

CORRELATION OF BANANA CV GRAND NAINE WITH GROWTH AND YIELD ASPECT

Manoj Kumar Tak¹, Vikas Kumar*, Sanjay Attar¹, Amit K. Revale¹ and Ruchit Patel¹

¹ACHF, Navsari Agricultural University, Navrari-396450 (Gujarat)

*College of Forestry, Kerala Agricultural University, Thrissur-680656(Kerala)

Received-11.12.2014, Revised-09.01.2015

Abstract: The experiment was laid out in a non replicated trial for metric and non metric variables. A wide range of variation was observed for vegetative growth parameters of banana at various growth periods viz., leaf length (39.42 - 157.52 cm), leaf width (19.17 - 41.09 cm), variation in functional leaf area (0.43 - 6.06 m²), petiole length (10.28 - 34.61 cm), variation in functional leaf (6.99 - 13.27), height of pseudo stem (19.08 - 198.37 cm), girth of pseudo stem (16.77 - 59.01 cm), PCA (23.41 - 277.55 cm²), peduncle length (43.67 cm), peduncle width (14.49 cm), male bud size (31.18 cm length and 30.70 cm girth) showed continuously increased during crop cycle of banana and bunch position was slightly angled. The number of days taken from planting to inflorescence emergence (272.4), days taken from inflorescence emergence to harvesting (101.65) and total crop duration (374.05 days) was recorded during crop cycle of banana plant. The yield attributing characters viz. weight of bunch (21.88 kg), hands per bunch (11.43), fruits on 2nd hand (17.80), hand weight per bunch (1827.45 g), fruits per bunch (202.88), length and girth of fruit (17.61 cm and 10.81 cm, respectively), fruit pedicel length (2.25 cm), fruit pedicel width (1.62 cm), fruit weight (102.58 g) and non metric characters like fruit shape was observed curved (sharp curved) and fruit apex was observed blunt tipped. Coefficient of correlation was estimated for 23 characters of banana cv. Grand Naine. Among these fruit yield exhibited strong positive correlation with leaf area at harvesting time (0.459) and shooting time (0.418), pseudo stem girth at shooting time (0.523) followed by 8th and half MAP (0.476) and harvesting time (0.401), PCA at shooting time (0.521) followed by 8th and half MAP (0.469) and harvesting time (0.398), number of functional leaves at harvesting time (0.402) and shooting time (0.382) and yield attributing characters such as fruits per 2nd hand (0.362), hands per bunch (0.611), fruits per bunch (0.693), fruit weight (0.792), hand weight (0.691), plant crop cycle (0.340) and days taken from flowering to harvesting (0.381).

Keywords: Banana, Phenological characters, Correlation, Yield

INTRODUCTION

Banana (*Musa paradisiaca* L.) is a herbaceous, perennial, monocotyledonous and monocarpic crop belonging to the family Musaceae. It is known as "Apple of Paradise". Its origin is tropical region of South – East Asia. Banana has nutritional, medicinal and industrial value. Owing to its multifaceted uses, it is referred as Kalpatharu (a plant of virtues). Banana is one of the most important tropical fruit crops of the world and many consider banana as one of man's first food (Manoj *et al.*, 2014).

India is the largest banana growing country in the world. Among the fruits, banana holds first position in production and productivity in India. Banana is grown all over India and is available round the year. However, Tamil-Nadu, Maharashtra, Gujarat, Andhra Pradesh and Karnataka have ideal conditions for its growth and production. In India, it is cultivated on an estimated area of 770 thousand ha, with an annual production of 26,470 thousand MT and productivity of 34.4 MT/ha (Anonymous, 2010a). In Gujarat, it is cultivated on an estimated area of 61.9 thousand ha, with production of about 3779.6 thousand MT and productivity of 61 MT/ha (Anonymous, 2010b). It is one of the most important fruit crops of middle and south Gujarat regions. The farmers prefer its cultivation because of its high demand as a fresh fruit in the market.

Banana plant produces the parthenocarpic fruit of commercial importance is propagated vegetatively

from underground storage organ rhizome and surface level is the meristematic region which gives rise to the leaves, and finally to the inflorescence which produces the fruit. The leaves emerge in sequence with each rolled leaf pushing throughout the centre of an increasingly greater number of overlapping leaf sheath base which constitute a pseudo stem. There is a marked polymorphism of the leaves exhibited by the rapid change in dimension of succeeding leaves; they are one of the largest photosynthetic units in the plant kingdom. The pseudo stem produces flowers only once and is cut off after fruiting. The fruits are called fingers, which are borne in hands. The Grand Naine Bananas (also spelled Grande Naine) literally translates from French meaning "Large Dwarf." It is a cultivar of the well known Cavendish bananas. This group of bananas is distinguished from other groups by its AAA genotype. The AAA genotype refers to the fact that this group is a triploid variant of the species *M. acuminata*. There are 33 chromosomes present in the AAA cultivar and all produce seedless fruits through parthenocarpy (Ploetz, 2007).

The Grand Naine has become one of the most popular varieties for commercial plantations. Its characteristic medium height and large fruit yields make it ideal for commercial agriculture. The moderate height allows easy harvesting and some resistance to wind throw (plants breaking due to strong winds). Plantations growing Grand Naine range from the tropical regions of Central America,

*Corresponding Author

Africa, India, and Southeast Asia. In many tropical communities, entire local economies are based upon banana production and export. Because of its importance as a staple crop as well as a cash crop, much botanical research has focused around the Grand Naine (Anonymous, 2007). There is no authentic information available on morphological, phenological and yield attributing variations required for an ideal production by a banana plant under South Gujarat Agro Climatic conditions, so the investigation was undertaken on banana cv. Grand Naine to describe various phenological characters and to work out correlation of different characters with yield. Therefore, the present study was undertaken to evaluate effect of various growing medias on mango cultivars in regard with their growth parameters.

MATERIAL AND METHOD

An experiment was conducted at Block "C" of N. M. College of Agriculture, Navsari Agricultural University, Navsari entitled "Correlation of banana cv. Grand Naine with growth and yield aspect" during the year 2011-12. The studies consisted of 150 plants of banana cv. Grand Naine for various parameters and their correlation with yield. The experiment was laid out in a non replicated trial for metric and non metric variables. Observation period was as mentioned below. P₁- 2nd MAP of banana, P₂-2nd and half MAP of banana, P₃-3rd MAP of banana, P₄-3rd and half MAP of banana, P₅-4th MAP of banana, P₆-4th and half MAP of banana, P₇-5th MAP of banana, P₈-5th and half MAP of banana, P₉-6th MAP of banana, P₁₀-6th and half MAP of banana, P₁₁-7th MAP of banana, P₁₂-7th and half MAP of banana, P₁₃-8th MAP of banana, P₁₄-8th and half MAP of banana, P₁₅- At the shooting time of banana, and P₁₆- At the harvesting time of banana.

A wide range of variation was observed for vegetative growth parameters of banana at various growth periods viz., leaf length leaf width, variation in functional leaf area, petiole length, variation in functional leaf, height of pseudo stem, girth of pseudo stem, PCA, peduncle length, peduncle width, male bud size showed continuously increased during crop cycle of banana and bunch position was slightly angled. The number of days taken from planting to inflorescence emergence, days taken from inflorescence emergence to harvesting and total crop duration was recorded during crop cycle of banana plant. The yield attributing characters viz. weight of bunch, hands per bunch, fruits on 2nd hand, hand weight per bunch, fruits per bunch, length and girth of fruit, fruit pedicel length, fruit pedicel width, fruit weight and non metric characters like fruit shape was observed curved (sharp curved) and fruit apex was observed blunt tipped.

RESULT AND DISCUSSION

Growth characters and their correlation with yield:

The variation in vegetative characters among plants of banana cv. Grand Naine differed considerably with respect to growth characters like leaf characters, pseudo stem characters, inflorescence or male bud *etc.*

The among different plants of banana cv. Grand Naine, leaf length (39.42-157.52 cm), leaf width (19.17-41.09 cm), variation in functional leaf area (0.43-6.06 m²), petiole length (10.28-34.61 cm), variation in functional leaf (6.99-13.27), height of pseudo stem (19.08-198.37 cm), girth of pseudo stem (16.77-59.01 cm), PCA (23.41-277.55 cm²), peduncle length (43.67 cm), peduncle width (14.49 cm), male bud size (31.18 cm length and 30.70 cm girth) was continuously increased during crop cycle of banana plant (Table 4.1).

Table 1. Leaf characters and Pseudo stem characters during crop cycle of banana cv. Grand Naine.

Time	Leaf characters					Pseudo stem characters		
	Leaf length(cm)	Leaf width(cm)	Leaf area/plant(m ²)	Petiole length(cm)	No. of functional leaves	Pseudo stem height (cm)	Pseudo stem girth (cm)	PCA (cm ²)
P1	39.42	19.17	0.43	10.28	6.99	19.08	16.77	23.41
P2	53.64	21.74	0.82	12.34	8.61	29.22	18.50	27.78
P3	62.18	24.31	1.26	14.56	10.23	38.57	19.13	29.97
P4	76.40	25.96	1.71	16.60	10.74	53.94	22.33	40.87
P5	84.93	27.59	2.27	18.43	11.95	62.74	25.85	54.09
P6	96.31	29.46	2.86	19.90	12.42	83.31	34.52	96.75
P7	105.04	31.10	3.29	20.90	12.47	91.45	35.09	99.02
P8	113.42	32.07	3.67	22.77	12.53	98.91	35.66	102.70
P9	122.50	33.72	4.41	24.60	13.27	109.06	41.21	137.02
P10	127.61	34.71	4.53	26.36	12.64	121.44	42.96	149.75
P11	131.25	35.96	5.03	28.14	13.24	130.08	46.32	173.36
P12	138.06	37.26	5.23	29.77	12.66	141.37	50.90	208.87
P13	142.00	38.07	5.46	31.38	12.59	169.78	51.50	211.90

P14	152.52	39.99	6.06	33.56	12.42	187.83	54.28	234.99
P15	155.79	40.65	5.93	34.06	11.70	191.83	55.40	244.89
P16	157.52	41.09	4.81	34.61	9.27	198.37	59.01	277.55

Such differential response may probably be due to continuous increasing age of the banana plant however less functional leaf area were observed at shooting and harvesting time this might be due to less number of functional leaf during growth period.

Similar finding has also been reported by Uma *et al.* (2000); Mandal and Sharma (2001); Rajamanickam and Rajmohan (2005); Panday *et al.* (2005); Rajamanickam *et al.* (2007); Kumar *et al.* (2008) and Rajmanickam and Rajmohan (2010).

Table 2. Correlation coefficient (r) of Leaf characters and Pseudo stem characters during crop cycle of banana cv. Grand Naine.

Time	Leaf characters					Pseudo stem characters		
	Leaf length (cm)	Leaf width (cm)	Leaf area per plant (m ²)	Petiole length (cm)	No. of functional leaves	Pseudo stem height (cm)	Pseudo stem girth (cm)	PCA (cm ²)
P1	0.040	0.122	0.084	-0.053	0.037	0.058	0.057	0.062
P2	0.019	0.134	0.112	-0.054	0.111	0.095	0.151	0.152
P3	0.020	0.067	0.140	-0.057	0.182	0.084	0.139	0.151
P4	0.045	0.150	0.069	-0.054	-0.034	0.031	0.027	0.035
P5	0.038	0.006	0.044	-0.054	0.035	0.086	0.131	0.123
P6	0.051	0.034	0.151	-0.055	0.208	0.104	0.033	0.032
P7	0.004	0.066	0.084	-0.054	0.105	0.147	0.069	0.061
P8	0.048	0.148	0.051	-0.052	-0.058	0.140	0.151	0.144
P9	0.104	0.129	0.156	-0.048	0.072	0.155	0.008	0.027
P10	0.169	0.152	0.154	-0.043	0.065	0.174	0.174	0.175
P11	0.136	0.168	0.144	-0.032	0.028	0.155	0.175	0.178
P12	0.137	0.166	0.184	-0.008	0.085	0.193	0.216	0.220
P13	0.132	0.165	0.142	0.044	0.044	0.165	0.055	0.061
P14	0.073	0.084	0.144	0.076	0.108	0.190	0.476	0.469
P15	0.173	0.202	0.418	0.066	0.382	0.219	0.523	0.522
P16	0.192	0.249	0.459	0.061	0.402	0.209	0.401	0.398

Note: Correlation coefficient (r) At 2 Tail, (0.05%) $r = \pm 0.160$

It is also evident that among different plants of banana cv. Grand Naine, banana fruit yield showed significantly positive correlation with growth characters (Tables 4.2) viz., leaf length at harvesting time (0.192) and shooting time (0.173), leaf width at harvesting time (0.248) and shooting time (0.202), leaf area at harvesting time (0.459) and shooting time (0.418), pseudo stem height at shooting time (0.219) and harvesting time (0.208), pseudo stem girth at shooting time (0.523) followed by 8th and half MAP (0.476) and harvesting time (0.401), PCA at shooting time (0.521) followed by 8th and half MAP (0.469) and harvesting time (0.398), number of functional leaves at harvesting time (0.402) and

shooting time (0.382), peduncle length (0.221) whereas it was non significant with petiole length (0.076) and male bud girth (0.029) but negatively correlated with peduncle width (-0.143) and male bud length (-0.058) as presented (Table 4.3). The increase in yield might be due to more area of functional leaf, which synthesized and accumulate more photosynthetic matters. Several variations have been observed in the plant when a single cultivar is planted on a commercial scale which is mainly due to differences in root characters leading to nutrient uptake. The results are in accordance with the finding of Patil *et al.* (2010), Patil *et al.* (2010) and Kumar and Panday (2010).

Table 3. Inflorescence or male bud of banana cv. Grand Naine.

Inflorescence or male bud	Unit (cm)	Correlation coefficient (r) At 2 Tail, (0.05%) $r = \pm 0.160$
Peduncle length (cm)	43.68	0.221
Peduncle width (cm)	14.50	-0.143
Male bud length (cm)	31.18	-0.058
Male bud girth (cm)	30.70	0.029

Crop duration and their correlation with yield

The number of days from planting to inflorescence emergence (272.4), days taken from inflorescence emergence to harvesting (101.65) and total crop duration (374.05 days) were recorded during crop cycle of banana plant (Table 4.4). The present results confirmed the report of Sirisena and Senanayake (2002); Badgular *et al.* (2004); Rajamanickam and Rajmohan (2005); Panday *et al.* (2005); Rajamanickam *et al.* (2007); Uazire *et al.* (2008); Kavitha *et al.* (2009); Hazarika and Ansari

(2010); Rajmanickam and Rajmohan (2010) and Patel *et al.* (2011). It is evident from the data presented in tables, banana fruit yield showed significantly positive correlation with days taken from inflorescence emergence to harvesting (0.381) and plant crop cycle (0.340) while it was non significant with days taken to shooting (0.120). This might be due to more time available for accumulation of reserved in the bunch. Similar findings are reported earlier by Rajamanickam and Rajmohan (2008).

Table 4. Crop duration (days) and Correlation coefficient (r) of plant crop cycle with yield of banana cv. Grand Naine.

Parameters	Crop duration (days)	Correlation coefficient (r) At 2 Tail, (0.05%) $r = +/- 0.160$
Days to shooting (days)	272.40	0.120
Flower emergence to harvesting (days)	101.66	0.382
Plant crop cycle (days)	374.06	0.341

Yield and yield attributing characters and their correlation with yield

The yield attributing characters viz., weight of bunch (21.88 kg), number of hands per bunch (11.43), number of fruit on 2nd hand (17.80), hand weight per bunch (1827.45 g), number of fruits per bunch (202.88), length and girth of fruit (17.61 cm and 10.81 cm, respectively), fruit pedicel length (2.25 cm), fruit pedicel width (1.62 cm) and fruit weight

(102.58 g) of banana cv. Grand Naine (Tables 4.5). The results are coincided with the finding of Sirisena and Senanayake (2002); Dens *et al.* (2002); Weerasinghe and Ruwanpathirana (2004); Nainwad *et al.* (2005); Rajamanickam *et al.* (2007); Ebeed *et al.* (2008); Rajamanickam and Rajmohan (2008); Kavitha *et al.* (2009); Khalequzzaman *et al.* (2009); Baiyeri *et al.* (2010); Rajmanickam and Rajmohan (2010) and Patel *et al.* (2011).

Table 5. Yield attributing characters and Correlation coefficient (r) with yield of banana cv. Grand Naine.

Parameters	Yield	Correlation coefficient (r) At 2 Tail, (0.05%) $r = +/- 0.160$
Bunch weight (kg)	21.88	0.362
Fruits on 2 nd hand	17.81	0.612
Hands/bunch	11.43	0.694
Fruits/bunch	202.89	0.068
Fruit length (cm)	17.62	0.232
Fruit diameter (cm)	10.81	-0.007
Fruit pedicel length (cm)	2.25	0.029
Fruit pedicel width (cm)	1.62	0.792
Fruit weight (g)	102.59	0.691
Hand weight (g)	1827.46	0.362

The banana fruit yield showed significantly positive correlation with number of hands per bunch (0.6112), number of fruits on 2nd hand (0.362), hand weight per bunch (0.691), number of fruits per bunch (0.693), fruit diameter (0.232), fruit weight (0.792) while it was non significant with fruit length (0.06821) and fruit pedicel width (0.0292) (Table 4.5). However fruit yield showed negatively correlated with fruit pedicel length (-0.0070) of banana cv. Grand Naine therefore, for high fruit yield in banana improvement, selection can be based on number of hands per bunch, number of fruits on 2nd hand, hand weight per bunch, number of fruits per bunch, fruit diameter and fruit weight. The results are coincided with that of George (2005);

Rajamanickam and Rajmohan (2008) and Patil *et al.* (2010).

CONCLUSION

The present investigation concluded that all the vegetative parameters were significantly increased with crop cycle of banana plant except functional leaf area and number of functional leaf and also studies on correlation coefficient analysis were conducted on the "Grand Naine" variety of banana to identify the major factors contributing to yield. Fruit yield exhibited strong positive correlation with leaf area, pseudo stem girth, PCA, number of functional leaves and yield attributing characters such as fruits

per 2nd hand, hands per bunch, fruits per bunch, fruit weight, hand weight, plant crop cycle and days taken from flowering to harvesting apart from this yield attributes recorded at harvest can also be used for predicting fruit yield though it is late. However, the yield attributes recorded at harvesting are going to remain to same even 3 to 4 month prior to harvesting (complete emergence of bunch). Banana fruit can be predicted precisely well in advance using leaf area, pseudo stem girth, PCA, number of functional leaves and yield attributing characters such as fruits per 2nd hand, hands per bunch, fruits per bunch, fruit weight, hand weight, plant crop cycle and days taken from flowering to harvesting. This will help the farmers in planning the sound marketing strategy.

REFERENCES

- Anonymous** (2007). *Banana and plantain overview with emphasis on pacific island cultivars*, pp. 10.
- Anonymous** (2010a). All India area, production and productivity of banana. Indian Horticulture Database 2010. *National Horticulture Board.*, pp. 4.
- Anonymous** (2010b). State wise area, production and productivity of banana. Indian Horticulture Database 2010. *National Horticulture Board.*, pp. 38.
- Badgular, C.; Dusane, S. M. and Desmukh, S.** (2004). Influence of plant spacing on growth, maturity and yield of Grand Naine (AAA) banana. *South Indian Hort.*, 52(1-6): 13-17.
- Baiyeri, K. P.; Aba, S. C. and Tenkovano, A.** (2010). Region of bunch pruning influences, the bunch and fruit physical traits of “PITA24” plantain hybrid. *J. Appl. Biosci.*, 33: 2119-2127.
- Dens, K.; Vargas, M.; Malton, G.; Coensens, S.; Van, I. and Sweenen, R.** (2002). Introduction and multiplication of improved banana and plantains in Nicaragua and distribution to farmers. *INFOMUSA*, 11(1): 44-47.
- Ebeed, S.; Mostafa, E. and Salem, M.** (2008). Effect of gibberellic acid and male bud removal on yield and fruit quality of banana. *Res. J. Agric. and Biol. Sci.*, 4(4): 289-292.
- George, S.** (2005). Path coefficient analysis of yield parameters in Nendran banana in Kerala soil. *South Indian Hort.*, 53(1-6): 209-211.
- Hazarika, B. and Ansari, S.** (2010). Effect of integrated nutrient management on growth and yield of banana cv. Jahaji. *Indian J. Hort.*, 67(2): 270-273.
- Kavitha, P.; Balamohan, T.; Veeraragavathatham, D. and Poornima, K.** (2009). Genetic variability and correlation in ecotypes of Nendran banana. *Banana New Innovation*, Westville Publishing House, New Delhi, pp. 91 – 98.
- Khalequzzaman, K. M.; Rahim, M. A.; Mollah, M. and Kaiser, M.** (2009). High density planting effect on banana yield. *J. Agric. Res.*, 47(4): 359-364.
- Kumar, D. and Panday, V.** (2010). Relationship of pseudostem cross sectional area with bunch weight, fruit quality and nutrient status in banana cv. Rasthali (Pathkapooraa-AAB). *Indian J. Hort.*, 67(1): 26-29.
- Kumar, D.; Panday, V. and Anjaneyulu, K.** (2008). Effect of planting density and nutrient management on growth, yield and quality of micropropagated banana cv. Rasthali. *Indian J. Hort.*, 65(3): 272-276.
- Mandal, B. and Sharma, S.** (2001). Effect of leaf pruning on the growth and yield of banana cv. Alpan. *The Hort. J.*, 14(1): 7-11.
- Manoj Kumar Tak, Vikas Kumar and Sanjay Attar.** (2014). *Studies on Characterization of Banana cv. Grand Naine*. LAP LAMBERT Academic Publishing.
- Nainwad, R.; Kullkarni, N. and Kalalbundi, B.** (2005). Extent of variation in growth and yield attributes of some tissue culture vs conventional sucker planted banana varieties. *Karnataka J. Agric. Sci.*, 18(1): 221-222.
- Panday, V.; Kumar, D. and George, S.** (2005). Response of micropropagated “Robusta” banana to varying combinations of N, P, K nutrition in lateritic soils of coastal Orissa. *Indian J. Hort.*, 62(2):122-126.
- Patel, C. M.; Patel, N. L.; Gaikwad, S. S. and Patil, S. J.** (2011). Effect of post shooting treatments on yield and its attributes of banana cv. Grand Naine. *Green Farming*, 2(2): 210-212.
- Patil, S.; Solia, B. and Patil, B.** (2010). Prediction of fruit yield of banana using stem girth and yield attributes. *Green Farming*, 1(2): 219.
- Ploetz, R.C.** (2007). Banana and plantain—an overview with emphasis on Pacific island cultivars. *Species Profiles for Pacific Island Agroforestry* ver.1.
- Rajamanickam, C. and Rajmohan, K.** (2005). Intra clonal variation in *Musa* (AAB) “Nendran”. *South Indian Hort.*, 53(1-6): 195-204.
- Rajamanickam, C. and Rajmohan, K.** (2008). Genetic variability and correlation studies in banana (*Musa spp.*). *Madras Agric. J.*, 95(7-12): 258-265.
- Rajamanickam, C. and Rajmohan, K.** (2010). Variability studies in Palayankodan ecotypes AAB genomic group of banana (*Musa spp.*). *J. Hortl. Sci.*, 5(2): 109-113.
- Rajamanickam, C.; Rajmohan, K.; Parthiban, S. and Venkatesan, K.** (2007). Performance of triploid banana (*Musa spp.*) cultivars of Kerala. *South Indian Hort.*, 55(1-6): 119-132.
- Sirisena, J. and Senanayake, S. G.** (2000). Estimation of variability parameters within “Mysore” banana clones and their implication for crop improvement. *Scientia Hortl.*, 84: 49-66.
- Uazire, A.; Ribeiro, C.; Mussane, R.; Pillay, M.; Blomme, G.; Fraser, C.; Staver, C. and Karamura, E.** (2008). Preliminary evaluation of improved varieties in Mozambique. *African Crop Science Journal*, 16(1): 17-25.

Uma, S.; Dayarani, M.; Singh, H. P.; Shyam, B. and Sathiamoorthy, S. (2000). Studies on genetic variability in banana *Silk* sub group (AAB). *Indian J. Hort.*, 57(2): 106-109.

Weerasinghe, S. and Ruwanpathirana, K. (2004). Effect of dehanding on bunch characteristics of banana. *Annals of the Srilanka. Depart. of Agriculture*, 6: 227-235.