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## A critical review on effect of trailing and staking on growth and yield of cucurbitaceous crops

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**Abstract**

Cucurbitaceae is the largest family in vegetable crops. Cucurbits comprise 117 genera and 825 species. Out of this 30 species of nine genera are used as cultivated plants. Most of the cucurbits viz., cucumber, bottle gourd, ridge gourd, bitter melon, snake gourd, water melon and muskmelons are monoecious and annual in habit. However plants like pointed gourd, spine gourd, ivy gourd and chow-chow are dioecious and perennials. It is of high market demand with a special delicacy for the people of India and it fetches premium price in the market. Though are potential vegetable crops, there is not much standardized scientific cultivation technology available for improving the yield. Agro techniques like nutrition, spacing, trailing and staking play an important role in commercial production. Spacing is an important factor which will influence the plant population and affect the nutrient uptake in plants by creating competition between plants for nutrients, water and availability of light to the plants for synthesizing the food. By manipulation of inter and intra row spacing, trailing and staking several workers reported higher yields to overcome the bottleneck of production. Canopy manipulation through pruning and training together with appropriate spatial arrangements has been identified as key management practices for getting maximum marketable yields from greenhouse crops especially cucurbits. Trailing and staking is done to increase yield, better exposure of plant to sunlight and ventilation and increases fruit yield, reduces the proportion of unmarketable fruit, enhances the production of high quality fruits, prevent diseases of fruit rot, allows better aeration and exposes the foliage to sunlight for photosynthetic activities. The relevant literature pertaining to the trailing, stacking and plant densities on growth, yield and yield attributes is reviewed and presented here under with the following sub-heads in different cucurbits.

**Keywords:** genetic combining ability, specific combining ability, okra, variance, growth, yield, quality

**Introduction**

Cucurbitaceae the gourd family of flowering plants belonging to the order cucurbitales, containing 98 genera, about 975 species of food and ornamental plants. They are widely distributed in the tropics & warm temperate regions. They are mostly used as vegetables and fruits which are valuable source of vitamins and minerals. Cultivated cucurbits are really useful in human health; members of cucurbitaceae have multipurpose functions in the lives of humans and animals, besides they have specific medicinal uses. Cucurbits are mostly climbers and vines. It has been noticed that some level of advantage came with the regular farm practice of applying stakes to the cucurbits. Staking method plays a very important role in growth and quality of Cucurbitaceae family crops. When fruits are come in contact with the ground, it is likely to decay and reduce the quality, under irrigation condition and during rainy season, the crop should be staked or trailed so that fruits will be prevented from direct contact with the soil. Higher productivity is also observed in trailing is due to increase in the photosynthesis. Sunlight is utilized by maximum number of leaves and higher number of side branches resulting in enhanced assimilation of carbohydrates caused to increase in yield. To increase the productivity of the crop, it is essential to standardize the agro techniques such as trailing of vines to modify the fruit set and fruit yield. Trailing of vines over pendal or telephone wire at a height of around 1.5-2.0 m plays an important role in growth and quality of the fruits. During rainy season or under irrigated situations, the crop should be staked or trailed on pendals or telephone wire to prevent the crop from direct contact with the soil and to get better quality fruits. Farmers sometimes allow the vines to trail on the ground leading to the production of fruits with yellow bellies, overcrowding of vines and subsequently the attack by mould due to high humidity. Staking of watermelon shows enormous disparity and difference over un staked one, as a result of avoiding competition, overcrowding and correct exposure or positioning of watermelon leaves to sunlight for effective photosynthetic activities that will enhance fruiting.

It is observed that staked treatment gave higher yield than the un staked treatment in case of watermelon (*Citrullus lanatus* L.) Studies has shown that cucumber appropriately spaced and staked show enormous disparity and difference with the both un staked and un spaced, as a result of avoiding competition, overcrowding and correct exposure or positioning of cucumber leaves to sunlight for effective photosynthetic activities, that will enhance fruit yield. Higher fruit yield was observed on trellis treatment than for the non-trellised treatment (Hardy and Rowell, (2002) [8]; Hirata and Tilato (2000) [10] also Nelson, (2005) [20] and Paulo *et al.*; (2003) [24] reported increases in fruit yield as plant density increased.

The horticultural practice of staking had been reported to improve yield in ridge gourd (Hilli *et al.*, 2009) [9]; cucumber (Hardy and Rowell, 2002) [8] and yam (Ndegwe *et al.*, 1990) [19]. Asante (1996) [3] maintained that in cultivation of climbing crops, the use of suitable supports, in the form of stakes or trellises, is very important as they not only expose the leaves to sunlight for optimum photosynthesis but also keep the fruits off the ground, thereby preventing them from being infected by soil borne pathogens.

Trellising improves total and marketable yield compared with ground culture because it is a useful technique to utilize vertical space & to keep crops off the ground resulting in clearer & quality fruits that are less susceptible to rot, to certain soil borne diseases & to ground dwelling pests. Trellising also improves air circulation around plants and can help to reduce foliar disease problem. It increases harvesting. The efficiency by reducing damage to vines and improving intercultural operations *viz.*, irrigation, mulching, weeding net photosynthetic rate.

## Reviews

### Trailing

Konsier & Strides, (1973) [14] stated that vertical training or trellising has been reported to improve the yield and quality of Cucumber and to aid in the control of its foliar and fruit diseases.

Singh *et al.*, (1982) [26] suggested that the trellis method on muskmelon and reduction in plant to plant spacing to 30 cm resulted in further increase in the fruit yield than the plants spreading on the ground.

Hanna. *et al.*, (1987) [7] studied on vertical training and trellising in case of cucumber and concluded that improved photosynthetic efficiency has also been cited as one of the possible reasons for the observed increased yield.

Yadav *et al.*, (1989) [28] reported that trailing of vines on bower system could produce higher number of branches per plant, increased vine length, less number of days to flower, initiation of more number of female flower, and longer fruits than trailing on ground.

Hanna *et al.*, (1991) [6] stated that trellis has been suggested to increase harvesting efficiency in cucumber while improving yield by reducing damage to vines & improving net photosynthetic rate.

Malik, (1994) [17] studied and concluded that if support is provided for climbing, yield is considerably increased in case of luffa.

Hilli *et al.*, (2009) [9] studied the Influence of method of trailing and fertilizer levels on seed yield of ridgegourd and concluded that telephone method of trailing with higher dose of fertilizers (100:100:100 kg NPK per ha) recorded significantly more vine length, number of leaves dry matter,

higher fruit and seed yield compared to other levels of fertilizer with farmers method (without trailing).

Solangi *et al.*, (2009) [2] studied the effect of vertical trailing on vegetative, reproductive and yield of luffa as intercrop in coconut field and concluded that the staked method compared to unstaked had 30-35% increase in yield and also insect pest protection and intercropping did not affect the agronomic traits and yield of the coconut, but increase the yield compared to palms alone.

Kalyanrao *et al.*, (2012) [13] studied the Influence of vertical trailing on seed yield and quality during seed production of bottlegourd (*Legenaria siceraria*) cv. Pusa hybrid-3 and revealed that seed yield attributes showed that the number of filled seeds/fruit (584.7), seed yield/vine (517.5 g) and seed yield/acre (689.6 kg) were significantly higher in trailing. The seed quality attributes *viz.* germination percentage, seedling length, seedling dry weight, vigour index I & II and seed moisture content, immediately after harvest were also significantly superior in trailing method. The cost-benefit analysis of hybrid seed production showed higher BC ratio in trailing (3.87) than those in traditional method (2.10).

Nair *et al.*, (2013) [18] conducted a study on trellising and plastic mulch effects on cucumber production in high tunnel and reported that trellising cucumbers in high tunnel production systems affects fruit length and yield higher number of marketable fruits as compared to non-trellised systems. Trellising allows for better air movement and heat dissipation and reduces the occurrence of fungal and bacterial diseases. Although white plastic mulch reflected almost double the amount of light when compared to black, it did not translate to enhanced yield or productivity. White plastic mulch kept the soil cooler than black and could be used in high tunnel production when crop plantings occur during peak summer.

Chukwudi *et al.*, (2014) [27] studied the effect of trellis height and cutting frequency on leaf and fruit yield of fluted pumpkin and reported that improvement on the number of days to flowering as the trellis height increased. The trellised plants were significantly ( $p < 0.05$ ) higher than the non-trellised in total leaf yield/hectare. The uncut vines produced higher values in average fruit weight, fruit circumference, fruit length and total fruit weight/ha than the cut vines in both years. Trellis (staking) improved the vegetative phase, flowering and yield of *T. occidentalis* and should therefore, be introduced as an agronomic practice in fluted pumpkin production.

Kurhekar *et al.*, (2015) [15] studied on development and evaluation of bamboo trellis system for growing cucurbits in konkan region and reported that No standard trellis system is available suiting to different habits of cucurbits. Failure of trellis occurred, resulting in considerable cost of fruit loss and trellis repair. Three types of trellis system Bower trellis system, T-trellis system and Vertical trellis system were designed and developed using bamboo as structural member. Ridge gourd and bottle gourd were cultivated on different trellis. Total fruit load on Bower trellis system, T-trellis system Vertical trellis system and control system was 6.4 N/m<sup>2</sup>, 6.3 N/m<sup>2</sup>, 6.2 N/m<sup>2</sup> and 6.3 N/m<sup>2</sup> respectively.

Juang *et al.* (2017) [12], studied the use of trellis and mulch increased fruit production of spaghetti squash and the study revealed that spaghetti squash would be preferable to obtain the high fruit production provided the crops were mulched and grown with trellis.

GV Rajalingam *et al.*, (2017) [5] studied the Influence of different training systems in cucumber under naturally

ventilated poly house and concluded that, the drape system of training was suitable in cucumber under polyhouse over Pinch system (The apical meristem is removed at 8 feet height and a lateral shoot is trained over the cable wire at 8 feet height and back down to the floor).

### Staking

Egun (2007) <sup>[1]</sup> studied comparative marketable leaf yield of staked and un staked pumpkin in a tropical utisoils and reported that there is no significant difference ( $t$  – test:  $p > 0.05$ ) in marketable leaf yield between the staked (500.0 – 500.5g) and unstaked (498.3 – 499.5g) plants and better economic return on revenue to farmers with the elimination of cost of stakes and staking operation.

Agu (2010) <sup>[4]</sup> studied the effect of growth and yield responses of pumpkin (*cucurbita maxima*) to poultry manure applications and staking techniques and reported that there was no significant ( $P = 0.05$ ) interaction between staking technique and poultry manure rate, the application of 20 tons/ha of poultry manure in combination with vertical staking technique appeared to enhance growth and yield of pumpkin relative to other treatments.

Okonmah,(2011) <sup>[22]</sup> conducted a study on the effects of different types of staking and their cost effectiveness on the growth, yield and yield components of cucumber and concluded that a positive influence of staking on the yield and yield components of cucumber. Plant growth, yield and yield components were better under staking than no staking and best with 5 meter raised platform staking method since the number of leaves, flowering pollination and fruiting were well enhanced due to better display to sunlight. The result of the estimated revenue after the subtraction of cost of staking from the market value of cumulative total pod yield indicated that 5-metre raised platform method significantly recorded N33,500, followed by Bamboo Tip method (N27,750) 3 metre Trellising method (N22,200) 1-metre individual method (N20,180) while no staking at no cost recorded the least (N12,000) the same 5-metre Raised platform staking method is apparently recommended with a view to exploiting the great economic potential of cucumber for determining the influence of various types of staking or the yield and yield components of cucumber.

Nweke *et al.*, (2013) <sup>[21]</sup> studied staking and plant spacing on the growth and yield of cucumber. The result generated from the study showed that number of fruits, number of marketable fruits and weight of fruits. Staking had no significant effect on weight of fruits, but showed significant effect on number of branches, number of leaves and vine length decreased as the plant spacing increased from 50cmx30cm to 50cmx40cm. The closest plant spacing (50cmx30cm) recorded the highest value in all the parameters assessed in this trial except for number of flowers, Days to 50% anthesis, length of fruit and weight of fruit. The staked treatment constantly performed better with higher values than the non-staked treatment except for the flowers and number of non-marketable fruits. Hence for maximum production of cucumber staking and closer plant spacing should be adopted.

Umekwe *et al.*, (2015) <sup>[23]</sup> studied effects of organic manure and staking methods on the growth and yield of fluted pumpkin (*Telfairia occidentalis*) and concluded that organic manure(control, poultry, pig dung and compost) had significant effect on the vine length, fresh weight of leaves and leaf yield. Raised platform staking constantly performed better with higher values than the other staking methods (without staking, raised platform and bamboo tip staking)

except in number of vines. Hence, for maximum production of fluted pumpkin, compost manure and raised platform staking should be adopted.

Oga *et al* (2015) <sup>[11]</sup> studied the on the effects of NPK fertilizer and staking methods on the growth and yield of watermelon and suggested that NPK fertilizer had a significant effect on the vine length, number of flowers, number of fruits and number of marketable fruits. The staked treatment constantly performed better with higher values than unstaked plants except in number of leaves and weight of fruits. Hence, for maximum production of watermelon, NPK fertilizer rates at 60kg/ha and staking should be adopted.

Ekwu *et al.*, (2017) <sup>[16]</sup> studied the effect of staking and pruning on the growth and yield of cucumber and found that vine length, number of flowers, total number of fruits and the number of non-marketable fruits were higher on the non staked treatment while staking resulted in a higher number of marketable fruits, weight, length and diameter of fruits. The unpruned plants produced the highest total number of fruits, marketable and non-marketable fruits while the weight, length and diameter of fruits were highest on one stem pruning. Staking, pruning and their interaction had no significant effect on the number of days to 50% anthesis.

### Conclusion

The relevant literature pertaining to the trailing, stacking and plant densities on growth, yield and yield attributes is reviewed and presented above showed that trailing, staking and plant spacing treatment had effect on the vegetative growth and yield of cucurbits. The non-staked treatment consistently gave least values in all the vegetative and yield parameters measured except in the number of flowers and number of non-marketable fruits respectively, while the closest plants spacing produced highest values virtually in all the parameters assessed. Thus it can be suggested that the vegetable farmers who have the intention of producing high quality cucurbitaceous fruit from different Agro-ecological zones should adopt trailing, staking methods and use of an optimum plant spacing for maximum production.

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