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Karanjeev Kumar
Department of Horticulture
Fruit & Fruit Technology, Bihar Agriculture College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Kumari Madhumala
Department of Horticulture
Fruit & Fruit Technology, Bihar Agriculture College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Sanjay Sahay
Department of Horticulture
Fruit & Fruit Technology, Bihar Agriculture College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Corresponding Author:
Karanjeev Kumar
Department of Horticulture
Fruit & Fruit Technology, Bihar Agriculture College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Response of different sources of potassium on fruit quality and fruit colour enhancement in litchi

Karanjeev Kumar, Kumari Madhumala and Sanjay Sahay

Abstract
The present investigation was carried out to study the "Response of different sources of Potassium on fruit quality and fruit colour enhancement in litchi" during the year 2019. Ten years old uniformly grown "Deshi" litchi plants established at Bihar Agricultural University Sabour Fruit Research Station, were Sprayed with K_2SO_4 and KCl @ 0%, 1% and 2% at two different stages i.e. Marble and Stone hardening. The plants treated with potassium as foliar feeding significantly improved fruit skin colour, marketable fruit yield and quality attributes over the control. Maximum fruit yield was 88.13 Kg was recorded in trees treated with K_2SO_4 @1% over the control. Fruit weight, length and fruit pulp were also improved with different doses of potassium as foliar feeding. Fruit quality characteristics *viz*. Juice percent, TSS, TSS/acid ratio, total sugars, reducing sugar, ascorbic acid were also enhanced with marble and stone hardening stage with sprays of different concentrations of potassium fertilizers over untreated trees. Anthocyanin content higher with K_2SO_4 application at stone hardening stage. So, it is concluded that K_2SO_4 @1% and 2% at stone hardening stage significantly improved fruit weight, length, pulp weight, juice percent, total sugar, reducing sugar and anthocyanin litchi cv. Deshi.

Keywords: Litchi, colour, marble, stone, potassium, anthocyanin

Introduction
Litchi (*Litchi chinensis* Sonn.) recognized as "Queen of the fruits". It is an important sub-tropical evergreen fruit crop belongs to the family Sapindaceae. It is native of south China and was introduced in India by the end of 17th century to explore the possibilities of litchi cultivation in India due to available of conducive temperature and climatic requirements. Litchi crop is widely distributed in the tropics and warm subtropics of the world. It is a highly perishable nature and is used in the form of fresh fruit and value added products i.e. RTS, squash, dry nut etc. It grows best in the regions possessing cool frost free winters and warm summers with high rainfall and humid climatic conditions (Menzel 1983) [7]. Its fruits are rich in sugar contents and it varies from 6.74-18.0%, acid content 0.20 to 0.64% in the form of malic acid and also possesses citric acid, levulinic acid, phosphoric acid, glutamic. It also contains 40-90 mg vitamin-C/100 g edible portion, 0.9% protein, 0.3% fat, 0.42% pectin and 0.7% minerals (Ca, P, Fe). Its skin also contains free radical scavenging compounds like ascorbic acid, carotenoids, polysaccharides (Yang *et al.* 2006) and phenolic substances flavonoids (flavonols and anthocyanins) and phenolic acids. Besides, litchi seeds are responsible for decreasing blood sugars and lipids and promote the function of the liver. In India litchi fruit production 497 MT and productivity 7.02 MT/ha is obtained from an area of 78 thousand ha (Anonymous 2017). Major growing state are Bihar, West Bengal, Assam and Jharkhand and to a small extent to a Tripura, Punjab, Uttarakhand and Odisha. It is cultivated on 32 thousand ha area with annual production of 300 MT and productivity 9.37 thousand MT/ha in Bihar state (Anonymous 2017) and approximately 90 percent of the total area under litchi cultivation is mainly Champaran, Siwan, Darbhanga, Purniya, Bhagalpur, Saharsa, Araria, Munger, Mdhubani, Madhepura and Begusarai. Generally fruit plants require sixteen mineral elements for various physiological processes whereas N and K are required in sufficient amount for the production of quality fruits. Zhang *et al.* (2004) [13] observed that nutrition plays a significant role in improvement of litchi flowering, fruiting and productivity. It has been also observed that leaves and fruit absorbed most of the nutrients within 24-72 hours after spray and thereafter depletion of leaf nutrients content was noted due to translocation of N, P and K to the active developing organs in plant system (Singh *et al.* 2007) [12]. In horticultural crops potassium improves fruit yield, fruit size, soluble solids concentrations, ascorbic acid, colour, shelf life (Geraldson 1985, Lester *et al.* 2007) as it concerns with the process of phosphorylation, transportation of photo assimilates from source

tissues via the phloem to sink tissues, enzyme activation, turgor pressure, transpiration, photosynthesis and stress tolerance (Usherwood 1985, Pettigrew 2008).

Material and Methods

The present investigations conducted at Fruit Research Station, Bihar Agriculture University, Sabour situated in Bhagalpur district of Bihar receives average annual rainfall of 1111 mm and nearly 75 percent of the total rainfall is received in July to September whereas 15 percent during January and February. The material and methods employed during the investigation are described here under. The present studies were carried out on 10 years old fully mature uniform healthy plants of litchi cultivar "Deshi" planted at 10.0 m x 10.0 m. The uniform cultural practices were given to all the plants as per recommendation of Package and Practices for Fruit Crops of Bihar Agricultural University Sabour. The experiment was layout by Factorial Randomized Block Design (FRBD) and plants were (in addition to soil application of recommended doses of fertilizers) sprayed with different concentrations 0%,1%, and 2% (D_0, D_1, and D_2 respectively) of K_2SO_4(48%) and KCl (60%) (K_1, K_2 respectively) at two different sub treatments stages i.e. Marble stage (S_1) and Stone hardening stage (S_2). Each treatment was replicated three times. The plants were sprayed with hand operated Knapsack sprayer during early morning hours after dissolving calculated dose of respective treatment. Different sources of potassium were applied as foliar spray three times on twigs. The first and second spraying was done on the 1st and 3rd week of April and third spraying was 1st week of May

Table 1: Show the Treatment symbol

S. No.	Treatment symbol	Treatment detail
1	$S_1K_1D_0$	Potassium sulphate @ 0% at Marble stage
2	$S_1K_1D_1$	Potassium sulphate @ 1% at Marble stage
3	$S_1K_1D_2$	Potassium sulphate @ 2% at Marble stage
4	$S_1K_2D_0$	Potassium chloride @ 0% at Marble stage
5	$S_1K_2D_1$	Potassium chloride @ 1% at Marble stage
6	$S_1K_2D_2$	Potassium chloride @ 2% at Marble stage
7	$S_2K_1D_0$	Potassium sulphate @ 0% at Stone stage
8	$S_2K_1D_1$	Potassium sulphate @ 1% at Stone stage
9	$S_2K_1D_2$	Potassium sulphate @ 2% at Stone stage
10	$S_2K_2D_0$	Potassium chloride @ 0% at Stone stage
11	$S_2K_2D_1$	Potassium chloride @ 1% at Stone stage
12	$S_2K_2D_2$	Potassium chloride @ 2% at Stone stage

Fruit weight: The weight of five fruit were was measured by electronic balance and expressed in gram (g).

Stone weight: The weight of stone was measured by electronic balance and expressed in gram (g).

Pulp weight

The weight of aril (pulp) was measured by electronic balance and expressed in gram (g).

Fruit length

Fruit length was determined by measuring individual fruit by digital Vernier caliper and average of 5 fruit was worked out and expressed in (cm).

Fruit colour

Colour of the whole litchi pericarp was observed by a Descriptors for litchi released by The International Plant Genetic Resources Institute (IPGRI).

Pulp stone ratio

Pulp stone ratio was calculated by dividing the value of total pulp with that of the corresponding total stone.

Juice (%)

Juice percent was calculated by dividing the value of juice weight with that of the fruit weight and expressed in (%).

Results and Discussion

Table 2: Main effect of foliar application of different sources of potassium, doses and stages with respect to fruit wt, fruit length, stone wt, pulp wt, juice%, yield in litchi cv. Deshi

Treatments	Fruit weight(g)	Fruit length(cm)	Stone weight(g)	Pulp weight(g)	Pulp/Stone	Juice (%)	Yield (kg/plant)
Source of Potassium(Main Effect)							
Potassium sulphate(K_1)	15.34	3.66	3.33	8.77	2.62	35.81	83.50
Potassium chloride(K_2)	14.59	3.24	3.07	7.95	2.66	34.72	80.50
SE m ±	0.25	0.05	0.05	0.15	0.07	0.49	1.11
CD(P=0.05)	0.73	0.16	0.16	0.45	NS	NS	NS
Dose of potassium(Main Effect)							
@ 0%	12.95	3.15	2.63	6.51	2.49	32.26	76.40
@ 1%	15.63	3.58	3.51	9.02	2.59	37.70	83.72
@ 2%	16.31	3.64	3.46	9.55	2.84	35.83	85.89
SE m ±	0.31	0.07	0.07	0.19	0.09	0.61	1.36
CD(P=0.05)	0.89	0.20	0.20	0.55	0.26	1.78	3.99
Stage of application(Main Effect)							
Marble stage (S_1)	14.27	3.42	2.99	8.00	2.70	34.75	80.40
Stone hardening stage (S_2)	15.66	3.49	3.41	8.73	2.59	35.78	83.61
SE m ±	0.25	0.05	0.05	0.15	0.07	0.49	1.11
CD (P=0.05)	0.73	NS	0.16	0.45	NS	NS	NS

Table 3: Interaction effect of foliar application of different sources of Potassium, doses and stages with respect to fruit wt, fruit length, stone wt, pulp WT, juice %, yield in litchi cv. Deshi

Interaction effect		Fruit weight(g)	Fruit length(cm)	Stone weight(g)	Pulp weight(g)	Pulp/Stone	Juice (%)	Yield (kg/plant)
Interaction Effect (K x D)								
Potassium sulphate (K_1)	@0%	12.26	3.13	2.67	6.21	2.34	31.72	74.39
	@1%	16.97	3.94	3.69	10.24	2.77	41.25	88.13
	@2%	16.8	3.93	3.65	9.87	2.75	34.46	87.99
Potassium chloride(K_2)	@0%	13.64	3.17	2.59	6.81	2.64	32.80	78.41
	@1%	14.3	3.23	3.33	7.80	2.41	34.15	79.31
	@2%	15.82	3.34	3.28	9.24	2.94	37.21	83.79
SE m ±		0.43	0.09	0.09	0.26	0.13	0.86	1.93
CD(P=0.05)		1.27	0.28	NS	0.77	0.37	2.51	5.65
Interaction Effect (K X S)								
Potassium sulphate(K_1)	Marble (S_1)	14.56	3.64	3.30	8.06	2.43	33.86	81.11
	Stone (S2)	16.12	3.69	3.36	9.49	2.81	37.75	85.89
Potassium chloride(K_2)	Marble (S_1)	13.98	3.20	2.68	7.93	2.96	35.63	79.68
	Stone (S_2)	15.19	3.29	3.45	7.97	2.37	33.81	81.33
SE m ±		0.35	0.08	0.08	0.22	0.10	0.70	1.57
CD(P=0.05)		NS	NS	0.23	0.63	0.30	2.05	NS
Interaction Effect (S X D)								
Marble stage (S_1)	@0%	12.49	3.13	2.64	6.22	2.37	32.22	75.43
	@1%	13.68	3.22	2.94	7.84	2.68	35.78	79.36
	@2%	16.65	3.91	3.41	9.93	3.04	36.24	86.40
Stone hardening stage (S_2)	@0%	13.41	3.16	2.62	6.80	2.61	32.30	77.37
	@1%	17.59	3.94	4.08	10.21	2.50	39.61	88.08
	@2%	15.97	3.37	3.52	9.18	2.65	35.43	85.38
SE m ±		0.43	0.09	0.09	0.26	0.13	0.86	1.93
CD(P=0.05)		1.27	0.28	0.28	0.77	NS	2.51	NS

The highest fruit weight was observed when fruit sprayed with KCl @1% at stone hardening stage (17.59g) over the control (12.95 g). Similarly highest fruit length was observed with K_2SO_4@1% (3.94cm) and KCl @1% at stone hardening stage (3.94cm) over the control (3.13cm). Pulp weight was also significantly influenced by the foliar application of K nutrient and the highest value was observed with K_2SO_4 @ 1% (10.24g). Pulp/ stone ratio was obtained maximum with KCl on marble stage (2.96) over the control (2.34). Juice % was also significantly affected by the foliar application of potassium and maximum was noted with K_2SO_4 @1% (41.25). Fruit yield was also improved and the highest yield was observed with K_2SO_4 @1% (88.13kg) over control (74.39 kg). The fruit skin colour intensity was also observed visually that showed attractive litchi fruit with the application of potassium sulphate @ 2% at stone hardening stage. The application of different source of potassium indicated that the potassium sulphate is better than that of potassium chloride. Further, potassium applied at stone hardening stage was more effective as compared to marble stage. Potassium sulphate @ 2% increase fruit weight. The two way interaction effect depicted that application of potassium @ 1% applied at stone hardening stage has been found more effective in increasing the fruit weight of litchi. The fruit length was maximum with K_2SO_4 @1% and KCl @1% at stone hardening stage and minimum with K_2SO_4 at marble stage. The improvement in fruit weight with potassium spray might be due to increased photosynthesis which results in supply of more carbohydrates to the fruits. Potassium is an important nutrient for fruit weight and improvement in fruit quality and it is required for the production and transport of plant sugars which in turn intend to increase the fruit weight (Menzel 1983) [7]. These results are in conformity with the finding of Pathak and Mitra (2010) [10] who observed an improvement in fruit weight with higher leaf K content in litchi cultivar**.** The results also find support by Gill *et al.* (2012) [3] in Patharnakh pear suggested that fruit weight was improved by foliar sprays of K nutrient. Similarly two pre-harvest foliar sprays of Poly feed (19:19:19) on litchi plants at the interval of 15 and 45 days after fruit set effectively increased fruit weight (Singh *et al.* 2007) [12]. Increase in fruit length with the application of K is due to increase in entry of water into the cells by osmotic processes which subsequently increase cell size. Bhargava *et al.* (1993) [1] reported that K nutrient is known to effect fruit length. Dutta and Banik (2007) [2] also conclude that fruit size was increased with potassium application in "Sardar" guava. Mukadam and Haldankar (2013) [9] observed that foliar application of KNO_3 (3%) at 20 days after fruit set improved fruit length and diameter in Karonda. Khayyat *et al.* (2012) [5] conclude that pomegranate tree sprayed with KNO_3 (250 mg) had shown the markable effect on fruit length as compared to the control. The pulp weight under the influence of various treatment (main effect) was recorded maximum with the application of potassium sulphate @ 2% at stone hardening stage. However, Interactive effect of potassium sulphate applied @ 1% registered maximum pulp weight. The increased in pulp (Aril) weight might be as a result of the role of potassium in increasing cell wall construction. These results are in accordance with earlier findings of Pathak and Mitra (2010) [10] who observed that maximum fruit pulp percent recovery was noted with medium rates of potassium (600 g K_2O) applied in two splits at 15 days after fruit set and 30 days before flowering. Two pre-harvest foliar sprays of Polyfeed (19:19:19) on litchi plants at the interval of 15 and 45 days after fruit set improved aril weight (Singh *et al.* 2007) [12]. Similarly increase in fruit aril weight was noted with the application of K on "Red Delicious" apples (Rashid *et al.* 2008) [11]. Similar result were also observed in case of pulp/stone ratio. Kumar and Kumar (2004) [6] observed that Multi K (13:0:46) significantly improved aril weight in litchi cv. "Rose" Scented under Pantnagar conditions of Uttaranchal. Similarly, "Bombai" litchi cultivar under West

Bengal conditions Mitra *et al.* (2002) [8] also opined that single spray of 4% KCl at 15 days after anthesis improved fruit aril percentage. Josan *et al.* (1995) also recorded highest juice with foliar spray of K_2SO_4 @8% at 15th and 30th days followed by K_2SO_4 @6%.

Fruit colour

Colour of the whole litchi pericarp was recorded at maturity as per litchi descriptors of The International Plant Genetic Resources Institute (IPGRI)

Table 4: Fruit colour score by IPGRI

Fruit colour	Score by IPGRI
Green	1
Greenish red	3
Pinkish red	4
Rosy red	10
Deep pink	12

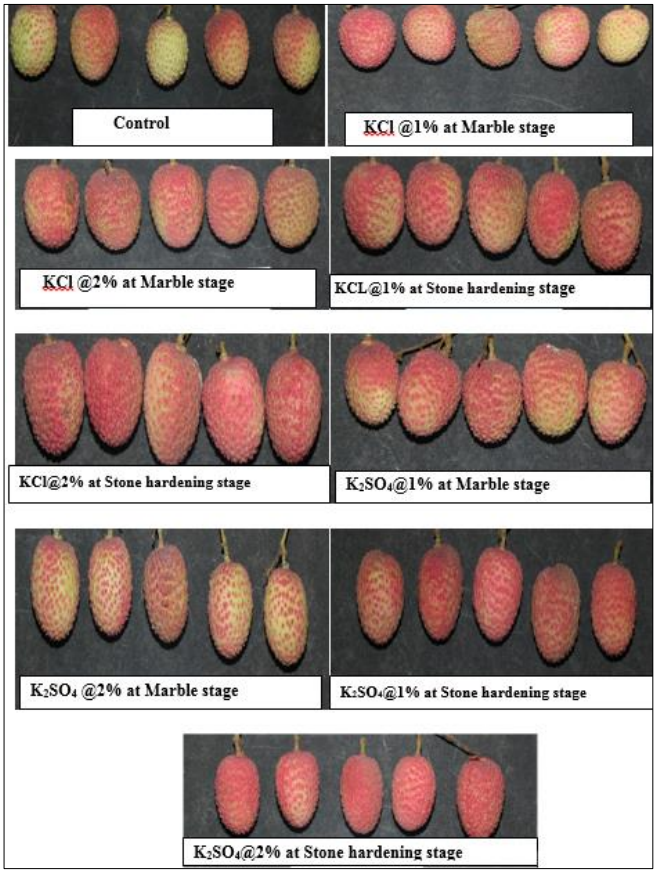

Fig 1: Effect of Litchi

References

1. Bhargava BS, Singh HP, Chadha KL. Role of potassium in development of fruit quality. In: K L Chadha and O P Pareek (Ed) Advances in Horticulture. 1993; 2:947-60.
2. Dutta and Banik AK. Effect of Foliar feeding of nutrients and plant growth regulators on physico-chemical quality of Sardar Guava grown in red and lateritic tract of West Bengal. Acta Hort. 2007; 735:407-12.
3. Gill PPS, Ganaie MY, Dhillon WS, Singh NP. Effect of foliar sprays of potassium on fruit size and quality of "Patharnakh" pear. Indian J Hort. 2012; 69:512-16.
4. Josan G, Srivastava PC, Singh PK, Singh SK, Lal RL. Effect of leaf age on nutrient composition of litchi (*Litchi chinensis* Sonn.) foliage. Prog Hort. 2010; 42:119-20.
5. Khayyat M, Tafazoli E, Eshghi S, Rajaee S. Effect of nitrogen, boron, potassium and zinc sprays on yield and fruit quality of date palm. American-Eurasian J Agric Environ Sci. 2012; 2:289-96.
6. Kumar A, Kumar G. Effect of foliar applications of water soluble fertilizer "Multi- K" on yield and quality of Litchi cv. Rose Scented. Adv Pl Sci. 2004; 17:519-23.
7. Menzel CM. The control of floral initiation in lychee: a review. Scient Hort. 1983; 21:201-15.
8. Mitra SK, Sarkar A, Mandal D, Pathak PK. Delaying the ripening of "Bombai" litchi. Acta Hort. 2002; 975:299-302.
9. Mukadam SJ, Haldankar PM. Effect of paclobutrazol and post flowering foliar sprays of nutrients for accelerating harvesting of Karonda (*Carissa carandas* Linn.). J PlStudies. 2013; 2:145.
10. Pathak PK, Mitra SK. Rate and time of potassium fertilization influence yield and quality of litchi. Acta Hort. 2010; 863:235-42.
11. Rashid A, Kirmani NA, Nazir N, Shafi S. Quality of apple cv. Red Delicious as influenced by potassium. Asian J Soil Sci. 2008; 3:227-29.
12. Singh VP, Kumar G, Singh AK. Effect of water soluble fertilizer 'Polyfeed‟ on physicochemical attributes of litchi fruits cv. Rose Scented. Prog Agric. 2007; 7:22-24.
13. Zhang JH, Yan-an T, Guo WZ, Lu JM, Xiao PL, Guang LZ. Effect of potash application on the output and quality of Dangshan Suli pear variety in loess area. J Fruit Sci. 2004; 19(1):8-11.