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Evaluation of 14 Accessions of Amaranthus cruentus for Production of Early Vegetative Yield

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Abstract

The present study was conducted to identify cultivar(s) of *Amaranthus cruentus* with the ability for production of vegetative yield within a short period of growth. A total of fourteen accessions of *Amaranthus Cruentus* were evaluated at 4weeks, 6weeks, 8weeks and 10weeks after planting (WAP) for plant height, leaf number, fresh and dry weights of leaves, stem and branches to measure the relative performance of the accessions. The experiment was planted, using a randomized complete block design (RCBD), with the *Amaranthus cruentus* as the treatment. The result showed significant differences in all the traits evaluated at each harvest period. The result also indicates significant variation in the ability of the accessions for early and rapid production of early vegetative yield. Three potentially suitable accessions BAM18, BAM 13, and BAM 22 were identified based on their outstanding performances at 4WAP and 6WAP harvest. Further field trial is required before they can be recommended for commercial production by farmers.

Keywords: Vegetative Yield; Accessions; Cultivars; Traits.

Introduction

Amaranthus is collectively known as Amaranth or Pigweed and it is of the family Amaranthaceae (Adewole and Dedeke, 2012).The species are all herbaceous and short lived annuals, they are upright and branch sparsely. Amaranth leaves are rich in iron, vitamin A and C, minerals and protein (Makus, 1990a; Rangarajan and Kelly, 1994; Segura-Neito *et al*., 1994; Teutonica and Knorr, 1985).The crop is one of the few leaf vegetables that can be used to improve the nutrition and income of rural farming families because of its high nutritional quality, ease of establishment and potential for good yields with low level of inputs (Awe and Osunlola 2013). *Amaranthus*, is a cosmopolitan genus of annual or short-lived perennial plant. Approximately 60 species are recognized, with inflorescences and foliage ranging from purple and red to green or gold, several of which are cultivated as leaf vegetables, grain crop, and ornamental plants while some others are weeds (Rusu *et al*. 2010). Members of this genus share many characteristics and uses with members of the closely related genus Celosia. Although several species are often considered weeds, people aroundthe world value amaranths as leaf vegetable, cereal, and ornamental. It is also known as "love lies bleeding", In Nigeria it is known as '*tete'*. Amaranthus shows a wide variety of morphological diversity among and even within certain species. Although the family (*Amaranthaceae*) is distinctive, the genus has few distinguishing characters among the species *which* include *Amaranthus hypochondriacus, Amaranthus cruentus, Amaranthus caudatus, Amaranthus tricolor, Amaranthus dubius, Amaranthus lividus, Amaranthus palmeri, Amaranthus hybridus*). Among these species, the regularly cultivated are *Amaranthus cruentus, Amaranthus hybridus*, and *Amaranthus dubius.* Three species of Amaranthus domesticated for grain production are *Amaranthus hypochondriacus, Amaranthus cruentus*, and *Amaranthus caudatus* (Marin *et al*., 2008; Law-Ogbomo and Ajayi, 2009).

Amaranthus cruentus is a popular leafy vegetable cultivated in Nigeria and other West African countries although it originated from South America (Saunder and Beciker, 1984). In Nigeria it is a vegetable of national importance which is cultivated throughout the entire country. It differs from vegetables such as *Celosia argentea* which is a vegetable of regional importance and only cultivated in some areas and not in others. It is an annual C_4 plant that grows best at warm temperatures and high light intensities (El-Sharkawy *et al.,* 1968). They are characterized by a more effective photosynthesis, more intensive nitrogen metabolism, as well as physiological and biological peculiarities of metabolic processes (Breus, 1997).

Amaranthus cruentus thrives well on soils with high organic matter. Apart from its uses as a vegetable, it has also been used as an effective alternative to drug therapy for people with hypertension and cardiovascular disease (CVD) (Martiorosyan and Miroshnichen, 2007). Vegetable crops production in West Africa, including *Amaranthus* has been plagued with an array of factors such as poor farm input, poor cropping system, incidence of pest and diseases (Nwangburuka *et al.,* 2012a) as well as the fact that farmers grow all kinds of varieties without any knowledge of which one is capable of rapid and early vegetative yield making them suitable for early harvesting by uprooting or those which have to be allowed more time on the field by cutting. Such practices may be affecting the yields that are produced by the crop as well the effective utilization of land. The longer the crop is maintained on the plot the more the increase in the cost of crop management arising from delay in harvest. The demand for this crop as vegetable has increased, especially in the urban centres where people are not involved in its primary production (Schippers, 2000). This has made the vegetable to become an important commodity in our markets.

Fast growing varieties will be able to produce appreciable vegetative yield for early harvesting within 4-6 weeks and thus providing the farmers with quick revenue and also satisfy the high demand of urban consumers who are not involvrd in its production. With fast growing varieties the farmers can plant several crops within a short period of time (4-6 weeks) in a year on the same plot. Consequently, fast growing varieties of *Amaranthus* would make for optimal land utilization. Therefore this research was designed to evaluate 14 accessions of *Amaranthus cruentus* for early vegetative yield and fast-growing varieties which are suitable for harvesting by uprooting.

Materials and Method

Experimental site

The field experiment was carried out on the research farm of the School of Agriculture and Industrial Technology, Babcock University Ilishan Remo, Ogun State, between December 2014 and March 2015. The land was mechanically prepared, 45 beds were made with each having a dimension of 1.3m x 1.5m. On each bed, four rows with a depth of 1.0 cm were drilled and the seeds mixed with fine sand to allow for even distribution in the drilled holes. An inter-row spacing of 30cm was maintained between two rows drilled.

Experimental treatments

The treatments were made from 14 accessions of *Amaranthus cruentus* collected from different sources in western part of Nigeria.

The experiment was a Randomized Complete Block Design (RCBD), with three replications.

Management Practices

Fertilizer application NPK 15:15:15 was basally applied at a quantity of 53.4g for each bed using broadcasting method. Weeding was done at 4, 6 and 8 weeks after planting (WAP). Destructive harvesting was done at an interval of 2 weeks after planting for a total period of 10 weeks.

Data Collection

Data were collected on the field from 10 randomly selected plants from each bed at each harvest

as follows: Plant Height (cm), Number of leaves/plant, Fresh weight of leaves/plant, Fresh weight of shoot/plant, Dry weight of leaves (g) and Dry weight of shoot (g).

Statistical Analysis

Data collected from each harvest were subjected to analysis of variance (ANOVA) to determine the level of significance of treatments and significant means were separated by the use of Duncan Multiple Range Test at 5% probability level.

Results and Discussion

Plant height

Result of the fresh leaf weight is presented in table 2 for 4 periods of sampling (4, 6, 8, and 10 WAP). BAM 18 had significantly highest plant height at 4 WAP, compared to BAM 10, BAM 20 and BAM 8, but was not different from other treatment except for BAM 16 which had significantly lower plant height (Table 2). At 6 WAP BAM 18, had significantly highest plant height compared to BAM 16, 20 , 7, 8,15,and 12 but was not different from other treatments. At 8 WAP the highest plant height was observed in BAM 13, which was significantly different from BAM 7,8,10,12,15,16, 20, but was not different from other treatments. Significantly highest plant height was observed in BAM 22 at 10 WAP compared to BAM 7, 8, 10,11,12,14,15,16,18, 19, 20, however least plant height was observed in BAM 15.

Leaf number

Result of observation carried out on leaf number is presented in table 3 for 4 periods of sampling (4, 6, 8, and 10 WAP). At 4 WAP there was no significant difference among treatments. At 6 WAP, BAM 15 showed the highest leaf number, which is not significantly different from BAM 18, BAM 10, BAM 13, BAM 16, and BAM 7 at 6 WAP, while the least leaf number was noticed in BAM 19. BAM 9 showed the highest leaf number at 8 WAP, which is not significantly different from BAM 20, BAM 18, BAM 11, BAM 13, BAM 19, BAM 16, BAM 12, and BAM 8, while BAM 15 showed the least leaf number at 8 WAP. The highest leaf number was observed in BAM 18 at 10 WAP, which is not significantly different from BAM14, BAM 10, BAM 19, BAM 9, BAM 8, BAM 16, BAM 12, BAM 11, BAM 7, BAM 20, BAM 13 and BAM 15 while the least leaf number was observed in BAM 22 at 10 WAP. These results are in full conformity with Gondane and Bahatia (1995) and Martin and Rhodes (1983), who found significant varietal differences for the number of leaves per plant in okra.

Fresh leaf weight

Table 4 shows record of the fresh leaf weight. It was observed that BAM 13 had the highest fresh leaf weight at 4 WAP, which is not significantly different from BAM 9, BAM 22, BAM 18, BAM 7, BAM 15, BAM 11, BAM 14, BAM 12 and BAM 10, while BAM 20 showed the least fresh leaf weight at 4 WAP. At 6 WAP, BAM 18 had the highest fresh leaf weight, which is not significantly different from BAM 10, BAM 9 and BAM 14, while BAM 20 had the least fresh leaf weight. It was observed that BAM 9 had the highest fresh leaf weight at 8 WAP, which is not significantly different from BAM 18, BAM 11, BAM 13, and BAM 7, while the least fresh leaf weight was noticed in BAM 15. At 10 WAP it was observed that BAM 11 had the highest fresh leaf weight, which is not significantly different from BAM 9, BAM 7, BAM 14, BAM 10, BAM 22, BAM 18, BAM 13, BAM 16, and BAM 19, while the least fresh leaf weight was observed in BAM 15.

Dry leaf weight

Table 6 presents the dry leaf weight of the crop for 4 periods of sampling (4, 6, 8, and 10 WAP). The highest dry leaf weight was recorded in BAM 13 at 4 WAP, which is not significantly different from BAM 22, BAM 9, BAM 18, BAM 15, BAM 11, BAM 12, BAM 7, BAM 14 and BAM 16, while the least dry leaf weight was observed in BAM 20. At 6 WAP, the highest dry leaf weight was noticed in BAM 18, which is not significantly different from BAM 10, BAM 9, BAM 15, BAM 14, BAM 13, BAM 22, BAM 7, BAM 19, BAM 12, BAM 16, and BAM 8, while BAM 20 had the least dry leaf weight. Highest dry leaf weight was observed in BAM 9 at 8 WAP, which is not significantly different from BAM 11, BAM 7, BAM 18, BAM 8, BAM 19, BAM 13, BAM 10, BAM 14, BAM 20, BAM 16, and BAM 12, while the least dry leaf weight was observed in BAM 15. The highest dry leaf weight was recorded in BAM 11 at 10 WAP, which is not significantly different from BAM 9, BAM 10, BAM 18, BAM 14, BAM 22, BAM 8, BAM 13, BAM 7, and BAM 19, while BAM 15 had the least dry leaf weight.

Conclusion

Generally the study shows which variety has the ability for early vegetative yield with 4 and 6 WAP regarded as the early growth period. At 4 WAP vegetative parameters showed that BAM 18 had the highest plant height, BAM 13 had the highest leaf weight and the highest dry leaf weight, BAM 22 showed the highest fresh shoot weight and dry shoot weight. At 6 WAP, BAM 18 showed the highest in all growth parameters except leaf number while BAM 15 had the highest leaf number. Since the varieties was cultivated for early vegetative yield, BAM 18, 13 and 22 can be regarded as suitable for harvesting by uprooting at 4weeks while BAM 18 is suitable for harvesting by uprooting at 6 weeks. Further studies should be conducted to know which variety has an early vegetative yield among BAM 18, 13 and 22 at 4 weeks after planting.

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Table 1. The treatments and their sources

Treatments	Sources
BAM10	Babcock university
BAM11	Babcock university
BAM12	Babcock university
BAM13	Babcock university
BAM14	Babcock university
BAM15	Babcock university
BAM16	Babcock university
BAM18	NIHORT
BAM19	NIHORT
BAM20	Babcock university
BAM22	Babcock university
BAM7	Babcock university
BAM8	Babcock university
BAM9	Babcock university

Table 2. Plant height at varying sampling periods of weeks after planting (WAP)

Treatment	4WAP	6WAP	8WAP	10WAP
BAM10	18.937edc	52.743bac	65.887ebdgcf	76.233edc
BAM11	23.817bdac	52.400bac	74.557ebdac	83.750bedc
BAM12	20.007ebdac	43.750bc	56.377egf	70.390fe
BAM13	27.990ba	55.023bac	87.220a	89.563bac
BAM14	19.500ebdac	53.613bac	69.643ebdacf	80.423bedc
BAM15	20.517ebdac	41.470bc	48.017g	62.200f
BAM16	14.643e	37.153c	53.713gf	71.047fe
BAM18	28.100a	67.873a	82.047bac	86.370bdc
BAM19	19.887ebdac	53.327bac	74.560ebdac	80.557bfdc
BAM20	16.823ed	40.260c	63.697edgcf	71.710fe

BAM22	26.393bac	58.773ba	77.263bdac	99.947a
BAM7	19.370ebdc	46.840bc	66.063ebdgcf	73.413fed
BAM8	16.337ed	43.607bc	60.250edgf	70.897fe
BAM9	26.067bac	52.693bac	83.137ba	92.233ba

Means with the same letters are not significantly different from another according to Duncan multiple range test at 5% probability level.

Table 3. Leaf numbers at varying sampling periods of weeks after planting (WAP)

Treatment	4WAP	6WAP	8WAP	10WAP
BAM10	9.5333a	15.200bac	14.833edc	18.467ba
BAM11	8.993a	12.767c	15.767bdac	16.200ba
BAM12	9.533a	12.933c	15.067ebdac	16.500ba
BAM13	9.633a	14.533bac	15.700bdac	15.400ba
BAM14	9.667a	13.467bc	14.600edc	19.667a
BAM15	10.000a	16.000a	11.967e	15.033ba
BAM16	8.700a	13.833bac	15.133ebdac	16.667ba
BAM18	9.800a	15.833ba	17.033bac	19.967a
BAM19	8.467a	12.600c	15.233ebdac	17.767ba
BAM20	8.433a	13.300bc	18.167ba	15.400ba
BAM22	9.467a	13.200c	13.067ed	14.567b
BAM7	9.133a	13.500bac	14.933ebdc	16.033ba
BAM8	8.933a	12.833c	15.033ebdac	17.633ba
BAM9	9.567a	13.300bc	18.233a	17.700ba

Means with the same letters are not significantly different from another according to Duncan multiple range test at 5% probability level

Table 4. Fresh leaf weight at varying sampling periods of weeks after planting (WAP)

Treatment	2WAP	4WAP	6WAP	8WAP	10WAP
BAM10	0.036c	1.003bdac	6.564a	5.468bdc	7.471bac
BAM11	0.091ba	1.115bdac	3.873bc	7.434bac	9.583a
BAM12	0.066bac	1.091bdac	3.926bc	4.262dc	5.159bc
BAM13	0.071bac	1.718a	4.293bc	7.295bac	6.370bac
BAM14	0.043c	1.105bdac	5.520bac	6.139bdc	7.683bac
BAM15	0.069bac	1.199bdac	4.640bc	3.094d	3.797c
BAM16	0.036c	0.896bdc	4.075bc	4.743dc	6.098bac
BAM18	0.087ba	1.485bac	7.443a	9.030ba	6.649bac
BAM19	0.072bac	0.798dc	4.459bc	5.957bdc	5.757bac
BAM20	0.050bc	0.639d	3.276c	5.913bdc	4.822bc
BAM22	0.102a	1.595ba	4.211bc	5.724bdc	6.768bac
BAM7	0.038c	1.221bdac	4.482bc	6.816bac	8.464ba
BAM8	0.037c	0.759dc	3.989bc	5.463bdc	5.082bc
BAM9	0.065bac	1.708a	5.595bac	9.862a	8.700ba

Means with the same letters are not significantly different from another according to Duncan multiple range test at 5% probability level

Table 5. Dry leaf weight at varying sampling periods of weeks after planting (WAP)

Treatment	4WAP	6WAP	8WAP	10WAP
BAM10	0.190bc	1.265a	1.186bac	1.799ba
BAM11	0.275bac	0.710b	1.610ba	2.130a
BAM12	0.244bac	0.804ba	1.075bac	1.324bc
BAM13	0.349a	0.909ba	1.203bac	1.468bac
BAM14	0.233bac	0.951ba	1.185bac	1.685bac
BAM15	0.294bac	1.058ba	0.791c	1.071c
BAM16	0.221bac	0.792ba	1.119bac	1.149bc
BAM18	0.320ba	1.265a	1.491bac	1.705bac
BAM19	0.191bc	0.805ba	1.312bac	1.357bac
BAM20	0.169c	0.667b	1.165bac	1.269bc
BAM22	0.344a	0.895ba	0.934c	1.631bac
BAM7	0.243bac	0.845ba	1.530bac	1.366bac
BAM8	0.188bc	0.765ba	1.378bac	1.496bac
BAM9	0.340a	1.079ba	1.779a	2.129a

Means with the same letters are not significantly different from another according to Duncan multiple range test at 5% probability level