International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 1396-1399
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Received: 21-09-2018
Accepted: 24-10-2018

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Effect of chemical drenching in improving growth and vigour of papaya seedlings raised in cocopeat medium

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Abstract
A study to assess the effect of chemical drenching to improve the growth and vigour of papaya seedlings raised in cocopeat medium was conducted at College Orchard, Horticultural College and Research Institute, TNAU, Coimbatore during January to May, 2018. The experiment included nine treatments *viz*., control (T_1-without drenching), Di ammonium Phosphate (DAP) @ 0.5% (T_2), Di ammonium Phosphate (DAP) @ 1.0% (T_3), Potassium dihydrogen orthophosphate (KH_2PO_4) @ 0.5% (T_4), Potassium dihydrogen orthophosphate (KH_2PO_4) @1.0% (T_5), 19-19-19 @ 0.5% (T_6), 19-19-19 @ 1.0% (T_7), Humic acid @ 0.5% (T_8), Humic acid @ 1.0% (T_9) at seven days interval on 30 DAS, 37 DAS and 44 DAS. The morpho-physiological and the biochemical traits of the papaya seedlings were recorded at 37 DAS, 44 DAS and 51 DAS. The experiment revealed that drenching of papaya seedlings with humic acid @ 1% was found to significantly influence the growth and vigour of seedlings raised in cocopeat medium. Among the different parameters observed, seedling height, leaf area, shoot length, fresh weight and dry weight of shoot and root, leaf nutrient contents (N, P, K), leaf chlorophyll content and leaf soluble protein content were found to be significantly influenced by the treatments imposed.

Keywords: papaya, seedling, cocopeat, growth, vigour

Introduction

Papaya (*Carica papaya*), belonging to the family Caricaceae, is a fast growing and high yielding fruit crop grown in tropical regions of the world. It is native to Tropical America and was introduced to India in the 16th century. In India, it is cultivated primarily for its delicious fruits which are the rich source of carbohydrate, minerals, vitamin A and ascorbic acid. The fruits are also used for processing and products *viz*., jam, jelly, tuty-fruity, marmalade, nectar, wine, syrup, dehydrated flakes and baby foods are prepared from mature papaya fruits. The latex obtained from the immature fruit consists of proteolytic enzyme called papain and is used in various industries *viz*., pharmaceuticals, brewery, meat, dairy, textile, photographic, optical, tanning, cosmetic, detergent, food and leather industries. Papaya is a short duration fruit crop, owing to its high productivity and high returns, it is becoming very popular among fruit growers in India (Chattopadhyay, 2003) [7]. The tremendous yielding potential along with precocious bearing and indeterminate growth habit with simultaneous vegetative growth, flowering and fruiting has attracted many fruit growers.

Propagation of papaya is done commercially only through seeds. The seeds are usually sown in polybags filled with potting mixture (red soil: sand: FYM = 2:1:1). Use of suitable growing media as substrate is essential for production of quality seedlings as media directly affects the development and later maintenance of the extensive functional root system of the seedlings. A good growing medium would provide sufficient anchorage or support to the seedlings, serves as reservoir for nutrients and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate (Abad *et al*. 2002) [1]. The quality of seedlings obtained from a nursery influences reestablishment in the field and the eventual productivity of an orchard (Baiyeri, 2006) [4]. The usual potting mixture containing red soil, river sand and FYM in the ratio 2:1:1 provides the seeds and later the seedlings with adequate nutrients and the seedlings produced are strong and erect. However, the transportation of the seedlings raised in potting mixture was also found to be difficult because of the heaviness of the potting mixture.

Hence, as an alternative, medium lighter in weight and capable of producing healthy seedlings *viz*., cocopeat has been tried in this study. Cocopeat is considered as a good growth media component, with acceptable pH, electrical conductivity and other chemical attributes (Abad *et al*, 2002) [1]. Cocopeat has good physical properties, high total pore space, high water holding capacity, low shrinkage, low bulk density and is slow to biodegrade. Results of many experiments revealed that cocopeat (used alone or as a component of soil medium), is suitable for roses, gerbera, many potted plants and also for vegetables (Bhardwaj, 2013) [5]. In the present study, root trainers (35.5 cm x 22 cm x 9.5 cm) with 40 cells, were tried as containers for papaya seedling production because root trainers were found to promote tap root growth without coiling and this combination of cocopeat and root trainer facilitates better handling and easy transportation of papaya seedlings.

The significant role of chemical application in nursery in relation to growth and development of papaya seedlings has been observed by earlier workers (Padma, 1988; Desai *et al*., 2017) [17]. Vigorous and healthy seedling production is the most important factor which ultimately decides success or failure of the crop. Since seed is a costly input, proper germination, growth and vigour of the seedlings are the most important considerations in successful seedling production. Hence, the current study was taken up to find out the effect of drenching of chemicals in improving seedling growth and vigour of papaya raised in cocopeat medium using root trainers.

Materials and Methods

The experiment was conducted with the genetically pure seeds of TNAU papaya CO.8 variety, obtained from the Department of Fruit Crops, Horticultural College and Research Institute, Coimbatore. The blocks of cocopeat were soaked in water and washed repeatededly. Then after draining the excess water, bio-control agent's *viz*., *Trichoderma viride* and *Pseudomonas fluorescens* (@ 100 g each) were added and kept for stabilization for a week. The cocopeat media amended with bio-control agents was used for filling the root trainers. Papaya seeds soaked in 200 ppm of GA_3 for 6 hours and shade dried were sown in root trainers at the rate of one seed per cell. About 95 - 98% germination was observed after 10-12 DAS. Seedlings were drenched with chemicals *viz*., Diammonium phosphate (DAP), Potassium dihydrogen orthophosphate (KH_2PO_4), 19-19-19 and humic acid @ 0.50 and 1% at seven days interval on 30 DAS, 37 DAS and 44 DAS.

Treatments Details

T_1 : Control (without drenching)
T_2 : Di ammonium Phosphate (DAP) @ 0.5%
T_3 : Di ammonium Phosphate (DAP) @ 1.0%
T_4 : Potassium dihydrogen orthophosphate (KH_2PO_4) @ 0.5%
T_5 : Potassium dihydrogen orthophosphate (KH_2PO_4) @ 1.0%
T_6 : 19-19-19 @ 0.50%
T_7 : 19-19-19 @ 1.0%
T_8 : Humic acid @ 0.50%
T_9 : Humic acid @ 1.0%

Seedling height, seedling girth, number of leaves and leaf area were observed and recorded at 37, 44 and 51 DAS. Shoot length, root length and fresh weight and dry weight of shoot and root were recorded at 51 DAS. Leaf nutrient contents were determined using digested sample of the leaf (Piper, 1966) [18]. From the digested solution, nitrogen content was estimated following Microkjeldahl method described by Humphries (1956) [13], phosphorus content was estimated colorimetrically by vanadomolybdate phosphoric yellow colour method (Jackson, 1973) [14] and potassium content was estimated using Flame photometer and expressed in per cent. Leaf chlorophyll content and soluble protein content in leaves were estimated as per the method suggested by Yoshida *et al*. (1971) [22] and Lowry *et al.* (1951) [15] respectively.

The data collected from various treatments were analyzed statistically adopting the procedure described by Panse and Sukhatme (1985). Percentage values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 per cent (0.05) probability level.

Results and Discussion

In the present study, significant differences for seedling height, number of leaves and leaf area were observed among the treatments (Table 1). The treatments T_8 and T_9 (drenching with humic acid @ 0.50% and 1.0%, respectively) showed on par results for seedling height (16.77 cm and 15.72 cm respectively) at 37 DAS. But, at later stages *viz*., 44 DAS and 51 DAS, the treatment T_8 (humic acid @ 0.50%) showed an acute increase in the seedling height (23.56 cm and 33.43 cm at 44 DAS and 51 DAS respectively) when compared to rest of the treatments. The seedling girth and total number of leaves were statistically significant among the treatments at 37 DAS only. The treatments with T_8 and T_9 (humic acid @ 0.50% and 1.0%, respectively) were found to be on par for stem girth (0.67 cm and 0.63 cm respectively) at 37 DAS. The total number of leaves was high in T_9 (humic acid @ 1.0%) with 5.67 leaves at 37 DAS. The results of leaf area showed significant difference among the treatments. The treatments T_8 and T_9 (humic acid @ 0.50% and 1.0%, respectively) showed remarkable increase in the leaf area during the entire observation period (37, 44 and 51 DAS). The leaf area due to T_8 and T_9 is 7.80 cm^2 and 8.23 cm^2, respectively at 51 DAS. Humic acid aids in nitrogen uptake, regulation of photosynthesis and carbon metabolism in plants. Therefore, the treatments with humic acid drenching have increased the nitrate uptake in seedlings and increased availability of nitrogen would have promoted the vegetative growth of the seedlings by improved seedling height and increased leaf area when compared to the control.

Significant differences were observed for seedling shoot and root growth parameters at 51 DAS (Table 2). The maximum shoot length (26.17 cm) was registered by the treatment T_8 (Humic acid @ 0.50%) whereas the minimum shoot length (12.33 cm) was observed in the treatment T_7 (19-19-19 @ 1.0%). The highest fresh shoot weight was recorded in the treatment T_9 (1.96 g) which was on par with the treatment T_8 (1.94 g) and the lowest fresh shoot weight was observed in the treatment T_7 (0.85 g). The maximum shoot dry weight (0.36 g) was recorded in the treatment T_8 which was on par with the treatment T_9 (0.35 g) while the lowest shoot dry weight was seen in the control T_1 (0.07 g). The maximum root fresh weight was recorded in the treatment T_9 (0.36 g) and was observed to be on par with the treatment T_8 (0.35 g) whereas the lowest fresh root weight was recorded in the treatment T_1 (0.09 g). The highest dry weight of root (0.08 g) was recorded in the treatment T_8 and T_9 and the lowest root dry weight was observed in the control treatment T_1 (0.04 g). Application of humic acid might have enhanced the nitrate uptake which inturn improved the vegetative growth and showed an increase in shoot length. The influence of humic acid on shoot growth was also noted by Canellas *et al.* (2015) [6].

The effect of chemical drenching on major nutrient content was found to be significantly different among treatments (Table 3). The highest nitrogen content of the seedlings (1.95%) was registered in the treatments T_8 and T_9 whereas the lowest nitrogen content was recorded in the treatment T_6 (19-19-19 @ 0.50%) with 1.41%. The maximum phosphorous content of the seedlings was observed in the treatment T_9 (0.99%) which was on par with the treatment T_8 (0.97%) and the minimum phosphorous content was seen in the treatment T_7 (0.66%) which was on par with the treatment T_6 (0.68%). The potassium content of the seedlings was found to be highest (2.98%) in the treatment T_9 which was on par with the treatment T_8 (2.97%). The lowest potassium content (2.65%) was observed in the treatments T_6 and T_7. Humic substances induce H+-ATPase activity that, in turn, can energize secondary ion transporters and promote nutrient uptake (Nardi *et al*., 2000) [16].

The analysis of leaf chlorophyll and leaf soluble protein content revealed that the treatments were statistically significant among each other (Table 3). The treatment T_9 recorded the highest chlorophyll content and leaf soluble protein content of 3.45 mg g^{-1} and 72.55 mg g^{-1} respectively, whereas the lowest leaf chlorophyll and leaf soluble protein content were recorded in the treatment T_6 (2.08 mg g^{-1} and 45.12 mg g^{-1} respectively). The increased chlorophyll and soluble protein content in humic acid drenching may be due to the induction of carbon and nitrogen metabolism (Hernandez *et al*., 2015) [11].

Summary and Conclusion

In the present study, drenching the papaya seedlings raised in cocopeat medium with humic acid (1%) at 30 DAS, 37 DAS and 44 DAS, was found to improve the growth and vigour of seedlings. Humic acid drenching improved height, leaf area, nutrient content, chlorophyll content and soluble proteins of the papaya seedlings when compared to other treatments. Further study in the cost economics of nursery propagation of papaya using cocopeat media in root trainers with humic acid drenching must be made and should be compared with the conventional method of propagation using potting mixture in polybag. Thereby, it is concluded that humic acid drenching (1%) showed the best results on seedling growth and vigour in papaya.

Table 1: Effect of chemical drenching on seedling growth parameters of papaya

Treatments	Seedling height (cm)			Seedling girth (cm)			Number of leaves			Leaf area (cm^2)		
	37 DAS	44 DAS	51 DAS	37 DAS	44 DAS	51 DAS	37 DAS	44 DAS	51 DAS	37 DAS	44 DAS	51 DAS
T1	12.90	19.30	21.27	0.30		1.30	4.00	5.33	5.67	6.67	6.90	7.40
T2	14.43	20.80	25.80	0.30	1.33	1.57	4.33	6.33	7.00	6.83	6.80	7.23
T3	14.63	19.43	22.33	0.40	1.27	1.47	4.67	7.00	8.00	4.57	5.47	5.67
T4	13.37	18.30	21.30	0.45	1.27	1.43	4.00	7.00	7.33	5.00	6.17	6.37
T5	12.70	19.37	24.80	0.67	1.33	1.67	3.67	7.00	6.67	5.83	6.30	7.60
T6	13.80	19.17	24.40	0.47	1.20	1.50	4.33	6.33	7.00	4.75	5.60	5.87
T7	13.83	19.27	20.43	0.47	1.30	1.37	4.33	6.33	7.00	5.42	5.40	6.33
T8	16.77	23.56	26.52	0.67	1.40	1.47	5.00	6.33	8.00	6.50	7.20	7.80
T9	15.72	19.97	22.10	0.63	1.27	1.67	5.67	6.67	8.00	6.83	7.63	8.23
Mean	14.24	19.91	23.22	0.48	1.29	1.50	4.44	6.48	7.19	5.82	6.34	6.94
S Ed	1.02	1.10	1.71	0.09	-	-	0.68	-	-	0.88	0.68	0.68
CD (p=0.5)	2.09	2.25	3.51	0.18	NS	NS	1.40	NS	NS	1.80	1.39	1.39
CV%	8.74	6.80	8.86	21.56	-	-	18.44	-	-	17.54	11.83	11.83

Table 2: Effect of chemical drenching on shoot and root growth parameters of papaya seedlings

Treatments	Shoot length (cm)	Fresh weight of shoot (g)	Dry weight of shoot (g)	Root length (cm)	Fresh weight of root (g)	Dry weight of root (g)
T1	15.33	0.86	0.07	5.93	0.09	0.04
T2	19.07	0.96	0.26	6.73	0.18	0.06
T3	15.57	0.98	0.25	6.77	0.19	0.06
T4	15.97	1.37	0.18	5.33	0.25	0.07
T5	18.87	1.38	0.19	5.93	0.23	0.07
T6	17.10	0.87	0.08	7.30	0.14	0.05
T7	12.33	0.85	0.09	6.10	0.11	0.06
T8	24.33	1.94	0.35	8.30	0.35	0.08
T9	14.87	1.96	0.36	7.23	0.36	0.08
Mean	17.05	1.24	0.20	6.62	0.21	0.06
SEd	0.94	0.03	0.01	-	0.01	0.01
CD (p=0.5)	1.93	0.06	0.02	NS	0.02	0.02
CV%	6.76	2.99	5.11	-	5.59	13.77

Table 3: Effect of chemical drenching on leaf nutrient content, leaf chlorophyll content and soluble protein content of papaya seedlings

Treatments	Leaf nutrient content			Leaf chlorophyll content (mg g^{-1})	Soluble protein content (mg g^{-1})
	N (%)	P (%)	K (%)		
T1	1.65	0.77	2.77	2.25	45.40
T2	1.73	0.85	2.86	2.30	47.50
T3	1.77	0.83	2.85	2.48	47.00
T4	1.76	0.86	2.76	2.47	51.05
T5	1.74	0.88	2.78	2.48	52.50

T6	1.41	0.68	2.65	2.08	45.12
T7	1.44	0.66	2.65	2.13	46.00
T8	1.95	0.97	2.97	3.45	71.45
T9	1.95	0.99	2.98	3.40	72.55
Mean	1.71	0.83	2.81	2.56	53.17
SEd	0.02	0.01	0.01	0.04	0.23
CD (p=0.5)	0.03	0.02	0.03	0.09	0.48
CV%	1.07	1.66	0.53	2.13	0.53

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