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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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TABLE OF CONTENTS

	Page
Abstract	i
Acknowledgements	vi
List of Tables	xiii
List of Figures	xviii
List of Plates	xxiv
List of Appendices	xxviii
 CHAPTER 1. INTRODUCTION AND OBJECTIVES	 1
 CHAPTER 2. LITERATURE REVIEW	 5
2.1 <u>Stylosanthes hamata</u> cv Verano	5
2.1.1 Origin, Taxonomy, Distribution and Ecology	5
2.1.2 Morphological and Growth Habit	7
2.1.3 Fertilizer, Nodulation and Yield	8
2.2 Effect of Defoliation on Tropical Legumes	10
2.2.1 Morphology and Growth Habit	11
2.2.2 Regrowth Following Cutting	12
2.2.3 Dry Matter Yield	18
2.2.4 Underground Plant Organs	19
2.2.5 Herbage Quality	21
2.3 Effect of Defoliation on <u>Stylosanthes hamata</u> cv Verano	22
2.3.1 Morphology and growth habit	22
2.3.2 Dry matter yield	23
2.3.3 Underground plant organs	24
2.3.4 Herbage quality	24
2.4 Effect of Water Stress on Tropical Legumes	24
2.4.1 Germination, Establishment and Survival	25
2.4.2 Morphological Effects	28
2.4.3 Physiological Effects	29
2.4.4 Dry Matter Yield	30
2.5 Management of Tropical Forage Legumes	34
2.6 Management of <u>Stylosanthes hamata</u> cv Verano (Verano stylo)	42

CHAPTER 3. EXPERIMENT 1: GROWTH PATTERN OF STYLOSANTHES
HAMATA CV VERANO UNDER CONTROLLED
 ENVIRONMENT CONDITIONS 46

I. Introduction	46
II. Materials and Methods	47
A. Environmental Conditions and Planting Procedures	47
B. Harvesting Schedule	48
C. Plant Measurements	48
III. Results and Discussion	48
A. Morphological Features	48
B. Growth and Development	51

CHAPTER 4. THE EFFECT OF DEFOLIATION ON THE GROWTH AND
 REGROWTH CHARACTERISTICS OF STYLOSANTHES
HAMATA CV VERANO 56

EXPERIMENT 2: STAGE OF GROWTH AND INTENSITY	56
I. Introduction	56
II. Materials and Methods	57
A. Environmental Conditions and Planting Procedures	57
B. Treatments	57
C. Harvesting Schedule	58
D. Plant Measurements	59
E. Chemical Measurements	60
F. Statistical Analysis	60
III. Results	62
A. Phenological Observations	62
B. Plant Regrowth	62
C. Chemical Composition	66
D. Relationship Between Regrowth and Residual (stubble) Plant Variables	68
E. Relationship Between Total Plant Dry Weight and Growth Parameters (Branch Number, Leaf Number and Leaf Area per Plant)	68
IV. Discussion	69

EXPERIMENT 3: INTENSITY OF DEFOLIATION	75
I. Introduction	75
II. Materials and Methods	76
A. Environmental Conditions and Planting Procedures	76
B. Treatments	76
C. Number of Cutting Occasions	77
D. Harvesting Schedule	77
E. Plant Measurements	77
F. Chemical Measurements	78
G. Statistical Analysis	78
III. Results	78
A. Phenological Observation	78
B. Plant Regrowth	80
C. Chemical Composition	82
D. Relation Between Regrowth Yield and Residual Plant Variables	84
E. Relationship Between Total Plant Dry Weight and the Main Growth Parameters (Branch Number, Leaf Number and Leaf Area)	84
IV. Discussion	85
EXPERIMENT 4: FREQUENCY OF DEFOLIATION	90
I. Introduction	90
II. Materials and Methods	91
A. Environmental Conditions and Planting Procedures	91
B. Treatments	91
C. Plant Measurements	92
D. Chemical Measurements	93
E. Statistical Analysis	93
III. Results	93
A. Phenological Observations	93
B. Plant Regrowth	94
C. Chemical Composition	96
D. Relationship Between Plant Dry Weight and the Main Growth Parameters (Branch Number, Leaf Number and Leaf Area)	97
IV. Discussion	98

CHAPTER 5. EXPERIMENT 5: EFFECT OF WATER STRESS AT DIFFERENT DEFOLIATION LEVELS ON REGROWTH CHARACTERISTICS OF <u>STYLOSANTHES</u> <u>HAMATA</u> (VERANO STYLO)	101
I. Introduction	101
II. Materials and Methods	102
A. Environmental Conditions and Planting Procedures	102
B. Treatment	103
C. Measurements	104
D. Statistical Analysis	108
III. Results	108
A. Phenological Observations	108
B. Plant Regrowth	109
C. Chemical Composition	116
D. Relationship Between Total Plant Dry Weight and the Main Growth Parameters (Branch Number, Leaf Number and Leaf Area)	121
IV. Discussion	121
CHAPTER 6. EXPERIMENT 6: EFFECT OF GRAZING MANAGEMENT ON <u>STYLOSANTHES</u> <u>HAMATA</u> PRODUCTION AND SURVIVAL	128
I. Introduction	128
II. Materials and Methods	129
A. Environmental Conditions and Planting Procedures	129
B. Treatments	130
C. Measurements	131
III. Results	132
A. Seedling Establishment	132
B. Plant Regrowth	132
C. Weed Content	134
IV. Discussion	137

CHAPTER 7. GENERAL DISCUSSION	139
A. Growth and Development	139
B. Defoliation and Plant Growth	140
C. Water Stress and Plant Growth	143
D. Herbage Quality	146
E. Management Recommendations	150
E.1 Cutting	150
E.2 Grazing	151
APPENDICES	154
BIBLIOGRAPHY	160

LIST OF TABLES

	Page
Table 1.1 Number of branches per plant	50a
Table 1.2 Plant height of Verano stylo (cm)	51b
Table 1.3 Leaf number, leaf size, dry weight per leaf and specific leaf area	53b
Table 1.4 Inflorescence number and dry weight	53c
Table 2.1 Plant components analysed	60a
Table 2.2 Effect of stage and intensity of defoliation on branch number per plant	64b
Table 2.3 Effect of stage and intensity of defoliation on leaf area (cm ²)(LA) and leaf number (LNO) per plant	65b
Table 2.4 Effect of stage and intensity of defoliation on number of "growing points" on the stubble 10 days after defoliation (no/plant)	66a
Table 2.5 Effect of stage and intensity of defoliation on crude protein concentration (% of dry matter) in leaf (L), stem (S), inflorescence (I) and root (tap (T) and fibrous (F)) components and in the residual stubble (R)	66b
Table 2.6 Correlations of residual plant variables with net regrowth yield	68a

Table 2.7	Linear correlation coefficients between plant dry weight (DM) and various main growth parameters (branch number (B), leaf number (LNO) and leaf area (LA)	68b
Table 3.1	Plant components analysed	78a
Table 3.2	Effect of defoliation intensity on net regrowth yield over the experimental period (g/plant)	80a
Table 3.3	Effect of defoliation intensity on residual leaf area (cm ²) (LA) and leaf number per plant remaining immediately after each cut	81e
Table 3.4	Effect of defoliation intensity on number of "growing points" on the stubble 10 days after cutting	82a
Table 3.5	Effect of defoliation intensity on crude protein concentration (% of dry matter) in leaf (L), stem (S), inflorescence (I), root (tap (T) and fibrous (F) components and in the residual stubble (R)	82b
Table 3.6	Effect of defoliation intensity on sugar concentration (% of dry matter) in the residual above ground (stubble) and below ground (roots)	83b
Table 3.7	Effect of defoliation intensity on starch concentration (% of dry matter) in the residual above ground (stubble) and below ground (roots)	83d
Table 3.8	Correlations of residual plant variables with net regrowth yield	84a

Table 3.9	Linear correlation coefficients between plant dry weight (DM) and main growth parameters (branch number (B), leaf number (LNO) and leaf area (LA)	84b
Table 3.10	Effect of defoliation intensity on number of residual branches per plant	85a
Table 4.1	Plant components analysed	93b
Table 4.2	Effect of intensities (A) and frequencies (B) of defoliation on absolute growth rate (mg/day)	94e
Table 4.3	Effect of intensities (A) and frequencies (B) of defoliation on residual leaf area (cm ² /plant)	95d
Table 4.4	Effect of intensities (A) and frequencies (B) of defoliation on residual leaf number (no/plant)	95e
Table 4.5	Effect of intensities (A) and frequencies (B) of defoliation on the number of "growing points" on the stubble (no/plant) 10 days after cutting	96a
Table 4.6	Effect of intensities and frequencies of defoliation on crude protein concentration in the leaf (L), stem (S), inflorescence (I), root (tap (T) and fibrous (F)) components and in the residual stubble (R)	96b
Table 4.7	Effect of intensities and frequencies of defoliation on sugar concentration (% of dry matter) in residual above ground (stubble) and below ground (roots)	97a

Table 4.8	Effect of intensities and frequencies of defoliation on starch concentration (% of dry matter) in residual above ground (stubble) and below ground (roots)	97b
Table 4.9	Linear correlation coefficients between plant dry weight (DM) and main growth parameters (branch number (B), leaf number (LNO) and leaf area (LA))	97d
Table 5.1	Soil moisture content (% of dry weight) during drought and recovery period	104a
Table 5.2	Plant components analysed	108a
Table 5.3	Main effect of water stress and defoliation on total plant dry weight during drought and recovery period (g/plant)	109a
Table 5.4	Effect of water stress and defoliation on absolute growth rate and relative growth rate during drought and recovery period	110a
Table 5.5	Main effect of water stress and defoliation on rate of branching during drought and recovery period (no/plant/day)	112a
Table 5.6	Effect of water stress and defoliation on leaf appearance rate (no/plant/day)	114a
Table 5.7	Effect of water stress and defoliation on leaf size (cm ² /leaf)	114a
Table 5.8	Effect of water stress and defoliation on specific leaf area (cm ² /g)	115a

Table 5.9	Main effect of water stress and defoliation on crude protein concentration in the leaf, stem, inflorescence, stubble and tap and fibrous root components (% of dry matter)	116a
Table 5.10	Main effect of water stress and defoliation on total crude protein (leaves + stem + stubble + inflorescence) during drought and recovery period (mg/plant)	117b
Table 5.11	Linear correlation coefficients between plant dry weight (DM) and main growth parameters (branch number (B), leaf number (LNO) and leaf area (LA))	121a
Table 6.1	Plant density on the day before first grazing and at the end of the experiment (plants/m ²)	132a

LIST OF FIGURES

		Page
Figure 1.1	Length of primary branches along the main stem (cm)	51a
Figure 1.2	Changes in total dry weight with time: A. Actual data; B. From fitted data; 1 and 2 represent line of best fit between each phase of growth	51c
Figure 1.3	Relative growth rate of Verano stylo calculated from fitted growth model (Figure 1.2)	52a
Figure 1.4	Relative growth rate of Verano stylo calculated from fitted growth model (Figure 1.2)	52a
Figure 1.5	Dry matter yield of leaf, stem, inflorescence and roots of Verano stylo (g/plant)	53a
Figure 1.6	Distribution of dry matter yield on the primary branches of the main stem B = lower primary branches (1 - 6) T = upper primary branches (7 - 12)	54a
Figure 1.7	Changes in total leaf area of Verano stylo with time (cm ² /plant)	55a
Figure 2.1	Diagrammatic illustration of the appearance of the plants after different intensities of defoliation.	58a
Figure 2.2	Harvesting schedules over the experimental period	58b
Figure 2.3	Total dry weight (cut at ground level) A. Cut at early stage of growth (g/plant) B. Cut at late stage of growth (g/plant)	62a

Figure 2.4	Effect of stage and intensity of defoliation on the components of plant dry weight (g/plant)	63a
Figure 2.5	Effect of stage and intensity of defoliation on the absolute growth rate (g/day)	63b
Figure 2.6	Effect of stage and intensity of defoliation on the relative growth rate (mg/mg/day)	63c
Figure 2.7	Effect of stage and intensity of defoliation on total net regrowth yield over ten weeks with two successive defoliations (g/plant)	64a
Figure 2.8	Effect of stage and intensity of defoliation on rate of branching (no/day)	65a
Figure 2.9	Effect of stage and intensity of defoliation on crude protein yield in leaf, stem (including stubble), inflorescence and roots components (g/plant)	66c
Figure 2.10	Effect of stage and intensity of defoliation on sugar and starch concentration in the residual top (stubble) and below ground (% of dry matter)	67a
Figure 2.11	Effect of stage and intensity of defoliation on sugar yield in the residual top (stubble) and below ground (mg/plant)	67b
Figure 3.1	Planning of Experiment 3	77a

Figure 3.2	Main effect of defoliating the main stem (A) and the primary branches (B) on total net regrowth yield over the four regrowth cycles	80b
Figure 3.3	Effect of defoliation intensity on total plant dry weight at various cutting cycles (g/plant)	80c
Figure 3.4	Effect of defoliation intensity on absolute (A) and relative (B) growth rate at various regrowth cycles	80d
Figure 3.5	Effect of defoliation intensity on total net regrowth yield over the four regrowth cycles (g/plant)	81a
Figure 3.6	Effect of defoliation intensity on the components of plant dry weight (g/plant)	81b
Figure 3.7	Effect of defoliation intensity on branch number per plant	81c
Figure 3.8	Effect of defoliation intensity on leaf area (cm ²) and leaf number per plant at all regrowth cycles	81d
Figure 3.9	Effect of defoliation intensity on total crude protein yield at cycle 1 and 4 (g/plant)	82c
Figure 3.10	Effect of defoliation intensity on crude protein yield in the plant components (g/plant) at cycle 1 and 4	83a
Figure 3.11	Effect of defoliation intensity on sugar yield in the residual top (stubble) and below ground (roots)(mg/plant)	83c
Figure 4.1	Planning of Experiment 4	92a

- Figure 4.2 Effect of cutting intensities and frequencies on the net regrowth yields of Verano stylo over the experimental period 94a
- Figure 4.3 Total dry weight following each cutting: A. cutting every 3 weeks at different intensities; B. cutting every 3 weeks vs cutting every 6 weeks at the same intensity 94b
- Figure 4.4 Effect of cutting intensities (A) and cutting frequencies (B) on regrowth components (g/plant) 94c and 94d
- Figure 4.5 Branch number per plant: A. cutting every 3 weeks at different intensities; B. cutting every 3 weeks vs 6 weeks at the same intensity 95a
- Figure 4.6 Effect of cutting intensities (A) and cutting frequencies (B) on leaf area per plant 95b
- Figure 4.7 Effect of cutting intensities (A) and frequencies (B) on leaf number per plant 95c
- Figure 4.8 Effect of cutting intensities (A) and frequencies (B) on crude protein yield per plant 96c
- Figure 4.9 Effect of cutting intensities (A) and cutting frequencies (B) on total non-structural carbohydrate (TNC) yield (mg/plant) 97c
- Figure 5.1 Mean percentage of relative water content (% RWC) 105a
- Figure 5.2 Effect of water stress and defoliation on total plant dry weight (g/plant) 109b

- Figure 5.3 Main effect of water stress (A) and defoliation (B) on plant components dry weight (g/plant) 110b
- Figure 5.4 Effect of water stress and defoliation on plant components dry weight (g/plant) 110c
- Figure 5.5 Effect of water stress and defoliation on total branch number per plant during drought and recovery period 111a
- Figure 5.6 Effect of water stress and defoliation on leaf area (cm²) and leaf number per plant during drought and recovery period 113a
- Figure 5.7 Effect of water stress and defoliation on crude protein concentration in the plant components (% of dry matter). Note: different letters above column and in the same shade differ at the 5% level 117a
- Figure 5.8 Effect of water stress and defoliation on crude protein yield in the plant components(mg/plant) 117c
- Figure 5.9 Main effect of water stress (A) and defoliation (B) on carbohydrate concentration in the plant components (% of dry matter) 118a
- Figure 5.10 Main effect of water stress (A) and defoliation (B) on non-structural carbohydrate concentration in the tap and fibrous roots (% of dry matter) 119a
- Figure 5.11 Effect of water stress and defoliation on total non-structural carbohydrate (TNC) yields (mg/plant) 119b

Figure 5.12	Effect of water stress and defoliation on sugar yields of the plant components (mg/plant)	119c
Figure 5.13	Effect of water stress and defoliation on starch yields of the plant components (mg/plant)	119d
Figure 5.14	Effect of water stress and defoliation on total non-structural carbohydrate yield in the roots (tap + fibrous) (mg/plant)	120a
Figure 6.1	Monthly rainfall and maximum and minimum temperatures at Muaklek, Thailand	130a
Figure 6.2	Timing of grazing and regrowth period throughout the experiment	130b
Figure 6.3	Changes in legume plant density with time (number/m ²)	132b
Figure 6.4	Total net regrowth yield over the experimental period (ton/ha)	132c
Figure 6.5	Effect of grazing management on dry matter production (ton/ha)	133a
Figure 6.6	Total plant dry weight (g/plant)	133b
Figure 6.7	Effect of grazing management on the plant components dry weight (g/plant)	133c
Figure 6.8	Effect of grazing management on branch number per plant	133d
Figure 6.9	Effect of grazing management on leaf area (cm ²) and leaf number per plant	134a
Figure 6.10	Percentage of weeds during the experimental period	134b

LIST OF PLATES

	Page
Plate 1.1 General view of the Controlled Climate Room	47a
Plate 1.2 Growth and development of Verano stylo after seedling emergence up to first flowering appearance	49a
Plate 2.1 Uncut control treatment at early stage (39 days after seedling emergence)	61a
Plate 2.2 Immediately after lax defoliation of the primary branches (E-5-4) at early stage (39 days after seedling emergence)	61a
Plate 2.3 Immediately after hard defoliation of the primary branches (E-5-0) at early stage (39 days after seedling emergence)	61a
Plate 2.4 Immediately after lax defoliation of the primary branches (L-5-4) at late stage of growth (88 days after seedling emergence). <u>Note</u> : L-5-4 (forward) and uncut control (backward)	61
Plate 2.5 Immediately after hard defoliation of the primary branches (L-5-0) at late stage of growth (88 days after seedling emergence)	61
Plate 3.1 The cutting treatments immediately after the first cut (LH = E-3-0; LL = E-3-4; HH = E-7-0; HL = E-7-4; C = uncut control)	79a
Plate 3.2 Cutting treatments immediately after the second cut (for the symbols see Plate 3.1) showing a greater number of leaves on plant HL (lightest cutting treatment: E-7-4)	79a

- Plate 3.3 The cutting treatments immediately after the third cut (for the symbols see Plate 3.1) showing that only a small number of leaves and branches remain under all treatments but the size of the residual stubble differs greatly between the E-3-0 (LH) and the E-7-4 (HL) treatment 79
- Plate 3.4 The cutting treatments immediately after the fourth cut (for the symbols see Plate 3.1) showing the negligible number of leaves or active branches along the primary branches 79
- Plate 4.1 Comparison of cutting intensities and frequencies taken immediately prior to the third 3 weekly cutting and second 6 weekly cutting (Note: greater production under 6 weekly versus 3 weekly cutting; greater production under lax versus severe cutting of the main stem) 93a
- Plate 5.1 Plant under mild water stress compared with non-stressed plant immediately before the cutting treatment was imposed (Note: plant is slightly wilted under mild water stress) 103a
- Plate 5.2 Plant under severe water stress compared with non-stressed plant immediately before the cutting treatment was imposed (Note: death and significant wilting of leaves on the main stem under severe water stress 103a
- Plate 5.3 A general view of the plants under the mild water stress six weeks after cutting (Note: significant retention of leaves) 106a
- Plate 5.4 A general view of the plants under severe water stress six weeks after cutting (Note: large number of leaves senescent and falling off) 106a

- Plate 5.5 Plants under mild water stress nine weeks
after cutting 106
- Plate 5.6 Plants under severe water stress nine weeks
after cutting (Note: maintenance of fresh
green leaves and stems under mild water
stress compared with grey-green leaves and
reddish-purple stems under severe water
stress 106
- Plate 5.7 Cutting treatments of plants under mild
water stress twelve weeks after cutting
(Note: clusters of small branches along
the primary branches). E-6-4 = W1C1,
E-4-4 = W1C2 and E-2-4 = W1C3 107a
- Plate 5.8 Cutting treatments of plants under severe
water stress twelve weeks after cutting
(Note: fewer clusters of branches along
the primary branches compared with plants
under mild water stress, Plate 5.7). E-6-4
= W2C1, E-4-4 = W2C2 and E-2-4 = W2C3 107a
- Plate 5.9 Cutting treatments of plants under previous
mild water stress three weeks after
re-watering (Note: significant increase in
plant size and in number of branches and
leaves) 107
- Plate 5.10 Cutting treatments of plants under previous
severe water stress three weeks after
re-watering (Note: significant increase in
plant size and in number of branches and
leaves) 107
- Plate 6.1 A general view of the experimental site,
showing the well prepared seed-bed before
sowing 129a

- Plate 6.2 The area was irrigated after sowing to ensure good germination 129a
- Plate 6.3 A general view showing good Verano stylo establishment 135a
- Plate 6.4 Immediately before first grazing when approximately 50% of plants begin to flower - approximately 30 - 35 cm in height 135a
- Plate 6.5 Dry cows on Verano stylo at first grazing (Note: ready acceptance by grazing animals) 135
- Plate 6.6 Immediately after first grazing - plant height approximately 12 - 15 cm 135
- Plate 6.7 Immediately before third grazing of four weekly intervals (Note: large number of green leaves and branches close to ground) 136a
- Plate 6.8 Immediately before second grazing at eight weekly intervals (Note: negligible number of green leaves and branches close to the ground) 136a
- Plate 6.9 During second grazing at eight weekly intervals and third grazing at four weekly intervals (Note: Ease of prehension of four weekly grazing and severe wastage of eight weekly grazing) 136
- Plate 6.10 Four weekly grazing treatment at the end of experimental period (Note: maintenance of relatively dense and clean stand of Verano stylo) 137a
- Plate 6.11 Eight weekly grazing treatment at the end of experimental period (Note: relatively low density of Verano stylo and subsequent ingression of weeds) 137a

LIST OF APPENDICES

	Page
1 Controlled environment conditions	154
2 Climate Lab - N.C.U.S. Phytotron Nutrient	155
3 Changes in total dry weight with time: A. Fitted with logistic growth model B. Fitted with polynomial growth model (0 - 131 days after seedling emergence)	156
4 Effect of defoliation on total dry matter (g/plant)	157
5 Effect of defoliation on total plant dry weight (g/plant)	158
6 Effect of water stress and defoliation on total non-structural carbohydrate concentration of the plant components (% of dry matter)	159