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PLANT PHYSIOLOGY

Effect of Solid Matrix Priming Combined with Plant Extracts on Seedling Studies of Papaya

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ABSTRACT

This study aims to determine the effects of solid matrix priming combined with plant extracts on seedling studies of papaya for 48 hrs. Different treatments were T1; sawdust + 5% neem extracts, T2; sawdust + 5% tea extracts, T3; sawdust + 5% turmeric extracts, T4; sawdust + 5% marigold extracts, T5 ; sawdust + 5% amaranthus extracts and T6; sawdust + 5% water. The solid matrix priming of papaya seed significantly influenced on the germination rate growth and development of papaya seedlings. Overall, from the study it was found that T3 (sawdust + 5% turmeric extract), T4 (sawdust + 5% marigold extract) and T5 (sawdust + 5% amaranthus extract) performed better than other treatments.

HIGHLIGHTS

- Solid matrix priming combined with plant extracts was found effective in papaya seed germination and development.

Keywords : Solid matrix priming, sawdust, amaranthus, tea, turmeric, marigold, neem

Papaya has long been known as a wonder fruit of the tropics and grown primarily for its delicious fruits and for extraction of its digestive constituent papain. Papaya belongs to the family caricaceae. It produces fruits throughout the year and requires less area for tree, comes to fruiting in a year, is easy to cultivate and provides more income per hectare next to banana. It has high nutritive and medicinal value. Papaya provides cheap source of vitamins and minerals in the daily diet of the people. It is an abundant source of carotene, precursor of vit A which removes blindness. Papaya fruits are used for the treatment of piles, dyspepsia of spleen and liver, digestive disorders deptheria and skin blemishes (Chandha and K.L., 1999). Today's competitive and developing agricultural environment demands that growers produce high yield of good quality seeds to meet the market demand. In this scenario fruits play a vital role in the health and nutritional security of human beings in addition to improve the economy of the farmers. Hence, there is a great need to enhance the productivity of fruits gradually to boost up the production. The most promising invigoration technique for improving the rate and uniformity of plant stand is seed priming. Seed priming can be defined as pre-sowing treatment that involves the controlled hydration of seed sufficient to allow pre-germinative metabolic events to take place, but insufficient to allow radicle protrusion through the seed coat. Priming entails imbibition's of seeds in different solution for a specific duration of time under controlled conditions, then drying them to their original moisture content, so that radicle does not emerges before sowing. This stimulates various metabolic process that improve germination and emergence of several seed species, particularly seeds of vegetables, small seeded grasses and ornamental

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species. Solid matrix priming is one of the priming method consists of mixing seed with an organic or inorganic carrier and water for a period of time. The moisture content of the matrix is brought to a level just below what is required for radicle protrusion. Seeds can imbibe water from the carrier till the equilibrium is reached. Taylor *et al*., (1988) introduced the term solid matrix priming (SMP), in which solid matrix instead of osmotic is employed (Vanangamudi *et al*. 2010).

Furthermore, if during the process of solid matrix priming to maintain the moisture in spite of adding water if extracts. From some horticultural plants can be added then it could provide enhanced effects. Therefore, keeping in mind, the utility of priming of seeds the present study was under taken where solid matrix priming of papaya seeds were done combined with the treatment with extracts from some horticultural crops.

MATERIALS AND METHODS

The Experiment has been executed in the Department of Horticulture, Institute of Agricultural Science, University of Calcutta during June-July 2022. Over ripe papaya fruits were taken for seed extraction. Garden soil was collected from the campus pond-side area and garden. Then mixed with 50% cocopeat + 50% garden soil. The mixture was left for three days so that the microorganisms in the mixture develop enough and finally the medium was ready to use. The experiment comprised of six different treatments viz. T1: sawdust + 5% neem extract, T2: sawdust + 5% tea extract, T3: sawdust + 5% turmeric extract, T4: sawdust + 5% marigold extract, T5: sawdust + 5% amaranthus extract, T6: sawdust + 5% water. For statistical design Completely Randomized Design (Gomez and Gomez, 1984; Sheoran *et al*. 1998) was used with these six treatments in total 3 replications of each treatment with 5-6 seeds in each pot. For the extract preparation 10 gm of each material were taken and boiled with 200 ml water for approx. 10mins filtered to get extract solution. For the treatments saw dust were mixed with extract solution and seeds and kept for priming for 48 hours. Thereafter pots containing 50% garden soil and 50% cocopeat were prepared, then the seeds were sprinkled and covered with soil 10-15 mm thick lastly light irrigation was done. Parameters such as leaf number (Tian *et al.* 2014), leaf length (Dhal *et al*. 2022), rootlet number (Aryal 2020), root length (Mondal *et al*. 2018), seedling total length (Kumari *et al*. 2017), germination percentage (Nichols and Heydecker 1968) and chlorophyll content (Ranganna *et al*. 2003) were evaluated.

RESULTS AND DISCUSSION

Number of Leaves

It has been observed from the experimental result in Table 1, that highest number of leaves was observed 7.50 in the treatment T5 (sawdust + 5% amaranthus extract) whereas lowest number of leaves was 5.08 in the treatment T1 (sawdust + 5% neem extract) and these data were recorded on 30 DAS. Next counting of leaves was done on 35 DAS here the highest number of leaves were observed 8.00 in two treatments viz. T5 (sawdust + 5% amaranthus extract) & T6 (sawdust + 5% water) whereas lowest number of leaves was observed 6.89 in T1 (sawdust + 5% with neem extract). Last reading was recorded on 40 DAS and the highest number of leaves was observed 8.53 in T4 (sawdust + 5% marigold extract) and lowest was observed 7.07 in T3 (sawdust + 5% with turmeric extract).

Table 1: Number of leaves of the papaya seedlings influenced by solid matrix priming combined with plant extract

Treatments	30 DAS	35 DAS	40 DAS
T1	5.08	6.89	7.43
T2	5.50	7.22	7.77
T3	6.17	8.67	7.07
T4	6.08	7.11	8.53
T5	7.50	8.00	7.77
T6	6.92	8.00	8.40
CD	**0.764**	**N.S.**	**N.S.**
SEm±	**0.245**	**0.712**	0.528

Length of leaves

Variations was recorded in case of length of leaves under different treatments of papaya seed is shown in Table 2. First reading was done on 30 DAS where highest length of leaf shows 3.34 cm in the treatment T4 (sawdust + 5% marigold extract) whereas lowest leaf length was observed 2.18cm in T1 (sawdust + 5% neem extract). Next observation was done on 35 DAS, the maximum leaf length 4.59cm was recorded in T5 (sawdust + 5% amaranthus extract) and

lowest leaf length observed 2.07cm in T1 (sawdust + 5% neem extract). And the last observation was done on 40 DAS, maximum leaf length of 4.30cm was seen in T5 (sawdust + 5% amaranthus extract) and lowest in T1 (sawdust + 5% neem extract) i.e. 3.27cm. However other treatments also maintained significant appreciable number of leaves till the last day of observation.

Table 2: Length of leaves of the papaya seedlings influenced by solid matrix priming combined with plant extract

Treatments	30 DAS	35 DAS	40 DAS
T1	2.18	2.07	3.27
T2	2.60	2.34	3.73
T3	2.88	3.19	3.57
T4	3.24	3.24	3.89
T5	3.18	4.59	4.30
T6	2.42	4.03	4.23
CD	**N.S.**	**1.185**	**N.S.**
SEm±	**0.268**	**0.380**	**0.738**

Number of rootlets

Remarkable variations in rootlet numbers were observed in case of different replications in different pots. It was noticed in (Table 3) that the highest number of rootlets was 12.33 observed in T6 (sawdust + 5% water) where lowest number of rootlets was 10.00 observed in T2 (sawdust + 5% with tea extract). The above data was collected on 30 DAS. Thereafter at 35 DAS an increasing trend for the number of rootlets was seen for all the treatments except T3 (sawdust + 5% with turmeric extract). It was evident that the T6 (sawdust + 5% water) was with the maximum number of rootlets followed by T4 (sawdust + 5% with marigold extract) & T3 (sawdust + 5% with turmeric extract) was recorded with the least number of 10.56

Table 3: Number of rootlets of the papaya seedlings influenced by solid matrix priming combined with plant extracts

Treatments	30 DAS	35 DAS
T1	10.08	11.33
T2	10.00	11.56
T3	11.42	10.56
T4	11.58	14.56
T5	11.50	11.67
T6	12.33	14.67
CD	**N.S.**	N.S.
SEm±	0.560	1.366

Length of roots :

It is being observed from the experimental results shown in (Table 4) that the highest root length of 4.06cm was observed in T6 (sawdust + 5% water) and lowest root length of 2.73cm in T1 (sawdust + 5% with neem extract) on 30 DAS. Next observation was done on 35 DAS where highest root length of 5.40cm was observed in T5 (sawdust + 5% with amaranthus extraction) followed by T6 (sawdust + 5% water) and lowest root length of 2.42 cm in T1 (sawdust + 5% with neem extract). And the last observation was done on 40 DAS where highest root length of 6.18 cm was observed in T6 (sawdust + 5% water) which was closely accompanied by T4 (sawdust + 5% with marigold extract) with 5.24cm and lowest root length of 2.73cm in T1 (sawdust + 5% with neem extract).

Table 4: Length of roots of the papaya seedlings influenced by solid matrix priming combined with plant extracts

Treatments	30 DAS	35 DAS	40 DAS
T1	2.73	2.42	2.73
T2	3.21	4.51	3.99
T3	3.81	3.61	4.19
T4	3.30	3.72	5.24
T5	3.81	5.40	4.76
T6	4.06	4.92	6.18
CD	**0.838**	**0.516**	**N.S.**
SEm±	**0.269**	**0.823**	**1.014**

Total length of seedlings

In Table 5 the highest seedling length of 15.32 cm in T6 (sawdust + 5% with water) followed by 14.36 cm for T5 (sawdust + 5% with amaranthus extract) and lowest seedling length of 11.44 cm in T1 (sawdust + 5% with neem extract) was documented and this reading was observed on 30 DAS. Next observation was done on 35DAS, where the highest seedling length of 18.66 cm in T6 (sawdust + 5% water) and lowest seedling length of 12.19 cm in T1 (sawdust + 5% with neem extract) were obtained respectively. Last reading was taken on 40 DAS, the highest seedling length of 20.67 cm in T3 (sawdust + 5% with turmeric extract) was seen and this was closely followed bt treatments T6 (sawdust + 5% water) & T5 (sawdust + 5% with amaranthus extract) maintaining a length of 19.07cm and 19.02cm lastly

the lowest seedling length of 14.90cm was seen for T1 (sawdust + 5% with neem extract).

Table 5: Total length of the papaya seedlings influenced by solid matrix priming combined with plant extracts

Treatments	30 DAS	35 DAS	40 DAS
T1	11.44	12.19	14.90
T2	12.18	13.68	18.12
T3	12.81	14.89	20.67
T4	12.08	14.88	18.22
T5	14.36	18.64	19.02
T6	15.32	18.66	19.07
CD	**1.782**	**3.078**	**N.S.**
SEm±	**0.572**	**0.988**	**1.288**

Germination percentage

It was observed from Table 6 that at 30 DAS that highest germination percentage was recorded as 76.67 % in T2 (sawdust + 5% with tea extract), T3 (sawdust + 5% with turmeric extract), T5 (sawdust + 5% with amaranthus extract) & T6 (sawdust + 5% water) respectively and lowest germination percentage was 66.67% in T1 (sawdust + 5% with neem extract) & T4 (sawdust + 5% with marigold extract). Next observation was done on 35 DAS, highest germination percentage was recorded as 86.67 % in T4 (sawdust + 5% with marigold extract), T5 (sawdust + 5% with amaranthus extract) & T6 (sawdust + 5% water) and lowest germination percentage was 76.67% in T1 (sawdust + 5% with neem extract).

Table 6: Germination percentage of the papaya seedlings influenced by solid matrix priming combined with plant extracts

Treatments	30 DAS	35 DAS
T1	66.67	76.67
T2	76.67	80.00
T3	76.67	83.33
T4	66.67	86.67
T5	76.67	86.67
T6	76.67	86.67
CD	**N.S.**	**N.S.**
SEm±	**4.082**	**3.043**

Total chlorophyll content

From Table 7 it was observed that on 30 DAS highest chlorophyll content of 19.37mg/ml in T5 (sawdust + 5% with amaranthus extract) and lowest chlorophyll content of 4.23 mg/ml in T1 (sawdust + 5% with neem extract). Then observation taken at 35 DAS the chlorophyll content increased for the treatments T1 (sawdust + 5% with neem extract), T2 (sawdust + 5% with tea extract), T3 (sawdust + 5% with turmeric extract) & T4 (sawdust + 5% with marigold extract) was found to have accumulated with the highest chlorophyll concentration of 14.82 mg/ml. T1 (sawdust + 5% with neem extract) showed the least figure of 10.34 mg/ml.

Table 7: Total chlorophyll content of the papaya seedlings influenced by solid matrix priming combined with plant extracts

Treatments	30 DAS (mg/ml)	35 DAS (mg/ml)
T1	4.23	10.34
T2	8.76	11.61
T3	8.81	14.82
T4	13.97	14.82
T5	19.37	14.60
T6	15.22	13.64
CD	**6.374**	**5.981**
SEm±	**2.046**	**2.594**

In this study, the effect of solid matrix priming combined with plant extracts on the seeds of local papaya variety showed significant influence of seed treatment on papaya seed germination. Similar results were found by Ikramullah *et al.*, (2017), on effects of soaking durations and sowing dates of germination and seedling growth of peach stone. Remarkably higher germination percentage observed in solid matrix primed seeds as compared to non-primed seeds this indicates a positive effect of seed priming in synchronizing the seed germination process (Table 6). The least number of days taken for germination was 7-10 days and the highest germination percentage was recorded 86.67 % in T4 (sawdust + 5% with marigold extract), T5 (sawdust + 5% with amaranthus extract) & T6 (sawdust + 5% with neem extract) on 40 DAS and least germination was recorded in T1 (sawdust + 5% with neem extract) 76.67%. Similar results were obtained by Jett *et al.* (1996) where it was concluded that matric priming had a greater effect on germination and root growth rates.

Effect of solid matrix priming on the growth of papaya seedlings showed remarkable benefits on

the number of leaves & length of leaves (Table 1 & Table 2). Significant changes on total length of seedlings were observed (Table 5) on 40 DAS compared to 30DAS These changes occurred may be due to cocopeat that assist to increase number of leaves in plant. Similar experiment has been done by Awang *et al.* (2009) that chemical and physical characteristics of cocopeat-based media mixtures and their effects on the growth and development of *Celosia cristata*. Cocopeat has limited antifungal properties which helps in keeping pests away. Satishkumar, (2005) also reported that when brinjal seeds when treated with osmo priming solution, increases the number of leaves, plant height, fruit length, fruit yield. Root length was also improved after treatment with plant extraction as the highest root length of 6.18 cm was observed in T6 (sawdust + 5% water) on 40DAS (Table 4). Similar experiment has been done by Rehman *et al*., 2021 that signifies the role of seed priming in root development and crop production. The experiment showed that different treatments have different effect on growth of seedlings of papaya. Among the treatments all of them responded significantly in case of highest seedling length, shown by T3 (sawdust + 5% with turmeric extract), leaf length and number of leaves in T4 (sawdust + 5% with marigold extract). The results are in accordance with the findings of Duarte and Suchini (2001), in sapota with respect to seedling height and stem diameter.

Papaya seedlings also showed appreciable effect on solid matrix priming on the chlorophyll content. The highest chlorophyll content was observed in T3 (sawdust + 5% with turmeric extract) and T4 (sawdust + 5% with marigold extract) was 19.37 on 30 DAS where lowest is 4.23 in T1 (sawdust + 5% with amaranthus extract) mentioned in the above Table 7. Similarly, Mohajeri *et al.* 2017 experimented on seed priming on chlorophyll content and yield components of pinto beans and the study showed that seed treatment with water in plants increased the total chlorophyll contents and the rate of photosynthesis and eventually increased the biomass and yield.

CONCLUSION

From the experiment it can be concluded that solid matrix priming of papaya seed with plant extracts significantly influenced on the germination rate, growth and development of papaya seedlings. Overall from the study it was found that T3 (sawdust + 5% turmeric extract), T4 (sawdust + 5% marigold extract) and T5 (sawdust + 5% amaranthus extract) performed better than other treatments. Therefore, this result suggested that solid matrix priming combined with plant extracts may be used for enhancing germination of papaya seed and quickening of papaya seedling growth.

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