LIGHT AS A CONTROL IN THE GERMINATION AND DEVELOPMENT OF SEVERAL MISTLETOE SPECIES.

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Synopsis.

It is shown that daylight is necessary at some stage in the germination and early development of some mistletoes.

When, in the ripe fruit, the embryo is white, no germination can occur unless sunlight falls on the seed after the removal of the pericarp. If the embryo is green, germination can occur in the dark, but continued growth will stop unless the surface of the endosperm is coloured.

When the surface of the endosperm is coloured, growth will continue in the dark, but no clamp will form unless light is permitted to fall on the seedling.

The orientation of the seed has no effect on its ability to germinate.

Introduction.

Germination tests in light and darkness were carried out on the species listed below. *Amyema miquelii* was also tested in various orientations.

Germination is defined as an enlargement in size of the embryo recognizable to the naked eye.

Species Tested.

The species tested are listed below, with the colour of both embryo and the surface of the endosperm, and the locality where collected.

Amyema pendula: Embryo white; endosperm white; collected Blackburn (Vic.), 1956–1957.

Muellerina eucalyptifolia: Embryo green; endosperm white; collected Eildon (Vic.), December, 1957.

Amyema miquelii: Embryo green; endosperm white; collected Emmaville (N.S.W.), September, 1958.

Lysiana exocarpi: Embryo green; endosperm bright green with four longitudinal straw coloured ribs passing medially between the longitudinal furrows mentioned by Brittlebank (1908) who found that fruits at Myrniong possessed five furrows; collected Swanwater (Vic.), April, 1958.

Amyema linophylla: Embryo green; endosperm red with longitudinal deep red ribs, these rapidly become purple on exposure to light. The inter-rib reddish colour appears as if it were derived from diluted pigment permeating outwards from the ribs. Blakely (1923, p. 146) described the seeds as white. Collected Swanwater (Vic.), April, 1958.

Techniques Adopted.

All seed was used within 24 hours of collection.

The pericarp was removed, then the seed was stuck to a vertically placed sheet of glass unless otherwise stated. The viscin formed an ideal adhesive. The viscin was reinforced by a colourless thread, normally contained within the viscin, that arises in the region of the hilum. It is more adhesive than the viscin. The thread appears to be the one by which seeds hang from twigs after being passed by birds.

All seeds were supplied with moisture and air, but no nutritive substances.

Samples in light were so placed as to receive as much direct sunlight as possible.

Germination in the Dark.

Amyema pendula.—Seed rotted away, with no evidence of life.

Muellerina eucalyptifolia.—The embryo expanded noticeably for the first two or three days, then became dormant. Neither endosperm nor embryo rotted as in *A. pendula.*

Lysiana exocarpi.—The embryo first showed signs of growth four hours after extrusion. Growth continued rapidly—a relative term with mistletoes—until the seedlings were between ¾ and 1 inch high after 2½ months. The stem with the adhesive cushion at its end grew vertically upwards and appeared etiolated—pale green colour, slender and much elongated stem and adhesive cushion. The adhesive cushion was thimble shaped, approximately three times as long as that of a seeding grown in daylight.

In this case seeds were grown on the ends of corks to which the seeds adhered by a lacquer formed from dried viscin. After four or five weeks in some seedlings the lacquer cracked, which allowed the endosperm and seedling to roll over in such a manner that the direction of growth was inverted. The adhesive cushion made weak movements to change the direction of growth towards horizontal. A disc formed at the base of the cotyledons at about 2 months, where abcission occurred at 2½ to 3 months. After abcission no further growth occurred. The seedlings lived up to 3 weeks in this state. All were dead 3½ months after extrusion from the pericarp.

Amyema linophylla.—This species was seen to be following a similar pattern to *Lysiana exocarpi*, but at a slower rate, so after 15 days the test was stopped.

Germination in Daylight.

Amyema pendula.—Growth was very slow. From 4 to 6 weeks after extrusion from the pericarp leaves appeared. The leaves always remained very small, never exceeding 2 mm. throughout life. Little further development occurred after the appearance of the leaves. After 5 months all seedlings were dead.

Muellerina eucalyptifolia and *Amyema miquelii.*—In both species the embryo expanded in the same manner as plants grown in the dark, and continued to grow at a uniform rate for a fortnight, when tests were concluded.

Lysiana exocarpi.—Growth commenced four hours after extrusion and continued unabated, but at a slower rate than in the seedlings germinated in the dark. The hypocotyl at first grew vertically, but within a week it curved away from the light until the adhesive cushion touched a solid object, a cork. Contact became permanent with the cork a fortnight after extrusion. When the convex adhesive cushion touched the cork it developed a central dimple, which expanded to make the cushion concave within two days. The clamp then became fixed. All seedlings had died after two months.

Amyema linophylla.—A similar but slower growth rate to *Lysiana exocarpi* was shown. First evidence of growth occurred after one day when the embryo elongated and the dark red ribs became purple. In four days the purple pigment had covered most of the endosperm. The change of colour was the most dramatic effect of exposure to daylight.

In *Muellerina eucalyptifolia* and *Amyema pendula* light was shone on the seed through the support; the hypocotyl grew away from the source of light, not necessarily towards the support. This is in complete agreement with Blakely (1922*a*) and McLuckie (1923).

Growth in Alternating Daylight and Dark.

Muellerina eucalyptifolia.—Growth had entirely ceased after four days for seeds germinated in the dark. The seedlings were then put in the sun for one day. This proved a sufficient stimulus for growth to continue for up to two days in the dark, when growth ceased. Light exposure was repeated with the same result. The shortest exposure tried was four hours, which provided an adequate stimulus.

Lysiana exocarpi.—When seedlings germinated in the dark were placed in daylight, they behaved as seedlings grown in daylight.

Growth in Various Orientations.

This was tried only for *Amyema miquelii*, the only species for which large quantities of seed were available.

Twenty seeds per test: (*a*) Grown in the pendulous or normal position; 95% germination. (*b*) Grown horizontally; 90% germination. (*c*) Grown inverted; 100% germination.

Discussion.

With the mistletoe species tested, light appears to be the controlling factor for successful germination and adhesion of the plant to the host. The effect of light may be predicted from the presence or absence of colour in the embryo and/or on the surface of the endosperm.

If the embryo is white, daylight is necessary before any evidence of growth can occur. If the embryo is green, growth can commence, but will continue only if the surface of the endosperm is coloured other than white. If it is white, sunlight is necessary before growth will continue. When the surface of the endosperm is coloured, sunlight is necessary before the adhesive cushion will attach to the host, but growth to the stage preceding attachment will occur.

The orientation of the seedling has no effect on successful germination.

It is of interest to note that *Muellerina celastroidea*, for which the germination was described by McLuckie (1923), appears to conform to the hypothesis stated above. This species was not examined by the author.

McLuckie states that the embryo contains chlorophyll even when enclosed in the fruit, also that the endosperm is white. He found that germination would occur only in light, but made no statement on the fate of the seed grown in the dark.

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