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Effect of different types of mulches on the germination and seedling growth of mulberry (*Morus* SP.)

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Abstract
Mulberry (*Morus* sp.) is the sole food for the silkworm (*Bombyx mori* L.) and contributes 38.20 per cent towards the success of a cocoon crop. The investigation was carried out at Temperate Sericulture Research Institute (TSRI) Mirgund, SKUAST- K, in the year 2015.Amongst various mulches used, plastic mulch and dried weeds seemed to best in terms of quick germination of mulberry seeds and better germination rate, germination percentage and parameters like number of leaves per seeding, thickness of seedling, root-shoot ratio and seedling vigour index. The germination rate and percentage was recorded highest in plastic mulch with values 0.088 and 84.60 percent respectively. Further the parameters like number of leaves per seeding, thickness of seedling, root-shoot ratio and seedling vigour index was highest in the treatment receiving dried weeds. Therefore, in this article we explore the effect of different mulch treatments on the germination success and other growth parameters of mulberry seedlings. Thus, mulching appears to be a viable tool to increase the mulberry production under temperate conditions.

Keywords: Germination, Mulch, Mulberry, Seedling and vigour index

Introduction
Mulching influences the various parameters of mulberry seedlings right from the germination up to growth of seedlings. Like all others crops, the germination of seed and the subsequent growth of seedlings in mulberry are affected by a number of factors. Amongst these the type of mulch used in nursery bed also play a very important role in the germination and overall growth of the mulberry seedlings. Mulberry (*Morus* sp.) is the sole food for the silkworm (*Bombyx mori* L.). Mulching practices have been a common activity in vegetable production for better growth and good yield of most horticultural crops. A mulch is a layer of material applied to the surface of soil. Reasons for applying mulch include quick seed germination and seedling growth, conservation of soil moisture, improving fertility and health of the soil, reducing weed growth. Water deficit often limits the crop growth and development. Mulberry seedlings are sensitive to water stress. Similarly young chilli seedlings cannot withstand either water deficit or excess soil moisture while older plants can withstand deficit or excess water (Ayoub, 1986) [3]. Mulching stimulates the microbial activity in soil through improvement of soil agro-physical properties (Strizaker *et al*., 1989) [15]. Mulching also minimizes the use of N fertilizer, warms the soil (Singh *et al*., 1988) [14], improves the soil physical condition (Lal, 1989) [8], and suppresses weed growth (Mohler and Calloway, 1992) [10] and could account for increased yield (Nagalakshmi, 2002) [12]. Mulching has been proved very effective to conserve the soil moisture thereby leading to better yields in Sorghum (De *et al*., 1983) [4], Wheat (Mittal *et al*., 1986) [9] and mustard (Mondal *et al*., 1987) [11]. Purohit *et al*. (1990) [13] have reported 24.16-48.63% increase in leaf yield in mulberry by the use of mulches. Water deficit often limits the crop growth and development and scarcity of water during the process of germination decreases the survivability of seedlings. So it seems to be important to test various mulches for better germination and seedling growth of mulberry.

Material and methods
The experiment was carried out at Temperate Sericulture Research Institute Mirgund (SKUAST-K) in the year 2015. Freshly collected fruits were used to get the seed which was used after proper extraction, drying, and testing of viability.

The seeds were pre-soaked for 24 hours before sowing in polytubes having an exposed area of one square foot. The polytubes were filled with medium comprising of garden soil and well decomposed FYM by mixing 100 grams of FYM per two kilograms of garden soil. The design used was CRD (Completely randomized design) with four treatments (T_1: Plastic mulch, T_2: Dried weeds, T_3: Paddy straw, T_4: Saw dust and T_5: Control). Each treatment was replicated six times. The germination of seeds started after 11 days. The following parameters were observed.

Germination percentage

Germination started after 11 days of sowing the seeds. From 11th day observations were taken regularly and germinated seeds were counted daily to calculate germination percentage as per the International Seed Testing Association (ISTA) procedure. It was calculated as per the following formula given below:

$$\text{Germination percentage} = \frac{\text{No. of seeds germinated}}{\text{No. of seeds sown}} \times 100$$

Germination rate

It was calculated by the formula suggested by Ellis and Roberts (1980) [7]

$$R = \sum n / \sum Dn$$

Where, R is the germination rate, n is the number of seeds germinated in days and D is the number of days counted from the beginning of the test.

Thickness of seedling (cm)

This was done by using Vernier Calliper. Three readings of each seedling were taken at three different places viz. bottom, middle and top portion and then average thickness per seedling was calculated. From every treatment five observations were taken to calculate the average thickness of seedling.

Height of seedlings (cm)

The height (cm) of seedling was measured by using normal scale in centimeter from base to the tip of the seedlings. Five observations were taken to calculate the average height of seedling.

No. of leaves per seedling

The leaves of seedlings were counted manually. Five observations were taken to calculate the average number of leaves.

Root-shoot ratio

The root-shoot ratios were calculated by using the following formula:

$$\text{Root-shoot ratio} = \frac{\text{Weight of the root}}{\text{Weight of shoot}}$$

Five seedlings were taken in each treatment to calculate the average value of root -shoot ratio.

Seedling vigour index (SVI)

It was computed by the formula suggested Abul-Baki and Anderson (1973) [1] as

SVI= Germination (%) × Seedling length (cm)

For all the parameters except germination percentage and germination rate, five seedlings per treatment per replication were taken to calculate the average value. The day sowing was taken as the first day and the total number of seeds germinated on each day was counted and recorded.

Statistical analysis

The data collected was compiled and analysed statistically using a method described by Gomez and Gomez (1984). The significance of 'F' &'t' was tested at 5 per cent level of significance. Software package used for analysis was "OPstat" Whenever the F test was found significant at 5 per cent probability; critical difference values were used to compare the treatment means.

Results and Discussion

The germination rate was maximum (0.088) in T_1 and the least value was observed in T_5 which represents control. Similarly germination percentage was highest in T_1 and lowest value was observed in T_5.This is because plastic mulches maintain soil temperature and retention of soil moisture. Another possible reason could be modulation of temperature by plastic mulches than non-mulched treatments. The same was reported by Aniekwe in 2013, who reported that plastic mulches cause modulation of soil temperature which causes early germination. Highest seedling height was observed in T_2 and least was observed in T_5.The possible reason could be positive effect of dried weed mulch on seedling height. This might be due to release of nutrients into the soil from the mulch as they slowly decomposed. This is in accordance with Duppong *et al*. (2004) [5]. Mulching produced significantly higher number of leaves per seedling than that of control. The maximum number of leaves per seedling was found on the plants mulched with dried weeds. The microclimate condition improved by the mulches might have provided a suitable condition for producing higher number of leaves in the mulberry seedlings. Thickness of seedling was also recorded highest in T_2 treatment. Mulched plants have higher thickness. This might be due to higher number of leaves per seedling synthesizing more food and hence increases the seedling thickness. This result was in conformity with the report of Easson and Fearnehough (2000) [6] on maize. The root-shoot ratio was also increased by dried weeds compared to control. Mulching increased stem dry weight of tomato as reported by Wien (1993) [16]. Seedling vigour index was also recorded highest in T_2 compared to control. This is because of the reason mulching increases the germination and seedling height and hence increased the seedling vigour index of the seedlings.

Table 1: Influence of different mulches on seed germination parameters in mulberry.

Treatment	Number of days for seed germination	Germination rate	Germination percentage
T_1:Plastic mulch	12.00	0.088	84.60
T_2:Dried weeds	12.25	0.070	80.60
T_3:Paddy straw	13.00	0.068	78.30
T_4:Sawdust	13.10	0.065	76.20
T5:Control	14.00	0.040	56.20
C.D ($p \leq 0.05$)	1.05	0.003	6.06
SEm±	0.35	0.001	2.02

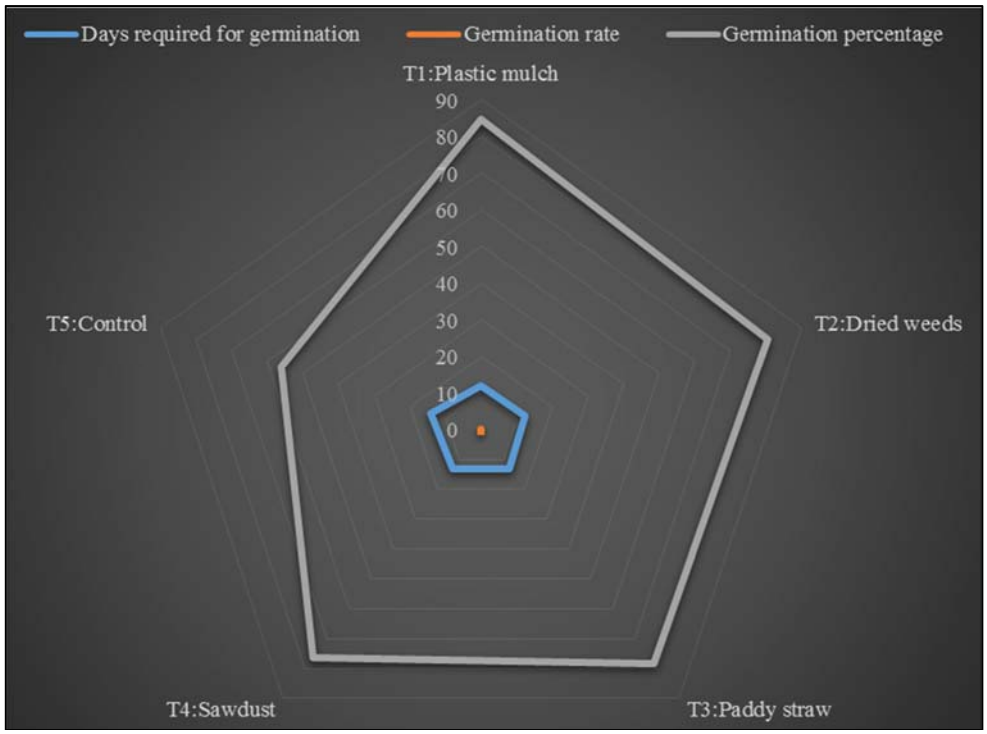

Fig 1: Showing germination rate and percentage.

Table 2: Influence of different mulches on shoot parameters of mulberry seedlings.

Treatment	Seedling height (cm)	Leaves per seedling	Mean thickness of seedling(cm)	Seedling vigour index	Root-Shoot ratio
T_1:Plastic mulch	15.21	11.30	0.30	1286.77	0.65
T_2:Dried weeds	16.50	13.00	0.45	1329.9	1.05
T_3:Paddy straw	14.30	12.25	0.36	1119.69	0.69
T_4:Sawdust	12.21	11.69	0.30	930.40	0.89
T5:Control	10.20	9.89	0.20	573.24	0.52
D ($p \leq 0.05$)	0.15	0.90	0.06	19.89	0.09
SEm±	0.05	0.30	0.02	6.63	0.03

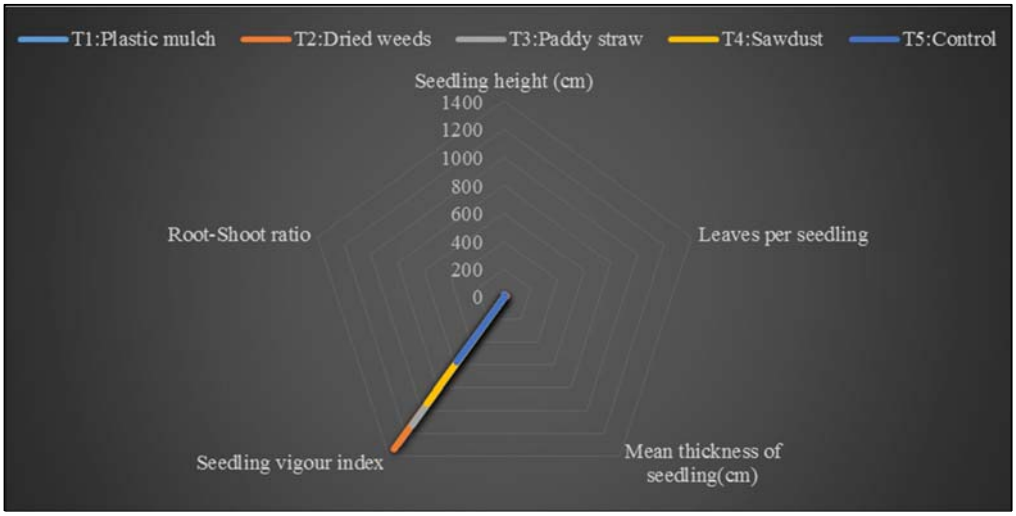

Fig 2: showing shoot parameters of mulberry seedlings.

Summary and Conclusion

In general, from the present investigation it can be concluded that germination of mulberry seed is influenced by different mulches and the best mulch for quick germination of mulberry seed is plastic mulch. Further the parameters like number of leaves per seeding, thickness of seedling, root-shoot ratio and seedling vigour index was highest in dried weed mulch. These findings could support the use of phytomulches as an effective means of weed suppression so that our dependency on phytochemicals is reduced.

Conflict of interest

There is no conflict of interest among the authors.

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