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Effects of Different Mulching Materials on Growth, Bulb Development, and Yield of Onion (*Allium cepa* L.) at Bardiya Nepal

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Received: 26 May, 2026

Accepted: 29 Jun., 2026

Published: 13 Jul., 2026

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Preferred citation for this article:

Koirala B., Gautam A., and Chaudhary S., 2026, Effects of different mulching materials on growth, bulb development, and yield of onion (*Allium cepa* L.) at Bardiya Nepal, International Journal of Horticulture, 16(4): 206-213 (doi: [10.5376/ijh.2026.16.0018](https://doi.org/10.5376/ijh.2026.16.0018))

Abstract Onion (*Allium cepa* L.) is a high-value bulb crop cultivated extensively across Nepal. However, yield is limited by suboptimal soil moisture and temperature regulation, particularly under subtropical conditions. A field experiment was conducted during the rabi season (November 2024–April 2025) using a randomized complete block design with five mulching treatments (control, black plastic, rice straw, banana leaf, and sawdust mulch), each replicated three times. Growth and yield parameters were recorded at regular intervals after transplanting and at harvest. Plastic mulch significantly increased bulb yield (35.27 t/ha), showing a 91.5% improvement over the control (18.42 t/ha), while rice straw mulch produced the tallest plants and longest leaves. Rice straw mulch is recommended as a cost-effective and ecologically sustainable alternative for smallholder onion production under Nepal's subtropical Terai conditions.

Keywords Onion (*Allium cepa* L.); Polyethylene mulch; Organic mulch; Bulb yield; Soil moisture conservation; Terai Nepal

1 Introduction

Onion (*Allium cepa* L., family Alliaceae) is one of the most important vegetable crops cultivated worldwide because of its high economic value and widespread use in household consumption and the food industry (Griffiths et al., 2002; Khokhar, 2014). Global onion production is close to 100 million tonnes annually, with South and Southeast Asia accounting for a significant share (FAOSTAT, 2023). In Nepal, onion is grown on approximately 19,346 hectares, producing about 334,047 metric tonnes each year. However, the average productivity remains around 17–18 t/ha, which is lower than the global average of 20–22 t/ha (MoALD, 2023). Improving onion productivity is therefore an important priority for meeting domestic demand and reducing dependence on imports.

One of the major factors limiting onion yield is its shallow and fibrous root system, which makes the crop highly sensitive to soil moisture stress and temperature fluctuations (Mutetwa and Mtaita, 2014). In the tropical Terai region of Nepal, high temperatures during the bulbing stage increase soil water loss, reduce nutrient uptake, and ultimately restrict bulb development (Brewster, 2008). Since many smallholder farmers have limited access to reliable irrigation, practices that conserve soil moisture are essential for sustaining onion production.

Mulching is an effective agronomic practice for improving the soil environment. By covering the soil surface, mulch reduces evaporation, moderates soil temperature, suppresses weed growth, and minimizes soil erosion (Bhardwaj, 2013; El-Beltagi et al., 2022). Organic mulches, such as rice straw, banana leaves, and sawdust, also improve soil structure and fertility as they decompose, whereas black polyethylene mulch provides greater short-term moisture conservation and soil warming (Ham et al., 1993; Lamont, 2005; Ramakrishna et al., 2006; Nair and Ngouajio, 2012).

Although the benefits of mulching have been reported for several vegetable crops, comparative studies evaluating different mulching materials for onion under the Terai conditions of Nepal are still limited. Most previous research has focused on crops such as garlic, potato, and leafy vegetables, with little information on the performance of locally available organic mulches compared with black polyethylene under the same field