western part. It also occurs in the Sai Kung Peninsula. *Sphenomorphus indicus* seems to be restricted to the Tai Mo Shan massif in central New Territories. With forests becoming more mature, it is likely that the latter species will spread to other parts of the New Territories.

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FLORA

A survey on some native tree legumes for their ability to form root nodules and fix nitrogen in Hong Kong

by Angie Y. S. Ng

Introduction

Nitrogen is one of the most important nutrients required by plants but also one of the most deficient nutrients in most ecosystems, particularly on degraded land. Due to increasing land degradation around the world, forest restoration has been a hot research topic over the last decade. Reforestation in Hong Kong was started in the 19th century by the British colonial government (Corlett, 1999). Since World War II in 1945, mainly exotic tree species, for example *Acacia confusa*, *Acacia auriculiformus*, and *Eucalyptus* spp., were planted (Corlett, 1999). More native tree species were tried over the last decade and some more studies on native tree species were conducted. However, no work has been conducted on native legume tree species which should in theory have high potential for forest rehabilitation and restoration. It is because legumes are able to fix atmospheric nitrogen that they may allow them to perform better on degraded soils and improve the soil condition. The aim of my final year project was to investigate the nodulation and nitrogen fixing ability of native tree legume species in the field as well as in nursery conditions.

Materials and methods

Eight native tree legume species were investigated in the Native Tree Nursery of Kadoorie Farm and Botanic Garden and in the field (4 of the 8 species only) from September 2003 to early 2004 for their abilities to form root nodules and fix nitrogen (Table 1).

In the nursery study, about 20 nursery grown seedlings (mean height 6.4 - 41.6 cm) of each species were examined for the formulation of root nodules. The ability to form root nodules was measured in terms of presence of nodules, number and size of nodules. In the field survey, 3 seedlings of each species from 3 sites were examined (Table 1). The occurrence of nodules was examined by excavating the roots to 20 cm deep and 30 cm in diameter around the main stem. The activity of the nodules found was determined qualitatively by examining the interior colour of the nodules – effective nitrogen fixing nodules appear to be red inside due to the presence of the nitrogen fixing enzyme nitrogenase while ineffective nodules are white inside (Sprent, 2001). Quantitative methods such as acetylene-reduction assay (Hardy *et al*., 1968) or N-15 methods (Galiana *et al*., 2002) were not used due to limitation in laboratory equipment and facilities.

Since two of the studied nursery species formed root nodules in some individuals only, the nitrogen content between nodulated and non-nodulated individuals of these two species were compared by measuring the Kjeldahl total nitrogen in shoots (Bremer and Mulvaney, 1982).

Table 1. Nodulation survey results in the nursery and the field.

Species name	No. of nodulating individuals (No. examined)	
	Nursery	Field [Site]
Gleditsia australis	0 (20)	Not surveyed
Adenanthera pavonina	0 (20)	Not surveyed
Archidendron clypearia	20 (20)	3 (3) [Mui Tze Lam] 3 (3) [Tai Po Kau] 1 (3) [Wu Kau Tang]
Archidendron lucidum	20 (20)	0 (3) [Mui Tze Lam] 0 (3) [Tai Po Kau] 0 (3) [Pak Ngau Shek]
Archidendron utile	4 (10)	Not surveyed
Ormosia emarginata	9 (20)	0 (3) [Mui Tze Lam] 0 (3) [Pak Ngau Shek] 0 (3) [Wu Kau Tang]
Ormosia pachycarpa	20 (20)	0 (3) [Shek O]
Ormosia semicastrata	11 (20)	Not surveyed

Results

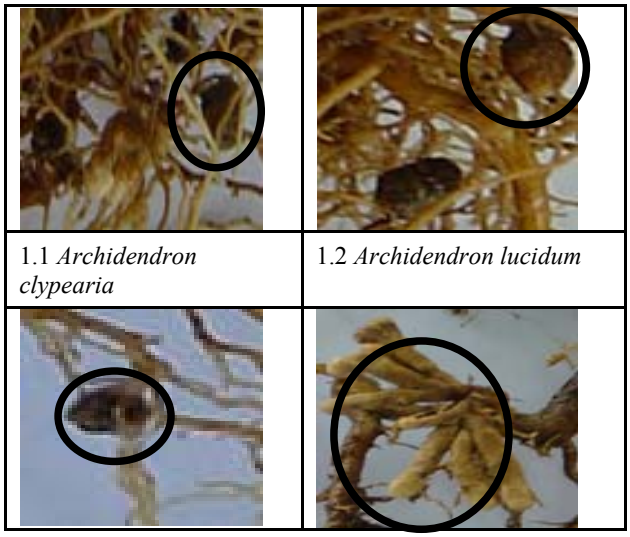
In the nursery study, *Adenanthera pavonina* and *Gleditsia australis* did not form root nodules in all samples examined. *Archidendron utile*, *Ormosia emarginata* and *O. semicastrata* nodulated in around half of the samples. Nodules were found in all samples of *A. clypearia*, *A. lucidum* and *O. pachycarpa* (Table 1). Field surveys showed that *A. clypearia* formed root nodules in all samples examined but no nodules were found in *A. lucidum*, *O. emarginata* and *O. pachycarpa* (Table 1).

Coralloid was the commonest shape among mature nodules while all young nodules were spherical (Fig. 1). Nodules concentrated in the top 10 cm of soil around the main root. Nodule interior colour varied from pale yellow to dark orange among species (Fig. 2). This indicated that most nodules were active in fixing nitrogen. In the nursery, the total nitrogen content in the shoot of nodulating seedlings was not significantly different from those in non-nodulating seedlings in *O. emarginata* (U=21.5, p>0.5, n=9, 6) and *O. semicastrata* (U=26.0, p>0.5, n=7, 8).

Conclusion

This study provided preliminary nodulation and nitrogen-fixing data on several native tree legume species in Hong Kong. Unfortunately, quantitative assessment of the nitrogen-fixing ability of these species was not conducted due to the lack of suitable equipment and time constraints. Future studies should include a more comprehensive survey on nodulation status of native legume species in the field. The rhizobia species associated with root nodules in these legumes may also identified. The nitrogen-fixing ability of the legume species should be assessed quantitatively, for example by acetylene-reduction assay or N-15 methods. Finally, the growth performances of the nitrogen-fixing legume species should be assessed by field planting trials. With these studies, suitable nitrogen fixing native legume species can then be selected for forest restoration on degraded land in Hong Kong.

Fig. 1. The six nodulating tree legume species from the KFBG nursery. The circled areas are root nodules. Young nodules are spherical in shape while mature nodules differentiate into variable shapes.



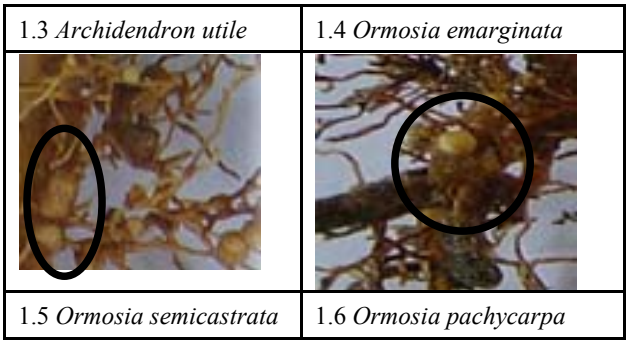
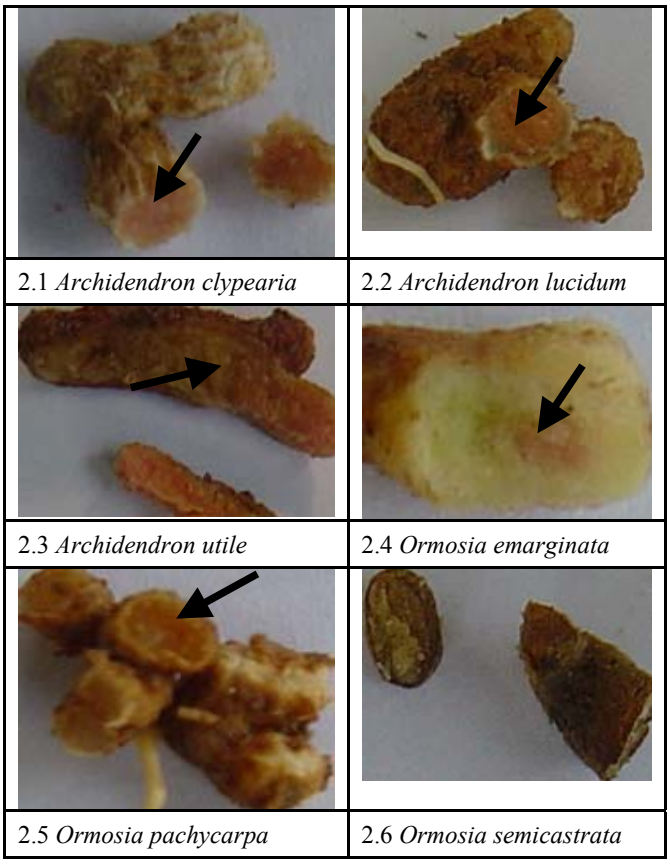


Fig. 2. Root nodules and their interior colours from the six native tree legume species from KFBG nursery. Pinkish to orange colour (Fig. 2.1 - 2.5, as indicated by arrows) indicates active nitrogen fixing nodules.



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