Crop performance of *Amaranthus* (Diyapalagoda accession) produced by reaping and regrowth system

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ABSTRACT

This experiment was conducted at the Horticultural Crop Research and Development Institute (HORDI), Sri Lanka to study the growth and yield of amaranthus accession Diyapalagoda. In this experiment, seeds were obtained from main crop and ratoon crop and sown separately at a spacing of 15 cm within row and 30 cm between rows. The experiment was laid out in a Completely Randomized Design (CRD) with eight replications. Seedling and plant growths were measured at regular intervals and statistically analyzed. The present study revealed that plant performance was better in ratoon crop and there was significant differences ($P<0.05$) between plant yield. Yield of crop raised from ratoon was 48.20 tons/ha and it was high as compared to crop raised from main seeds. Other seedling and plant growth parameters were statistically similar between treatments. However, seedling and plant growth parameters were slightly high in plant produced from ratoon seeds compared to plant produced from main crop seeds. From this study it could be concluded that the high yield benefit can be obtained by plant produced from ratoon seeds of Diyapalagoda accession of amaranthus as an important leafy vegetable for human nutrition in Sri Lanka.

Key words- Amaranthus, plant growth, ratoon crop, seed, yield.

1. INTRODUCTION

Many plants have been considered beneficial in the diet. Especially leafy vegetables play a vital role in human daily diet as reported by many nutritionists. These are rich in vitamins and mineral elements. Over the last decade, several research have been reported that diets, low in fat and rich in fiber are protective against cancers and the risk of coronary heart disease[1]. Among the leafy vegetables, amaranthus is a commonly available and used, due to its easiness in culture, nutritive value, fast growth rate, adaptability to varying agro climates, high yield potential, relatively less susceptible to soil born diseases and serious pests. And also it is an important vegetable for human nutrition. The leaves of amaranthus are high in protein, vitamins, and minerals [2]. Further, it fits well in a crop rotation because of its very short duration and large yield of edible matter per unit area.

Growers usually harvest the whole plant of leafy vegetable, which is sold with little or no processing [3]. Growers maintain a supply of amaranthus vegetable for sale at the market, by repeatedly sowing, growing and harvesting crops. Alternatively, a reaping and regrowth system can be used in leafy vegetable production. The reaping and regrowth system is feasible for leaf vegetable production [4-5]. The reaping and regrowth method leads to higher yields with earlier cropping and less space is needed to produce the same amount of vegetables [3] and this method can save costs and labour thus improving the profit. This production system is not new and it has been widely used in grass and tea production [6]. In leafy vegetable production, the reaping and regrowth system has been shown to be suitable for leafy vegetables. The leafy vegetable and shoot vegetable can be successfully produced using a reaping and regrowth system [4]. Growers can harvest many times during period of crop life time. Reaping and regrowth can improve the productivity of leafy vegetables and save time and costs [4-5].

Leafy vegetable are often harvested by repeated cutting of edible tops and allowed a period for regeneration between harvests. This is repeated several times until flower initiation and there after plants are left to form and mature seeds. In Sri Lanka, only one variety DOA Green has been released by the Department of Agriculture. Another accession, Diyapalagoda shows promising quality characters in vegetables as well as in seed production. Therefore this experiment was carried out to study the growth and yield of amaranthus accession Diyapalagoda raised from ratoon and main seeds at the Horticultural Crop Research and Development Institute (HORDI), Sri Lanka.

2. MATERIALS AND METHOD

The experiment was conducted in the field at Horticultural Crop Research and Development Institute (HORDI), Sri Lanka. This experiment was laid out in a Completely Randomized Design (CRD) with eight replications. Seeds obtained from main and ratoon crops were sown in nursery bed separately. After four weeks of sowing, the seedlings were transplanted in the field at a spacing of 15 cm within row and 30 cm between rows. Agronomic practices were done as recommended by the Department of Agriculture of Sri Lanka. Seedling and plant growth parameters were measured and data were analyzed statistically.

3. RESULTS AND DISCUSSION

Plants developed from main crop seeds referred as main crop and plant raised from ratoon crop seeds referred as ratoon crop in whole text.

Seedling growth

In this experiment, there were no significant differences between plants produced from main and ratoon seeds in seedling height, fresh and dry weights of seedlings. The highest plant height was recorded in ratoon crop seedling, having 26.92 cm and 20.32 cm in main crop seedling however they are statistically similar (Table 1). Plant height was highly influenced by stem and leaf weights [7]. Leaf plays a major role in photosynthesis. No significant differences (P>0.05) was noted in number of leaves per seedling and also length and width of leaf. Mean number of leaves per seedling was high in ratoon crop (10.52) compared to main crop.

In California, most of the specialty salad greens are grown in beds in the open or under plastic covered tunnels for multiple harvests and they give better yield [8]. Further it was noted that number and length of roots per seedling and stem thickness were high in ratoon crop and low in main crop. But both treatments were statistically similar. Also there was no significant differences (P>0.05) in fresh and dry weights of plants. The amount of radiation intercepted is typically dependent on leaf area index (LAI). In this experiment land area/ plant in both treatments were same. But leaf area was changed. It was high in crop produced from ratoon seeds. Linear relationship between total dry matter and fresh leaf production was reported in lettuce [9-10-11]. It may be the reason for high fresh and dry weight in plant raised from ratoon seeds. The root/shoot ratio is one measure to help you evaluate the overall health of plants. Higher proportion of shoots can collect more light energy. Most of the agronomic parameters were well in ratoon crop as compared to that of main crop.

Table 1: Seedling growth of amaranthus at 35 days after sowing.

Agronomic Parameters	Main Crop	Ratoon Crop
Seedling height (cm)	20.32 ± 0.97	26.92 ± 0.77
No. of leaves per seedling	06.77 ± 0.45	10.52 ± 0.64
Length of Leaf (cm)	03.90 ± 0.35	03.50 ± 0.40
Width of Leaf (cm)	08.38 ± 0.33	09.61 ± 0.67
Thickness of stem (cm)	06.01 ± 0.27	06.73 ± 0.28
No. of roots per seedling	01.93 ± 0.12	02.22 ± 0.18
Length of root (cm)	05.90 ± 0.38	06.00 ± 0.26
Fresh weight of seedling (g)		
Leaves	03.80 ± 0.60	04.36 ± 0.54
Stem	03.91 ± 0.49	06.01 ± 0.69
Root	01.04 ± 0.15	01.29 ± 0.20
Shoot/root ratio	7.41	8.03
Dry weight of seedling (g)		
Leaves	0.47 ± 0.08	0.58 ± 0.08
Stem	0.22 ± 0.04	0.31 ± 0.03
Root	0.12 ± 0.02	0.12 ± 0.01
Shoot/root ratio	5.75	7.41

Plant growth

The height of amaranthus plant at 1st harvest or 2nd harvest (Table 3) was not remarkably varied (P>0.05) between the main and ratoon crop. Height of plant at 2nd harvest was lower in both treatments compared to 1st harvest. For shoot type vegetables, if the shoots are harvested, new shoots and leaves can regrow from the side growing points [4-5]. It may be the reason for low plant weight in second harvest compared to first harvest. Number of branches per plant at 2nd harvest in main crop was 3.23 and ratoon 3.02. It was not remarkably differed (P>0.05) between the treatments. The number of leaves per plant was not significantly varied (P>0.05) at 1st harvest and at 2nd harvest (Table 2) between the treatments.

Length and width of leaf in main crop of leafy vegetable amaranthus at 1st harvest and at 2nd harvest (Table 2) were not significantly varied (P>0.05) from ratoon crop. It was further noted that length and width of leaf in main and ratoon crops at 1st harvest were higher than those at 2nd harvest (Table 2). Harvesting caused plant branching, leading to an increase in leaf number and decrease in leaf size [3].

No significant differences (P>0.05) in length of petiole and internodes and also stem thickness between treatments (Table 2). Fresh and dry weights of leaf and stem not remarkably varied (P>0.05) between main and ratoon crop. At 1st harvest, ratoon crop gave more weight compared to main crop. However both harvest weight were statistically similar. The agronomic parameters were slightly high in ratoon crop as compared that of main crop

mostly at 1st harvest. The reaping and regrowth system is feasible for leaf vegetable production [4-5].

Yield

At harvest, yield was significantly varied ($P<0.05$) between the main and ratoon crop of leafy vegetable amaranthus (Table 2). Yield of ratoon crop was slightly high as compared to main crop. Repeated cuttings yield better quality, less inedible waste and give higher economic returns. The products of leafy lettuce harvested in reaping and regrowth system could be distributed directly as cut-vegetables and packing work might also be simplified [4,12].

In a reaping and regrowth system, when plants are harvested, it means a removal of the top growth and plants have to regrow from residual biomass indicating plant produced from ratoon seeds are more suitable for raising amaranthus Diyapalagoda accession compared to plant raised from main crop seeds.

Table 2 Yield of main and ratoon crops of *Amaranthus*

Treatment	Yield (ton/ha)
Main crop	41.45
Ratoon crop	48.20
"t" test	*

4. CONCLUSION

The present study concluded that almost all the agronomic parameters were good in ratoon crop. This was probably because most of the agronomic parameters of ratoon crop were high as compared to main crop. And seedling growth and plant growth of next generation are not affected by reaping and regrowth system in amaranthus crop.

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Table 3: Agronomic parameters of amaranthus at 1st harvest and 2nd harvest.

Agronomic Parameters	1st harvest (4th week)		2nd harvest (7th week)	
	Main Crop	Ratoon Crop	Main Crop	Ratoon Crop
Plant height (cm)	60.81 ± 3.82	66.81 ± 3.64	37.02 ± 2.75	36.02 ± 2.33
No. of leaves per plant	45.92 ± 3.61	45.33 ± 2.83	60.89 ± 4.12	49.98 ± 5.19
Length of Leaf (cm)	19.15 ± 0.49	19.16 ± 0.41	12.75 ± 0.34	12.56 ± 0.67
Width of Leaf (cm)	12.22 ± 0.34	12.64 ± 0.33	7.97 ± 0.14	7.88 ± 0.32
Length of petiole (cm)	11.06 ± 0.52	11.95 ± 0.33	8.00 ± 0.37	9.29 ± 0.42
Length of internode (cm)	5.87 ± 0.46	6.56 ± 0.23	5.02 ± 0.26	5.40 ± 0.25
Thickness of stem (cm)	4.11 ± 0.15	4.31 ± 0.14	3.13 ± 0.10	3.18 ± 0.14
Fresh weight of Leaves (g)	46.41 ± 3.98	50.49 ± 5.32	37.44± 4.48	43.41 ± 2.32
Fresh weight of Stem (g)	65.95 ± 8.70	78.88 ± 7.86	36.76 ± 5.35	44.15 ± 4.59
Dry weight of Leaves (g)	6.36 ± 0.47	7.16 ± 0.69	4.53 ± 0.50	4.97 ± 0.31
Dry weight of Stem (g)	6.02 ± 1.50	6.47 ± 0.73	4.31 ± 0.60	4.85 ± 0.44