The Pharma Innovation Journal 2022; 11(10): 547-551

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(10): 547-551

www.thepharmajournal.com
Received: 04-07-2022
Accepted: 30-09-2022

Krupashree R
Department of Agronomy, College of Agriculture, UAS, GKVK, Bangalore, Karnataka, India

Shivaramu HS
Dean, College of Horticulture, UHS, Kolar, Karnataka, India

Lingaraj Huggi
Department of Agrometeorology, UAS, GKVK, Bangalore, Karnataka, India

Thimmegowda MN
Department of Agrometeorology, UAS, GKVK, Bangalore, Karnataka, India

Manjunatha MH
Department of Agrometeorology, UAS, GKVK, Bangalore, Karnataka, India

K Pushpa
Department of Agronomy, College of Agriculture, UAS, GKVK, Bangalore, Karnataka, India

Corresponding Author:
Krupashree R
Department of Agronomy, College of Agriculture, UAS, GKVK, Bangalore, Karnataka, India

Studies on impact of weather on growth and yield of Mallika mango

Krupashree R, Shivaramu HS, Lingaraj Huggi, Thimmegowda MN, Manjunatha MH and K Pushpa

Abstract
A field experiment was conducted to know the influence of weather parameters on growth, yield and crop water balance in Mallika mango hybrid at "C" and "I" block, UAS, GKVK, Bengaluru during 2020-21. The plantations of Mallika hybrid of different ages (20 and 28 years), with and without plant protection chemicals were selected and data was analysed using FRBD with five replications. Among the different age of trees, mango trees of 28 years has shown higher tree height, volume and girth (5.91 m, 324.7 m^3 and 1.33 m, respectively) compared to 20 years of age trees. Maximum number of flowers was noted in 20 years of age trees (1091.7), which were significantly higher than 28 years of age (1078.0) and spray treatment had shown significantly higher number of flowers (1100.7) compared to control (1069.1). Mango trees with 20 years of age had shown significantly higher volume of the fruit and mango yield (401.2 and 60.30 kg/tree) compared to 28 years old plantation (344.4 and 40.90 kg/ tree). But among the spray treatments, with spray treatment recorded significantly higher volume of the fruit and yield (387.1 and 58.02 kg/tree) compared to control (358.5 and 43.19 kg/ tree).

Keywords: Growth, quality, yield and mango

Introduction
Climate and weather play a significant role in growth and productivity of any crop in a region. While climate decides the suitability of a crop or variety to a location, the weather decides its performance in that particular location. This stresses the role of short term weather variability on crop performance. Weather parameters have proven influence on the performance of a crop through their sole and interactive effects. For example, variabilities in air temperature and rainfall influence vegetative and phenological phases in several horticultural crops. The influence of weather parameters on crop yield depends on the magnitude and distribution of weather variables during crop growth period. Mango is growing well in areas receiving annual rainfall of 25 to 250 cm. High humidity, rainfall and frost during flowering period is harmful for the crop. Rainfall during flowering adversely affects fruit set, fruit development and yield. Excessive vegetative growth and flower drop occurs due to heavy and prolonged rainfall. Fruits develop better colour and are less affected by diseases where the air is comparatively dry during flowering.

Mango (*Mangifera indica* L.) is one of the important tropical fruits of the world belongs to the family Anacardiaceae and is native to Indo-Burma region. It is rich source of nutrients and has been rightly described as "King of fruits" owing to its delicious taste. Mallika (hybrid developed from IARI, New Delhi. Neelum x Dashehari) is a regular bearer, good colour, uniform fruits and moderate keeping quality (Vidya *et al.*, 2014) [2]. It can be grown from sea level to an altitude of about 1400 meters. The favourable temperature is 18 to 35 °C. But can however tolerate temperature as high as 48 °C with protective irrigation. India ranks first among mango producing countries in the world with 20.9 million metric tonnes accounting for about 50% of the global mango production. In India, mango crop occupies an area of 2.3 million hectare, with productivity of 9.1 tonnes per hectare (Anon., 2021) [1].

Time and peak period of flowering, sex ratio, flowering behaviour, insect pests, diseases and weather parameters like temperature and relative humidity influences flowering and fruit set in mango (Anon., 2017) [3]. The pest status does not remain static throughout the year, but uninfluenced by the abiotic factors like temperature, humidity, rainfall and light etc. Hence a study was conducted to establish relationship of impact of weather on growth and yield of mango with different age groups and spray treatments.

Material and Methods

The present investigation was executed at 2 locations/orchards with two management levels (M_1: Control and M_2: With Plant Protection Chemicals) with sample size of 5 plants each in 2 locations with different age groups (20 and 28 years old plantation) located at Dry land Agriculture Project, Zonal Agricultural research station, UAS, GKVK, Bengaluru belonging to Eastern dry zone of Karnataka (Zone 5) at 12º N latitude and 77º 35' E Longitude, at an altitude of 930 m above mean sea level. Mallika hybrid developed by IARI was selected for the study in this experiment.

Daily meteorological data recorded at the observatory at AICRP on Agrometeorology unit, Zonal Agricultural Research Station (ZARS), University of Agricultural Sciences, GKVK, Bengaluru for the crop growth period during 2020-21 and 2021-22 was collected. The normal and actual of weather parameters *viz.*, rainfall, mean temperature (maximum and minimum), relative humidity, bright sunshine hours and wind speed were collected. The field was cleaned at the starting of the mango season to avoid contamination from the host plants in and around the orchard trees and basins were done for each tree. To manage the major diseases and pests like powdery mildew, anthracnose, fruit fly and mango hoppers two sprays were given to the spray treatment trees with Hexaconazole @ 5% SC, Lambda Cyhalothrin @ 5% EC and Sulphur @ 80% WP at the time of flower bud initiation and fruiting stage.

Results and Discussion

Growth

Tree height: Mango trees with 28 years of age has shown significantly higher tree height (5.91 m) as compared to 20 years of age (5.41 m). But between the spray treatments, there is no significant difference in the tree height of the mango trees (Table 1). The interaction of mango tree age and management practices did not influence on the tree height of Mallika mango statistically.

The mango tree age showed different growth habits and the difference in plant height might be due to the advancement in tree age, height with the annual growth involving the cell division, differentiation and expansion of new cells, tissues or organs and meristematic tissues activity at terminal branches will be higher. These results are in conformity with the findings of Parshant *et al.* (2012) [13] and Dong *et al.* (2019) [8].

Tree girth: Mango trees with 28 years of age has shown significantly higher tree girth (1.33 m) as compared to 20 years of age (1.22 m) (Table 1). Between the spray treatments, no statistical difference observed in the tree girth. Interaction of tree age and management practices did not influence on the tree girth of Mallika mango statistically.

Variation in the girth of tree might be associated with primary growth followed by secondary growth, which allows the plant stem to increase in thickness or girth. Secondary vascular tissue is added as the plant grows, as well as a cork layer. The trunk needs to get thicker to support the extra height and breadth as the tree grows annually. Similar results of higher trunk girth in old trees were reported by Parshant *et al.* (2012) [13].

Volume of the tree: Mango trees with 28 years of age has shown significantly higher tree volume (324.70 m^3) as compared to 20 years of age (239.81 m^3) and in the interaction, there is no significant difference in the tree volume of the mango trees (Table 1).

The mango tree ages studied showed variation in the tree volume due to the different age of the tree, as the tree growth rate increases with age, higher tree volume may be due to maximum tree height, N–S and E –W spread of the cultivar and higher vegetative flushes during the flowering and fruiting period might have been attributed to higher tree volume in old age trees. These results were also reported by Parshant *et al.*, 2012 [13] and Rattan *et al.* (2020) [16]. The gradual increase in canopy volume of Kinnow trees might be associated with increase in trunk cross-sectional area (Dalal and Brar, 2012) [6] and can be correlated with finding of current research as the maximum trunk cross-sectional area was recorded in the 28 years old trees.

Total number of flowers/inflorescence: Maximum number of flowers was noted in 20 years of age trees (1091.7), which were significantly higher than 28 years of age (1078.0) and spray treatment had shown significantly higher number of flowers (1100.7) compared to control (1069.1). In cultivar Mallika, significantly higher number of flowers was observed on the panicle in north side (1091.4) which is on par with east (1089.6) and south direction (1088.3). Minimum flowers was found on the panicle of the west side (1070.1). The interaction between the tree age, management practices and directions of the plant did not influence the number of panicles statistically (Table 2).

Mango flowering only occurs in tropical warm temperatures in initiating shoots of stems that have achieved sufficient age since the previous vegetative flush, *i.e.*, four to five months depending upon cultivar (Davenport, 1997) [7]. The number of flowers vary from 887.33 to 4242.0 observed in different varieties. Similar findings were made by Kumar *et al.* (2015) [10], Rajatiya *et al.* (2018) [14], and Saheda *et al.* (2019) [17] in five different cultivars of mango. This may be due to the physiology of cultivar, age and environmental conditions. The higher intensity of flowering in Mallika might be due to the synchronisation in the shoot maturity as flowering in the tropics is primarily regulated by the age of the initiating shoots as well as high level of florigenic promoter.

Volume of the fruit (ml): Mango trees with 20 years of age has shown significantly higher fruit volume (420.78 ml) as compared to 28 years of age trees (365.10 ml). But between the spray treatments, PPC spray treatment recorded significantly higher average fruit weight (411.50 ml) compared to control (374.38 ml) (Table 3). The interaction between the tree ages and management practices did not influence on the volume of the fruit statistically. These results are in confirmation with the findings of Ayasha (2013) [5] and Kumar *et al.* (2015) [10].

Fruit yield (kg/tree): Mango tress with 20 years of age has shown significantly higher mango yield (64.24 kg/tree) as compared to 28 years of age trees (46.60 kg/tree). Between the spray treatments, PPC spray recorded significantly higher yield (64.75 kg/tree) compared to control (46.09 kg/tree). The interaction between the tree age and management practice did not influence the average fruit yield statistically (Table 3).

Increased yield in moderate aged trees (20 years) was due to increased yield attributing factors like panicle number, fruit set percentage, number fruits per tree and fruit weight.

Increased fruit yield with moderate tree age may be due to increase in bearing capacity so they produce more fruits (Minor and Kobe, 2019) [11]. The trees with good canopy and productive age might have greater ability to gain and store nutrients and carbohydrates, resulting in larger fruit mass (Aregay *et al.*, 2021) [4]. Ozeker (2000) [12] also reported similar results wherein, 20-year-old seedless grape gave bigger fruit compared to 34-year-old. Tree age and plant height are important factors affecting yield. The mango yield is lower at the early stage of bearing fruit and increases with time, reaching the highest fruit production during 10 to 20 years and starts declining trend in the later stage as the trees shade each other and begin ageing. However, as tree age increases, height also increases, which leads to greater management challenges and affects mango yield.

In the traditional planting patterns, tall trees have been found to be less productive than dwarfing cultivars (Dong *et al.*, 2019) [8]. Biomass difference among trees can be attributed to CO_2 assimilation during photosynthesis. However, the distribution of these photosynthates is dependent on the competition existing between vegetative growth and reproductive development. The flowering and fruiting in citrus depends on supply of photosynthates during flower bud differentiation, fruit set and fruit development thus, acts as major sink for carbohydrates, Islam *et al.*, 2013 [9], Vijayanand *et al.*, 2015 [18] and Rattan *et al.* (2020) [16].

Table 1: Tree height, tree girth and volume of the tree as influenced by different age and management practice in Mallika mango

Parameter	Tree height (m)			Volume of the tree (m^3)			Tree girth (m)		
Treatment	**2020-21**	**2021-22**	**Pooled**	**2020-21**	**2021-22**	**Pooled**	**2020-21**	**2021-22**	**Pooled**
Age (A)									
20 years (A_1)	5.03	5.78	5.41	206.84	272.78	239.81	1.14	1.30	1.22
28 years (A_2)	5.65	6.16	5.91	286.51	362.88	324.70	1.26	1.41	1.33
F - test	*	*	*	*	*	*	*	*	*
S.Em+	0.16	0.12	0.10	9.83	13.60	7.71	0.03	0.02	0.02
CD at 5%	0.49	0.37	0.30	30.28	41.89	23.76	0.10	0.07	0.07
Management practice (M)									
Control (M_1)	5.13	5.92	5.53	231.58	310.69	271.13	1.19	1.33	1.26
PPC (M_2)	5.55	6.02	5.79	261.78	324.97	293.38	1.22	1.38	1.30
F - test	NS	NS	NS	NS	NS	NS	NS	NS	NS
S.Em+	0.16	0.12	0.10	9.83	13.60	7.71	0.03	0.02	0.02
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Age x Management practice (A x M)									
A_1M_1	4.84	5.70	5.27	203.37	275.25	239.31	1.14	1.28	1.21
A_1M_2	5.22	5.86	5.54	210.32	270.31	240.31	1.14	1.32	1.23
A_2M_1	5.42	6.14	5.78	259.78	346.12	302.95	1.23	1.37	1.30
A_2M_2	5.88	6.18	6.03	313.24	379.64	346.44	1.29	1.44	1.37
F - test	NS	NS	0.01	NS	NS	NS	NS	NS	NS
S.Em+	0.22	0.17	0.14	13.90	19.23	10.90	0.05	0.03	0.03
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: * Significant at 5% level NS: Non significant PPC: Plant protection chemicals

Table 2: Total number of flowers as influenced by different age, management practice and direction in Mallika mango

Treatment	20 years (A_1)		28 years (A_2)		D Mean
	Control (M_1)	**PPC (M_2)**	**Control (M_1)**	**PPC (M_2)**	
2020-21					
D_1 - North	1113.4	1132.5	1079.5	1103.3	1107.2
D_2 - South	1097.1	1129.1	1075.9	1111.4	1103.4
D_3 - East	1097.8	1133.6	1073.5	1109.4	1103.6
D_4- West	1056.7	1093.5	1072.1	1095.6	1079.4
A - Mean	1106.7		1090.1		
M - Mean	1083.2	1113.5			
	A		**M**	**D**	
F - test	*		*	*	
S.Em+	3.94		3.94	5.57	
CD at 5%	11.15		11.15	15.77	
	AM	**AD**	**MD**	**AMD**	
F - test	NS	NS	NS	NS	
S.Em+	5.57	7.88	7.88	11.15	
CD at 5%	NS	NS	NS	NS	
2021-22					
D_1 - North	1062.0	1114.0	1056.2	1070.6	1075.7
D_2 - South	1056.1	1095.5	1062.9	1078.3	1073.2
D_3 - East	1047.4	1114.9	1058.6	1081.9	1075.7
D_4- West	1045.2	1079.1	1050.9	1068.1	1060.8
A - Mean	1076.8		1065.9		
M - Mean	1054.9	1087.8			
	A		**M**	**D**	

F - test	*		*	NS	
S.Em+	3.19		3.18	4.51	
CD at 5%	9.02		9.02	NS	
	AM	**AD**	**MD**	**AMD**	
F - test	*	NS	NS	NS	
S.Em+	4.51	6.38	6.38	9.02	
CD at 5%	12.76	NS	NS	NS	
Pooled					
D_1 - North	1087.7	1123.3	1067.8	1086.9	1091.4
D_2 - South	1076.6	1112.3	1069.4	1094.9	1088.3
D_3 - East	1072.6	1124.2	1066.1	1095.6	1089.6
D_4- West	1050.9	1086.3	1061.5	1081.8	1070.1
A - Mean	1091.7		1078.0		
M - Mean	1069.1	1100.7			
	A		**M**	**D**	
F - test	*		*	*	
S.Em+	3.06		3.06	4.33	
CD at 5%	8.66		8.66	12.25	
	AM	**AD**	**MD**	**AMD**	
F - test	NS	NS	NS	NS	
S.Em+	4.33	6.12	6.12	8.66	
CD at 5%	NS	NS	NS	NS	

Note: * Significant at 5% level NS: Non significant PPC: Plant protection chemicals

Table 3: Number of fruits, average fruit weight and fruit yield as influenced by different age and management practice in Mallika mango

Parameter	Volume of the fruit (ml)			Fruit yield (kg/ tree)		
Treatment	**2020-21**	**2021-22**	**Pooled**	**2020-21**	**2021-22**	**Pooled**
Age (A)						
20 years (A_1)	325.6	476.7	401.2	60.30	68.17	64.24
28 years (A_2)	258.9	429.9	344.4	40.90	52.30	46.60
F - test	*	*	*	*	*	*
S.Em+	11.0	7.20	7.60	3.01	2.80	2.08
CD at 5%	33.9	22.1	23.4	9.26	8.64	6.42
Management practice (M)						
Control (M_1)	275.2	441.8	358.5	43.19	48.99	46.09
PPC (M_2)	309.4	464.9	387.1	58.02	71.49	64.75
F - test	*	*	*	*	*	*
S.Em+	11.0	7.2	7.6	3.01	2.80	2.08
CD at 5%	33.9	22.1	23.4	9.26	8.64	6.42
Age x Management practice (A x M)						
A_1M_1	315.7	456.2	386.0	55.58	52.69	54.13
A_1M_2	335.6	497.2	416.4	65.03	83.65	74.34
A_2M_1	234.6	427.4	331.0	30.79	45.28	38.04
A_2M_2	283.2	432.5	357.8	51.01	59.33	55.17
F - test	NS	NS	NS	NS	NS	NS
S.Em+	15.6	10.1	10.7	4.25	3.96	2.94
CD at 5%	NS	NS	NS	NS	NS	NS

Note: * Significant at 5% level NS: Non significant PPC: Plant protection chemicals

Conclusion

Present study on impact of weather variability during different phenological phases of mango (2020-21 and 2021-22) stresses the importance of age groups and spray treatment on flowering and fruiting behaviour. The outcomes of the investigation indicated age groups plays an important role on yield, yield attributes and flowering in mango hybrid Mallika. Impact of this variability was clearly observable by parameters like total number of flowers, volume of fruit, and fruit yield. This outcome envisages use of measures for timely application of plant protection chemicals to the crop and other management practices for bringing out sustainability in the mango productivity in the region.

References

1. Annoymous. National Mango Data Base, Statista research department (2020-21); c2021.
2. Vidya A, Swamy GSK, Prakash NB, Jagadeesh RC, Jagadesh SL, Gangadharappa PM, *et al*. Effect of Pre-harvest Sprays of Nutrients on the Physico-Chemical Characters in mango (*Mangifera indica*) hybrid Mallika. Mysore J Agric. Sci. 2014;48(4):529-533.
3. Anonymous. Annual Report, 2016-17, AICRP on Agro-meteorology, UAS, GKVK, Bangalore; c2017.
4. Aregay N, Derbew Belewc AB, Amanuel Zenebe, Mitiku Hailed AD, Girmay G, Atkilt G. Tree Age and Harvesting Season Affected Physico-chemical and Bioactive Compounds of Elite Type of Gunda Gundo Orange (Citrus *Spp*) in the Northern Ethiopia. Int. J Fruit. Sci. 2021;21(1):26-39.
5. Ayasha A. Fruit growth development and quality changes of mango varieties at different growth stages. M.Sc. thesis, Bangladesh Agric. Uni. Mymensingh, Bangladesh; c2013.
6. Dalal RPS, Brar JS. Relationship of trunk cross-sectional area with growth, yield, quality and leaf nutrient status in Kinnow mandarin. Indian J Hort. 2012;69(1):111-113.
7. Davenport TL. Reproductive physiology. In: Litz R.E. (ed). The Mango. Wallingford, CAB International; c1997. p. 97-169.
8. Dong Z, Zhang Z, Li XL. Yield gap and production constraints of mango (*Mangifera indica*) cropping systems in Tianyang County, China. J Integrative Agri. 2019;18(8):1726-1736.
9. Islam K, Khan MZH, Sarkar MAR, Absar N, Sarkar SK. Changes in acidity, TSS, and sugar content at different storage periods of the postharvest Mango (*Mangifera indica* L.) Influenced by Bavistin DF. Int. J Food Sci; c2013. p. 08.
10. Kumar RKN, Nachegowda V, Reddy PVK, Rajegowda MB, Janardhana Gowda NA. Studies on water balance in mango (*Mangifera indica* L.) Orchard. Proc. Global Conference on Augmenting Production and Utilization of Mango: Biotic and Abiotic Stresses; c2015. p. 1066.

11. Minor DM, Kobe RK. Fruit production is influenced by tree size and size asymmetric crowding in a wet tropical forest. Eco. Evolution. 2019;9(3):1458-1472.
12. Ozeker E. Determination of fruit characteristics of Marsh seedless grapefruit cultivar in Izmir (Turkey). Pak. J Biol. Sci. 2000;3:69-71.
13. Parshant B, Rakesh K, Arshant B, Rakesh K, Amit J, Wali VK. Growth and yield performance of mango varieties under rainfed areas of Jammu. Indian J Agric. Res. 2012;46(3):281-285.
14. Rajatiya JH, Varu DK, Farheen HH, Meera BS. Correlation of climatic parameters with flowering characters of Mango. Int J Pure App. Biosci. 2018;6(3):597-601.
15. Rajput SS, Pandey SD. Studies on physico-chemical characteristics of some mango cultivars under Chhattisgarh region of Madhya Pradesh. Hortic. J. 1997;10(1):9-14.
16. Rattan CS, Singh SK, Badhan BS. Influence of tree age on vegetative growth, leaf nutrient content and yield of Kinnow trees. Plant Arc. 2020;20(2):5257-5262.
17. Saheda MD, Balahussaini M, Ramaiah M, Balakrishna M. Study on morpho-physical characters of mango flower varieties/hybrids in Kodur Agro-Climatic Conditions. Int. J Curr. Microbiol. App. 2019;8(3):28-38.
18. Vijaynand P, Deepu E, Kulkarni SG. Physico chemical characterization and the effect of processing on the quality characteristics of Sindhura, Mallika and Totapuri mango cultivars. J Food Sci. Technol. 2015;52(2):1047-1053.