Assessment of time of planting in banana in context to climate change

NB SHAIKH, RD PAWAR, VM RAJENIMBALKAR and CD BADGUJAR

Banana Research Station, Mimkhedi Road, Jalgaon 425001 Maharashtra, India
Email for correspondence: brsjalgaon@gmail.com

 Received: 28.2.2017/Accepted: 19.5.2017

ABSTRACT

A field experiment on time of planting of banana was carried out at Banana Research Station, Jalgaon, Maharashtra during period 2011-2015 to find out planting time and to identify the suitable month of planting banana in context to climate change. The experiment was laid out in randomized block design comprising six treatments of bimonthly planting of banana tissue culture plants in the month of June (T_1), August (T_2), October (T_3), December (T_4), February (T_5) and April (T_6). Each treatment was replicated four times. The December planting recorded highest yield (93.5 MT/ha) with 95 per cent plant harvest. The harvest index was maximum (98.70%) under February planting.

Keywords: Banana; planting time; month; climate change

INTRODUCTION

Banana is the second important fruit crop of India after mango. Maharashtra is the leading banana producing state with 83000 ha area and productivity of 58.2 MT/ha (Anon 2014). Jalgaon district is the important banana production centre covering an area of 46000 ha with productivity of 76 MT/ha.

Jalgaon district is located at 20-21°N latitude and 74-76°E longitude (Rane et al 2008, Sastry 1988). Here in summer maximum temperature is around 47°C while in winter temperature goes below 10°C for maximum period. The average rainfall is 600-700 mm concentrated in June to September months of the year. Cold waves during winter and high desiccating winds during summer are harmful to the crop (Sastry 1988). June and October planting is the main banana planting season of Jalgaon. During the last few years under the changing climatic scenario higher temperatures, cyclonic winds and unseasonal rains have been adversely affecting the banana crop causing severe economic losses to the banana growers in Jalgaon district. Under the existing recommended planting time ie June and October planting for tissue culture banana the plants are at bunch development and fruit bud differentiation stages respectively during hot and dry summer leading to poor fruit development and damage due to cyclonic wind blowing during April-May.

With a view to identify the suitable month of planting of banana to minimize the crop losses due to biotic and abiotic stresses under changing climatic scenario the present studies were undertaken.

MATERIAL and METHODS

The field experiment on time of planting in banana was carried out at the Banana Research Station, Jalgaon, Maharashtra during 2011-2015 to find out planting time to identify the suitable month of planting banana in context to climate change to minimize the crop losses due to biotic and abiotic stresses. The experiment was laid out in randomized block design comprising six treatments of bimonthly planting of banana tissue culture plants in the months of June (T_1), August (T_2), October (T_3), December (T_4), February (T_5) and April (T_6). Each treatment was replicated four times. The tissue culture banana plants of cv Grand Naine were planted in 30 cm deep furrows at a recommended distance of 1.5 x 1.5 m in the first week of the respective months. Irrigation was provided by the drip irrigation method. The recommended cultural practices were uniformly applied to all the treatments.

The observations on growth, shooting, yield, quality, lodging and harvest were recorded and subjected to statistical analysis as described by Panse and Sukhatme (1985).

RESULTS and DISCUSSION

Growth attributes

The data presented in Table 1 reveal that the growth attributes except number of functional leaves at shooting of banana were significantly influenced by different planting time treatments. Maximum pseudostem height (232.13 cm) was recorded in August and maximum pseudostem girth (70.48 cm) in October planting over other treatments. It might be due to average temperatures and humid climate during early establishment and development stage of the crop. December planting recorded the least pseudostem height (199.83 cm) and pseudostem girth (62.88 cm).

The dwarfing in December planting might be due to the reduction in growth rate owing to the lower temperatures during December-February in the early establishment of the crop leading to the reduction in net assimilation, leaf emergence and increased transpiration rate during summer season during March-May with dry and hot climatic conditions. It might have led to shortening of distance between emerging leaves.

The number of functional leaves at shooting showed the non-significant results with maximum number of functional leaves (11.30) in August and the least (10.63) in October planting. This might be due to the congenial hot and humid conditions from June to November which enhanced the early growth of the plant.

Ghose and Amzad Hossain (1992) reported the similar growth results of increase in plant height, girth and number of functional leaves at shooting in cvs Amrit Sagar and Sabri with May planting over the September and February planting. Robinson and Galan Saúco (2010) have also reported that where water is not limiting the rate of growth and development in banana is determined by temperature.

Phenological attributes

The least days to shooting (240.30) were recorded in December planting which was significantly superior over October planting (260.90) but statistically at par with rest of the treatments. The least days to harvest were found in June planting (344.60) being statistically at par with rest of the treatments except October planting (363.97).

The duration from shooting to harvest was the minimum in June planting (101.4 days) which was statistically similar to April (101.7 days), August (102.1 days) and October (103.1 days) planting treatments and significantly similar to December (106.2 days) and February (109.5 days) planting treatments. Comparative reduction in interval from shooting to harvest in June, August and April planting treatments might be due to the availability of more bright sunshine hours and higher mean temperatures contributing to availability of more heat units within short time span during fruit development and maturity under summer months of February to June over the rest of the treatments. Turner and Barkus (1982) and Robinson and Human (1988) also recorded the strong relationship between relative fruit growth rate and the mean daily temperature during the rate of fruit development and Ara et al (2011) opined that the crop duration variation was as a result of difference in edaphic and climatic factors at different stages of plant growth which ultimately determined crop duration.

Yield and quality attributes

The data presented in Table 2 reveal that all the yield contributing attributes of banana were significantly influenced by the different treatments.

The number of hands per bunch in August planting (11.56) was significantly higher over rest of the treatments except October planting (11.48). Number of fingers in October planting (170.20) was significantly highest over the December (140.90) and February planting (135.40) followed by August planting (165.90). Stress conditions due to comparatively dry and hot climate and the reduced plant vigour during summer from March to mid-June that coincided the fruit bud differentiation and flower initiation stage might have resulted in reduction in number of hands and fingers per bunch in December and February planting treatments. All other treatments were having good plant vigour and optimal temperature conditions that increased the number of hands and fruits per bunch. Robinson and Galan Saúco (2010) have reported the control of plant vigour, temperature, crop cycle and management practices over the number of hands and fruits per bunch and opined that flowers which initiate in summer result in small bunches as temperature at

Table 1. Banana growth attributes as influenced by planting time under Jalgaon condition (pooled data 2011-2015)

Planting time	Pseudostem height (cm)	Pseudostem girth (cm)	Functional leaves/plant	Days to flower	Days to harvest	Days from shooting to maturity
T_1	206.13	68.72	11.13	243.20	344.63	101.4
T_2	232.13	67.23	11.30	250.70	352.80	102.1
T_3	226.10	70.48	10.63	260.90	363.97	103.1
T_4	199.83	62.88	11.23	240.30	346.53	106.2
T_5	212.87	65.11	11.13	246.80	356.27	109.5
T_6	215.33	65.69	10.97	255.30	356.97	101.7
SE±	8.78	1.35	0.44	5.7	4.79	
$CD_{0.05}$	27.65	4.25	NS	17.9	15.08	

Table 2. Banana yield and quality attributes as influenced by planting time under Jalgaon condition (pooled data 2011-2015)

Planting time	Hands /bunch	Fingers /bunch	Finger length (cm)	Finger girth (cm)	Bunch weight (kg)	Lodging /ha (%)	Harvest /ha (%)	Yield (MT/ha)	Pulp-peel ratio	TSS (^{o}Brix)
T_1	9.62	150.9	20.72	12.00	20.97	13.0	87.0	83.63	2.26	20.67
T_2	11.56	165.9	21.17	12.14	22.70	13.0	87.0	89.99	2.32	20.70
T_3	11.48	170.2	20.97	12.48	22.13	16.0	84.0	84.97	2.22	20.50
T_4	9.16	140.9	22.93	12.68	22.67	05.0	95.0	93.26	2.16	20.90
T_5	8.75	135.4	22.28	12.48	20.87	01.3	98.70	88.69	2.19	20.63
T_6	9.48	149.7	20.87	12.17	20.67	09.7	90.30	82.21	2.24	20.53
SE±	0.61	7.08	0.48	0.16	0.61	-	0.32	3.05	0.014	0.09
$CD_{0.05}$	1.92	22.3	1.51	0.51	1.82	-	1.00	9.62	0.044	0.29

that time is much higher than optimum range for flower initiation. Barlow et al (2015) studied the effect of temperature extremes, frost and heat on wheat (*Triticum aestivum* L) and revealed that excessive heat caused reduction in grain number. Hatfield and Prueger (2015) reported that the exposure of maize plants to temperature extremes at the onset of the reproductive stage has a major impact on fruit or grain production across all species.

The finger length was found to be maximum in December planting (22.93 cm) which was on par with February planting (22.28 cm) and significantly superior over the rest of the planting time treatments. This increase in finger length might be due to the warm and humid climate during the early growth stage which is essential for the early finger elongation. The finger girth was significantly more in December planting (12.68 cm) over rest of the treatments except October and February (12.48 cm). Results of finger girth are in agreement with Ara et al (2011). The enhancement in fruit size in December planting might be due to the better finger filling attributed by high humidity, reduced evapo-transpiration rate with more root activity, congenial temperature with less day-night temperature variation and good soil moisture content. These conditions might have made the plants to remain physiologically more active with higher net assimilation rate to build up sufficient food stock for the developing fruits. Ram et al (1962) and Robinson and Galan Saúco (2010) stated that the finger length rapidly increases up to 30 days from shooting and then slows down as the rapid cell multiplication occurs up to 4 weeks from emergence but the fruit diameter continues to increase up to harvest as a result of cell enlargement that occurs rapidly from 8 to 12 weeks after emergence and maturation from 12 to 15 weeks after emergence.

The bunch weight was maximum in August planting (22.70 kg) followed by December (22.67 kg) and was significantly superior over February (20.87 kg) and April (20.67 kg). The comparative reduction in bunch weight in February and April planting may be attributed to the reduced number of hands and fingers per bunch over others.

The per cent harvest was found to be significantly higher in February planting (98.70) followed by December (95.0). It may be due to the less lodging percentage in these treatments. The higher bunch weight accompanied with high wind speed in June plantation and loose, ill-drained, wet soils and tall plants with higher bunch weight in August and October planting during bunch development and harvest might have led to the increased lodging and uprooting of the banana plants thereby reducing the per cent harvest.

The yield per hectare of December planting (93.26 MT/ha) was significantly higher over June (83.63 MT/ha) and April (82.21 MT/ha) and was on par with rest of the treatments. The two components of yield are number of bunches and mean bunch weight (Gowen 1995). In December planting both number of bunches harvested and mean bunch weight were reflected in the enhanced yields. Whereas in June and April planting the reduced harvest per cent, short fruits and reduced bunch weight were reflected in the reduced yields. This might be due to the reduced finger size due to prevailing hot and dry climatic conditions during the fruit development that retarded the cell elongation and finger filling. It confirms the results of Kimengsi and Muluh (2013) who opined that higher than normal temperature stress the fragile plant leading to lower quality of banana and reduction in output.

The pulp-peel ratio in August planting (2.32) was found to be significantly highest over rest of the treatments. It might be due to better cell enlargement due to warm and humid climate during fruit filling. The TSS was found to be highest in December planting (20.9^{o}B) followed by August (20.7^{o}B) and June (20.67^{o}B).

REFERENCES

Anonymous 2014. Indian horticulture database 2014. National Horticulture Board, Gurgaon, Haryana, India.

Ara N, Basher MK and Hossain MF 2011. Growth, yield and quality of banana (*Musa sapientum* L) influenced by different banana varieties/lines and planting time. Tropical Agricultural Research and Extension **14(2):** 45-51.

Barlow KM, Christy BP, O'Leary GJ, Riffkin PA and Nuttall JG 2015. Simulating the impact of extreme heat and frost events on wheat crop production: a review. Field Crops Research **171:** 109-119.

Ghose G and Amzad Hossain AKM 1992. Effect of time of planting on growth and yield of two commercial banana varieties. Acta Horticulturae **321:** 463-471.

Gowen S 1995. Bananas and plantains. Springers, Netherlands.

Hatfield JL and Prueger JH 2015. Temperature extremes: effect on plant growth and development. Weather and Climate Extremes **10:** 4-10.

Kimengsi JN and Muluh NG 2013. A comparative assessment of the effect of climatic variations on the crops of the Cameroon Development Corporation (CDC): adaptation options. Environment and Natural Resources Research **3(1):** 144-156.

Panse VG and Sukhatme PV 1985. Statistical methods for agricultural workers. 4th edn, ICAR Publication, New Delhi, India.

Ram HYM, Ram M and Steward FC 1962. Growth and development of banana. I. The origin of the inflorescence and the development of flower. II. The structure and development of fruit. Annals of Botany **26:** 665-673.

Rane G, Kumar A, Mahajan C, Joshi B, Myers W and Patil GP 2008. Biogeographical and bio-cultural context for collaborative conservation and resource sustainability in Jalgaon district of Maharashtra, India. Technical Report Number 2008-1015, Department of Statistics, The Pennsylvania State University, University Park, PA.

Robinson JC and Galan Saúco V 2010. Climatic requirements and problems. In: Bananas and plantains (JC Robinson and V Galan Saúco eds), CAB International, pp 67-88.

Robinson JC and Human NB 1988. Forecasting of banana harvest (Williams) in the subtropics using seasonal variations in bunch development rate and bunch mass. Scientia Horticulturae **34(3):** 249-263.

Sastry PSN 1988. Agrometeorology of the banana crop. World Meteorological Organization, 82p.

Turner DW 1995. The response of the plant to the environment. In: Bananas and plantains (S Gowen ed), Springer Netherlands, pp 206-229.

Turner DW and Barkus B 1982. Yield, chemical composition, growth and maturity of Williams banana fruit in relation to supply of potassium, magnesium and manganese. Scientia Horticulturae **16(3):** 239-252.