A STUDY OF NITROGEN FIXATION, NITROGEN DISTRIBUTION AND SEED YIELD OF SELECTED LEGUMES WITH TWO DIFFERENT GROWTH TYPES.

A thesis

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SUWIT LAOHASIRIWONG

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ABSTRACT

Plant growth types of the determinate and indeterminate growth forms are commonly distinguished in many legume species. However, there do not appear to be many studies where direct comparisons have been made of the two growth types in relation to nitrogen fixation and nitrogen distribution. Furthermore, there are disagreements in the literature about the yield advantage of these two growth types.

This study was initiated to identify the influence of different growth types of selected grain legumes on seed yield, nitrogen fixation, and nitrogen distribution. In addition, the emphasis was also put on finding amongst the measured parameters, one that had the greatest influence on the differences observed.

Initially determinate and indeterminate growth types of bean (Phaseolus vulgaris) and soybean (Glycine max), were studied in glasshouse conditions. The indeterminate cultivar of both species had higher leaf area and nodule dry weight, more root growth, accumulated more total dry weight and had higher yield than that of the determinate cultivar. In both species, the indeterminate cultivar accumulated more total plant nitrogen than the determinate cultivar. However, only the indeterminate soybean cultivar showed significantly more nitrogen fixation (Acetylene reduction) than that of the determinate cultivar.

Subsequently the same soybean cultivars ('Matara' =determinate and 'Amsoy' =indeterminate) were studied in controlled

environment conditions. The indeterminate cultivar produced higher vegetative dry-matter and seed yield than that of the determinate cultivar. The higher acetylene reduction activity of the indeterminate cultivar came primarily from a greater nodule mass. About 30-40% of seed nitrogen of both cultivar came from re-distribution from vegetative parts, but the stem of the indeterminate cultivar re-distributed a higher proportion of nitrogen to the seed than that of the determinate cultivar. Among several plant characters measured (viz. the dry-weights of the roots, nodules, stems, leaves, and pods, the leaf area, acetylene reduction activity and the total plant nitrogen) leaf area was identified as the key factor in determining the difference between the two growth types.

In order to determine the relative importance of leaf area as a factor influencing seed yield, nitrogen fixation and nitrogen distribution the leaf area of the indeterminate cultivar 'Amsoy' was manipulated by imposing different levels of partial leaf removal starting at the flowering stage. For one treatment, partial pod removal was also applied to induce a reduced demand of assimilate. Partial defoliation of the indeterminate cultivar reduced markedly the root growth and the number of branches, but nodule growth, acetylene reduction activity and nitrogen distribution was reduced to a lesser extent. Partial pod removal did not change the overall pattern of response. When about 60% of the leaves of the indeterminate cultivar were removed, seed yield was reduced by about 17% and it was still significantly higher than the undefoliated determinate cultivar. There was no significant difference between the rates of nitrogen accumulation in the pods under each treatment. The final seed

nitrogen concentration was not affected by defoliation treatments nor was the partitioning of nitrogen to seed.

It was concluded that there were differences between the two growth types of soybean for seed yield, nitrogen fixation, and nitrogen distribution. Leaf area was the most important parameter in determining these difference. The greater overlapping of vegetative and reproductive growth in the indeterminate cultivar seemed to be advantageous rather than disadvantageous. This longer period of vegetative growth enabled the indeterminate cultivar to produce a bigger source capacity which consequently supported more nitrogen fixation activity and produced higher seed yield.

The possible implications to tropical agriculture were discussed and some future research topics were also suggested.