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Eucalypts of Australia

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Eucalypts, or gum trees as they are called in Australia, made up 75 per cent of the original vegetative cover of Australia and comprise nearly 700 species and varieties (4). They range in size from the multiple-stemmed mallees 6 feet tall to some of the loftiest trees in the world, towering to a record 375 feet for *Eucalyptus regnans*—11 feet taller than the tallest California Redwood. The tallest living eucalypt today is reported to be 321.5 feet tall (8).

Eucalyptus is a distinctively Australian genus and it was not originally present in such nearby islands as New Zealand or New Caledonia (12). Though now disputed by Wood (12), botanists earlier claimed that Eucalyptus species originated in northern Australia and spread from there to other parts of the continent and to Tasmania. Moreover the presence of 6 species of Eucalyptus in New Guinea suggested a northern origin. Apparently New Guinea was attached to Australia and separated from it in late Pleistocene times, leaving these 6 species common to both areas.

The earliest fossil records can be traced to the early Tertiary period, in the Eocene but increasing from the Miocene onwards (12). Palynologists could not confirm macrofossil indentification earlier than the Oligocene because genera of the Myrtaceae are not identifiable by pollen morphology (9). Thus Eucalypts were in existence about 60-70 million years ago, contemporary with the emergence of the Rocky Mountain system in North America and with the appearance of the dawn horse and other hoofed animals in America, Asia and Africa.

Today eucalypts grow mainly on the portions of the continent where the annual rainfall is at least 15 inches (10); however, no species occur in the rainforest (12). Not more than a dozen or two species survive the arid interior except along watercourses or in specialized habitats (see Figure 1).

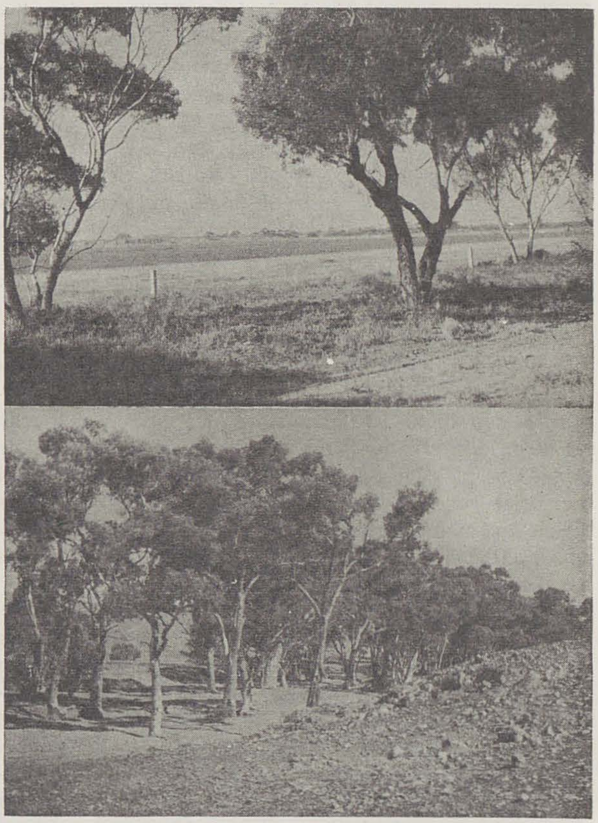

FIGURE 1. Two scenes in South Australia of Eucalyptus spp: multiple-stemmed mallees growing along an irrigated alfalfa field, and the lower showing River Gums growing in a currently dry creek bed in the Flinder Ranges.

Eucalypts are presently grown in many areas of the world—in California and Florida, several South American countries, Ethiopia and South Africa, from countries bordering the Mediterranean to as far east as the shores of the Black Sea, India and Russia. The first species introduced into California was *Eucalyptus globulus* (blue gum); later others were introduced. However, Benson (2) observed that eucalypts usually do not maintain themselves in California outside of cultivation although a few have apparently become established locally.

Though ancient in origin, eucalypts are recent in discovery. In 1688, William Dampier encountered on the northwest coast of Australia, trees with a gummy secretion which he thought were characteristic of *Calamus draco* (8). Then on May 1, 1770, Captain Cook, Joseph Banks and Dr. Solander, a former student of Linnaeus, saw eucalypts in the woods near Botany Bay, not far from the present site of Sydney. Banks (1), in his journal, likened this tree to "sangius draconis" again because of the gummy exudates; this species was later described as *Eucalyptus alba.* Thus eucalypts came to be known as gum trees.

The name Eucalyptus was given to this tree by a French botanist, Charles-Louis L'Heretier de Brutelle, who was in England in 1786-1787, studying the botanical collection at Kew. In 1788, he published in Paris an illustrated folio in which he described *Eucalyptus obli-*

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qua, known commonly in Australia as stringybark (3). The name "eucalyptus" derives from two Greek words, "eu" meaning "well" and "kalyptos" meaning "covered", descriptive of the operculum, or lid, of the fruit (Figure 2). What L'Heretier saw was a collection of specimens that William Anderson and David Nelson gathered from an island near Tasmania during Cook's third voyage around the earth (8).

Eucalyptus is a genus in the Myrtaceae, or myrtle family, which is comprised of about 2500 species distributed primarily in Australia and the American tropics (2). Eucalypts are difficult to classify or identify because of the close relationship of species and the great variability in parts of a given plant.

Pryor (11) divided the genus into five subgeneric groups: Eudesmia, Corymbosa, Adnata, Renanthera, and Macranthera. He also observed that the species in the Renanthera required mycorrhizae for effective growth.

Within each subgeneric group hybridization freely occurs (11), contrary to earlier reports that the woody operculum effectively prevented hybridization (3). Thus there is interbreeding of Eucalyptus species from separate stands each occupying a different ecological situation. Mixed stands are comprised of species which may be genetically isolated. This led Crocker (6) to conclude that, "it is possible that these (species) might reduce in the strict genetic sense (coenospecies—that is species which are maintained by a genetic barrier)—to as few as 5 or 10", instead of the 522 species and 150 varieties listed by Blakely, in 1955 (4).

Nearly all species are evergreen but a few are monsoon deciduous (11). Costin (5), cited earlier by Pryor (11), also illustrates this with the Snow Gum (*Eucalyptus niphophila*) which grows to the timber line on Mt. Kosciusko in the Australian Alps, at 6500 feet elevation, and yet retains the evergreen habit, despite the cold winters. The ground is covered by several feet of snow and although temperatures can fall to 10° F., the snow cover apparently prevents the ground from freezing.

Botanical features of this genus are described in a number of standard works such as Black (3). Such works emphasize the hollow torus or receptacle of the 3-to-5 chambered capsule. It is apparently not clear whether the operculum is derived from calyx or petals, or both (8). Sometimes two separate lids may be seen suggesting that one may be calyx and one corolla in origin.

This woody capsule shown in Figure 2C may be an adaptation to fire as pointed out by Gardner (7), because some of these trees will not flower until the second or third year after exposure to fire.

Though the abundant stamens might suggest pollination by wind this is not so; flowers are mostly pollinated by insects and some are pollinated by birds (honey-eaters) (8). About 15 kg seed may be produced from a single tree, and there may be from 10,000 to 400,000 fertile seeds per killogram, depending on the species (8). Flowers and fruits are shown in Figure 2.

Lignotubers are common in mallees and certain other eucalypts (Figure 3E). These underground swellings of the stem base serve as organs of food and regeneration. It was once thought that these organs were pathological overgrowths. More recently it has been shown that they are normal structures and that they can be bred into species of Eucalyptus that do not normally produce them (8).

The Australian aborigines utilized the lignotubers as a source of water during their nomadic travels in the arid mallee scrub. Perhaps a quart or two of water might have accumulated within these structures.

Mallees are usually dwarf or stunted forms of eucalypts and grow generally in sandy, often calcareous, desert soil. Though mallees generally lack a definite trunk and rarely exceed 6 feet in height, the term mallee is sometimes used to describe eucalypts with single and even tall stems when they make up a scrub type of vegetation (3). The mallee habit may be an adaptation to the influence of fire, for it has been observed that mallees always survive fire and that they flower and fruit only after exposure to fire. Perhaps the deciduous bark shown in Figure 3 provides some fire protection.

There are many economic uses for eucalypts and these are listed by Penfold and Willis (8). About 60 species are important hardwood timber sources and some of the best timber comes from the magnificent karri and jarrah stands of southwest Australia. Some fine quality timbers come from Queensland and other states as well. In species not suitable for high grade lumber, pulp is utilized in making hard fiber board. There are 13 plywood mills in Queensland alone. Pulp is used also for making rayon and paper.

High-grade tannins are harvested from leaves. Also from leaves come oils useful in medicine (oil of eucalyptus), industry (as disinfectants and deodorants) and in making of perfumes, especially from the lemon-scented gums.

Eucalypts are also prized for their shade and ornamental value. Some of the most colorful flowers are found on eucalypt trees and shrubs, or mallees. These serve also as sources of nectar and pollen for honeybees, and blue-gum honey is renowned for its delicate flavor.

Eucalypts are necessary for the survival of koala bears (*Phascolarctos cinereus*). These marsupials ingest leaves of about a dozen species of Eucalyptus and this is their sole diet. They drink no water, depending upon gum leaves for moisture. This diet is reputed to account for the pleasant body odor of koala bears.

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FIGURE 2. Flowers and fruits of Eucalyptus species.

A. *E. ficifolia*, Scarlet-flowered Gum, has red filaments and yellow anthers. Note the membranous operculum over the emerging stamens.

B. *E. erythrocorys*, a Western Australia mallee. The filaments are green ending in yellow anthers while the operculum is crimson.

C. *E. macrocarpa*, a Western Australia mallee. Note the glaucous ovate leaves and the glaucous woody operculum. The filaments are red and tipped with yellow anthers. The capsule diameter is 2.5 inches.

D. *E. megacornuta*, a Western Australia mallee. The green cone-shaped operculum falls to release the greenish-yellow stamens.

E. *E. stoatei*, a Scarlet Pear Gum from Western Australia. The fluted capsule is scarlet while the stamens are bright yellow.

FIGURE 3. Trunk and leaf characters of Eucalyptus spp.

A. *E. tetraptera,* a Western Australia mallee showing characteristic leaves and the large, red 4-angled and almost 4-winged fruits. Stamens are red.

B. *E. viminalis,* from eastern Australia and Tasmania. Bark of eucalypts is deciduous falling in strips for this species, hence the name Ribbon Gum. In summer, a sweet sap exudes through the bark which gives it another common name of Manna Gum.

C. *E. grandis,* illustrating the deciduous nature of bark by loss in irregular sheets.

D. Trunk of Blue Gum, common in South Australia. The bluish-gray bark is renewed annually.

E. Lignotubers of a mallee, ranging from 1 to 2 feet in diameter. The lignotuber on the left shows mode of attachment to the stem, while the one on the right had several stems attached, none visible in the photo.

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BOTANY

The Translocation of Foliar Applied P-32 in Field Grown Corn, With Respect to Fruit Development[1]

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Introduction: Absorption, and the subsequent translocation of materials from the leaves of plants, is a phenomenon of common occurrence and the subject has been extensively reviewed in recent years (Arisz, 1952; Biddulph, 1959; Boynton, 1954; Swanson, 1959; Williams, 1955; Wittwer and Teubner, 1959). Foliar absorption and translocation is important physiologically for it bears upon the problems of foliar nutrition and herbicide and fungicide action in plants as well. The translocation of substances from "supply" leaves to metabolically active "sinks" is also part of this problem and has received attention in this laboratory particularly with respect to the accumulation of translocated materials by developing fruits.

Linck and Swanson (1960) studied the movement of P-32 from various leaves of *Pisum sativum* to the first developing fruit and concluded that 70 to 90% of the P-32 which moves out of the bloom node leaf is transported to the fruit at that node. They also concluded that the only other leaf that contributed a significant amount of P-32 to this same fruit was the leaf below it in phyllotaxic rank. Linck and Sudia (1962) and Sudia and Linck (1962) were also able to confirm a similar relationship of transport from the bloom node leaf to the fruit in *P. sativum* for C-14-labeled photo-synthate and Zn-65.

Ahlgren (1962), in studies of P-32 transport in soybean (*Glycine max*), concluded that P-32 applied foliarly is translocated preferentially to the fruits at the node of treatment and to the fruits at the node below.

To ascertain the extent to which a similar specificity of transport might occur between the leaf and the ear at the same node in corn, studies were undertaken with mature corn in the field. The objective of these studies was to delineate the pattern of movement of P-32 from the 7th leaf of the corn plant with respect to the development of the fruit of the corn plant at that node.

Materials and Methods: Corn grains of the variety Minhybrid 507 were planted according to good agronomic practice in the field laboratory on the Plant Pathology and Botany Farm at the Agricultural Experiment Station, Rosemount, Minnesota. Sixty-five days after planting, radioisotope treatments were begun. Plants were treated at intervals of 3 days early in the experiments and later at 5-days until the plants were 125 days old; a total of 17 treatments was made.

For each treatment, 3 plants selected for uniformity of development were used. Each of the 3 plants were treated by placing 50 μc of P-32 in a 10-lambda drop of 20 mM NaH_2PO_4 carrier solution on the surface of the 7th leaf midway between the base and tip and near the midrib. The 7th leaf subtended the first developed ear of the corn variety used. The radioisotope, as received from the Oak Ridge National Laboratory, was carrier free $H_3P^{32}O_4$ dissolved in HC1. These samples were dried on a hot plate and re-dissolved in 20 mM NaH_2PO_4. The NaH_2PO_4 increased the pH and provided a small amount of carrier phosphate.

The treated plants were allowed a 4-hour uptake period after which they were harvested and dissected at the field laboratory into the following parts: plant parts above the treated node, plant parts below the treated node, and the ear and husk at the treated node. Neither

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