J. Hortl. Sci.
Vol. 11(1):76-79, 2016

Short communication

Fruit/seed morphology, seed drying and germination studies in *Baccaurea courtallensis* (Muell.) Arg., a threatened under-utilized fruit species of Western Ghats in India

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ABSTRACT

A study was under taken on fruit and seed morphology, seed drying, seed germination and storage behavior in *Baccaurea courtallensis*, as, this plant is propagated mainly through seeds. Its fruit is a berry consisting of an outer, semi-hard but fleshy rind 2-3 mm thick. The cavity inside the rind is normally occupied by a single, arillate seed, but, two seeds are also seen occasionally. Fresh rind was found to be rich in antioxidants, with 237mg total phenols and 93mg flavonoids per 100 gram fresh weight, but was poor in Vitamin C. A thick, fleshy endosperm is surrounded by the inner seed-coat. The endosperm surrounds the embryo consisting of two papery-thin cotyledons and a minute embryonic axis. Germination was highest (96.7%) when seeds were sown immediately after extraction, with moisture content of about 50%. Reduction in moisture to below 34% showed a drastic decrease in germination. Dried seeds took longer to germinate than did the fresh ones. Seeds with 21% moisture recorded about 60% germination whereas, seeds with 10.2% or 8% moisture failed to germinate, indicating a recalcitrant seed. Temperature in the range of 25-30°C was found to be optimum. Of the two media tested for raising the seedlings, cocopeat medium was superior as, it induced faster growth of the seedlings. Seedling root and shoot were considerably longer, with higher seedling survival rate in cocopeat than in the soil-mix medium. Seedling establishment was poor when planted out of their natural habitat.

Key words: *Baccaurea courtallensis*, seed morphology, seed moisture, seed germination

Baccaurea courtallensis (Muell.) Arg., a member of Euphorbiaceae family, is endemic to the Western Ghats of India. It is popularly known as Burmese grape or *Khattaphal*. The plant is a medium-sized tree growing to a height of 8-10m and produces crimson-red edible fruits, sour to sweet in taste when fully ripe. Village folk of Western Ghats of India eat the fruits, and use them in folk medicine besides making pickles out of them (Srinivasa Mohan, 2009; Ratheesh Narayanan *et al*, 2011). The fruit is reported to be a good source of Vitamin C and antioxidants. Presence of palmitic and oleic acids in the seed oil makes it useful as a lubricant and an additive in industrial preparations (Srinivasa Mohan, 2009). This tree species has ornamental value as well,as, at full bloom it is a treat to watch. Blooms occur during February-March, and fruits mature in May-June. Cauliflory is seen (production of flowers and fruits on the main trunk). When the tree attains maturity, floral primordia appear on the main trunk, from which crimson-red flowers emerge. Male and female flowers are produced on separate stalks of the same tree (Monoecea). Crimson-red fruits are arranged in racemose type of inflorescence and hang in symmetric clusters. Fruit clusters are seen all around the trunk from base upwards. Fruits can be seen even on exposed roots. Bunches of fruits hang downwards, even touching the ground, hence the name, *Moottilkkaippan* in Malayalam. International Union for Conservation of Nature and Natural recourses (IUCN) has listed this as a threatened species in its Red Data Book, and the tree requires special conservation measures. Though propagation of this plant is mainly through seeds, no information whatsoever is available on seed viability or storage. The present investigation was made to study fruit and seed morphology in this species, and also the seed structure, seed germination and storage behaviour.

Fully mature fruits of *Baccaurea courtallensis* were collected from Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), Palode, Trivandrum, in June 2012. The fruits were kept in closed polythene covers at 12°C for 2 days when fruit characters were recorded,

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viz., shape, size, colour, number of seeds per fruit, internal fruit texture and seed morphology. The rind of the fruit used for making pickles was analyzed for total phenols, flavonoids (Kavitha *et al*, 2014) and Vitamin C. Seeds were extracted from the fleshy fruits, and, the fleshy tissue surrounding was removed by rubbing between fingers and repeated washings under running water. Seeds with no or underdeveloped embryo were removed by the floatation technique. The sinkers were collected and soaked in Carbendazim (2.0%) for 15 minutes, and surface-dried. The seeds were further dried for different durations under shade to raise seed lots with varying moisture levels, viz., 51.01% (fresh seed), 34.19% (after 20h of drying), 21.00% (after 26h of drying), 10.37% (after 48h of drying), and 8.00% (after 6 days of drying). These dried seeds (with varying moisture content) were placed in polybags containing moist cocopeat and held at room temperature (ranging between 24-28°C) for germination. Seeds that showed radical protrusion of 5mm and more were assumed as germinated, and were transferred to plastic *protrays* containing cocopeat, for further establishment. At two-leaf stage, the seedlings were transferred to polythene bags containing cocopeat alone. In another experiment fresh (undried) seeds (with 51-53% moisture) were subjected to germination at different temperature regimes. Five replications of 25 seeds each were placed between two germination paper towels and subjected to alternate temperatures of 20-30°C, (16h at 20°C and 8 h at 30°C), and constant temperatures of 30°C and 35°C using germinators. One set of seeds was also kept at ambient temperature, fluctuating between 24°C and 28°C. Seeds were observed for germination rate at regular intervals. Data was analyzed using simple CRD and means were compared using critical difference at 1% level of significance.

Fruits are round, with crimson-red skin colour (Plate 1) at an average berry diameter of 2.5cm. The fruit is a berry, consisting of an outer semi-hard but fleshy rind 2-3mm thick and used for pickle making (fresh or dried). The cavity inside the rind is normally occupied by a single, arillate seed (Plate 2). Two seeds could also be seen in a few fruits bigger in size.

Plate 1. Crimson-red fruit of *Baccaurea courtallensis*

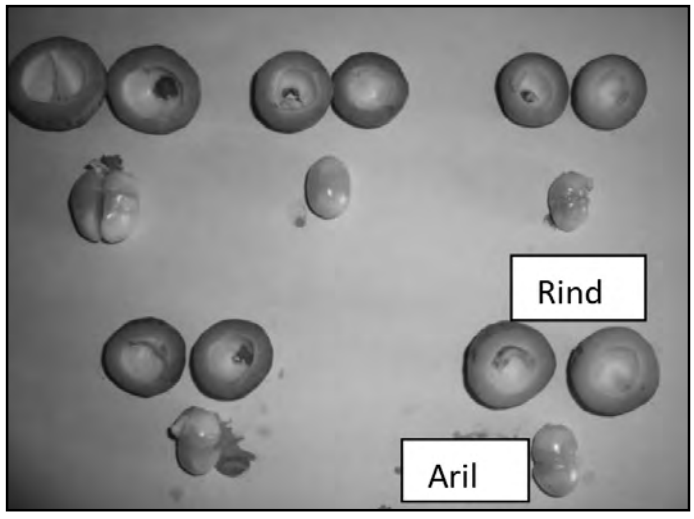

Plate 2. Various parts of *Baccaurea courtallensis* fruit

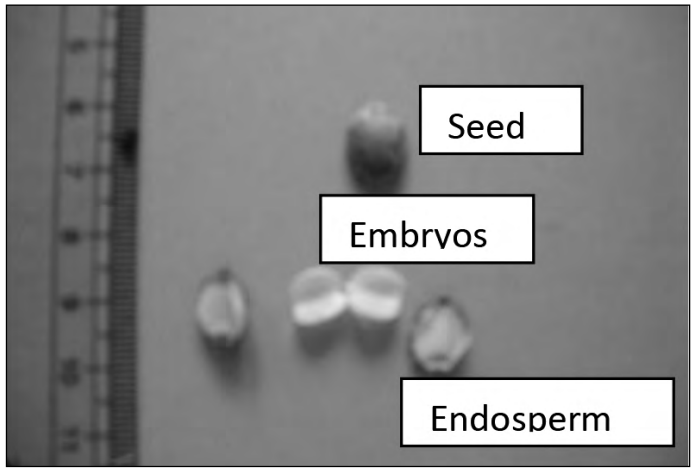

Plate 3. Various parts of *Baccaurea courtallensis* seed

The seed is covered completely with a white, juicy, soft tissue called aril. The all is edible and sour to taste. Fresh rind was found to be rich in antioxidants, with 237mg total phenols and 93mg flavonoids per 100g fresh-weight. Abhishek *et al* (2011) also reported presence of phenols and flavonoids in the fruit rind. Vitamin C content was found to be 2.93mg which is very low, and corroborates with the findings of Nazaruddin (2010) who also observed traces of Vitamin C in the fruit rind. The seed is broad and flat, ovate and white. It consists of a leathery outer seed-coat and a thin, brown inner seed-coat. Outer seed-coat is surrounded by fuzz which can be removed by rubbing against any rough surface. The thick, fleshy endosperm is surrounded by the inner seed-coat. The endosperm surrounds the embryo consisting of two thin, papery cotyledons and a minute embryonic-axis (Plate 3).

Plate 4. *Baccaurea courtallensis* seedlings grown on cocopeat (left) and soil mixture (right)

Germination was highest (96.7%) when seeds were sown immediately after extraction, having a moisture content of about 50% (Fig.1). Reduction in moisture content from an initial 50% to 34% showed a little decrease in germination (7.5%), but further drying resulted in a drastic reduction in germination. Dried seeds took longer to germinate than did fresh seeds. Seeds with 50% moisture showed more than 60% germination by the 12th day, whereas, seeds with 34% and 21% moisture took more than 24 and 43 days, respectively, to attain this rate (60%) of germination. Seeds with 21% moisture recorded about 60% germination whereas seeds with 10.2% and 8% moisture failed to germinate. This indicates that *Baccaurea courtallensis* seeds are recalcitrant in nature and, thus cannot withstand drying to low moisture, unlike orthodox seeds. Critical moisture level below which there is no germination probably around 20% moisture, as, seeds with 21% moisture recorded just above 50% germination. Hence, to raise seedlings of *Baccaurea courtallensis*, fresh seeds should be sown, as, seeds with high moisture content cannot be stored for long.

Results on effect of temperature on seed germination showed that temperatures in the range of 25-30°C registered higher and rapid germination, compared to the alternate temperatures of 20-30°C or a constant 35°C (Fig. 2). Seeds exposed to room temperature of 24-28°C or a constant 30°C took only 20 days to germinate @ 84-85%, whereas, at the other two temperature regimes, germination was only 51-59% at 20 days. However, the final germination count at 43 days from sowing was almost the same across different temperature regimes. Accordingly, the speed of germination was higher (7) at room temperatures of 24-28°C and a constant 30°C, than at the alternate temperature of 20-30°C (4.5) or a constant 35°C (4.9) (Fig. 3).

Of the two media tested for raising seedlings, cocopeat medium was found to be ideal, as, it led to faster growth of seedlings. Root and shoot were considerably longer in cocopeat than in the soil mix, as also survival rate of the seedlings. At the 80th day from sowing, root length

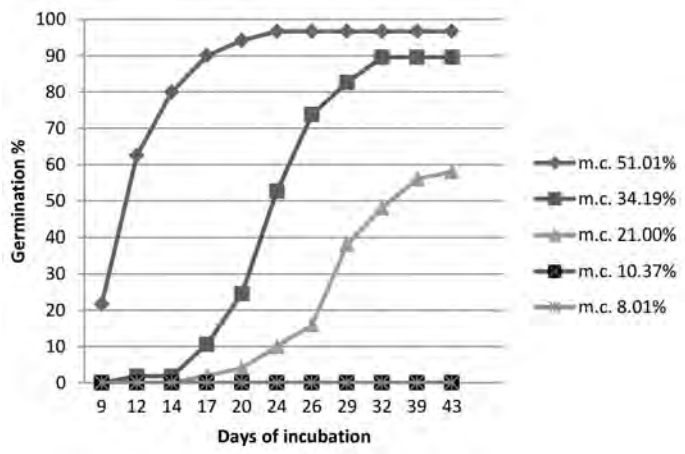

Fig 1. Effect of seed moisture on germination in *Baccaurea courtellensis*

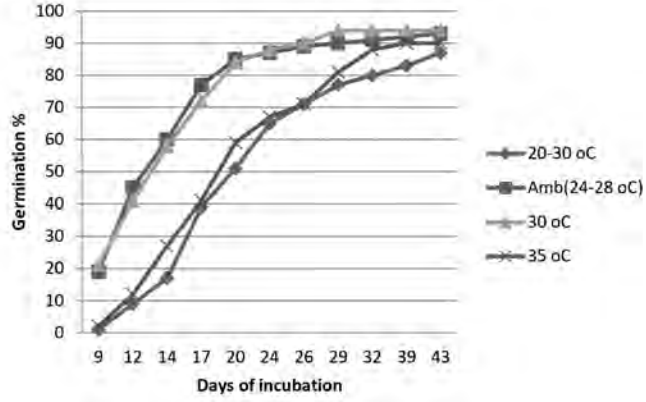

Fig 2. Effect of temperature on seed germination in *Baccaurea courtellensis*

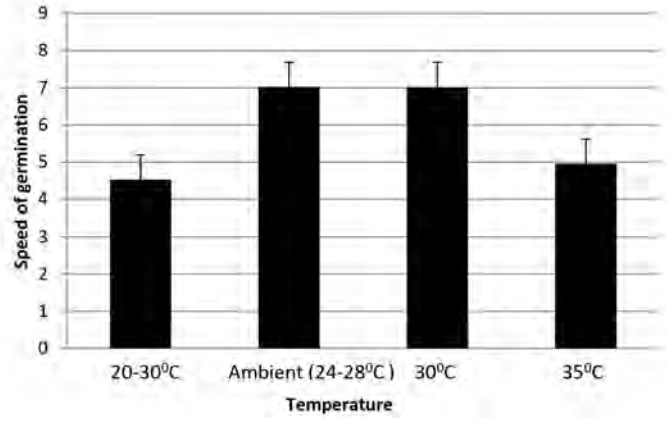

Fig 3. Effect of temperature on speed of germination in *Baccaurea courtellensis*

was 16cm in cocopeat and 12cm in the soil-mix (Plate 4). Establishment of seedlings was poor when these were planted outside their natural habitat. A preliminary attempt to establish the species outside its niche was partially

successful and indicated that, with retirement, it may be amenable to conservation, domestication and development as a multi-purpose tree in the tropics (John *et al*, 2003).

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(MS Received 12 October 2015, Revised 16 March 2016, Accepted 24 March 2016)