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Response of mango cultivars to agro-chemicals in relation to yield attributes

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Abstract

Mango has wide adaptability, high nutritive value, richness in variety, delicious taste, pleasant flavour, attractive appearance and it enjoys the unique popularity among the masses and classes. Mango fruits are rich in vitamin A and C. Application of agro-chemicals alter the behavior of trees for the economic benefit of the fruit growers. In this regard an experiment was conducted at Agriculture Research Station, Banswara district of Rajasthan to find out the response of different agro-chemicals. The experiment consisted of thirteen treatments along with control and replicated thrice in a Randomized Block Design. Fifteen years old mango orchard was selected for experiment which has Dashehari, Langra and Kesar. Plants were planted with square system of planting at 10 m x 10 m spacing. Agro-chemicals *viz*., calcium chloride (0.3, 0.6 & 0.9%), potassium nitrate (1, 2 & 3%), paclobutrazol (500, 1000 & 1500 ppm), sorbitol (1.5, 2.0 & 2.5%) and control-water spray were used at different stages and time. Among alternate bearing mango cultivars (Dashehari, Langra and Kesar), cultivar Kesar recorded higher fruit weight while Langra recorded higher fruit yield over Dashehari. Fruit diameter significantly influenced by agro-chemicals. Yield per tree and estimated yield per hectare were enhanced by application of paclobutrazol 1500 ppm.

Key words: *Mango, calcium chloride, potassium nitrate, paclobutrazol, sorbitol, yield*

Introduction

Mango is one of the oldest and choicest tropical fruit of the world and is rightly designated as "King" of fruits in India. It belongs to family Anacardiaceae and indigenous to Indo-Burma region (Mukherjee, 1951) and most outstanding among the tropical fruits of India. Fruits are rich in vitamin A (1082 IU/100g) and also vitamin C (36.4 mg/100 g) (Anonymous, 2011). It is grown in almost all the states in India. In Rajasthan, mango is commonly cultivated in Banswara, Dungarpur, Chittorgarh, Pratapgarh, Udaipur, Bhilwara, Dhaulpur and Dausa districts. The mango tree is long-lived, medium to large (10 to 40 m in height) with profuse, wide-spreading feeder roots, the tree also sends down many anchor roots, which penetrate several feet of soil (6 m). The inflorescence is a many branched panicle borne at shoot terminals, possessing from 550 to more than 4,000 flowers. Flowers are monoecious, polygamous and small. Both male and perfect flowers are found within a single inflorescence the pistil aborts in male flowers. The fruit takes three to six months to ripen from fruit set.

Application of agro-chemicals (for regular flowering and improve fruit set) alter the behaviour of trees for the economic benefit of the fruit growers. Control of vegetative vigour, stimulation of flowering, regulation of crop load, reduction of fruit drop, delay or stimulation of fruit maturity and ripening are important horticultural processes in fruit trees that can be regulated with exogenous applications of agro-chemicals. Yield enhancement of mango by agro-chemicals like sorbitol and potassium nitrate help in pollen tube growth which facilitates better fertilization and fruit set. Besides, KNO_3 has been shown to stimulate flowering under tropical condition in number of mango cultivars. As KNO_3 is suggested to induce ethylene production and efficacy of KNO_3 is suppressed by ethylene biosynthesis inhibitors, the involvement of ethylene appear an important factor in mango flower process (Upreti *et al.,* 2014). Calcium compound improve firmness, delay fruit ripening, storability, better skin and pulp colour (Anjum and Ali, 2004) and paclobutrazol help for regular bearing in biennial habits of mango cultivars. The effect of paclobutrazol in improving flowering per cent was due to its anti-gibberellins activity. Paclobutrazol helps in getting more number of reproductive shoots (Muhammad *et al.*, 2010) and also increase the perfect flowers per panicle in mango (Kumar *et al.,* 2005). Paclobutrazol is a broad spectrum plant growth retardant that selectively controls tree vigour without marked effect on the size of fruit. The cropping manipulations possible with paclobutrazol ranges from off-season or early season to simply increased yield.

Materials and Methods

Experiment was conducted in Banswara district of Rajasthan. The region comes under agro-climatic zone IV b "Humid Southern Plain Zones of Rajasthan" at an altitude of 302 metre above mean sea level and lies between 23°11' N to

23°56' N latitude and 73°58' E to 74°49' E longitude. This region has a typical sub-tropical climate, characterized by mild winters and summers. Soils predominantly reddish medium textured well drained calcareous, shallow on hills and deep soils in valleys. The following treatment combinations were applied control-water spray (T_0), calcium chloride 0.3% (T_1), calcium chloride 0.6% (T_2) & calcium chloride 0.9% (T_3) potassium nitrate 1% (T_4), potassium nitrate 2% (T_5) & potassium nitrate 3% (T_6), paclobutrazol 500 ppm (T_7), paclobutrazol 1000 ppm (T_8) & paclobutrazol 1500 ppm (T_9), sorbitol 1.5% (T_{10}), sorbitol 2.0% (T_{11}) & sorbitol 2.5% (T_{12}). There were three varieties Dashehari (V_1), Langra (V_2) and Kesar (V_3). Stage and time of applications of different agro-chemicals were calcium chloride at one month prior to harvesting (May, 7-8), potassium nitrate at marble size stage (February, 27- March, 1), paclobutrazol at fruit bud differentiation stage (October, 11) and sorbitol at pea nut size (January, 19).Yield and yield attributes such as fruit weight, fruit diameter, yield per tree and estimated yield per hectare were recorded as per the standard methods.

Results and Discussion

Fruit weights of different cultivars were influenced during both the year of investigation as well as in pooled analysis (Table-1). On pooled data basis, the maximum fruit weight 204.87 g was recorded with treatment V_3 (Kesar) followed by 199.15 g with the treatment V_2 (Langra) and lowest fruit weight 181.92 g was recorded in treatment V_1 (Dashehari). Cultivar Kesar recorded 10 per cent higher fruit weight over Dashehari. Fruit weight was affected by various agro-chemicals. The highest fruit weight 211.33 g was observed in T_0 and lowest fruit weight 187.83 g was obtained under T_7 (PBZ 500 ppm). The application of PBZ (500 ppm) reduced about 23.5 g weight over control. The combination of cultivars and agro-chemicals had no significant effect on fruit weight. Fruit diameter as affected by different cultivars and agro-chemicals. The maximum polar diameter (9.60 cm) was recorded in Dashehari followed by Langra (9.00 cm) and Kesar resulted minimum polar diameter (8.54 cm). Different agro-chemicals also had significant effect on polar diameter. The lowest polar diameter recorded under T_1 (8.83 cm). Whereas, treatment T_0 resulted in maximum (9.32 cm) polar diameter followed by T_5 (9.22 cm). Interaction of different cultivars and agro-chemicals resulted in non-significant effect on polar diameter during both the years of experimentation.

A reference of data reveals that the equatorial diameter showed the significant difference in cultivars of mango. The maximum equatorial diameter was recorded in Langra (5.26 cm) followed by Kesar (5.04 cm). Further, the minimum equatorial diameter was registered in Dashehari (4.70 cm). Agro-chemicals significantly influenced equatorial diameter of fruit. The minimum equatorial diameter (4.83 cm) recorded in T_1 ($CaCl_2$ 0.3%), which was at par with treatment T_2 (4.84 cm),T_3 (4.85 cm), T_{10} (4.88 cm), T_{11} (4.92 cm)and T_{12} (4.94 cm) as compared to maximum equatorial diameter (5.26 cm) in T_0 (water spray) followed by T_6 (5.21 cm) and T_5 (5.14 cm), which were at par with each other. The interaction effect of cultivars and agro-chemicals on equatorial diameter of mango was found non-significant.

Fruit yield was significantly higher in cultivar Langra as compared to Dashehari and Kesar. The values of fruit yield under V_2 were 103.74, 68.09 and 85.92 kg tree^{-1}, respectively against the corresponding values of 83.56, 49.31 and 66.44 kg tree^{-1} under V_3. The maximum fruit yield during first, second year and pooled was found under treatment T_9 (PBZ 1500 ppm) *i.e.,* 100.67, 72.56 and 86.61 kg tree^{-1}, respectively (Table 1). Whereas, minimum fruit yield (71.00, 46.36 and 58.68 kg tree^{-1}) was recorded in T_0, respectively. During second year, the maximum yield per tree (83.58 kg) was recorded in the treatment V_2T_9 (Langra + PBZ 1500 ppm) followed by V_2T_8 (Langra + PBZ 1000 ppm) which was statistically at par (80.01 kg) with treatment V_2T_9 and minimum (42.24 kg) was observed in Dashehari + water spray. On the basis of pooled analysis, the mean maximum (99.29 kg) yield per tree was registered in treatment V_2T_9 and minimum (54.12 kg) was obtained in V_1T_0 treatment combination. The significantly higher yield (10.32, 6.81 and 8.56 t ha^{-1}, respectively) was recorded with treatment V_2 (Langra) during both the years, while, lowest (8.26, 4.93 and 6.60 t ha^{-1}, respectively) in Kesar. Among the different agro-chemicals T_9 (PBZ 1500 ppm) registered significantly higher yield (8.66 t ha^{-1}) followed by T_8 (8.48 t ha^{-1}) as compared to rest of treatments. Where, the lowest yield (5.38 t ha^{-1}) was registered in treatment T_0 (Water spray).

Interaction effect of cultivars and agro-chemicals was found significant. During second year, the maximum yield (8.36 t ha^{-1}) was recorded under Langra + PBZ 1500 ppm followed by Langra + PBZ 1000 ppm which was statistically at par (8.00 t ha^{-1}) with treatment V_2T_9 and minimum (4.22 t ha^{-1}) was observed under V_1T_0 (Dashehari + water spray). On the basis of pooled analysis, the mean maximum yield (9.93 t ha^{-1}) was registered in treatment V_2T_9 and minimum (4.91 t ha^{-1}) was obtained in V_1T_0 treatment combination. Among alternate bearing mango cultivars (Dashehari, Langra and Kesar), cultivar Langra recorded higher economic trait like yield (85.92 kg tree^{-1} & 8.56 t ha^{-1}) over Dashehari and Kesar (Table 1). With respect to compact growth (short shoot length, diameter and canopy volume), early flowering (but not regular) and good fruit quality (peel & pulp colour, pulp recovery and shelf life) were observed in Kesar, but poor yielder. Thus, Langra and Dashehari cultivars are promising in this region. Agro-chemicals affected the yield significantly. Paclobutrazol (1500 ppm) treated trees were found better with respect to yield (yield 86.61 kg tree^{-1} & 8.66 t ha^{-1}).The present results are also supported by the finding of Sergent *et al.* (1993) and Bally *et al.* (2000). Interaction between cultivars and agro-chemicals showed significant effect on growth parameters with yield attributes maximum recorded under combination V_2T_9 (Langra + PBZ 1500 ppm) with respect to yield (99.29 kg tree^{-1} & 9.93 t ha^{-1}). Thus, cultivar Langra and agro-chemical paclobutrazol 1500 ppm were found better for yield and return in mango crop

production. Patel and Patel (1998) reported that the increase in yield was mainly because of better growth of the plant under optimum amount of nutrients.

Based on the above findings, it is concluded that supplementation of paclobutrazol 1500 ppm as foliar spray in the month of October in biennial bearing cultivar Langra resulted in higher yield and net return to the farmers.

Table 1. Response of mango cultivars to agro-chemicals with respect to yield attributes

Treatments/ varieties	Fruit weight (g)	Fruit diameter (cm)		Yield/tree (kg)	Estimated yield/ha (t)
		Polar	Equatorial		
V_1 (Dashehari)	181.92	9.60	4.70	70.13	6.97
V_2(Langra)	199.15	9.00	5.26	85.92	8.56
V_3(Kesar)	204.87	8.54	5.04	66.44	6.60
SEm±	0.95	0.05	0.03	0.549	0.055
CD at 5%	2.66	0.13	0.07	1.533	0.153
Agro-chemicals					
T_0 (Control) WS	211.33	9.32	5.26	58.68	5.38
T_1 ($CaCl_2$ 0.3%)	189.67	8.83	4.83	69.47	6.95
T_2($CaCl_2$ 0.6%)	190.48	8.84	4.84	70.43	7.04
T_3($CaCl_2$ 0.9%)	191.05	8.85	4.85	70.70	7.07
T_4 (KNO_3 1%)	194.42	9.11	5.02	71.10	7.11
T_5 (KNO_3 2%)	195.45	9.22	5.14	72.37	7.23
T_6 (KNO_3 3%)	196.65	9.26	5.21	73.24	7.32
T_7(PBZ 500ppm)	187.83	9.08	5.01	82.52	8.25
T_8(PBZ 1000ppm)	188.40	9.12	5.04	84.77	8.48
T_9(PBZ 1500ppm)	189.05	9.16	5.07	86.61	8.66
T_{10} (Sorbitol 1.5%)	199.97	8.90	4.88	73.19	7.32
T_{11}(Sorbitol 2.0%)	201.73	8.94	4.92	74.87	7.49
T_{12} (Sorbitol 2.5%)	203.00	8.97	4.94	76.17	7.62
SEm±	1.979	0.096	0.053	1.142	0.114
CD at 5%	5.528	0.269	0.148	3.191	0.319

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