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GROWTH ANALYSIS OF CASSAVA (*MANIHOT ESCULENTA* CRANTZ) VARIETIES IN RELATION TO TIME OF PLANTING[1]

S. BEGUM[2] AND N.K. PAUL

Department of Botany, University of Rajshahi, Rajshahi-6205, Bangladesh

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Abstract

A field experiment was carried out during 1999-2000 & 2000-2001 to study the effect of time of planting on the growth of two cassava varieties using functional technique of growth analysis. Total dry matter and leaf area index at most of the growth stages were found highest for 15 May planting (S_3) and lowest for 1 July (S_6). The highest value of crop growth rate was found for S_4 (1 June) and lowest for S_6. Net assimilation rate (NAR) and relative leaf growth rate had higher values for S_1 (15 April) but at the later stages of growth NAR had higher values for S_5 in Local-l and for S_4 in Local-3. Leaf area ratio was higher for S_4 in Local-l and for S_6 in Local-3. Simple correlation coefficients indicated that tuber yield was positively correlated with LAI, CGR, RGR, LAR and LWR

Introduction

Cassava is generally considered a long-term crop. In the tropics, cassava is planted at the onset of the rainy season during which it attains maximum growth; then growth declines sharply during the dry season but resumes again in the following rainy season. As cassava occupies an important position in root crops, it is important that its growth pattern in relation to planting time be properly understood in order to achieve optimum growth, development and yield of cassava in Bangladesh.

The present experiment was designed to study the effect of time of planting on the production of physiological attributes of cassava.

Materials and Methods

The experiment was carried out in the Botanical Research field of BCSIR Laboratories, Rajshahi in two consecutive years from 1999-2000 to 2000-2001. The experiment was laid out in a split plot design with two varieties (Local-l & Local-3) of cassava in the main plot, and six date of planting (15 April, 1 May, 15 May, 1 June, 15 June and 1 July) in the subplot in 1999. Each treatment was replicated three times. The soil of the experimental field was sandy loam. The unit plot size was 0.81×0.45 m^2 and fertilized with cowdung (12.5 t/ha) and urea, triple superphosphate and muriate of potash at the rate of N_{100} P_{100} K_{100} kg/ha. The distance between the rows was 90 cm and plant to plant distance was also 90 cm. All the crops were harvested on 1 May in the next year. The same experimental design was followed in 2000. Irrigation and intercultural operations were given whenever necessary.

For growth analyses, six harvests were taken at equal intervals of 30 days. Three plants were selected for each variety from each treatment for each harvest. The first harvest was taken at 30 days after planting (DAP). At each harvest, plants were cut down into leaf, petiole, stem and root. The underground portions were recovered by washing in water. Plant parts were separately dried in an electric oven at about 85°C for 24 hours till they reached constant weight. Leaf area was

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[1]Part of the Ph.D. thesis of the first author. [2]Present address: BCSIR Laboratories, Rajshahi-6205, Bangladesh.

measured by the disc method (Islam and Paul 1986). The curve-fitting method (functional technique) was followed to determine different growth attributes. In this method, polynomial functions were fitted to natural logarithmic values of total dry weight and total leaf area. The $\log_e$ transformation was made in order to render the variance homogeneous with time (Hughes and Freeman 1967). The selection of appropriate polynomial regression model was done by "lack of fit" method of Nicholls and Calder (1973). Simple correlation coefficients between growth attributes and tuber yield were calculated.

Results and Discussion

The experiment was carried out in two consecutive years. Average value of two years data (1999-2000, 2000-2001) have been presented in figures and table. It was observed that maximum and minimum temperature and rainfall become decreased from S_1 to S_6 but on the other hand sunshine hour increased. Effect of planting time on total dry matter (TDM) of two cassava varieties at different stages of growth is shown in Fig. 1. TDM was significantly higher for S_3 (15 May planting) than the other plantings in both the varieties. Medium temperature, sunshine hour and rainfall may be the cause for such fact. Manrique (1990) in cassava observed significant differences in top (stem + branches + leaves) and total dry weight per plant between summer and winter and also found that plants from summer plots accumulated more dry matter in the tops than the winter crop.

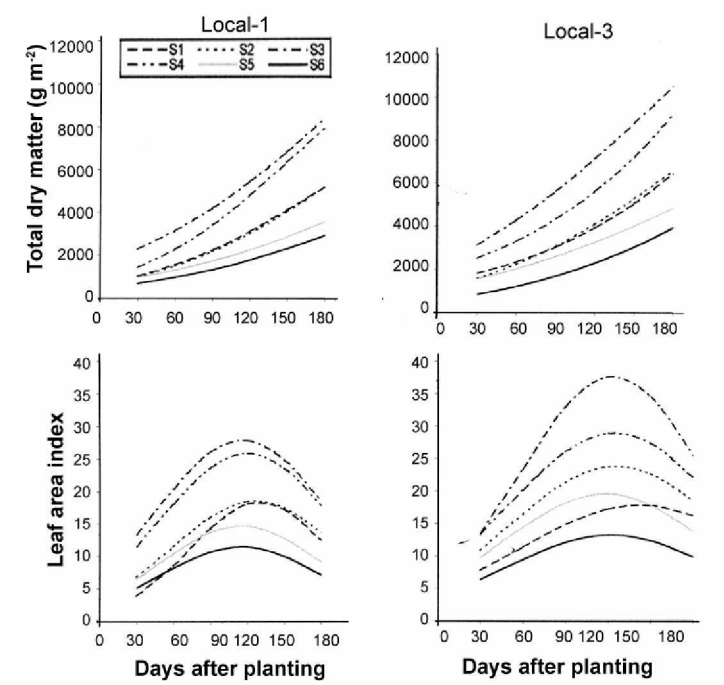

Fig. 1. Total dry matter and leaf area index of two cassava varieties at different ages as affected by different time of planting.

Ezedinma *et al.* (1980) obtained higher dry matter yields of cassava from the September planting and lowest in June planting. TDM increased slowly up to 60 DAP and then increased rapidly with the advancement of growth period. Similar result was also reported by Manrique (1990) in cassava. Varietal effect was highly significant at all the stages of growth in both the

years. Significant planting time × variety interaction effect was also observed at all the stages of growth except at 150 and 180 DAP in the 2nd year. Local-3 produced the highest TDM planted on 15 May.

Higher leaf area index (LAI) was observed for S_3 plants and lower for S_6 in both the varieties (Fig. 1). LAI reached their highest peak at 120 DAP for S_2, S_3, S_4, S_5 and S_6 in both the varieties whereas S_1 at 150 DAP in Local-3. The highest LAI was found in Local-3 planted on 15 May. Williams and Ghazali (1969) in *Manihot utilissima* observed that leaf area of all the varieties approached a maximum after approximately 140 DAP. Opas-Boonseng (1988) observed that LAI was higher during the rainy season and was much less during the dry season in cassava. Manrique (1990) observed that maximum LAI values of cassava were attained during the summer than the winter. But Enyi (1972) reported that early planting (29 April, 13 May) encouraged the production of greater leaf area. In the present investigation, LAI reached a certain peak and then declined with age. Doku (1965) observed that for all the varieties of cassava, the number of leaves per plant increased from May to July, after which the behaviour of the varieties differed. Highly significant varietal effect was found at all the stages of growth. Planting time × variety interaction was significant at all the stages of growth in both the years except at 60, 90, 150 and 180 DAP in the 1st year.

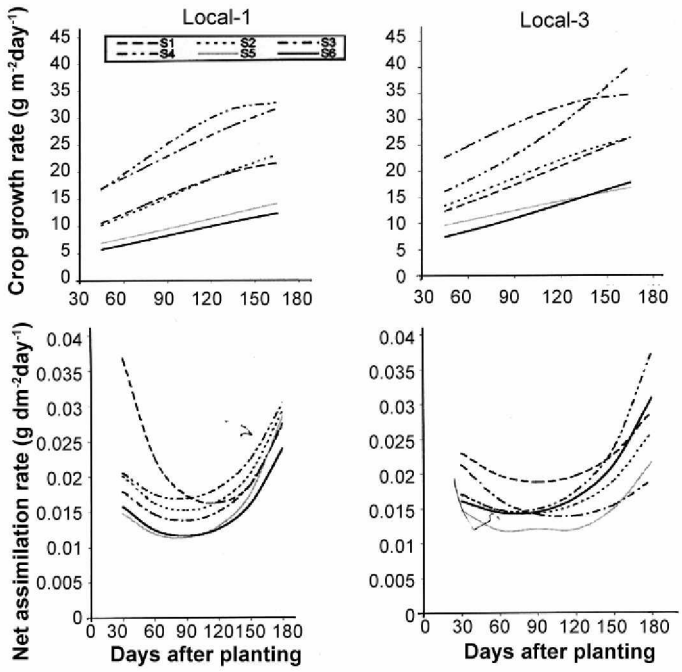

Fig. 2. Crop growth rate and net assimilation rate of two cassava varieties at different ages as affected by different time of planting.

Among the growth attributes, in both the varieties higher CGR was observed for S_4 (1 June) and lower for S_6 (1 July) in both the years (Fig. 2) and it was found highest in Local-3. Higher CGR for S4 plants was due to higher production of dry matter owing to greater LAI (Watson 1947). Starting from lower value, CGR reached a certain peak and then declined at the later stages of growth. But in some of the plantings after reaching a certain peak, CGR values declined and again increased up and then declined at the later stages of growth.

Buttery (1969) in soybean observed that CGR increased for the first 50 to 60 days, falling sharply thereafter. Varietal effect was significant at all the stages of growth except at (30-60) and (60-90) DAP in the 1st year and (150-180) DAP in the 2nd year. Significant variety and planting time interaction (V × T) was observed at (60-90) DAP in the 1st year, and (60-90), (90-120) and (150-180) DAP in the 2nd year.

NAR values showed that starting from a point it decreased at the early stage of growth while it increased up sharply at the later stage of growth (Fig. 2). It is probably due to low temperature and rainfall and more susnshine hour. In some of the treatments NAR declined at the later stages of growth. Similarly Buttery (1969) in soybean and Okezie *et al.* (1980) in white guinea yam observed that NAR tended to decrease with the advancement of time or season. Doku (1965) in cassava reported that all the varieties started with high NAR between May and June, fell between June and July, rose again between July and August, thereafter falling between September and October during which period all the varieties except Ankra had negative NAR values. Enyi (1972) in cassava reported that NAR value tended to decrease with delay in planting. Higher NAR value was found in Local-l for S2 in the 1st year, S_1 in the 2nd year whereas in Local-3 higher NAR was observed for S_1 in both the years. Between the varieties higher NAR was observed in Local-3. Varietal differences were non-significant except (120-150) DAP in the 1st year and (30-60) and (150-180) DAP in the 2nd year. However V × T interaction effect was significant at (30-60), (120-150) DAP in the 1st year and (90-120), (150-180) DAP in the 2nd year.

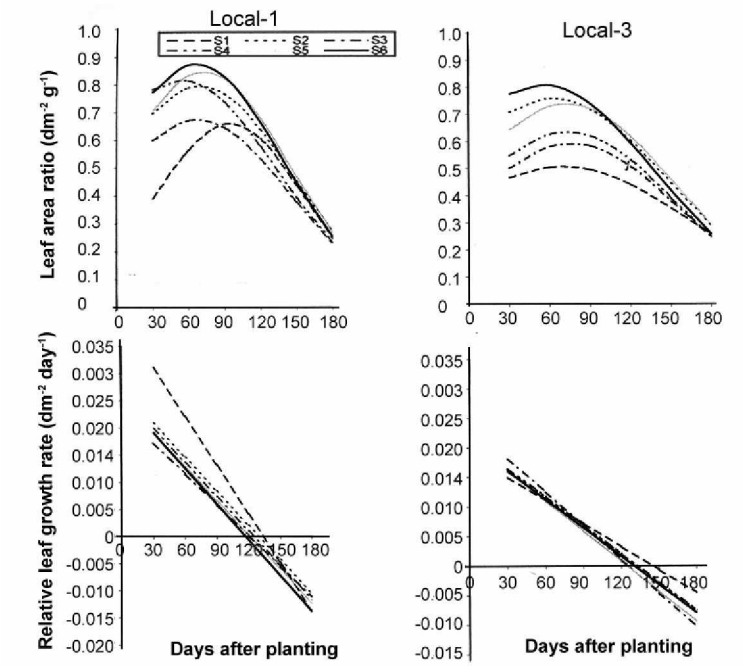

Fig. 3. Leaf area ratio and relative leaf growth rate of two cassava varieties at different ages as affected by different time of planting.

LAR declined steadily with increasing plant age (Fig. 3). Similar results were reported by Okezie *et al.* (1980) in white guinea yam. Shamsuddin and Paul (1988) also reported similar result in sweet potato. In the present study, the highest LAR was observed for S4 in Local-l and for S6 in Local-3. Significant varietal effect was found at all the stages of growth in both the years except

(60-90) and (120-150) DAP in the 1st year. The interaction between variety and planting time was found to be significant only at (30-60) DAP in the 1st year and at all the stages of growth in the 2nd year.

Relative leaf growth rate (RLGR) for all the plantings in both the varieties declined with increasing plant age (Fig. 3). Similar results were reported by Buttery (1969) in soybean. The cause of decline of RLGR at the later stages was due to the abscission of older leaves. In the present study, higher RLGR was found for S_1 Varietal effect was significant only at (30-60) and (120-150) DAP in the 1st year and (30-60) and (150-180) DAP in the 2nd year. Significant interaction between variety and planting time (VXT) was found at (30-60) and (120-150) DAP in the 1st year and (30-60) and (60-90) DAP in the 2nd year.

Simple correlation studies (Table 1) showed that CGR was positively correlated with RGR, LAR, LWR, LAI, FWT and DWT. Opas-Boonseng (1988) observed positive correlation of CGR and LAI in cassava. Bourke (1984) in sweet potato reported that CGR was very closely correlated with tuber yield and positively correlated with LAL RGR had positive relation with NAR, LAR, RLGR, LWR, FWT and DWT.

Table 1. Correlation between growth attributes and root yield of two cassava varieties as affected by planting date

Parameters	CGR	RGR	NAR	LAR	RLGR	LWR	LAI	FWT	DWT
CGR	1.000	0.425**	0.219	0.443**	- 0.085	0.401**	0.733**	0.881**	0.871**
RGR		1.000	0.717**	0.439**	0.510**	0.527**	- 0.075	0.335*	0.346*
NAR			1.000	- 0.027	0.773-	-0.026	- 0.233	0.145	0.144
LAR				1.000	- 0.383**	0.946**	0.339*	0.358**	0.373**
RLGR					1.000	-0.303*	- 0.464**	0.016	0.014
LWR						1.000	0.277*	0.303*	0.321*
LAI							1.000	0.608-	0.602**
FWT								1.000	0.998**
DWT									1.000

*,** Differ significantly at 5% and 1% level respectively.

Positive association of RGR and NAR was reported by Shamsuddin and Paul (1988) in sweet potato. NAR showed positive relation with RLGR. Bourke (1984) in sweet potato observed that NAR was correlated with tuber yield. In cassava, Doku (1965) obtained negative relation between NAR and LAI but Opas-Boonseng (1988) reported positive correlation. LAR was positively correlated with LWR, LAI, FWT and DWT, and negatively with RLGR.

RLGR had negative relation with LWR, and LAI. LWR was positively correlated with LAI, FWT and DWT. Paul and Shamsuddin (1990) stated that LAR was affected by LWR in sweet potato. LAI was associated positively with FWT and DWT. FWT was positively correlated with DWT. Positive relation of tuber yield with LAI was reported in cassava (Doku 1965, Cock 1976) and in sweet potato (Bourke 1984).

It is concluded that Local-3 variety of cassava showed better performance than Local-1 in respect of TDM, LAI, CGR, NAR productions. 15 May planting plants gave maximum values of TDM and LAI for both the varieties and followed by 1 June planting. Tuber yield was positively correlated with LAI, CGR, RGR, LAR and LWR.

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