GLOBAL JOURNAL OF AGRICULTURAL AND ALLIED SCIENCES (2025) VOL 5, S2, PAGES 11-12

EXTENDED ABSTRACT
NAPA 2024 Conference Special Issue

Evaluation of Turmeric (*Curcuma longa*) Varieties in High Tunnel vs. Open Field

Trang Pham[1,*], Sravan Sanathanam[1], Srinivasa Rao Mentreddy[1], Charles L. Cantrell[2], and Mei Wang[2]

[1]*Department of Natural Resources & Environmental Sciences, Alabama A&M University, Huntsville, AL 35811, USA.*
[2]*United States Department of Agriculture, Agricultural Research Service, Natural Products Utilization Research Unit, Oxford, MS 38677, USA.*

Abstract history:
Received: April 30, 2024
Revised: February 17, 2025
Accepted: February 17, 2025

Keywords: curcumin, rhizome yield, season extension, turmeric varieties

Turmeric (*Curcuma longa*) is a rhizomatous tropical herb from the *Zingiberaceae* family. Turmeric is well known for its anti-inflammatory and medicinal properties. It has been used extensively in the Indian Ayurveda and traditional Chinese medicine systems for centuries. Modern medicine also recognizes the importance of turmeric and has investigated its bioactive compounds, particularly curcumin, for medicinal properties. Curcumin has several medicinal properties including, anti-inflammatory, antioxidant, and anti-tumor properties. It has been reported to be effective against HIV, Herpes simplex virus (HSV), Hepatitis viruses, influenza type A virus (IAV), and Ebola virus. Additionally, a-R-turmerone has high antioxidant activity *in vitro*, improves the bioavailability of curcumin, and is effective against cancer. For these reasons, the demand for turmeric is increasing in both the food and pharmaceutical sectors in the USA. The US herbal manufacturers are seeking to replace their imported turmeric with domestically produced turmeric with levels of curcumin higher than 3.5%. However, the lack of adapted varieties with short growing seasons (7-8 months compared to the required 9-10 months) limits the expansion of turmeric production in the USA. Due to the late frosts in April and early frosts in October, the growing season in North Alabama is limited to seven to eight months. Producing turmeric in high tunnels might extend the crop growing season by a month or two, consequently increasing turmeric rhizome yields and accumulation of curcuminoids. The objectives of this research were to i) assess varietal performance for rhizome yield in the high tunnel and open field conditions and ii) determine the relative levels of curcuminoids among the three varieties of turmeric in the high-tunnel and open field growing conditions.

Three-month-old greenhouse-grown plants of three turmeric varieties (CL11, VN39, and VN50) were planted at five plants per plot on raised beds covered with plastic mulch with drip tape underneath. The beds were 0.75 x 0.45 m spacing, in high tunnel and open field conditions. The plots were arranged in a randomized block design with four replications. A mixture of composted poultry and cow manure was applied to provide an equivalent of 50 kg ha^{-1} N. Crop growth parameters (plant height and number of shoots per plant), rhizome yield, and curcumin levels were assessed. Curcuminoids, diferuloymethane (DM-curcumin I), desmethoxycurcumin (DMC-curcumin II), and bisdemethoxycurcumin (BDMC-curcumin III) were determined using the HPLC method. The three curcuminoids were combined and expressed as total curcumin yield as a product of curcumin times rhizome yield, expressed in t ha^{-1}. Plant height and shoot number data were analyzed separately using a mixed procedure with repeated measures option, and rhizome yield and curcumin data were analyzed using GLM procedure with MANOVA options since these were highly correlated ($r = 0.83$, $p < 0.0001$) in SAS 9.4.

The plants in the high tunnel remained green for at least 45 days after the first frost in October, which killed the plants in the open field. The plants in the high tunnel were about 18% taller than those in the open field (Fig. 1a). The VN50 plants were taller than the other two varieties, which were similar in height ($p < 0.05$). Plants in the open field produced more shoots per plant than those in the high tunnel (Fig. 1b). Overall, plants of VN50 were taller but had fewer shoots than the other varieties. Varieties CL11, VN39, and VN50, respectively, produced 9.4, 7.6, and 4.0 t ha^{-1} of marketable fresh rhizome yield in the high tunnel compared to 4.2, 2.5, and 5.7 t ha^{-1} in the open field (Fig. 1c). In the open field, the crop lost 59% of rhizome yield due to rotting caused by frost and waterlogging. The rhizomes in the high tunnel were healthy, firm, and more attractive than those from the open field. There was a varietal difference between growing conditions. CL11 and VN39 in the high tunnel produced twice as much rhizome yield as in the open-field condition ($p = 0.0001$), but VN50 showed no such advantage. The high-tunnel growing conditions also increased the curcumin content of VN50 (5.4%) compared to that grown in the open field condition (4.7%). The three turmeric varieties had different levels of curcumin content. The curcumin yield (product of curcumin content x rhizome yield) was higher in high tunnel-grown than in open-field for all varieties (Fig. 1d).

The study showed that high-tunnel cultivation extends crop-growing duration and increases turmeric rhizome and curcumin yields compared to open-field production. However, actual yields may depend on soil quality, irrigation management, and cultivation practices. Excess water due to rain or melting snow/ice could pose a risk to the marketable yield of the open-field-grown turmeric. Therefore, a high-tunnel turmeric production system has potential in the limited growing season of North Alabama, USA.

* *Corresponding author.* E-mail address: phtrangvn85@gmail.com

https://doi.org/10.35251/gjaas.2025.006

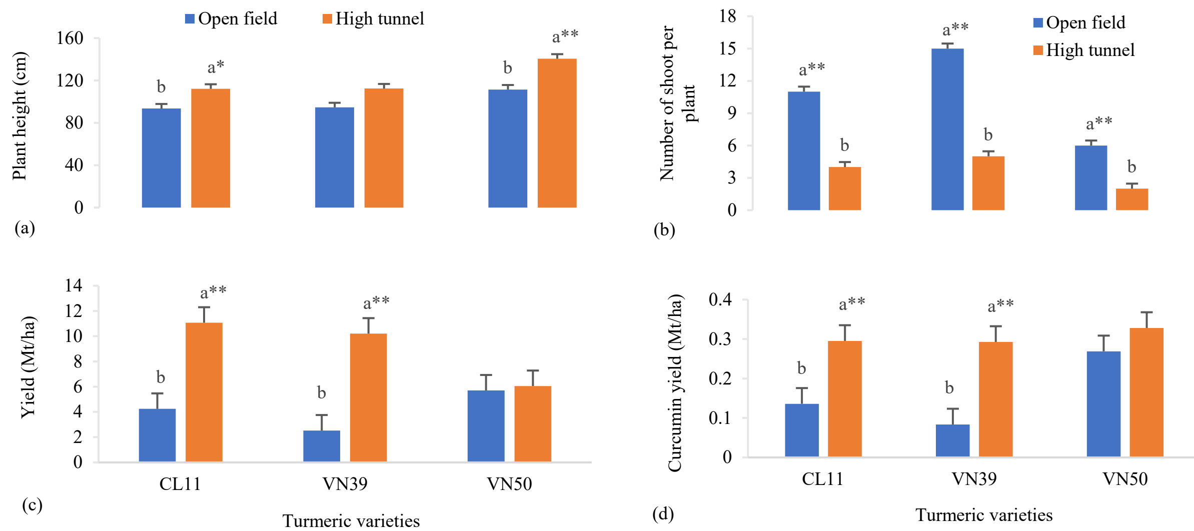

Figure 1. Plant height (a), number of shoots per plant (b), fresh rhizome yield (c), and curcumin yield (d) (mean ± SE) of three turmeric varieties grown in high tunnel and open field May 2022-February 2023, Hazel Green, Alabama, USA (*$p < 0.05$, **$p < 0.01$).

Citation: Pham, T., Sanathanam, S., Mentreddy, S. R., Cantrell, C., & Wang, M. (2025). Evaluation of turmeric (*Curcuma longa*) varieties in high tunnel vs. open field. *Global Journal of Agricultural and Allied Sciences, 5(S2),* 11-12. https://doi.org/10.35251/gjaas.2025.006.