

# Evaluation of Growth and Yield of Kattupatavalam (*Trichosanthes cucumerina* L.) in Open and Shade Conditions

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## Abstract

This study evaluated the growth and yield traits of *Trichosanthes cucumerina* seedlings and clonal progenies in two different environmental settings viz, open and shaded. The results of the study demonstrated that different growth and yield metrics of both seedlings and clonal progenies were significantly impacted by shade and open situations. Significant differences were seen in a few growth indicators and yield variables between seedlings and clonal progenies. A comparison of clonal progenies and seedlings revealed that the clonal progenies had longer main vines, while the seedlings produced more fruits per plant, especially when grown in shade. However, in both shade and open conditions, no significance difference was found in fruit yield per plant, total fresh yield, or total dry yield between seedlings and clonal progenies. The study emphasizes that while plants grown in shade showed a larger number of fruits and fruit yield per plant, whereas plants grown in open conditions had a greater vegetative biomass. When considering total fresh plant yield inclusive of fruits, it was observed similar performance was in both open and shaded conditions. The study shows that tissue culture plants function better than seedlings in both open and shaded environments.

**Key words:** *Trichosanthes cucumerina* L., Growth, Yield, Seedlings, Clonal progenies

*Trichosanthes cucumerina* L., commonly known as Kattupatavalam, holds significant importance in the Ayurvedic pharmaceutical industry due to its profitability and market viability. Renowned for its laxative and blood purifying properties, this medicinal plant is esteemed for treating dermatological and intestinal ailments [1]. Belonging to the Cucurbitaceae family, *Trichosanthes cucumerina* L. is an annual, slender climber with furrowed stems and bifid or trifid tendrils. Leaves are typically simple, orbicular, reniform, or broadly ovate, often with five lobes. The monoecious flowers are brightly coloured and insect-pollinated, with male flowers borne on axillary racemes and solitary female flowers in the axils. The fruits are ovoid, fusiform, indehiscent berries tapering at both ends, initially striped with white and ripening to a scarlet red hue. The seeds, surrounded by red pulp, are semi-ellipsoid and compressed when ripe [2-3].

The plant is native to Sri Lanka, Northern Australia, the Malay Peninsula, and India. *Trichosanthes cucumerina* L. performs well in forest margins of semi-evergreen, moist deciduous forests, as well as plains. In Kerala, specific locales such as Methaganam, Moozhiar, Konni, Chandanathode, Karasurymala, Kadakarapally, Pooyamkutty and Karuvarakundu have been identified as habitats for this plant. Currently, its demand is largely met through wild harvesting, resulting in the depletion of its genetic resources. Efforts to promote cultivation in Kerala's homesteads have been impeded by a significant shortage of seeds, accelerating the risk of extinction due to overexploitation. Moreover, the plant's low

seed yield, typically ranging from 4 to 10 viable seeds per crop, poses a further challenge to large-scale propagation in natural conditions. Urgent attention is warranted to ensure the sustainable cultivation and conservation of this invaluable medicinal plant.

## MATERIALS AND METHODS

A field experiment was conducted at the Department of Plantation Crops and Spices, College of Agriculture, Vellanikkara, Kerala Agricultural University. The experimental crop was planted in a coconut plantation with 35% shade as well as in an open field. The experiment lasted for four months, covering February, March, April, and May, during which meteorological data were also recorded. This included mean maximum temperature (°C), mean minimum temperature (°C), highest maximum temperature (°C), lowest minimum temperature (°C), mean RH morning (%), mean RH evening (%) and mean RH (%) as well as rainfall (mm), rainy days, evaporation (mm), sunshine hours, and mean sunshine hours for each month.

Seedlings and clonal progenies were raised in both open-field conditions and within a mature coconut plantation, following a Randomized Block Design (RBD) with 5 replications and 4 treatments. The planting spacing was 2m x 2m, and during field preparation, farmyard manure was applied at a rate of 10 t/ha. Each planting pit retained one plant, and post-cultivation practices such as irrigation, mound preparation,

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and setting up pandals were performed as required. Observations were made on various morphological characteristics, including main vine length, number of fruits per plant, fruit yield per plant (grams), total fresh yield of the entire plant in grams (including shoots, fruits, and roots) and total dry yield of the entire plant in grams (including shoots, fruits, and roots).

## RESULTS AND DISCUSSION

The growth and yield characteristics of *T. cucumerina* L. cultivated under shaded and open conditions are as follows:

In the main plot experiments, where plants were grown in shaded and open areas, there was no notable difference in the main vine length of the experimental plants. However, a slight increase in average vine length was observed in plants grown in open areas (306.18 cm) compared to those in shaded areas (304.44 cm). Seedlings displayed a mean vine length of 363.87 cm under shade, which was comparable to plants grown in open

areas (362.25 cm). Clonal progenies also exhibited similar results, with a vine length of 245.05 cm in shade and 250.10 cm in open areas. This discrepancy may be attributed to reduced photosynthetic rates, stomatal conductance, transpiration rates, stomatal index, and stomatal frequency in shaded conditions, as reported [4]. In a similar study, it has been found that no significant difference in plant height between different cultivars of turmeric at varying shade levels [5].

Significant variability was observed in the mean main vine length within subplot treatments (seedlings and clonal progenies). Seedlings displayed a higher average vine length of 363.04 cm compared to clonal progenies (247.58 cm). Among interactions, seedlings exhibited maximum vine lengths of 363.87 cm and 245.05 cm under shade and in open areas, respectively, which was significantly superior to clonal progenies grown under shaded and open conditions (Fig 1). These results align with the similar performance in plants derived from tissue culture [6] and lower branching was observed in clonal progenies of cocoa [7].

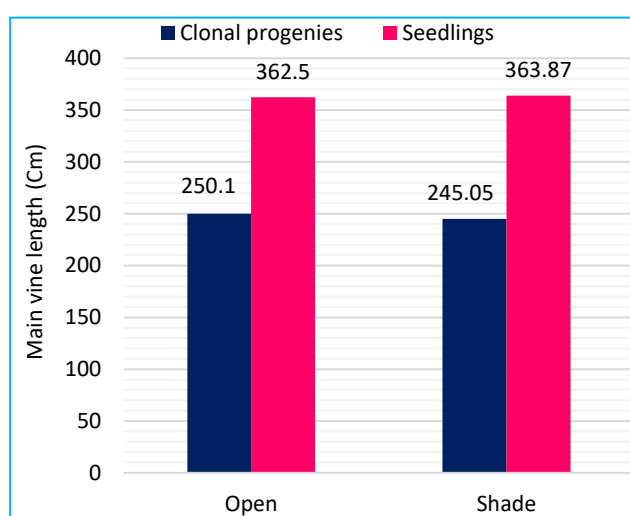


Fig 1 Interaction effect in seedlings and clonal progenies of *Trichosanthes cucumerina* L. on main vine length in open and under shade

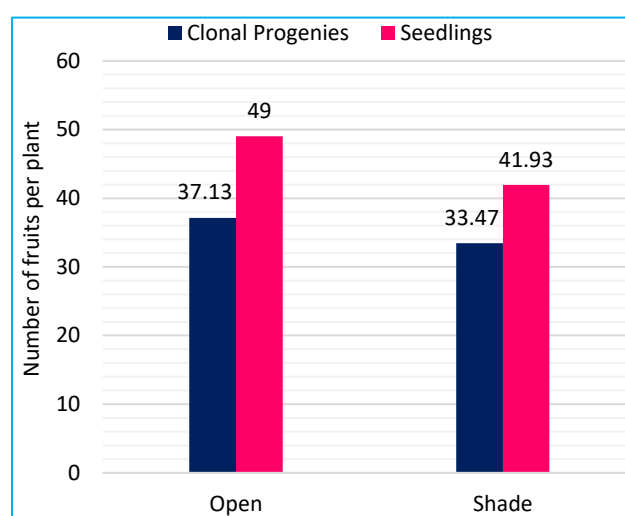


Fig 2 Interaction effect in seedlings and clonal progenies of *Trichosanthes cucumerina* L. on number of fruits per plant in open and under shade

Significant variability was noted in the number of fruits per plant between plants grown in open and shaded conditions. However, there was no discernible difference in the performance of seedlings and clonal progenies concerning the number of fruits per plant under both shaded and open conditions. Seedlings produced a mean of 37.13 fruits under shade and 33.47 fruits in open conditions, while clonal progenies yielded 49.00 fruits under shade and 41.93 fruits in open conditions (Fig 2). Temperature plays a pivotal role in fruit initiation, fruit set, and fruit growth, with its effects closely linked to light exposure [8]. Similar results were obtained in *Capsicum annuum* L. [9].

In terms of interaction effects, although clonal progenies displayed a greater number of fruits than seedlings under shade, in open conditions, both clonal progenies and seedlings exhibited similar numbers of fruits per plant. The supplementation of growth hormones like BA during the *in vitro* phase of tissue culture-derived plants likely contributed to an increased number of flowers, thereby resulting in a higher number of fruits per plant. This observation is also similar to the findings, in which it was observed that the tissue culture-derived plants exhibited a higher number of flowers per plant compared to seed-derived plants [10].

The fruit yield per plant exhibited no variation between plants cultivated in shaded and open conditions. Plants

cultivated under shade yielded a mean of 275.00g of fruit, while those grown in open conditions yielded a mean of 244.64g of fruit. Similar results observed in soybean, where the number of grains per pod and hundred-grain weight did not differ significantly between shaded and open conditions [11]. Seedlings and clonal progenies demonstrated comparable performances, with fruit yield per plant values aligning closely, at 248.68g for seedlings and 270.96g for clonal progenies (Table 1). Nonetheless, although not statistically significant, a slight increase in fruit yield was observed in tissue culture-derived plants. The similar observations have been found in Nendran banana, in banana, in passion fruit, and in taro [12-15]. In papaya also, increase in fruit yield was observed [16].

Table 1 Fruit yield per plant in seedlings and clonal progenies of *Trichosanthes cucumerina* in open and under shade

Field conditions	Shade (S <sub>1</sub> )	Open (S <sub>2</sub> )	Mean
Progenies			
T <sub>1</sub> : Seedlings	248.19 <sup>aa</sup>	249.17 <sup>aa</sup>	248.68 NS
T <sub>2</sub> : Clonal progenies	301.82 <sup>aa</sup>	240.10 <sup>aa</sup>	270.96 NS
Mean	275.00 NS	244.64 NS	

NS - Non-significant

In the current study, there was no significant difference observed in the total fresh yield of the entire plant between plants cultivated under shaded conditions and those grown in open conditions. However, a slight increase in fresh yield was noted in plants cultivated under shade (654.73g) compared to those in open (613g) (Table 2). The lack of significant variation in total fresh yield per plant between open and shaded conditions can be attributed to the higher vegetative biomass in plants grown in open conditions, indicated by greater main vine length and a higher number of primary branches. Conversely, plants grown under shade exhibited a higher number of fruits and fruit yield per plant. Therefore, when considering the total fresh plant yield inclusive of fruits, plants in both open and shaded conditions performed similarly. Some crops exhibit better performance under shade due to the presence of a threshold illumination intensity beyond which the stomata of shade-loving plants tend to close [17]. In many medicinal plants it was reported that the yield is more in shade compared to open conditions [18-20].

There was no significant difference observed between seedlings and clonal progenies concerning the total fresh yield of the entire plant. However, clonal progenies displayed a slightly higher total fresh yield (655.25g) compared to seedlings (612.49g) (Table 2). This could be attributed to the increased number of fruits and fruit yield in clonal progenies. Therefore, in terms of overall fresh plant biomass inclusive of fruits, clonal progenies did not demonstrate inferiority. The superior performance of tissue culture-derived plants in terms of yield has also been supported by in patchouli and by in taro and in turmeric [21-23].

Table 2 Total fresh yield of whole plant in seedlings and clonal progenies of *Trichosanthes cucumerina* L. in open and under shade

Field conditions	Shade (S <sub>1</sub> )	Open (S <sub>2</sub> )	Mean
Progenies			
T <sub>1</sub> : Seedlings	614.66 <sup>aA</sup>	610.31 <sup>aA</sup>	612.49 NS
T <sub>2</sub> : Clonal progenies	694.80 <sup>aA</sup>	615.69 <sup>aA</sup>	655.25 NS
Mean	654.73 NS	613.00 NS	

NS - Non-significant

Regarding the total dry yield of the entire plant, seedlings and clonal progenies performed similarly under both shaded and open conditions, with no significant difference observed (145.65g in open and 157.15g in shade). A study revealed that oregano exhibited the highest yield in both fresh and dry weight under shade-enclosure conditions. Similarly, thyme also demonstrated significant yields, with its maximum fresh and dry weights being higher under shade-enclosure, comparable to the results observed for oregano [24].

Seedlings and clonal progenies did not exhibit a significant difference in total dry yield. However, clonal progenies displayed a slightly higher mean dry yield (156.20g) compared to seedlings (146.59g). Specifically, seedlings recorded a mean dry yield of 148.25g under shade, while clonal

progenies yielded 166.04g. In both shaded and open conditions, seedlings performed similarly, with mean yields of 148.25g under shade and 144.93g in open. Clonal progenies registered 166.04g of dry yield in shade and 146.37g in open conditions (Fig 3). High biomass of tissue culture-derived plants after drying has been reported in several medicinal species. In *Rauvolfia serpentina*, the biomass of tissue culture-derived plants exceeded that of normal plants on a dry weight basis [25].

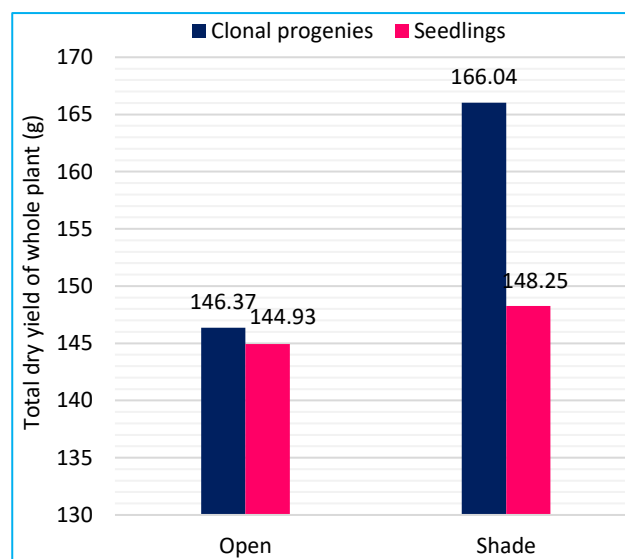


Fig 3 Total dry yield of whole plant in seedlings and clonal progenies of *Trichosanthes cucumerina* L. in open and under shade

## CONCLUSION

This study conducted to analyze the impact of open and shade conditions on growth and yield of seedlings and clonal progenies of *Trichosanthes cucumerina* L. From the results, it was observed that seedlings recorded significantly higher mean main vine lengths compared to clonal progenies in both open and shade conditions across subplot treatments. The study results revealed that shade significantly influenced the number of fruits per plant in both seedlings and clonal progenies. Fruit yield per plant did not differ significantly between shade and open conditions. Seedlings and clonal progenies also yielded similar results. Shade and open conditions had no significant influence on the total fresh yield or total dry yield of the whole plant. Similarly, seedlings and clonal progenies showed no significant variation in fresh and dry yield. However, the maximum fresh and dry yield per plant was observed in clonal progenies grown under shade, although the differences were not significant. Currently the procurement of *Trichosanthes* is mainly done by collecting them from the natural habitat as whole plant. It leads to the non-availability of the plants in future. Hence the study conclusively proved that *Trichosanthes* can be successfully cultivated as a profitable intercrop in the coconut gardens of Kerala, with the performance of tissue culture plants being comparable to that of seedlings.

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