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# Effect of off season soil management practices on growth and yield of *Amaranthus species*

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## ABSTRACT

*An investigation was conducted to study the effect of off season management practices on growth and yield of Amaranthus species viz. Amaranthus dubius and Amaranthus tristis, during 2018 at Annamalai University, Annamalai Nagar (Tamil Nadu). The experiment was laid out in a randomized block design with seven treatments in three replications. The highest growth and yield components viz., plant height (33.1, 38.1 and 55.0 cm) number of leaves per plant (33.2, 35.3 and 45.2), leaf area (38.2, 46.2 and 50.0 $cm^2$), stem weight per plant (16.1,37.1 and 40.1g), leaf weight per plant (19.1,50.0 and 65.3 g), leaf : stem ratio (1.2, 1.3 and 1.4 ), yield of greens Amaranthus dubins (10.67 t $ha^{-1}$). In Amaranthus tristis, plant height ( 36.1,49.1and 50.2 cm) number of leaves per plant ( 39.3, 45.1 and 51.2), leaf area (49.5, 51.2 and 61.2 $cm^2$)stem weight per plant (15.2,37.1 and 40.1g), leaf weight per plant (19.1,48.1 and 68.1 g), leaf : stem ratio (1.3,1.6 and 1.7), yield of greens (13.25 t $ha^{-1}$) at 15, 30 and 45 DAS were recorded. Application of transparent polyethylene sheet significantly increased the growth and yield parameters in Amaranthus dubius and Amaranthus tristis when compared to the control.*

***Key words*:** Soil management, *Amaranthus dubius species*, growth yield

## INTRODUCTION

Leafy vegetables contain many typical plant nutrients, but since they are photosynthetic tissues, their vitamin K levels in relation to those of other fruits and vegetables, as well as other types of foods, are particularly notable. Plant foods are sources of energy, micronutrients and nutrients essential to health, in addition to phytochemicals with further health benefits including glycemic control, immune stimulation or antioxidant activity. Soil solarization is a process in which soil temperature is increased by using solar radiation as an energy source. It was initially intended as a method for controlling soil pathogens but research has shown that it has other effects on soil characteristics that can influence the performance of crops, such as nutrient concentration and soluble organic matter content. The physical, chemical and biological principles of soil solarization, as well as its commercial implementation have been researched in many countries around the world and also the effects of solarization have been investigated for many vegetable crops such as artichokes, bell pepper *etc.*, (Julio Eduardo Hasing, 2002) Further, increased crop growth and yield response was also reported as a collateral effect of solaraization, not only due to the control of weeds and soil pathogens, but also due to a heat-induced release of soil nutrients (Yanyan Dai , 2016). Further Soil solaraization increased temperature by up to $21^0$ C in the upper soil layer and increased nutrient level of N,P, K in the solarised soil comparing with an un solarised one. It also improves soil structure and texture increases that are needed for plant growth. Hence an experiment was conducted to study the effect of off season management practices on growth and yield of *Amaranthus species.*

## MATERIALS AND METHODS

A field experiment was carried out during 2018 at Annamalai University, Annamalai Nagar and Chidambaram in Cuddalore District of Tamil Nadu, India. The experiment was laid out in a randomized block design with three replications and seven treatments *viz.,* $T_1$- Control, $T_2$ - Summer ploughing 1 time (30 days), $T_3$ - Summer ploughing 2 times (30 days), $T_4$ - Summer ploughing 1 time (45 days), $T_5$ - Summer ploughing 2 times (45 days), $T_6$ - Application of transparent polythene sheet of 0.05 mm thickness and $T_7$ - Application of

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biodegradable polythene sheet of 0.05 mm thickness. The two species of genus *Amaranthus* (*Amaranthus dubius* (CO 1) and *Amaranthus tristis* (CO 3) popularly grown in this region were utilized for the present study.The experimental field was divided into seven equal strips of which, one was maintance as the fallow (Control) and the others were subjected to off-season land management treatments in six different methods. Immediately after receiving the summer showers, the solarization works were started in strips (strips allotted for summer ploughing 1 and 2 times) by ploughing one time in one strip and in the another strip for two times at 15 days intervals for 30 and 45 days respectively, so as to bring the soil to a fine tilth and more aerated. Then the solarization treatment was done for 45 days in May-June by covering with transparent polyethylene film of 0.05 mm thick in one strip and with biodegradable polyethylene film in another strip. The polyethylene films should be tarped over the levelled soil and the sides were buried into the soil to maintain air tight condition. After the completion of the solarization period the experimental area was ploughed thoroughly to bring it to fine tilth and the field was divided in to beds of 1mX1m size. At the time of last ploughing the required quantity of 25 t $ha^{-1}$ farm yard manure was incorporated. The seeds of *Amaranthus dubius* and *Amaranthus tristis* were sown (02.07.2018) separately and irrigations were carried out as per the requirement of crop. The recommended intercultural operations were carried out as per the requirement of the crop. Observations were recorded on randomly selected six plants in each treatment. The observations on plant height, number of leaves per plant, leaf area, stem weight per plant, leaf weight per plant, leaf : stem ratio and yield of greens were recorded and statistically analysed by statistical analysis system SAS.

## RESULTS AND DISCUSSION

### Growth parameters

In the present investigation, all the growth parameters were significantly influenced due to the various off-season land management practices. Among the various treatments. The highest plant height, number of leaves per plant, leaf area at 15,30 and 45 DAS were recorded with application of transparent polyethylene sheet in both the *Amaranthus species viz., Amaranthus dubius and Amaranthus tristis*. In case of *Amaranthus dubius,* application of transparent polyethylene film of 0.05 mm thickness recorded the highest plant height (33.2, 38.1 and 55.0 cm), number of leaves per plant (33.1, 35.3 and 45.18) at 15, 30 and 45 DAS, respectively. The least growth parameters *viz.,* plant height (12.2, 18.3 and 31.1 cm), number of leaves (7.1, 10.1 and 15.3) at 15, 30 and 45 DAS) were recorded in $T_1$ control (Fallow) respectively. With regard to *Amaranthus tristis*, treatments, $T_6$ (application of transparent polyethylene film of 0.05 mm thickness) recorded the highest plant height (36.1, 49.1 and 50.2 cm), number of leaves per plant (39.3, 45.1 and 51.2) at 15, 30 and 45 DAS respectively. The least growth parameters *viz.,* plant height (11.3, 17.3 and 25.1 cm), number of leaves (14.1, 23.1 and 32.1) at 15, 30 and 45 DAS were recorded in control. Similar results were obtained by Pramanick *et al.* (2006) in onion. This might be due to soil solarization through transparent polyethylene film comprised several modes of action including thermal inactivation of weed seeds and weakening of the propagules will alter the plant root environment and result in increased growth response (Elamathi *et al.,* 2005).

The soil solarization with transparent polyethylene film of 0.05 mm thickness recorded leaf aera of 38.23, 46.14 and 50.08$cm^2$ at 15, 30 and 45 DAS in *Amarathus dubius*, in Amaranthus *tristis* the highest leaf area was recorded in the same treatment (49.05, 51.21 and 61.17 $cm^2$ at 15, 30 and 45 DAS). This was followed by the treatment where biodegradable film was applied. The least leaf area of 22.12, 26.15 and 31.06 $cm^2$ at 15, 30 and 45 days after sowing was recorded in *Amarathus dubius.* In *Amaranthus tristis* the lowest leaf area (26.09, 32.11 and 40.12 $cm^2$ at 15, 30 and 45 DAS) was recorded in control. The increase in leaf area with soil solarisation technique was reported by Luis Ibarra-Jiménez *et al.* (2012). This might be due to better growth of leaves in the solarized plots that would have resulted in better leaf area thereby aiding the higher photosynthetic efficiency. The improvement of plant growth by using soil solarisation technique was reported by Abdallah (2000). The effects on highest plant growth parameters was mainly owe to biological control of soil borne pathogens and pests, improve soil structure and increase the availability of nitrogen and other essential plant nutrients.

Table 1: Effect of off season land management on growth parameters of leafy vegetables

| Treatments | *Amaranthus dubius* | | | | | | | | | *Amaranthus tritis* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant height(cm) | | | Number of leaves | | | Leaf area ($cm^2$) | | | Plant height (cm) | | | Number of leaves | | | Leaf area ($cm^2$) | | |
| | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS |
| $T_1$ | 12.18 | 18.30 | 31.14 | 7.10 | 10.12 | 15.26 | 22.12 | 26.15 | 31.06 | 11.32 | 17.24 | 25.14 | 14.12 | 23.12 | 32.14 | 26.09 | 32.11 | 40.12 |
| $T_2$ | 15.04 | 20.18 | 34.08 | 9.21 | 13.25 | 18.12 | 24.17 | 29.10 | 33.18 | 14.18 | 20.12 | 28.04 | 17.08 | 26.19 | 33.11 | 29.10 | 34.15 | 43.17 |
| $T_3$ | 18.32 | 23.75 | 37.21 | 13.15 | 16.74 | 22.36 | 27.09 | 32.13 | 36.05 | 17.23 | 24.19 | 32.15 | 20.14 | 30.15 | 36.17 | 32.07 | 37.08 | 49.35 |
| $T_4$ | 23.04 | 27.12 | 42.12 | 17.10 | 20.01 | 27.14 | 30.15 | 36.21 | 39.25 | 22.36 | 29.33 | 37.07 | 24.03 | 33.17 | 41.05 | 38.11 | 40.13. | 51.24 |
| $T_5$ | 26.41 | 30.18 | 45.33 | 24.22 | 26.17 | 33.21 | 32.11 | 40.02 | 43.11 | 27.15 | 25.23 | 40.26 | 30.17 | 37.18 | 44.23 | 42.05 | 43.10 | 54.12 |
| $T_6$ | 33.19 | 38.13 | 55.04 | 33.18 | 35.34 | 45.18 | 38.23 | 46.14 | 50.08 | 36.11 | 49.11 | 50.21 | 39.28 | 45.09 | 51.18 | 49.45 | 51.21 | 61.17 |
| $T_7$ | 29.34 | 34.21 | 49.17 | 7.10 | 30.12 | 15.26 | 35.32 | 43.27 | 45.12 | 30.41 | 30.41 | 44.12 | 35.21 | 40.22 | 47.32 | 44.36 | 47.16 | 58.08 |
| SE.d | 0.50 | 0.59 | 0.86 | 0.44 | 0.23 | 0.61 | 0.18 | 0.21 | 2.25 | 0.52 | 0.71 | 0.77 | 0.59 | 0.70 | 0.84 | 0.23 | 0.29 | 0.32 |
| CD (P = 0.05) | 1.01 | 1.18 | 1.72 | 0.97 | 0.45 | 1.32 | 0.26 | 0.42 | 0.50 | 1.04 | 1.42 | 1.54 | 1.18 | 1.40 | 1.68 | 0.46 | 0.58 | 0.64 |

*$T_1$- Control, $T_2$ - Summer ploughing 1 time (30 days), $T_3$ - Summer ploughing 2 times (30 days), $T_4$ - Summer ploughing 1 time (45 days), $T_5$ – Summer ploughing 2 times (45 days), $T_6$ - Application of transparent polythene sheet of 0.05 mm thickness and $T_7$ - Application of biodegradable polythene sheet of 0.05 mm thickness*

Table 2: Effect of off season land management on yield parameters of leafy vegetables

| Treatments | *Amaranthus dubius* | | | | | | | | | *Amaranthus tritis* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Leaf weight/plant (g) | | | Stem weight/plant ) | | | Leaf :Stem ratio | | | Leaf weight/plant (g) | | | Stem weight/plant ) | | | Leaf :Stem ratio | | |
| | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS | 15 DAS | 30 DAS | 45 DAS |
| $T_1$ | 8.11 | 15.13 | 23.10 | 6.10 | 13.11 | 15.10 | 1.02 | 1.08 | 1.18 | 9.55 | 18.21 | 24.11 | 8.51 | 13.11 | 15.10 | 1.10 | 1.12 | 1.18 |
| $T_2$ | 10.52 | 20.15 | 31.06 | 9.01 | 17.08 | 19.21 | 1.05 | 1.10 | 1.20 | 10.58 | 21.14 | 30.43 | 9.03 | 17.08 | 19.21 | 1.15 | 1.14 | 1.20 |
| $T_3$ | 12.21 | 24.30 | 37.20 | 11.01 | 19.11 | 20.08 | 1.09 | 1.13 | 1.23 | 12.29 | 24.32 | 38.11 | 10.24 | 19.11 | 20.08 | 1.16 | 1.15 | 1.23 |
| $T_4$ | 13.75 | 27.65 | 42.18 | 12.68 | 21.14 | 27.15 | 1.11 | 1.15 | 1.28 | 13.87 | 27.11 | 45.16 | 11.56 | 21.14 | 27.15 | 1.19 | 1.17 | 1.28 |
| $T_5$ | 15.28 | 31.34 | 49.15 | 14.21 | 23.05 | 30.23 | 1.22 | 1.20 | 1.32 | 15.38 | 30.06 | 51.10 | 13.05 | 23.05 | 30.23 | 1.21 | 1.23 | 1.32 |
| $T_6$ | 19.10 | 50.05 | 65.26 | 16.08 | 37.12 | 40.12 | 1.25 | 1.48 | 1.38 | 19.11 | 48.12 | 68.12 | 15.23 | 37.12 | 40.12 | 1.25 | 1.62 | 1.68 |
| $T_7$ | 17.02 | 39.23 | 56.09 | 15.03 | 30.16 | 35.14 | 1.20 | 1.31 | 1.36 | 17.05 | 35.31 | 62.05 | 14.21 | 30.16 | 35.14 | 1.20 | 1.51 | 1.36 |
| SE.d | 0.62 | 0.73 | 1.27 | 0.65 | 0.74 | 0.34 | 0.01 | 0.03 | 0.04 | 0.70 | 1.38 | 1.46 | 0.55 | 0.73 | 0.82 | 0.01 | 0.03 | 0.04 |
| CD (P = 0.05) | 1.24 | 1.45 | 2.54 | 1.27 | 1.49 | 1.68 | 0.02 | 0.06 | 0.08 | 1.41 | 2.76 | 2.91 | 1.10 | 1.45 | 1.64 | 0.02 | 0.05 | 0.06 |

**Yield parameters**

In the present investigation, the yield parameters were significantly influenced due to the various off-season land management practices. In *Amaranthus dubius,* the highest leaf weight per plant of 19.10,50.05 and 65.26 g), stem weight per plant ( 16.08,37.12 and 40.12g), leaf:stem ratio (1.25, 1.38 and 1.48) at, yield per plant (445.20g), yield of greens per plot (5.35kg) and yield of greens per hectare (10.67 t) were recorded with $T_6$ treatment. The least leaf weight per plant (8.11,15.13 and 23.10 g), stem weight per plant ( 6.10,13.11 and 15.10 g ), leaf:stem ratio (1.02, 1.08 and 1.18 g), yield of greens per plant (190.05g), yield of greens per plot (1.94 kg) and yield of greens per hectare (5.11 t) respectively were recorded in control. In *Amaranthus tristis* the same treatment registered the highest leaf weight per plant (19.11,48.12 and 68.12 g), stem weight per plant ( 15.23, 37.12 and 40.12 g), leaf:stem ratio ( 1.25 1.38 and 1.62), yield per plant (487.17g ), yield of greens per plot (6.24kg ) and yield of greens per hectare (13.25 t) .The least leaf weight per plant of 9.55, 18.21 and 24.11g, stem weight per plant (8.51, 13.11 and 15.10 g), leaf:stem ratio ( 1.10, 1.12 and 1.18 g), yield of greens per plant ( 201.04 g), yield of greens per plot (2.72 kg ) and yield of greens per hectare (6.28 t) respectively was recorded in control in *Amaranthus tristis.*

Table 3: Effect of off season land management on yield parameters of leafy vegetables

| Treatments | *Amaranthus dubius* | | | *Amaranthus tritis* | | |
|---|---|---|---|---|---|---|
| | Yield of greens (g plant$^{-1}$) | Yield of greens plot$^{-1}$ ( kg) | Yield of greens (t ha$^{-1}$) | Yield of greens (g plant$^{-1}$) | Yield of greens plot-$^{1}$ ( kg) | Yield of greens (t ha-$^{1}$) |
| $T_1$ | 190.05 | 1.94 | 5.11 | 201.04 | 2.72 | 6.28 |
| $T_2$ | 215.21 | 2.25 | 7.13 | 235.11 | 3.54 | 8.16 |
| $T_3$ | 268.34 | 2.48 | 7.25 | 287.23 | 3.89 | 8.89 |
| $T_4$ | 311.10 | 3.01 | 8.05 | 345.08 | 4.32 | 9.85 |
| $T_5$ | 367.23 | 3.28 | 8.46 | 391.24 | 4.71 | 10.35 |
| $T_6$ | 445.20 | 5.35 | 10.67 | 487.17 | 6.24 | 13.25 |
| $T_7$ | 404.05 | 4.01 | 9.29 | 401.60 | 4.80 | 11.09 |
| SE.d | 35.58 | 0.24 | 0.08 | 41.25 | 0.24 | 0.53 |
| CD (P = 0.05) | 71.15 | 0.47 | 1.16 | 82.50 | 0.47 | 1.25 |

It was followed by biodegradable plastic film treatment. According to Cimen *et al.* (2010), solarization for five weeks with a transparent polyethylene film increased yield of soybean by 110% compared with the yield in non-solarized soils. Similar findings on yields of onion, lettuce and carrot were significantly enhanced by solarization (Abouziena and Haggag, 2016). The reason for increase of yield characters could be attributed by controlled the weed growth in the soil condition and distribution of nutrients to the soil might have increased the yield of plant.

Based on the present investigation, among the various treatments of soil management practices, application of transparent polyethylene sheet 0.05 mm thickness recorded the highest growth and yield parameters in both the *Amaranthus species.*

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