PRELIMINARY EVALUATION OF TEMPERATE SUGAR BEET ACCESSIONS FOR TUBER YIELD AND QUALITY IN JOS PLATEAU.

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ABSTRACT

Twenty nine temperate sugar beet accessions were evaluated for their tuber yield, total sugar and fibre contents at the NRCRI Sub-station, Vom., Jos Plateau in 2005. Seven accessions gave yield ranging between 300 700g/plant out of 9 accessions that reached the harvesting stage. Beta 166/97 that gave the highest leaf number also gave higher root yield ($p<0.05$). The total sugar content of the root ranged between 44.6% and 74.3% while the crude fibre content range between 7.3% and 17.9% on dry weight basis. Four accessions, namely, Beta 267/99, Beta 347/00, Beta 166/97 and Beta 266/92 gave relatively high sugar contents comparable to sugar beet produced under the temperate agro-ecology. The four accessions were identified as being promising but further studies were advocated.

Key Words: Sugar Beet, accessions, temperate, tuber yield, tuber quality.

INTRODUCTION

Sugar beet (*Beta vulgaris*) is one of the industrial crops reputable for table sugar production the second being sugar cane. The sucrose concentration ranges between 16-18% on wet weight basis and more than 75% on dry weight basis for the storage root (Elliot and Weston, 1993; Scott and Jaggard, 1993; Ajala, 1995). About 37% of world table sugar production is derived from sugar beet while the remaining 63% is from sugar cane (Cooke and Scott, 1993). Although sugar cane contributes the largest percentage to sugar production, sugar beet seems to have an overriding advantage in that it is less expensive to cultivate and harvest than sugar cane. In addition, sugar beet matures approximately within 6 months and is possible to produce twice a year as compared to sugar cane that matures between 12 to 18 months.

Sugar beet is regarded as a temperate crop; however, some varieties are found growing well under sub-tropical environment like Egypt, Algeria and in high altitude areas like Jos in Northern Nigeria (Cooke and Scott, 1993; Winner, 1993; Ajala, 1995; Ajala, 2002). Further, a preliminary green house investigation carried out at Umudike has shown the adaptability of sugar beet to Umudike environment in terms of growth and tuber yield (Olojede, 2001; unpublished data). However, the tuber quality component was not considered. The present effort is an attempt to evaluate these materials under field conditions for their growth, yield performance and tuber quality with the view to selecting adaptable varieties to Nigerian agro-climatic environment.

MATERIALS AND METHODS

The experiment was conducted during the rainy season of 2005 at the National Root Crops Research Institute, Kuru Sub-station. Kuru is located on Longitude 08° 53'E and Latitude 09° 57'N at an elevation of 1159m above sea level in Plateau state, Nigeria. Twenty nine Sugar beet accessions (15 FC series from US and 14 Beta series from Germany) were evaluated using a randomized complete block design with 3 replications. The land was ploughed, harrowed and ridged before planting. The plot size was 4m x 3m ($12m^2$) while the plant spacing was 1m x 25 cm to maintain a plant population of 50,000 plants/ha. Split dosage of NPK 15:15:15 fertilizer was applied at 4 and 8 weeks after planting at 400 kg/ha. The plots were kept weed free throughout the crop growing period.

Data on germination counts were taken at weekly interval after planting while number of functional leaves per plant was taken at 10 weeks after planting (WAP) being the peak of vegetative growth (Milford *et al.*, 1985a,b). Harvesting was done when the leaves began to senesce at 6 months after planting. The harvested tubers from the net area were cleaned and weighed. The mean root yield/plant was calculated by dividing the total root weight/plot with the total number of plants harvested/plot. Root samples were taken for dry matter, sugar and fibre contents determination.

Chemical Analysis: The harvested sugar beet tuber samples were prepared for relevant chemical analysis by size reduction, oven drying (at 60°C) to constant weight and converted to powder with a milling machine. A standard spectrophotometer method (AOAC, 1990; Bainbridge *et al.*, 1996) was used to determine reducing and non-reducing sugar content/total sugar. Total sugar content was estimated as sum of estimates of reducing and non-reducing sugar content of experimental samples. The total fibre content of the samples was further determined by the neutral detergent procedure (AACC, 1983; Bainbridge *et al.*, 1996).

Only data on leaf number at 10 WAP and tuber yield at harvest were subjected to analysis of variance as described by Snedecor and Cochran (1967) and significant means were separated using the New Duncan Multiple range test (NDMRT) (Duncan, 1955). The root sugar and fibre contents were correlated to establish the degree of relationship between the two parameters.

RESULTS AND DISCUSSION

Germination started at 3 weeks after planting. About 83% of the 29 accessions planted germinated with an average of 23.9% (Table 1). Establishment count range from 0 51.2% but number of stands per plot gradually reduced with increasing time. Only 9 accessions survived till the harvest time and these were mostly accessions imported from Germany. Generally, plant establishment was poor probably due to loss of viability of seeds or fungal attack that caused seed rot, damping off or root rot. The number of functional leaves per plant ranged between 6.5 and 24 at the peak of vegetative growth (10 WAP). Beta 265/00 had the lowest leaf number while Beta 166/97 had the highest; thus giving about 1-3 average leaf productions per week as reported by Milford *et al.* (1985a, b). For the root yield, significant difference was recorded among the 9 accessions that reached the harvesting stage. Beta 166/97 that had the highest functional leaf number also had highest root yield ($p<0.05$) followed by Beta 268/02, Beta 267/99, Beta 266/92, Beta 269/00, Beta 347/00 and Beta 224/97. Beta 81/97 and Beta 86/97 appeared to be poor root yielders.

Root Total Sugar and Crude Fibre Contents

Data on root total sugar and crude fibre contents are shown in Table 2 below. Total sugar content of the root ranged from 44.6% to 74.3% on dry weight basis. Four accessions, namely, Beta 267/99, Beta 347/00, Beta 166/97 and Beta 266/92 gave relatively high sugar content comparable to sugar beet produced under the temperate agro-ecology (Scott and Jaggard, 1993). These workers reported sugar concentration range between 67 to 78% in series of experiments conducted over years in Britain under irrigation system. However, the slight difference in sugar concentration as compared to their report could be explained in terms of seasonal differences as sugar beet have been reported to perform better under irrigation than rainfed conditions (Ajala, 1995; 2002). As regards the crude fibre content, Beta 269/00 recorded the highest value while the lowest value was recorded in Beta 347/00. An inverse non-significant correlation coefficient, $r = -0.65$ ($p = 0.1617$) was established between total sugar content and crude fibre. Although sugar content is an important quality trait in sugar beet for table sugar production (Oldfield, 1974), accessions or varieties with high fibre contents could be selected for livestock feed. From the foregoing, the four accessions listed above are very promising but a further study is suggested.

Table 1. Establishment count (%), functional leaf number and root yield of sugar beet accessions evaluated at Kuru Sub-Station in 2005

Accession	Establishment count			Leaf no/plant	Av. Yield (g/plant
	3WAP	6WAP	9WAP	10 WAP	
Beta 267/99	51.20	47.90	27.10	19.50^{ab}	500.0^{ab}
Beta 347/00	43.80	39.60	35.40	19.00^{ab}	300.0^{bc}
Beta 266/92	50.00	37.50	29.20	11.20^{bc}	400.0^{ab}
Beta 166/97	51.20	51.20	41.70	24.00^{a}	700.0^{a}
Beta 268/02	31.30	29.20	25.00	17.80^{ab}	650.0^{ab}
Beta 81/97	39.60	27.10	14.60	10.30^{bc}	60.0^{c}
Beta 86/97	37.50	33.30	22.90	20.20^{a}	30.0^{c}
Beta 224/97	25.00	14.60	10.40	9.80^{c}	300.0^{bc}
Beta 269/00	41.70	35.40	16.70	13.20^{bc}	350.0^{bc}
Beta 265/00	56.30	12.50	6.25	6.50^{c}	0.00
Beta 165/97	37.50	16.70	2.08	13.00^{bc}	0.00
Beta 87/86	28.80	8.30	2.08	22.00^{a}	0.00
Beta 91/97	10.40	4.20	2.08	7.00^{c}	0.00
Beta 242/88	39.60	12.50	0.00	0.00	0.00
FC 726	6.25	4.20	2.08	17.70^{ab}	0.00
FC 725	18.80	10.40	4.20	0.00	0.00
FC 709	2.08	0.00	0.00	0.00	0.00
FC 716	2.08	0.00	0.00	0.00	0.00
FC 715	2.08	2.08	2.08	0.00	0.00
FC 708	0.00	0.00	0.00	0.00	0.00
FC 712(4x)	0.00	0.00	0.00	0.00	0.00
FC 717	0.00	0.00	0.00	0.00	0.00
FC 727	0.00	0.00	0.00	0.00	0.00
FC 607	0.00	0.00	0.00	0.00	0.00
FC 709-2	0.00	0.00	0.00	0.00	0.00
FC 710(4x)	0.00	0.00	0.00	0.00	0.00
FC 720	0.00	0.00	0.00	0.00	0.00
FC 722	0.00	0.00	0.00	0.00	0.00
FC 724	0.00	0.00	0.00	0.00	0.00
Mean	20.53	13.33	8.33	7.28	355.6

Means followed by the same letter (s) within the same column are not significantly different at 5% level of probability.

Table 2. Total Sugar and Fibre contents of Sugar Beet accessions on dry weight basis.

ACCESSIONS	TOTAL SUGAR CONTENT (%)	FIBRE CONTENT (%)
BETA 347/00	70.5	7.3
BETA 269/00	44.6	17.9
BETA 268/02	47.2	8.4
BETA 166/97	69.9	8.4
BETA 267/99	74.3	8.8
BETA 266/92	57.5	9.8

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