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RESPONSE OF VEGETABLE AMARANTH TO DIFFERENT SEEDLING TRANSPLANTING DATES

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Abstract
Appropriate transplanting age for Amaranthus has remained a controversial issue both among farmers and researchers. Therefore, an experiment was carried out on the teaching and research farm of the department of Agricultural Education, Federal college of Education (Technical) Akoka within the wet season of 2016 to evaluate the response of vegetable amaranth to age at transplanting. The experiment was laid out in a randomized complete block design (RCBD) in three replicates. Treatments consist of Amaranthus seedlings transplanted at three weeks after planting (3 WAP); at two weeks after planting (2WAP) and at one week after planting (1 WAP), the control. All data collected on plant height, number of leaves, stem girth and yield were subjected to analysis of variance (ANOVA) while the significant means were separated with LSD at 5% level of probability. The vegetable amaranth transplanted at 3WAP had the highest ($p < 0.05$) mean values of 30.73 to 75.27cm ; 11.46 to 22.07; 1.89 to 3.02 cm and 38.38 t /ha for plant height, number of leaves, stem girth and yield respectively, while those transplanted at 1 WAP had the least values for the aforementioned variables. However, the plants transplanted at 2 WAP produced comparable yield (35.27t / ha) with that of the highest.

Keywords: Amaranthus, growth, yield, nursery, plant height.

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Introduction

Amaranthus is one of the ancient classes of vegetables with huge potential for solving hunger and malnutrition challenges currently confronting the population in many parts of the world. The vegetable is cheap with high nutritive value and usually propagated by seeds. Generally, leafy vegetables, in addition to their very important role in health and nutritional security of human beings, play a major role in improving the economy of the people. India is the second largest producer of vegetables only next to china in the world (Manikandan and Srimathi, 2015). Vegetable amaranth is a fast growing crop with high yield potential of about 30 tonnes per hectare fresh or 4.5 tonnes per hectare dry leaf within four weeks after planting (Barau *et al.*, 2018).

Amaranthus is commonly cultivated and consumed throughout India, Nepal, China, Indonesia, Malaysia; whole of Central America, Mexico; Southern and Eastern Africa. It is also cultivated and consumed in various parts of West African countries (O'Brien and Price, 2008;Neelesh and Pratibha, 2018).In Nigeria, especially Yoruba community, all species are referred to as "tete" even though they may add another name as an indication of a particular variety or species. The Hausa tribe refers to amaranthus as "alaiyaho while Igbos call it "imne" (Janet, 2013).

Virtually all parts of the vegetable are useful. The leaves, shoots and tender stems of amaranth are eaten as a potherb in sauces or soups, cooked with other vegetables, with a main dish or by itself. The seed/ grain are also edible. As a matter of fact, chopped plants have been used as forage for livestock (Janet, 2013).

Babalola *et al*. (2010) further reported that amaranth leaves, stems and entire plants may be eaten raw or cooked as spinach or greens. The author noted that cooking and discarding the water removes potentially harmful oxalates and nitrates while boiling and squeeze washing lead to more loss than blanching especially the vitamin C content. In African countries, leave amaranth is highly valued for the nutritional content which has been discovered to be medically useful in treating those suffering from HIV/AIDS (Janet, 2013). The high nutrient profile is mainly due to its huge amount of protein, vitamins and essential amino acid content (Grubben and Van Slotten, 1981; Schippers, 2000). The leaf is also rich in vitamins, minerals, sugar and water needed for healthy body growth and maintenance (Bailey, 1992).

Some of the problems encountered by amaranth farmers include declining soil fertility and unavailability of quality manure required for optimum crop productivity (Lucas and Ojeifo, 1985; Adeyemi et al., 1987), inadequate supply of chemical fertilizer and lack of capital to buy them (Adeyemi et al., 1987; Olufolaji et al., 1990; Olufolaji et al., 1999). Apart from the aforementioned challenges confronting vegetable amaranth farmers, perhaps the greatest one is the inappropriate age at which seedling transplanting is carried out by many farmers which has consistently impacted negatively on yield potentials of the crop. The effect of transplant age on yield is an issue that is of major interest to growers of horticultural crops because when transplants are too old, growth and yield are adversely affected (Vavrina, 1990). In general, older transplants mature early while younger ones may produce comparable or even higher yields but take longer time to do so (Vavrina,1991).

In order to increase the availability of high quality amaranth throughout the year at moderate price, there is a need to determine the right age at which amaranth seedlings should be

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transplanted from nursery site to the permanent field. Therefore, the objective of this study was to evaluate the influence of different transplanting ages on growth and yield of leave amaranth

Materials and Methods

The experiment was carried out on the teaching and research farm of the department of Agricultural Education, Federal college of Education (Technical) Akoka, Lagos located on 6^0 31`31'' N Latitude, $3^0$ 23` 47''E Longitude (Mindat, 2020) within the wet season of 2016. The trial was laid out in a randomized complete block design (RCBD) in three replicates. Treatments consist of seedlings transplanted at three weeks after planting (3 WAP); at two weeks after planting (2WAP) and at one week after planting (1 WAP),the control.

Seedlings were raised in the nursery. The first planting done on the nursery bed was on 9th may 2016, which was the (3 WAP), the second planting was done on 16th may 2016 (2 WAP) while the third planting was done on 23rd may 2016 (1 WAP). Planting at the nursery was done by broadcasting on the prepared beds. Transplanting to the experimental plots made of 9 beds each measuring I x I m was done on the 30th May, 2016. Poultry manure was uniformly applied at 20 tonnes / ha, on the experimental beds a week before transplanting while transplanting was carried out early in the morning for each treatment at the spacing of 10 x 10cm.

All data collected on plant height, number of leaves / plant, stem girth and yield were subjected to analysis of Variance (Anova) while significant means were separated with Least Significant Difference (LSD) at 5% level of probability.

Results and Discussion

Transplanting age had significant ($P < 0.05$) effect on all growth and yield variables considered in the study (Tables 1 – 4).

Plant height of vegetable amaranth was significantly affected by transplanting age . Vegetable seedlings transplanted at 1 week after planting maintained the shortest height (4.05cm to 22.33 cm) throughout the period of study while those transplanted at 3 WAP were significantly higher (30.73cm to 75.27cm) in height compared to other treatments (Table 1).

Table 1: Effect of Transplanting Age on *Amaranthus* Plant height (cm)

Treatments	1 WAT	2 WAT	3 WAT
Transplant at 3WAP	30.73a	55.73a	75.27a
Transplant at 2WAP	15.00b	32.07b	54.00b
Transplant at 1WAP	4.05c	11.43c	22.33c
LSD (0.05)			

WAP = weeks after planting, WAT = weeks after transplanting, means having the same letter in the same column are not statistically different from each other using LSD at 5% level of probability

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Transplanting age had significant effect on number of leaves of amaranthus. Except at a week after transplanting where number of leaves of seedling transplanted at 2 WAP was comparable with those of the ones transplanted at 3WAP, the older seedlings transplanted at 3 WAP, maintained significantly higher number of leaves (11.46 to 22.07) throughout the experiment (Table 2).

Table 2: Effect of Transplanting Age on *Amaranthus* Number of Leaves

Treatments	1 WAT	2 WAT	3 WAT
Transplant at 3WAP	11.46a	18.95a	22.07a
Transplant at 2WAP	9.37a	13.32b	15.33b
Transplant at 1WAP	6.07b	10.81b	12.45b
LSD (0.05)			

WAP = weeks after planting, WAT = weeks after transplanting, means having the same letter in the same column are not statistically different from each other using LSD at 5% level of probability

Response of amaranthus stem girth to transplanting age significantly differed across treatments (Table 3). The youngest transplanted seedlings had significantly lower stem girth (0.48cm to 1.58cm) relative to other plants transplanted at more matured stages (2 and 3 WAP). However, seedlings transplanted at 3 WAP had highest stem girth which was significantly higher (1.89cm to 3.02cm) than other treatments but comparable to the values obtained for seedlings transplanted at 2 WAP both at 1 and 3 weeks after transplanting).

Table 3: Effect of Transplanting Age on *Amaranthus* Stem Girth (cm)

Treatments	1 WAT	2 WAT	3 WAT
Transplant at 3WAP	1.89a	2.71a	3.02a
Transplant at 2WAP	1.13a	1.84b	2.54a
Transplant at 1WAP	0.48b	1.22b	1.58b
LSD (0.05)			

WAP = weeks after planting, WAT = weeks after transplanting, means having the same letter in the same column are not statistically different from each other using LSD at 5% level of probability

There was a significant difference in yield of vegetable amaranth as affected by transplanting age of seedlings (Table 4). Minimum yield (25t/ha) was obtained in plants transplanted at 1 WAP which was significantly lower than the values obtained for seedlings transplanted both at 2 and 3WAP (35.27 and 38.38 t/ ha), respectively. However, the yield obtained in plants transplanted at 3 WAP was comparable to those of 2 WAP.

Table 4: Yield Response of *Amaranthus* to Different Transplanting Age

Treatments	Yield (t/ha)
Transplant at 3WAP	38.38a
Transplant at 2WAP	35.27a
Transplant at 1WAP	25.22b
LSD (0.05)	

WAP = weeks after planting, WAT = weeks after transplanting, means having the same letter in the same column are not statistically different from each other using LSD at 5% level of probability

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The major reasons that could be attributed for significantly higher values obtained both in growth and yield parameters in older seedlings of vegetable amaranth, relative to the younger ones are: the roots of older plants (seedling transplanted at 2 or 3 WAP) were probably able to adapt better to new environment (the permanent field) and were able to capture environmental growth resources such as water and nutrients better coupled with larger leaf area for more effective photosynthesis. Also, the older seedlings have tendency of forming canopy coverage earlier on soil. This might have helped more matured seedlings to smoother the later emerging weed seedlings which normally would offer strong competition with younger plants for limited growth resources. The advantageous canopy of older plants assists the plants in capturing solar radiation better, relative to the younger plants. All these could be attributed to taller height, increased number of leaves, stem girth as well as higher yields in more matured transplants.

The comparable yields obtained in seedlings transplanted both at 2 and 3WAP (35.27 and 38.38 t/ ha), respectively in this study were in agreement with those of the earlier researchers who reported that older transplants mature early while younger ones may produce comparable or even higher yields but take longer time to do so (Vavrina,1991). Similarly, (Mulundana *et al.*, 2009 and Barau *et al*., 2018) also indicated that the most appropriate transplanting age for vegetable amaranth was between two and three weeks after planting.

Conclusion and Recommendation

The vegetable amaranth transplanted at 3WAP had the highest ($p > 0.05$) mean values of 30.73 to 75.27cm ; 11.46 to 22.07; 1.89 to 3.02 cm and 38.38 t /ha for plant height, number of leaves, stem girth and yield, respectively while those transplanted at 1 WAP had the least values for the aforementioned variables. However, the plants transplanted at 2 WAP produced comparable yield (35.27kg / ha) with that of the highest.

From this study, transplanting vegetable amaranth seedlings at the age of between 2 to 3 weeks after emergence enhanced the growth and yield of the crop and it is therefore recommended to farmers to boost performance and yield.

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