

Germplasm Characterization and Flowering, Fruiting Nature of Burmese Grape (*Baccaurea Sapida* Muell. Arg.) –a Potential Fruit Crop for Nutrition in Rural South East Asia

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Abstract

Burmese grape (*Baccaurea sapida* Muell. Arg.) belongs to the family Euphorbiaceae, is a minor underexploited fruit crop grown wild as well as under cultivation in Nepal, India, Myanmar, Bangladesh, China, Thailand, for fresh consumption. It is a dioecious plant and reported to have an excellent nutritive value, but mainly grown in homestead condition mostly in neglected ways without fullest utilization of its potentiality. The present study was aimed to understand and first time characterize the germplasm nature, and details of flowering and fruiting system of Burmese grape. The experiment showed that, tree growth habit and crown shape of all the accessions surveyed were semi erect and irregular, respectively. The flower bud differentiation in male and female accessions started during the mid February and anthesis occurred from mid March for both male and female accessions. The colour of the male flowers varied from yellow to green yellow shades while the colour of the female flowers varied from yellow to yellow green and green yellow shades. Significant variation of leaf area, number of flowers per panicle, length and diameter of inflorescence, fruit length, breadth, weight etc. were observed. The variation present on fruit length (2.81 cm to 3.80 cm), fruit weight (12.25g to 22.95g), pulp percentage (49.82% to 65.33%), total soluble solids (9.00° to 13.10°Brix), titratable acidity (0.73mg to 1.28mg/100g fruit pulp) and ascorbic acid content ranged from (23.18mg to 57.80mg/100g fruit pulp) suggest suitable selection method for identification of promising Burmese grape genotypes.

Introduction

Baccaurea is a genus of flowering plants belonging to the family Euphorbiaceae. Burmese grape (*Baccaurea sapida*) is one of the popular underutilized fruit plants native to South East Asian region and growing wild as well as under cultivation in Nepal, India, Myanmar, Bangladesh, South China, Indo- China, Thailand, the Andaman Island and Peninsular Malaysia. The generic name is derived from Latin '*Baccaurea*' referring to its golden yellow colour of the fruits (Chakrabarty and Gangopadhyay 1997). This fruit crop is grown in forest, semi-forest, forest fringed areas and also domesticated in homestead condition. In India it is grown as a minor underexploited fruit crop under the sub-Himalayan Terai region of West Bengal and north east India, Andaman Island for fresh local consumption. It is a slow growing, evergreen, dioecious, short to medium height, shade loving plant species, and fruits are acidic in taste (Bhowmick, 2009). Apart from fresh consumption the fruits can be used for making wine, juice and jams. The haploid chromosome no. of *B. sapida* is reported to be 13 (Mehra and Hans, 1969). It flowers during summer months and fruits are matured during rainy season. The edible portion is aril (3–4 in no. per fruit) and is covered by leathery rind. The tree show mild bienniality in cropping pattern (Pal et. al., 2008). It is a hardy plant, and grown as neglected crop without much more care even in forest fringed area, road side plantation. The Burmese have plentiful nutrients as reflected in world literature. Though the crop is reported to contain good nutritional properties like ascorbic acid, antioxidant capacity, proteins, minerals like calcium, phosphorous, and seeds having antifungal activity, however, its potentiality for alleviation of rural malnutrition particularly in south east Asiatic region (area of its occurrence) has yet not tapped properly, which may be explored. Fruits of Burmese grape contain 5.5 percent protein, 178 mg vitamin C,

169 mg calcium, 137 mg potassium, 177 mg phosphorous, and 100 mg iron per 100g of fruit pulp (Kermasha *et al.*, 1987) indicating its nutritive value for the rural areas. In spite of the potentiality, the Burmese grape is grown as little care on homestead condition raised by seeds creating variability in genotypes. However, very little systematic information is available in world literature regarding the characterization of germplasms and flowering, fruiting behaviour of this crop. The present attempt was the first report to characterize the genotypes of the crop and systematic documentation of flowering time, flowering duration, number of flowers per panicle, initial fruit set per panicle, ultimate fruit retention, yield, physico-chemical properties of fruit.

Materials And Methods

Burmese grape (*Baccaurea sapida* Muell.Arg) is dioecious and highly heterozygous in nature as well as no information is available regarding the variety/cultivars/types of the crop in worldwide. Keeping this point in consideration it has assumed that a variation among the population is present and each germplasm was treated as single accession during this experiment. During the study a survey was made on various home gardens of sub-Himalayan Terai region of West Bengal by making a questionnaire and after the whole survey, twenty numbers of female plants (accession) and fifteen numbers of male plants (accession) were selected as superior accessions based on plant vigour, bearing habit, size, shape and colour of fruits, taste, appearance for further analysis during the experiment to characterize the flowering and fruiting behaviour of germplasm as well as to know the variability among the selected plants. The germplasm with four replications for each observation were analyzed using one way classified data. Analysis of variance (one way classified data) for each parameter was performed using ProcGlm of Statistical analysis System (SAS) Software (Version 9.3). Means separations for different accessions under different parameter were performed using Tukey's Studentized Range (HSD) test ($P \leq 0.05$) (Tukey, 1953). The parameters like tree growth habit, branching pattern, crown shape, and trunk surface were recorded following the Litchi Descriptor (as the standard descriptor is not available and the canopy size is similar with litchi) of International Plant Genetic Research Institute (IPGRI), Rome, Italy. The colour of different plant parts were recorded with the help of Royal Horticulture Society Colour Chart (fifth edition). Different bio-chemical properties of fruit were recorded following the methods described by Ranganna (1977).

Results

After the experiment conducted on surveyed population of Burmese grape it was found that the tree growth habit was varied from semi erect to spreading, crown shape of all accession were irregular, branching pattern was erect or irregular or horizontal and trunk surface was rough. Leaf blade shape was elliptic, leaflet base shape was cuneate. It was also observed that the type of phyllotaxy was alternate, leaf apex shape varied from acute to acuminate and the bearing habit of Burmese grape was cauliflory (flowers and fruits are directly coming from the stem). The present investigation revealed that there was significant variation among different Burmese grape accessions from various parameters observed under

this study. The height of the male and female accessions varied from 2.59–7.39 m and 4.92–13.06 m respectively. While the length of leaf blade ranged between 16.50 cm (ACC-12) to 19.58 cm (ACC-5) and 18.15cm (ACC-10) to 25.30 cm (ACC-19) in male and female germplasms, respectively. The breadth of leaf blade varied from 5.00cm (ACC-9) to 6.78 cm (ACC-10) in male and 6.28 cm (ACC-15) to 9.61 cm (ACC-2) in female germplasms, respectively. Similarly, the leaf area of male and female Burmese grape germplasms ranged from 16.94 cm² (ACC-8) to 19.66 cm² (ACC-3) and 15.23 cm² (ACC-8) to 20.12 cm² (ACC-4), respectively. The colour of the upper side of the leaves in both male and female accessions ranged from G 137 A – G 141B shade to G N137 A to G 141 A shades of Royal Horticulture Society colour chart (5th edition). The colour of the male flowers varied from yellow to green yellow shades while, the colour of female flowers varied from yellow to yellow green and green yellow shades of Royal Horticulture Society colour chart (5th edition). The flower bud differentiation of male and female germplasms were started from first to mid week of February while the emergence of inflorescence was started from mid to last week of February. The anthesis occurred between first to mid week of March for both the male and female accessions surveyed showed synchronization of flowering leading to good fruit set. The number of sepals and petals were 4–5 and 1, in both male and female germplasms, respectively. The flowering duration varied significantly among the germplasms surveyed. The duration of flowering in male accessions varied from 5 days (ACC-4) to 7.5 days (ACC-1) while in female accessions it was ranged from 6.50 days (ACC-10 and 11) to 9.25 days (ACC-4). The number of flower per panicle in male and female germplasms ranged from 38.00 (ACC-12) to 63.00 (ACC-11) and 24.50 (ACC-13) to 31.50(ACC-7) respectively. The length and diameter of male inflorescence varied from 60.42mm (ACC-5) to 117.99mm (ACC-14) and 1.42mm (ACC-8) to 1.91mm (ACC-2), respectively. Similarly, the length and diameter of female inflorescence varied from 67.90mm (ACC-16) to 141.48mm (ACC-15) and 1.78mm (ACC-1) to 2.54mm (ACC-16), respectively. The fruit set in different germplasms were observed during the mid to last week of March. The shape of the fruit was oval or round.. The time taken for aril formation after fruit set and maturity of fruits varied from 42 to 51 days and 94.5 to 105.25 days respectively. The colour of the aril during maturity varied from white (W N155 A) to grayish white (W NN155 A), while the colour of ripe fruits varied from yellow to yellow orange groups (Y 13 A to YO 14, 15 B and C) of Royal Horticulture Society colour chart (5th edition). Experimental results showed that the initial fruit set per panicle in Burmese grape ranged from 20.00 (ACC-16) to 25.25 (ACC-9). Similarly the initial fruit set percentage ranged from 69.90% (ACC-16) to 89.47% (ACC-10). However, it was experienced different phases of fruit drop during the course of growth and development phases and finally the fruit retention percent was ranged from 20.40% (ACC-18) to 38.72% (ACC-14). The number of fruits at harvest per panicle was maximum (8.50) in ACC-10 and minimum (4.25) in ACC-18 respectively. The number of fruits harvested ranged from 567 to 4745. Similarly, yield per tree ranged from 9.97 kg (ACC-12) to 85.36 kg (ACC-14). Experimental results show that the fruit length ranged between 2.81 cm (ACC-3) to 3.80 cm (ACC-9). Similarly, the fruit breadth ranged from 1.39 cm (ACC-15) to 3.04 cm (ACC-20).The fruit weight varied from 12.25g (ACC-8) to 22.95g (ACC-3). Similarly peel weight was highest in ACC-3 (9.03g) and lowest in ACC-8 (4.04g). Similarly, the maximum (65.33%) and minimum (49.82%) pulp percentage was observed in ACC-18 and in ACC-17 respectively. It is evident from the study that the total soluble solids was maximum in ACC-2 (13.10°Brix) and minimum in ACC-12 (9.00°Brix). Similarly, the total sugar was

highest (7.22mg/100g pulp) and lowest (4.84mg/100g pulp) in ACC- 13 and in ACC-2 respectively. Reducing sugar was found to be highest (6.45mg/100g pulp) and lowest (3.99mg/100g pulp) in ACC-14 and ACC-20 respectively. While, the non-reducing sugar was highest (2.91 mg/100g pulp) and lowest (0.08mg/100g pulp) in ACC-13 and ACC-16 respectively, while acidity and Vitamin C was maximum (1.28mg/100g pulp, 57.80mg/100g pulp) and minimum (0.73mg/100g pulp, 23.18mg/100g pulp) in ACC-17, ACC-2 and ACC-16, ACC-4 respectively.

Discussion

The present investigation revealed that, there was significant variation among different Burmese grape accessions. The variation of plant height was observed from 2.59-7.39m and 4.92 to 13.06 m, respectively in male and female germplasms surveyed. Similar observations of variation of plant height of 5-25m were also reported by previous workers (Abdullah *et.al.*,2005 Anon., 2012; Chakrabarty and Gangopadhyay, 1997) from different parts of world. The variation presence in leaf colour, leaf sizes revealed from the present study confirms the differences among the germplasms. The previous workers also reported that the leaves of Burmese grape were simple, alternatively arranged with petiole and oblong or elliptic in shape (Anon., 2012; Chakrabarty and Gangopadhyay, 1997). Anon. (2012) reported that the inflorescence is tomentose and appears on branches and the length of inflorescences of the Burmese grape is similar with the present experiment and the variation of number of flowers present in a panicle may be due to the genetic differences of the germplasms surveyed. Time of flowering observed in this investigation is with the same line as reported by Bhowmick (2009) during March- April. Chakraborty and Gangopadhyay (1997) reported that the flowers are clauiflorous in nature and are 10 to 40 cm long. The variation of flowering duration of male and female germplasms was noted in the present investigation and it was also observed by Sundriyal and Sundriyal (2004). The high fruit set percentage may be due to the synchronization of anthesis of male and female flowers as well as abundance of pollinating agent. The shape of the fruit was oval or round and the aril colour during maturity varied from white to grayish white, while the colour of ripe fruits varied from yellow to yellow orange groups of Royal Horticulture Society colour chart (5th edition). Bhowmick, (2009) also observed that the fruits were roundish to oval and yellow to yellowish brown in colour when matured. The findings regarding germplasm variation showed that the fruits of *Baccaurea* were sub-globose, ovoid, ellipsoid or obovoid in shape and are 15–30 mm long and 15 to 25 mm broad are having similar trends reported by Chakraborty and Gangopadhyay (1997). In a study, Bhowmick (2009) reported that the colour of the Burmese grape fruits is yellow or yellowish brown at ripening. The colour variation of different fruit crops due to germplasm variability was also observed by several scientists (Dhillon and Dhillon, 2008; Shyamali *et al* 2009). The highest yield in ACC- 14 may be due to highest fruit retention percent (38.72%); as well as high number of fruits at harvest. The variation of fruit physio-chemical properties, yield parameters on different germplasm confirms the differences of germplasms which may be due to highly heterozygous in nature of Burmese grape in the present experimental areas. This variation is also supported by the earlier workers in different other fruit crops (Sanyal and Maity,1989; Sundriyal and Sundriyal,2001; Anila

and Radha,2003; Dabral and Misra, 2007; Babu et al., 2007; Pal et al., 2008; Dhillon and Dhillon, 2008; Rekha et al., 2011).

Declarations

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Tables

Due to technical limitations, table 1 to 4 is only available as a download in the Supplemental Files section.

Supplementary Files

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