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Evaluation of Grape (*Vitis vinifera* L.) Genotypes for Growth, Phenological and Yield under North-Eastern Dry Zone of Karnataka, 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

Eight grape genotypes were evaluated during 2021-2022 at New orchard, University of Agricultural Sciences, Raichur, Karnataka. The experiment was conducted in Randomized Block Design with three replication. The grape cultivars of five year old vines planted at spacing of 3.0m× 1.5m and trained on Y system of training. The forward pruning was done on 21st October, 2021. There were

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eight table grape genotypes under the evaluation study, *i.e.,* Thompson Seedless, Manik Chaman, Sharad Seedless, 2A Clone, K.R. White, Manjari Naveen, Fantasy Seedless and Medica. Among genotypes, Medica recorded the maximum pruning weight (1.39 Kg vine^{-1}), number of fruitful canes vine^{-1}(36.00). Thompson Seedless observed maximum shoot length (126.49 cm). Manik Chaman recorded maximum cane diameter (10.31 mm). The genotype Thompson Seedless has recorded earliness in bud sprouting (7.10 days), minimum number of days to anthesis (29.12 days) and fruitset (35.25 days). The early ripening genotypes was Sharad Seedless (98.70 days). The maximum bunch weight was recorded in the genotype 2A Clone (598.87 g). The genotype Medica recorded the maximum number of bunches vine^{-1}(112.00) with highest bunch yield (41.32 kg vine^{-1})

Keywords: Vitis vinifera L.; genotypes; growth; phenology; yield.

1. INTRODUCTION

Grape (*Vitis vinifera* L.) belongs to the family vitaceae. Orginally, a temperate crop native to Caspian Sea, it behaves as both deciduous in temperate region and evergreen in sub-tropical and tropical region. The commercial grape varieties were introduced into India by invaders of Iran and Afghanistan. It is one of the most delicious and nutritious fruits containing calcium (0.37 mg 100 g^{-1}), phosphorous (0.24 mg 100 g^{-1}) and iron (0.26 mg 100 g^{-1}) minerals. It also contains rich source of vitamin B_1 and B_2, sugars, organic acids and antioxidant compounds which are the essential part of human diet and are required for normal growth and development of human being [1]. Therefore, the fruits are known as 'Nectar of gold' and very rich in antioxidant and pro-anthocyanidin compounds helps in curing cancer. In world, grapes is utilized for various purposes for table, wine, jam, juice, jelly, grape seed extract, raisins, vinegar, and grape seed oil [2-4]. In world grapes are cultivated 75,866 sq.km with 21.94 MMT production. In India, its production is increasing annually and it is cultivated nearly 2.24 percent of the total area with 3489 thousand tons production and productivity of 19.7 metric tonnes per hectare [5]. About 70% of grapes are grown in Maharashtra and 24% in Karnataka. India has exported 2.46 lakh metric tons of grapes to the world for the worth of Rs. 2,298 crores during 2020-21 [6-8]. However, the performance of growth, phenology and yield of grapes differ with genotypes and location of cultivation. Hence, the experiment was initiated to evaluate different grape genotypes with a main objective to find out the elite genotypes with high yield under North-Eastern Dry Zone of Karnataka.

2. MATERIALS AND METHODS

The experiment was conducted during 2021-2022 in the Department of Horticulture, University of Agriculture Sciences, Raichur, Karnataka. The experimental site is located at 16°15 N' latitude and 77°21 E' longitude in the North Eastern Dry Zone of Karnataka at an altitude of 389 m above msl. The relative humidity is high in monsoon months which ranged from 55 to 89 per cent. The grape cultivars were established on dogridge rootstock. Eight genotypes of table grapes were evaluated for the present study includes Thompson Seedless, Manik Chaman, Sharad Seedless, 2A Clone, K.R. White, Manjari Naveen, Fantasy Seedless and Medica. The vines were trained on Y system of training by adopting a spacing of 3.0m X 1.5m. The design adopted for study is Randomized Block Design with three replications. Level of pruning differs with the variety, so seven to twelve buds were retained on the canes and it may depends upon the variety and cane thickness. The backward pruning was done 21st April 2021 and forward pruning on 21st October 2021. The standard package of practices and viticulture operations were followed as per the recommendation of National Research Centre for Grapes. Observations were made on growth parameters such as pruning weight (kg), number of initial canes vine^{-1}, number of fruitful canes vine^{-1}, shoot length (cm), length of internode (cm), cane diameter (mm), number of leaves shoot^{-1} and leaf area (cm^2). Phenological parameters such as days taken to bud sprout after pruning, days taken for panicle appearance, days taken for fifty per cent flowering, days to anthesis, days to fruit set, days to fruit ripening and yield parameters such as berry length (mm), berry diameter (mm), weight of 100 berries (g), bunch length (cm), bunch width (cm), bunch weight (g), number of bunches vine^{-1}, yield (kg vine^{-1}). The data collected on growth, phenology and yield parameters during the course of investigation were subjected to Fisher's method of analysis of variance and interpretation of data was done as per the procedure described by Panse and Sukhatme [9].

3. RESULTS AND DISCUSSION

The comparison of eight grape genotypes for different growth parameters has been presented in Table 1. The results of the evaluation study revealed that the maximum pruning weight was recorded in the genotype Medica (1.39 kg vine^{-1}). However, the minimum pruning weight was recorded in Fantasy Seedless (0.72 kg vine^{-1}).The pruning weight is considered as the indirect measure of the vine vigour of the grapes. High pruning weight is mainly due to increased assimilation rate of carbohydrates due to more number of canes, number of leaves produced and other growth parameters results in more dry matter production due to high number of canes, number of leaves produced results in more dry matter production. Similar significant variation for pruning weight was found by Jayalakshmi et al. [10] in grapes. The genotype Medica recorded the maximum number of initial canes vine^{-1} (52.35) and mature canes vine^{-1} (44.00) were found on par with the genotype Thompson Seedless for number of initial canes vine^{-1}(51.71) and mature canes vine^{-1} (42.00) While, the minimum number of initial canes per vine (27.60) and matured canes vine^{-1} (21.00) was recorded in Fantasy Seedless. These variation in the number of initial and matured canes may be due to the variation in vigour which might be due to genetic expression of the genotypes reported by Ratnacharyulu [11]. The maximum number of fruitful canes per vine was observed in the genotype Medica (36.00). However, the minimum number of fruitful canes per vine was recorded in Fantasy Seedless (10.33). Highest number of fruitful canes serves as the pre-requisite for determining the vine vigour which ultimately leads to the production fruiting spur and renewal spur production.

The maximum shoot length was observed in the genotype Thompson Seedless (126.49 cm) was found on par with Fantasy Seedless (121.31 cm). However, the minimum shoot length was recorded in Sharad seedless (91.25 cm) Length of the shoot depends upon the vigour of the variety and extent of pruning [12]. Vigorous varieties have produced shorter shoots than less vigorous varieties due to number of buds retained on the cane after pruning Veena et al. [13]. The longer internodal length was observed in the genotype Medica (6.33 cm). While, the shorter internodal length was recorded in genotype Sharad Seedless (5.62 cm) Variation in length of internode may be due to variation in genetic behaviour of the genotype and shorter internodes accumulates higher carbohydrates reserves for flower bud initiation Somkuwar and Ramteke (2008). The genotype Manik Chaman recorded maximum initial cane diameter (7.19 mm) and cane thickness (10.31 mm) while thinner canes was K.R. White (8.92 mm). More photosynthate assimilates were partitioned during peak vegetative phase and results in more food material at basal portion of the cane Chalak et al. [14]. The maximum number of leaves shoot^{-1} was observed in the genotypes Thompson Seedless (37.14). However, the minimum number of leaves per shoot was recorded in the genotype Fantasy Seedless (27.22). The maximum leaf area was observed in the genotypes Manjari Naveen (140.79 cm^2). While, the minimum leaf area was recorded in Fantasy Seedless (119.93 cm^2) Genotypes having less number of leaves have recorded higher leaf area and vice versa which might be due to translocation of more photosynthates to the leaf growth which ultimately resulted in higher leaf area Jayalakshmi et al. [10].

In phenological attributes, the data recorded are represented in Table 2. The genotype Thompson Seedless recorded an early bud sprouting (7.10 days), while, the delayed bud sprouting was observed in Medica (9.20 days). Bud sprouting is a genotypic character and it is strongly influenced by temperature. Days taken for bud sprouting varies from genotype to genotype and climatic conditions. The maximum number of days taken for panicle appearance observed in the genotype Medica (14.10 days). While, the minimum number of days taken for panicle appearance observed in the genotype Thompson Seedless (12.20 days). The climatic conditions are important factor in panicle appearance of a grape crop. Similar studies were reported by Huang and Lu [15]. The maximum number of days taken for fifty per cent flowering observed in the genotype Medica (18.00 days) was found on par with Manjari Naveen (17.64 days). However, the minimum number of days taken for fifty per cent flowering was observed in the genotype Thompson Seedless (15.75 days). Flowering is considered as transition and early flowering is desirable trait in grape which depends on the prevailing temperature. The maximum number of days taken for anthesis observed in the genotype Manjari Naveen (31.80 days) and the minimum number of days taken for anthesis observed in the genotype Thompson Seedless (29.12 days). Warm weather induces early flowering than rainy and cool weather. Similar result are reported by Gupta et al. [16]. The maximum number of days

Table 1. Evaluation of grape (*Vitis vinifera* L.) genotypes on growth attributes

Treatments/ Genotypes	Pruning weight (kg vine^{-1})	Number of initial canes vine^{-1}	Number of mature canes vine^{-1}	Number of fruitful canes vine^{-1}	Shoot length (cm)	Internodal length (cm)	Cane diameter (mm)	Number of leaves shoot^{-1}	Leaf area (cm^2)
Thompson Seedless	0.94	51.71	42.00	21.67	126.49	6.15	9.86	37.14	135.91
Manik Chaman	0.86	48.50	38.33	19.00	105.83	5.91	10.31	30.42	133.46
Sharad Seedless	1.01	49.10	38.67	19.67	91.25	5.62	9.65	27.22	123.90
2A Clone	0.87	41.15	32.00	17.00	101.85	6.13	9.18	30.39	135.12
K.R. White	0.74	43.07	31.33	18.67	95.71	6.31	8.92	31.08	130.01
Manjari Naveen	0.92	31.15	25.00	13.00	101.22	5.74	9.82	31.15	140.79
Fantasy Seedless	0.72	27.60	21.00	10.33	121.31	6.00	9.71	32.07	119.93
Medica	1.39	52.35	44.00	36.00	106.27	6.33	9.48	31.82	130.93
S.Ed	0.104	0.509	0.375	0.634	2.996	0.050	0.079	1.466	1.159
CD (0.05%)	0.319	1.559	1.150	1.943	9.176	0.152	0.243	4.491	3.550

Table 2. Evaluation of grape (*Vitis vinifera* L.) genotypes on phenological attributes

Treatments/ Genotypes	Days to bud sprouting	Days taken for panicle appearance	Days taken for 50% flowering	Days to anthesis	Days to fruit set	Days to fruit ripening
Thompson Seedless	7.10	12.20	15.75	29.12	35.25	109.20
Manik Chaman	7.50	12.65	16.10	29.50	35.60	101.35
Sharad Seedless	7.90	12.78	16.29	30.14	35.95	98.70
2A Clone	8.21	13.30	17.15	31.25	36.20	110.25
K.R. White	8.00	12.95	16.72	30.43	36.00	105.40
Manjari Naveen	8.43	13.65	17.64	31.80	37.20	100.65
Fantasy Seedless	8.10	13.21	16.95	30.75	37.75	113.85
Medica	9.20	14.10	18.00	29.70	35.79	104.95
S.Ed	0.068	0.112	0.145	0.241	0.299	1.032
CD (0.05%)	0.209	0.344	0.443	0.737	0.915	3.159

Table 3. Evaluation of grape (*Vitis vinifera* L.) genotypes on yield attributes

Treatments/ Genotypes	Berry length (mm)	Berry diameter (mm)	Weight of 100 berries	Bunch length (cm)	Bunch width (cm)	Bunch weight (g)	Number of bunches vine^{-1}	Yield (kg vine^{-1})
Thompson Seedless	19.25	14.69	237.67	19.03	10.13	427.73	46.00	19.67
Manik Chaman	24.10	13.12	255.90	22.30	11.37	505.53	36.00	18.19
Sharad Seedless	22.53	14.64	333.67	15.67	10.53	406.67	35.00	14.23
2A Clone	20.15	15.53	320.97	22.17	11.63	598.87	34.00	20.92
K.R. White	19.48	16.00	306.67	20.73	12.13	554.70	37.00	20.53
Manjari Naveen	24.72	16.05	392.70	19.43	10.10	561.17	24.00	13.46
Fantasy Seedless	30.82	17.61	466.80	11.67	8.47	300.33	23.00	10.78
Medica	19.15	17.68	320.53	16.07	11.70	375.67	112.00	41.32
S.Ed	0.609	0.400	3.985	0.547	0.311	4.414	1.711	0.615
CD (0.05%)	1.866	1.224	12.204	1.675	0.951	13.519	5.240	1.883

taken for fruit set observed in the genotype Fantasy Seedless (37.75 days) was found on par with Manjari Naveen (37.20 days). While, the minimum number of days taken for fruit set observed in the genotype Thompson Seedless (35.25 days). Nithin et al. (2019) also found similar significant variation for number of days taken for fruit set after pruning in grapes. The early ripening genotype was Sharad Seedless (98.70 days). However, the delayed fruit ripening was observed in the genotype Fantasy Seedless (113.85 days) Due to the availability of high growing degree days leads to early maturity of berries accelerates the phenological phase of grapes grown under tropical and subtropical conditions of India. Similar findings were also reported about variation in fruit ripening in grapes grown under subtropical conditions of Punjab reported by Thakur et al. [17].

The data recorded on yield parameters are presented in Table 3. The maximum length of berry was observed in the genotypes Fantasy Seedless (30.82 mm). However, the minimum berry length was recorded in Medica (19.15 mm). Variations are under the combined influence of changes in various physiological processes and partially subjected to influence of temperature variation. The maximum berry diameter was observed in the genotypes Medica (17.68 mm). However, the minimum berry diameter was recorded in Manik Chaman (13.12 mm). Upadhay et al. [18] reported the similar findings with different wine varieties. The maximum weight of 100 berries was observed in the genotypes Fantasy Seedless (466.80 g). While, minimum weight of 100 berries was recorded in Thompson Seedless (237.67 g). The variation in the weight of 100 berries might be due to variation in the diameter of the berries reported by Thakur *et al.* [17]. The maximum bunch length was observed in the genotypes Manik Chaman (22.30 cm) However, the minimum bunch length was recorded in Fantasy Seedless (11.67 cm). The extent of variation in grape genotypes for physical bunch characters is primarily due to genetic differences.

The maximum bunch width was observed in the genotypes K.R. White (12.13 cm) while, the minimum bunch width was recorded in Fantasy Seedless (8.47 cm). The maximum number of bunches vine^{-1} was observed in the genotypes Medica (112.00). However, the minimum number of bunches vine^{-1} was recorded in Fantasy Seedless (23.00). The bunch characteristics have significant correlation with the fruit yield. Number of bunches per vine differs significantly with the genotypes, nutrition of the vine and probable site of growing. Similar line of work in grapes was reported by Havinal et al. [12]. The maximum bunch weight was observed in the genotype 2A Clone (598.87 g). While, the minimum bunch weight was recorded in Fantasy Seedless (300.33 g). The variation in the bunch weight in different genotypes may be attributed to inherent genetic character of the variety. The maximum bunch yield was observed in the genotypes Medica (41.32 kg vine^{-1}). However, the minimum bunch yield was recorded in

Fantasy Seedless (10.78 kg vine^{-1}). Genetic constitution of individual vines and the local climatic conditions also influence the variation in yield. The difference in the yield per vine in different grape cultivars might be due to the differences in weight of the bunch, number of bunches, weight of the berries besides their successful adoption to the varying agro-climatic conditions Havinal *et al.* [12]. Similar line of work is reported by Al-Obeed et al. [19], Khan et al. [20], Veena et al. [13], Vijaya et al. [21]. The research findings in consonance with research results reported by Pingle [22] in Kagzi lime, Sahu et al. [23] in Ber.

CONCLUSION

The present investigation for grape genotypes revealed that significant variability in relation to different growth, phenological and yield attributes. On the basis of research, it is concluded that, among eight grape genotypes, “Sharad Seedless” was found early variety. The “2A Clone” genotype, which exhibits maximum bunch weight and good fruit size, has great market potential. Whereas the “Medica” genotype with attractive red colour performed best in terms of pruning weight, number of mature canes, berry diameter, bunch width and high yielding and it is most suitable for commercial cultivation under North Eastern Dry Zone of Karnataka. Enhancing grapes productivity involves prioritizing traits from high-yielding varieties with market advantages. These genotypes are recommended for future study and application in comparable environments to optimize productivity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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