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Effect of Chemicals and Agro-techniques on growth and flowering of mango cv. Kesar

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Abstract
An experiment entitled "Effect of chemicals and agro techniques on growth and flowering of mango cv. Kesar" was carried out at Fruit Research Station, Lalbaug, Junagadh Agricultural University, Junagadh during 2019-20 to 2020-21. Ten different modules arising from different chemical and agro technique, were allocated in randomized block design in three replications. The result revealed that significantly highest number of coppery shoots (317.33, 418.33 and 367.83) was registered with foliar application of GA_3 @ 100 ppm in July + KNO_3 @ 4% in September + KH_2PO_4 @ 1% in October + $Ca(NO_3)_2$ @ 2% in November during both the years as well as in pooled. Significantly maximum number of panicles (1417.0) were registered in soil drenching with PBZ @ 10 g/tree during July + foliar spray of KNO_3 @ 4% in October + $Ca(NO_3)_2$ @ 2% in November during first year, but for second year and pooled the maximum number of panicle per tree (1421.0 and 1399.0) was noted in pinching in July + foliar application of KNO_3 @ 4% spray in September + soil drenching with PBZ @ 10 g/tree in October + foliar spray of NAA @ 200 ppm at grain stage. The least days to flowering (50.0, 31.83 and 40.92) and maximum number of hermaphrodite flowers per panicle (307.33, 308.0 and 306.0) were recorded in pinching in July + foliar spray of KNO_3 @ 4% in September + soil drenching with PBZ @ 10 g/tree in October + foliar spray of NAA @ 200 ppm at grain stage during both the years as well as in pooled.

Keywords: Chemicals, agro techniques, growth and flowering

1. Introduction
Mango (*Mangifera indica* Linn.) is a commercial crop. Botanically it belongs to the family Anacardiaceae. India produce around 207.98 lakh tonne of mango from 22.93 lakh ha area with 8.71 t/ha productivity. Gujarat produces 12.22 lakh tonne of mango from 1.66 lakh ha area (Anon., 2019) [2]. Mango is an important fruit crop of tropical and subtropical region. The main objective of a mango grower is to harvest maximum quantity with good quality of marketable fruits at the lowest cost in early season. Moreover, induction of early flowering results in early maturity of the mango fruits which fetch the higher price in the market as compared to late maturing mango fruits. For successful production of mango, flowering is an important factor. The multifunctional effects of chemicals are apparent on various morphological and physiological phenomenons.
KNO_3 is one of the chemical inducing substances that have shown some potential for inducing flowering in mango by increasing the activity of nitrate reductase and stimulating the production of ethylene. Calcium has been reported to act as secondary messenger for flower induction (McKenzie, 1994) [22]. The fraction of phosphorus in the KH_2PO_4 increased flowering (Agusti, 2003) [1]; and increase metabolism in these buds, phosphorus promotes the absorption of Mg, an element that is fundamental in the floral formation and promotes the synthesis of nucleic acids. Thiourea is a reagent in organic synthesis. Gibberellin is normally associated with stimulation of vegetative growth. Principal mode of action of paclobutrazol is the inhibition of gibberellin biosynthesis which results in retardation of vegetative growth and diversion of assimilates to reproductive leading increased yield potential (Kulkarni, 1988) [14]. Ethrel release ethylene gas, when it comes in to contact with the plant tissues in turn the mechanism of flowering and breaking of the dormancy of shoots. Auxin is also necessary for female organ development. NAA can fulfil requirement of internal hormones in proper balance at different stages of fruit growth. Zinc sulphate plays a major role in flowering for synthesis of tryptophan which is a precursor of auxin and stimulates flowering.

Agro techniques like girdling and pinching also play an important role in the enhancement of growth and reproduction of fruit treess. Girdling improved leaf N content, C/N ratio and carbohydrate. The immediate effect of girdling is an intervention in the phloem transport between canopy and roots, in an attempt to manipulate the distribution of photosynthate, mineral nutrients and plant bioregulators (Goren *et al.,* 2004) [11]. Tip pruning reduces the auxin synthesis at the apex of branches directing the transport of assimilates and cytokinins to the auxiliary buds of branches under flowering conditions, inducing the formation of axillary inflorescences (Srivastava, 2002) [33].

Now a days farmers facing a problem of flowering. Despite of good quality production of fruit on a commercial scale is confronted with various problems such as disturbance in flowering pattern, delayed panicle emergence, lack of flowering, low perfect flowers, floral abortions, pollination failures**,** poor fruit setting, heavy drop of hermophrodite flowers and marble size fruits, small and irrregular size of fruits and poor yield which may be due to climate change. Hence, the study "Effect of chemicals and agro techniques on growth and flowering of mango cv. Kesar" was undertaken to enhance flowering.

2. Materials and Methods

The present experiment was carried out at Fruit Research Station, Lalbaug; Junagadh Agricultural University, Junagadh during July to June, 2019-20 to 2020-21. Ten different modules arising from different chemical and agro technique, were allocated in randomized block design in three replications.

The treatments were foliar application of GA_3 @ 100 ppm in July + KNO_3 @ 4% in September + KH_2PO_4 @ 1% in October + $Ca(NO_3)_2$ @ 2% in November (T_1), foliar application of GA_3 @ 100 ppm in July + KH_2PO_4 @ 1% in September + KNO_3 @ 4% in October + thiourea @ 0.5% in November (T_2), soil drenching with PBZ @ 10 g/tree during July + foliar application of KNO_3 @ 4% in October + $Ca(NO_3)_2$ @ 2% in November (T_3), girdling in July + foliar application of KNO_3 @ 4% in November + urea @ 2% in October + etheral @ 200 ppm in November (T_4), pinching in July + foliar application of KNO_3 @ 4% spray in September + soil drenching with PBZ @ 10 g/tree in October + foliar spray of NAA @ 200 ppm at grain stage (T_5), pinching in August + harrowing and spadding during September + foliar application of KNO_3 @ 4% in October + urea @ 2% at fruit setting stage (T_6), pinching in September + irrigation at 30 day after completion of rain + foliar application of GA_3 @ 100 ppm in October + KNO_3 @ 4% in November (T_7), light irrigation at 30 days after completion of rain and grain stage (T_8), foliar application of NPK (19-19-19) @ 2 g/l in November and $ZnSO_4$ @ 0.5% + $FeSO_4$ @ 1% + Borax @ 0.5% at full bloom stage and pea stage (T_9) and control (T_{10}).

Observations were recorded in respect to number of coppery shoots from each tree was manually counted and recorded at every 15 days interval from mid July to mid October. Total number of coppery shoots per tree was obtained by sum up the number of coppery shoots counted from each tree at every 15 days interval from mid July to mid October. Days to flowering are obtained by average of days to flowering in new shoots and old shoots. Total numbers of inflorescence on each tree was manually counted and recorded. Number of hermophrodite flowers were also manully counted and recorded.

3. Result and Discussion

Treatments efforts significant influenced on number of coppery shoots per tree during July month, 4th week of August and 4th week of September. Significantly maximum number of coppery shoots were found in foliar spray of GA_3 @ 100 ppm in July + KNO_3 @ 4% in September + KH_2PO_4 @ 1% in October + $Ca(NO_3)_2$ @ 2% in November (T_1) during both the years as well as in pooled.

Result might be due to action of gibberellin. Gibberellin was applied in July month resulted increase number of coppery shoots. It is fact that, gibberellin plays an important role in cell division, cell elongation and cell multiplication which reflects in emergence of new vegetative shoots resulted in coppery shoots per stem. It also increasing osmotic uptake of nutrients and thereby causing cell elongation resulting in increase number of shoots. Hence, maximum coppery or new shoots were obtained during July and August due to foliar application of GA_3.

During September**,** the KNO_3 was sprayed in same module which also increased the number of coppery shoots, It could be attributed to the effect of nitrogen on trees. The promoting effect of N on coppery shoots can be explained on the basis of the fact that N supply increases the number of meristematic cells and their growth leading to the formation of shoots in addition to leaf expansion and number. It also acts as a key component of a number of metabolites, including amino acids, chlorophylls, co-enzymes, enzymes, proteins, purines and pyrimidines. Furthermore, N application is known to increase the levels of cytokinin, which affects cell wall extensibility**.** It is, therefore, logical to speculate that N was involved directly or indirectly in the enlargement and division of new cells and production of tissues which in turn were responsible for increase in growth characteristics.

Potassium was also applied through KNO_3 is the most abundant inorganic cation and it is important for ensuring optimal tree growth. K is an activator of dozens of important enzymes, such as protein synthesis, sugar transport, N and C metabolism, and photosynthesis. In terms of the growth-promoting mechanism of K, it is generally agreed that K stimulates and controls ATPase in the plasma membrane to generate acid stimulation, which then triggers cell wall loosening and hydrolase activation, thus promoting cell growth and increase number of coppery shoots.

KNO_3 stimulated a vegetative response in younger stems. Application of nitrate earlier or later than recommended usually results in vegetative instead of flowering flushes. Trees receiving high rates of nitrogen fertilizer in moist conditions frequently initiate shoots resulting in vegetative shoots induction due to the short periods of stem rest between flushes. Hence, in this treatment after July mango stem are younger. KNO_3 stimulated a vegetative response which resulted in increasing number of shoots.

The result was found line up with Lawlor (2002) [17], Salisbury and Ross (1992) [28], Lea and Guadry (2001) [18], Marschner (2002) [20], Arnold *et al*. (2006) [3], White and Karley (2010) [9], Marschner (2012) [21], Oosterhuis *et al*. (2014) [26], Shanmugavelu (1966) [31], Sergent *et al*. (2000) [30], Davenport *et al*. (2010) [9] and Davenport (2006). Similarly, for number of coppery shoots per tree at 2nd week of August, September and October, the result was found significant during both the years as well as in pooled. Significantly maximum number of coppery shoots were obtained in pinching in July + foliar spray of KNO_3 @ 4% in September + soil drenching with PBZ @ 10 g/tree in October + NAA @

200 ppm at grain stage (T_5) at 2nd week of August, treatment T_6 (Pinching in August + harrowing and spadding during September + foliar spray of KNO_3 @ 4% in October + urea @ 2% at fruit setting stage) during 2nd week of September and treatment T_7 (Pinching in September + irrigation at 30 day after completion of rain + GA_3 @ 100 ppm spray in October + KNO_3 @ 4% spray in November) at 2nd week of October during both the years as well as in pooled.

In this all treatments, pinching was done in July, August and September and during these months, the maximum coppery shoots was observed. It might be due to pinching reduced the apical dominance and encouraged the growth of lateral buds and tree spread. Pinching increased number of coppery shoots. It also increased the availability of the food material to the meristamatic cells could be the reason for an increase in number of shoots. After 15 day of pinching, shoots initiation began and leaves of these trees developed to the limp red-leaf stage with dormant apical buds throughout the canopy by one month after pinching. So there is maximum number of coppery shoots found at 2nd week of August, September and October. Secondly, the maximum coppery in all above treatments might be due to foliar spray of KNO_3 in September and October which was also responsible for higher coppery was already discussed above. Similarly, the irrigation at 30 days after completion of rain plus foliar spray of GA_3 also would be responsible for the higher coppery. The result was also in confirmatory with Davenport *et al*. (2010) [9] Shanmugavelu (1966) [31], Lawlor (2002) [17], Oosterhuis *et al*. (2014) [26], Davenport (2006) [8] in mango; Moniruzzaman and Zahira (2016) [23] in fig.

From 2nd week of July to 2nd week of October, minimum number of coppery shoots was found in soil drenching with PBZ @ 10 g/tree during July + foliar spray of KNO_3 @ 4% in October + $Ca(NO_3)_2$ @ 2% in November (T_3). It might be due to paclobutrazol inhibits gibberellin biosynthesis which reduced vegetative growth and decreased number of coppery shoots per tree. Similar results have also been noticed by Burondkar and Gunjate (1991) [5], Voon *et al*. (1991) [38], Kurian and Iyer (1992) [15], Desai and Chundawat (1994) [10], Sarkar *et al*. (1998) [29], Hiller and Rudge (1991) [12] and Warner (1999) in mango. Significantly highest total number of coppery shoots per tree were registerd with foliar spray of GA_3 @ 100 ppm in July + KNO_3 @ 4% in September + KH_2PO_4 @ 1% in October $Ca(NO_3)_2$ @ 2% in November (T_1) during both the years as well as in pooled.

Significantly minimum days to flowering were recorded in pinching in July + foliar spray of KNO_3 @ 4% in September + soil drenching with PBZ @ 10 g/tree in October + NAA @ 200 ppm at grain stage (T_5) during both the years as well as in pooled.

The result might be due to pinching which break down the apical dominance resulting in regulation of auxin synthesis at apex directing the transport of assimilates and carbohydrates to the axillary buds resulted to emergence of new vegetative flush or coppery shoots during July and August. These coppery shoots which were further treated with KNO_3 during September added uptake of N_2 and K resulted to maturity of cane. Hence, this matured cane helps the bud break with support of biosynthesis of ethylene encouraged flower induction. So the bud is prepared for flowering and again same shoot was treated with PBZ during October. It is true that the PBZ suppressed vegetative growth which increased the level of carbohydrates due to increased chlorophyll metabolism and direct effect on carbohydrate metabolism resulting into flowering. It is also probable that the application of PBZ caused an early reduction of endogenous gibberellins levels within the shoots, causing them to reach maturity earlier than those of untreated trees. Hence, PBZ and KNO_3 induced early flowering compared to regular flowering time of non-treated trees.

The result was found line up with Srivastava (2002) [33], Nagao and Nishina (1993), Swamy (2012) and Rebolledo-Martinez *et al.* (2008) in mango; Wang *et al*. (1986) [39] in apple.

Likewise, maximum days to flowering were recorded in cinching in September + irrigation at 30 day after completion of rain + foliar spray of GA_3 @ 100 ppm in October + KNO_3 @ 4% in November (T_7). It may be due to late pinching in September encouraged the emergence of new coppery shoots during October might have taken more time to mature. Furthermore, the same was treated with irrigation after completion of rain as well as growth promoter GA_3 in October and KNO_3 as a nutrient during November, hastened the vegetative growth and suppressed the earliness of flowering. The result was supported by Davenport *et al*. (2010) [9], Shanmugavelu (1966) [31] in mango; Moniruzzaman and Zahira (2016) [23] in fig.

Significantly maximum number of panicle registered in soil drenching with PBZ @ 10 g/tree during July + foliar spray of KNO_3 @ 4% in October + $Ca(NO_3)_2$ @ 2% in November during first year, but for second year and pooled the maximum number of panicle per tree was noted in pinching in July + foliar application of KNO_3 @ 4% spray in September + soil drenching with PBZ @ 10 g/tree in October+ foliar spray of NAA @ 200 ppm at grain stage.

The good result might be due to the mechanism of action of KNO_3 involves a biochemical process where the reduction of nitrate to ammonia takes place. Ammonia is used in the nitrogen metabolism of trees to form amino acid and one of them is methionine. Methionine is converted to S- adenosyl methionine (SAM) and then to 1- amino cyclopropane -1- carboxylic acid (ACC) and is finally converted to ethylene. Ethylene might be an important second messenger in tree development, capable of promoting flowering and also increasing number of panicles per tree.

The increased percentage of flowered branches is due to lower expenditure of tree reserves to the vegetative growth parameters and consequently no assimilate limitations. The PBZ can considerably enhance the total phenolic content of terminal buds and alter the phloem to xylem ratio of the stem. Such alterations could be important in restricting vegetative growth and enhancing flowering by altering assimilates partitioning and patterns of nutrient supply for flowering. The PBZ application also increased the number of floweing shoots which ultimately increase number of panicle per tree. So, application of KNO_3 and paclobutrazol increased number of panicles per tree. The result was also in confirmatory with those of Burg and Burg (1966) [4], Kurian and Iyer (1992) [15] and Burondkar & Gunjate (1993) [6] in mango.

Similarly, minimum number of panicle was registered in pinching in September + irrigation at 30 day after completion of rain + foliar spray of GA_3 @ 100 ppm in October + KNO_3 @ 4% in November (T_7) during both the years as well as in cooled.

It might be due to pinching in September with irrigation at 30 days after completion of rain and foliar spray of GA_3 @ 100 ppm at initial of October which induced new shoots growth. There is short periods of resting of cane between flushes, hence mature cane is unsufficient for flowering due to pinching and irrigation. Gibberellic acid is also found to inhibit flowering which is antagonistic to the formation of flowering primodia. Hence, it is escorted with each other to promote vegetative growth and suppress the reproductive growth.

Similar results was also found with Shanmugavelu (1966) [31], Davenport *et al*. (2010) [9], Kachru *et al*. (1971) [13] and Davenport (2006) [8] in mango; Turianskii (1950) and Thomas and Barnard (1937) [35] in grape. Maximum number of hermophrodite flower per panicle was recorded in pinching in July + foliar spray of KNO_3 @ 4% in September + soli drenching with PBZ @ 10 g/tree in October + NAA @ 200 ppm during grain stage (T_5) during both the years as well as in pooled.

Higher level of hermaphrodite flowers in treatment T_5 might be due to application of PBZ which resulted for 15-20 days early flowering, during that time temperature would be higher as compared to late flowering and higher temperature might be responsible for more number of hermaphrodite flowers. The PZB as soil application also increased the number of perfect flowers. Hermaphrodite flowers per panicle produced was more with application of PZB.

Hence, using anti-gibberellin compounds (PBZ) in the present studies might be a possible reason for the higher proportion of hermaphrodite flowers. Similar results were also reported by Maiti *et al*. (1972) [19], Mukhopadhyay (1976) [24], Daulta *et al*. (1991) [7], Kurian and Iyer (1993) [16], Singh (2000) [32], Ghosh and Sen (1975), Burondkar and Gunjate (1991) [5], Yadav (1993) [42], Winston (1999), Voon *et al*. (1991) [38] and Desai and Chundawat (1994) [10] in mango.

4. Conclusion

From the foregoing discussion, it can be concluded that foliar application of GA_3 @ 100 ppm in July + KNO_3 @ 4% in September + KH_2PO_4 @ 1% in October + $Ca(NO_3)_2$ @ 2% in November (T_1) increase total number of coppery shoots per tree**.** Pinching in July + foliar spray of KNO_3 @ 4% in September + soil drenching with PBZ @ 10 g/tree in October + NAA @ 200 ppm at grain stage (T_5) gave 25-30 days early flowering, maximum number of panicle per tree and hermophrodite flower per panicle in mango cv. Kesar for Saurashtra region of Gujarat.

Table 1: Effect of chemicals and agro techniques on number of coppery shoots per tree at 15 days interval from 2nd week of July to 2nd week of August in mango cv. Kesar

Treatment	Coppery shoots per tree during 2nd week of July			Coppery shoots per tree during 4th week of July			Coppery shoots per tree during 2nd week of August		
	2019-20	2019-20	POOLED	2019-20	2020-21	POOLED	2019-20	2020-21	POOLED
T1	58.67	116.00	87.33	90.33	123.33	106.83	30.00	32.00	31.00
T2	57.00	87.00	72.00	90.00	98.33	94.17	24.67	25.67	25.17
T3	35.00	39.00	37.00	20.00	21.00	20.50	15.33	23.67	19.50
T4	40.00	66.67	53.33	21.00	25.33	23.17	53.00	52.67	52.83
T5	40.67	40.33	40.50	30.00	23.33	26.67	56.00	57.00	56.50
T6	41.67	60.33	51.00	48.33	66.67	57.50	19.33	24.00	20.00
T7	41.67	57.33	49.50	53.33	72.67	63.00	40.00	40.00	40.00
T8	43.33	60.00	51.67	37.00	91.33	64.17	29.00	31.67	30.33
T9	39.33	40.33	39.83	43.67	43.33	43.50	32.67	30.33	31.50
T10	45.53	42.67	44.10	42.67	46.67	44.67	30.67	27.00	28.83
S.Em.±	1.552	4.377	9.148	3.689	3.888	9.220	1.479	2.046	1.262
C.D. at 5%	4.61	13.01	29.27	10.96	11.55	29.49	4.39	6.08	3.62
C.V. %	6.07	11.52	10.81	13.41	10.32	12.06	7.75	9.89	9.16

Table 2: Effect of chemicals and agro techniques on number of coppery shoots per tree at 15 days interval from 4th week of August to 4th week of September in mango cv. Kesar

Treatment	Coppery shoots per tree during 4th week of August			Coppery shoots per tree during 2nd week of September			Coppery shoots per tree during 4th week of September		
	2019-20	2019-20	POOLED	2019-20	2020-21	POOLED	2019-20	2020-21	POOLED
T1	36.67	36.33	36.50	33.33	32.33	32.83	40.67	53.33	47.00
T2	26.67	29.67	28.17	28.67	27.00	27.83	26.67	28.00	27.33
T3	17.00	14.67	15.83	13.00	13.67	13.33	12.00	11.67	11.83
T4	25.00	28.67	26.83	22.33	23.67	23.00	23.33	24.33	23.83
T5	23.00	29.00	26.00	19.00	26.33	22.67	14.67	18.00	16.33
T6	26.67	22.67	24.67	53.67	48.33	51.00	18.67	17.33	18.00
T7	29.33	29.67	29.50	11.67	31.67	21.67	31.67	20.00	25.83
T8	29.67	25.67	27.67	31.00	28.33	29.67	18.67	40.67	29.67
T9	26.33	28.33	27.33	38.33	38.33	38.33	27.33	35.00	31.17
T10	27.00	28.00	27.50	38.67	36.33	37.50	32.33	30.67	31.50
S.Em.±	1.259	1.369	1.652	1.553	2.418	3.629	2.021	1.024	4.561
C.D. at 5%	3.74	4.07	5.29	4.61	7.18	11.61	6.01	3.04	14.59
C.V. %	8.15	8.77	8.44	9.28	14.48	11.82	14.23	6.65	10.57

Table 3: Effect of chemicals and agro techniques on number of coppery shoots per tree during 2nd week of October and total number of coppery shoots per tree in mango cv. Kesar

Treatment	Coppery shoots per tree during 2nd week of October			Total number of coppery shoots per tree		
	2019-20	2019-20	POOLED	2019-20	2020-21	POOLED
T1	27.66	25.00	26.33	317.33	418.33	367.83
T2	19.67	26.00	22.83	273.35	321.67	297.51
T3	10.00	10.33	10.17	125.33	138.33	131.83
T4	26.00	20.67	23.33	210.67	242.00	226.33
T5	10.00	12.00	11.00	193.33	200.67	197.00
T6	20.00	20.00	20.00	228.33	259.33	243.83
T7	82.67	84.00	83.33	290.34	335.33	312.84
T8	26.00	22.00	24.00	214.67	299.67	257.17
T9	53.67	52.00	52.83	257.33	269.66	263.50
T10	30.00	32.00	31.00	246.67	253.33	250.00
S.Em.±	2.185	0.829	1.169	8.992	11.783	16.357
C.D. at 5%	6.49	2.46	3.35	26.72	35.01	52.33
C.V. %	12.38	5.22	9.39	6.61	7.37	7.12

Table 4: Effect of chemicals and agro techniques on flowering parameters in mango cv. Kesar

Treatment	Days to flowering			Number of panicles per tree			Number of hermaphrodite flowers per panicle		
	2019-20	2019-20	POOLED	2019-20	2020-21	POOLED	2019-20	2020-21	POOLED
T1	74.83	53.83	64.33	520.00	533.33	526.67	202.33	215.00	208.67
T2	63.67	57.83	60.75	825.33	766.00	795.67	194.00	277.67	235.83
T3	55.00	35.00	45.00	1417.00	1327.33	1372.17	305.33	307.33	306.33
T4	57.00	44.00	50.50	1244.00	1304.33	1274.17	240.67	245.33	243.00
T5	50.00	31.83	40.92	1378.00	1421.00	1399.50	307.33	308.00	307.67
T6	70.00	68.50	69.25	646.67	633.33	640.00	213.33	208.78	211.06
T7	80.83	77.67	79.25	330.00	482.33	406.17	209.33	209.67	209.50
T8	66.00	49.67	57.83	866.67	866.00	866.33	223.00	223.67	223.33
T9	72.50	54.67	63.58	600.00	615.67	607.83	223.00	223.67	223.33
T10	81.17	59.50	70.33	568.67	517.00	542.83	199.33	206.67	203.00
S.Em.±	4.516	3.316	2.801	35.432	54.040	32.310	11.740	9.952	13.010
C.D. at 5%	13.42	9.85	8.04	105.28	160.57	92.75	34.88	29.57	41.62
C.V. %	11.66	10.98	11.40	7.31	10.21	9.39	8.77	6.91	7.95

5. References

1. Agustí M. Citricultura. Second edition. Mundi Prensa editions, Madrid, 2003, 422.
2. Anonymous. National Horticulture Board 2019. Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India. Available at http://nhb.gov.in/Statistics/horticulture accessed on 17th March, 2021.
3. Arnold JB, Frensch J, Taylor AR. Influence of inorganic nitrogen and pH on the elongation of maize seminal roots. Annals of botany 2006;97:867-873.
4. Burg SP, Burg EA. The interaction between auxin and ethylene and its role in plant growth. Proceedings of the National Academy of Sciences of the United States of America 1966;55(2):262-269.
5. Burondkar MM, Gunjate RT. Regulation of shoot growth and flowering in Alphonso mango with paclobutrazol. Acta Horticulturae 1991;291:79-84.
6. Burondkar MM, Gunjate RT. Control of vegetative growth and induction of regular and early cropping in Alphonso mango with paclobutrazol. Acta Horticulturae 1993;341:206-215.
7. Daulta BS, Singh HK, Chauhan KS. Effect of zinc and CCC sprays on flowering, fruiting and physico chemical composition of fruit in mango (*Mangifera indica* L.) cv. Dashehari. Haryana Journal of Horticultural Sciences 1981;10:161-65.
8. Davenport TL. Reproductive physiology of mango. Brazilian Journal of Plant Physiology 2006;19(4):363-367.
9. Davenport TL, Gerhard F, Julio CA, Ramırez F. The stem age required for floral induction of synchronized mango trees in the tropics. HortScience 2010;45(10):1453-1458.
10. Desai MM, Chundawat BS. Regulation of flowering mango by paclobutrazol. Indian Journal of Horticulture 1994;51(I):9-15.
11. Goren R, Huberman M, Goldschmidt EE. Girdling: Physiological and horticultural aspects. Horticultural Reviews 2004;30:1-35.
12. Hillar GR, Rudge TG. Promotion of regular fruit cropping in mango with cultar. Acta Horticulturae 1991;291:51-59.
13. Kachru RB, Singh RN, Chacko EK. Inhibition of flowering in mango (*Mangifera indica* L.) by gibberelic acid. HortScience 1971;6:141-160.
14. Kulkarni VJ. Chemical control of tree vigour and the promotion of flowering and fruiting in mango (*Mangifera indica* L.) using paclobutrazol. Journal of Horticultural Science 1988;63(3):557-566.
15. Kurian RM, Iyer CPA. Stem anatomical characteristics in relation to tree vigour in mango (*Mangifera indica* L.). Scientia Horticulturae 1992;50:245-253.
16. Kurian RM, Iyer CPA. Chemical regulation of tree size in mango (*Mangifera indica* L.) cv. Alphonso. II. Effects of growth retardants on flowering and fruit set. Hort Science 1993;68:355-60.
17. Lawlor DW. Carbon and nitrogen assimilation in relation to yield: mechanisms are the key to understanding

production systems. Journal of Experimental Botany 2002;53:773-787.
18. Lea PJ, Guadry MJF. Plant Nitrogen. Springer-Verlag Berlin Heidelberg, New York 2001.
19. Maiti SC, Maiti SK, Sen PK. Effect of ethylene producing chemicals on growth and flowering in mango (*Mangifera indica* L.). Indian Journal of Agricultural Sciences 1972;16:201-203.
20. Marschner H. Mineral Nutrition of Higher Plants, second ed. Academic Press Inc., New York, 2002.
21. Marschner H. Marschner's Mineral Nutrition of Higher Plants, MA: Academic press, Cambridge 2012.
22. McKenzie CB. Preliminary results of calcium and potassium uptake from foliar sprays on Sensation mango. Year Book - South African Mango Growers Association 1994;(14):24-25.
23. Moniruzzaman M, Zahira Y. Fig (*Ficus carica*) fruit yield improvement through apical bud pinching. International Fig Summit 2016, 24-26.
24. Mukhopadhyay AK. A note on the effect of growth retardants and L-methionine on flowering of mango (*Mangifera indica* L.). Haryana Journal of Horticultural Sciences 1976;5:169-71.
25. Nagao MA, Nishina MS. Use of potassium nitrate on mango flowering. In proceedings: Conference on mango in Hawaii 1993, 61.
26. Oosterhuis D, Loka D, Kawakami E, Pettigrew W. The physiology of potassium in crop production. Advances in Agronomy 2014;126:203-234.
27. Rebolledo-Martinez A, Lid-del-angel-perez A, Rey-moreno J. Effects of paclobutrazol and KNO_3 over flowering and fruit quality in two cultivars of mango manila. Interciencia 2008;33(7):523-527.
28. Salisbury FB, Ross CW. Plant Physiology, fourth ed. Wadsworth Publishing Company, Belmont, California, 1992.
29. Sarkar SK, Gautham B, Srihari D, Seethambran Y. Regulation of tree vigour in mango. Indian Journal of Horticulture 1998;55(1):37-41.
30. Sergent E, Leal F, Anez M. Potassium thiosulphate, urea and potassium nitrate applications on vegetative and floral growth in mango cv. Haden. Acta Horticulturae 2000;509:653-660.
31. Shanmugavelu KG. Studies on the effect of plant growth regulator on seedling of some tree plant species. South Indian Horticulture 1966;14:24-35.
32. Singh Z. Effect of paclobutrazol on tree vigour, flowering, fruit set and yield in mango. Acta Horticulturae 2000;525:459-469.
33. Srivastava LM. Plant growth and development: hormones and the environment. New York: Academic Press 2002.
34. Swamy JS. Flowering manipulation in mango: A science comes of age. Journal of Biological Science Research and Reviews 2012;1(1):122-137.
35. Thomas JE, Barnard C. Fruit bud studies III. The Sultana (Thompson Seedless); some relations between shoot growth, chemical composition, fruit bud formation, and yield. Council of Scientific and Industrial Research 1937;10:143-157.
36. Turianskii GF. Biology of grapevine buds and agrotechnics of increasing their fruitfulness 1933.
37. Voon CH, Pitakpavin C, Tan SI. Mango cropping manipulation with cultar. Acta Horticuturae 1991;291:219-28.
38. Wang SY, Steffens GL, Faust M. Effect of paclobutrazol on cell wall polysaccharide composition of apple tree. Phytochemistry 1986;25:II.
39. Warner H. Influence of paclobutrazol on growth and leaf nutrient content of mango cv. Balanco. Acta Horticuturae 1993;241:220-225.
40. White PJ, Karley AJ. Potassium Cell Biology of Metals and Nutrients. Berlin: Springer 2010, 199-224.
41. Winston EC. Evaluation of paclobutrazol on Kensington pride mango growth, flowering and cropping. Third International Mango Symposium. Darwin, Australia. 1989.
42. Yadav RBR. Effect of paclobutrazol on flowering, fruit growth and yield. Group workers meeting for STF, 30th Nov. To 3rd Dec., Research Reports Lucknow 1993;203-204