Bangladesh J. Sugarcane, **24-27** : 7-10 *July, 2005*

Growth Analysis of Different Sugarcane Varieties

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Received on 03.3.03

ABSTRACT

Growth analysis of sugarcane varieties was studied under different field conditions. Results showed that growth of different sugarcane varieties progressively increased with the advancement of time. Significant differences were obtained between varieties in respect of dry matter and leaf area. Relative growth rate (RGR) and net assimilation rate (NAR) differences among the varieties were not significant. But there was a significant difference in respect of leaf area index (LAI). Plant height also showed significant difference among the varieties. Growth analysis data revealed that sugarcane varieties had differences in respect of growth. Among the varieties, Isd 16 had a higher dry matter, leaf area, RGR and NAR followed by Isd 28.

Key words : Sugarcane, growth analysis, RGR, NAR, LAI.

INTRODUCTION

In plant growth studies, it is generally useful to compare values of the several well-known growth functions between species or treatments. Growth comparisons of different treatments or species are done by harvesting a number of plants from each treatment of the same day at weekly or longer intervals (Radford, 1967). On the broadest scale, growth study also involves in assessment of the primary production of vegetation in the field. By using the growth analysis method, it is certain that useful information can be gained between species or between treatments are involved (Hughes and Freeman, 1967). The basic component of growth analysis comes from the work of Blackman (1919). The relative growth rate (RGR) serves as a fundamental measure of day matter production and can be used to compare the performance of species. The net assimilation rate (NAR) is the measurement of net gain in dry weight of the plant per unit leaf area and differs from photosynthetic rate, which measures the net gain of carbon only during light period. The leaf area ratio (LAR) of a plant at any instant in time is the ratio of assimilatory material per unit of plant material present.

A critical summary of the development and use of functional growth analysis is given by Radford (1967), Hughes and Freeman (1967), and Hunt (1978). A growth study result showed that significant differences were obtained between sugarcane varieties in respect of NAR and leaf dry weight (Oworu, 1988). Differences in growth of different sugarcane varieties have been reported elsewhere (Hartt and Burr, 1965). Growth analysis of plant indicates the genetic consideration and its growth behaviour in the environments. The purpose of this study was to observe the growth and development responses of different sugarcane varieties under field condition.

MATERIALS AND METHODS

Seven sugarcane varieties were used in the present study. The experiment was laid out following randomized block design and replicated five times. Two budded double setts were planted continuously in the trench. The plot size was 8m x 6m and line to line distance was 1m. Fertilizer and insecticides application and intercultural operation were done as per recommendation.

The following morphological and physiological parameters were studied :

1. Stem dry weight
2. Leaf dry weight
3. Leaf area
4. Stalk height
5. Relative growth rate (RGR)
6. Net assimilation rate (NAR)
7. Leaf area ratio (LAR)
8. Leaf area index (LAI)

To determine RGR, NAR and LAR the following formulae were used :

$$RGR\ (mg\ mg^{-1}\ d^{-1}) = \frac{\log e\ W_2 - \log e\ W_1}{t_2 - t_1}$$

$$NAR\ (mg\ cm^2\ d^{-1}) = \frac{(W_2 - W_1)(\log e\ La_2 - \log e\ La_1)}{(t_2 - t_1)(La_2 - La_1)}$$

$$LAR\ (cm^2\ mg^{-1}) = \frac{La\ (\log e\ W_2 - \log e\ W_1)}{W_2 - W_1}$$

Where, W_1 and W_2 were the dry weights of plant La_1 and La_2 were the leaf area of plants at the time t_1 and t_2 respectively.

The leaf area was determined using a leaf area meter. The harvested plants were dried in a fan assisted drying oven at 70^0C to a constant weight. Plants were harvested destructively from an area of 1m x 1m of each plot. Harvesting was started from May and continued up to August. Data were subjected to statistical analysis by L.S.D test.

RESULTS AND DISCUSSION

Progression of crop growth in terms of dry matter and leaf area at various time intervals is shown in Figure 1 and Figure 2 respectively. Dry matter was increased sharply with the advance of time in all the sugarcane varieties. Leaf area increase was not prominent as dry matter increase. Total dry matter, leaf area, leaf area index (LAI), relative growth rate (RGR), net assimilation rate (NAR), leaf area ratio (LAR) and plant height at 9 months old plant of different sugarcane varieties are shown in Table 1. Results indicated that sugarcane varieties differed in respect of dry matter and leaf area production. It is evident that Isd 16 significantly produced highest dry matter followed by Isd 28. The dry matter produced in different sugarcane varieties were in the order of Isd 16> Isd 28> Isd 18> Isd 2-54> Isd 22. Similar type of observation was recorded

earlier in a growth study with different sugarcane varieties (Oworu, 1988). Maintaining higher dry matter production per unit area Isd 16 recorded highest leaf area followed by Isd 28. Leaf area production of Isd 16 and Isd 18 were significantly higher compared to other varieties. Physiologically defined primary growth parameters, the relative growth rate and net assimilation rate were increased with the increase of age of the crop (data not shown). Data of 9 months old plant presented in Table 1 showed that Isd 16 and Isd 28 registered non-significant highest RGR and NAR. At this stage, crop maintained a LAI of more than 5.0 in all varieties. Significantly higher LAI was recorded with Isd 16 and Isd 28 of 7.5 and 7.4 respectively. It is evident from the result that a variety with maximum LAI has a maximum NAR. Highest height was recorded with Isd 28.

It appears from the study that the varieties with higher leaf area had higher NAR. The work of Black man and Wilson (1951) showed that there were differences in NAR between species growing in comparable conditions. The significant variation in dry matter yield among the varieties indicated the potential for selecting for high tonnage canes. Further detail study is required to identify suitable characteristics responsible for higher yield of cane and sugar in order to incorporate in the breeding programmes.

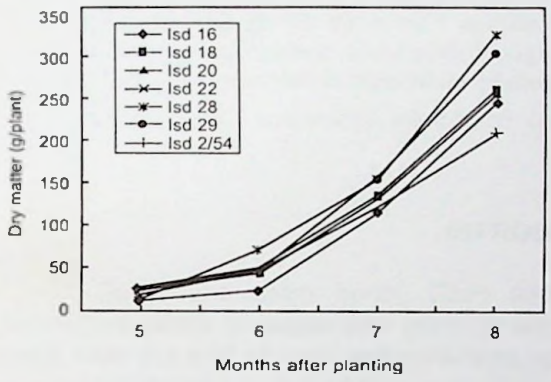

Figure 1. Progression of dry matter production of different sugarcane varieties.

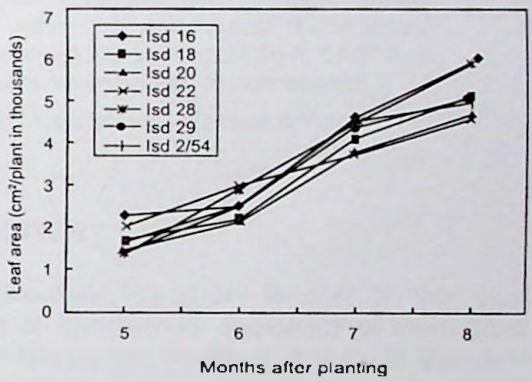

Figure 2. Progression of leaf area development of different sugarcane varieties.

Table 1. Morpho-physiological characteristics of seven sugarcane varieties (9 months old crop).

Variety	Dry matter (g plant^{-1})	Leaf area (cm^2 plant^{-1})	LAI	RGR (mg mg^{-1} day^{-1})	NAR (mg cm^2 day^{-1})	LAR (cm^2 mg^{-1})	Height (m)
Isd 16	356.2	5765.1	7.5	0.027	1.267	0.0206	2.08
Isd 18	259.6	4967.9	5.3	0.020	0.878	0.0235	1.71
Isd 20	264.5	4572.8	5.3	0.021	1.046	0.0214	1.99
Isd 22	215.4	4457.8	5.3	0.016	0.688	0.0243	1.83
Isd 28	327.1	5727.5	7.4	0.024	1.126	0.0219	2.97
Isd 29	305.3	5003.3	5.7	0.021	1.043	0.0206	2.10
Isd 2-54	249.6	4834.5	5.9	0.024	0.949	0.0257	2.40
LSD (0.05)	66.08	624.3	1.45	NS	NS	0.00355	0.7419

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