International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(4): 1608-1610

Received: 12-05-2017
Accepted: 14-06-2017

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Response of fertilizer application on quality and shelf life of papaya var. red lady

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Abstract
The present experiment entitled "Response of fertilizer application on quality and shelf life of papaya var. Red Lady" was conducted during the year 2016-17 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat). The experiment was laid out with nine treatments in a Randomized Block Design (RBD) and replicated thrice. The treatments included 100 % RDF (200:200:250 g NPK/plant) as control in four equal splits (2^{nd}, 4^{th}, 6^{th}, and 8^{th} MAP), 100 and 80 % recommended dose of nitrogen and potash in 8 equal splits starting from 2^{nd} month after planting in 30 days interval with or without foliar application of 1 % Grade-IV micronutrient and novel organic liquid fertilizer at 2^{nd}, 4^{th}, 6^{th} and 8^{th} month after planting. Results of present investigation revealed that papaya var. Red Lady plants fed with 80 % RDNK (160:200 g/plant) and applied in 8 equal splits starting from 2^{nd} month after planting in 30 days interval with foliar application of novel organic liquid fertilizer at 2^{nd}, 4^{th}, 6^{th} and 8^{th} month after planting gave minimum total acidity (%) and physiological loss in weight (%) and maximum TSS (^{0}Brix), total sugar (%) reducing sugar (%), shelf life (days), yield (t/ha), net realization and benefit cost ratio.

Keywords: Red Lady, Grade-IV micronutrient, novel organic liquid fertilizer, foliar spray and split application

Introduction
Papaya (*Carica papaya* L.) is an important fruit of tropical and subtropical regions of the world, it belonging to family Caricaceae and also known as papita, pawpaw and true melon. Papaya is a heavy feeder and needs heavy doses of manures and fertilizers. Apart from the basal dose of manures applied in the pits, 200 g each of N and P_2O_5 and 250 g K_2O are recommended for getting high yield. Application of 200 g N is optimum for fruit yield but papain yield increases with increase in N up to 300 g. Micronutrients can tremendously boost crop yield and improve quality and post-harvest life of produce. They play an important role in disease resistance, since they function as enzyme activators and also play a role in lignin biosynthesis. The decline in availability of organic manures due to greater use of inorganic fertilizer has made micronutrient supply precarious. Hence replacing micronutrients that have been removed or increasing organic matter to make native nutrients available, has not received sufficient attention. Foliar application of micronutrients has gained importance in recent years, because the nutrients are sprayed directly to leaves, and can be made available to the plants at proper time when needed. Successful commercial cultivation of improved high yielding varieties of papaya crop depends on critical nutrient management due to its continuous growth, flowering and fruiting habit. Papaya requires high amounts of nutrients for growth and fruit production, and it was estimated that papaya removes about 989 mg B, 300 mg Cu, 3364 mg Fe, 1847 mg Mn, 8 mg Mo and 1385 mg Zn per tonne of fruit. While, separating fibers from the banana pseudo stem, the liquid available is known as banana pseudostem sap which contains amount of essential macro and micro plant nutrients. Hence, there is a vast scope to utilize banana pseudostem sap as a liquid fertilizer. Apart from direct use of sap as liquid fertilizer, an enrichment process was developed (patented) for preparing Novel Organic Liquid Fertilizer (NOLF) suitable for foliar and soil application. It was tested in mango, banana, wheat and paddy crops. The OLF has been prepared using only organic inputs and hence suitable for use in organic farming system as liquid formulation. Organic liquid fertilizer is good source of plant nutrient along with growth promoting substances like cytokine, GA, etc. (Anon, 2014) [14].

Material and Methods

The present experiment entitled "Response of fertilizer application on quality and shelf life of papaya var. Red Lady" was conducted during the year 2016-17 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat). The experiment was laid out with nine treatments in a Randomized Block Design (RBD) and replicated thrice. The treatments included 100 % RDF (200:200:250 g NPK/plant) as control in four equal splits (2^{nd}, 4^{th}, 6^{th}, and 8^{th} MAP), 100 and 80 % recommended dose of nitrogen and potash in 8 equal splits starting from 2^{nd} month after planting in 30 days interval with or without foliar application of 1 % Grade-IV micronutrient and novel organic liquid fertilizer at 2^{nd}, 4^{th}, 6^{th} and 8^{th} month after planting. Quality parameters, shelf life and yield were recorded and analyzed statistically.

Results and Discussion

Effect on Physical Parameters

The presented in table 1 clearly revealed that physical parameters like physiological loss in weight (%), fruit firmness (kg/cm^2) and shelf life (days) were statistically differ due to different treatments.

Firmness of fruits is an important characteristic that is used to determine stability and it is predominantly determined by structure and composition of cell wall. Calcium is essential for structural integrity of both the cell wall and plasma membrane.

Shelf life extension was more in the treatments receiving 80% RDNK through 8 equal split application + foliar application of 1 % novel organic liquid fertilizer indicating their effectiveness in the controlling the weight loss, which might be due to presence of higher calcium content, reduced rate of respiration and transpiration from fruit surfaces. The decreased in the respiration could be further attributed to lowering of succinate and malate dehydrogenase activities associated with TCA cycle. Presence of epicuticular wax on the fruit skin also reduces respiration and transpiration during postharvest period by partially blocking the lenticels, cuticle and consequently retards the moisture loss caused by transpiration. Higher availability of secondary nutrients, metabolites like GA and reduced gaseous exchange effects delay in ripening, senescence, less tissue break down and softening of tissue which increases firmness and extends storage life. These results are in conformity with the findings reported by Singh *et al.* (2010) in papaya.

Shelf life of the fruits was affected significantly with different levels of novel organic liquid fertilizer. This might be due to the fact that, shelf life is not control by nutritional factors. It depends on various factors such as stage of maturity, ethylene content and chemical composition of the fruits, temperature, humidity *etc*.

Table 1: Response of fertilizer application on quality and economics of papaya var. Red Lady

Treatments	PLW (%)	Fruit firmness (kg/cm^2)	Shelf life (days)	TSS (^{o}Brix)	Reducing sugar (%)	Total acidity (%)	Ascorbic acid (mg/100g of pulp)	Total sugar (%)	Yield (t/ha)	Gross realization	Net return	BCR
T_1	17.83	5.49	5.39	8.69	6.95	0.027	20.31	8.19	71.57	715700	572167	3.99
T_2	16.55	6.66	7.17	10.16	8.28	0.024	23.44	9.24	78.86	788600	634302	4.11
T_3	15.52	6.61	6.56	9.31	7.93	0.022	23.32	9.62	87.62	876200	722408	4.70
T_4	13.35	7.42	6.88	11.35	8.02	0.023	23.86	10.00	80.90	809000	657274	4.33
T_5	13.42	6.03	7.14	11.69	8.23	0.021	23.72	10.29	97.33	973300	806269	4.83
T_6	12.47	7.80	7.61	12.03	9.28	0.018	23.90	10.87	106.57	1065700	898935	5.39
T_7	14.15	6.41	6.56	10.43	8.93	0.023	23.18	9.92	91.49	914900	756059	4.76
T_8	13.12	7.15	7.39	9.71	8.48	0.021	23.07	9.42	77.94	779400	620214	3.90
T_9	15.41	7.27	7.13	10.88	8.09	0.023	23.22	8.99	88.38	883800	724280	4.54
S.Em±	0.93	0.41	0.40	0.62	0.41	0.0013	0.76	0.48	5.03	---	---	---
CD at 5%	2.78	1.23	1.20	1.86	1.22	0.0040	NS	1.45	15.07	---	---	---
CV%	10.95	10.51	10.05	10.26	8.52	10.28	5.71	8.69	10.04	---	---	---

Effect on Quality parameters

The Quality parameters like TSS (%), reducing sugar (%), total acidity (%), ascorbic acid (mg/100 g pulp) and total sugar (%) presented in table 1 clearly revealed significant difference due to application of different treatments.

The current study represents that fruit quality in terms of TSS, reducing sugars, total acidity, ascorbic acid and total sugars increased significantly in the treatment of split application of N and K. The highest level of potassium increased the TSS content of fruit while highest level of nitrogen decreased it. The maximum TSS was recorded in application of medium level of nitrogen (80 %). Total sugar as well as reducing sugar content of fruit also increased with increasing level of potassium while higher level of nitrogen reduced the sugar content. Higher doses of potassium reduced fruit acidity while, higher levels of nitrogen increased it. Similar results were obtained by Purohit (1977) [9]. Reddy *et al.* (1986) [10]. And Ghanta *et al.* (1995) [6]. Bisht *et.al* (2010) [4]. in papaya

The current study represents that fruit quality in terms of TSS, reducing sugars, total acidity, ascorbic acid and total sugars increased significantly in 1 % novel organic liquid fertilizer treatment. The increased in the sugars, TSS and higher acidity might be due to respirational demand and adequate supply of nutrients, synthesis of invertase and starch splitting enzymes (Ram and Prasad, 1988). Similar results were obtained in relation to fruit quality by Anon. (2014) [14]. In banana and Anon. (2013) [13]

In papaya. Fruit quality characters *viz*., fruit firmness, TSS, total sugars, reducing sugars, non-reducing sugars, acidity and shelf life were altered significantly due to the application of micronutrients over control. The maximum percentage of TSS, total sugars and reducing sugars were recorded with foliar application of 1 % micronutrient Grade- IV application. It might be due to the Fe is associated with the development of flavor-proteins and the adequate amount of zinc which improved the auxin content and it also acts as a catalyst in

oxidation-reduction processes in plants. Besides, zinc helped in other enzymatic reactions like transformation of carbohydrates, activity of hexokinase and formation of cellulose and change in sugar are considered due to its action on zymohexose (Dutta and Dhua, 2002) [5]. The higher TSS was due to the increased total sugar content owing to the efficient translocation of available photosynthates to fruit pulp rather than to other parts. As an alternative proposal, it is suggested that borate ion may be associated with the cell membrane where it could be complex with sugar molecules and facilitates its passage across the membrane that might be the reason of increased total soluble solid (Meena *et al.*, 2006) [7]. Ascorbic acid content of fruit was found minimum in all the treatments because rapid destruction of ascorbic acid during ripening of papaya fruit due to presence of active enzymes, the conversion of starch to dextrose, levulose and sucrose. Similar results were obtained by Shekhar *et al.* (2009) [11]. Modi *et al.* (2012) [8]. and Bhalerao *et al.* (2014) [3]. in papaya. The yield of papaya cv. Red Lady was significantly influenced by micronutrients. The maximum yield was obtained from plant treated with 1 %, Grade – IV micronutrient at 2nd, 4th, 6th and 8thmonth after planting compared to control. This might be due to iron (Fe) is highly associated with chlorophyll synthesis which later on boosted up to the photosynthesis. Promotion of starch formation followed by rapid transportation of carbohydrates in plants is activated by micronutrients like Zn and B which are well established. These results are in confirmation with those of Shekhar *et al.* (2010) [11]. Modi *et al.* (2012) [12]. and Bhalerao *et al.* (2014) [3].in papaya.

Economics

Among the different treatments, maximum net return and higher benefit cost ratio were obtained in papaya var. Red Lady plants when they were fed with80% RDNK through 8 equal split application + foliar application of 1 % novel organic liquid fertilizer treatment. In present investigation same treatment gave maximum fruit retention, yield and yield attributing characters which leads to higher net returns and benefit cost ratio.

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