as shown below, the percentage of non-reducing sugar was determined (Somogyi, 1952).

Non-reducing sugars (%) = (Per cent total sugar – Per cent reducing sugar) × 0.95.

Total sugars (%)

The same method was used to estimate total sugars as that of reducing sugars after inversion (Anon., 1984). 1 ml of evaporated extract was collected and kept in boiling water till the alcohol completely evaporated and allowed it to cool. After adding 1N sodium hydroxide and phenolphthalein indicator, the solution turned pink. To make the solution discolored, 0.1N hydrochloric acid was added once more. Next, the Dinitro-salicylic acid (DNSA) method was applied to estimate the amount of reducing

sugars. The results were expressed in terms of percentage.

pH of juice

The pH of juice was known with the help of pH meter. The pH of juice was measured by immersing the pH meter in 20 ml of juice was taken for a few seconds and stabilized pH reading was recorded. To get rid of any leftover effects before every observation, the bulb of the pH meter was washed with distilled water.

Berry firmness (Newton)

Firmness of the berry was determined using TAXT plus texture analyser (Make: Stable Micro System, Model: Texture Export Version 1.22) the force with the sample get cut was recorded in the graph and the peak force value in the graph was taken as the texture value in terms of Newton force (N). During the experiment below mentioned instrument settings were used.

Type of probe used	:	Piercing probe
Test option used	:	Return to start
Test Speed	:	5.0 mm/s
Post-test speed	:	10.00 mm/s
Distance	:	10 mm
Load cell	:	5 kg

Juice content (%)

The juice content of the berries was extracted and measured by weighing fifty grams of berries. Volume by weight was used to calculate the juice content. A percentage was used to express the values that were found.

Pedicel thickness (mm)

Using digital vernier callipers, the grape's pedicle thickness was measured and expressed in millimeters (mm).

Physiological loss in weight (PLW)

The bunches from each treatment were kept separately in cold storage conditions in order to calculate the PLW, which was subsequently taken daily. The PLW was computed using the following formula and expressed as a percentage.

$$\text{Physiological loss in weight (\%)} = \frac{\text{Initial weight–Final weight}}{\text{Initial weight}} \times 100$$

Colour values (*L*a*bvalues)**

A popular colour space was used to measure the external colour of red grapes is CIE *L*a*b**, based on the opposite colour theory, which states that an object cannot be green or red and blue or yellow at the same time. System *L*a** and *b** describe the rectangular dimensions of the three colour spaces, where L* is the lightness and ranges from 0 to 100, a* is the green-red coordinate and b* is the blue-yellow coordinate. The values a* and b* can vary from -60 to +60, where positive a* means red, negative a* green, positive b* yellow and negative b* blue. Colour space can be effectively used to evaluate fruits that vary in colour between red and yellow.

Results and Discussion

The predominant acids of grape *viz.,* malic and tartaric acids are synthesized in leaves. These acids are translocated from leaves to bunch. There was a maximum accumulation of higher reducing and total sugar content in varieties, where there was balanced canopy maintained between reproductive and vegetative growth and also where there was a lesser competition for metabolites. The TSS, Titratable acidity, TSS: acid ratio and pH of the berry varied significantly among the different table grape varieties, which are shown in Table 1. Among the different table varieties, Nanasaheb Purple Seedless (21.80 ºB) recorded the highest TSS, which was at par with Thompson Seedless (21.71 ºB), Manjari Kishmish (21.61 ºB), Merbein Seedless (21.24 ºB), 2A-Clone (21.23 ºB) and Sharad Seedless (20.78 ºB). The lowest TSS of the berry (18.81 ºB) was recorded in Red Globe. Nanasaheb Purple Seedless (0.51%) recorded the lowest titratable acidity which was at par with Thompson Seedless (0.52%), Manjari Kishmish (0.53%), Fantasy Seedless (0.53%), Merbein Seedless (0.53%), 2A-Clone (0.56%) and Sharad Seedless (0.55%). The highest titratable acidity of the berry (0.60%) was recorded in Red Globe. Thompson Seedless (56.46%) recorded the maximum TSS: acid ratio of the berry, which was at par with Manjari Kishmish (54.00%). The lowest TSS: acid ratio of the berry (31.23%) was recorded in Red Globe. Sharad Seedless recorded the maximum pH (3.80) of the juice followed by Nanasaheb Purple Seedless (3.69). The minimum pH of the juice (3.18) was recorded in Manjari Shyama. The biochemical parameters changes as the site, location and environment changes. However, these parameters are genotypically specific controlled by quantitative genes. Therefore, changes in varieties do not depict real association. The TSS: Acid ratio is primarily governed by phenotypic and genotypic factors along with day and night temperature which favors the development of solutes and sugar in the berry. The present results are in harmony with the findings of Thakur *et al.* (2008) and Khalil *et al.* (2019).

Reducing sugars of the juice exhibited a significant difference in different table grape varieties are presented

Table 1 : TSS, titratable acidity, TSS: acid ratio and pH of the juice in different table grape varieties.

Treatment	TSS (°Brix)			Titratable acidity (%)			TSS: acid ratio (%)			pH of the juice		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_1	19.28	18.35	18.81	0.60	0.61	0.60	32.16	30.29	31.23	3.51	3.45	3.48
V_2	19.78	20.13	19.95	0.52	0.52	0.53	37.89	38.57	38.23	3.71	3.55	3.63
V_3	20.05	19.23	19.64	0.57	0.57	0.57	35.33	33.89	34.61	3.47	3.46	3.46
V_4	20.58	19.75	20.16	0.58	0.56	0.57	36.09	35.58	35.83	3.17	3.20	3.18
V_5	22.35	21.25	21.80	0.53	0.49	0.51	41.98	43.87	42.92	3.65	3.73	3.69
V_6	21.10	20.45	20.78	0.60	0.51	0.55	34.34	40.29	37.81	3.79	3.81	3.80
V_7	21.25	21.23	21.24	0.54	0.52	0.53	52.83	48.60	50.72	3.53	3.59	3.56
V_8	21.33	21.13	21.23	0.58	0.55	0.56	50.33	46.43	48.38	3.67	3.50	3.59
V_9	21.75	21.48	21.61	0.56	0.51	0.53	52.03	55.97	54.00	3.45	3.49	3.47
V_{10}	22.08	21.35	21.71	0.52	0.51	0.52	59.17	53.75	56.46	3.48	3.65	3.57
S.Em ±	0.52	0.37	0.37	0.01	0.02	0.02	1.21	1.60	1.40	0.03	0.02	0.02
CD at 5%	1.56	1.12	1.13	0.04	0.07	0.06	3.64	4.80	4.22	0.09	0.07	0.06

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 : Reducing sugars, non reducing sugars and total sugars in different table grape varieties.

Treatment	Reducing sugars (%)			Non reducing sugars (%)			Total sugar (%)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_1	14.58	14.33	14.46	2.08	2.05	2.06	16.66	16.38	16.52
V_2	14.86	14.64	14.75	1.96	1.92	1.94	16.82	16.55	16.69
V_3	13.58	13.49	13.54	2.08	2.03	2.05	15.66	15.52	15.59
V_4	15.99	15.71	15.85	1.87	1.83	1.85	17.86	17.54	17.70
V_5	16.86	16.76	16.81	1.96	1.92	1.94	18.82	18.68	18.75
V_6	16.28	16.21	16.24	2.03	1.95	1.99	18.30	18.16	18.23
V_7	16.08	16.18	16.13	2.05	1.96	2.00	18.13	18.14	18.13
V_8	16.26	16.14	16.20	2.04	1.94	1.99	18.30	18.08	18.19
V_9	16.80	16.76	16.78	1.92	1.82	1.87	18.72	18.58	18.65
V_{10}	16.68	16.55	16.62	1.88	1.83	1.86	18.56	18.38	18.47
S.Em ±	0.11	0.16	0.13	0.05	0.05	0.04	0.07	0.17	0.09
CD at 5%	0.33	0.47	0.39	0.15	0.14	0.12	0.21	0.50	0.27

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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)

in Table 2. Among the different varieties, Nanasaheb Purple Seedless recorded the maximum reducing sugars (16.81%), which was at par with Manjari Kishmish (16.78%) and Thompson Seedless (16.62%). The minimum reducing sugars (13.54%) was recorded in Crimson Seedless. Red Globe recorded the maximum non reducing sugars (2.06%) which was at par with Crimson Seedless (2.05%), Merbein Seedless (2.00%), 2A-Clone (1.99%), Sharad Seedless (1.99%), Fantasy Seedless (1.94%) and Nanasaheb Purple Seedless (1.94%). The lowest non reducing sugars (1.85%) was recorded in Manjari Shyama. Nanasaheb Purple Seedless recorded the maximum total sugars (18.75%), which was at par with Manjari Kishmish (18.65%). The lowest total

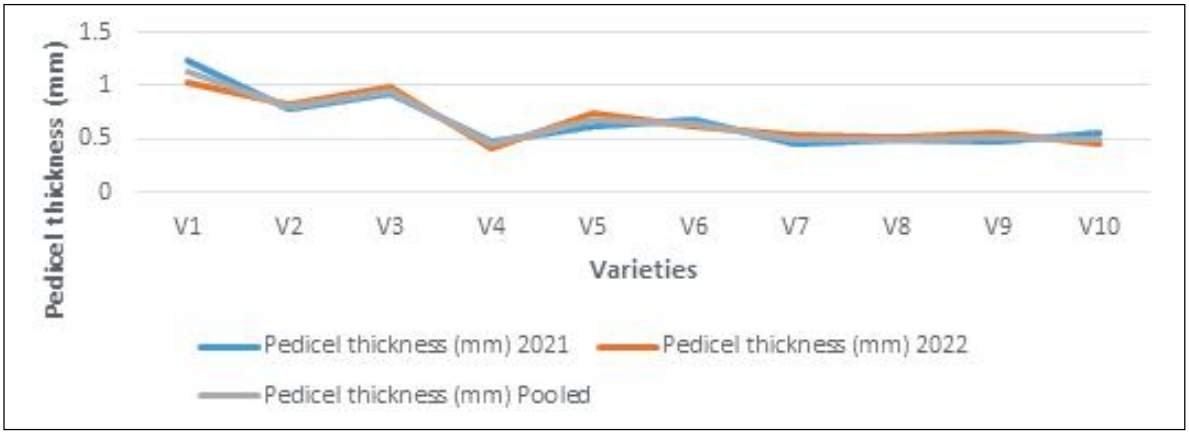

Fig. 1 : Pedicel thickness (mm) in different table grape varieties.

Table 3 : Berry firmness, juice content, pedicel thickness and PLW at cold storage (5% loss in weight) in different table grape varieties.

Treatment	Berry firmness (N)			Juice content (%)			Pedicel thickness (mm)			5% PLW at cold storage (Number of days)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_1	6.80	6.62	6.71	58.05	61.20	59.63	1.23	1.02	1.13	17.00	19.09	18.04
V_2	4.06	4.17	4.11	52.28	56.15	54.21	0.78	0.82	0.80	9.63	9.38	9.50
V_3	6.39	6.44	6.42	53.40	51.63	52.51	0.92	0.98	0.95	12.75	12.17	12.46
V_4	3.18	3.25	3.22	58.33	55.18	56.75	0.48	0.42	0.45	9.50	9.13	9.31
V_5	3.41	3.26	3.33	56.33	61.10	58.71	0.62	0.74	0.68	9.75	9.54	9.65
V_6	3.28	3.40	3.34	45.43	49.53	47.48	0.68	0.62	0.65	9.50	10.08	9.79
V_7	3.43	3.64	3.53	48.23	43.63	45.93	0.45	0.53	0.49	8.54	9.13	8.83
V_8	3.13	3.38	3.25	47.13	45.25	46.19	0.49	0.51	0.50	9.17	8.63	8.90
V_9	3.27	3.35	3.31	43.40	45.85	44.63	0.48	0.55	0.52	10.13	9.54	9.83
V_{10}	3.33	3.52	3.42	44.63	40.60	42.61	0.55	0.46	0.50	9.79	9.17	9.48
S.Em ±	0.34	0.29	0.21	2.18	2.28	1.75	0.05	0.04	0.03	0.67	0.72	0.65
CD at 5%	0.97	0.85	0.62	6.54	6.84	5.25	0.15	0.13	0.10	2.01	2.16	1.95

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V_7 - Merbein Seedless
V_8 - 2A-Clone
V_9 –Manjari Kishmish (Kishmish Rozavis White)
V_{10} - Thompson Seedless (Check)

sugars (15.59%) was recorded in Crimson Seedless. The higher reducing and total sugar content in balanced pruning for reproductive and vegetative growth might be due to the occurrence of optimum number of bunches per vine and there was a lesser competition for metabolites. The prevalence of high temperature during summer encouraged more respiration, thus ultimately resulting in higher utilization of organic acids in the catabolic process of the plants. These results are in accordance with the findings of Mohanakumaran *et al.* (1964), Singh and Kumar (1980) and Disha *et al.* (2023).

A perusal of data presented in Table 3 revealed berry firmness in different table grape varieties had a significant difference. Among the different table grape varieties, Red Globe recorded the highest value for berry firmness (6.71 N), which was at par with Crimson Seedless (6.42 N). The lowest values for berry firmness (3.22 N) was recorded in Manjari Shyama. Firmness of the berry is mainly due to inherent varietal character which promotes a thicker skin and robust cell structure, which was influenced by internal turgor pressure, skin thickness and presence of polyphenolic compounds, which contribute for enhanced firmness. Whereas, in contrast to this, relatively lower berry firmness is genetically associated due to presence of lower polyphenolic compounds, which contribute for reduced firmness. The present investigations are in conformity with the findings of Rolle *et al.* (2013) and Balic *et al.* (2014).

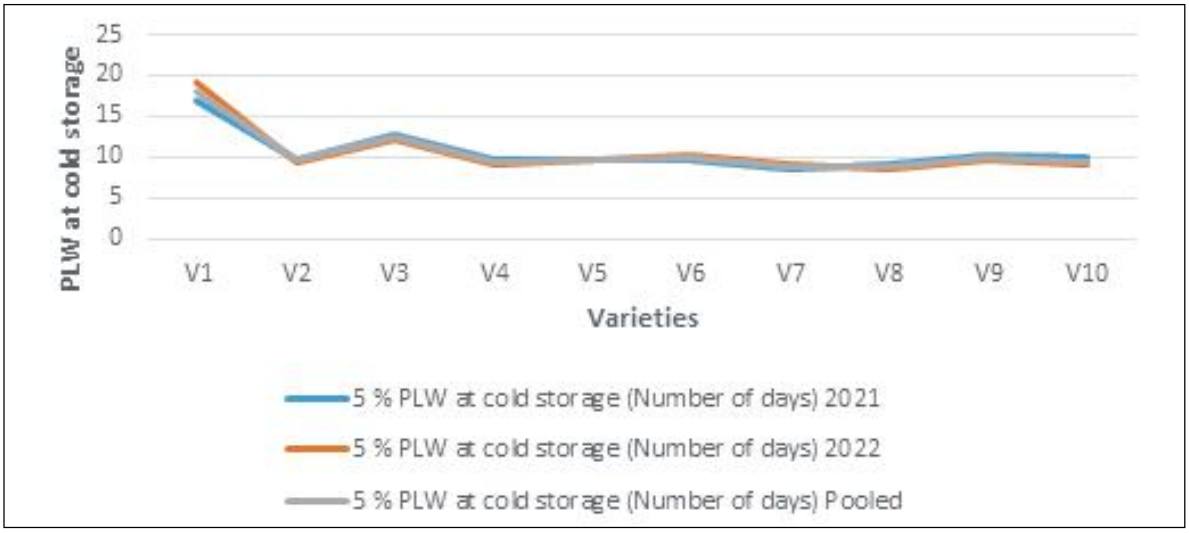

Fig. 2 : PLW at cold storage (5% loss in weight) in different table grape varieties.

Table 4 : Colorimetric (Colour *L* a* b**) values in different table grape varieties.

Treatment	Colorimetric								
	Colour *L** values			Colour *a** values			Colour *b** values		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_1	30.45	32.10	31.27	8.51	8.79	8.65	4.84	5.03	4.94
V_2	20.68	19.30	19.99	0.66	0.57	0.62	0.49	0.44	0.47
V_3	18.55	17.79	18.17	12.49	12.16	12.32	5.00	5.27	5.13
V_4	12.54	12.93	12.74	1.04	1.11	1.08	0.29	0.40	0.34
V_5	7.69	7.96	7.82	1.26	1.15	1.20	1.31	1.45	1.38
V_6	17.61	17.92	17.77	0.86	0.93	0.89	0.27	0.22	0.25
V_7	23.89	23.74	23.82	0.91	0.84	0.87	11.57	12.90	12.23
V_8	34.97	34.11	34.54	2.05	2.01	2.03	16.68	16.27	16.48
V_9	34.85	33.46	34.15	2.31	2.31	2.31	16.61	16.88	16.75
V_{10}	33.39	33.92	33.66	0.74	0.87	0.80	14.28	14.58	14.43
S.Em ±	1.12	1.09	1.07	0.45	0.27	0.35	0.45	0.51	0.47
CD at 5%	3.36	3.27	3.22	1.35	0.82	1.05	1.35	1.53	1.42

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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).

Red Globe recorded the maximum juice content of 59.63%, which was at par with Nanasaheb Purple Seedless (58.71%) and Manjari Shyama (56.75%). The lowest juice content of 42.61% was recorded in Thompson Seedless. Red Globe recorded the maximum pedicel thickness (1.13 mm) followed by Crimson Seedless (0.95 mm). The minimum pedicel thickness (0.45 mm) was recorded in Manjari Shyama (Fig. 1). Red Globe recorded the maximum number of days of storage (18.04 days) for loss of 5% physiological weight followed by Crimson Seedless (12.46 days). The minimum number of days (8.83 days) of storage was recorded in Merbein Seedless for loss of 5% physiological weight (Table 3 and Fig. 2). The pedicel thickness of the berry plays important role in extending the shelf life of the grapes. The strong pedicel attachment to the fruit due to genetical make up of the variety also plays important role in increasing the self life of the produce. The findings are in agreement with the results of Ballinger and Nesbitt (1982), Goswami *et al.* (2013) and Isbat and Zeba (2011).

The data presented in Table 4 with respect to colorimetric values tested for *L**, *a** and *b** colour

showed significant difference. The *L** value for the berry differed significantly in different table grapes varieties. Significantly the highest dark colour was found with the lowest reading for *L** in Nanasaheb Purple Seedless (7.82) followed by Manjari Shyama (12.74). The lowest colour value was found in 2A-Clone with higher reading (34.54). The two years data recorded for *a** value of berries in different table grape varieties differed significantly. The highest *a** value found in Crimson Seedless (12.32) followed by Red Globe (8.65). The lowest *a** value found in Fantasy Seedless (0.62). The highest *b** value for berry colour was recorded in Manjari Kishmish (16.75), which was at par with 2A-Clone (16.48). The lowest *b** value for berry colour was found in Sharad Seedless (0.25). Variation in the colour of different varieties is mainly dependent on the inherent characteristic of the variety which is mainly due to environmental factors like sunlight, temperature and soil composition which play major role in variation of pigments that are present in the grape skin which can affect *L**, *a**, *b** value. The findings are in line with the results of Rolle *et al.* (2013), Pavitra (2022) and Shruti (2022).

Conclusion

Based on the findings, Nanasaheb Purple Seedless exhibited the highest values for TSS, lowest titratable acidity, maximum reducing sugars and maximum total sugar whereas, Red Globe displayed the highest value for berry firmness and maximum number of days of storage (18.04 days) for loss of 5% physiological weight. Nanasaheb Purple Seedless and Red Globe performed exceptionally better with respect to quality traits, so these two coloured varieties can be grown in Northern dry zone of Karnataka for better quality as an alternative to green seedless varieties.

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