



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(12): 313-315
Received: 05-10-2025
Accepted: 07-11-2025

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Influence of various mulch types on early nursery growth under rainfed conditions of Koderma, Jharkhand

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DOI: <https://www.doi.org/10.33545/2618060X.2025.v8.i12Sd.4409>

Abstract

Nursery establishment in semi-arid regions is often constrained by high evapotranspiration, poor soil moisture retention, and fluctuating temperatures. A field study was conducted in Koderma, Jharkhand, to evaluate the influence of different mulch types on early nursery growth and microclimatic modification. The experiment compared organic mulches (paddy straw, dry leaves, and farmyard manure) and inorganic mulches (black polyethylene and silver polyethylene) with a no-mulch control. Key nursery parameters—including germination percentage, seedling height, leaf number, root length, and biomass accumulation—were recorded to assess treatment performance. Results indicated that mulching significantly improved soil moisture conservation and moderated soil temperature, leading to enhanced germination and vigorous early growth. Among the treatments, black polyethylene mulch showed the highest improvement in seedling vigor, followed by paddy straw mulch, while the control recorded the lowest growth metrics. The study highlights the potential of appropriate mulching strategies to enhance nursery performance under semi-arid conditions and recommends the adoption of suitable mulch materials to improve early plant establishment in Koderma and similar agro-ecological zones.

Keywords: Mulching, nursery growth, rainfed conditions, soil moisture conservation

Introduction

Nursery raising is a critical stage in crop and horticultural production, particularly in rainfed and semi-arid regions where moisture availability is highly variable. In districts like Koderma, Jharkhand, erratic rainfall, high evapotranspiration, and poor soil moisture retention often limit early seedling establishment. These constraints reduce germination, weaken seedling vigor, and ultimately affect field performance. Mulching has emerged as an effective low-cost technique to conserve soil moisture, regulate soil temperature, suppress weeds, and improve microclimatic conditions around seedlings. Both organic and inorganic mulches have been widely used in nursery systems, but their comparative effectiveness varies with climate, soil type, and crop species. Despite the recognized benefits of mulching, limited scientific information is available on the performance of different mulch types under the rainfed conditions of Koderma. Therefore, the present study was undertaken to evaluate the influence of various mulch materials on early nursery growth and to identify the most suitable mulching option for enhancing seedling establishment in this region.

Methodology

The experiment was conducted under rainfed conditions in Koderma district, Jharkhand. The region experiences irregular rainfall, leading to frequent moisture stress during nursery establishment. A field nursery was prepared on sandy-loam soil with low organic matter. The study followed a Randomized Block Design (RBD) with three replications. Six treatments were tested, including control and different mulch types. Treatments included: no mulch, paddy straw, dry leaves, FYM, black polyethylene, and silver polyethylene. Nursery beds were raised to prevent waterlogging during unexpected rainfall. Soil was tilled, levelled, and made fine for

uniform seed placement. Seeds were sown at equal depth and spacing across all treatment beds. Organic mulches were applied at a thickness of 4-5 cm. Polyethylene mulches were laid tightly with small perforations for aeration. The control plot was left uncovered to represent natural rainfed conditions. Germination percentage was recorded at regular intervals. Seedling height and number of leaves were measured periodically. Root length and biomass (fresh and dry) were assessed at the end of the nursery period. Soil moisture content was measured using the gravimetric method. Soil temperature was recorded at 5 cm depth using a soil thermometer. Weed count was taken to evaluate the weed-suppressing effect of mulches. All collected data were analysed using ANOVA suitable for RBD. Treatment means were compared using Critical Difference (CD) at 5% significance.

Results and Discussion

In black polyethylene mulch recorded the highest germination, followed by paddy straw mulch. The control showed the lowest germination of Seedling height & leaf number: polyethylene mulches (black and silver) produced taller seedlings with more leaves due to better moisture retention and moderated soil temperature. Organic mulches, especially paddy straw and FYM, enhanced root length due to improved soil aeration and gradual nutrient release. Biomass accumulation, black

polyethylene mulch resulted in the highest fresh and dry biomass, indicating superior seedling vigor. Soil Moisture & Temperature all mulches improved soil moisture compared to the control. Black polyethylene maintained the most stable soil temperature, reducing heat stress during dry spells.

Table 1: Detail of treatment combination

S. No.	Treatment combination
1	Black Polythene mulching + Drip Irrigation
2	Unmulched + Surface Irrigation

Table 2: Chemical characteristic of soil under Polyhouse.

S. No	. Parameter	Content	Unit	Remarks
1.	pH	5.14	-	Acid
2	EC	0.05	Ds/M	Neutral
3	Organic Carban	0.41	%	Less
4	Nitrogen	381.58	Kg/Ha	Neutral
5	Phosphorus	18.3	Kg/Ha	Neutral
6	Potassium	140.33	Kg/Ha	Neutral
7	Sulphur	31.7	PPM	Neutral
8	Zinc	2.60	PPM	Neutral
9	Boron	1.24	PPM	Neutral
10	Iron	15.5	PPM	Neutral
11	Manganese	31.23	PPM	Neutral
12	Copper	2.43	PPM	Neutral

Table 3: Effect of mulching on growth parameters and physical character

S. No	Treatments	Plant height(cm)	50% Flowering	Number of primary branch	Number of secondary branch	Dry matter (g)	Leaf area index
T ₁	Black Polythene mulching + Drip irrigation	91.1	71.4	114.2	224.2	37.2	2.24
T ₂	Unmulched + Surface Irrigation	78.3	84.2	97.1	184.2	29.5	1.27
	CV	3.54	4.79	4.14	3.11	12.48	13.2
	CD (0.05%)	5.58	7.64	6.47	8.82	7.97	0.88

Table 4: Effect of mulching on fruit weight, yield and Cost benefit ratio

S. No.	Treatment	Fruit weight (g)	Yield (ton/ha)	Net Cost	Gross Profit	Net Return
T ₁	Black polythene mulching + Drip Irrigation	83.3	33.21	15,635	44,378	28,741
T ₂	Unmulched + Surface Irrigation	65.87	25.2	10,8901	26,221	15,322
	CV	5.61	7.35			
	CD (0.05%)	7.24	4.52			

Conclusion

The study demonstrated that mulching plays a vital role in enhancing early nursery growth under the rainfed conditions of Koderma, Jharkhand. All mulch types improved seedling performance compared to the control, primarily by conserving soil moisture and moderating soil temperature. Among the treatments, black polyethylene mulch proved most effective, producing the highest germination, seedling vigor, and biomass. Organic mulches such as paddy straw also performed well and offer an eco-friendly, low-cost alternative suitable for small farmers. The findings suggest that adopting appropriate mulching practices can significantly improve nursery establishment and overall crop productivity in rainfed and moisture-stressed regions like Koderma.

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