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Characterization of Some Germplasms on Physiology, Yield and Quality of Greater Yam (*Dioscorea alata* L.)

Loitongbam Sulochana Devi, Herojit Singh Athokpam*, A.K. Bijaya Devi and Naorem Brajendra Singh

College of Agriculture, Central Agricultural University, Impha, Manipur (India)-795004

ABSTRACT: A field experiment was conducted in the Horticulture Research Farm, Andro, Imphal East during 2014 – 2015. The treatments consisted of IGDa-4, IGDa-2, NAUDa-2, Da-199, Da-11, Da-25 and local cultivar as check. The physiological parameters at 135 days after planting *viz.*, leaf area index (2.83), harvest index (76.37%) and crop growth rate (3.10 g day^{-1}) were highest in Local cultivar. Da-25 was highest in net assimilation rate (0.007 g^{-2} day^{-1}) and relative growth rate (0.0078 $g^{-1}day^{-1}$). Length of the tuber (27.40 cm), single tuber weight (1228.77 g and tuber weight per plant (1228.77 g) and tuber yield (15.17 tha^{-1}) were highest in Local cultivar, while diameter of the tuber (12.13 cm) and number of tubers per plant (1.67) were highest in Da-11 and Da-199, respectively. Highest dry matter percentage (34%) and starch (21.67%) content were in Da-11 and IGDa-2, respectively.

Keywords: Local cultivar, tuber, leaf area index, relative growth rate, net assimilation rate, starch

- **Corresponding address E mail: hathokpam@yahoo.in**

I.INTRODUCTION

Greater yam (*Dioscorea alata* L.) is a climbing monocotyledonous tuber crop belongs to the family of Dioscoreaceae and it is reported to be an old crop species native to South East Asia (Burkill 1951). Nigeria accounts for about 70% of the world's production of yam, generating a global annual output of over 33 million metric tons. In India, the data on cultivated area, production and productivity of *Dioscorea alata* L. are lacking. Yam yield is influenced by numerous environmental factors such as soil moisture, temperature, light and photoperiod during the growth stages. Other constraints of yam production include the biotic factors such as pests and diseases in the field and during storage. These factors have led to decrease in production over the years and have prompted breeding activities to generate high yielding varieties with some tolerance to environmental stresses. Evaluation of local cultivars or land races into

different morphological variability groups makes it easy for plant breeders in identifying and also selecting the desired promising lines of different characters.

II. MATERIALS AND METHODS

The experiment was conducted in the Horticulture Research Farm, Andro, Imphal East during 2014 – 2015. The studied area is located at $24^0$45.89′N latitude and $94^0$03.46′E longitude with an elevation of 808 m MSL. The treatments consisted of IGDa-4, IGDa-2, NAUDa-2, Da-199, Da-11, Da-25 and local cultivar as check with replicated thrice.

Leaf area index: Leaf area index (LAI) was recorded and calculated at 135 days after planting (Watson 1947)

LAI = Total leaf area (cm^2)/ Canopy of the plant (cm^2)

Harvest index: Harvest index (HI) is calculated by the formula given by Yoshida (1981) as;

HI = Economic yield/Biological yield x 100

Net assimilation rate (NAR): It ia expressed as gram of dry matter produced per square meter of leaf in a day. NAR was computed by the formula given by Gregory (1926) as;

$$NAR = (W_2 – W_1 / L_2 – L_1) \times (\text{Log } L_2 – \text{Log } L_1 / t_2 – t_1)$$

Where, W_1 and W_2 refer to whole plant dry matter weight at t_1 and t_2. L_1 and L_2 refer to leaf area on two successive periods at t_1 and t_2.

Crop growth rate (CGR): CGR is the rate (g day^{-1}) of a crop growing (Gardner *et al.*2010) as;

$$CGR = W_2 – W_1 / t_2 – t_1$$

Where, $W_2 – W_1$ refer to the whole plant dry weight on two successive periods at t_1 and t_2, respectively.

Relative growth rate (RGR) is the gram of dry matter produced by a gram of existing dry matter in a day and is calculated by the formula given by Blackman (1919) as,

$$RGR = \log W_1 \text{ and } \log W_2 / t_2 – t_1 \ (gg^{-1}day^{-1})$$

Where, $W_2 – W_1$ refer to the whole plant dry weight on two successive periods at t_1 and t_2, respectively.

Dry matter of tuber, length of the tuber, number of tubers per plant tuber weight, dry matter per cent and tuber yield were recorded at the time of harvesting. Starch content was determined by Anthrone reagent method (Thimmaih 2006).

III. RESULTS AND DISCUSSION

Leaf area index

There were significant differences of leaf area index (LAI) among the treatment. LAI increased with advancing of days and decreased at the later stages of growth, which was due to the production of more number of active leaves at early stages and decreased due to senescence, mutual shading of leaves within the canopy. The highest LAI at 135 days after planting was associated in Da-199 and local check and lowest was in Da-25. Similar result in white yam was also reported by Eruola *et al.* (2012).

Net assimilation rate

Net assimilation rate (NAR) was significant different among the cultivars at 135 days after planting. The highest NAR was observed in Da-25 (0.0076 $gm^{-2}day^{-1}$) and minimum was in IGDa-4 (0.0041 $gm^{-2}day^{-1}$). The higher rate of NAR at 135 days after planting might be due to the rapid increase of dry matter in the vine and tubers as reported by Tsuno and Fujise (1965).

Crop growth rate and relative growth rate

The highest crop growth rate (CGR) was in local cultivar (3.10 $gday^{-1}$) which significantly superior to other cultivars and minimum in Da-11 (2.10 $gday^{-1}$). The highest relative growth rate (RGR) was in Da-25 and Da-199 (0.0078 $gg^{-1}day^{-1}$) and minimum in local cultivar (0.0042 $gg^{-1}day^{-1}$). In the active vegetative growth stages the RGR was increased and then gradually decreased at later stages of growth. Similar observation was also reported by Das *et al.* (1997).

Harvest index

The harvest index (HI) at 135 days after planting war varied from 68.03 to 76.37. The HI was greatly different among the cultivars. The highest HI was associated in local cultivar which was significantly higher than the IGDa-2, Da-199, Da-11 and Da-25. The high HI in the local cultivar might be due to the high LAI and CGR resulting to the high yield of the tuber. This result also conformity with the finding of Bhagsari and Ashley (1990).

Diameter of the tuber and tuber length

The diameter of the tuber and tuber length were significantly different among the cultivars. The tuber diameter and tuber length was in Da-11 (12.13 cm) and local cultivar (27.40 cm), respectively. In length of the tuber, local cultivar was significantly superior to the other cultivars tested. Similar observation in length and diameter of the tuber of yam was also reported by Islam *et al.* (2011).

Number of tuber per plant

All the tested yam cultivars, there was only one tuber per plant, except Da-199 (1.67) which was significantly higher than the other cultivars. Such type of finding was also reported by Behera *et al.* (200).

Single tuber weight and tuber weight per plant

The single tuber weight and tuber weight per plant were highest in local cultivar (1228.77 g) which was significantly higher than the other cultivars and lowest was in Da-199 (494.63 g and 826.23 g, respectively). The lower single tuber weight in Da-199 was due to the higher number of tubers per plant (Agbaje *et al.* 2003 and Islam *et al.* 2011).

Tuber yield

There was significant different in tuber yield among the cultivars of yam. The highest tuber yam was recorded in the local cultivar (15.17 t ha^{-1}). This higher yield of tuber is the combined effect of the length of the tuber, single tuber weight and tuber weight per plant. The tuber yield in yam was dependent on its photosynthetic efficiency and this correlated with the LAI and greater exposure to the sunlight. Similar findings was also reported by Eruola *et al.* (2012) in white yam, Khandekar *et al.* (2000) in greater yam and Mhaskar *et al.* (2013) in greater yam.

Dry matter percentage

The highest dry matter percentage was in Da-11 (34.00%) which was significantly superior to other cultivars and minimum dry matter in IGDa-2 (21.97%). Such findings was also observed by EaswariAmma *et al.* (1989) I greater yam and Behera *et al.* (2010).

Starch content (%)

The highest starch content was recorded by the cultivar of IGDa-2 (21.67%) which was significantly higher than other cultivars, except IGDa-4 (21.23%) and local cultivar (20.87%). Starch content of the tuber differ on different cultivar/varieties of the same crop plants. Similar observation was also reported by EaswariAmma *et al.* (1989) and Rugchti and Thanacharoenchanaphas (2010).

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Table 1. Some physiological parameters of greater yam germplasms at 135 days after planting

Cultivars	LAI	HI	CGR	RGR	NAR
IGDa-4	2.60	74.40	2.70	0.0066 (0.7118)	0.0041 (0.7100)
IGDa-2	2.36	70.67	2.27	0.0069 (0.7120)	0.0046 (0.7104)
NAUDa-2	2.73	76.03	2.93	0.0075 (0.7124)	0.0068 (0.7119)
Da-199	2.83	70.27	2.80	0.0078 (0.7126)	0.0060 (0.7114)
Da-11	2.40	68.03	2.10	0.0052 (0.7108)	0.0060 (0.7113)
Da-25	2.10	70.73	2.87	0.0078 (0.7126)	0.0076 (0.7124)
Local	2.83	76.37	3.10	0.0042 (0.7101)	0.0052 (0.7108)
S.Ed(±)	0.06	1.80	0.066	0.00011	0.00010
CD (0.05)	0.14	3.92	0.144	0.00023	0.00022

(**Note**: Values in parenthesis are square root transformed values)

Table 2. Yield attributes and quality of some germplasms of greater yam at harvest

Cultivars	Tuber diameter (cm)	Tuber length (cm)	Single tuber weight (g)	Number of tuber /plant	Tuber weight/plant (g)	Tuber yield (t ha^{-1})	Dry matter percentage (%)	Starch content (%)
IGDa-4	11.33	24.13	982.50	1.00	982.50	12.13	29.00	21.23
IGDa-2	9.70	22.73	915.30	1.00	915.30	11.30	21.97	21.67
NAUDa-2	10.70	24.10	980.10	1.00	980.10	12.10	29.00	16.47
Da-199	8.50	19.23	494.63	1.67	826.23	10.17	27.00	13.80
Da-11	12.13	15.23	848.07	1.00	848.07	10.47	34.00	18.60
Da-25	9.50	21.27	920.97	1.00	920.97	11.40	26.00	19.10
Local	10.23	27.40	1228.77	1.00	1228.77	15.17	30.03	20.87
S.Ed(±)	0.13	0.45	24.95	0.018	20.42	0.25	0.60	0.41
Cd (0.05)	0.29	0.99	54.37	0.039	44.49	0.55	1.32	0.90