



Effect of Foliar Application of Ca, Zn, Fe and B on Physiological Attributes, Nutrient Status, Yield and Economics of Papaya (*Carica papaya* L.) cv. Taiwan Red Lady

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The experiment on foliar application of Ca, Zn, Fe and B on physiological attributes, nutrient status, yield and economics of papaya (*Carica papaya* L.) cv. Taiwan Red Lady revealed that the foliar application of calcium nitrate 1000 mg/l + borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l during 60, 90 and 120 days after planting were found better with respect to increase in photosynthetic rate, transpiration rate, leaf temperature and total chlorophyll contents with pronounced results regarding nutrient contents of papaya cv. Taiwan Red Lady. Looking to the yield and economics, there was higher yield (80.76 t/ha), net return (₹ 282727) and BCR (3.50) in the same treatment.

Key words: Economics, *Carica papaya*, foliar, nutrient status, physiological attributes, yield.

Papaya (*Carica papaya* Linn.) is an important fruit crop of tropical world and has long been known as wonder fruit of the tropics. It gives higher production of fruits per hectare and an income next to banana (Singh, 1990). In Gujarat, it is cultivated on an estimated area of 15.3 thousand hectares with 832.9 thousand M.T. of production and average productivity of 54.3 M.T. per hectare. Micronutrients are key elements in plant growth and development. The Ca, Zn, Fe and B are essentially required and play very important role in various enzymatic activities and synthesis. These micronutrients also help in uptake of major nutrients and play an active role in the plant metabolic processes (Das, 2003). Presently, farmers of Gujarat state are much interested in cultivation of Taiwan Red Lady variety of papaya due to the gynodioecious in nature and also ease and convenient in its raising. Though production technology of papaya is known and farmers are harvesting higher fruit yield. But, the main problem lies in its nutrients deficiency which needs to be standardized through systematic experimentation that will generate useful information on recovery of deficiency symptoms on papaya plant as well as fruits. Therefore, this study was carried out in order to know the effect of foliar application of Ca, Zn, Fe and B on physiological attributes, nutrient status, yield and economic of papaya cv. Taiwan Red Lady.

Materials and Methods

The present experiment was carried out at the Regional Horticultural Research Station, Navsari Agricultural University, Navsari during the year 2008-2009 and 2009-2010. The seeds of papaya (cv.

Taiwan Red Lady) were sown in small sized plastic polythene bags and the seedlings were raised with all possible care. Forty five days old seedlings of uniform size and vigour were planted during last week of August at evening in the pits of 30 x 30 x 30 cm dimensions at a distance of 2 m in both directions. Soil application of fertilizers (200g N, 200g P and 250g K per plant) were done in four equal splits at two months interval starting from transplanting of seedlings. The experiment was laid out in Randomized Block Design (RBD) with eleven treatments replicated thrice. The treatments were T₁- calcium nitrate 500 mg/l, T₂- calcium nitrate 1000 mg/l, T₃- borax 15 mg/l, T₄- borax 30 mg/l, T₅- zinc sulphate 100 mg/l, T₆- zinc sulphate 200 mg/l, T₇- ferrous sulphate 100 mg/l, T₈- ferrous sulphate 200 mg/l, T₉- calcium nitrate 500 mg/l + borax 15 mg/l + zinc sulphate 100 mg/l + ferrous sulphate 100 mg/l, T₁₀- calcium nitrate 1000 mg/l + borax 30 mg/l + zinc sulphate 200 mg/l + ferrous sulphate 200 mg/l and T₁₁- control (water spray). The time of application or spray was done at 60, 90 and 120 days after planting. The observations on physiological attributes viz., photosynthetic rate, transpiration rate and leaf temperature were recorded by using Lc-Pro photo-system as well as total chlorophyll contents was measured by DMSO method. The nutrient contents (Ca, Zn, Fe and B) at five days before first spray and fifteen days after third spray and yield were recorded. The data of individual year and pooled over two years were analyzed separately by adopting analysis of variance method as suggested by Panse and Shukhatme (1967). Only pooled data are presented in this paper.

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Results and Discussion

Physiological attributes

The data on physiological attributes are presented in Table 1. Physiological parameters viz., photosynthetic rate, transpiration rate and total chlorophyll contents were significantly affected by

foliar spray of micronutrients. The papaya plants sprayed with calcium nitrate 1000mg/l + borax 30mg/l + zinc sulphate 200mg/l + ferrous sulphate 200mg/l (T₁₀) significantly increased the physiological parameters and resulted into higher production of photosynthates, translocation of water, nutrient and photosynthates resulting into rapid cell division.

Table 1. Effect of Ca, Zn, Fe and B spray on physiological attributes of papaya cv. Taiwan Red Lady (Pooled data)

Treatment	Photosynthetic rate($\mu\text{mol m}^{-2}\text{s}^{-1}$)			Transpiration rate ($\text{m mole m}^{-2}\text{s}^{-1}$)			Total chlorophyll contents(mg/100g tissue)			Leaf temperature ($^{\circ}\text{C}$)		
	90 DAP	120 DAP	150 DAP	90 DAP	120 DAP	150 DAP	90 DAP	120 DAP	150 DAP	90 DAP	120 DAP	150 DAP
T ₁	48.54	52.63	55.56	6.69	7.76	9.22	127.36	126.18	124.47	34.20	34.63	36.38
T ₂	49.29	53.14	56.05	6.92	7.91	9.42	127.54	126.39	124.88	34.37	34.53	36.61
T ₃	48.02	51.78	55.15	6.67	7.74	9.08	125.70	124.40	122.89	34.07	34.17	36.11
T ₄	52.15	55.54	58.82	7.26	8.28	10.02	134.13	133.23	131.60	34.71	35.90	38.23
T ₅	50.12	54.15	56.57	7.06	7.99	9.59	129.80	128.89	126.86	34.43	35.58	37.74
T ₆	51.67	55.53	57.73	7.22	8.15	9.85	132.46	131.47	129.57	34.68	35.95	37.95
T ₇	51.32	54.99	57.05	7.12	8.05	9.74	131.75	130.67	128.85	34.45	35.77	37.67
T ₈	56.31	59.08	62.87	7.40	8.71	10.51	140.45	139.70	138.12	35.10	36.38	38.99
T ₉ -T ₁ + T ₃ + T ₅ +T ₇	55.63	58.06	61.72	7.33	8.56	10.25	138.01	137.05	135.70	34.95	36.15	38.75
T ₁₀ -T ₂ + T ₄ + T ₆ +T ₈	58.15	61.55	65.59	7.71	8.86	10.79	144.58	143.16	141.83	35.12	37.24	39.85
T ₁₁	47.61	51.71	54.57	6.25	7.29	8.80	119.63	116.86	114.99	33.35	33.77	35.79
S. Em.±	1.20	1.25	1.45	0.13	0.18	0.23	2.88	2.76	2.97	0.94	1.04	1.10
C. D. at 5 %	3.40	3.56	4.12	0.38	0.51	0.65	8.20	7.85	8.43	NS	NS	NS
C. V. %	6.19	6.32	6.79	5.08	6.06	6.36	5.98	5.78	5.28	7.46	8.03	8.00

Activity of macro and micronutrients also helped in various processes. This might be due to enzymatic activity, synthesis of chlorophyll, transfer of energy etc. governed by iron in plants. Similarly, boron found to be responsible for translocation of sugars. Likewise, zinc is essential for functions like saccharite metabolism, photosynthesis and protein synthesis in plants. On the other hand, leaf

temperature was not affected by any single or combined treatments in papaya. The leaf temperature of papaya varies greatly depending upon the environmental conditions. This result is also affirmed by Ghumare (2009) in sapota. In general, treated plants registered more photosynthetic rate and transpiration. In the present investigation increased rate of photosynthesis is

Table 2. Effect of Ca, Zn, Fe and B spray on nutrient status of papaya leaves cv. Taiwan Red Lady (Pooled data)

Treatment	Ca (ppm)		Zn (ppm)		Fe (ppm)		B (ppm)	
	5 days before first spray	15 days after third spray	5 days before first spray	15 days after third spray	5 days before first spray	15 days after third spray	5 days before first spray	15 days after third spray
T ₁	2.58	3.44	28.80	32.05	222.55	252.55	20.61	34.06
T ₂	2.41	3.68	30.27	32.37	221.26	252.55	20.87	34.82
T ₃	2.35	3.20	30.10	32.82	222.55	255.69	20.09	36.84
T ₄	2.47	3.22	30.86	32.88	223.27	258.02	20.38	38.55
T ₅	2.76	3.27	30.29	35.66	221.44	264.37	22.42	36.22
T ₆	2.51	3.36	30.62	36.50	225.53	265.40	22.51	36.49
T ₇	2.37	3.23	29.94	32.98	223.43	268.71	20.69	34.69
T ₈	2.66	3.30	29.84	33.90	224.33	280.32	23.09	35.27
T ₉ -T ₁ + T ₃ + T ₅ +T ₇	2.68	3.48	31.30	36.05	222.44	274.99	23.30	35.70
T ₁₀ -T ₂ + T ₄ + T ₆ +T ₈	2.69	3.52	31.00	35.91	223.34	275.02	21.93	37.26
T ₁₁	2.64	3.12	30.89	31.95	221.90	251.75	21.05	32.92
S. Em.±	0.07	0.10	0.76	0.86	6.50	8.01	0.66	0.95
C. D. at 5 %	0.20	0.29	NS	2.46	NS	NS	1.87	2.70

associated with increased transpiration rate with maximum leaf temperature. The similar result was reported by Jeyakumar *et al.* (2001) in papaya.

Nutrient status of papaya leaf

The healthy as well as matured leaves of papaya were used for analysis of nutrient status in present study (Chapman, 1964). The leaf analysis was done at two times i.e. five days before first spray and fifteen

days after third spray. The foliar application of calcium nitrate, zinc sulphate, ferrous sulphate and borax on papaya were found to have pronounced result with respect to their nutrient status during experiment. The calcium, zinc and boron contents of leaves were increased when plants treated with treatment T₁₀, T₆ and T₄ after application of third spray, respectively (Table 2). In case of boron content, results found to be non-significant. The micro

nutrients which are required in less quantity but essential for various physiological activities, such as photosynthesis, activation of enzymes, oxidation-reduction process and increase in active salt absorption and translocation of metabolites including nutrients. This might have resulted into higher level of nutrient status after application of treatments in the leaves of papaya cv. Taiwan Red Lady of present study over control (water) treatment. Calcium, zinc, iron, and boron contents in leaf were increased appreciably due to the higher dose of calcium nitrate, borax, ferrous sulphate and zinc

sulphate application. It may be attributed to the fact that the Ca and micronutrients might have enhanced the physiological processes of the leaves which in turn have led to rapid absorption and utilization of nutrients for primary metabolic processes. The results are in line with the findings of Jeyakumar *et al.* (2001) in papaya.

Yield and economic of treatments

From the Table 3, it is observed that the economical yield (80755 kg/ha) with highest net return (282727) and benefit cost ratio (3.50) in papaya

Table 3. Effect of Ca, Zn, Fe and B spray on yield and economics of papaya cv. Taiwan Red Lady (Pooled data)

Treatments	Yield (Kg/ha)	Cost of treatments (₹/ha)	Other expenditure (₹/ha)	Total expenditure (₹/ha)	Total return (₹/ha)	Net return (₹/ha)	BCR
T1	51825	121	79520	79641	233221	153570	1.92
T2	55375	243	79520	79763	249187	169423	2.12
T3	63425	16	79520	79536	285412	205876	2.58
T4	72275	32	79520	79552	325237	245685	3.08
T5	66475	297	79520	79817	299137	219319	2.74
T6	76425	595	79520	80115	343912	263796	3.29
T7	56100	184	79520	79704	252450	172754	2.16
T8	60975	368	79520	79888	274387	194499	2.43
T9 -T1 + T3 + T5 +T7	69125	620	79520	80140	311062	230922	2.88
T10 -T2 + T4 + T6+T8	80755	1240	79520	80760	363487	282727	3.50
T11	49075		79520	79520	220837	141317	1.77

cv. Taiwan Red Lady were recorded with the treatment T₁₀ (foliar spraying of calcium nitrate 1000mg/l + borax 30mg/l + zinc sulphate 200mg/l + ferrous sulphate 200mg/l at 60, 90 and 120 days after planting (DAP)).

Conclusion

The spraying of micronutrients on papaya cv. Taiwan Red Lady during 60, 90 and 120 DAP was found to be good. Spraying of calcium nitrate 1000mg/l + borax 30mg/l + zinc sulphate 200mg/l + ferrous sulphate 200mg/l at 60, 90 and 120 DAP for higher yield and economics of papaya.

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