Monkey-apples: the fruit and seed of two *Syzygium* spp. (Myrtaceae)

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Introduction

The species examined here are the two familiar ornamental trees that have until recently been known as *Acmena smithii* and *Waterhousea floribunda*. Both are native to Australia. They and their relatives are now regarded as belonging to the large Asian-Pacific genus *Syzygium*. To have the best of both worlds as regards nomenclature I shall refer to them as acmena and waterhousea.

In Australia acmena is known as "lillypilly". I like the name "monkey-apple", partly because it seems to be a genuine NZ coinage but also because it can serve as a hint that the fruits have something tricky about them. As mentioned in a previous article (Gardner 1987), some sygygiums have crops of seedless fruit, or polyembryonic seeds. But acmena and waterhousea are even more remarkable.

Firstly, the matured seed is naked, that is, it lacks a testa, or seed-coat — the embryo consists of a mass of cotyledonary tissue (clearly bipartite only when young) directly in contact with the endocarp (inner lining of the ovary chamber). Secondly, the seed contains a dark branched structure, contained by the cotyledonary tissue but not fused with it. In acmena this "inclusion" spreads down into the seed from near the top of the ovary chamber, whereas in waterhousea it spreads up from chamber's base. See Fig. 1b, h.

Fruit Development

What has happened to the seed-coat, and how does the intrusion originate? We can begin by dissecting the ovary of the flower. In both species, and in all sygygiums as far as I know, the ovary is inferior and is divided in half vertically by a septum. The ovules are located on this septum and are supplied by an ascending vascular strand in it. The ovules in acmena and waterhousea are small ovoid short-stalked structures typical of the family. There are differences between the two species though: in the former the ovules are rather more numerous (c. 14 as opposed to c. 8); also, the septum of the waterhousea ovary is swollen in its basal half, where the ovules are located — the upper part of the septum is very thin and will soon tear as the seed grows (see Fig. 1a, g.)

Despite having a number of ovules, the ovary in each species only ever develops a single seed. The "sterile" (unfertilized?) ovules persist as flattened darkened structures, and their position relative to the septum and the ovule that eventually forms the seed is most helpful in understanding the course of fruit development.

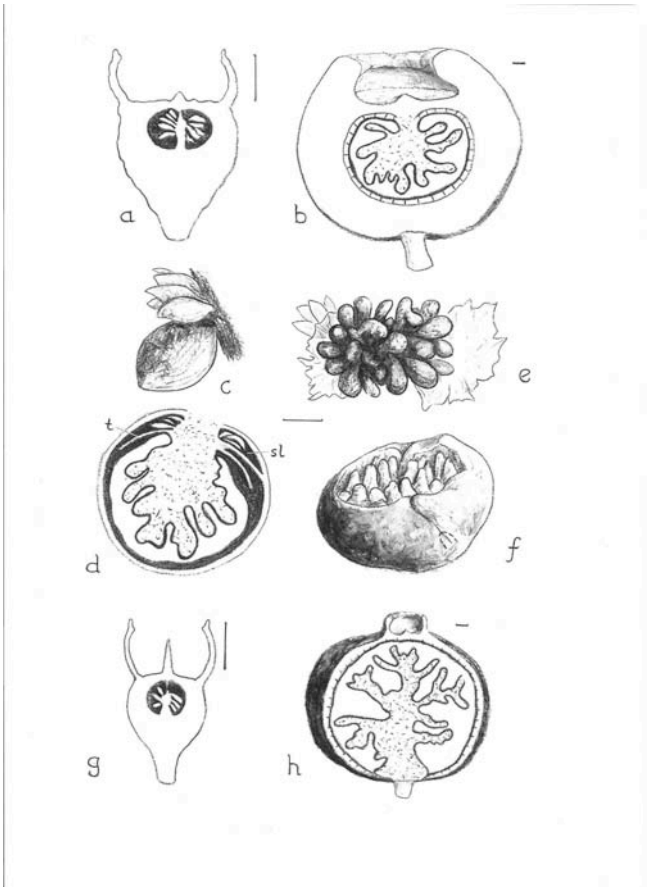

Fig. 1 a. *Syzygium smithii.* Section of flower.
b. *S. smithii.* Section of ripe fruit. Intrusion stippled. Endocarp (hatched) well-developed. Air-gaps (dark) between placental region and embryo, and embryo and endocarp, are exaggerated.
c. *S. smithii.* Early in fruit growth. Single "fertile ovule" and several neighbouring "sterile ovules".
d. *S. smithii.* Section of young fruit. Intrusion (placental region) darkly stippled. *sl* locule with the "sterile ovules". *t* testa (seed-coat). Air-gaps exaggerated.
e. *S. smithii.* Young fruit's placental region, showing lobed outgrowths, burst testa to each side, and beyond testa on upper left the group of "sterile ovules" in this locule.
f. *S. smithii.* Young fruit's embryo (cotyledonary mass), showing the lobed outgrowths of its hollowed adaxial face. Position of the radicle dashed at lower right, inside the division between the cotyledons.
g. *Syzygium floribundum.* Section of flower. Note that the septum is swollen below and thin above.
h. *S. floribundum.* Section of ripe fruit. Intrusion stippled. Note the weakly developed endocarp (hatched) and the thin flesh of the fruit.
Scale bars 1 mm.

Examination of a fruit at a very early stage (Fig. 1c) shows one swelling ovule, which can be called the "fertile" one (although in point of fact I do not know whether or not it has been fertilized). The other ovules in this locule, and all those in the other locule, are as they were at flowering. Examination a week or

so on (in acmena, when the fruit is c. 5 mm diam; in waterhousea, c. 3 mm diam.) shows that a very peculiar thing has happened (Fig. 1d, e, f): the embryo has burst out of the testa. It has grown considerably and has become lobed on its inner side against the placental region, which in turn has grown out towards the embryo. So we see two free but interlocked structures (like a hand plunged into a bowl of dough). A curious difference between the two species is that the embryo is green in acmena but red in waterhousea.

The growing embryo then is seen to have the septum and enlarging placental region on its adaxial side, and beyond that the "infertile locule" which is becoming compressed in a latero-apical position. The testa typically persists as a kind of ragged-edged hood at the base of the placental region. Crucially for this interpretation, the other ovules of the "fertile locule" are latero-apical between the testa hood and the top of the endocarp (See Figs. e, d, f) .

In waterhousea, because of the more or less basal position of the ovules on the septum, the seed as it grows can be serviced by a very short strand of vascular tissue coming up from below, that is, the placental region remains basal. In contrast, the septum in the acmena fruit is elongated and flattened to one side of the maturing seed, which consequently is supplied by a strap-like bundle several millimeters long. Anyone wanting to confirm this can take an acmena fruit and dissect out the strand — it will be found that where it curves over into the placental region there will be, hardly enlarged, the fruit's "infertile locule", its ten or so defunct ovules lying one on top of the other like a stack of scales. The defunct ovules of the fertile locule will be nearby, separated by the septum of the ovary, this appearing as a very thin oval patch of tissue but having the curve of the seed's vascular strand within it.

Early on in fruit development the tissue intruding from the placental region is yellowish and fleshy — perhaps surprisingly, it lacks lignified vascular tissue. Whether all this intrusion derives from multiplication of the testa at the attachment point of the ovule, or whether its inner part comes from multiplication of the placenta in the strict sense, that is, the attachment region on the septum, I cannot say.

It can be supposed that when the fruit nears maturity the presumed food-transferring function of the intrusion would no longer be needed. Consequently the intrusion loses its fleshy nature and, compressed to a degree by the final swelling of the embryo, transforms into a dark-yellowish (tannin-filled?) gummy branching.

Notes

1. Seeds with a very thin coat are not unknown -- in drupaceous fruits mechanical protection is often the function just of the endocarp, e.g. as in a peach. In a few other taxa it seems that an initially thin seed-coat is absorbed by the endosperm during development. But I am not aware that the situation described above has been reported elsewhere than in *Syzygium* and relatives.

2. In contrast, seeds with intrusions into the space normally occupied just by the cotyledons or endosperm are known in quite a number of families. Most commonly, e.g. in numerous palms, in pawpaw, and in many rubiaceous taxa, the intrusion is made by the seed-coat. The ecological advantage such "ruminate" seeds might have is unknown, but I think it reasonable to suppose that by this morphology attack of the seed by insects might be slowed down.

Reference

Gardner, R.O. 1987: *Syzygium* and related genera (Myrtaceae) in Auckland. *Auckland Botanical Society Journal 42*: 12-14.

Note on the flowers of *Hebe speciosa* (Scrophulariaceae)

Rhys Gardner

Introduction

For several years I have been growing authentic material (cuttings ex Maunganui Bluff) of this fine plant, a true "easy care" shrub. I had thought to experiment with its pollination, to learn whether there might be some self-incompatibility here (de Lange & Cameron 1992) and so help answer one of urban ecology's medium-sized questions: "why, in the world's weediest city, have hebes (*Hebe* spp.) naturalized in almost none of the many and varied habitats available to them ?"

In the meantime though I just want to offer an observation concerning floral morphology, of minor import but apparently novel. (I am not breaking a promise made long ago to my parents that I would never get involved with a hebe - since they are all veronicas now ...).

Flower development

My several bushes of *H. speciosa* have two main flowerings per year, once in summer (January) and again in winter (May to mid-July). The flowering on the larger ones takes place over a month or so. The opening of the flowers on a single inflorescence has a