Int.J.Curr.Microbiol.App.Sci (2019) *8*(1): 1106-1117

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 01 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.801.119

Floral Biology and Fruit Set of Mango (*Mangifera indica* L.) as Influenced by Different Chemicals

Manoj Kumar Singh[1]*, Vinod Bahadur Singh[2], S.S. Singh[1] and Anil Kumar Singh[3]

[1]Department of Crop Science, Faculty of Agriculture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot-485780, Satna (M.P.) India
[2]Krishi Vigyan Kendra, Basuli, Maharajganj (NDUA&T, Kumarganj, Ayodhya, U.P.), India
[3]Department of Horticulture, CSAUA&T, Kanpur, UP., India

**Corresponding author*

Keywords

Floral biology, Fruit set, *Mangifera indica*, Influence, Chemicals

Article Info

Accepted:
10 December 2018
Available Online:
10 January 2019

A B S T R A C T

Field experiment was carried out at mango orchard, Department of Crop Sciences, Faculty of Agriculture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) India, during 2016-17 and 2017-18 to study the response of different mango cultivars viz. Bombay Green, Dashehari and Langra to various chemicals namely potassium nitrate, potassium di-hydrogen orthophosphate, di-potassium hydrogen orthophosphate. The results of the experiment revealed that the per cent of bud swelling, panicle emergence and flowering shoot and length of panicle were higher with application of KH_2PO_4-1%+KNO_3-1%. In case of cultivars, mango cv. Langra produced lengthier panicle than Bombay Green and Dashehari in both treated and untreated trees. Significantly narrowest sex ratio and higher number of hermaphrodite flowers, fruit set, fruit retention per panicle and number of fruits per tree were recorded with application of KH_2PO_4-1%+KNO_3-1% treatment. In case of mango cultivars the narrowest sex ratio and higher number of hermaphrodite flowers, fruit set per panicle and number of fruit per tree were observed with Langra.

Introduction

Mango (*Mangifera indica* L.), the choicest fruit of the world originating in South East Asia at an early date, is called as 'King of the Fruit', and attained the status of National Fruit of India. Owing to its luscious taste and appealing qualities internationally known as 'Ambassador Fruit of India'. It has been grown in India sub-continent for 4000 years (De Candolle, 1904) or more and has a massive fan favorite due to its wide range of adaptability and richness in varietal wealth over 1200 varieties are said to exist in the country. Mango is grown almost in 111 countries around the world but this fruit occupies a unique place amongst the fruit crops grown in India. The India's mango production is estimated to be up by 8 per cent to 21.02 million tonnes in the 2017-18 cropping year on higher output by major growing states like Uttar Pradesh, followed by

Andhra Pradesh and Karnataka. Mango production in Uttar Pradesh is pegged higher at 4.54 million tonnes in 2017-18 as against 4.34 million tonnes in the preceding year (Economic Times, 2018).

Biennial bearing or irregular cropping is a serious problem for the mango growers. The nature of flower production in mango is a very complex one related to the mechanism of controlling the balance between vegetative and reproductive development and of course, the climatic condition which play vital role in the condition growth and flowering. Phenomena of Flowering in mango trees is especially challenging for physiologists, breeders and growers (Rani, 2018). KNO_3 has potential for inducing flowering in mango by stimulating activity of nitrate reductase and increasing the production of ethylene.

In Mango, the application of KNO_3 is effective twice at first flower bud differentiation followed by another spray during the full bloom stage with concentration of 1% for flowering, fruiting and yield and quality characteristics (Sudha *et al.,* 2012, Dadhaniya *et al.*, 2018b).

For the induction of flowering in mango H_3PO_4, KH_2PO_4, K_2HPO_4, and KNO_3 at 0.5% and 1.0 % either alone or in conjunction with paclobutrazol were used on mango cv Baneshan. It was found that H_3PO_4 @ 0.5% and KH_2PO_4 at 1% were superior in the induction of early flowering with greater intensity percent of flowering, panicle length and breadth (Rajkumar *et al.*, 2007 a, b and Krishna *et al.*, 2017). Moreover, induction of early flowering results in early maturity of mango fruits which fetch the higher price in the market as compared to late maturing mango fruits. Thus it leads to an idea about the exploitation of chemicals for improving flowering and fruiting in north Indian mango cultivars i.e. Bombay Green, Dashehari and Langra.

Materials and Methods

The present investigation was carried out to study the effect of different chemicals on flowering and fruiting parameters of different commercial cultivars of mango during 2016-17 and 2017-18 at mango orchard, Department of Horticulture, CSA University of Agriculture Technology, Kanpur (UP). There were nine treatments associated with different chemicals including control. The experiment was laid out in Randomized Block Design and replicated three times. During the investigation, the efficacy of different chemicals containing, nitrogen, phosphorus and potassium viz. Potassium di hydrogen orthophosphoric acid (KH2PO4), Di-potassium hydrogen orthophosphate (K_2HPO_4), Potassium nitrate (KNO3) and Thiourea (CH4N2S) alone and in combination against flowering and fruiting characteristics were tested in different cultivars of mango viz. Bombay Green, Dashehari and Langra. The foliar application of each chemical was applied at the rate of one percent in the month of November, during 2016-17 and 2017-18.

The observations pertaining to the flower bud swelling were recorded on10 randomly tagged shoots in all the directions for the investigations. After bud swelled, 50 buds were marked randomly on each tree for recording percentage of panicle emergence. Length of ten randomly marked panicles was measured in centimeters. The period (days) between the opening of first and last flower in each panicle under each treatment was recorded as estimate of the duration of flowering. For the study of flowering shoots percent, numbers of shoots producing flowers per tree were observed.

For the count of different types of flowers bags of perforated oil paper were used. They were opened upward and the lower portion was tied with the shoot bearing panicle. The

bags were fixed vertically in order to avoid the loss of flowers. There was no hindrance for the entry of sunlight, air and insects to the panicle, which also facilitated the natural pollination. Flowers were collected by opening the lower side of the bag on each day in separate Petridis and counted. The average numbers of staminate and hermaphrodite flowers per panicle were counted. The sex ratio was calculated as staminate flowers divided by hermaphrodite flowers.

Fruit set was recorded at pea stage under natural conditions, on ten randomly tagged panicles and average per panicle was calculated. The fruit retention was recorded on the same ten tagged panicles on which fruit set was studied. The number of fruits reaching harvest maturity was counted and recorded. The number of fruits reaching harvest maturity in all the treated and control was counted as number of fruits per tree.

Results and Discussion

Effect of chemicals on per cent of bud swelling, emergence and length of panicles

The findings on per cent of bud swelling apparently revealed that potassium nitrate with combination of potassium di hydrogen orthophosphoric acid (KH_2PO_4-1% + KNO_3 - 1%) were found to significantly enhance the swollen bud among all the test cultivars of mango (Table 1). It was comparatively higher in Dashehari with all the test chemicals during both the years of study. Contrary to this, Pal *et al.,* (1979) opined that potassium nitrate at 10 g/1 was found ineffective in 'Dashehari' mango under North Indian conditions probably due to variation in growth habit and monoembryonic nature.

In the present studies, nitrate of potassium with combination of potassium di hydrogen orthophosphoric acid showed a very positive effect on the panicle emergence among all the test cultivars of mango, whereas, it was lowest in those of control (Table 2). The higher per cent of panicle appearance in KH_2PO_4-1% + KNO_3-1% treated trees might be due to the fact that KNO_3 acts as a bud dormancy breaking agent (Tongumpai *et al.,* 1989). Davenport and Nunez-Elisea (1997) opined that KNO_3 stimulated flowering in mango is mediated by increased levels of endogenous ethylene. Potassium nitrate is a universal rest-breaking agent in deciduous fruit trees (Erez and Lavee, 1974) that may simply hasten flower emergence of a differentiated, but dormant, mango bud. Saha *et al.,* (2017) reported that amongst the different chemicals used, treatment KH_2PO_4 1% + KNO_3 1% was most effective regarding the Panicle emergence and it was noted 5.67 days earlier in comparison to control.

A perusal of the data revealed that there was significant effect of different chemicals on the length of panicles in all the cultivars of mango. Panicle lengths of all the test cultivars were also greatly influenced by KH_2PO_4 -1% with KNO_3- 1% (Table 3), which was lengthier than other treatments results are in line with Garad *et al.,* (2013) who stated that the maximum panicle length (34.41 cm) was observed by spraying of K_2HPO_4 1 % + KNO_3 1 %.

Effect of chemicals on duration of Flowering and percentage of flowering shoots

A significant shortest duration of flowering was noted with the application of KH_2PO_4-1% + KNO_3 -1% treatment. However, among the cultivars shortest duration of flowering was observed with mango cultivar Bombay Green (Fig. 1). So far as the start of flowering as well as its duration is concerned KH_2PO_4 - 1% in combination with KNO3- 1% flowered earlier and thus reduced the duration of flowering

period. Early initiation of panicle, flowering and lesser duration in these processes are in line with Ubale and Banik (2017a) observed shortest flowering duration in the trees treated with KNO_3 2% (14 days) whereas longest (20 days) was perceived with T_7 (Control - water spray) and $_{T8}$ (Control), respectively. Earlier flowering in mango promoted by foliar spray of KNO_3, which promotes ethylene biosynthesis has also been reported by Mosqueda-Vazquez and Avila-Resendiz (1985). Panicle initiation and also flowering are guided by different plant hormones and the nutrient status of the plant. Early flowering would refer to an early morphological differentiation of these panicles. Saha *et al.,* (2017) opined that treatment KH_2PO_4 1% + KNO_3 1% was most effective regarding the panicle emergence and it was noted 5.67 days earlier in comparison to control whereas the flowering was recorded 4.66 days earlier with the treatment KH_2PO_4 1.5 % + KNO_3 1% than control.

In the present study significant increase in percentage of flowering shoots has been obtained with KH_2PO_4-1% + KNO_3-1% during both years (Fig. 2). In earlier study Saha *et al.,* (2017) reported the highest percent (74.01) of flowering shoot was observed with K_2HPO_4 1.5 % and KNO_3 1%. These findings are in conformity with Garcia *et al.,* (2008), Sudha *et al.,* (2012), Sarker and Rahim (2013), Afiqah *et al.,* (2014), Maloba *et al.,* (2017) and several others in mango fruit.

Effect of chemicals on number of staminate, hermaphrodite flower per panicle and sex ratio

An increase in number of staminate flowers per panicle due to chemicals was noticed in mango cultivars Bombay Green with KH_2PO_4-1% + KNO_3 -1% and in Dashehari with K_2HPO_4-1% + CH_4N_2S-1% during the experimentation. However in case of Langra, a reduction in number of staminate flowers per panicle due to application of chemicals was noticed during 2016-17 and 2017-18. Likewise, The number of hermaphrodite flowers per panicle was highest in all the test cultivars of mango viz. Bombay Green, Dashehari and Langra when treated with KH_2PO_4-1% + KNO_3 -1%. Among the all test cultivars of mango, maximum number of flowers was observed in Langra in the present studies (Table 4 and 5). Variation in number of flowers panicles^{-1} attributed to inherent genetic differences of the mango cultivars. In an evaluation of mango cultivars maximum number of flowers was observed in Langra (Hada and Singh, 2017). Similar results of increased percentage of hermaphrodite flowers over control due to the chemical treatments were observed by Oosthyse (1996), Barros *et al.,* (1998), Kumar and Reddy (2008) Ubale and Banik (2017a) in mango which might be due to the availability of more nutrients to panicles.

This result also agrees with that reported by other fruits, in which an application of phosphorus increased flowering (Agusti, 2003); 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 (Feucht, 1982). According to Marschner (2002), the number of flowers formed is reduced in the case of a deficiency of phosphorus. Furthermore, the fraction of K in the KH_2PO_4 could stimulate photosynthesis and transport of photo assimilates, among others, which is very important for the formation of flowers (Swietlik, 2003). This may also be due to the applications of nitrogenous compounds containing NO_3^- or NH_4+ increased levels of arginine, compound which can promote flowering as reported by George *et al.,* (2003). Moreover, the fraction of K in the KH_2PO_4 also could stimulate photosynthesis and transport of photo

assimilates, among others, which is very important for the formation of flowers (Swietlik, 2003).

The inflorescence of mango bears mainly two types of flowers male and hermaphrodite. It is only perfect or hermaphrodite flowers, which after proper pollination and fertilization, sets fruits. The sex ratio in different cultivars is greatly influenced by the environment of their surroundings. In the present studies significant variation in the sexuality of flowers has been observed due to chemicals application. However, the least sex ratio was recorded with the treatment of KH_2PO_4-1% + KNO_3 -1% as compared to other treatments in all test cultivars of mango during both years of study (Fig. 3). The effect of these chemicals in minimizing sex-ratio was due to the production of ethylene which in turn helped in the production of more hermaphrodite flower. Saha *et al.*, (2017) recorded the highest number (306.33) of hermaphrodite flowers and lowest sex ratio (2.21) under the treatment KH_2PO_4 1% + thiourea 1%. Kumar *et al.*, (2017) opined that combined spray of 1% mono-potassium phosphate and 1 % potassium nitrate led to least sex ratio (1.03) in litchi.

Effect of chemicals on fruit set and retention per panicle

In the present study, it was observed that the spraying of different chemicals affected the fruit setting and retention of all the test cultivars of mango viz. Bombay Green, Dashehari and Langra during the both years of study. The highest fruit setting (at marble stage) per panicle was with KH_2PO4-1% + KNO_3 -1% (Fig. 4). It means the contribution of potassium nitrate along with mono-potassium phosphate was excellent over other combination of test chemicals. Thus, it is clear that treatment KH_2PO_4-1% + KNO_3 -1% not only improved fruit set but also enhanced the retention of fruits when compared with either control or individual spray (Fig. 5).

Table.1 Effect of chemicals on bud swelling in mango cv. Bombay Green, Dashehari and Langra

Treatments	Bud Swelling (%)								
	Bombay Green			Dashehari			Langra		
	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
KNO_3 -1%	53.3	54.7	54.0	56.0	52.3	54.2	50.0	52.3	51.2
KH_2PO_4-1%	54.7	52.0	53.3	58.3	55.0	56.7	52.7	54.0	53.3
K_2HP1%	57.3	59.0	58.2	61.7	63.0	62.3	59.3	61.0	60.2
CH_4N_2S-1%	52.0	51.3	51.7	55.7	46.3	51.0	50.3	51.0	50.7
KH_2PO_4-1% + KNO_3 -1%	73.3	74.0	73.7	73.7	74.3	74.0	70.3	72.0	71.2
K_2HPO_4-1% + KNO_3 -1%	71.3	71.7	71.5	67.7	69.0	68.3	64.7	66.0	65.3
KNO_3 -1% + CH_4N_2S-1%	62.3	61.3	61.8	56.0	57.0	56.5	54.7	53.0	53.8
K_2HPO_4-1% + CH_4N_2S-1%	70.7	71.0	70.8	63.3	62.0	62.7	58.3	58.0	58.2
Control	47.3	49.7	48.5	41.0	46.3	43.7	42.3	40.7	41.5
C.D. (at 5%)	3.58	4.64		4.36	5.48		4.12	5.23	

Table.2 Effect of chemicals on Panicle emergence per cent in mango cv. Bombay Green, Dashehari and Langra

Treatments	Panicle Emergence (%)								
	Bombay Green			Dashehari			Langra		
	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
KNO_3 -1%	54.00	53.33	53.67	50.00	51.67	50.84	49.00	50.33	49.67
KH_2PO_4-1%	57.33	56.00	56.67	53.00	54.33	53.67	51.33	53.67	52.50
K_2HP1%	56.67	58.00	57.34	60.33	62.00	61.17	58.67	60.33	59.50
CH_4N_2S-1%	41.00	40.67	40.84	44.00	45.33	44.67	39.00	41.00	40.00
KH_2PO_4-1% + KNO_3 -1%	76.00	77.00	76.50	75.00	77.33	76.17	69.67	70.67	70.17
K_2HPO_4-1% + KNO_3 -1%	60.67	58.00	59.34	66.33	68.00	67.17	63.00	65.33	64.17
KNO_3 -1% + CH_4N_2S-1%	51.00	50.67	50.84	55.00	56.33	55.67	53.67	52.00	52.84
K_2HPO_4-1% + CH_4N_2S-1%	59.33	60.00	59.67	62.67	61.33	62.00	57.00	57.33	57.17
Control	36.00	38.33	37.17	30.67	35.00	32.84	25.67	29.00	27.34
C.D. (at 5%)	5.28	4.58		3.58	4.15		3.54	3.71	

Table.3 Effect of chemicals on Panicle length (cm) in mango cvs Bombay Green, Dashehari and Langra

Treatments	Panicle Length (cm)								
	Bombay Green			Dashehari			Langra		
	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
KNO_3 -1%	21.93	21.98	21.96	23.50	23.65	23.58	27.95	28.05	28.00
KH_2PO_4-1%	22.17	22.68	22.43	24.60	24.68	24.64	29.23	29.65	29.44
K_2HPO_4-1%	23.45	23.94	23.70	25.12	25.74	25.43	31.57	32.20	31.89
CH_4N_2S-1%	21.96	23.24	22.60	24.35	25.10	24.73	28.05	28.55	28.30
KH_2PO_4-1% + KNO_3 -1%	29.63	30.25	29.94	32.30	33.05	32.68	34.85	35.98	35.42
K_2HPO_4-1% + KNO_3 -1%	28.60	29.03	28.82	27.85	27.90	27.88	28.65	28.74	28.70
KNO_3 -1% + CH_4N_2S-1%	27.23	27.95	27.59	26.05	26.54	26.30	27.67	28.00	27.84
K_2HPO_4-1% + CH_4N_2S-1%	31.45	32.05	31.75	28.85	29.55	29.20	33.15	33.85	33.50
Control	17.30	17.35	17.33	21.90	22.30	22.10	25.90	26.35	26.13
C.D. (at 5%)	0.88	0.91		0.94	0.9		0.82	1.06	

Table.4 Effect of chemicals on staminate flower per panicle in mango cvs Bombay Green, Dashehari and Langra

Treatments	Number of staminate Flowers Panicle^{-1}								
	Bombay Green			Dashehari			Langra		
	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
KNO_3 -1%	249.62	252.62	251.12	483.37	479.84	481.61	286.24	287.16	286.70
KH_2PO_4-1%	248.40	256.94	252.67	497.26	492.28	494.77	295.31	299.76	297.54
K_2HPO_4-1%	321.96	331.15	326.56	491.61	495.79	493.70	297.63	304.08	300.86
CH_4N_2S-1%	253.93	271.58	262.76	497.48	505.82	501.65	305.63	311.01	308.32
KH_2PO_4-1% + KNO_3 -1%	354.40	364.95	359.68	523.02	529.00	526.01	265.38	266.17	265.78
K_2HPO_4-1% + KNO_3 -1%	324.00	332.47	328.24	544.65	537.78	541.22	285.07	285.85	285.46
KNO_3 -1% + CH_4N_2S-1%	309.52	321.24	315.38	516.67	518.47	517.57	321.72	325.62	323.67
K_2HPO_4-1% + CH_4N_2S-1%	353.26	338.12	345.69	555.80	561.85	558.83	271.35	275.01	273.18
Control	213.13	216.23	214.68	458.36	460.08	459.22	325.55	331.20	328.38
C.D. (at 5%)	22.36	18.42		12.14	13.08		10.06	9.82	

Table.5 Effect of chemicals on hermaphrodite flowers per panicle in mango cvs Bombay Green, Dashehari and Langra

Treatments	Number of Hermaphrodite Flowers Panicle^{-1}								
	Bombay Green			Dashehari			Langra		
	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
KNO_3 -1%	190.24	193.31	191.78	168.51	168.15	168.33	730.59	734.77	732.68
KH_2PO_4-1%	196.28	203.20	199.74	185.13	183.93	184.53	768.09	780.46	774.28
K_2HPO_4-1%	248.69	255.99	252.34	205.21	209.46	207.34	850.90	869.06	859.98
CH_4N_2S-1%	186.54	189.91	188.23	177.98	181.90	179.94	714.84	729.15	722.00
KH_2PO_4-1% + KNO_3 -1%	300.08	309.63	304.86	289.75	294.32	292.04	966.09	971.82	968.96
K_2HPO_4-1% + KNO_3 -1%	249.65	256.49	253.07	227.90	226.65	227.28	757.23	761.22	759.23
KNO_3 -1% + CH_4N_2S-1%	236.66	245.82	241.24	205.95	208.70	207.33	684.92	694.49	689.71
K_2HPO_4-1% + CH_4N_2S-1%	277.56	312.11	294.84	244.49	247.79	246.14	934.66	958.23	946.45
Control	133.87	135.77	134.82	149.14	150.92	150.03	616.70	628.80	622.75
C.D. (at 5%)	5.27	7.25		12.50	12.57		20.85	32.50	

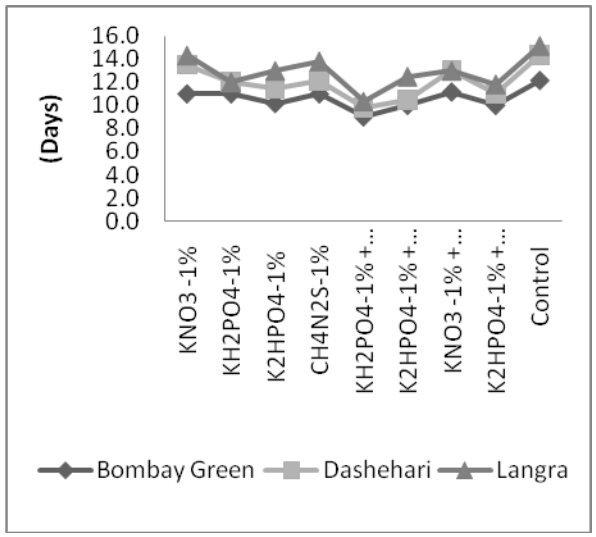

Fig.1 Effect of chemicals on duration of flowering

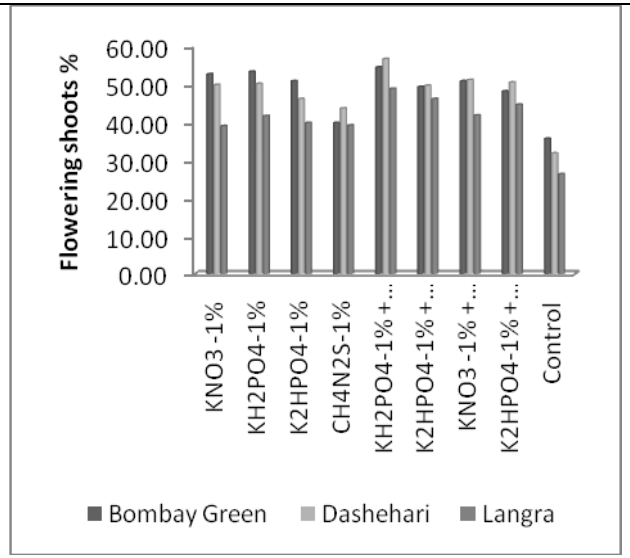

Fig.2 Effect of chemicals on flowering shoots per cent

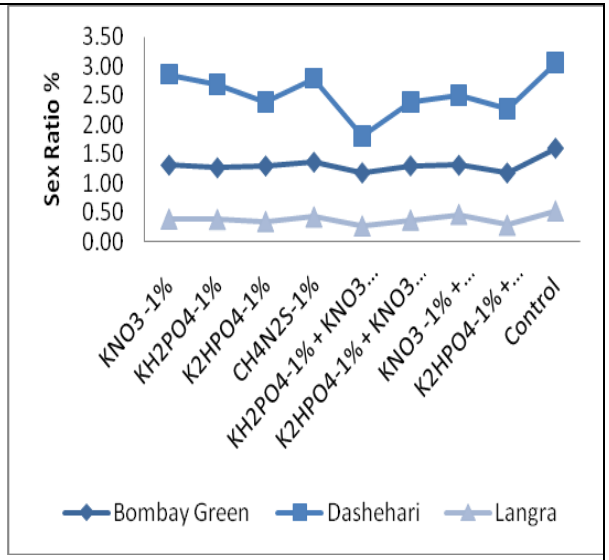

Fig.3 Effect of chemicals on Sex Ratio

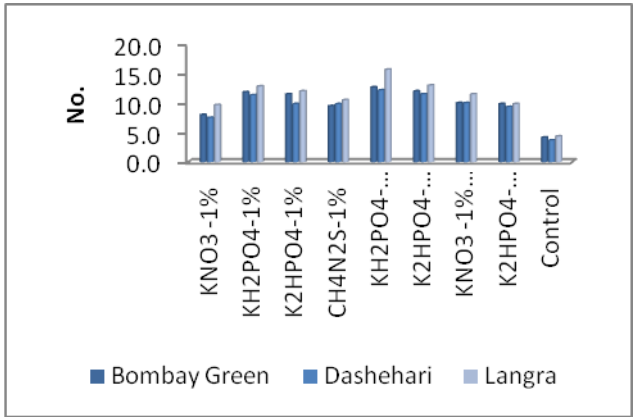

Fig.4 Effect of chemicals on no. of fruit set per panicle

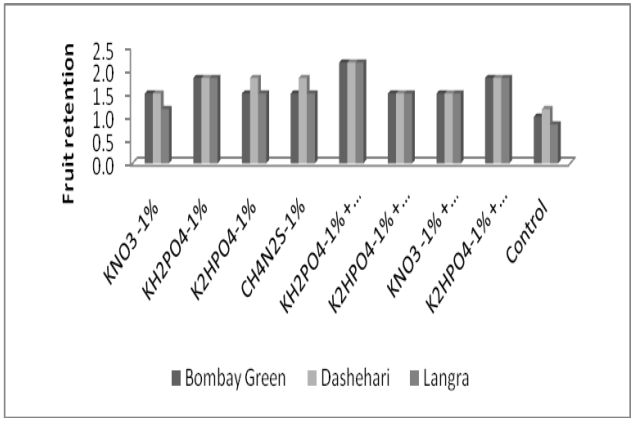

Fig.5 Effect of chemicals on Fruit retention

Table.6 Effect of chemicals on Number of Fruits per tree in mango cvs. Bomb Green, Dashehari and Langra

Treatments	Number of Fruits per tree								
	Bombay Green			Dashehari			Langra		
	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
KNO_3 -1%	318.0	257.0	287.5	224.0	281.0	252.5	307.0	235.0	271.0
KH_2PO_4-1%	328.0	406.0	367.0	309.0	368.0	338.5	615.0	380.0	497.5
K_2HPO_4-1%	579.0	512.0	545.5	410.0	350.0	380.0	467.0	616.0	541.5
CH_4N_2S-1%	248.0	334.0	291.0	356.0	304.0	330.0	526.0	549.0	537.5
KH_2PO_4-1% + KNO_3 -1%	600.0	721.0	660.5	580.0	686.0	633.0	778.0	944.0	861.0
K_2HPO_4-1% + KNO_3 -1%	417.0	341.0	379.0	381.0	301.0	341.0	763.0	613.0	688.0
KNO_3 -1% + CH_4N_2S-1%	395.0	327.0	361.0	344.0	278.0	311.0	643.0	524.0	583.5
K_2HPO_4-1% + CH_4N_2S-1%	555.0	521.0	538.0	489.0	414.0	451.5	670.0	598.0	634.0
Control	134.0	136.0	135.0	149.0	201.0	175.0	217.0	153.0	185.0
C.D. (at 5%)	15.5	20.2		21.5	14.3		18.3	19.5	

Results are in conformity with those of Garcia *et al.*, (2008), Nahar *et al.*, (2010), Sudha *et al.*, (2012), Sarker and Rahim (2013), Garad *et al.*, (2013), Oosthuyse (2015), Maloba *et al.*, (2017) and Saha *et al.*, (2017). This result fully confirms the affirmations of Agustí (2003) that the availability of mineral elements becomes vital at the time of flowering and fruit setting and demand must be properly contented.

Effect of chemicals on number of fruits per tree

The data of the present studies indicated that the number of fruits per tree was maximum over all with the chemical combinations of KH_2PO_4-1% + KNO_3-1% among all the test cultivars of mango viz. Bombay Green, Dashehari and Langra during both years of experimentation (Table 6). The application of potassium di hydrogen orthophosphoric acid in combination with potassium nitrate in the present investigation has increased the intensity of flowering, better fruit set (Fig. 4), better fruit retention (Fig. 5), which might have resulted in increase in the number of fruits per tree. The findings are in line in mango fruits with those of Garcia *et al.*, (2008), Sudha *et al.*, (2012), Sarker and Rahim (2013), Abd El-Razek *et al.*, (2013), Oosthuyse (2015), Amarcholi *et al.*, (2016) and Dheeraj *et al.*, (2016). In general, lower concentrations of various chemicals were proved better than higher concentrations and the average number of fruits per panicle at harvest was more with spraying of KH_2PO_4, KH_2PO_4 and KNO_3 and minimum with control (Kumar *et al.*, 2007).

The maximum per cent of flowering shoot, increase in fruit set per panicle and retentions of fruits per panicle, prevention of abscission of young fruit lets, would have resulted in the increase the number of fruits per tree sprayed with the above treatment in the present study. Moreover, early flowering, fruiting and better retention of fruits would have facilitated the better utilization of nutritional resources within the tree resulting in maximum yields (Kumar and Reddy, 2008). Phosphoric acid and potassium nitrate may have acted synergistically to increase the number of flowering shoots thereby increasing fruits

numbers of mango cv. Alphonso (Reddy and Kurian, 2012). Similar results were also reported in mango by MC Kenzie (1994) in cv. Sensation, Rojas (1996b) in cv. Haden, Srihari and Rao (1998) in cv. Alphonso, Nahar *et al.*, (2010) in cv. Amrapali, Elkhishen (2015) in cv. Zebda, Dheeraj *et al.*, (2016) in cv. Banganapalli, Amarcholi *et al.*, (2016) in Kesar.

Acknowledgement

This work was supported in part by the CSA University of Agriculture and Technology; Kanpur (UP) for providing facility of Lab. Acknowledgment is also made to Prof. P.N. Katiyar supported a lot by providing planting material for the research work.

References

Afiqah, A., Nulit, R., Hawa, Z. E. J. and Kusnan, M. 2014. Improving the yield of 'Chok Anan' (Ma 224) mango with potassium nitrate foliar sprays. *Int. J. Fruit Sci.*, 14: 416-23.

Agustí, M. 2003. Citricultura. Second edition. Mundi Prensa editions, Madrid. pp. 422.

Amarcholi, J.J., Singh, V., Sharma, K. M., Momin, S.K. and Patel, R.J. (2016). The impact Of Chemicals on Fruiting Parameters, Quality Parameters And B:C Ratio of 'Kesar' mango. *Multilogic in Science*, 5. 279-282.

Barros, P.G., daCunha, G.A.P., Reinhardt, D.H., Fonseca, N. and Barbosa, N.M.L. 1998. Effect of potassium nitrate on flowering and fruit set of mango trees (*Mangifera indica* L.) cv. Tommy Atkins in southwest Bahia. *Revista Brasileira de Fruticultura*, 20 (2) pp. 188-194

Candolle, A. de 1904. Origin of Cultivated Plants 2nd ed, Kegan Paul, London.

Dadhaniya, D., Adodariya, B.A., Mishra, P., Purohit, H., Solanki, R., Kadegiya, L., Barad, R., Kinjal, H., Patel, H.N., Makwana, S.M. and Jadeja, S.R. 2018. Effect of foliar application of chemicals on flowering of fruit crops. *Journal of Pharmacognosy and Phytochemistry*, 7(4): 2768-2770.

Davenport, T.L. and Nunez-Elisea 1997. Reproductive physiology. The Mango: botany, production and uses. Wallingford: CAB International, pp. 69-146.

Dheeraj, G., Bhagwan. A., Rajkumar, M. and Venkatlaxmi, A. 2016. Studies on the effect of bioregulators on flowering and yield of mango (*Mangifera indica* L.) cv. Banganpalli. *International Journal of Agricultural Science and Research*, 6(3): 55-64.

Economic Times 2018. https://economictimes.indiatimes.com/news/economy/agriculture/mango-output-in-2017-18-seen-higher-by-8-pc/articleshow/65196730.cms

Elkhishen, M.A. 2015. Enhancing Flowering and Fruiting Attributes of Mango (*Mangifera indica*) CV. Zebda in the Off-Year by Binary Application of KNO3, Ethrel and Paclobutrazol. *Journal of Horticultural Science & Ornamental Plants*, 7 (3): 87-93.

Garad, B.V., Jogdand, S.M., More, V. and KulKarni, S.S. 2013. Effect of Chemicals on flowering and fruiting in mango (*Mangifera indica* L) cv Keshar. *Ecology, Environment and Conservation Paper*, 19(3): 835-838.

Garcia, Oscar Javier, Dueflez, E.Y., Fischer, G., Chaves, B.O. and Quintero, C. 2008. Fruit set response of pineapple guava in response to potassium nitrate, potassium phosphate and ethephon. *Agron. Colomb.*, 26(2): 217-225.

George, A.P., Broadley, R.H., Nissen, R.J. and Ward, G. 2003. Effects of chemicals on breaking new rest flowering shoot production and yield of

subtropical tree crops. *Acta Hort.*, 575, 835-840.

Hada, T.S. and Singh, A.K. 2017. Evaluation of Mango (*Mangifera indica* L.) Cultivars for Flowering, Fruiting and Yield Attributes. *International Journal of Bio-resource and Stress Management,* 8(4): 505-509.

Krishna, G.V., Bhagwan, A., Rajkumar, M. and Shankar, A.S. 2017. Foliar Chemicals Application impact on flowering and yield of Mango cv. Banganapalli. *Int. J. Pure App. Biosci.* 5 (3): 657-666.

Kumar, A., Singh, S. K., Pandey, S.D., Patel, R.K. and Nath, V. 2017. Effect of Foliar Spray of Chemicals on Flowering and Fruiting in Litchi. *Int.J.Curr.Microbiol.App.Sci*., 6(5): 1337-1343.

Kumar, M. R., Reddy, Y. N., Chandrasekhar, R. and Srihari, D. 2007. Studies on the effect of foliar application of chemicals and growth regulators on the fruit yield of unpruned mango (Mangiferaindica L.) trees cv. Baneshan. *Orissa J. of Hort.*, 35 (2) 44-47.

Kumar, M.A. and Reddy, Y.N. 2008. Preliminary investigations on the effect of foliar spray of chemicals on flowering and fruiting characters of mango cv. Baneshan. *Indian journal of Agricultural Research*, 42(3): 164-170.

Maloba, S., Ambuko, J., Hutchinson, M. and Owino, W. 2017. Off-Season Flower Induction in Mango Fruits Using Ethephon and Potassium Nitrate. *Journal of Agricultural Science,* 9(9): 158-167.

Marschner, H. 2002. Mineral nutrition of higher plants. Academic Press, London. 889 p.

McKenzie, C. B. 1994. Preliminary results of calcium and potassium uptake from foliar sprays on Sensation mango. *Yearbook - South African Mango Growers' Association,* 14: 24-25.

Mosqueda-Vazquez, R and Avila-Resendiz, C. 1985. Floral induction of Mango with KNO3 applications and its inhibition by $AgNO_3$ or $COCl_2$ application. *Horticultura Mexicana*, 1(1): 93-101.

Nahar, N., Choudhury, M.S.H. and Rahim, M.A. 2010. Effects of $KClO_3$, KNO_3 and urea on the flowering and fruiting of mango and longan. *J. Agrofor. Environ.*, 4 (1): 31-34.

Oosthuyse, S. A. 2015. Spray application of KNO3, low biuret urea, and growth regulators and hormones during and after flowering on fruit retention, fruit size and yield of mango. X International Mango Symposium. ActaHorticulturae. pp. 135-141

Oosthuyse, S.A. 1996. Effect of KNO_3 to flowering mango trees on fruit retention, fruit size, tree yield and fruit quality. *Acta Hort.*, 455: 33-36.

Pal, R. N., Chadha, K.L. and Rao, M.R.K. 1979. Effect of different plant grown regulators and other chemical on flowering behaviour of mango. Paper presented at Mango workshop meeting, Panaji, Goa, p. 331-336.

Rajkumar, M, Reddy, Y.N, Chandrashekhar, R and Srihari, D. 2007 a. Effect of pruning, paclobutrazol and chemicals on the induction of flowering on new laterals in mango (*Mangifera indica* L) cv. Baneshan. *J. Res. ANGRAU*, 35(1): 22-26.

Rajkumar, M., Reddy, Y.N., Chandrashekhar, R. and Srihari, D. 2007 b. Studies on the effect of foliar application of chemicals and growth regulators on the fruit yield on unpruned mango (*Mangifera indica* L.) trees cv Baneshan. *The Orissa Journal of Horticulture*, 35(2): 44-47.

Rani, K.U. 2018. Advances in Crop Regulation in Mango (*Mangifera indica* L.). *Int. J. Curr. Microbiol. App. Sci.*,

7(9): 35-42.

Rani, S., Sharma, A., Wali, V.K., Bakshi, P., Bakshi, M. and Gupta, S. 2017. Effect of foliar nutrition on yield, quality and shelf-life of mango (*Mangifera indica*) cv. Dashehari under Jammu sub-tropics. *Indian Journal of Agricultural Sciences*, 87(2): 185-190.

Reddy, Y.T.N. and Kurian, R.M. 2012. Effect of pruning and chemicals on flowering and fruit yield in mango cv. Alphonso. *J. Hortl. Sci.*, 7(1): 85-87.

Saha, D.P., Jha, K.K., Sengupta, S., Misra, S., Lal, H.C. and Prasad, K. 2017. Preliminary investigations on the effect of foliar spray of chemicals on flowering, fruit setting and retention of fruits of mango cv. Mallika. *International Journal of Science, Environment and Technology*, 6(2): 1574 – 1580.

Sarker, B.C.and Rahim, M.A. 2013. Yield and Quality of Mango (*Mangifera indica* L.) as influenced by foliar application of Potassium Nitrate and Urea. Bangladesh J. Agril. Res. 38(1): 145-154.

Sergent, E, Ferrari, D, Leal, F, Lavi, U Degani, C, Gazit, S, Lahav E, Pesis, E, Prusky, D, Tomer, E and Wysoki, M. 1997. Effect of potassium nitrate and paclobutrazol on flowering induction and yield of mango (*Mangifera indica* L.) cv. Haden. Proceedings of the fifth International mango Symposium, Tel Aviv, Israel, 1-6 September, *Acta Horticulturae*, 455:180-187.

Srihari, D. and Rao, M.M. 1998. Effect of spraying nutrients and chemicals on vegetative growth and flowering in "off" phase Alphonso mango trees. *Karnataka Journal of Agricultural Sciences*, 11(1): 257-259.

Sudha, R., Balamohan, T.N. and Soorianathasundaram, K. 2012. Effect of foliar spray of nitrogenous chemicals on flowering, fruit set and yield in mango (*Mangifera indica* L.) cv. Alphonso. *J. Hortl. Sci.*, 7(2):190-193.

Swietlik, D. 2003. Plant nutrition. pp. 251-257. In: Baugher, TA and Singha S. (eds.). Concise Encyclopedia of temperate tree fruit. Food Products Press, New York. 387 p.

Tongumpai, P., Charnwichit, S., Srisuchon, S., Subhadrabandhu, S. 1997. Effect of thiourea on terminal bud break of mango. *Acta Horticulturae*, 455: 71-75.

Ubale, N. B. and Banik, B. C. 2017a. Effect of Foliar Nutrition on Flowering Characteristics in Mango (*Mangifera indica* L.) *Trends in Biosciences*, 10(40): 8284-8286.

Ubale, N. B. and Banik, B. C. 2017b. Effect of Foliar Nutrition and Bagging on Fruit Set and Fruit Drop in Mango. *Trends in Biosciences*, 10(40): 8311-8313.

How to cite this article:

Manoj Kumar Singh, Vinod Bahadur Singh, S.S. Singh and Anil Kumar Singh. 2019. Floral Biology and Fruit Set of Mango (*Mangifera indica* L.) as Influenced by Different Chemicals. *Int.J.Curr.Microbiol.App.Sci.* 8(01): 1106-1117. doi: https://doi.org/10.20546/ijcmas.2019.801.119