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Recognize of Elite Carambola (*Averrhoe carambola*) Germplasms Grown under Rainfed Condition of West Bengal

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ABSTRACT: Experiment was conducted to identify elite carambola germplasm accessions during flowering and fruiting season from different location of Medinipur of West Bengal. To aim of this study was to evaluate flower and chemical analysis of various accessions of carambola in West Bengal. The 12 different germplasms are selected for detailed study of flowering and fruiting season, number of flowering flush, Fruits weight (gm), Fruit colour and shape, fruit length (cm), fruit Equatorial diameter (cm), No of seeds per fruit, TSS (°BRIX), titratable acidity (%), total sugar(%), reducing sugar(%), pH and Ascorbic acid (mg/100gm) in each accessions. Highest TSS was noticed in ACC-6 (10.03°BRIX), and ascorbic acid ACC-8 (16.64 mg/100gm) total sugar and reducing sugar respectively (6.74% 0 and (5.9%) in ACC-12, highest fruit weight was recorded in ACC- 5 (204.46 gm) and lowest fruit weight and reducing sugar ACC-3 (90.66), (2.86%). After all the parameters analysis ACC-12 is best for further study and research work for germplasms conservation due to three flush per year, fruit weight (155 gm) comfortable for marketing and total sugar and reducing sugar content highest suitable for raw consumption and expected to have tremendous market demand, Hence the following accessions can be conservation by asexual propagation or plant breeders to develop more improve germplasms.

Keywords: Accessions, carambola, germplasm.

INTRODUCTION

Carambola (*Averrhoa Carambola*) is a tropical minor fruit crop belong to the family Oxalidaceae often called five star fruit different place is known different names in India Kamrakh in Gujrat, Ambanamkaya in Telugu, Karambal in Marathi, and kamranga in Bengal, Karmanga in Oriya. The meaning of carambola in Sankrit is karmaranga that meaning 'food appetizer' (Monalisa *et al.,* 2014). The fruit originated in Malaysia or Indonesia, but it is now distributed throughout tropical and subtropical region of world and extensively cultivated country are china and India. In India cultivated higher elevation to lower elevation mainly area western coastal to Nilgiri hills. The fruit is non climacteric nature and content high value of ascorbic acid, calcium, magnesium (Bose *et al.,* 2002) and fruit juice content antimicrobial, hypoglycemic, anti-inflammatory medicinal properties use for treat diarrhea, vomiting, bleeding piles and relieving trust.

In West Bengal carambola fruits seen to be grown unutilized and west land in villages and road side area. Flower occur periodically which depending on the different accessions and agro-climatic condition of west Bengal. It is reported that carambola blossoms in rainy season and fruit ripens in December –January (Watt, 1889). Fruit development of summer flowering it may take 10 to 12 weeks from anthesis, while it may take 12 to 16 weeks with autumn flowering. Carambola fruit varies widely composition during maturation. Chemical composition of carambola juice *i.e.,* moisture content (92.1%), TSS (6°brix), Ascorbic acid (16mg/100gm), reducing sugar (5.68%), non-reducing sugar (2.04%) total sugar (7.72%) (Shirsat and Thakor 2014). These fruits are either consumed raw or prepare value added product like salad, drunk, pickle, nectar, preserve, jam and jelly for future uses these product market value is high and farmers cannot be grow as a commercial scale they are propagated by vegetative means bud grafting and cleaft method. In western countries fruit is

generally eaten ripe stage yellowish greenish colour. A confined difference are observed among carambola are growing different place. Also similar result found in Indian olive grown different place of north Bengal (Mani *et al.,* 2017). Study was conducted to identify elite germplasms basis on physical nutritional composition like fruit size, attractive fruit colour, performance of flowering and fruiting, Ascorbic acid(mg/100 gm, total sugar percent, TSS (^{0} Brix) , are growing different place of Medinipur.

MATERIALS AND METHODS

Robust carambola plant are selected different place of purba and paschim medinipur district of West Bengal. Among the best 19 carambola germplasms best 12 accessions are selected for further study depend on fruit weight, fruit size flowering initiation, and their nutritional quality at 19 different locations. Flowering and fruiting season and colour of carambola tree are determined by regular physical observation of carambola tree. Others physico Chemical parameter of fruits are determine in Post Graduate Labrotary, Department of Post-Harvest Technology, Faculty of horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur during year 2019-2020. The experiment was laid out in complete Randomized Design (CRD) with 3 replication, the individual plants were denote as ACC-1, ACC-2, ACC-3, to ACC-12, from different place of Medinipur (Ghatal, Panskura, Tamluk, Nandigram, Datan, Keshiary, Kharagpur, Narayangarh, Sabang, Pingla, Kharagpur, Debra,).

Physical parameters *i.e.,* Fruit weight, length and diameter, No of seeds/fruit and seed weight. Fruits weight: Three fruits from each individual plant are randomly selected and measure by electronics balance. Average weight is calculated. Equatorial diameter and length measure by verneier caliper and average weight are calculated Chemical parameters *i.e.,* Total sugar, pH, Ascorbic acid, Reducing sugar, TSS. Total soluble solids (TSS) were estimated by hand refractometer and pH determine by pH meter. Titratable acidity, Ascorbic acid, Total sugar and reducing sugar were determining method given by Ranganna (1986).

RESULTS AND DISCUSSION

After observation of flowering parameter different accessions of carambola (Table 1) showed that Number of flowering flush ACC-2, ACC-4, ACC-7,ACC-9,ACC-12 are three and ACC-1,ACC-3, ACC-5,ACC-6, ACC-8, ACC-10, ACC-11 are two in a year. First flowering season early April in case of ACC-3, ACC-7, ACC-11, Mid April ACC-1, Late April –ACC-4, early May ACC-3, ACC-8 , ACC-9, ACC-11, Mid May ACC-5, and Late May ACC-6, ACC-10. Second flowering flush are observed July in case of ACC-1, ACC-2, ACC-4, ACC-5, and August ACC-3, ACC-8, ACC-9, ACC-6, ACC-10,ACC-11, Second flowering very early are identifying ACC-7, ACC-12 in June months. Early fruiting is observed in case of ACC-7. Flowering and fruiting performance best in ACC-1, ACC-2, ACC-4, ACC-5, ACC-6, ACC-9, ACC-10, ACC-12. and Moderate performance ACC-3, ACC-7, ACC-8, ACC-11. Flower colour white purplish flowering colour in case of ACC-3, ACC-4, ACC-5, ACC-6, ACC-7, ACC-8, ACC-9, ACC-12 and purplish in ACC-1, ACC-2, ACC-12 and white reddish colour are present in accessions of ACC-4. Similar flowering and fruiting characteristic of carambola found (Nand-1990) and Hayes (1957) and green house condition carambola produce four flush in a year (Sauco and Menini, 1993). Similarly flowering characteristic found in jamun grown in Nadia district of West Bengal (Alam *et al*., 2020).

Table 1: Flowering performance of carambola accessions from different location.

Accessions	No of flowering flush	First flowering time	second flowering season	First fruiting Season	Flowering and fruiting performance	Flower colour
ACC-1	2	Mid –April	Early- July	Early-July	Abundance	Purplish
ACC-2	3	Early-April	Mid- July	Mid-July	Abundance	Purplish
ACC-3	2	Early-May	Late-August	Mid-Aug	Moderate	White Purplish
ACC-4	3	Late – April	Early-July	Late-July	Abundance	White Reddish
ACC-5	2	Mid-May	Late-July	Early-Aug	Abundance	White Purplish
ACC-6	2	Late-May	Early-august	Early-Sep	Abundance	Reddish
ACC-7	3	Early-April	Late-June	late-Jun	Moderate	White Purplish
ACC-8	2	Early-May	Mid-Aug	Late-Aug	Moderate	White Purplish
ACC-9	3	Early-May	Early-Aug	Early-July	Abundance	White purplish
ACC-10	2	Late-May	Early-Aug	Last-Aug	Abundance	Purplish
ACC-11	2	Early-May	Mid-Aug	Mid-Aug	Moderate	Purplish
ACC-12	3	Early-April	Mid-Jun	Late-July	Abundance	White Purplish

Physical properties of carambola accessions from different location are present in (Table 2) basis on data highest fruit weight, length and diameter was noticed in ACC-5 (204.6 gm) followed by ACC-4 (170.50) and minimum weight recorded in ACC-3 (90.66 gm). No. of seed highest present in ACC-7 (7.66) and minimum was recorded in ACC-4 (3.66) all the accessions from ACC-1 to ACC-12 no of rib presents 5 per fruit. Oval shaped fruit are noticed in accessions ACC-1, ACC-5, ACC-7, ACC-9, ACC-10, oval shaped big at the top

and narrow at the bottom noticed in ACC2, ACC-6, ACC-8 and ACC-12 and oblong shaped are ACC-3, ACC-4 and ACC-11. Fruit colour was greenish yellow noticed in ACC-1, ACC-2, ACC-6, ACC-8, ACC-9, ACC-11, ACC-12; Yellow with white freckle ACC-3, ACC-7; reddish orange ACC-4, ACC-5. ACC-10. Sharma *et al.,* (2015) found that fruit weight are 99.12 to 146 g, circumference 17.21-20.13 cm and length 10.69 to 12.53cm. Rathod *et al.,* (2011) fruit weight 96g to111 g, length 5.1 cm, and 4.7cm are diameter.

Table 2: Physical parameters of Carambola accessions from different location.

Accessions	Fruit weight (gm)	Fruit length (cm)	Fruit Equatorial Diameter (cm)	No of Seed/fruit	No of Rib per fruit	Fruit shape	Fruit colour
ACC-1	102.56	11.26	6.4	6	5	Oval	Greenish yellow
CC-2	155.53	12.8	6.36	6.66	5	Oval, big at the top and narrow at the end	Greenish Yellow
ACC-3	90.66	8.63	5.96	6.33	5	Oblong	Yellow with white freckle
ACC-4	170.50	13.16	7.36	3.66	5	Oblong	Reddish orange
ACC-5	204.46	13.46	7.53	4.33	5	Oval	Reddish yellow
ACC-6	120.36	11.36	7.16	6	5	Oval big at the top and narrow at the end	Greenish yellow
ACC-7	97.13	8.7	5.66	7.66	5	Oval	Yellow with white freckle
ACC-8	160.23	12.4	7.26	6	5	Oval big at the top and narrow at the end	Greenish yellow
ACC-9	130.80	11.8	6.46	6.66	5	Oval	Greenish yellow
ACC-10	147.36	12.4	7.23	6	5	Oval	Reddish orang
ACC-11	155.40	12.5	7.23	6	5	Oblong	Greenish Yellow
ACC-12	133.23	12.36	6.6	4	5	Oval big at the top and narrow at the end	Greenish yellow
S.Em (±)	3.534	0.19	0.18	0.74			
C.D. at 5%	4.40	0.57	0.54	2.18			

Chemical parameter different carambola accessions after chemical analysis data present in (Table 3) °Brix basis on TSS analysis find that highest value TSS content ACC-12(10.46°Brix) followed by ACC-11 (10.26°Brix), ACC-6 (10.03°Brix) and ACC-10 (9.33°Brix) and Minimum value was recorded in ACC-4 (7.53°Brix) followed by ACC-8 (7.6°Brix). (Narian *et al*., 2001) reported that ripe carambola TSS content 10.54 to 11.12°Brix , and Basena *et al.,* (2019) observed that TSS in carambola are increase advancement of maturity 6.9 to 7.36°Brix. Titratable acidity in carambola from different location present huge different Highest value of acidity found in ACC-3 (0.480%) followed by ACC-11 (0.440%) and ACC-9 (0.430%) and minimum value was recorded in ACC-4 (0.327%) followed by ACC-7 (0.333%). Highest Value of pH found in ACC-4 (4.1 pH) followed by ACC-9 (4 pH) and lowest value ACC-8 (2.8 pH) followed by ACC-3 (2.9 pH) Narian *et al*., (2001) same result found in carambola acidity also increase during advancement of maturity and ripe carambola content 0.34 to 0.36% Acidity, Soumy and Nair 2014 also found that acidity content in sour carambola fruits 0.378% acidity and pH 2.59 and sweet carambola 0.253% acidity and pH 3.7. Highest value of total sugar was observed in ACC-12 (6.74%) followed by ACC-11 (6.5%) and lowest value ACC- 4 (5.44%) followed by ACC -8 (5.51%) and Highest value of Reducing sugar ACC-12 (5.9%) followed ACC-11 (5.16%) and ACC-(4.16%) and lowest value was recorded ACC-3 (2.86%) followed by ACC-9 (3.23%), ACC-2(3.53%).

Table 3: Chemical parameters of carambola accessions from different location.

Accessions	TSS (°brix)	Acidity(%)	Total sugar(%)	Reducing sugar(%)	pH	Ascorbic acid (mg/100 gm)
ACC-1	8.76	0.410	5.71	3.83	3.06	14.13
ACC-2	9.2	0.367	5.87	3.53	3.2	12.93
ACC-3	7.9	0.480	5.62	2.86	2.8	13.45
ACC-4	7.53	0.327	5.44	3.76	4.1	14.62
ACC-5	9.33	0.387	5.98	3.76	3.1	16.48
ACC-6	10.03	0.403	6.36	4.16	3.3	16.19
ACC-7	8.5	0.333	5.97	3.4	3.1	12.86
ACC-8	7.6	0.373	5.51	3.76	3.06	16.64
ACC-9	8.16	0.430	5.75	3.23	4	13.16
ACC-10	9.33	0.427	6.14	3.93	3.1	13.68
ACC-11	10.26	0.440	6.5	5.16	2.9	12.62
ACC-12	10.46	0.390	6.74	5.9	3.6	13.58
Sem(±)	0.15	0.054	0.15	0.17	0.44	0.16
C.D .at 5%	0.44	0.019	0.46	0.5	0.15	0.48

Highest value of ascorbic acid content recorded in ACC-8 (16.64 mg/100g) followed by ACC-5 (16.48 mg/100g) and lowest value was recorded in ACC-11 (12.62mg/100gm) followed by ACC-7 (12.86mg/100g). Basena *et al*., (2019) found that ripe carambola content total sugar (6.39%) and reducing sugar (5.93 %) and ascorbic acid v(35.41mg/100g) and Narian *et al*., (2001) reported that total sugar 6.33 and ascorbic acid content (23.6 mg/100g) Patil *et al*. (2010) total sugar content (2.25%) and reducing sugar (1.32%) and ascorbic acid content (18mg/100g). similar chemical changes found in water apple grown in different location of West Bengal (Mani *et al*., 2020) .

SUMMARY AND CONCLUSION

Depend on above data ACC-11 (Tamluk) considered most elite germplasm due to three flowering in a year and raw consumption is suitable, average fruit size is medium (133.23gm) total sugar and reducing sugar respectively (6.74%) and (5.9%) and Total Soluble Solid (10.46^0 BRIX). Therefore it can be considered that accession-12 collected from Tamluk is elite accession among twelve accessions beside ACC-11 are also elite germplasm.

FUTURE SCOPE

Carambola is an important minor tuber crop, its consume raw or prepared value added product like pickle, nectar, preserve, jam and jelly that market value is high, farmer do not identifying good quality germplasms this research promote selected improve germplasms for future perspective. The improve accessions can be conservation by asexual propagation and can be harnessed in future breeding programs.

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Conflict of Interest. None.

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