Effect of Potassium on Quality and Storage life of Fruit Crops

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WHAT IS QUALITY ?

-the degree of excellence or superiority, is a combination of attributes, properties, or characteristics that give each commodity value in terms of its intended use

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QUALITY COMPONENTS

A) APPEARANCE (VISUL) QUALITY FACTORS

- Size
- Shape
- Colour
- Gloss
- Defects and Decay

B) TEXTURAL (FEEL) QUALITY FACTORS

- Firmness
- Crispiness
- Juiciness
- Mealiness
- Toughness

C) FLAVOUR (EATING) QUALITY FACTORS

- Sweetness
- Sourness (Acidity)
- Astringency
- Bitterness
- Aroma
- Off-flavours

D)NUTRITIONAL QUALITY FACTORS

- *Vitamins (C,A,B, Thiamine, Niacin)*
- *Minerals*
- *Dietary Fibre*
- *Fat*
- *Oil*
- *Carotenoids*
- *Flavonoids*
- *Sterols*
- *Antioxidants*

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Potassium is referred as the quality element for crop production.

Involvement of potassium in physiological processes relevant to crop quality

- activates more than 60 enzyme systems
- aids in photosynthesis
- favours high energy status
- maintains cell turgour
- regulates opening of leaf stomata
- promotes water uptake
- regulates nutrients translocation in plant
- favours carbohydrate transport
- enhances N uptake and protein synthesis
- promotes starch synthesis

Multiple functions of K in many metabolic processes lead to numerous positive effect.

- Increase root growth
- Improve drought resistance
- Reduces water loss and wilting
- Enhances winter hardiness
- Improves resistance to pests and diseases
- Builds cellulose and reduces stalk lodging
- Increases nodulation of legumes.

The specific effect of K on quality are:

Improves
- fruit colour and flavour
- size and shape

Increases
- protein content of plants
- starch content in tubers
- soluble solids, vitamin C
- peel thickness

Reduces
- acidity
- physiological disorder
- incidence of pests & diseases

Enhances
- storage and shipping quality.

Fruit crops are heavy feeders of potash and removal of K is higher than N.

Nutrient removal by fruit crops

Crop	Yield (t/ha)	Uptake (kg/ha)		
		N	P_2O_5	K_2O
Banana	40	250	60	1000
Citrus	30	270	60	350
Grapes	20	170	60	220
Mango	15	100	25	110
Papaya	50	90	25	130
Pineapple	50	185	55	350
Passion fruit	15	60	15	75

Direct relationship between K supply and

A) Fruit size :

- **Citrus** (Reese and Koo, 1975)
- **Grape** (Gopalaswamy and Rao, 1972)
- **Banana** (Mustaffa, 1988)
- **Litchi** (Mitra, 2006)
- **Mango** (Thakur *et al.*, 1983)
- **Guava** (Mitra *et al.*, 1985)

B) Colour :

- **Citrus** (Embleton, 1976)
- **Grape** (Bhargava *et al.*, 1993)
- **Apple** (Sansavini, 2004)
- **Litchi** (Menzel, 1983)
- **Banana** (Turner, 1999)

C) Soluble solids:

Citrus (Chundwat *et al.*, 1996)
Banana (Chattopadhyay and Bose, 1986, Kumar and Kumar 2007))
Grape (Bhargava *et al.*, 1993)
Guava (Mitra, 1987, Kundu *et.al.*;2007)
Mango (Singh *et al.*, 1984,)
Papaya (Jauhari & Singh, 1987)
Pineapple (Mitra and Roy, 1985)

D) Acidity :

Citrus (Ghosh, 1986)
Grape (Bhargava *et al.*, 1993)
Papaya (Mitra, 2007)
Guava (Mitra, 1987)
Mango (Banik *et al.*, 1993)
Pineapple (Mitra and Roy, 1985)
Banana (Chattopadhyay and Bose, 1986)

E) Soluble solids:

Citrus (Singh & Tripathi, 1978)
Guava (Mitra, 1987, Kundu *et.al.*;2007)
Aonla (Pathak *et al.*, 2002)
Banana (Mustafa, 1988, Kumar and Kumar,2007)
Pineapple (Martin-Prevel, 1961, Quaggio *et.al.*;2009)
Papaya (Awada and Long, 1987)

F) Storage life :

Mango (Shinde *et al.,* 2006)
Citrus (Alva *et al.*, 2006)
Pineapple (Vis, 1989, Quaggio *et.al.*;2009)
Grape (Vis, 1989, Bhargava, 2006)
Banana (Turner *et al.*, 1999)

Sulphate of potash foliar spray effects on yield, quality and post-harvest life of Neypoovan banana*

Treatment	Bunch wt. (kg)	TSS (%)	Acidity (%)	Sugar: acid ratio	Shelf-life (days)
Control (water spray)	10.80	24.4	0.40	50.9	6.5
0.5% SOP	11.53	27.9	0.30	71.0	7.8
1.0% SOP	12.63	28.9	0.23	84.3	7.8
1,5% SOP	14.27	28.9	0.23	976	8.7
CD (P=0.05)	1.02	2.06	0.024	6.72	0.98

* Kumar and Kumar (2007)
Sprayed twice, initially after the opening of last hand (7th month after planting) and 30 days later

Effect of KCl spray on 'Sardar' guava

Treatment	Fruit weight (g)	TSS (%)	Acidity (%)	Ascorbic acid (mg $100g^{-1}$ pulp)
Control (water spray)	133.0	11.28	0.296	237.4
1.0% KCl	136.7	11.52	0.326	239.9
2.0% KCl	141.8	11.66	0.338	242.4
CD (P=0.05)	5.61	0.144	0.009	1.543

* Kundu *et al.* (2007)
Two spray – May 10th and September 10th .

Post-harvest behaviour of pineapple affected by sources of potassium*

Source of K	TSS ^{0}Brix	Acidity (%)	Firmness (Neuton)
AT HARVEST			
KCl	15.5	0.55	11.7
K_2So_4	15.1	0.50	12.7
K_2So_4+ KCl	15.4	0.53	13.9
28 days of STORAGE			
KCl	14.7	0.67	8.5
K_2So_4	15.4	0.54	9.6
K_2So_4+ KCl	15.5	0.59	8.0

* Quaggio *et al*. (2009)

- Total soluble solids of the smooth Cayenne pineapple fruit pulp varied significantly as a function K rates.
- Total titratable acidity increased in response to K application, especially with KCl.
- The use of K as sulphate resulted better fruit sugar acid ratio, especially at higher K rates.
- Post-harvest characteristics of fruits were more affected by K rates than by K sources.

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Increased leaf-K content increased yield and improved fruit quality in litchi*

K-rates	Leaf K content (%)	Photosynth-esis µmol Co2/sq/m/sec.	Water use efficiency mmol/mol	Yield kg/tree	TSS/ acid ratio
K-400 tree^{-1} year^{-1}	0.95	8.78	20.43	77.3	38.7
K-600 tree^{-1} year^{-1}	0.89	5.86	17.47	79.6	48.2
K-800 tree^{-1} year^{-1}	1.00	12.19	26.45	78.9	62.1
SEm±	0.014	0.798	1.41	3.72	2.93

Pathak *et al.* (2007)

Research results from BCKV:

	K levels (g/plant/year)	
Mango (Fazli) 35 years	500 → 1000g	Fruit weight (g) : 595 → 748 Total sugar (%) : 12.0 → 12.5 (Mallick *et al.*, 1985)
Banana (Gaint Governor)	120 → 240g	Fruit weight (g) : 117 → 139 Total sugar (%) : 14.6 → 16.7 (Chattopadhyay and Bose, 1985)
Pineapple (Kew) 64,000/ha	200 → 600kg	Fruit weight (kg) : 1.4 → 1.9 Total sugar (%) : 12.8 → 15.2 (Roy *et al.*, 1987)

Litchi (Bombai) 22 years	200 → 600g	Fruit weight (g) : 18.1 → 20.6 Total sugar (%) : 13.9 → 15.8 (Ghosh and Mitra, 1990)
Guava (Sardar) 4 years	130 → 260g	Fruit weight (g) : 152 → 176 Total sugar (%) : 7.93 → 8.72 (Mitra & Bose, 1985)
Papaya (Ranchi) 2500/ha	200 → 600kg	Fruit weight (kg) : 1.42 → 1.64 Total sugar (%) : 5.07 → 6.80 (Mallick *et al.*, 1985)
Mandarin orange 22 years	200 → 600g	Fruit weight (g) : 84 → 107 Total sugar (%) : 8.3 → 9.8 (Mitra & Ghosh, 1991)

Summary

1. **Potassium is important in optimizing both crop yield and economic quality.**
2. **Tree fruit crops, in general requires more potassium than nitrogen**
3. **The role of potassium in fruit quality has been well documented in many fruits vegetables and ornamentals.**
4. **A balance nutrition programme allows K to contribute its best towards higher yield, quality and profitability.**

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