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# Effect of sarcotesta on papaya seedling

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**Abstract**
Papaya (*Carica papaya* L.) belongs to Caricaceae family and 2n chromosome number is 18. It is native of tropical America and it was introduced in India in 16th century from Malacca. It is an interesting plant producing fruits of many uses and grown under tropical and subtropical conditions. It is popularly known as paw paw or papaw (British), mamao (Brazil) and lechosa (Venezuela). Papaya is a fast growing, short lived herbaceous plant and unbranched which bears fruits within a year. Being a quick and heavy yielding crop, it is grown widely all over India; both commercially as well as in home gardens. The growers are increasing area under papaya cultivation due to great demand as table fruits as well as vegetable when unripe. The ripened fruit are the richest source of sugar, vitamin "A" and mineral matter and they are used in preparation of jam, syrup, murabba etc. Unripe fruits are used for extraction of papain, which is a proteolytic enzyme used in manufacture of chewing gums, cosmetics, also used for degumming natural silk, and as a drug for digestive aliments. Papaya is a nutritive fruit. Propagation of papaya is done only through seeds as a viable option. With the commercialization of papaya cultivation, the demand for quality seeds of well-established varieties has increased therefore proper seed germination and seedling growth are most important considerations in successful seedling production under nursery technique of papaya cultivation. The seed is enclosed within a gelatinous sarcotesta (Aril or outer seed coat which is formed from the outer integument). The slow and synchronous germination of papaya seeds is attributed to the presence of inhibitors (mainly phenolic compounds) in the sarcotesta and seed coat. Climatic parameters plays an important role in seed germination and seedling growth. Erratic change in climatic parameters shows to impose the effect on seed germination and growth of seedlings. Sarcotesta is a gelatinous material that covers the papaya seed. In papaya seeds, the slow and asynchronous germination has been attributed to the presence of sarcotesta which contain inhibitors. Thus, gently removal of papaya sarcotesta will play an important role for the quick germination – as the removal of inhibitors present in the sarcotesta. So the sowing of seeds without sarcotesta gives quick germination with more germination percentage which attribute to the faster growth and development of papaya seedlings.

**Keywords:** Sarcotesta, papaya, *Carica papaya* L.

## Introduction
Papaya is a member of family Caricaceae and chromosome number is 18. It is native of tropical America and it was introduced in India in 16th century from Malacca. It is an interesting plant producing fruits of many uses and grown under tropical and subtropical conditions. It is popularly known as paw paw or papaw (British), mamao (Brazil) and lechosa (Venezuela). Papaya is a fast growing, short lived herbaceous plant and unbranched which bears fruits within a year. The plant is 2-10 m in height with a straight, cylindrical, soft and hollow trunk surrounded by the apex portion and forming a crown. The fruits are borne on the growing axils of the plant. Being a quick and heavy yielding crop, it is grown widely all over India; both commercially as well as in home gardens. The growers are increasing area under papaya cultivation due to great demand as table fruits as well as vegetable when unripe. The ripened fruit are the richest source of sugar, vitamin "A" and mineral matter and they are used in preparation of jam, syrup, murabba etc. Unripe fruits are used for extraction of papain, which is a proteolytic enzyme used in manufacture of chewing gums, cosmetics, also used for degumming natural silk, and as a drug for digestive aliments. Papaya is a nutritive fruit. Papaya provides a chief source of carbohydrate, vitamins and minerals in the daily diet of the people. It is an abundant source of carotene (2020 IU/100 g), precursor of vitamin "A" which prevents night blindness. The yellow pigment in papaya is due to Caricaxanthin. Propagation of papaya is done only through seeds as a viable option.

With the commercialization of papaya cultivation, the demand for quality seeds of well-established varieties has increased therefore proper seed germination and seedling growth are

most important considerations in successful seedling production under nursery technique of papaya cultivation. The seed is enclosed within a gelatinous sarcotesta (Aril or outer seed coat which is formed from the outer integument). The slow and synchronous germination of papaya seeds is attributed to the presence of inhibitors (mainly phenolic compounds) in the sarcotesta and seed coat. Climatic parameters plays an important role in seed germination and seedling growth. Erratic change in climatic parameters shows to impose the effect on seed germination and growth of seedlings. Sarcotesta is a gelatinous material that covers the papaya seed. In papaya seeds, the slow and asynchronous germination has been attributed to the presence of sarcotesta which contain inhibitors.

**Review of Literature**

Lange (1961) [26] studied the effect of the sarcotesta on seed germination of *Carica papaya*. He observed the minimum days required for the first germination and the highest seed germination per cent with washing of seeds in tap water for 24 hours. Ehara *et al.* (1973) [13] studied the effects of physical treatment and the presence of pericarp and sarcotesta on seed germination of sago palm. They revealed that the presence of pericarp and sarcotesta were the major factors that limits the germination percentage of sago palm seeds. Chow and Lin (1991) [8] observed maximum germination percentage of papaya seeds under the treatment removal of sarcotesta, pre-soaking and leaching of seeds in tap water. Sangakkara (1995) and Meera *et al.* (2018) [36, 28] revealed that the presence of the sarcotesta reduced germination and enhanced the number of abnormal seedlings in papaya. Germination percentage after 30 days of planting was 87.5% in case of seeds without sarcotesta and 56.8% in with sarcotesta. He also noticed percentage abnormal seedling was 10% in case of seeds without sarcotesta and 21% in seeds with sarcotesta. Holt and Rothwell (1997) [18] compared the germination percent with sarcotesta and without sarcotesta in *Ginkgo biloba* seeds. They found that total germination percentage and growth of seedling were significantly reduced with sarcotesta seeds as compared to without sarcotesta seeds. Ehara *et al.* (1998) [12] reported that seeds in which sarcotesta and husk removed shows higher germination rates (40%) when incubated in water at 30ºC in sago palm. Whereas, germination percentage of non- treated seeds was 10-20% at 25 ºC. Tokuhisa *et al.* (2007) suggested that the slow and erratic germination of papaya seeds has been attributed to inhibitors present in the sarcotesta. They evaluate the effect of sarcotesta extract on lettuce seed germination and to quantify phenolic compounds in papaya seeds. A bioassay was performed with lettuce seeds which germinated in substratum moistened with water (control) and with solutions obtained from papaya sarcotesta extract. The bioassay indicated that sarcotesta extract inhibits the germination and growth of lettuce seedling primary roots due to the presence of inhibitory substances (phenols).

A high amount of these substances were found in the papaya seed sclerotesta, followed by sarcotesta but there was typically no concentration of these compounds in the embryo and endosperm. Tredici (2007) [41] suggested that seeds of *Ginkgo biloba* when cleaned of their sarcotesta germinated faster and at higher percentage than those with their sarcotesta intact. Okeyo and Ouma (2008) observed that papaya seeds in which washing were done by rubbing the seed coat to remove the gelatinous cover, germination was increased. The presence of the gelatinous material (sarcotesta) reduced the average percent of germination. The higher germination resulting from soaking and washing in the absence of sarcotesta may indicate that the sarcotesta acts as a barrier to the movement of water-soluble inhibitor out of the seed coat. They suggests that the presence of a leachable inhibitor in the seed coat that prevents sarcotesta from leaching in adequate concentration to reduce germination at any concentration. Dias *et al.* (2009) [11] showed that during the 15 month storage, papaya seeds without sarcotesta maintained better physiological quality than seeds with sarcotesta, independent of initial moisture content. In general, the physiological quality of seeds without sarcotesta with 8 or 11% moisture content was maintained for about twelve months under laboratory conditions, independent of packaging material.

Dias *et al.* (2010) [10] reported that papaya seeds without sarcotesta maintained better physiological quality than those with sarcotesta. Gomez (2010) [16] noticed the influence of the sarcotesta on the germination of papaya seeds and observed the seeds with sarcotesta delayed germination, lower germination percentage and seedling growth compared to without sarcotesta. While removing the sarcotesta from papaya seeds improved the rate of survivability of germinating seeds. Kranner *et al.* (2010) [24] indicated that some biproducts of anaerobic metabolism can impair respiratory transport leading to some chain reactions that can result in loss of cell function and death and ultimately seed death in papaya. Ibrahim *et al.* (2011) [20] investigated the effect of sarcotesta and storage temperature on the longevity of seeds of papaya (*Carica papaya*) landraces. They concluded that seeds extracted from ripe fruits with shade dried to a moisture of about 10% with the removal of sarcotesta gave the higher seed germination and normal seedling compared to without removal of sarcotesta.

Parasana *et al.* (2013) [31] concluded that among the different growing medias M3 i.e. Soil + Sand + Farm Yard Manure (2: 1: 1) is found to be the most effective for better germination of mango stone as well as growth of mango seedlings (height, number of leaves, length of root and shoot, stem girth, fresh and dry weight of seedlings as well as survival per cent of seedlings). Similarly among the cultivars tried, V3 (LSM–12-Master Royal) found better for the above parameters. Therefore, the combination of M3V3 (Soil + Sand + Farm Yard Manure (2: 1: 1) + LSM-12-Master royal) found most suitable for growing of mango stone for rootstock purpose under nursery conditions.

Yadav (2015) and Farheen *et al.* (2017) [44, 14] conducted a research to find the effect of washing and media on the seed germination and growth of papaya and he found that the maximum height of seedling (18.33 cm), leaf area (135.22 $cm^2$), fresh weight of seedling (9.92 g), dry weight of shoot (0.771 g) and dry weight of papaya seedling (1.23 g) after 45 days of sowing was recorded with seedlings resulted from removal of sarcotesta by washing and use of media soil+ sand+ vermicompost+ vermiculite+ cocopeat (1:1:1:1). Vidyasagaran *et al.* (2016) studied the effect of pre sowing treatments on germination parameters of the four *Calmus* species. The best treatment which gave faster, and maximum germination percentage was for complete removal of outer pericarp and sarcotesta. Carvalho *et al.* (2017) [7] noted that the quicklime method associated to drying, for three days, is efficient to degrade and to eliminate the sarcotesta on *Punica granatum* L. seeds, promoting better physiological quality. They also observed a liner increase on germination percentage, normal seedlings and germination speed index

when upgrades the immersion period in quicklime solution until 25 hours.

Rodriguez *et al.* (2019), Dadhaniya *et al.*, 2020 for custard apple) and Bandhiya *et al.* (2022) [35, 9, 5] suggested that in natural conditions, the germination of papaya seeds has difficulty by the presence of aril (sarcotesta) that become a physical barrier which limits the diffusion of water and gases into the seeds and by the effect of phytohormones which preventing germination of seeds, causing dormancy, limiting the development of the embryos and causes a low and variable germination affecting the final percentage. Chemical scarification of seeds with calcium hydroxide can improve germination percentage and vigor of the papaya seeds.

## Conclusion

Papaya (*Carica papaya* L.) belongs to Caricaceae family is native of tropical America. It is an interesting plant producing fruits of many uses and grown under tropical and subtropical conditions. The fruits are borne on the growing axils of the plant. Being a quick and heavy yielding crop, it is grown widely all over India; both commercially as well as in home gardens. The growers are increasing area under papaya cultivation due to great demand as table fruits as well as vegetable when unripe. Propagation of papaya is done only through seeds as a viable option. With the commercialization of papaya cultivation, the demand for quality seeds of well-established varieties has increased therefore proper seed germination and seedling growth are most important considerations in successful seedling production under nursery technique of papaya cultivation. The seed is enclosed within a gelatinous sarcotesta (Aril or outer seed coat which is formed from the outer integument). The slow and synchronous germination of papaya seeds is attributed to the presence of inhibitors (mainly phenolic compounds) in the sarcotesta and seed coat. No doubt, climatic parameters plays an important role in seed germination and seedling growth; erratic change in climatic parameters shows to impose the effect on seed germination and growth of seedlings. Sarcotesta is a gelatinous material that covers the papaya seed. In papaya seeds, the slow and asynchronous germination has been attributed to the presence of sarcotesta which contain inhibitors. Thus, gently removal of papaya sarcotesta will play an important role for the quick germination – as the removal of inhibitors present in the sarcotesta. So the sowing of seeds without sarcotesta gives quick germination with more germination percentage which attribute to the faster growth and development of papaya seedlings.

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