

Fruit characteristics in litchi are strongly influenced by cultivar genetics and their interaction with environmental conditions. Previous studies have documented considerable variation among cultivars in fruit size, fruit weight, seed morphology, aril development, and physicochemical quality (Nacif et al., 2001; Singh et al., 2012; Wang et al., 2017; Nath et al., 2022). Similarly, Chaudhary et al. (2023) evaluated major litchi cultivars in the central Terai of Nepal and reported significant differences in several fruit quality traits, highlighting the importance of cultivar selection for commercial production. However, most published studies have focused on general varietal descriptions or evaluations conducted under different agroecological conditions. Because fruit quality is influenced by both genetic background and environmental factors, cultivar performance may vary considerably across production regions. Consequently, findings from other countries or even other regions of Nepal cannot be directly extrapolated to the orchards of Sarlahi.

Sarlahi represents one of Nepal's important commercial litchi-producing districts, yet comprehensive comparative information on the fruit morphological and quality characteristics of its major cultivated varieties remains limited. Scientific evaluation under local agro-climatic conditions is necessary to identify cultivars with superior commercial traits, provide reliable recommendations to growers, and support evidence-based orchard management. Furthermore, understanding varietal differences in fruit quality can assist breeding programs, improve cultivar selection, and enhance the competitiveness of Nepalese litchi in domestic and potential export markets.

Therefore, this study aimed to evaluate the differences in fruit morphological and quality characteristics among seven major litchi cultivars grown under the agro-climatic conditions of Sarlahi, Nepal. The study specifically compared fruit morphology, fruit size, fruit weight, pericarp weight, aril weight, seed characteristics, and total soluble solids (TSS) to identify superior cultivars with greater commercial potential. The findings are expected to provide valuable scientific information for cultivar selection, orchard management, future breeding programs, and the sustainable development of the litchi industry in Nepal.

2 Materials and Methods

2.1 Study site

The experiment was conducted during the 2024 fruiting season at the Tropical Horticulture Center (THC), Sarlahi District, Madhesh Province, Nepal (26.4703° N, 86.7325° E). The experimental site is located in the subtropical Terai region of Nepal at an altitude of approximately 85 m above sea level. The area experiences a humid subtropical climate characterized by hot summers, mild winters, and a distinct monsoon season. The average annual temperature ranges from 10 °C–38 °C, with an annual rainfall of approximately 1,400–1,800 mm, most of which occurs from June to September. The orchard soil is deep, well-drained alluvial loam with good fertility, which is considered suitable for commercial litchi production.

2.2 Plant materials and experimental design

Seven commercially important litchi (*Litchi chinensis* Sonn.) cultivars, namely Shahi, China, Seedless, Early Large Red (ELR), Calcuttia, Muzaffarpur, and Bombai, were selected for evaluation. The cultivars were maintained in the experimental orchard of the Tropical Horticulture Center, Sarlahi. Uniform, healthy, air-layered trees aged 15–20 years with comparable canopy size and vigor were selected for the study. The orchard was established under a square planting system with uniform spacing of 10 m × 10 m. Standard orchard management practices, including irrigation, fertilizer application, weed management, pruning, and plant protection measures, were uniformly followed throughout the experimental period to minimize management-related variation.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. Each tree represented one experimental unit, resulting in a total of 28 experimental trees (7 cultivars × 4 replications).

2.3 Fruit sampling

Fruits were harvested at commercial maturity based on uniform peel colour development, characteristic cultivar appearance, and market harvest stage. Twenty fruits were randomly collected from each experimental tree, representing all four canopy directions (north, south, east, and west) and different canopy heights to minimize