

Germination and Seedling Development in Pawpaw *Asimina triloba*

C.L.H. Finneseth, D.R. Layne and R.L. Geneve

Department of Horticulture and Landscape Architecture, University of Kentucky,
Lexington, Kentucky 40526-0091

Pawpaw [*Asimina triloba* (L.) Dunal] is a small, deciduous fruit tree indigenous to most of the eastern United States. It is the only temperate member of the tropical Annonaceae or Custard Apple family. As a member of this primitive family, its large seeds have a characteristic ruminant endosperm and underdeveloped embryo.

Seed anatomy and seedling development have been outlined for a limited number in the Annonaceae family (Corner, 1948, Hayat and Canright, 1968). Ovule and seed development as well as seed morphology have been described in pawpaw (Mohana Rao, 1982, Lampton, 1957), but there are no descriptions of morphological changes during seed germination or seedling development. This study was designed to describe important developmental stages during germination and seedling development of pawpaw.

Seeds were extracted from ripe fruit (Keedysville Orchard, University of Maryland, Keedysville, MD), packed in moist sphagnum moss and stored in plastic bags at 4°C until planting. Cold-stratified pawpaw seeds were sown in vermiculite and placed in a growth chamber (25°C, 16 h of 25 $\mu\text{mol sec}^{-1} \text{m}^{-2}$ light, 8 h of dark, and watered every 2 days).

Ten seedlings were randomly chosen and destructively harvested for length measurements (mm) and fresh and dry weight (mg) determinations. To obtain length measurements prior to radicle protrusion, the testa was removed and a 4-mm \times 4-mm portion of endosperm containing the embryo was excised from the hilar end of the germinating seed. Paraffin-embedded tissue samples were sectioned using a rotary microtome and stained with safranin-fast green.

Pawpaw has an underdeveloped embryo surrounded by ruminant endosperm tissue. The embryo measured less than 2 mm at 9 days after planting. Extending from the cotyledon tips were two parallel channels of cells which stained differently than embryo or endosperm tissues. These growth channels have not been previously described. The cotyledons grow through these channels and it is possible that this facilitates absorption and translocation of materials to the developing axis.

Recognizable stages of seedling development include radicle protrusion, hypocotyl emergence, epicotyl elongation, and seed coat abscission. Prior to radicle protrusion, the cotyledons and radicle grow concurrently at approximately the same rate. Cotyledons reached a maximum length after 40 days, well after hypocotyl emergence (27 days).

As the seedling developed, a reallocation of fresh and dry matter occurred. Initially, the largest proportion of fresh weight and dry weight was in endosperm tissue. This gradually decreased as storage material in the endosperm was mobilized and the seedling became autotrophic (45 days).

Pawpaw exhibits an epigeal pattern of seedling emergence. The cotyledons remain encased within the seed and are shed as one unit (Day 50). Pawpaw seeds may remain subterranean, but are most often raised above the soil surface as the

hypocotyl elongates. This unusual pattern may explain why pawpaw germination has been reported as hypogeal.

LITERATURE CITED

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Capillary Mats Modify Media Moisture During Mist Propagation of Chrysanthemum Cuttings

Jennifer Marohnic, Robert Geneve, and Jack Buxton

Department of Horticulture and Landscape Architecture, University of Kentucky, Lexington KY 40546

INTRODUCTION

A central feature of the propagation of leafy cuttings is that lacking roots they readily develop water deficits. Slight water deficits, even though insufficient to cause any visual symptoms of distress, can result in considerable delay or reduction in the rooting response (Davis et al., 1988). With the use of intermittent mist, a film of water remains on the leaf surface lowering the vapor pressure deficit and reducing transpirational water loss (Synder and Hess, 1953). However, misting, either applied too frequently or too long at each interval, can result in excessive wetness leading to restricted aeration and reductions in root development (Grange and Loach, 1983b).

Capillary mats can be used to add or reduce the water content of growing media in containers (Buxton and Jia, 1991). In the present study, Vatec capillary mats added or removed water from Smithers-Oasis 1-in. Rootcubes[®] during mist propagation. The objective of the current study was to evaluate the efficacy of using capillary mats to maintain uniform moisture in the medium during mist propagation.

MATERIALS AND METHODS

Mats placed on the surface of the propagation bench extended over the edge of the bench and downward into a water reservoir located a distance of 0, 5, or 10 cm below bench level. The water table established at bench level was determined by the location of the water reservoir. Oasis blocks with *Dendranthema* 'Boaldi' and 'Salmon Charm' were placed on the mats under intermittent mist (10 sec every 5 min) between 5 AM. and 8 PM. Leaf relative water content and quantity of water in the growing medium (ml of water per gram oasis) were measured every 3 days for 15 days. After 21 days, the number of roots per cutting was evaluated.