# OPTIMUM GROWTH AND PRODUCTION OF VEGETABLE SOYBEAN AND WINGED BEAN WITH IMPROVED *BRADYRHIZOBIUM* TECHNOLOGY AND CULTURAL PRACTICES

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## Introduction

Vegetable soybean is a highly nutritious and highly priced economic crop in Malaysia providing a possible net earning of RM$11960 $ha^{-1}$ in 70 days [1]. Local agronomic studies on vegetable soybean is minimal but reports on grain soybean using saturated soil culture technique have shown that it was possible to raise the grain yield of inoculated soybean from 1.5 to 3.0 t $ha^{-1}$. In vegetable soybean, the short vegetative growth phase to harvest (70 days), makes it an ideal intercrop between the two rain-fed and irrigated padi seasons. Exploiting its $N_2$- fixing potential through *Bradyrhizobium* inoculation would not only reduce the input cost but also raise its value as a cash crop.

Winged bean (Psophocarphus tetragonolobus (L.) DC), an indeterminate, climbing perennial legume requires a support system to achieve high yields. Leguminous crops are an important source of protein and improve soil fertility from their $N_2$ fixing activities. Thus, accurate estimations of the amount of $N_2$ fixed by different legume crops in a particular agro-ecosystem are required to assess the contribution of biological nitrogen in a given cropping system. In grain legumes nitrogen accumulation is closely linked to biomass accumulated and seed growth. Nitrogen accumulation in the grain is important in terms of both the physiology of pod filling and the nutritive value of the grain. Leaf N is the dominant source of mobilised N in many grain legumes. Studies on winged bean yield have mainly been done on dry matter and nitrogen accumulation with single staked supports but no comparison has been made between plants grown on a support system and those without support. There is little experimental evidence on nitrogen partitioning and its significance to seed yield of winged bean. This experiment was designed to estimate N2 fixation and investigate the accumulation and partitioning of nitrogen in relation to seed yield in winged bean grown under three support systems.

## Materials and Methods

Vegetable soybean Two small-plot studies were conducted in MADA and KADA, Kelantan. The plots (3.0 x 2.5m) were laid out in a Randomised Complete Block Design with four treatments and five replicates. The treatments were: MADA plots: T1 (No fertiliser -N; no *Bradyrhizobium* inoculation), T2 (No fertiliser -N; Inoculated with *Bradyrhizobium* UPMR48 ), T3 (No fertiliser-N; Inoculated with *Bradyrhizobium* + TAL 102), T4 (Complete fertiliser +N (100 kg N $ha^{-1}$) ; No *Bradyrhizobium* inoculation). KADA plots: T1 ( as MADA plots), T2 (No fertiliser -N; Inoculated with *Bradyrhizobium* UPMR 48 + TAL 102), T3 (Complete fertiliser +N (100 kg N $ha^{-1}$) ; Inoculated with *Bradyrhizobium* UPMR48 + TAL 102) , T4 ( as MADA plots). Basal fertiliser was applied at rates (kg $ha^{-1}$) of 25 N: 95 $P_2O_5$: 95 $K_2O$ by using 54 kg urea $ha^{-1}$, 206 kg Triple Superphosphate $ha^{-1}$, and 159 kg Muriate of Potash $ha^{-1}$. Additional fertiliser N (75 kg N $ha^{-1}$ = 162 kg urea $ha^{-1}$) was applied to the complete fertiliser +N treatment. Seeds were planted at 10 cm intervals within rows and 50 cm between rows. *Bradyrhizobium* inoculation was done by mixing the 150 seeds (approx. 50g)/inoculated plot with 5 g of the respective coir dust inoculum. Plants were harvested after 63 (KADA) and 70 (MADA) days of planting. The following parameters were taken: green pod yield, top fresh weight (5 plants/plot (MADA), 8 plants/plot (KADA), youngest expanded leaves (YEL) for N, P, K, Ca and Mg analyses and chlorophyll content (SPAD® meter).

Winged bean: The experiment was conducted on Serdang sandy loam with pH 6.0-6.5. The experiment was laid out in a randomised complete block design with three support systems replicated eight times. The support systems were: I) control plants grown on the ground surface i.e. unsupported, ii) plants grown with support height of one metre (wire trellis) and iii) plants grown with support height of two metres. After emergence of the seedlings, 16 plants from each treatment were harvested at seven-day intervals from 42 to 70 days and thereafter at 14-day intervals until 140 days of growth for the nitrogen content determinations. The sampled plants were separated into stems, leaves, petioles and pods (when available). All plant parts were rinsed with water, dried, ground and analysed for total nitrogen. Nitrogen fixation was estimated by the acetylene reduction assay (ARA) method. Roots and nodules were harvested by removing the soil around the crown and roots of the plant and carefully separating visible nodules and roots from soil.

## Results and Discussion

Vegetable soybean: Results showed a significant increase in nodulation, growth of plant top and root, and pod yield for the inoculated treatments. Nodule dry weight were significantly higher in plants treated with UPMR 48 than TAL 102; UPMR 48 formed more lateral nodules while TAL 102 encouraged more crown nodules. There was also a significant increase in chlorophyll content of YEL due to the *Bradyrhizobium* inoculation.

Winged bean Plants grown with 2-m supports produced substantial nodule mass, the highest rate of nitrogen fixation, increased nitrogen accumulation of the plant, and seed yield compared to those grown with 1-m supports and unsupported plants. Nitrogenase activities increased and reached a peak at the onset of flowering i.e. 70 days of growth (D70) but declined during the pod formation stage in plants grown with a support system. The descending order o total plant nitrogen accumulation at $D_{140}$ was: plants with 2-m supports (6.30 g N $plant^{-1}$) > those with 1-m supports (4.06 g N $plant^{-1}$) > control plants (2.10 g N $plant^{-1}$)

## Conclusions

Vegetable soybean: *Bradyrhizobium* inoculation increased nodulation, growth and pod yield of vegetable soybean grown in MADA and KADA padi soils. Winged bean: Supported plants contributed significantly to higher $N_2$ fixation and leaf N at the vegetative stage. Seed N was also significantly higher than in unsupported plants.

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