POTENTIAL FOR PEANUT PRODUCTION IN SOUTHERN AUSTRALIA

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Peanut (*Arachis hypogaea* L.) is grown over a wide area in Australia under various environmental conditions. The market demand for peanuts often exceeds local production and so importation is required. Currently most peanut production occurs in northern Australia, but there is potential for the development of new production areas, particularly in areas with irrigation. Numerous studies have been conducted on peanut production in northern Australia, but there is very little experimental information from southern Australia. The object of this thesis was to obtain information relevant to the development of peanut production in southern Australia. Initially peanut cultivars were identified with short maturity adaptation, and tolerance to extreme (both high and low) ambient temperatures. The pod yield potential of selected cultivars was examined with various plant density and spatial arrangements. Finally, a crop simulation model developed for cultivars grown in northern Australia was used to predict yields within the climatic environment of southern Australia.

A cultivar by time of sowing trial (with irrigation) was used to assess the physiological response of 24 cultivars to environmental conditions, at Roseworthy, 50 km north of Adelaide. Response to 3 sowing times (4th October, 7th November and 11th December) for parameters such as pod number and pod yield per plant was large, and varied considerably amongst the cultivars. For example, the Virginia cultivar VB97 and its sub-line VA61102 produced a large number of pods per plant (average 53 and 54 respectively) and thus a large yield (107 and 132 g plant$^{-1}$ respectively) across all three sowing times. This was in contrast to another Virginia cultivar, Mani Pintar, which produced an average of 24 pods per plant and a pod yield of 37 g plant$^{-1}$. This experiment enabled the identification of cultivars with the potential to adapt to the shorter season and high-day temperature and low-night temperature encountered in southern Australia.

Plant density experiments with a single Virginia peanut cultivar, VB97, grown under optimal conditions, were conducted at the Loxton Research Station, 200km
NE of Adelaide. Here the lowest plant density treatments produced the highest pod yield, a result, which is in contrast to yield responses previously reported for a number of different crops. However, where plant density arrangements were converted into spatial ratio values, it was shown that the squarer arrangements had the highest pod yields, and as the degree of rectangularity increased, the yields became lower. Pod yields of about 5t ha$^{-1}$ obtained at the lower plant density (ie. 50,000 plants ha$^{-1}$) were comparable to yields reported in northern Australia.

More detailed information was therefore sought on the influence of spatial arrangement on yield (using the Virginia peanut cultivar, VB97). In field experiments conducted at Roseworthy, where four different plant densities and spatial arrangements were compared, showed the more rectangular the arrangement the lower the yields. In this situation, the highest pod yields being achieved at the higher plant densities. Pod yields of about 7t ha$^{-1}$ were obtained at the highest plant density (518,000 plants ha$^{-1}$) and a spatial ratio of 1:1. Spatial arrangement influenced the solar radiation intercepted and subsequent utilisation of this light to produce dry matter and yield. Based on the results of this study, it is likely that a plant density of between 250,000 to 300,000 plants ha$^{-1}$ at a spatial ratio of 1:1 would be the optimal density for an adapted cultivar grown in this region.

The growth and yield data from the spatial arrangement experiment was used to validate the peanut simulation model developed under the Agricultural Production Systems Simulator (APSIM) framework. In particular, the spatial arrangement data was used to refine the existing population response routine in the model, thereby enabling better prediction of yields with different spatial and plant density arrangements. Subsequent scenario analysis, using a probability of exceedance framework, showed the importance of sowing longer maturing crops early in the season, as well as the yield penalties involved when sowing occurred too late. Whilst the early maturing cultivar, Chico, had a lower yield potential than the longer maturing cultivar (NC7), it produced a very consistent yield when sown on all five sowing dates. But the pod yield data obtained for NC7 was inconsistent, with large variation occurring between the early and late sowing times. The APSIM model inputs are mainly based on information from experiments conducted in the northern
part of Australia. The data obtained in this thesis provided valuable validation for the APSIM peanut model that, in turn, allowed a valid assessment of the commercial potential for peanuts grown in southern Australia.

The results from the thesis showed the importance of spatial arrangement and plant density when trying to optimise yield potential in the southern Australian environment. In addition, it was shown that cultivar maturity is a crucial factor in the successful adaptation of peanut to this environment, due to the shorter growing season available. In southern Australia, there is a high yield potential with certain cultivars, when grown with irrigation, at relatively high plant density in more isometric planting arrangements. Thus the opportunity exists to produce high yielding peanut crops on a commercial scale in southern Australia.