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RESEARCH ARTICLE

STUDIES ON THE EFFECT OF CERTAIN CHEMICALS ON FLOWER REGULATION AND FRUITING IN MANGO (*MANGIFERA INDICA* L.) CV. BANESHAN.

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Abstract

A field experiment was carried out to identify the best chemical to regulate flowering and increase fruit production in mango cv. Baneshan at JVR HRS, Malyal for continuous period of five years from 2010-11 to 2014-15. The experiment was conducted with seven treatments using K_2HPO4 1%, KH_2PO_4 1% alone and in combination with 1% of KNO_3 and thiourea, the untreated trees were regarded as control. The results revealed during the five years (2010-15) that, the highest per cent of flowering (79.36 %) was recorded in T_4 – KH_2PO_4 1% + KNO_3 1% and fruit set per panicles (6.15%) in T_1- K_2HPO4 1% and lowest in control (49.00% & 5.41%). The highest yield per tree (114.67 kg) was noticed in T_4 (KH_2PO_4 1% + KNO_3 1%) and lowest (75.13 kg) in control which was on par with T_1- K_2HPO4 1% (73.98 kg).

Introduction:-

Mango (*Mangifera indica* L.) a member of Anacardiaceae is a delicious fruit of India, and is regarded as 'King of Fruits'. India is the largest producer of mango contributing 50 per cent to the world's production, from an area of 25 lakh ha, the production is 18.4 mt (NHB, 2015). It occupies 34.9 per cent of total area under fruit crops and accounting for 20.7 per cent of total production in India. Telangana is the fourth largest state contributing 9.3 per cent of total mango production in India after Uttar Pradesh, Andhra Pradesh and Karnataka. The area under mango cultivation in the state is 1.9 lakh ha with a production of 1.7 mt and productivity of 9.0 MT/ha (NHB, 2015).

Baneshan is an important and extensively cultivated variety for domestic and international markets in Telangana and Andhra Pradesh states. It is an important tropical fruit crop in India like apple in temperate region. An interesting feature in these crops is seasonal flowering and tendency of biennial bearing habit. Flowering in mango takes place on past season growth, the number of aged shoots on tree and their maturity towards flowering season will decide the crop load in ensuing season. Usually, the production of succeeding season depends on preceding crop under normal management practices. Moreover, flowering period in Mango is mainly related to weather patterns and to some degree to cultivar (Whiley, 1985). Low temperature is the environmental factor with the greatest influence in flower induction (Nunez-Elisa and Davenport, 1992) in mango. It was concluded that water stress was not responsible for mango flower induction, but could enhance the response of cool temperature (Whiley, 1992).

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Even though, tropical climates are conducive to year round vegetative growth of perennial tropical fruit crops like mango but flowering and fruit set are usually seasonal. Hence, flowering from one season to the next is uncertain because the environmental signals for flower initiation are inconsistent. An alternative method for environmental signals for flower initiation is the development of management strategies. Several works concluded and achieved success in stimulating flowering in mango with chemical treatments. Reddy and Majumder (1983) observed an increase in the yield of mango trees by spaying 0.5 per cent ortho phosphoric acid (H_3PO_4) and 0.2 per cent urea. Ashok kumar and Reddy (2008) reported that fruit bearing in Baneshan cultivar was highest with Di-Potassium phosphate (K_2PO_4)1.0 per cent.

Hence, in light of above facts the present investigation was carried out to study the effect of foliar spray of certain chemicals on flowering and fruiting characters of pruned trees of mango cv. Baneshan under Northern Telangana conditions.

Material and Methods:-

An experiment was carried out on exsisting ten year old mango trees at JVR HRS, Malyal, Warangal (Dist.), Telangana State during 2010-11 to 2014-15 for a period five years. The cultivar selected for the study was Baneshan planted at a spacing of 7X7 m. Seven treatments were imposed on the trees T_1 - K_2HPO_4 1%, T_2 - KH_2PO_4 1%, T_3 - K_2HPO_4 1% +KNO_3 1%, T_4 - KH_2PO_4 1% +$KNO_3$1%, T_5 - K_2HPO_4 1% +Thiourea1%, T_6 - KH_2PO_4 1% +Thiourea1% and control (sprayed with water). In all the treatments Potassium hydrogen phosphate (K_2HPO_4) and potassium dihydrogen phosphate (KH_2PO_4) was sprayed as first spray in October; in T_3, T_4 - potassium nitrate (KNO_3) and in T_5 ,T_6 thiourea as second spray before bud break. Every year after the harvest of the crop pruning of fruited shoots was done back to 10-15 cm during June 15th to July 15th . The experiment was laid out in Randomized Block Design with four replications, each treatment was imposed on four trees. The data was collected on flowering and fruit parameters such as per cent flowering (%), panicle length (cm), breadth (cm), percentage of perfect flowers, fruit set per panicle, number of fruits per tree and fruit yield (kg/tree).

Data were analyzed using analysis of variance as described by Panse and Sukhatme (1985).

Results and Discussion:-

Percent flowering:-

Different chemical treatments significantly influenced the percentage of flowering in mango (Table 1). From five years of study it was revealed that, the highest percentage of flowering was recorded in T_4 - KH_2PO_4 1% + KNO_3 1% (79.36) which was on par with T_5 - K_2HPO_4 1% + Thiourea 1% (75.36). The lowest (49.00) percentage of flowering was registered in T_7 control. All chemical treatments significantly influenced percentage of flowering, however, potassium dihydrogen phosphste (KH_2PO_4) in combination with potassium nitrate and potassium hydrogen phosphate (K_2HPO_4) with thiourea recorded highest percentage of flowering compared to single chemical spray.

Table 1:- Effect of different chemical sprays on per cent flowering of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	69.50^{b}	70.50^{b}	63.80^{b}	78.96^{b}	64.57^{b}	69.46^{bc}
T_2	KH_2PO_4 1%	46.00^{d}	58.50^{cd}	57.05^{c}	75.57^{b}	58.62^{bc}	59.14^{d}
T_3	K_2HPO_4 1% +KNO_3 1%	46.00^{d}	63.50^{c}	61.25^{b}	69.60^{c}	78.95^{a}	63.86^{cd}
T_4	KH_2PO_4 1% +$KNO_3$1%	78.00^{a}	84.00^{a}	76.25^{a}	85.42^{a}	73.17^{a}	79.36^{a}
T_5	K_2HPO_4 1% +Thiourea1%	69.00^{b}	82.25^{a}	75.40^{a}	75.70^{b}	74.47^{a}	75.36^{ab}
T_6	KH_2PO_4 1% +Thiourea1%	58.00^{c}	78.25^{ab}	72.00^{a}	77.32^{cb}	72.87^{ab}	71.68^{b}
T_7	Control	44.50^{d}	51.25^{d}	45.20^{d}	54.07^{d}	50.02^{c}	49.00^{e}
	CD at 5 %	4.21	7.46	6.51	9.481	14.06	6.09

Panicle length (cm):-

It is evident from table 2, during five years of study significant differences were recorded pertaining to panicle length. During five years of study the longest panicle length (29.47) was registered in T_5 - K_2HPO_4 1% + Thiourea 1% followed by T_4 - KH_2PO_4 1% + KNO_3 1% (28.22) and T_3 K_2HPO_4 1% +KNO_3 1% (27.31) without any significant difference. The shortest panicle (24.41) was registered in T_1 . K_2HPO_4 1% (24.41) which was on par with

T_7 control (26.24). The significant increase in panicle length was witnessed in combination spray of K_2HPO_4 and KH_2PO_4 with Thiourea and KNO_3. The increase in panicle length might be due to more availability of required nutrients at critical stages.

Table 2:- Effect of different chemical sprays on Panicle length (cm) of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	22.87	25.62	24.50	25.00	24.10	24.41[c]
T_2	KH_2PO_4 1%	25.05	27.52	26.50	26.66	27.27	26.60[bc]
T_3	K_2HPO_4 1% +KNO_3 1%	25.10	28.37	27.20	27.93	27.95	27.31[ab]
T_4	KH_2PO_4 1% +$KNO_3$1%	26.20	27.17	28.90	28.71	30.12	28.22[ab]
T_5	K_2HPO_4 1% +Thiourea 1%	26.50	28.00	30.75	29.16	32.96	29.47[a]
T_6	KH_2PO_4 1% +Thiourea 1%	23.20	24.92	26.50	26.16	27.92	25.74[bc]
T_7	Control	24.20	27.15	27.70	25.57	26.60	26.24[bc]
	CD at 5 %	0.72	1.84	2.15	1.70	3.29	2.67

Panicle breadth (cm):-

The data presented in table 3, shows significant differences in panicle breadth. The highest panicle breadth was recorded in T_1 - K_2HPO_4 1% in (13.82) and lowest (9.69) in T_5 - K_2HPO_4 1% + Thiourea 1%. From the data it was clear that, the treatment in which increase in panicle length decreased breadth, showing inverse relation.

Table 3:- Effect of different chemical sprays on Panicle Breadth (cm) of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	11.26	11.67	11.89	12.00	10.99	11.56[b]
T_2	KH_2PO_4 1%	10.97	10.40	9.80	10.89	10.31	10.47[c]
T_3	K_2HPO_4 1% +KNO_3 1%	11.15	11.45	12.10	12.79	11.18	13.82[a]
T_4	KH_2PO_4 1% +$KNO_3$1%	9.21	10.12	10.51	11.46	9.49	10.15[cd]
T_5	K_2HPO_4 1% +Thiourea1%	9.35	10.00	9.91	9.92	9.28	9.69[d]
T_6	KH_2PO_4 1% +Thiourea1%	9.26	9.62	10.10	10.35	9.25	9.71[d]
T_7	Control	10.29	9.90	9.89	10.15	9.48	9.94[cd]
	CD at 5 %	0.39	0.39	0.41	0.73	0.42	0.58

Per cent perfect flowers per panicle:-

The per cent perfect flowers in the panicle recorded statistical differences (Table 4). The highest perfect flowers (6.15) were registered in T_1 - K_2HPO_4 1% which was on par with T_4, T_6 and T_5 and significantly lowest (5.41) in control. The chemical treatments increased the perfect flowers over untreated trees which might be due to availability of more nutrients to panicles. Similar results were recorded by Ashok Kumar and Reddy (2008).

Table 4:- Effect of different chemical sprays on perfect flowers per panicle (%) of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	6.17	6.32	6.34	5.40	6.53	6.15[a]
T_2	KH_2PO_4 1%	5.20	5.97	5.99	5.30	5.44	5.58[bc]
T_3	K_2HPO_4 1% +KNO_3 1%	5.43	5.63	5.82	5.22	6.64	5.74[abc]
T_4	KH_2PO_4 1% +$KNO_3$1%	6.23	5.70	6.20	5.33	6.53	5.99[ab]
T_5	K_2HPO_4 1% +Thiourea1%	6.25	5.93	6.12	4.87	6.00	5.83[ab]
T_6	KH_2PO_4 1% +Thiourea1%	5.96	6.17	5.97	5.80	6.04	5.98[ab]
T_7	Control	5.12	5.94	5.87	5.07	5.08	5.41[c]
	CD at 5 %	0.26	N.S.	0.24	0.35	0.91	0.41

Fruit set per panicle (%):-

It is evident from the table 5, that the per cent fruit per panicle was influenced by chemical treatments. The highest per cent (5.11) fruit set per panicle was recorded in T_3 - K_2HPO_4 1% + KNO_3 1% and lowest (3.62) in untreated trees. It was observed that there was decrease in fruit set compared to per cent perfect flowers in each panicle.

Table 5:- Effect of different chemical sprays on fruit set per panicle (%) of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	4.21	4.59	4.27	4.61	4.40	4.41[e]
T_2	KH_2PO_4 1%	3.30	5.56	5.30	5.43	5.66	5.05[b]
T_3	K_2HPO_4 1% +KNO_3 1%	3.09	5.63	5.51	5.53	5.79	5.11[a]
T_4	KH_2PO_4 1% +$KNO_3$1%	2.89	5.65	5.26	5.38	5.13	4.86[c]
T_5	K_2HPO_4 1% +Thiourea1%	2.56	5.12	4.86	4.88	4.13	4.31[f]
T_6	KH_2PO_4 1% +Thiourea1%	4.80	4.91	4.65	4.87	4.09	4.66[d]
T_7	Control	2.39	4.07	3.91	4.41	3.34	3.62[g]
	CD at 5 %	0.66	N.S.	0.32	0.23	0.59	0.04

Fruit number per tree:-

The data from the table 6 revealed that, the highest (316) number of fruits per tree were consistently recorded in T_4 - KH_2PO_4 1% + KNO_3 1% during five years of study and significantly lowest (223.66) in control. Potassium dihydrogen phosphate in combination with potassium nitrate was found better to increase fruit number. In the present study increased number of fruits per tree could be due to increased hormonal activity by pruning and increased set and retention by phosphorous and potassium chemical sprays. Srihari and Rao (1998) reported increased fruit set and number of fruits per tree in cv. Alphonso with KH_2PO_4 1.0 per cent.

Table 6:- Effect of different chemical sprays on fruit number per tree of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of Study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	180.25	237.25	196.25	246.35	258.27	223.67[f]
T_2	KH_2PO_4 1%	182.25	286.00	246.40	277.55	289.11	256.26[e]
T_3	K_2HPO_4 1% +KNO_3 1%	190.00	334.50	305.50	347.55	352.84	306.07[b]
T_4	KH_2PO_4 1% +$KNO_3$1%	190.25	317.00	290.50	377.97	404.30	316.00[a]
T_5	K_2HPO_4 1% +Thiourea1%	194.50	282.50	246.50	275.25	300.90	259.93[d]
T_6	KH_2PO_4 1% +Thiourea1%	193.25	287.50	253.50	277.27	297.75	261.85[c]
T_7	Control	173.25	269.50	193.50	225.37	256.71	223.66[f]
	CD at 5 %	13.91	34.08	29.07	18.83	28.13	1.66

Fruit weight (g):-

The results pertaining to fruit weight was found significant (Table 7). The highest (366.04) fruit weight was recorded in T_5 followed by T_4 . From the data it can concluded that the treatments which recorded more fruit number showed less fruit weight.

Table 7:- Effect of different chemical sprays on fruit weight (g) of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of Study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	299.62	323.75	332.5	335.42	351.50	328.55[d]
T_2	KH_2PO_4 1%	261.90	302.50	310.75	331.80	348.42	311.07[e]
T_3	K_2HPO_4 1% +KNO_3 1%	325.37	331.50	347.25	369.72	343.80	343.52[c]
T_4	KH_2PO_4 1% +$KNO_3$1%	319.75	373.50	390.25	383.12	336.95	360.71[a]
T_5	K_2HPO_4 1% +Thiourea1%	312.65	391.25	407.25	378.62	340.45	366.04[a]
T_6	KH_2PO_4 1% +Thiourea1%	296.42	361.50	380.00	367.42	348.60	350.78[b]
T_7	Control	279.97	344.75	350.00	338.12	347.45	332.05[d]
	CD at 5 %	N.S.	46.33	42.42	19.80	9.13	5.37

Fruit Yield (Kg/tree):-

Consistent yields were recorded in T_4 - KH_2PO_4 1% + KNO_3 1% in all the years compared to other treatments. From the five years data, the highest (114.67) fruit yield was recorded T_4 - KH_2PO_4 1% + KNO_3 1% followed by T_3 - K_2HPO_4 1% +KNO_3 1% (106.44) with significant difference. The lowest yield (73.98) was registered in T_1 followed by control without any significant difference. The increase in yield in T_4 (Phosphorous - potassium) might be due to better nutritional distribution in the tree and also retention good fruit resulting in higher yields.

Table 8:- Effect of different chemical sprays on fruit yield per tree (kg) of mango cv. Baneshan during 2010-11 to 2014-15

	Treatments	Period of study					Pooled Data for 5 years
		2010-11	2011-12	2012-13	2013-14	2014-15	
T_1	K_2HPO_4 1%	54.01	77.18	65.20	81.11	92.44	73.98[f]
T_2	KH_2PO_4 1%	47.71	86.38	76.50	92.06	101.12	80.75[e]
T_3	K_2HPO_4 1% +KNO_3 1%	57.08	111.66	105.2	128.56	129.74	106.44[b]
T_4	KH_2PO_4 1% +$KNO_3$1%	60.89	118.37	113.25	144.77	136.11	114.67[a]
T_5	K_2HPO_4 1% +Thiourea1%	60.85	110.40	106.25	104.21	102.48	96.83[c]
T_6	KH_2PO_4 1% +Thiourea1%	57.30	103.82	96.50	99.92	104.16	92.34[d]
T_7	Control	48.79	93.03	67.00	76.03	90.80	75.13[f]
	CD at 5 %	N.S.	20.01	16.50	7.92	13.41	2.55

The mode of action of chemical treatments on flower induction and fruit set is not fully understood; therefore an explanation for the variable results between chemical treatments within the cultivar, between cultivars and application periods is not clear. Hence, to use the chemical treatments effectively to regulate mango flowering and fruit production, application should be assessed in relationship to the plants growth phenology. Further studies should be conducted to develop different management systems that ensure consistent seasonal yields in mango.

From this it can be concluded that, mango (cv. Baneshan) sprayed with KH_2PO_4 1% (Potassium dihydrogen phospahate) in October followed by KNO_3 1% (Potassium nitrate) before bud break resulted highest fruit yield.

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