Pollen quality, parents, and weather factors in relation to seed production in plants of *Acacia myrtifolia*[1]

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INTRODUCTION

This paper examines genetic and environmental factors that may relate to reproduction in *Acacia*. Pod set in many Australian *Acacia* species is erratic and may vary considerably from year to year. Some factors which could affect seed set are pollen quality, weather conditions and parentage. Pollen quality may be directly affected by the weather as it matures and during the time between pollen maturity and dehiscence. This is a preliminary report of our investigation of some of these factors using *Acacia myrtifolia* plants grown in pots from seed collected in the Brisbane Ranges National Park near Melbourne, Victoria, Australia.

Acacia myrtifolia is a spring flowering shrub. The flower heads consist of one to three flowers. Each flower has between 300 and 650 anthers and a single pistil. Each anther contains 8 polyads, a compound of eight pollen grains resulting from two tetrads arranged in a flat oval disk. The stigma is a cup-shaped depression a little greater in diameter than the largest diameter of the polyad. The stigma is connected by a style, 3 to 5.5 mm long, to an ovary containing eight ovules. Pollination is usually by a single polyad (52% of cases in the field), 5% of pistils collected in the field had more than 1 polyad on the stigma and 43% were unpollinated. The pollen germinates in the post-pollination exudate, and the pollen tubes grow through the style to the ovary, carrying the sperm cells to fertilise the ovules (Kenrick and Knox 1985 and 1989, Kenrick *et al.* 1986).

MATERIALS AND METHODS

Samples of pollen were collected by touching flowers with dehiscing anthers onto clean microscope slides which were either used to pollinate flowers or treated with Fluorescein Diacetate (FCR) for the estimation of pollen quality (Heslop Harrison *et al.* 1984). In the pollen quality estimation about 100 polyads were scored by fluorescence microscopy for each sample. The percentage of polyads with all 8 grains fluorescent in each sample was used as the measure of pollen quality.

All flowers were bagged in cellophane prior to flower opening and crosses were performed by touching pollen coated slides on to the stigmas which can just be seen with the naked eye. The flowering shoots were rebagged until the flowers were senescent. The results of cross pollination were monitored to give data on the numbers of pods which were developing three weeks after pollination, the numbers of ripe pods harvested and the mean number of seed set/pod for each bag pollinated. Daily weather data in the form of barometric reading, maximum

[1] This paper is an expanded abstract of the talk delivered to the 7th IGSM Meeting titled: "Environmental factors related to seed-set in some Australian acacias."

and minimum temperature, relative humidity, average wind speed, maximum wind gust, hours of sunlight, evaporation and rainfall in millimetres were given for the 24 hours from 9AM in monthly reports supplied by the Bureau of Meteorology, Melbourne.

The analysis is a preliminary one using analysis of variance and regression analysis (without estimating any interactions) from a MINITAB 7 package.

RESULTS

Pollen Quality

Polyads appears to lose quality as individual grains (Figure 1). It is rare to find a fresh sample with no fully viable polyads as well as to find samples without some non-fluorescent grains in some polyads.

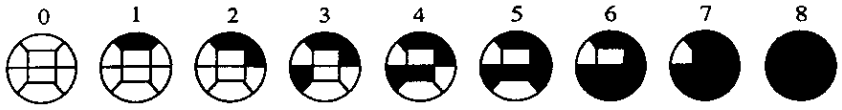

Figure 1. Decline in pollen quality.

Pollen quality varies considerably between samples. Samples ranged from those which have only a few polyads with all grains fluorescent to those in which all polyads were fully fluorescent. The mean of all the samples tested was 34.7% fully fluorescent polyads. One collection of 14 flowers which were picked after several days rain had a mean of only 16.1% of polyads fully fluorescent. Generally, flowers which developed and became dehiscent in sunny weather, produced pollen of better quality; for example, nine flowers sampled in good weather had a mean of 47.9% top quality polyads.

Pollen quality varied between pollen parents giving an F-test = 3.18 with 33, 155 Degrees of Freedom (DF) which has a probability, p = <0.001 which is significant at 99.9% level[1].

Weather conditions for the 24 hours before collection affected pollen quality. Nine meteorological factors accounted for 16.1% of the variation in pollen quality. When a pollen parent weight was included, 40.7% of the variation was accounted for. Evaporation was the most significant predictor, having a negative coefficient with a t-ratio of 2.97 and probability = 0.003**.

Does pollen quality have any real influence on seed set? Analysis of variance indicates that pollen quality does have a significant effect on the number of pods set but, once pods are set, the

[1] Significance levels: * = <5%; ** = <1%; *** = <0.1%.

effects of pollen quality on the number of pods matured becomes statistically non-significant. Pollen quality has no effect on the number of seed/pod harvested about 4.5 months after pollination. Out of 165 pods harvested, only one contained less than 2 seeds set, however, about half the pods included at least one aborted seed.

Effects of Parents on Yield

Pollen parents did not have a statistically significant effect on the pods set, or the seed yielded. However, some of the pod parents had a significant effect on numbers of pods set, pods harvested and seed set/pod.

Post Pollination Weather Effects

Using meteorological data for 24 hours after pollination as predictors of pod set, the regression was significant at 5% level and 12.1% variation in numbers was explained. When the pollen parent quality factor was added, 14.7% variation in pod numbers was accounted for by the regression. The barometric reading was the single most significant predictor, with a t-ratio = 3.37 $p = 0.001^{***}$ and Pollen parent quality as a predictor gave a t-ratio = 2.15 $p = 0.033^{*}$.

Pods harvested and seed/pod numbers did not have a statistically significant relationship with the weather factors measured.

CONCLUSIONS

The quality of pollen in different samples varied significantly from one pollen parent to another. Pollen collected after rain was less viable than when collected after fine sunny days. Based on analysis of 189 samples, the most significant factor in lowering pollen quality was high levels of evaporation. Pollen quality did affect the number of pods set but pollen parent effects were not great enough to give a statistically significant result. However, the pod parent effects were statistically significant for pods set and pods harvested and seed/pod. The weather during the first 24 hours after pollination also had a significant effect on pod set and the best predictor was barometric reading.

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