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EFFECT OF THICKNESS OF POLYTHENE SHEET AND DURATION OF SOLARIZATION ON SOIL TEMPERATURE IN PRIMARY NURSERY

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ABSTRACT

The study indicated that, solarization treatment receiving mulching with thin polythene sheet (0.03 mm) recorded significantly higher soil temperature at all stages. Soil temperature recorded in treatments with thin (0.03 mm), medium (0.06 mm) and thick polythene sheet (0.12 mm) was 56.0, 54.4 and 53.7 ^{0}C respectively. Soil temperature in primary nursery bed was significantly higher with longer duration of solarization than with short or medium duration 54.3, 54.4 and 55.3 ^{0}C respectively. Thin (G_1) or medium (G_2) polythene sheet in combination with longer duration of solarization (D_3) significantly increased the soil temperature at all the intervals of study (57.3 ^{0}C).

Key words : Solarization, Mulching, Polythene sheet, Primary nursery

Introduction

The common method of raising seedlings of minute seeds involves sowing of seeds in primary nursery beds and later transplanting tender seedlings into suitable containers. Raising the seedlings in primary nursery is very crucial, as weed competition at this stage is one of the major constraints. Moreover, seedlings are found to be very sensitive to weeds especially grasses during initial phase (FSI, 1997). For this initial weed free period of 20-30 days is essential for good growth and development in primary nursery. At this stage, manual weeding is quite difficult as tender seedlings are damaged. Chemical toxicants are being developed since 1950's to combat weeds and are extensively used in developed countries. In modern agriculture, chemical weed control using herbicides is most popular method as it is labour and energy efficient than the other methods. However, wide spread application of herbicides has led to polluting the environment, residue problems in soil and water, toxicity to animals and development of resistance in weeds. According to Blok (1997) and Blok *et al*. (1998) three alternative methods for non chemical soil disinfestation are: 1. incorporation of soil organic amendements in the soil. The mechanisms involved include stimulation of microbial antagonism and production of toxic volatiles, 2. soil flooding where possible factors are lack of oxygen, high levels of carbon dioxide, fungi toxic products and biological control, 3. soil solarization method alone or in combination with reduced doses of soil fumigants or biological factors, is effective in controlling many annuals, some perennials, parasitic weeds, pest and pathogens (Elena and Tjamos, 1997; Katan, 1981). It is relatively cheap, simple, no-hazardous and the solarized soils are less receptive to weeds and pathogens reinfestation (Katan, 1987). Soil solarization has been developed mainly in tropical countries where temperature and solar radiation during the summer months are high in this context, use of soil solarization for weed control is of gaining importance.

Soil solarization was developed by Katan and his associates in 1976 in Israel. It is a method of soil disinfection. It is basically a method of heating the surface of soil by plastic sheets placed on the moist soil to trap the solar radiation and thereby increasing the soil temperature. Solarization process would raise the surface soil temperature by 8 -12 ^{0}C as compared to non-solarized soil. Duration of 4-8 weeks is sufficient to give satisfactory control of weeds, pest and pathogens (Katan, 1980). Soil solarization technique is simple and easy to adopt. It is safe and effective method of disease, pest and weed control, which may reduce the necessity for chemical application to soil.

In soil solarization two important aspects has to be considered are thickness of polythene sheet and duration of solarization. So, finding appropriate combination of thickness of polythene sheet and

Soil temperature with thin (0.03 mm) polythene sheet was higher (56.0^{0}C) than medium (0.06 mm) or thick (0.12 mm) polythene.

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duration of solarization assumes significance. Hence, keeping this point in view the present study was carried out.

Material and methods

The experiment was carried out at the nursery of Karnataka Forest Department, Kalave near Sirsi. There were 9 treatment combinations comprising of 3 levels of thickness of polythene sheet (G_1 – 0.03 mm, G_2 – 0.06 mm and G_3 – 0.12 mm) and 3 levels of duration of soil solarization (D_1 – 30 days, D_2 – 45 days and D_3 – 60 days).

The experiment was laid out in Completely Randomized Block Design (Factorial) with 3 replications. The raised nursery bed of size 0.7 m x 1.0 m was prepared for each treatment. After preparation of beds 2.5 kg FYM per bed was added and mixed thoroughly with the soil. Prior to spreading of polythene sheets, uniform irrigation was given and the plots were allowed to attain the moisture level nearly at field capacity. Transparent polythene sheets were spread on the nursery beds as per treatments. The free sides of the polythene sheets were buried in the soil to make airtight. The soil temperature of solarized plots was recorded at 5 cm depth by using thermometer at 15 days and 30 days after mulching of polythene sheets between 14.00 to 15.00 hours.

Table 1 : Soil temperature (°C) in nursery bed at different intervals (15 and 30 days) as influenced by thickness of polythene sheet and duration of solarization

Treatment	Soil temperature (°C)	
	15 Days	30 Days
Thickness of polythene sheet (G)		
G_1 – 0.03 mm	55.8	56.0
G_2 – 0.06 mm	53.7	54.4
G_3 – 0.12 mm	53.0	53.7
SEm±	0.25	0.21
CD (5%)	0.81	0.68
Duration of solarization (D)		
D_1 - 30 days	53.9	54.3
D_2 - 45 days	54.0	54.4
D_3 - 60 days	54.6	55.3
SEm±	0.25	0.21
CD (5%)	0.81	0.68
Interaction (GXD)		
G_1D_1	54.7	55.0
G_1D_2	54.0	55.3
G_1D_3	56.8	57.3
G_2D_1	53.7	54.0
G_2D_2	53.0	54.0
G_2D_3	56.0	55.7
G_3D_1	53.3	53.3
G_3D_2	53.0	53.7
G_3D_3	52.7	54.3
SEm±	0.44	0.37
CD (5%)	1.41	1.18

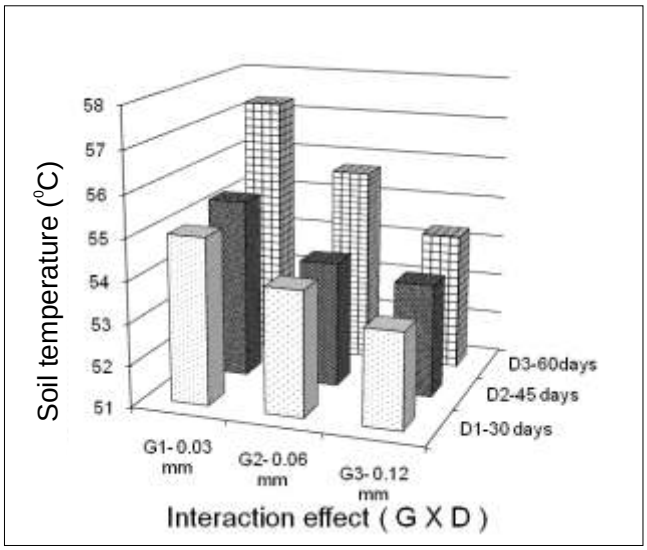

Fig. 1 : Soil temperature (°C) in nursery beds at 30 days after solarization as influenced by thickness of polythene sheet and duration of solarization

Results and Discussion

Effect of soil solarization on soil temperature

There was significant difference in soil temperature at 5 cm depth in nursery bed due to variation in thickness of polythene sheet, duration of solarization and their interaction at all the stages of study. Treatment receiving mulching with thin polythene sheet recorded significantly higher soil temperature at all stages. At 30 days, soil temperature recorded in treatments with thin, medium and thick polythene sheet was 56.0, 54.4 and 53.7 °C, respectively. Soil temperature in nursery bed was significantly higher with longer duration (60 days) of solarization than with short or medium duration at both intervals. At 30 days after mulching with polythene sheet, soil temperature with short, medium and long duration of solarization was 54.3, 54.4 and 55.3 °C, respectively. Thin (G_1) or medium (G_2) polythene sheet in combination with longer duration of solarization (D_3) significantly increased the soil temperature at all the intervals of study. Whereas, soil temperature did not vary significantly due to interaction between thick (G_3) polythene sheet and longer duration (D_3) of solarization (Table-1 and Fig. 1). This is due to better transmittance and retention of solar radiation for prolonged period. These results are in line with Waterer *et al.* (2008) Where they reported that plots covered with polythene sheeting had markedly higher maximum temperatures compared to non-solarized treatment. Solarization increased temperature by about 10 °C at 5 cm depth. Besides they observed that, the range of temperature was less in the short duration of solarization and increases with increasing duration of solarization (30 and 45 days) with different thickness of polythene sheet

(0.12 mm and 0.05 mm). The increase in temperature was probably due to the better transmittance and retention of solar radiation for prolonged period. The similar findings of higher soil temperature of 54.2° C with combination of thin polythene sheet (0.05 mm) and long duration of solarization treatment (45 days) were reported by Nanjappa *et al.* (2005) and Lalitha *et al*. (2001).

The combination of thin polythene sheet with long duration of solarization was more effective in building higher temperature. The temperatures higher than 45 °C and 50 °C, which could be lethal for most of the weed species and microorganisms during the initial growth and development stage. Therefore, for effective solarization of primary nursery beds thin polythene sheets (0.03 mm) are to be mulched for a period of 60 days during summer months.

प्राथमिक पौधशाला में मृदा तापमान पर सौरीकरण की अवधि और पॉलीथीन शीट की मोटाई का प्रभाव

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सारांश

अध्ययन ने दर्शाया कि पतले पॉलीथीन शीट (0.03 मिमी.) के साथ पलवार प्राप्त सौरीकरण उपचार ने सभी अवस्थाओं में महत्वपूर्ण रूप से उच्च मृदा तापमान अभिलिखित किया। पतले (0.03 मिमी.), मध्यम (0.06 मिमी.) और मोटी पॉलीथीन शीट (0.12 मिमी.) के साथ उपचारों में अभिलिखित मृदा तापमान क्रमशः 56.0, 54.4 और 53.7 डि0से0 था। प्राथमिक पौधशाला क्यारी में मृदा तापमान अल्प अथवा मध्यम अवधि क्रमशः 54.3, 54.4 और 55.3 डि0से0 की अपेक्षा सौरीकरण की दीर्घ अवधि के साथ महत्वपूर्ण रूप से उच्च था। सौरीकरण (डी3) की दीर्घ अवधि के साथ संयोजन में पतली (जी1) और मध्यम (जी2) पॉलीथीन शीट ने अध्ययन के सभी अन्तरालों पर मृदा तापमान को महत्वपूर्ण रूप से बढ़ाया (57.3 डि0से0)।

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