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Effect of Different Chemicals and PGR on Flower Induction and Physicochemical Properties of Litchi cv. Bombai Grown in New Alluvial Zone of West Bengal

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ABSTRACT

The present investigation was carried out at Regional Research Station, New Alluvial Zone, Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal, India to study the effect of different chemicals and plant growth regulators on flowering induction and physico-chemical properties of Litchi cv. Bombai for three consecutive years during September 2014 to July 2017. Nine treatments with 3 replications was chosen and laid out in Randomized Block Design using DMRT for the experiment. All the plants were 12 years of age uniform in growth and healthy spaced at 10 m apart. Results from the experiment revealed that application of different chemicals and PGR significantly improved the flowering and physicochemical properties of litchi. Among the different treatments in study, application of K_2HPO_4 @ 1%+KNO_3 @ 1% in (T_6) showed highest flowering characters in terms of flowering shoot (56.17%), sex ratio (3.62), fruits panicle^{-1} at harvest (26.34) and lowest fruit drop panicle^{-1} (14.00) followed by T_7 (KH_2PO_4 @ 1%+KNO_3 @ 1%). T_6 treatment also showed maximum fruit weight (21.78 g), fruit length (3.84 cm), aril weight (15.88 g) and yield (72.34 kg plant^{-1}). TSS (16.80°B), total sugar (13.63%), ascorbic acid (42.55 mg 100 g^{-1}), TSS: acid ratio (57.40) and anthocyanin content (46.14 mg 100 g^{-1}) of fruit was also found highest in T_6 (K_2HPO_4 @ 1%+KNO_3 @ 1%) followed by T_7 (KH_2PO_4 @ 1%+KNO_3 @ 1%) while the lowest in control. Thus, from the different treatment under study T_6 proved to be most effective followed by T_7 in improving the flower induction, yield and quality of litchi cv. Bombai.

KEYWORDS: Bombai, flowering, new alluvial zone, pgr, quality, yield

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1. INTRODUCTION

Litchi (*Litchi chinensis* Sonn.) recognized as "Queen of the fruits" is an important sub tropical evergreen fruit crop belongings to the family Sapindaceae well adapted to the areas of cool dry winters and warm wet summers. It usually likes low elevations but can be grown up to an altitude of 800 m above mean sea level (Priyadarshi et al., 2018). It is native of south china and reached India by the end of 17th century due to unique temperature and climatic requirements, it is widely distributed in the tropics and warm subtropics of the world (Pandey and Sharma, 1989). India ranks 2nd in the world from the production point of view with cultivated area expansion of 30% in the last 15 years, it occupies about 92 thousand ha of land with production of 600 thousand mt and productivity of 6 mt ha^{-1} (Anonymous, 2018). Low and irregular bearing is a hurdle in successful cultivation of litchi which is preventing litchi from becoming the major crop of subtropical region so far (Stern et al., 2000, Pandey and Sharma, 1989). The problem is generally due to failure of flower initiation, which put forth vegetative growth 1–2 months prior to panicle emergence and flowering, eliminating the crop completely. Delayed flushing during the autumn and erratic winter leading to physiological immaturity of the shoots seems primarily responsible for irregular bearing in litchi (Kumar et al., 2015). An increase in flowering and fruit in litchi occurs when there is growth check caused by dry or cool weather after shoots of the previous growth flush have matured. Due to the occurrence of late rain in Gangetic plains of West Bengal even up to 1st and 2nd week of October, a new flush of vegetative growth occasionally emerges in late November to 1st fortnight of December. This shoot rarely flowered as lack of adequate period or cool and dry weather or moisture stresses. The excessively wet weather during the post monsoon season (October to December) initiates vegetative flushing when the trees undergo rest period and these flushes used stored carbohydrates i.e. preferably removed from flowering and fruiting resulting in inconsistent yields (Nagao et al., 2000). So, there is urgent need for breaking off late flushing vegetative terminals by initiating vegetative growth for better flowering during January–February (Campbell and Diczbalis, 2001).

The main objectives of litchi growers are to harvest maximum quantity of marketable fruits at the lowest investment cost. Potassium, is an essential macro-element required in large amounts for normal plant growth and development involved in numerous biochemical and physiological processes, water relations, photosynthesis, assimilate transport and enzyme activation which have direct consequences on crop productivity (Menzel and Kirby 2001, Das and Dutta, 2022). When potassium uptake is lower than demand, foliar potassium is mobilized to the fruit, which is detrimental for plant growth, fruit set and quality (Besford and Maw, 1975). Pre-harvest sprays of potassium and growth regulators are one of the most important practices of the new strategies applied in the integrated fruit production systems, improving fruit quality (Mandal et al., 2012 and Yang et al., 2015). Application of ethrel @ 1,000 ppm, which could not only remove winter flushes but also dropped mature leaves, thereby affecting plant growth and development and sometimes bring flowering in coming season (Kumar et al., 2017). Response of various growth promoting chemicals and regulators on regulation of flowering and fruiting have been studied by various workers in different fruit crops (Mishra et al., 2012, Zhang et al., 2002). Foliar spray of KH_2PO_4 @ 1%+KNO_3 @ 1% seems to be beneficial for increasing the flowering, fruit set and improving the fruit size and weight of mango cv. Keshar (Garad et al., 2013). Thus, the aim of the present study was to test the effect of foliar spraying of KNO_3, potassium di-hidrogen phosphate, di-potassium hydrogen phosphate either alone or in combination and ethrel on the flowering, yield, fruit quality characteristics of litchi cv. Bombai grown in New Alluvial zone of West Bengal.

2. MATERIALS AND METHODS

2.1. *Experimental site*

The present investigation was carried out at Regional Research Station, New Alluvial Zone, Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal, India (22.57°N, 89.34°E and 9.75 m above mean sea level) for 3 consecutive years during September 2014 to July 2017. The climate of the region is humid sub-tropical with hot-humid summers and cool winters. The mean annual rainfall is 1,750 mm, out of which 80–90% is normally received from June to September. Soil at the experiment site was alluvial in nature and sandy loam in texture (sand 64.8%, silt 10.4%, and clay 24.8%) with a pH of 6.6 and contained organic carbon of 0.68%, available nitrogen 178.59 kg ha^{-1}, phosphorus 48.50 kg ha^{-1} and potassium 273.12 kg ha^{-1}. 12 years old healthy litchi plants cv. Bombai spaced at 10×10 m^2 apart having uniform growth and vigour were selected for the present study.

2.2. *Experimental design and crop husbandry*

Nine treatments with three replications having 2 plants $replication^{-1}$ were chosen and laid out in Randomized Block Design using DMRT for the experiment. Various treatments of different sources of chemicals viz. potassium alone or in combination and ethrel in different concentration were applied viz. T_1 Potassium Nitrate (KNO_3 1.0%), T_2 Di-potassium hydrogen phosphate (K_2HPO_4 1%), T_3 Potassium di-hydrogen phosphate (KH_2PO_4 1%), T_4 Di-potassium hydrogen phosphate (K_2HPO_4 2%), T_5 Potassium di-hydrogen phosphate (KH_2PO_4 2%) and in combination T_6 (K_2HPO_4 1%+KNO_3 1%), T_7 (KH_2PO_4 1 %+KNO_3 1%), T_8 (Etherel 400 ppm) and T_9 Control (water spray). The above treatments were applied separately along with fixed doses of N @ 1000 g and P_2O_5 @ 500 g and K_2O @ 1000 g plant^{-1} year^{-1} as soil application in two split doses once after fruit set and remaining after harvest of fruit (June–July) every year in circular trench away from the trunk depending upon the canopy spread the fertilizer are applied in the basin. The different chemicals and plant growth regulator treatments were applied twice as foliar spray to the healthy plants of uniform vigour and size in the morning hours first during October and second during November, 1st week of each month each year starting from 2014–2016 through foot sprayer to the point of run-off. Except ethrel all the chemicals were sprayed as salt dissolved in aqueous solution maintaining normal pH. Standard package of practices was followed for growing plants and plant protection measures were taken accordingly through chemical means.

2.3. Methods of data collection

The physico-chemical analysis was made following all standard methods as described by Ranganna (2003). Among the flowering characters the percentage of flowering shoots emerged was recorded by counting the number of new flowers emerged per square meter of the plant and multiplied by 100 to get the total number of flowering shoots plant^{-1}. The time of flowering and number of flowers male (M_1), hermaphrodite (F) and pseudo-hermaphrodite (M_2) flowers functioning as male were recorded manually by calculating the number of different types of flowers panicle^{-1} in a m^2 area of the plant. The sex ratio of flowers was obtained by adding the total number of male flowers and dividing it by the total number of female flowers i.e. total number of staminate flowers (M_1+M_2): total number of hermaphrodite flowers (F). The number of panicles m^{-2} was recorded by taking 10 observations at random from all direction of the plant. The length and breadth of panicle was measured in cm at full bloom stage with the help of a meter scale. The fruit set panicle^{-1} was calculated manually by taking average of 20 panicles, 5 each from 4 directions, from each tree and replicated trees were selected and tagged just after fruit setting. The fruit drop data were also calculated on the basis of initial and ultimate retention of fruits at harvest. It was recorded by subtracting the number of fruits at harvest from the number of initial fruit set and expressed in percentage.

Observations of fruit physical parameters like fruit size (length and diameter), peel thickness were done with the help of Vernier Calipers. Fruit weight, aril weight, seed and peel weight were measured with the help of digital weighing balance, based on random ten fruit samples. The average number of fruits panicle^{-1}, number of panicle m^{-2} of canopy area were recorded and multiplied by the average fruit weight for recording the yield plant^{-1}. The yield for each treatment was estimated in kg plant^{-1} by multiplying the weight of fruit and yield plant^{-1}. The biochemical fruit quality was determined from the juice extracted from 10 fruit sample for each treatment. The Total Soluble Solid (TSS) was estimated using digital refractometer (ATAGO, RX 5000, Tokyo, Japan) and was expressed as °Brix. Titratable acidity was determined by titrating 5 ml of juice against 0.1 N NaOH and expressed as percentage (Anonymous, 2000). Ascorbic acid (mg 100 g^{-1}) content of fruit was estimated by using 2, 6-dichlorophenolindophenol dye titration method (Casanas et al., 2002). Total sugar (%), reducing sugar (%) and non-reducing sugar (%) were determined as per the guidelines of AOAC (2000). Anthocyanin content of fruit peel at harvest was estimated by standard procedure described by Rangana (2003) and was expressed as mg 100 g^{-1} of peel.

3. RESULTS AND DISCUSSION

3.1. Effect of different sources of chemicals and plant growth regulators on flowering and panicle characteristics of litchi cv. Bombai

Data presented in Table 1 revealed that different sources of chemicals and plant growth regulators significantly improved the flowering characters viz. percentage of flowering shoots, number of staminate flowers, number of hermaphrodite flowers, length of panicle, breadth of panicle, initial fruit set panicle^{-1} and number of fruits panicle^{-1} at harvest. The maximum percentage of flowering shoots (56.17%) and number of hermaphrodite flowers (390.0) with least number of staminate flowers (843.17) was obtained for T_6 (K_2HPO_4 1%+KNO_3 1%) followed by (54.34%) flowering shoots and (355.0) number of hermaphrodite flowers in T_7 (KH_2PO_4 1%+KNO_3 1%) while control plants recorded the minimum percentage of flowering shoots (43.67%) and number of hermaphrodite flowers (251.50) with maximum no of staminate flowers (1204.0). The maximum sex ratio (3.62) was found in T_6 followed by (3.59) in T_7 while the minimum sex ratio (3.09) was observed in control plants T_9. The length of panicle (28.84 cm), breadth of panicle (17.87 cm), initial fruit set per panicle (39.83) and number of fruits per panicle at harvest (26.34) was found maximum in T_6 (K_2HPO_4 1%+KNO_3 1%) with minimum fruit drop per panicle (14.00) while the lowest length of panicle (22.00 cm), breadth of panicle (14.84 cm), initial fruit set panicle^{-1} (25.00) and number of fruits panicle^{-1} at harvest (13.00), with highest fruit drop panicle^{-1} (18.83) was recorded from T_9 control plants.

Table 1: Effect of different sources of chemicals and plant growth regulators on flowering and panicle characteristics of litchi

Treatment	Percentage of flowering shoot	No. of staminate flower (M_1+M_2)	No. of hermaphrodite flower (F)	Sex ratio (M_1+ M_2):F	Length of panicle (cm)	Breadth of panicle (cm)	Initial fruit set panicle^{-1}	No. of fruits panicle^{-1} at harvest	Fruit drop panicle^{-1}
T_1 (KNO_3 1%)	50.00	1165.10	269.67	3.10	25.50	17.57	31.50	18.00	15.84
T_2 (K_2HPO_4 1%)	48.17	1169.67	280.50	3.58	24.50	17.45	33.17	15.83	17.67
T_3 (KH_2PO_4 1%)	48.67	1010.00	292.00	3.50	23.84	15.50	30.00	15.17	17.50
T_4 (K_2HPO_4 2%)	52.17	1097.34	323.34	3.35	25.17	16.72	30.50	16.17	17.17
T_5 (KH_2PO_4 2%)	51.84	1150.67	349.17	3.22	24.50	15.75	30.17	17.00	18.17
T_6 (K_2HPO_4 1%+KNO_3 1%)	56.17	843.17	390.00	3.62	28.84	17.87	39.83	26.34	14.00
T_7 (KH_2PO_4 1 %+KNO_3 1%)	54.34	944.34	355.00	3.59	27.17	16.00	35.00	20.67	16.50
T_8 (Etherel 400 ppm)	49.17	994.17	344.67	3.30	24.17	15.07	35.58	23.84	14.50
T_9 (Control)	43.67	1204.00	251.50	3.09	22.00	14.84	25.00	13.00	18.83
SEm±	1.58	49.06	16.72	0.17	1.06	0.73	2.35	1.80	1.51
DMRT p=0.05	S	S	S	NS	S	S	S	S	NS

Data pertaining to the time of flowering in Table 2 as influenced by foliar spray of different chemicals and plant growth regulators revealed that during 2015 blossom started from the middle week of February with the earliest flowering on 10th to 16th February as reported in T_8 (Ethrel @ 400 ppm) while T_6 (KH_2PO_4 1%+KNO_3 1%) showed flowering between 12th to 18th February and late flowering during 14th to 20th February was observed in T_4 (KH_2PO_4 @ 2%), T_1 (KNO_3 @ 1%) and T_5. The control plants T_9 was found to blossom during 16th to 22nd February. During 2016, the litchi plants was found to blossom during the last week of February to 1st week of March, with the earliest flowering on 28th February to 4th March was found in T_3 (KH_2PO_4 @ 1%) and T_4 (KH_2PO_4 @ 1%), while T_6 ($KH_2PO_{4+}KNO_3$ 1%), T_7 (KH_2PO_4 1%+KNO_3 1%) and T_8 (Ethrel @ 400 ppm) showed flowering during 1st week from 2nd to 7th March. The control plants (T_9) were found to have very late flowering during 6th to 11th March.

Table 2: Effect of different sources of chemicals and plant growth regulators on time of flowering

Treatment	2015	2016
T_1 (KNO_3 1%)	14/02/15 to 20/02/15	02/03/16 to 10/03/16
T_2 (K_2HPO_4 1%)	12/02/15 to 18/02/15	01/03/16 to 08/03/16
T_3 (KH_2PO_4 1%)	10/02/15 to 18/02/15	28/02/16 to 04/03/16
T_4 (K_2HPO_4 2%)	14/02/15 to 20/02/15	28/02/16 to 05/03/16
T_5 (KH_2PO_4 2%)	14/02/15 to 20/02/15	02/03/16 to 10/03/16
T_6 (K_2HPO_4 1%+KNO_3 1%)	12/02/15 to 18/02/15	02/03/16 to 07/03/16
T_7 (KH_2PO_4 1 %+KNO_3 1%)	12/02/15 to 19/02/15	02/03/16 to 07/03/16
T_8 (Etherel 400 ppm)	10/02/15 to 16/02/15	01/03/16 to 06/03/16
T_9 (Control)	16/02/15 to 22/02/15	06/03/16 to 11/03/16

Application of different chemicals and plant growth regulator through foliar spray have shown varied results in respect of flowering characters, fruit and yield characters of litchi cv. Bombai. The different treatments significantly influenced the flowering characters and increased the length and breadth of panicle. Among the different treatments K_2HPO_4 @ 1%+KNO_3 @ 1% resulted in maximum flowering shoots with maximum sex ratio (Male: Female). Similar results were also reported by Kumar et al. (2017) in litchi cv. 'Shahi' and Suresh et al. (2003) on advancement of flowering in mango. Hoger (1997) opined that foliar application of KH_2PO_4 increase the duration of flush dormancy prior to the onset of florally inductive cool day night temperature in litchi. Many investigations reported the use of potassium salts (K_2HPO_4 or KNO_3) as a chemical agent for induction of plant resistance and induction of flowering. This [K^+] cation plays a major role in enzyme activation, protein synthesis, stomata function, stabilization of internal pH, photosynthesis, turgor-related processes and transport of metabolites (Abd El-Rahman and Hoda, 2016). Plant growth regulator and related chemicals had significant effect on length and breadth of panicle, number of fruit set and fruit drop. Maximum length and breadth of panicle and fruit set per panicle were obtained from K_2HPO_4 @ 1%+KNO_3 @ 1% while the least was obtained from untreated control. This result also confirms the earlier work by Srihari and Rao (1986) who reported increased flowering on axillary shoots and increased yield of fruit by foliar application of Orthophosphoric acid. Garad et al., (2013) and Prasad et al., (2018) also reported increased number of flower percentage, maximum fruits per panicle and maximum cost benefit ratio in mango by spraying KH_2PO_4 (1%)+KNO_3 (1%) in litchi.

3.2. Effect of different sources of chemicals and plant growth regulators on physical characteristics of litchi fruit

Perusal of data from Table 3 clearly indicated that different sources of chemicals and plant growth regulators significantly improved the physical characteristics of litchi fruit. Maximum fruit weight (21.78 g), fruit length (3.84 cm), fruit breadth (3.35 cm) and aril weight (15.88 g) were recorded from T_6 (K_2HPO_4 1%+KNO_3 1%). The fruit weight (20.10 g) was closely followed by T_7 (KH_2PO_4 1%+KNO_3 1%) while the data on fruit length (3.53 cm), fruit breadth (3.16 cm) and aril weight (14.57 g) were followed by T_8 (Etherel @ 400 ppm) application and the minimum value in all was recorded from T_9 (control) plants. Significantly differences among peel weight was observed due to different treatment with maximum (2.93 g) was noted from T_9 (control) while minimum peel weight (2.00 g) was found in T_6 (K_2HPO_4 1%+KNO_3 1%). The peel thickness showed non-significant influence with minimum value (0.99 mm) from T_7 and T_5 (KH_2PO_4 2%) while the maximum in T_9 (control) plants. Significant variation in seed weight of fruit was found with minimum value (2.84 g) in T_7 treatment and maximum weight of seeds (3.70 g) was obtained from T_9 (control) plants. Application of different sources of chemicals and plant growth regulators significantly increased the yield of fruits per plant as compared to control plant. T_6 (K_2HPO_4 1%+KNO_3 1%) treated plants recorded maximum yield (72.34 kg plant^{-1}) followed by (67.44 kg plant^{-1}) in T_7 (KH_2PO_4 1%+KNO_3 1%) while minimum (40.26 kg plant^{-1}) yield was obtained from control plants.

Plant growth regulator and related chemicals had significant improvement in fruit weight, fruit length, fruit breadth, aril weight and yield of tree due to application of different chemicals and plant growth regulator. Among the treatments K_2HPO_4 @ 1%+KNO_3 @ 1% showed maximum fruit weight, fruit length, fruit breadth, aril weight and yield of the tree followed by KH_2PO_4 @ 1%+KNO_3 @ 1%. These results are in conformity with the finding of Pathak and Mitra (2010) who observed an improvement

Table 3: Effect of different sources of chemicals and plant growth regulators on physical characteristics of litchi fruit

Treatment	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Aril weight (g)	Peel weight (g)	Peel thickness (mm)	Seed wt (g)	Yield (kg plant^{-1})
T_1 (KNO_3 1%)	20.03	3.17	2.60	14.08	2.40	0.95	3.25	52.31
T_2 (K_2HPO_4 1%)	18.65	3.33	2.59	13.42	2.46	0.88	3.23	50.76
T_3 (KH_2PO_4 1%)	17.93	3.31	3.09	13.14	2.46	0.97	3.64	45.67
T_4 (K_2HPO_4 2%)	19.30	3.36	3.01	14.42	2.17	0.94	3.17	59.78
T_5 (KH_2PO_4 2%)	18.28	3.31	3.02	13.65	2.36	0.99	3.05	53.49
T_6 (K_2HPO_4 1%+KNO_3 1%)	21.78	3.84	3.35	15.88	2.00	0.87	3.07	72.34
T_7 (KH_2PO_4 1 %+KNO_3 1%)	20.12	3.84	3.15	14.55	2.25	0.99	2.84	67.44
T_8 (Etherel 400 ppm)	19.91	3.53	3.16	14.57	2.13	1.02	3.23	62.50
T_9 (Control)	17.14	2.87	2.15	12.46	2.93	1.08	3.70	40.26
SEm±	0.49	0.12	0.10	0.53	0.06	0.07	0.18	5.37
DMRT p=0.05	S	S	S	S	S	NS	S	S

in fruit weight with higher leaf K content in litchi cultivar. The results also find support by Das and Dutta (2022) in litchi. Superior efficacy of chemicals on fruit yield might be due to better nutritional distribution in the tree. In the present study, increased number of fruits per tree could also be due to increased hormonal activity by pruning and increased set and retention by phosphorus and potassium spray. Present findings confirm the earlier work done by Prasad et al., (2018) in litchi cv. Mandraji who found that spraying litchi 3 times with PGR and different forms of potassium, namely KNO_3 (1%), K_2HPO_4 (1%) and KH_2PO_4 (1%) during October, November and December was very effective in inducing early flowering and increase yield plant^{-1}. Similar results were also reported by Kumar et al. (2017) who indicated that, foliar spray of different forms of potassium and ethrel improved flowering and final fruit yield in litchi trees. Increased weight of fruits was obtained by spray of K_2HPO_4 @ 1%+KNO_3 @ 1% followed by KH_2PO_4 @ 1%+KNO_3 @ 1%. Similar findings were also reported by Ashok and Reddy (2008). Different chemicals and plant growth regulator might increase the size of litchi fruits due to cell elongation and an increase in cell number or cell volume (Leopold, 1958, Singh and Singh, 1995).

3.3. Effect of different sources of chemicals and plant growth regulators on biochemical composition of litchi fruit

Bio-chemical composition of litchi fruit were also influenced by application of different sources of chemicals and plant growth regulators as evident in Table 4. The different treatments significantly increased the total soluble solid control of fruit with the maximum (16.80 °Brix) was measured in T_6 (K_2HPO_4 1%+KNO_3 1%) while minimum (14.22 °Brix) was noted in control plants. Total sugar and non-reducing sugar were also significantly influenced by the application of different sources of chemicals and plant growth regulators. Maximum total sugar (13.63%) and non-reducing sugar (3.66%) were obtained from T_6 treatment while minimum sugar content of fruit was found in T_9 control plants. The reducing sugar data showed that lowest value (9.32%) was recorded from T_6 treatment while the maximum (10.74%) value was obtained from control plants. Application of different sources of chemicals and plant growth regulators significantly decreased the acid content of fruit with minimum (0.29%) acidity obtained from T_6 while control plants recorded maximum (0.41%) acidity. Fruit treated with K_2HPO_4 1%+KNO_3 1% (T_6) showed maximum Vit-C (42.55 mg 100 g^{-1} pulp) and anthocyanin (46.14 mg 100 g^{-1} pulp) content of fruit followed by T_7. Control plant fruit recorded minimum (30.88 mg 100 g^{-1} pulp) Vit-C and (34.89 mg 100 g^{-1} pulp) anthocyanin content of fruit.

Application of different chemicals and plant growth regulator showed significant effect on bio-chemical compositions of litchi fruits. Among the treatments K_2HPO_4 @ 1%+KNO_3 @ 1% showed maximum TSS, total sugar, ascorbic acid and anthocyanin content with minimum titratable acidity while minimum was recorded from control fruits. These results are in accordance with the earlier findings of Ashok and Reddy (2008). The increase in TSS content might be due to the quick transformation of starch into soluble solids and rapid mobilization of photosynthetic metabolites from other parts of the plants to developing fruits (Singha, 2004). The increase in content of ascorbic acid by the application of different chemicals and growth regulator is probably due to the catalytic influence

Table 4: Effect of different sources of chemicals and plant growth regulators on biochemical composition of litchi fruit

Treatment	TSS (°Brix)	Total sugar (%)	Reducing sugar (%)	Non-reducing Sugar (%)	Acidity (%)	Vit-C (mg 100 g^{-1})	Anthocyanin content (mg 100 g^{-1})
T_1 (KNO_3 1%)	16.67	13.09	10.07	3.02	0.33	37.34	41.89
T_2 (K_2HPO_4 1%)	16.05	12.29	09.93	2.47	0.32	32.72	40.27
T_3 (KH_2PO_4 1%)	15.87	12.27	10.22	2.60	0.35	32.44	38.32
T_4 (K_2HPO_4 2%)	15.87	13.41	10.51	2.24	0.32	36.30	42.81
T_5 (KH_2PO_4 2%)	16.03	12.61	10.44	2.46	0.35	39.70	38.43
T_6 (K_2HPO_4 1%+KNO_3 1%)	16.80	13.63	09.32	3.66	0.29	42.55	46.14
T_7 (KH_2PO_4 1 %+KNO_3 1%)	16.43	13.29	09.85	2.92	0.32	35.33	43.73
T_8 (Etherel 400 ppm)	16.12	13.01	10.32	2.54	0.31	40.68	42.37
T_9 (Control)	14.22	11.50	10.74	1.65	0.41	30.88	34.89
SEm±	0.35	0.35	0.35	0.34	0.02	1.58	1.82
DMRT p=0.05	S	S	S	S	S	S	S

of growth regulator on the bio-synthesis of ascorbic acid. It is possible that growth substance might have inhibited the activities of oxidative enzymes as mentioned by Singha, (2004). Different treatments of chemicals and growth regulator decreased the acid content of fruits. It appears that acid under influence of growth regulator and chemicals might have either been quickly converted into sugars or their derivatives by the reaction involving reversal of glycolytic pathway or consumed in respiration or both. The present findings also corroborate the earlier findings of Biswas et al. (1988) in guava and Singh et al. (2005) in mango who obtained beneficial effect of growth regulator on fruit quality and yield characters. Mandal et al. (2014) reported that pre-harvest sprays of potassium and growth regulator are one of the most important practices of the new strategies applied in the integrated fruit production systems, improving yield and fruit quality in litchi. Similar results were also obtained by Das and Dutta (2022) in litchi cv. Bombai.

4. CONCLUSION

Among different chemicals and PGR under study, K_2HPO_4 @ 1%+KNO_3 @ 1% recorded maximum flowering shoots, number of hermaphrodite flowers, sex ratio, length and breadth of panicle, fruit weight, fruit length, fruit breadth, aril weight and ultimately yield of the plants along with maximum TSS, total sugar, ascorbic acid and anthocyanin contain of fruit. Finally, it can be concluded that application of K_2HPO_4 @ 1%+KNO_3 @ 1% proved most effective in increasing the flowering shoots, hermaphrodite flowers and physico-chemical characters of fruit.

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