QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 555

TOTAL SOLUBLE SUGARS AND STARCH IN CURLY MITCHELL GRASS (ASTREBLA LAPPACEA) AS RELATED TO VEGETATIVE GROWTH STAGE

By G. F. HAYDON, B.Sc.

SUMMARY

The growth pattern of curly Mitchell grass, grown from seed, as indicated by the levels of starch and soluble sugars in the aerial parts, was studied in pots over 100 days' growth During this time, moisture, radiation and nutrient supply were not limiting.

The plants established a reserve of starch and soluble sugars, particularly between 50 and 80 days of age. Vigorous regrowth was poor when severe defoliation preceded such build-up.

I. INTRODUCTION

For judicious use of grazing lands it is necessary to define the type of carbohydrate reserves and the time these take to build up in the constituent species. In order to obtain maximum nutritive value from the pasture, the type of grazing and the time of commencement thereof are important to enable grazed plants to make rapid recovery.

Large amounts of stem and root starch were reported in mature tufts of unspecified Mitchell grasses by Everist (1964).

This study was aimed at quantifying the synthesis, during April and July, of starch and soluble sugars in newly established curly Mitchell grass plants when grown in pots.

II. MATERIALS AND METHODS

Two kilograms of a brown alluvial self-mulching soil (Northcote classification Ug 5.3) from the Gatton area was weighed into each of 45 plastic pots (9 in. diam.) arranged in 3 blocks of 15.

Ten seeds of curly Mitchell grass, dehusked by milling and winnowing, were sown in each pot. A germination of 95% was obtained by hand-selecting large seeds, almost all of which germinated within 2 days.

The blocks were rotated every 14 days to equalize light distribution.

Total aerial parts were harvested at 22, 42, 53, 78 and 100 days after emergence. Each sample consisted of 15 g fresh weight, composed of approximately 5 g from each of the three blocks, obtained from three pots.

Samples were collected, weighed and placed in 150 ml boiling 95% ethanol within 2 min of harvesting to eliminate almost all water loss and to inhibit all biological activity.

Total soluble sugars were determined from a standard curve using glucose as a standard. The method used was adapted from that described by Hoffman (1937). Starch was determined by the method of Klegg (1956) suitably modified for use in this investigation so that small amounts of starch in grass could be measured.

The reason for calculating total soluble sugars and starch on a fresh weight basis was twofold. Firstly, the entire harvested sample could be used for analysis and, secondly, there was not enough material available for moisture to be determined. Since the moisture content is around 80%, small differences in results based on fresh weight can be significant.

Results were statistically analysed to determine whether enough samples were taken to ensure that the mean was within ± 5% of the true mean for the whole population of 225 plants. All but the last harvest provided enough samples to satisfy this requirement (Table 1).

III. RESULTS

Results are given in Table 1 and Figures 1 and 2.

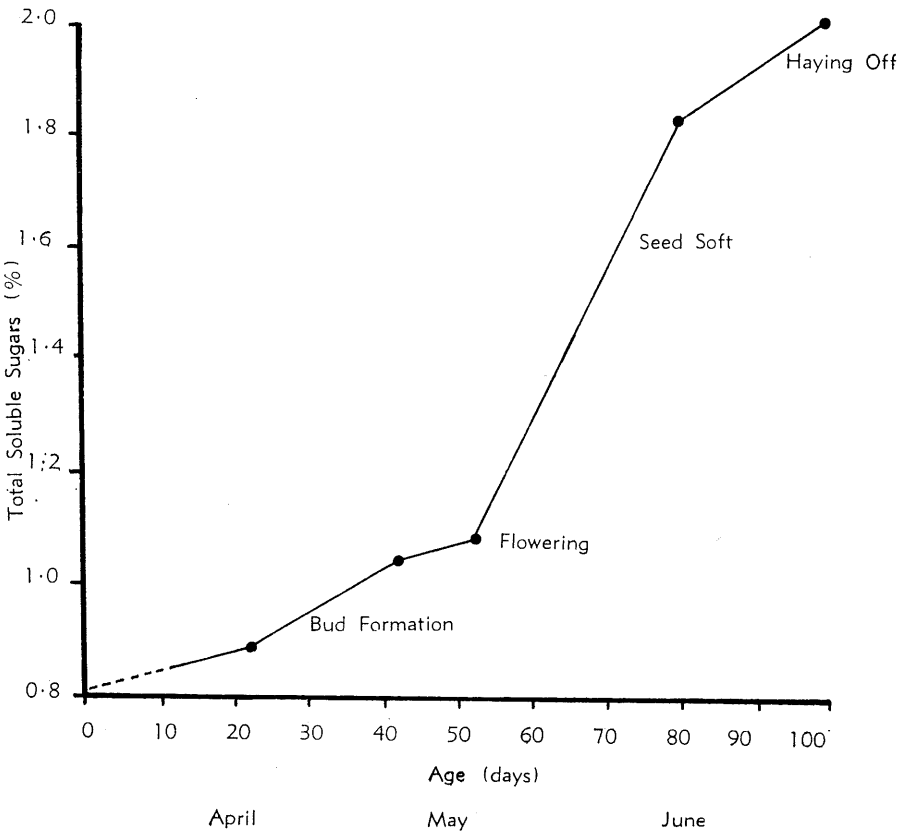

Fig. 1.—Total soluble sugars related to time. Points plotted are the means from Table 1.

TABLE 1

TOTAL SOLUBLE SUGARS (TSS) AND STARCH CONTENTS OF TOTAL AERIAL PARTS AT VARIOUS TIMES AFTER EMERGENCE ON MARCH 18, 1969

	Age 22 days			Age 42 days			Age 53 days			Age 78 days			Age 100 days		
	Sample No.	TSS (%)	Starch (%)	Sample No.	TSS (%)	Starch (%)	Sample No.	TSS (%)	Starch (%)	Sample No.	TSS (%)	Starch (%)	Sample No..	TSS (%)	Starch (%)
	1	1·12	1·38	1	0·98	1·20	1	1·04	1·85	1	1·90	7·90	1	2·10	4·30
	2	0·92	1·43	2	1·15	1·30	2	1·10	1·85	2	1·90	9·20	2	2·10	4·40
	3	0·94	1·32	3	1·14	1·30	3	1·00	1·40	3	2·00	9·70	3	2·00	3·80
	4	0·84	1·46	4	0·95	1·20	4	1·00	1·88	4	1·70	9·70	4	1·70	3·70
	5	0·80	1·37	5	1·05	1·20	5	1·12	1·75	5	1·80	9·90	5	1·80	3·80
	6	0·84	1·47	6	1·08	1·10	6	1·11	1·95	6	1·70	9·10	6	2·20	4·10
	7	0·84	1·46	7	1·02	1·10	7	1·10	1·85	7	1·90	8·90	7	1·90	4·00
	8	0·85	1·44	8	1·04	1·30	8	1·10	1·80	8	1·80	9·10			
	9	0·82	1·32	9	1·07	1·40	9	1·10	1·90	9	1·60	9·50			
	10	0·92	1·47	10	1·03	1·10	10	1·10	2·0	10	1·80	10·50			
	11	0·86	1·42												
	12	0·94	1·30												
	13	0·84	1·39												
	14	1·04	1·46												
	15	0·86	1·42												
Mean		0·895	1·41		1·05	1·22		1·08	1·82		1·81	9·40		1·97	4·00
Standard deviation		0·055	0·068		0·077	0·134		0·144	0·449		0·114	0·740		0·430	0·420
95% confidence interval		0·030	0·036		0·054	0·093		0·100	0·310		0·080	0·515		0·114	0·114

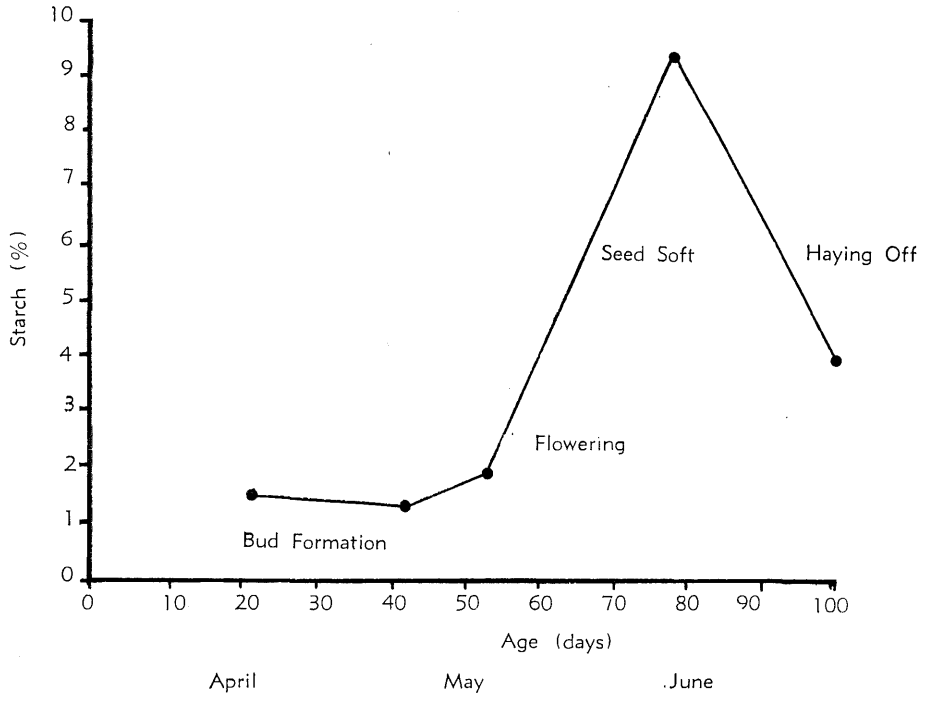

Fig. 2.—Starch content related to time. Points plotted are the means from Table 1.

IV. DISCUSSION

The vegetative characteristics and growth habit of the plant were noted at various stages. From the 40th day on, the internodes elongated rapidly and produced long reclining stems with a "curl" between internodes. In addition, leaf blades broadened, thereby providing greater leaf area.

As can be seen by the rise in the graphs from 40 to 80 days (Figures 1 and 2), this greater carbohydrate synthesis was probably associated with storage of reserves for the coming dormant or haying-off stage.

The ratio of total soluble sugars to starch fell rapidly from the 40-day to 80-day period. This indicated rapid translocation of soluble sugars in the plant and much of this material could have been converted into starch.

Starch reserves in grass represent the accumulation of carbohydrate in excess of the immediate needs of the plant for maintenance and growth. If these reserves are depleted to low levels—for example, by high soil temperatures or high soil nitrogen, or by heavy grazing—the plant could be placed in a state of dormancy which would delay recovery. In extreme situations, direct injury could occur due to metabolic breakdown (Zanoni *et al.* 1969).

Curly Mitchell grass in this experiment established a reserve of carbohydrate, especially in starch, after 70-80 days' growth. After this time plants grown in pots were beginning to hay off and results are unreliable.

From observations, plants that were severely defoliated at the 80-day stage recovered rapidly on the addition of water and a soluble fertilizer. Plants given water only also recovered but with less vigour.

The results of this investigation indicate that undefoliated curly Mitchell grass seedlings, with no moisture or nutrient limitations, have a rapid build-up of carbohydrates in the 30-40 day period following flowering.

The objective of this study was attained in that the synthesis of soluble sugars and starch was quantified in newly established Mitchell grass plants in pots. This may not apply to plants in the field with different physiological ages, stage of development, and under moisture stress and nutrient deficiency and under a different temperature regime. Some of these aspects are under investigation.

V. ACKNOWLEDGEMENT

Thanks are expressed to Dr. J. P. Ebersohn for helpful advice.

REFERENCES

EVERIST, S. L. (1964).—*Qd Nat.* 17 (3 and 4): 45.

HOFFMAN, W. S. (1937).—*J. biol. Chem.* 120:51.

KLEGG, K. M. (1956).—*J. Sci. Fd Agric.* 7:40.

ZANONI, L. J., MICHELSON, L. F., COLBY, G. G., and M. DRAKE (1969).—*Agron. J.* 61:195.

(Received for publication June 1, 1970)

The author is an officer of Agricultural Chemical Laboratory Branch, Queensland Department of Primary Industries, and is stationed at Brisbane.