

## STUDY ON RACHIS CHARACTERS OF DIFFERENT VARIETYS OF BANANA

### Abstract

Banana is one of the most important staple food around tropics. Bananas can be eaten as green when it is starchy. These crops are the most important components for food security around world by providing income to the farming community through local trade. This experiment was conducted to study the rachis behaviour and male bud characteristics of ABB genomic group and AAB genomic group banana cultivars. Here 5 varieties under ABB genomic group (Behula, Bara Beglo, Bluggoe, Green Bombay, Pantharaj) and 5 varieties of AAB genomic group (Dudhsagar, Martaman, Manohar, Desi Malbhog, Kalibhog) were observed. All of these 10 varieties showed different characteristics in case of male bud, like male bud shape, male bud size, colour of the bract (external face), male bract lifting, wax on the bract, male flower behaviour, compound tepal basic colour, anther colour, stigma colour, ovary shape and dominant colour of male flower, all these were explained in details in this study.

**Key word:** Banana, rachis and male bud

[Insert a map showing the location of the study area and describe the area \(soil, vegetation, climate, topography, etc\) and see if a link can be made between the variation in the characteristics of the different varieties.](#)

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### Introduction

Banana (*Musa spp.* L) is a antique fruit grown in the world. It is the 4<sup>th</sup> most important crop after rice, wheat and corn in the world (Paul *et al.*, 2023). It belongs to Musaceae family and edible banana native to South East Asia. It is possibly the world's oldest cultivated crop (Kumar *et al.*, 2012). It is divided into edible cultivars and non-edible wild species. The edible bananas include dessert, cooking and beer making cultivars, which mostly originated from Southeast Asia (Perrier *et al.* 2009). Their ancestors are *Musa acuminata* Colla denoted as AA and *Musa balbisiana* Colla (BB). The natural hybridization between and within *M. acuminata* and *M. balbisiana* resulted in several cultivars with different genomes and ploidy levels (Hippolyte *et al.* 2012). The possible genomic groups for bananas include; AA, BB, AB, AAA, AAB, ABB AABB, AAAB and ABBB (Cresteet *al.* 2003). Among AAB triploids, there are 11 subgroups as reported by Uma *et al.*, (2005). Many banana cultivars with ABB genomes, such as 'Kluai Tip Yai', 'Kluai HakMuk', and 'Kluai Nam Wa,' are grown in Thailand (Somsonget *al.*, 2015). The edible bananas are indigenous to Asia, which is the fourth most important commodity in the world after rice, wheat and corn. Banana are one of the most important commercial food crops, especially in the tropics. It is a monocotyledonous, perennial, herbaceous succulent plant and one of the world's important fruit crops. It comes under the order Zingiberales and botanically named as *Musa paradisiaca*. It also rich in Carbohydrate (21.8gm/100g), Protein (1.1gm/100gm), Potassium (385 mg/100gm),  $\beta$ -carotene (68 $\mu$ g), Niacin (610 $\mu$ g), Vit-C(11.7mg/100gm) and Water (74 gm) (Aurore *et al.* 2009). Banana contains 20% sugars. Bananas are nutritionally low protein food material but relatively high in carbohydrates, vitamins and minerals (Offemet *al.*

1993). Recently banana flower is an important agricultural by-product that is often consumed as vegetable in many Asian countries such as Malaysia, Indonesia, Sri Lanka, Philippines and other South East Asia countries and rich source of different minerals and nutrients. Thus acquiring knowledge on rachis of bananas can provide additional benefits on characterization and increasing its use. The present study aimed to characterize the different genomic groups of banana.

### Materials and methods

The present experiment was carried out at ICAR-AICRP on Fruits, Mohanpur Centre, Bidhan Chandra Krishi Viswavidyalaya, Mondouri, Nadia, West Bengal during the period of 2019-2021. The experimental site was situated at 23.50° North latitude and 89° East longitude with an altitude of 9.75 meter above the mean sea level. Ten varieties were planted in a spacing of 2.5m×2m, taken for present investigation and these were Behula (ABB), Bara Beglo (ABB), Bluggoe (ABB), Green Bombay (ABB), Pantharaj (ABB), Dudhsagar (AAB), Martaman (AAB), Manohar (AAB), Desi Malbhog (AAB) and Kalibhog (AAB). The rachis and male bud parameter were taken by daily visual observation. Rachis and male bud parameters of twelve characters were selected for characterization of rachis and male bud of different varieties of bananas by using NBPGR descriptor.

**Comment [kl1]:** he methodology must be detailed for better understanding

### Result and discussion

Table 1 present the rachis and male bud parameters of different variety under the ABB genomic group. The number of scars on rachis varied from 60 for Green Bombay to 34 for Bluggoe. The shape of male bud of all variety were ovoid. The length of male bud was varied from 21-30 cm for all variety. Red-purple colour of the external face of bract were Behula, Bara Beglo, Bluggoe and Pantharaj, whereas in case of Green Bombay was purple colour. Male bract was lifting one time for Behula and Green Bombay, where two or time for Bluggoe, Pantharaj and Bara Beglo. Most of the variety of ABB genomic group were very wax bract except Pantharaj which was moderate waxy bract. The male flower behaviour all variety of ABB genomic group were falling before bract. The compound tepal basic colour of all variety was cream except Behula which has white colour. Anthar colour was not varied among the variety, all were yellow. The stigma colour was cream for Behula, Bluggoe, Pantharaj, and Green Bombay, whereas pink-purple for Bara Beglo. The ovary shape was straight in Pantharaj, but arched in Behula, Bluggoe, Bara Beglo and Green Bombay. The dominant colour of male flower were pink in Behula, Bluggoe, Bara Beglo and Green Bombay but purple-brown in Pantharaj.

**Comment [kl2]:** The discussion needs to be improved, as only one author is cited (Premjet et al., 2022) in this study. Also, the results obtained in this study should be compared with the results of other authors.

In an experiment it was found that Mali-Ong (ABB genomic group) The male bud shape is ovoid. The male flower is yellow-orange. The male bud length at harvest is 27–29 cm. Bract base shape: tiny shoulder, obtuse apex, dark red exterior face, dark red interior face, deep grooves, and a waxy texture. Before falling, the bract rolls and creates very prominent scars on the rachis. Male flowers fall after the bracts. Free tepal is oval in shape, translucent white, obtuse, and has a developed apex. There are five anthers, which are yellow with red at the lobe margin, anther exertion is at the same level, and the filament is yellow-green. The ovary shape is curved, the basic color is yellow, the style is straight, and the stigma is yellow. The arrangement of the ovules is four-rowed (Premjet et al., 2022).

**Comment [kl3]:** Explain why the male bract is raised once for Behula and Green Bombay whereas it is raised more than once for Bluggoe, Pantharaj and Bara Beglo?

**Table1:RachisandmalebudparametersofABB**

	<b>Behula(AB B)</b>	<b>BaraBeglo( ABB)</b>	<b>Bluggoe(ABB )</b>	<b>GreenBombay(A BB)</b>	<b>Pantharaj(A BB)</b>
<b>Scaresonrachisnumber</b>	35	35	34	60	37
<b>Male bud shape</b>	Ovoid	Ovoid	Ovoid	Ovoid	Ovoid
<b>Malebudsize</b>	21-30cm	21-30(29) cm	21-30cm	21-30(29) cm	21-30cm
<b>Colourofthebract(externa lface)</b>	Red-purple	Red-Purple	Red-purple	Purple	Red-purple
<b>Malebractlifting</b>	Oneatatime	Lifting two or more at a time	Twoatatime	Liftingoneatati me	Twoatatime
<b>Waxonthebract</b>	Verywaxy	Very waxy	Verywaxy	Verywaxy	Moderate waxy
<b>Maleflowerbehavior</b>	Fallingbefo rebract	Falling before the bract	Fallingbefore bract	Fallingbeforebr act	Fallingbefo rebract
<b>Compoundtepalbasiccolo ur</b>	White	Cream	Cream	Cream	Cream
<b>Antharcolour</b>	Yellow	Yellow	Yellow	Yellow	Yellow
<b>Stigmacolour</b>	Cream	Pink-purple	Cream	Cream	Cream
<b>Overysshape</b>	Arched	Arched	Arched	Arched	Straight
<b>Dominantcolourofmalesf lower</b>	Pink	Pink	Pink	Pink	Purple- brown


Table2 present the rachis and male bud parameters of different variety under the AAB genomic group. The result showed that scares on rachis was varied from 33 (Manohar) to 47 (Desi Malbhog). The male bud shape was ovoid (Dudhsagar and Desi Malbhog), like a top (Manohar and Kalibhog) and intermediate (Martaman). The male bud size varied from 15 cm (Manohar) to 26 cm (Dudhsagar). Generally, the AAB Apple banana groups have a bare rachis at the time of fruit maturity, the SukariNdizi rachis is always bare, even just a few weeks after flowering (Onyango *et al.*, 2011). The bract colour of external face was purple in Dudhsagar, Martaman, Manohar, Desi Malbhog and Kalibhog. In AAB genomic group male phase is short with whip like rachis ending with a 'top' shaped male bud (Ravishankar *et al.*, 2017). In Dudhsagar, male bract lifting was one at a time and two at time lifting in Martaman, Manohar, Desi Malbhog and Kalibhog. Very waxy on the bract was present in Dudhsagar, Kalibhog and Manohar whereas, moderate wax on the bract was present in Martaman and Desi Malbhog. The male flower behavior was persistent (Dudhsagar) and falling before bract (Martaman, Manohar, Desi Malbhog and Kalibhog). All variety of AAb genome were cream colour compound tepal and anther, and ovary shape was arched. Stigma colour varied among

the different variety were cream (Manohar), yellow (Dudhsagar) and black (Desi Malbhog and Kalibhog). Purple brown colour dominant of male flower observed in Manohar and Kalibhog, whereas Dudhsagar, Martaman and Desi Malbhog were cream colour.

**Table 2: Rachis and male bud parameters of AAB**

	Dudhsagar (AAB)	Martaman (AA B)	Manohar (AA B)	Desi Malbhog (AAB)	Kalibhog (AAB)
<b>Score on rachis number</b>	42	42	33	47	39
<b>Male bud shape</b>	Ovoid	Intermediate	Like a top	Ovoid	Like a top
<b>Male bud size</b>	26cm	24cm	15cm	23cm	24cm
<b>Colour of the bract (external face)</b>	Purple	Purple	Purple	Purple	Purple
<b>Male bract lifting</b>	One at a time	Two at a time	Two at a time	Two at a time	Two at a time
<b>Wax on the bract</b>	Very waxy	Moderate wax	Very waxy	Moderate wax	Very waxy
<b>Male flower behaviour</b>	Persistent	Falling before bract	Falling before bract	Falling before bract	Falling before bract
<b>Compound tepal basic colour</b>	Cream	Cream	Cream	Cream	Cream
<b>Anthar colour</b>	Cream	Cream	Cream	Cream	Cream
<b>Stigma colour</b>	Yellow	Black	Cream	Black	Black
<b>Overy shape</b>	Arched	Arched	Arched	Arched	Arched
<b>Dominant colour of male flower</b>	Cream	Cream	Purple brown	Cream	Purple brown



				
Fig.6 GreenBombay	Fig.7 Martaman	Fig. 8 Bloggue	Fig. 9 BaraBeglo	Fig. 10 Dudhsagar

### Conclusion

These results indicate that out of 12 different characters of male bud the characters i.e. wax on the bract, compound tepal basic colour, ovary shape, anther colour are the most dominant characters in these 10 varieties. It will help us to characterize different varieties, also to evaluate the relationship among the different genotypes.

### Reference

- Creste S, Neto T, Silva S, Figueira A. Genetic characterization of banana cultivars (*Musa* spp.) from Brazil using microsatellite markers. *Euphytica*, 2003. 132:259-268.
- Hippolyte I, Jenny C, Gardes L, Bakry F, Rivallan R, Pomies V, Cubry P, Tomekpe K, Risterucci AM, Roux N, Rouard M, Arnaud E, Kolesnikova-Allen M, Perrier X. Foundation characteristics of edible *Musa* triploids revealed from allelic distribution of SSR markers. *Ann Bot.* 2012. 109 :937–951.
- Offem, JO, Njoku PC. Mineral distribution in the fruits of the plantain plant (*Musa paradisiaca*) in relation to mode and degree of maturation. *Food Chem.* 1993. 48(1):63-68.
- Paul R, Mondal T, Bauri FK, Mahato S, Mohanta R. Performance of AAB genomic group of banana under Gangetic Plain of West Bengal. *J. Crop and Weed*, 2023. 19(2): 72-77
- Perrier X, Bakry F, Carreel F, Jenny C, Horry JP, Lebot V, Hippolyte I. Combining biological approaches to shed light on the evolution of edible bananas. *Ethnobot. Res. Appl.*, 2009. 7:199–216.
- M Onyango, D Karamura, S Keeley, R Manshardt and D Haymer. Morphological Characterisation of East African AAB and AA Dessert Bananas (*Musa* spp.). *Acta Horticulturae*, 2011. 897(897):95-106
- Kumar, K. P. S., Bhowmik, D., Duraivel, S. and Umadevi, M. Traditional and medicinal uses of banana. *Journal on Pharma cogon Phytochemistry*, 2012. 1: 51-63.
- KV Ravishankar, A Rekha Rema Menon, CK Anoop, K Sudeepa and R Poornima. Genetic diversity studies among AAB group Indian banana cultivars using ISSR markers, *Journal of Horticultural Science*, 2017. 12(1): 54-58,
- Uma S, Sathiamoorthy S and Durai P. Banana- Indian genetic resources and catalogue, (ICAR-NRCB) 2005. 268.
- Somsong, P., Misala, P., Keeratisoontornwat, K., Inwan, M., Hempattarasuwan, P., Duangmal,

**Comment [kl4]:** The conclusion should be detailed, while opening the door to future research and highlighting the difficulties and limitations of this study.

K. Processing of dehydrated banana (Musa ABB “Kluai Nam Wa”) and market study in Nan Province, Thailand. *Acta Hort.* **2015**, *1088*, 619–622.

Premjet D, Boonsrangsom T, Sujipuli K, Rattanasut K, Kongbunkerd A, Premjet S. Morphological and Molecular Characterizations of Musa (ABB) ‘Mali-Ong’ in Thailand. *Biology*. 2022 Sep 29;11(10):1429.

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