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Phule pride for sustainable production of banana

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Abstract
With the benchmarks of a clone having dwarf plant stature, better finger size, early maturity and tolerance to higher temperature, higher wind velocity and Sigatoka leaf spot disease from Cavendish group, a survey for selection of promising clone in banana was carried out under AICRP research programme. A natural mutant of 'Grand Naine' variety with the promising traits was spotted in 2012 in an experimental block at the Banana Research Station, Jalgaon, which was designated as BRS2013-3. The passport data, comparative studies of the clone with other varieties *viz*., Grand Naine and Ardhapuri, for vegetative and yield traits were made for 04 years. The four-year pooled data revealed that the clone BRS2013-3 showed superiority over Grand Naine and Ardhapuri in respect of pseudostem height (1.53 m), earliness (days to flowering - 230 & days to harvest - 320) percent bunch harvest (100%), harvesting index (57.53), production index (6.68) and resistance to pseudostem breaking, bunch breaking and lodging. With the highest B:C ratio of 2.78, the clone 'BRS2013-3'was found to be a good alternative to Grand Naine for the banana growers of Maharashtra and this clone was released under the name 'Phule Pride'.

Keywords: Grand naine, phule pride, mutant, lodging, dwarf

Introduction
Jalgaon district of Maharashtra in India, popularly known as 'Banana bowl', is presently experiencing higher temperature and frequent cyclones, with hail storm during summer months and prevalent Grand Naine variety falling prey to the vagaries of such climate resulting in lodging, pseudostem breaking and bunch breaking. This has resulted in losses to banana growers to the tune of Rs. 15 crores per year (DSAO, Jalgaon, 2017) [1]. This necessitates the development of a clone from Cavendish group having dwarf plant stature, better finger size, early maturity and tolerance to higher temperature, higher wind velocity and Sigatoka leaf spot disease. In subtropics, the ideal banana should have a short and sturdy pseudostem, a large cylindrical bunch and short cycle (Robinson *et al*., 1993) [9]. Besides these horticultural characteristics, an improvement in fruit quality (finger length, finger girth, green life, shelf life), as well as tolerance to pests, diseases and climatic stress are also aims of genetic improvement.

Conventional breeding techniques through pollination are not applicable to the Cavendish subgroup due to low female flower fertility. Traditional Cavendish cultivars such as 'Dwarf Cavendish', 'Grand Naine', 'Poyo', 'Valery' and 'Williams', originated through naturally-occurring somatic mutations (Robinsons and Galan Sauco, 2009) [10]. Recent selection work in the subtropics revealed that the frequency of spontaneous mutations in traditionally propagated plants, not easily identified by obvious morphological differences, is higher than indicated before. A good example of a successful field selection programme is the one conducted in Canary Islands within 'Dwarf Cavendish' plantations, which led to the identification and commercial release of the cultivar 'Gruesa' and other promising selected clones (Cabrera Cabrera and Galan Sauco, 2006) [2]. A comparative study of banana cultivars Dwarf Cavendish, Grand Naine and Wiliams in Canary Islands found that Dwarf Cavendish (DC) was smaller than Grand Naine (GN) and GN was smaller than Williams (W) and these differences were in all cases significant for DC while the relationship height/circumference at bunch emergence showed significant differences (DC < GN < W) between cultivars in all cycles at 2,000 plants/ha. (Galan Sauco *et al*., 1995) [4]. The morphology, phenology and production potential of banana cultivars 'Dwarf Cavendish' and 'Williams' were compared under similar conditions of climate, soil and management at Burgershall Research Station, Eastern Transvaal. Pseudostem height increased progressively for both cultivars over 3 crop cycles, with 'Williams' plants being 41% taller than 'Dwarf Cavendish' in the second ratoon (Robinson and Nell,1985) [8].

Dwarfing is the most common variation in the 'Cavendish sub-group. It accounted for between 75% (Stover, 1987) [12] and 90% (Israeli and Nameri, 1985) [6] of the total variants. Various cultivars are characterized by typical variations in stature. Thus, in 'Wiliams' and 'Grand Naine' the most common off type is very similar to 'Dwarf Cavendish', while in the Israeli selection, 'Nathan' (derived from 'Dwarf Cavendish') is the most common variant and is an extra-dwarf variant (Israeli *et al*., 1991) [7].

Material and Methods

The clone BRS2013-3 (Phule Pride), a naturally mutated clone of Grand Naine, was detected in the field at Banana Research Station, Jalgaon, in 2013, and subsequently came to be referred as 'Phule Pride'. It was compared and studied with local dwarf Cv. Ardhapuri and commercial cultivar Grand Naine for four consecutive years from 2013 to 2017 in a Randomized Block Design at Banana Research Station, Jalgaon. Similarly, the multi-locational trials were also conducted at three different locations *viz*. College of Agriculture, Dhule, RFRS, Ganeshkhind, Pune, and Horticultural Nursery Farm, Rahuri, with the same set of treatments.

Morphological differences between the cultivars were determined by measurement of plant height at flowering and mean functional leaf area (MFLA) at harvest. Respective leaf area index (LAI) was then calculated by using the formula: MFLA per plant x density (pl/ha)/10000. Phenological records included days to shoot, days to maturity and days to harvest (total plant duration).

The records of yield components included bunch weight, hands per bunch, finger length and finger girth. The length of all fingers on the third hand of all bunches was measured according to the Stover and Simmonds (1987) [12] method. The production index was calculated by the formula: Bunch weight in kg/crop cycle (days) x 100. All morphological and yield parameters of the trials were statistically analyzed by standard analysis of variance using LSD-test.

Results and Discussion

Morphological and Phonological traits

The pooled results showed that Phule Pride recorded significantly lowest pseudostem height (1.55 m) over the other two varieties. With its plant architecture being dwarf and slender unlike Grand Naine, which is tapering towards top, Phule Pride was found resistant to pseudostem breaking and bunch breaking. During hot summers, Grand Naine faces the problem of lodging, but Phule Pride was found to be resistant to lodging. While pseudostem circumference was found to be significantly highest (72.11 cm) in Grand Naine, Phule Pride (67.70 cm) was at par with Ardhapuri (68.97 cm). Significantly, maximum leaf area (17.64 m2) and maximum leaf area index (7.84) was found in Grand Nine while the Phule Pride recorded 1.53 m2 and 5.13 l m2eaf area and LAI respectively. The Phule Pride recorded significantly the least days to shoot (229), while it was maximum (260) in Grand Naine. Similarly, significantly least days to maturity per bunch (92 days) were recorded in Phule Pride, while it was maximum (118 days) in Grand Naine. The total days to harvesting of bunch were significantly least (321 days) in Phule Pride, while it was maximum (385 days) in Grand Naine. The values recorded here (Table1) coincide broadly with those reported by different authors for the same characteristics in the subtropics (Galan Sauco, 1992) [5], with clear difference between Grand Naine and Phule Pride in both pseudostem and leaf parameters and as reported elsewhere for closely related cultivars Turner and Hunt, 1984 [14]; Stover and Simmonds, 1987 [12]; Stover, 1988 [11]; Daniells, 1990 [3]; Robinson and Nells, 1985 [8]. Under the trial conditions, the parameter pseudostem height/width at flowering seems to be the most sensitive indicator that can be used to discriminate between these cultivars. It may be worthwhile to mention here that this height/circumference relationship may be an indicator of wind resistance, i.e., the higher the ratio, the more prone to wind-caused uprooting; if this is the case, then Phule Pride showed the best adaptation, followed by Ardhapuri and Grand Naine. Being dwarf, Phule Pride has lower biomass than Grand Naine and therefore is found nearly two months earlier than Grand Naine.

Yield traits

Number of hands per bunch were significantly maximum (11.62) in Grand Naine and it was significantly minimum in Ardhapuri (9.30), which was almost at par with Phule Pride (9.17). The pooled results showed that the finger length was found to be significantly maximum (21.7 cm) in Grand Naine, while Ardhapuri (21.3 cm) and Phule Pride (21.4 cm) were found to be significantly at par with each other. The finger girth was significantly maximum (12.70. cm) in Grand Naine while it was again significantly at par between Phule Pride and Ardhapuri, with figures of 12.6 cm and 12.3 cm, respectively. The bunch weight was found to be significantly maximum (25.12 kg) in Grand Naine, while Phule Pride recorded a bunch weight of 22.60 kg, which was at par with Ardhapuri (21.79 kg). Significantly the highest yield tons per ha (109.75 tons /ha) was recorded in Grand Naine, followed by Phule Pride (98.06 t/ha), which was at par with Ardhapuri (97.37 t/ha).

Grand Naine recorded 3.0% lodging losses, while the figure was nil for Phule Pride and Ardhapuri. Consequently, there was 100% harvest in Phule Pride and Ardhapuri and 97% in Grand Naine. With its plant architecture being dwarf and slender unlike Grand Naine, which is tapering towards top, Phule Pride was found resistant to pseudostem breaking and bunch breaking. As Grand Naine faces lodging problem during hot summers, while Phule Pride is resistant to lodging, the actual harvested yield of BRS-2013-3 was found to be significantly highest (97.95t/ha) compared to that of Grand Naine (85.88t/ha). Similarly, Phule Pride recorded the highest (6.89) production index, while the figure was 6.44 for Grand Naine (6.44).

Biochemical traits

The pulp to peel ratio was significantly highest (2.33) in Phule Pride and at par with Grand Naine (2.28), while the pulp percentage was found to be maximum in Phule Pride (57.03%) than in Grand Naine (52.17%) and Ardhapuri (54.02%).

Percent Disease Intensity (PDI)

The PDI for Sigatoka leaf spot was significantly least (3.62%) in Phule Pride, while it was the highest in Grand Naine (9.64%), which was at par with that of Ardhapuri (11.90%).

Thrips infestation

Significantly, the least infestation (10.36) was recorded in

Phule Pride than in Grand Naine (23.04) and Ardhapuri (20.36).

Economics

Phule Pride recorded the highest net income of Rs.4, 78,739 per ha with maximum B: C ratio of 2.68, while Grand Naine registered a net income of Rs.2, 80,678 with B: C ratio of 1.72. The cost of cultivation of Grand Naine is more than that of Phule Pride due to expenditure required for bunch support system, dehanding operation, more quantity of farm inputs and labour charges required for two more months for harvesting.

Table 1: Results of pooled mean of vegetative traits among different cultivars of banana

Cultivars	Plant height (m)	Pseudostem girth (cm)	Total leaf area (m^2)	Leaf Area Index
Phule Pride	1.53	66.87	11.72	5.21
Grand Naine	2.33	71.62	17.66	7.84
Ardhapuri	1.84	69.22	14.11	6.27
S.E+	0.04	0.73	0.32	0.14
C.D at 5%	0.14	2.55	1.12	0.50

Table 2: Results of pooled mean of phenological traits among different cultivars of banana

Cultivars	Days to shooting	Days to maturity (From shooting to harvesting)	Days to harvesting (Total crop duration)
Phule Pride	230	90	320
Grand Naine	266	120	386
Ardhapuri	258	106	364
S.E+	2.99	3.64	2.22
C.D at 5%	10.35	12.61	7.7

Table 3: Results of pooled mean of yield traits among different cultivars of banana

Cultivars	Hands per bunch	Finger length (cm	Finger girth (cm)	Bunch weight (kg)	Yield ($t^{-}ha$)	Harvest (%)	Harvest index	Actual harvested yield	Production Index
Phule Pride	9.17	21.40	12.6	22.04	97.95	100	57.53	97.95	6.89
Grand Naine	11.62	21.77	12.7	24.81	108.82	78.87	44.64	85.88	6.44
Ardhapuri	9.3	21.22	12.2	21.59	96.32	100	46.93	96.31	5.93
S.E+	0.29	0.07	0.06	0.27	1.45	-	-	2.06	-
C.D at 5%	1.02	0.26	0.21	0.95	5.00	-	-	7.11	-

Table 4: Results of pooled mean of physic-chemical traits, shelf life and organoleptic test among different cultivars of banana

Cultivars	Pulp to peel ratio	Pulp (%)	T.S.S (%)	Acidity (%)	Total Sugar (%)	Shelf life (Days)	Organoleptic taste (1-10scale)
Phule Pride	2.33	57.03	19.40	0.32	16.95	7.92	7.76
Grand Naine	2.28	52.17	19.67	0.34	17.15	7.79	7.76
Ardhapuri	2.18	54.02	19.36	0.36	16.58	7.75	7.17
S.E+	0.02	-	0.10	0.010	0.08	0.17	0.14
C.D at 5%	0.09	-	NS	NS	0.27	NS	0.44

Table 5: Results of pooled mean of reaction to pest and disease among different cultivars of Banana

Cultivars	Thrips infestation %	Sigatoka leaf spot PDI %
Phule Pride	10.36 (18.64)	3.62 (5.43)
Grand Naine	23.04 (28.49)	9.64 (11.75)
Ardhapuri	11.93 (20.36)	11.90 (10.38)
S.E+	0.65	0.80
C.D at 5%	2.25	2.79

Table 6: Economics of cultivation of different varieties

Treatment	Varieties	Yield t/ha	Gross Monetary returns (Rs./ha)	Total cost of cultivation (Rs./ha)	Net Income Rs./ha	BC ratio
T_1	Phule Pride	97.95	7,64,010	2,85,271	4,78,739	2.68
T_2	Grand Naine	85.88	6,69,864	3,89,186	2,80,678	1.72
T_3	Ardhapuri	96.31	7,51,218	2,92,271	4,58,947	2.57
Selling rate of banana: Rs. 7,800/t						

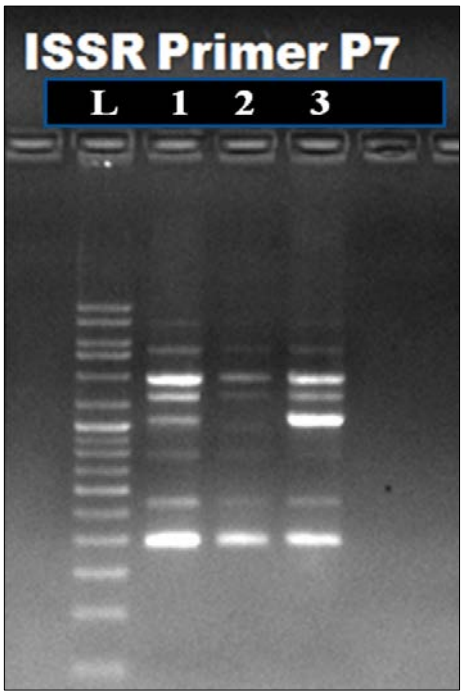

Fig 1: Molecular characterization of Banana clones using ISSR marker (Primer – P7)

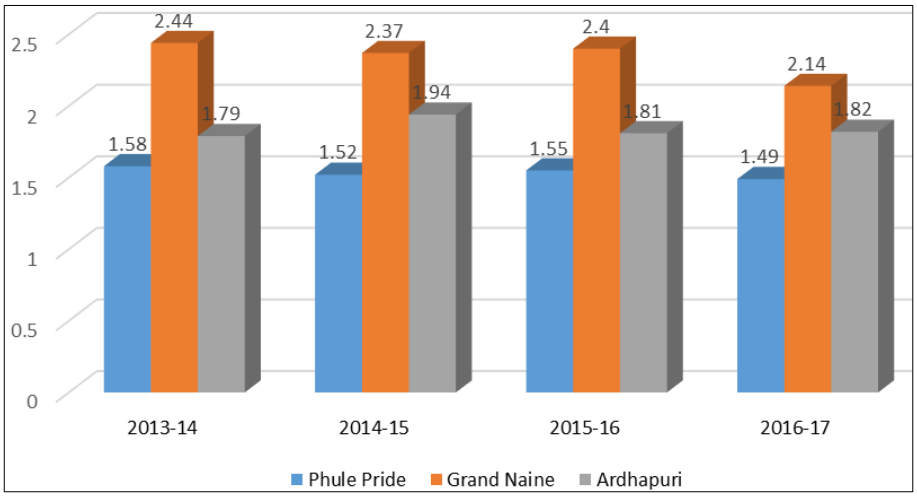

Plate 1: Pseudostem height of promising clones ('m')

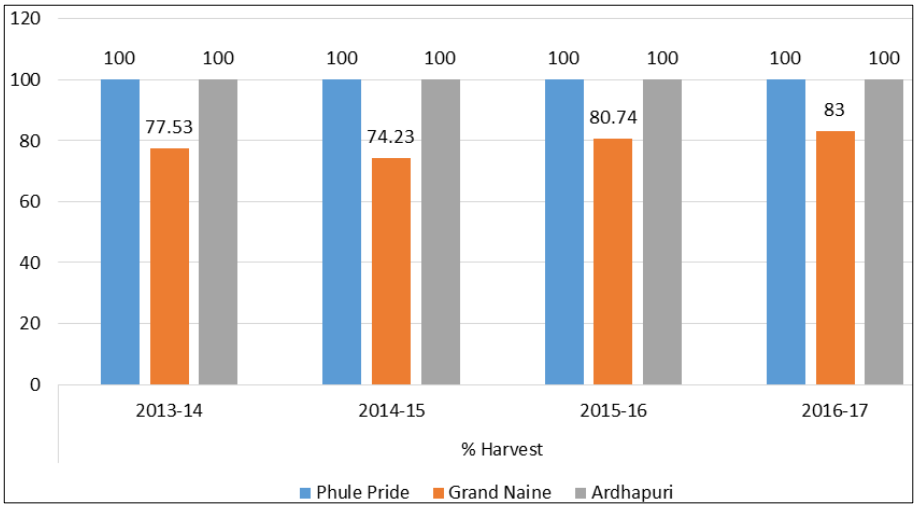

Plate 2: Percent harvest in the varieties

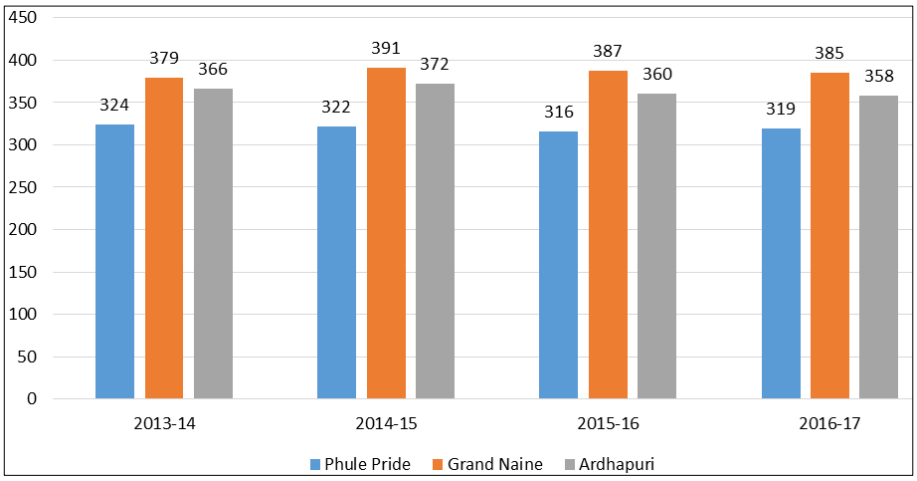

Plate 3: Total Crop duration of the varieties

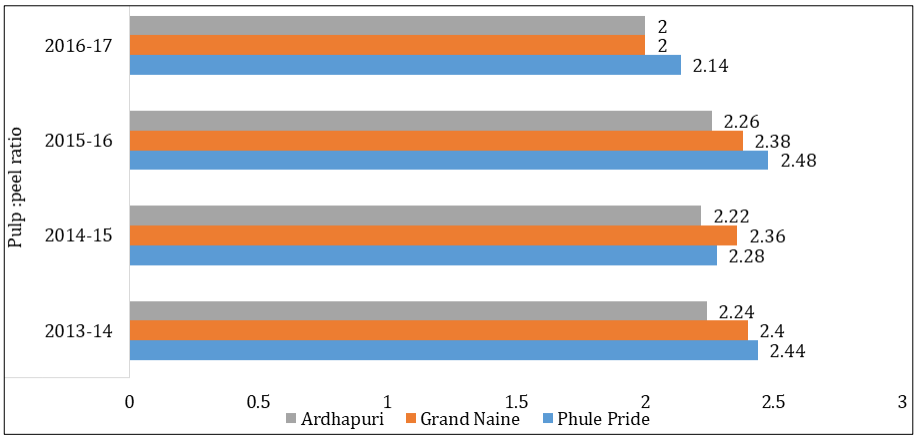

Plate 4: Pulp to peel ratio of the varieties

Plate 5: Hand and fingers of 'Phule Pride' variety of banana

Summary and Conclusion

The natural mutant of Grand Naine, BRS2013-3, which was later named as Phule Pride, showed consistent results for four years of trials conducted at Jalgaon and at three different locations. It showed superiority over Grand Naine and Ardhapuri in respect of very dwarf plant height (1.53m), earliness (days to flowering - 230 & days to harvest -320 under sucker planting), percent bunch harvesting (100%), harvesting index (57.53), production index (6.68). With the highest B: C ratio of 2.68, the 'Phule Pride' was found to be a good alternative to Grand Naine for banana growers in Maharashtra and elsewhere in India.

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References

1. DSAO. Annual Report of District Superintending Agricultural Officer, Jalgaon, Maharashtra; c2017.

2. Cabrera Cabrera J, Galano Sauco V. Banana: A Sustainable Business. Proceedings XVII ACORBAT International Meeting. 15-20 October 2006, Joinville, Brazil; c2006. p. 56-62.
3. Daniells JW. The Cavendish subgroup: Distinct and less distinct cultivars. In: Identification of Genetic Diversity in the Genus Musa. Proceedings of an international workshop held at Los Banos, Phillipines, 5-10 September 1988. Montpellier, France, Jarrel RL ed; c1990. p. 29-35.
4. Galano Sauco V, Cabrera Cabrera, Hernandez JY, Delgado PM. A comparison of banana cultivars Dwarf Cavendish, Grande Naine and Williams for the Canary Islands. Fruits. 1995;50:255-266.
5. Galano Sauco V. Losfructales tropicales en los subtropicos. II. EI platano. Madrid Espana, Mundi Prensa ed; c1992. p. 169.
6. Israeli Y, Nameri N. Off types of banana plants multiplied *in vitro*. In report on observations and experiments on banana plants in the Jordan Valley in the years (1978-84). Rep. Banana Exp. Stn. Jordan Valley, Israel. 1985;24:50-59.
7. Israeli Y, Reuveni O, Lahav E. Qualitative aspects of somaclonal variations in banana propagated by *in vitro* techniques, Scientia Hortic. 1991;48:71-88.
8. Robinson JC, Nel DJ. Comparative morphology, phenology and production potential of banana cultivars 'Dwarf Cavendish' and 'Williams' in the Eastern Transvaal Lowveld. Scientia Horticulturae. 1985;25:149-161.
9. Robinson JC, Nell D, Eckstein K. A field Comparison of ten Cavendish sub group banana cultivars and selections (Musa AAA) over four crop cycles in the subtropics. Journal of Horticultural Sciences. 1993;68(4):511-521.
10. Robinson JC, Galano Sauco Victor. Taxanomic, Classification Cultivars and Breeding. Bananas and Plantains, 2nd edition, CAB International, Oxfordshire; c2009. p. 39.
11. Stover RH. Variation and cultivar nomenclature in Musa, AAA group, Cavendish subgroup. Fruits. 1988;43(6):353-357.
12. Stover RH, Simmonds NW. Bananas 3rd edition, New York, USA, Longman, London; c1987. p. 73.
13. Stover RH, Simmonds NW. Bananas 3rd edition, New York, USA, Longman, London; c 1987. p. 468.
14. Turner DW, Hunt N. Growth, yield and leaf nutrient composition of 30 banana varieties in subtropical New South Wales. Tech Bull 31, Department Agric New South Wales, Australia; c1984. p. 36.