

Rhaphiolepis

Considerations on low fertility varieties for Australian Horticulture

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Introduction

The genus *Rhaphiolepis* in the family Rosaceae consists of around 15 species whose Asian origins include Japan, Korea, China, Thailand and Vietnam.

A recent review of the genus suggest that they are perceived as becoming weedy in some regions and Local Government Areas (LGA) in eastern Australia.

Background

Rhaphiolepis is represented horticulturally as an ornamental shrub for nursery, garden and landscape use in Australia by two species - *R. indica* and *R. umbellata* and hybrids likely derived from these species including *R. x delacouri*.

Some varieties of the above species are difficult to classify presenting attributes/characteristics of both species. These species and varieties/cultivars have over the past 30 years been moderately popular as garden and landscape subjects due to their hardiness, compact size (usually less than 2m high) and attractive flowers.

The accurate identification of the species and older varieties/cultivars is critical to differentiate between the perceived common genotypes as incorrect accusations of perceived weed risk can be directed based on incorrect taxon.

The common varieties/cultivars which had predominantly been propagated and grown in Australian possess levels of fertility via populations of viable seed which has supported to some naturalization of the plant in suitable micro-environments. These older common genotypes of *R. indica* which have been nominated as a noxious weed in several LGA's including six in the Sydney basin and others on the north coast and Blue Mountains areas as well as south eastern Queensland. The principal reasons attributed for this is their high fertile seed set, high germination rate and appeal to Birds who readily consume the fleshy fruit and distribute the seed often in bush land environments. The consideration of *R. indica* as noxious may be more as a response to an invasive habit rather than noxious by definition?

The determination of weeds is often done at a generic level broadly considering a 'genus' and all it's species even though a single species or even single genotype is the 'guilty party' becoming a weed. *Hypericum spp.* is an example of this where because a couple of species are weedy the whole genus is banned by Biosecurity Australia to the exclusion of sterile triploids bred by Esmeralda Farms in Ecuador. The risk of one or two is applied to all.

The South Australian Government recently considered fertility levels and seed set in allowing three *Gazania* Cv's including 'GT20' sold as 'Double Gold'TM, 'Sugaja' sold as 'Sunset Jane'TM and 'Sugamo' sold as 'Montezuma'TM to be propagated and grown while excluding all other *Gazania spp.* across the state.

Orange Eye Butterfly Bush, *Buddleja davidii* is gazetted as a noxious weed in the states of Washington and Oregon in the USA. Certain varieties referred to as "seedless butterfly bush"

that produce less than 2% viable seed, are considered sterile in Oregon and Washington where the propagation, cultivation and sale of these 'Sterile' cultivars is allowed as of September 2011.

New Developments

Recent plant breeding and variety releases by Ozbreed of **Cosmic Pink™** *Rhaphiolepis indica* 'RAPH02' PBR and **Cosmic White™** *Rhaphiolepis indica* 'RAPH01' PBR have attempted to address the perceived issue of weed potential that *Rhaphiolepis spp.* have due to high fertile seed production. For a number of years now Landscape Architects in Australia have been specifying these environmentally safe varieties due to very low seed set and low viability of seed.

These two new varieties were specifically selected with their low seed set as one of their desirable characters.

Time has shown this to be true with the breeder, Mr Vic Ciccolella indicating that for a number of years the seed set has been extremely low on these two varieties and that he has been unable to germinate to survivability any of the seed produced in optimal germination conditions for the purposes of further breeding, despite many repeated attempts. This is supported via field observations of the varieties 'Cosmic Pink' and 'Cosmic White'™ *Rhaphiolepis indica* 'RAPH01' PBR producing few seeds per flower head. Considering the low seed production and studies on plant breeding systems it is likely that these two CV's are agamosperous. This is a type of reproduction in which the embryo develops without fertilization, ie. It is female infertile. In the case of these two new varieties of *Rhaphiolepis* they are also rarely agamosperous, as they rarely set seed as evidenced later in this paper.



Image 1 shows 4 year old Nursery stock of 'Cosmic White'™ *Rhaphiolepis indica* 'RAPH01' PBR. There were two seeds present on the 11 plants. This low seed production is characteristic of this cultivar/variety and 'Cosmic Pink'™ *Rhaphiolepis indica* 'RAPH02' PBR replicated through several years of development and observation prior to commercial release in 2014.



Image 2 In 2014 100 seeds were collected from 13 mature plants growing at Clarendon NSW (Ozbreed's Nursery) of 'Cosmic White'[™] *Raphiolepis indica* 'RAPH01' PBR for the purpose of breeding and testing viability. These were sown in a standard nursery tray in an environment controlled tunnel house. Only 2 germinated (2%) and they died at around the third true leaf stage. In one germination trial conducted by the breeder of 'Cosmic Pink'[™] *Raphiolepis indica* 'RAPH02' PBR, zero germination was achieved from 40 seeds sown in 2013. True to varieties of angiosperms that are agamosperous it is often shown they were weak and slow to develop, and have low viability as evidenced in literature. In contrast literature based on scientific experiments has shown regular common female fertile *Raphiolepis spp* has a very high germination rate.

Analysis/Sampling - methodology

This study was to determine the potential seed set of an old *R. indica* cultivar/variety and compare it to the two new varieties 'Cosmic Pink'[™] *Raphiolepis indica* 'RAPH02' PBR and 'Cosmic White'[™] *Raphiolepis indica* 'RAPH01' PBR. Seed samples were taken at random with a single 'average' inflorescence being taken to represent the species or variety of *R. indica*. The inflorescences of *Raphiolepis spp.* and Cv's clearly show (see image 7) the abscission point of the flowers. This allows easy recognition of where the flowers were and hence where seed and even parts of the inflorescence had abscised. The sample *R. indica* showed a very low degree of flower/fruit abscission (drop) where 'Cosmic Pink' and 'Cosmic White' had a high degree of abscission. Further, most inflorescences of these new Cv's 'Cosmic Pink' and 'Cosmic White'[™] *Raphiolepis indica* 'RAPH01' PBR had totally abscised, leaving a single abscission point on the terminal branches.



Image 3 (left) 'Cosmic White' and 4. 'Cosmic Pink' in full flower. The general set of flowers on these varieties show a high flower production similar to that on older *Raphiolepis indica* varieties. 'Cosmic White' and 'Cosmic Pink' have a very low number of inflorescences remaining to carry seed. Most abscise leaving a single abscission point on the terminal branches with only a few seed bearing inflorescences remaining to carry any seed.

Seed viability is considered high for *R. indica* as evidenced in literature and very low for the two cultivars. To estimate seed set, for this paper, samples were taken from a random representative of *R. indica* in Bellingen NSW 30°deg 27.108' South 152° 53.461' East and the two Ozbreed Varieties 'Cosmic Pink' and 'Cosmic White' (bred by Mr Vic Chiccolella) were at Ozbreed Pty Ltd Clarendon NSW 33 ° 35.729' South 150 ° 47.394' East. All plants were healthy and of mature size grown in the ground, and all were at least 6 years old.

Data – Table 1

Plant	Inflorescence #	Fruit set/Inflorescence	Total fruit per plant
<i>R. indica</i> (Bellingen)	> 250	Approx 50	12,500/plant
'Cosmic Pink' [™] <i>Rhaphiolepis indica</i> 'RAPH02' PBR	150	Approx 0.5	Approx 75/plant
'Cosmic White' [™] <i>Rhaphiolepis indica</i> 'RAPH01' PBR	150	Approx 0.25	Approx 30/plant

Table 1 Demonstrates that a typical 'old' common form/variety of the species offer potentially high fertility and with due probability deserves to be considered as high risk from a weed perspective.



Image 5, 6 and 7. *Rhaphiolepis indica* from Bellingen NSW showing Left to Right, mature growth habit, flowers and fruit and detail of inflorescence containing 56 seeds. Note there are very few aborted fruit on the inflorescence.



Image 8, 9 and 10. 'Cosmic White'[™] *Rhaphiolepis indica* 'RAPH01' PBR 8 years old showing Left to Right, mature growth habit, Inflorescence that survived to maturity showing high degree of abortion, flowers and fruit showing low seed set and floral branches abscising.



Image 11, 12 and 13. 'Cosmic Pink'[™] *Rhaphiolepis indica* 'RAPH02' PBR 6 years old showing Left, mature growth habit – and Right, flowers and fruit showing high degree of abortion and limited seed set.

The 'Cosmic White'[™] *Rhaphiolepis indica* 'RAPH01' PBR and *Rhaphiolepis* 'Cosmic Pink' shown and tested here were at Ozbreed Pty Ltd Clarendon NSW.

In Conclusion

The new varieties Cv of *R. indica* 'Cosmic Pink'[™] *Rhaphiolepis indica* 'RAPH02' PBR and 'Cosmic White'[™] *Rhaphiolepis indica* 'RAPH01' PBR have a significantly reduced seed set over the old common species that have been grown for the past 30-40 years. All reproduction of these 2 varieties/ Cv is via vegetative propagation.

Analysis of the seed set data above supports that 'Cosmic Pink'[™] *Rhaphiolepis indica* 'RAPH02' PBR produces 0.6% of the seed set of the *R. indica* sample and 'Cosmic White'[™] *Rhaphiolepis indica* 'RAPH01' PBR is 0.24%. These are statistically very low numbers and support a 'statistical' sterility also supported by the poor germination tests above.

When you add low seed viability indicated by the germination test shown in image 2, and the experiences of the breeder who has unsuccessfully been able to breed from these varieties, to the numbers you have two varieties that do not contribute sufficient viable seed to the environment to become weedy. Particularly when a germination test in optimal greenhouse conditions had a 2% germination rate and 100% mortality within 300 days.

After many attempts to breed from 'Cosmic White'[™] *Rhaphiolepis indica* 'RAPH01' PBR and 'Cosmic Pink'[™] *Rhaphiolepis indica* 'RAPH02' PBR by both the breeder and Ozbreed, zero live plants have been observed on multiple germination trials. Only 2 seeds have germinated in these trials in total, and both plants died at a very young age. Based on this research, it is likely that 'Cosmic White'[™] *Rhaphiolepis indica* 'RAPH01' PBR is not only female infertile, but also incapable of replicating by seed. Based on the evidence from the breeder where no germination has been recorded for Cosmic Pink, it is likely that it is also female infertile, and incapable of replicating by seed.

While this study targets the *R. indica* varieties 'Cosmic Pink'[™] *Rhaphiolepis indica* 'RAPH02' PBR and 'Cosmic White'[™] *Rhaphiolepis indica* 'RAPH01' PBR, there are a number of other introductions from the last ten years that may have similarly low seed set and viability available in the nursery and garden industry.

It seems unjust to these authors to exclude varieties that are the result of sound and ethical breeding and development programs on limited data or a generic sweep of the hand. Scientific evidence presented in this paper clearly shows that 'Cosmic White'TM *Rhaphiolepis indica* 'RAPH01' PBR and 'Cosmic Pink'TM *Rhaphiolepis indica* 'RAPH02' PBR present zero potential of invasiveness due to likely female infertility, and for practical reason a zero potential of viable seed compared to common *Rhaphiolepis* spp.

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