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Effect of different month of Ratooning with bunch spray of GA_3 and BA on yield and yield attributes of banana (*Musa paradisiaca* L.) cv. Grand Nain

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Abstract
A field experiment entitled "response of different month of ratooning with bunch spray of ga_3 and Ba on yield and yield attributes of banana (*Musa paradisiaca* L.) cv. grand Nain" was carried out at the Instructional Farm and Regional Horticultural Research Station of the Navsari Agricultural University, Navsari, Gujarat, India during 2018-19 and 2019-20. The results revealed that month of ratooning *i.e.* M_2 treatment (7 month after planting) gave the maximum finger length, finger girth, length of bunch, girth of bunch, weight of bunch, weight of 3rd hand and yield.
Foliar application of GA_3 100 mg l^{-1} + BA 50 mg l^{-1}(S_5) after complete opening of the bunch gave significantly maximum finger length, finger girth, length of bunch, girth of bunch, weight of bunch, weight of 3rd hand and yield.
When banana cv. Grand Nain ratoon kept at 7 month after planting and foliar spray of GA_3 100 mg l^{-1} + BA 50 mg l^{-1} after complete opening of banana bunch (M_2S_5) gave significantly maximum yield parameters like finger length, finger girth, length of bunch, girth of bunch, weight of bunch, weight of 3rd hand and yield.

Keywords: Ratooning, Foliar application, GA_3, BA and Quality

Introduction
Banana is traditionally propagated through the suckers produced from the auxiliary buds of underground rhizomes, once the plant crop attains maturation. The planting of banana through tissue cultured plantlets on commercial scale was started from 1988 in Maharashtra. However, due to increased cost of tillage operations, labour and tissue culture plants, the banana growers are now gradually diverting towards taking one ratoon crop. Keep ratoon with or after fresh crop reduces the cost of plants and other cultivation operations like, tillage and planting. It also reduces the crop duration if we keep the ratoon with fresh crop. Some of the growers are keeping the ratoon randomly at any stage of plant crop without knowing the effect of ratoon on the growth and yield of crop.
Plant growth regulators such as gibberellic acid and benzyladenine plays important role in case of yield and quality. Gibberellic acid has been reported to influence vegetative growth, flowering, fruiting and various disorders in many fruit crops. Foliar sprayed of gibberellic acid at complete opening of bunch produced maximum yield contributed by bigger size bunch, having superior quality fruits and higher shelf life of banana (Patel *et al.*, 2011) [8]. Benzyladenine (BA) is one of the most active cytokinins which regulates various growth processes in plant and improve yield and chemical constituents of many crops and recently, BA has been identified as a natural cytokinin in a number of plants. Nevertheless, physiological responses to BA application may be associated with increased endogenous cytokinin concentrations (Mahmoud *et al*., 2015) [6].

Materials and Methods
A field experiment was carried out at the Instructional Farm and Regional Horticultural Research Station of the Navsari Agricultural University, Navsari, Gujarat, India during 2018-19 and 2019-20. The experiment was conducted in Split Plot Design (SPD) with three replications, which included 15 treatment combinations *viz.*, Main Plot (M): Different month of ratooning (M_1 - 6 month after planting, M_2 - 7 month after planting and M_3 - 8 month after planting); Sub Plot (S): Plant Growth Regulators (S_1- Control, S_2- $GA_3$50 mg l^{-1} + BA 25 mg l^{-1}, S_3- GA_3 100 mg l^{-1} + BA 25 mg l^{-1}, S_4- GA_3 50 mg l^{-1} + BA 50 mg l^{-1}, S_5- GA_3 100 mgl^{-1} + BA 50 mgl^{-1}).

Results and Discussion

Effect of month of ratooning

The data presented in Table 1 clearly revealed that there were significant difference due to different month of ratoon on finger length, finger girth, length of bunch, girth of bunch, weight of bunch, weight of 3rd hand and yield. Significantly maximum fruit finger length, finger girth, length of bunch, girth of bunch, weight of bunch, weight of 3rd hand and yield were observed in M_2 treatment (7 month after planting). Similar results were obtained by El-Fatih *et al.* (2014) [4], Sheikh *et al.* (2015) [9] and Borah *et al.* (2020) [2] in banana.

Effect of bunch spray of GA_3 and BA

A perusal of data presented in Table 1 revealed that foliar application of GA_3 100 mg l^{-1} + BA 50 mg l^{-1}(S_5) after complete opening of the significantly gave the maximum finger length, finger girth, length of bunch, girth of bunch, weight of bunch, weight of 3rd hand and yield. Finger length and bunch length were positively correlated to each other it might be due to cell enlargement by synthesis of enzymes that weaken the cell wall and thus offer scope for cell elongation. BA and GA_3 responsible for including the synthesis of specific DNA dependent new m-RNA and specific enzymatic protein causes increase cell plasticity and extension resulting ultimately in cell enlargement (Jaykumar *et al.*, 2010) [5].

Interaction effect

It is apparent from the data presented in Table 2 that when banana cv. Grand Nain ratoon kept at 7 month after planting and foliar spray of GA_3 100 mg l^{-1} + BA 50 mg l^{-1} after complete opening of banana bunch (M_2S_5) gave significantly maximum yield parameters like finger length, finger girth, length of bunch, girth of bunch, weight of bunch, weight of 3rd hand and yield.

The reason for increased in bunch size due to BA and GA_3 application might be due to the increased levels of carbohydrates and also BA and GA_3 might have stimulated cell division and cell elongation resulting in larger bunch length size as reported by Singh and Phogat (1984) [10]. This might be due to BA and GA_3 responsible for including the synthesis of specific DNA dependent new m-RNA and specific enzymatic protein causes increase cell plasticity and extension resulting ultimately in cell enlargement. GA_3 may also help in increasing auxin content and they may get transported to the site of action in plant (Dutta, 1994) [3]. BA and GA_3 increased the size of meristamatic region as well portion of cell undergoing cell division and cell enlargement (Pandey and Sinha, 2004) [7]. GA_3 and BA does bring about certain metabolic changes, which are reflected by more accumulation of food constituents in the fruit and thereby through increased weight of an individual berry, ultimately increased weight of third hand. The increased in berry size with gibberellins presumably primarily due to augmentation of the native supply of those hormones, which in present investigation have also been found to markedly increased the berry size when given at the time of flowering (Biswas and Lemtur, 2014) [1]. GA_3 was to multiply and to lengthen the meristem cell, which resulted in the increased of fruit weight and attributed to the cell multiplication and elongation in cambium tissues. While, application of BA might be due to an increased cell division caused by cytokinins (Pandey and Sinha, 2004) [7].

Table 1: Effect of different month of ratooning and bunch spray of GA_3 and BA on yield and yield attributes of banana cv. Grand Nain (mean of two years)

Treatments	Finger length (cm)	Finger girth (cm)	Length of bunch (cm)	Girth of bunch (cm)	Weight of bunch (kg)	Weight of 3rd hand (kg)	Yield (t ha^{-1})
Main Plot (M)							
M_1	17.88	9.91	79.12	83.75	18.87	1.97	65.52
M_2	19.62	10.96	85.80	91.92	21.70	2.24	75.34
M_3	19.01	10.67	83.79	89.23	20.85	2.16	72.39
S.Em.±	0.23	0.15	0.92	1.06	0.32	0.03	1.13
C.D. at 5%	0.75	0.48	2.99	3.46	1.06	0.10	3.67
CV%	6.68	7.61	6.06	6.58	8.68	7.59	8.68
Sub Plot (S)							
S_1	17.45	9.43	76.22	80.19	17.32	1.83	60.13
S_2	18.26	10.04	79.98	84.67	19.14	1.99	66.46
S_3	19.10	10.67	84.18	89.67	21.08	2.18	73.18
S_4	19.55	11.10	86.44	92.73	22.09	2.28	76.69
S_5	19.83	11.32	87.68	94.24	22.74	2.34	78.97
S.Em.±	0.27	0.14	1.15	1.36	0.32	0.03	1.11
C.D. at 5%	0.76	0.40	3.26	3.88	0.91	0.08	3.15
Interaction M x S							
S.Em.±	0.46	0.24	1.98	2.36	0.55	0.05	1.92
C.D. at 5%	1.31	0.68	5.65	6.72	1.57	0.13	5.45
CV%	5.99	5.60	5.86	6.55	6.60	5.28	6.60

Table 2: Interaction between different month of ratooning and bunch spray of GA_3 and BA on yield and yield attributes of banana cv. Grand Nain (mean of two years)

Treatments	Finger length (cm)	Finger girth (cm)	Length of bunch (cm)	Girth of bunch (cm)	Weight of bunch (kg)	Weight of 3rd hand (kg)	Yield (t ha^{-1})
M_1S_1	17.94	9.39	77.33	81.66	16.88	1.80	58.61
M_1S_2	16.68	9.04	73.54	77.22	16.57	1.79	57.52
M_1S_3	17.00	9.67	74.95	79.24	18.13	1.90	62.95
M_1S_4	19.04	10.77	86.12	90.73	21.43	2.20	74.39

M_1S_5	18.76	10.66	83.65	89.90	21.35	2.18	74.12
M_2S_1	17.38	9.71	77.64	80.32	18.15	1.89	63.03
M_2S_2	18.87	10.53	82.20	87.28	20.45	2.09	70.99
M_2S_3	20.02	10.89	87.57	94.65	22.76	2.34	79.03
M_2S_4	20.34	11.43	88.07	95.34	22.19	2.38	77.06
M_2S_5	21.48	12.26	93.52	102.02	24.94	2.51	86.61
M_3S_1	17.02	9.18	73.68	78.61	16.92	1.81	58.76
M_3S_2	19.24	10.55	84.21	89.50	20.41	2.10	70.86
M_3S_3	20.27	11.46	90.03	95.12	22.34	2.31	77.55
M_3S_4	19.26	11.10	85.12	92.13	22.65	2.25	78.62
M_3S_5	19.25	11.04	85.88	90.80	21.94	2.32	76.18
S.Em.±	0.46	0.24	1.98	2.36	0.55	0.05	1.92
C.D. at 5%	1.31	0.68	5.65	6.72	1.57	0.13	5.45
CV%	5.99	5.60	5.86	6.55	6.60	5.28	6.60

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