# A STUDY OF THE EFFECTS OF DEFOLIATION AND WATER STRESS ON GROWTH AND DEVELOPMENT OF *STYLOSANTHES HAMATA* (L.) TAUB. CV VERANO

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# ABSTRACT

Verano stylo (*Stylosanthes hamata* (L.) Taub.) is an important pioneer legume in the tropics and its potential as a pasture legume under grazing appears to be promising in Thailand.

This thesis was carried out in two parts - the first part was conducted in the Controlled Climate Rooms at the Plant Physiology Division, DSIR, Palmerston North, New Zealand. The aim of these studies was to obtain basic information on growth patterns and the response of Verano stylo to cutting at different intensities, frequencies and stages of growth and at two levels of water stress in terms of quantity and quality of herbage produced. The second part was a grazing trial conducted at Muaklek, Thailand, to test the grazing management hypothesis derived from the Controlled Climate Room studies.

The results from the Controlled Climate Room studies showed that the growth and development of intact Verano stylo was slow at the pre-flowering stage and increased rapidly after the onset of flowering. Maximum growth rate of 2.04 grams/plant/day was recorded between 70 and 80 days and maximum dry weight of 105 grams/plant was achieved approximately 108 days after seedling emergence. During this post-flowering stage, plant growth in terms of plant dry weight, branch development, leaf number and leaf area increased rapidly.

Flowering commenced 35 days after seedling emergence and continued throughout the experimental period. Stem was the major plant component, followed by the inflorescence and leaf fractions.

In terms of the response to various cutting regimes, the results showed that the more severe the cutting the more deleterious was the effect on regrowth. Cutting the primary branches had a greater effect on plant regrowth in terms of

plant dry weight, branch number, leaf number and leaf area than defoliating the main stem. Severe cutting of primary branches (i.e. to node 0) plus hard cutting of the main stem (i.e. to node 3) resulted in the death of the plant after two cuts. When defoliation was delayed to the later stage of growth (near maximum growth rate), severe cutting of the primary branches (i.e. to node 0) caused extensive plant death following only a single cut. All growth parameters recorded were markedly reduced when the interval between cutting was decreased. It is suggested that the response of Verano stylo to defoliation is dependent upon the number and especially the size of the primary branches, the number of growing points, the amount of stubble reserves and the residual leaf area immediately after cutting.

The differences in yields were largely due to changes in the stem and to a lesser extent the inflorescence and leaf fractions.

Growth of the plant in terms of plant dry weight, branch number, leaf number and leaf area were reduced to a greater extent under severe than under mild water stress. The differences in plant dry weight between the two levels of stress were largely due to the size of the stem fraction. After rewatering there was a rapid increase in growth by both the previously mild and severe water stressed plants, resulting in a marked increase of all the variables recorded. However, growth of plants previously under severe water stress was less than those previously under mild water stress. The increase in total plant dry weight was due to an increase in all plant components, especially leaf and inflorescence fractions. Severity of cutting had less effect on plant variables than water stress. The effect of cutting was more apparent under mild water stress than under severe water stress in terms of plant dry weight, branch number and leaf area, and continued to show this effect on rewatering with respect to leaf number and leaf area.

Verano stylo herbage quality, as measured by crude protein concentration, was relatively high even in the uncut control plants. Defoliation increased the protein concentration, but within the cutting treatments there was little effect of cutting intensities and frequencies on the crude protein concentrations of all plant components, except the stem fraction which was slightly superior under frequent than infrequent cutting. The protein concentration was higher in the leaf and inflorescence and lower in the stem at all cutting intensities and frequencies.

Severe moisture stress increased the crude protein content in the leaves, stems and inflorescences compared with mild moisture stress and continued to show this effect on rewatering with respect to the leaf and stubble fractions.

Hard cutting in the drought period also increased protein concentrations in the leaves, stems and inflorescences compared with lax cutting and continued to show this effect on rewatering with respect to the stubble and stem fractions.

Although the crude protein concentrations in different plant parts and for different cutting intensities, frequencies and stages of cutting and for different water regimes were relatively small, the amounts per plant were large due to the substantial and significant differences obtained in dry weight between treatments. The increase in crude protein was largely due to the inflorescence fraction, especially under lax cutting. Crude protein yields were also seriously reduced under frequent and hard cutting of the primary branches.

Previously stressed plants at either mild or severe levels greatly increased their crude protein yield after rewatering, and this was largely due to the crude protein yield of the leaf and inflorescence components.

In terms of carbohydrate reserves, the results of this study clearly showed that the concentration of these reserves in the residual top and roots of Verano stylo were low (< 3% of dry weight), were comprised mainly of sugar and were independent of the stage, intensity and frequency of cutting. However, carbohydrate concentrations were substantially increased by severe and especially mild water stress. Starch was the major component and accumulated in all plant parts especially the stubble, stem and tap root fractions. The effects of cutting during the drought period were only evident in the stubble, inflorescence and tap root fractions - the levels declining with increasing intensity of defoliation, particularly of the starch fraction. However, these carbohydrates, especially the starch fraction in the stubble, stem and tap root, almost totally disappeared during the rapid recovery phase, suggesting it was used for regrowth.

In terms of the amounts of carbohydrates, the results showed that the differences between cutting intensity were largely due to the differences in the residual dry weights especially in the stubble. Generally the more severe the cutting, the lower the amount of carbohydrates in the stubble. However, cutting frequency had no significant effect on carbohydrate accumulation. Severe water stressed plants accumulated only half the reserves of the mild water stressed plants during the drought period. Under both mild and severe water stress, the stem was the major accumulator of these reserves, particularly of the starch fraction. On rewatering, there was a marked increase in the accumulation of sugar akin to the increase in dry matter yields. However, starch yields in the stem and tap root showed a substantial drop during this period.

During the drought period, hard cutting significantly depressed the accumulation of sugar and starch especially under mild water stress. In the roots only the starch fraction was affected. On rewatering, previous hard cutting continued to depress carbohydrate yield but only of the starch fraction of those plants under previous severe water stress.

The results from the field experiment confirmed the importance of residual leaf and branch numbers on plant regrowth in terms of dry matter production, branch development, leaf number and leaf area and their persistence. Under climate room conditions, 6 weekly cutting produced significantly higher yields of all growth components than did 3 weekly cutting. However, under field grazing conditions frequent grazing (every 4 weeks) produced significantly higher yields than infrequent grazing (every 8 weeks). Frequent grazing also maintained a higher density of Verano stylo plants and a lower weed content.

The results are discussed in relation to the possible grazing management of Verano stylo in Thailand.

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