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Climate Change Induced Abnormal Flowering Pattern in Mango

Mango (*Mangifera indica* L) is one of the oldest and most popular fruits of the tropical world. It is being grown in sub-tropical climatic conditions with more success and high production. India ranks first in production in the world contributing 41 % of total Mango production. In India, it occupies an area of 2.51M.ha accounting to 42 % of fruit crops area with a total production of18.43 M tons. Mango is commercially cultivated in Andhra Pradesh, Karnataka, Kerala, Bihar, Uttar Pradesh, Uttara Khand, Haryana, Telagana, Maharashtra and Gujarat states. Andhra Pradesh ranks second in area and production (NHB, 2015). The predominant mango growing districts in Andhra Pradesh are Chittoor, Krishna, Vizianagaram and Kadapa. Chittoor ranks first in area and production (NHB, 2015).

Climatic factors, *viz*., rainfall, temperature, humidity, wind and sunshine affects the growth, flowering, fruiting and quality of fruits. Mango requires good rainfall during its growing season (June to October) and rainless dry weather from October 2nd fortnight onwards. Flowering season is mainly influenced by climatic conditions especially the temperature level. Rains during pre-flowering and flowering period lead to delayed flowering and increase vegetative growth. Cloudy weather during flowering results in heavy flower drop mainly due to increased population of plant hoppers. Flowering was found more dependent on moisture stress, which takes place earlier than unstressed trees. In tropical conditions flowering occurs after a period of drought (Scholefield et al. 1986).

Whiley *et.al* (1991) reported that for vegetative induction day temperature of 30^0 C and night temperature of 25^0 C is required. For floral induction at 15^0 C day and 10^0 C night temperatures are critical in mono and polyembrionic cultivars. Water stress advances floral bud sprouting. It stimulates growth of floral buds and delayed the development of vegetative buds. Low temperature after a period of drought has been shown to be beneficial for floral induction. The most suitable temperature for the growth of mango is 22 to 27°C. Rains at fruit maturity are beneficial for the improvement of fruit size and quality.

Evidences indicated that the primary impact of water stress on mango was to prevent vegetative flushing during stress period. The accumulating nutrients in stem will be high in water stressed trees than in trees maintained under favorable moisture conditions which encourage vegetative flushes more frequently and such delay may provide more time for accumulation of a proposed floral stimulus. One should take more flushes in young and non-bearing plants, but flushes should be restricted up to October in bearing trees. This phenomenon shall help the growers to get regular crop with good yield.

In Northern India flowering in mango takes place in February to March. Few plants in orchards flower in December or January. Whereas, in South India flowering occurs January to February. Flowering on the same tree can continue for a month due to differences in shoot maturity. This can be avoided by withholding irrigation to the orchards during October and November. It takes 5-6 months depending up on the cultivar to mature and ripen the fruits, after flowering.

In Andhra Pradesh during 2016 season the flowering phenomena in mango was observed very different from normal flowering pattern , more particularly in Rayalaseema districts. There were four to five staggered flowering frequencies i.e., during September, 2016, October, November, December and January 2017 and February as normal flowering season in Andhra Pradesh. The changes in flowering pattern are attributed to off year during 2015 for the Banganapalli variety and combined effect of cyclonic rains received during November and December 2015. The total annual

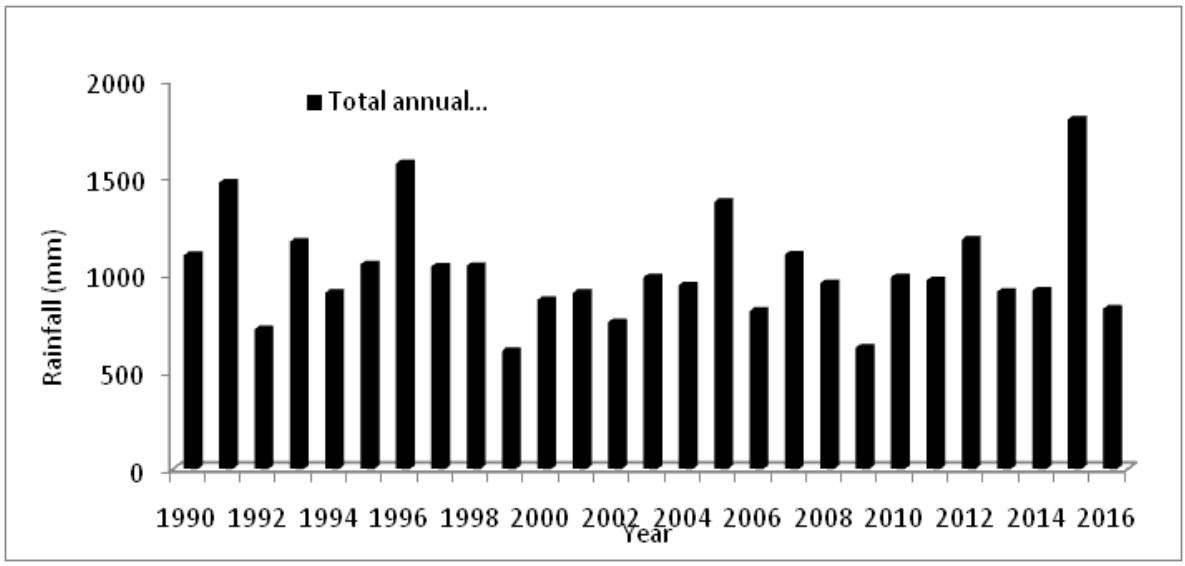

Fig 1. Long term rainfall trend at Tirupati

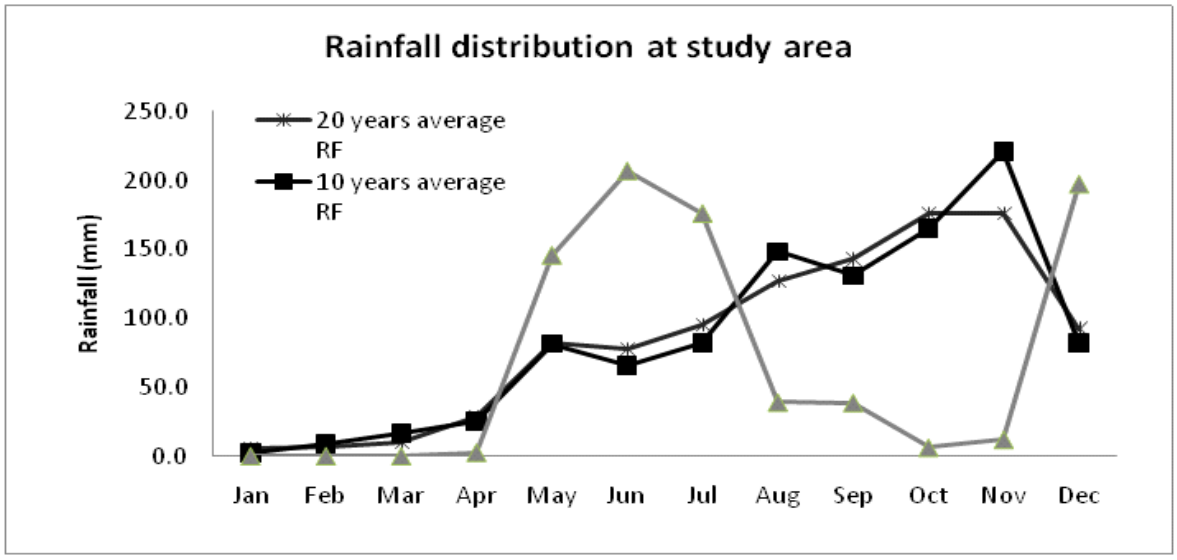

Fig 2.Average of 20 and 10 years rainfall vs actual 2016 rainfall distribution.

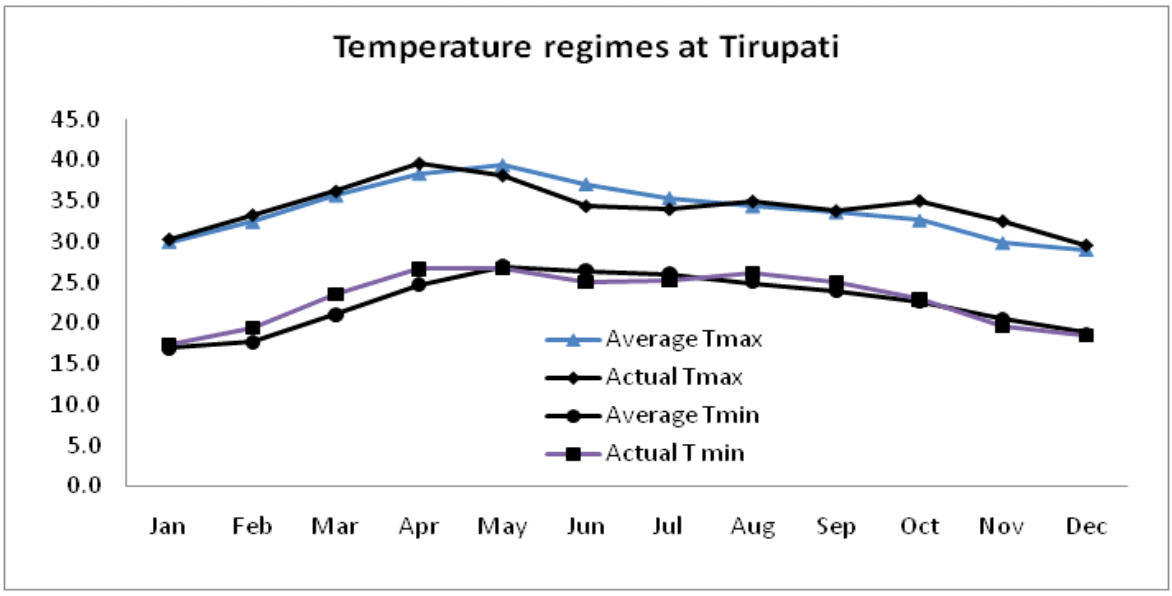

Fig 3.Normal maximum and minimum and 2016 maximum and minimum temperatures at Tirupati.

rainfall during 2015 was 1802 mm (Fig 1), which is 75 per cent more than average rainfall of last 26 years (1024 mm). As a result of cyclonic rains mango trees did not experience stress due to excess moisture or severe winter. Therefore, vegetative growth was abundant during January and February (2016) due to excess moisture. Without much flowering lead to accumulation of sufficient nutrients in the terminal twigs and with the advantages of rains received during July and August 2016 (Fig 2),and moisture stress from September onwards induced staggered flowering from October, November, December 2016 (due to winter stress) again normal flowering occurred in January and February 2017.

Changes in rainfall distribution pattern, occurrence of mid season drought conditions and prevalence of low temperature (Fig 3) caused staggered flowering, fruiting and maturity, which resulted in multiple harvests starting from March to July, extended availability of mango fruits in the market. It is a rare phenomenon observed during 2016-17 mango season. Under the changing scenario, early and late flowering are apparent in several parts of the world.

Profuse and erratic flowering pattern in mango subject the trees to exhaust stored nutrient reserve and cause multiple nutrient deficiencies resulting in decline in tree productivity and overall performance. Therefore, special management recommendations are to be evolved to control excess flowering through use of appropriate plant growth regulators and supplement plant nutrients by external application to overcome plant nutrient deficiencies and maintain tree vigor and productivity.

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