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Evaluation of seedlings and intervarietal grafts on biochemical properties and biotic stress tolerance enzymes activities of papaya (*carica papaya* L.)

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Abstract
An investigation was carried out during 2015- 2016 at Department of Fruit crops, HC & RI, Coimbatore to find out the biochemical properties and biotic stress inhibiting enzymes activities of papaya seedlings and intervarietal grafts. The experiment was laid out in RBD with four replications. Total chlorophyll content was maximum in TNAU Papaya Co.8 seedling (1.92 ± 0.008 mg g^{-1}) and minimum in Co.7 seedling (1.52 ± 0.010 mg g^{-1} respectively). Higher soluble protein content was found in *Carica papaya* (Co.7) grafted on *Carica papaya* (TNAU Papaya Co.8) (14.67 mg g^{-1}). The total phenolic content was found to be higher in T_1 (2.10 mg g^{-1}) and found to be lower in T_4 (1.44 mg g^{-1}). Among the treatments, the peroxidase activity was found to be higher in T_4 (0.40 ± 0.006 $min^{-1}g^{-1}$) and found to be lower in T_2 (0.34 ± 0.002 $min^{-1}g^{-1}$). The PAL activity was recorded higher (0.44 µ min g^{-1}) in TNAU Papaya Co.8 (T_1) while T_2 and T_4 recorded lower PAL activity (0.41 µ min g^{-1}).

Keywords: papaya, chlorophyll, phenols, PAL

Introduction
Papaya (*Carica papaya* L.) belongs to the family Caricaceae is one of the few rapidly growing and heavily yielding fruit tree cultivated throughout the tropical world and in the warmest part of sub- tropics. Papaya is believed to have originated in the lowlands of eastern Central America, from Mexico to Panama (Nakasone and Paul, 1998). India is the largest producer of papaya producing 5.69 million Metric Tonnes from an area of 0.13 million hectares with the productivity of 42.3 MT/ha (NHB, 2016). Earlier papaya cultivation was very easy, but nowadays the plants were affected by number of pests and diseases which causes huge yield loss. Efforts have been made to manage the pest infestation and disease incidence but sometimes it is not an economical option. The present study focuses on the biochemical properties and biotic stress tolerance enzymes activities in the papaya seedlings and intervarietal grafts.

Materials and methods
The experiment was carried out during the period of August, 2015 to May, 2016 at the orchard located at an altitude of 426.6 m above mean sea level with latitude of 11°N and longitude of 77°E. Fully matured and ripened fruits of TNAU Papaya Co.8 and Co.7 (*Carica papaya*) were harvested and the seeds were extracted manually. Then the sarcotesta (the outer seed coat) was removed and the fresh seeds were used for raising the seedlings and rootstocks. The papaya varieties TNAU Papaya Co.8 and Co.7 were raised in an insect proof net house in order to get the scions free of PRSV inoculum. The scions were taken only from the female plants of dioecious variety and andromonoecious plant of gynodioecious variety. Leaf chlorophyll was estimated as per the procedure suggested by Yoshida *et al* (1971) [3]. Total phenol was estimated by the method suggested by Malik and Singh (1980) [4]. Soluble protein content in leaves at the time of flowering was estimated as per the method suggested by Lowry *et al.* (1951) [3] and expressed as mg g^{-1}. Peroxidase content of the leaf sample was estimated by the method of Sumner and Gjessing (1943) [2]. Assay of PAL activity was estimated as per the procedure described by Dickerson *et al*. (1984) [1]. Enzyme activity was expressed in fresh weight basis as µg min g^{-1} trans-cinnamic acid of sample. Statistically, the mean of the observation for each parameter was calculated by dividing the sum of the observations by the

number of observations. Standard deviation was calculated by taking the square root of the mean of the squared deviations from the arithmetic mean. Standard error was calculated by dividing standard deviation (σ) with the square root of sample size (n). Coefficient of variation was calculated by dividing the standard deviation (SD) to the mean and it is expressed in percentage.

Results and discussion

Based on mean comparison, 'Chlorophyll a' content was registered maximum in TNAU Papaya Co.8 grafted on TNAU Papaya Co.8 (T_3) (1.34 ± 0.007 mg g^{-1}) followed by T_1 (Seedlings of TNAU Papaya Co.8) (1.31 ± 0.010 mg g^{-1}) and it was minimum in T_2 (Seedlings of Co.7) (0.93 ± 0.012 mg g^{-1}) followed by T_4 (Co.7 grafted on TNAU Papaya Co.8) (1.04 ± 0.005 mg g^{-1}). The variability for this trait was 17.44 per cent. 'Chlorophyll b' content was the highest in T_1 (1.00 ± 0.011 mg g^{-1}) followed by T_3 (0.98 ± 0.013 mg g^{-1}) and minimum was in T_2 (0.79 ± 0.006 mg g^{-1}). A coefficient of variation for this parameter was 11.13 per cent. Total chlorophyll content was maximum in T_1 (1.92 ± 0.008 mg g^{-1}) and minimum in T_2 (1.52 ± 0.010 mg g^{-1}). The variability was found to be 12.21 per cent (Table 1). The data obtained on leaf chlorophyll content at the time of flowering showed significant effect due to genetic variations in seedlings and different combination of rootstocks and scions. The variability of leaf soluble protein content at the time of flowering among the seedlings and intervarietal grafts was found to be 14.55 per cent. Higher soluble protein content was found in T_4 (14.67 mg g^{-1}) while T_3 and T_1 were on par with T_4 by registering soluble protein content of 14.65 and 14.63 mg g^{-1} and minimum was in T_2 (10.67 mg g^{-1}). The total phenolic content was found to be higher in T_1 (2.10 mg g^{-1}) and lower in T_4 (1.44 mg g^{-1}) while T_3 were on par with T_4 by registering total phenol content of 1.46 mg g^{-1}(Table 2). In papaya, the phenolic compounds, perhaps, acts as a stress inhibiting enzyme and responsible for reducing the PRSV incidence in field.

The coefficient of variation and population mean for peroxidase activity was 6.69 per cent and 0.38 respectively. Among the treatments, the peroxidase activity was found to be higher in T_4 (0.40 ± 0.006 $min^{-1}g^{-1}$) and found to be lower in T_2 (0.34 ± 0.002 $min^{-1}g^{-1}$). Among the various enzymes, peroxidase is considered as one of the important defence related enzymes due to its role in catalyzing the condensation of phenolic compounds into lignin. The PAL activity was recorded higher (0.44 µ min g^{-1}) in TNAU Papaya Co.8 seedlings (T_1) while T_2 (Co.7 seedlings) and T_4 (Co.7 grafted on TNAU Papaya Co.8) recorded lower PAL activity (0.41 µ min g^{-1}). The variability of this activity was 2.91 per cent with the population mean of 0.42 respectively.

Table 1: Chlorophyll content in seedlings and intervarietal papaya grafts

Treatment	Chlorophyll a (mg g^{-1})		Chlorophyll b (mg g^{-1})		Total chlorophyll (mg g^{-1})	
	Mean	SE	Mean	SE	Mean	SE
T_1	1.31	0.010	1.00	0.011	1.92	0.008
T_2	0.93	0.012	0.79	0.006	1.52	0.010
T_3	1.34	0.007	0.98	0.013	1.89	0.022
T_4	1.04	0.005	0.80	0.010	1.56	0.007
PM	1.15		0.89		1.72	
SD	0.20		0.10		0.21	
CV %	17.44		11.13		12.21	

Table 2: Soluble protein content and biotic stress inhibiting enzymes activity of seedlings and intervarietal papaya grafts at the time of flowering

Treatment	Soluble protein (mg g^{-1})		Total phenol (mg g^{-1})		Peroxidase ($min^{-1}g^{-1}$)		Phenylalanine ammonia lyase (µ min g^{-1})	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
T_1	14.63	0.097	2.10	0.020	0.38	0.007	0.44	0.005
T_2	10.67	0.034	1.82	0.005	0.34	0.002	0.41	0.006
T_3	14.65	0.198	1.46	0.015	0.39	0.002	0.42	0.004
T_4	14.67	0.096	1.44	0.010	0.40	0.006	0.41	0.005
PM	13.66		1.70		0.38		0.42	
SD	1.99		0.31		0.03		0.01	
CV %	14.55		18.37		6.69		2.91	

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