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# FERTIGATION AND STAKING TECHNIQUES FOR SUSTAINABLE SPIKE PRODUCTION IN LONG PEPPER (*PIPER LONGUM*) UNDER PARTIAL SHADE

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**ABSTRACT**
The experiment on "Precision farming techniques in long pepper (*Piper longum Linn.*) under protected cultivation" was carried out at the College of Agriculture, Padannakkad, Kasaragod, Kerala Agricultural University during 2013-2014 to develop cost effective agro techniques for improving the productivity and profitability of long pepper. The experiment consisting of 14 treatments replicated twice was laid out in RBD. The treatments were, T1 - Planting in trenches filled with enriched rooting medium + Staking + Fertigation through drip system; T2- Planting in trenches filled with enriched rooting medium+ Staking+ Fertigation through micro sprinkler; T3- Planting in trenches filled with enriched rooting medium+Without Staking+ Fertigation through drip system; T4- Planting in trenches filled with enriched rooting medium +Without Staking+ Fertigation through micro sprinkler; T5 -T1 +Planting in hanging pots and fertigation through mist; T6 -T2 + Planting in hanging pots and fertigation through mist; T7 -T3+ Planting in hanging pots and fertigation through mist; T8 - T4 + Planting in hanging pots and fertigation through mist; T9 - Planting in trenches filled with potting mixture + Without staking + Life saving irrigation (Control); T10 -T1 Under partial shade; T11- T2 Under partial shade; T12- T3 Under partial shade, T13- T4 Under partial shade; T14- Planting in trenches filled with potting mixture + Without staking + Life saving irrigation under partial shade (control). Spike number at 7, 8, 9, 10, 11 and 12 MAP per plant was found to be significantly influenced by treatments effects. The highest total spike number was recorded by the treatment $T_5$ and it was found to be on par with $T_6$. The increase in spike number in treatment $T_5$ was 63.69 per cent over the control, $T_{14}$. Protected cultivation and precision farming techniques significantly influenced dry spike yield per plant at all stages of harvest. T7 at 6 MAP and T5 at all other stages of harvest i.e. 8, 10 & 12 MAP showed the highest values recorded the highest total dry spike yield of 524 kg $ha^{-1}$ at 12 MAP. It is concluded that integrated management of long pepper by planting rooted cuttings of the variety 'Viswam' in trenches filled with enriched rooting medium and trailing on stakes and fertigation, ie., rotational application of liquid organic manures through drip irrigation system was found beneficial to improve the productivity and profitability of long pepper in the humid tropics.

**KEY WORDS**: *Piper longum*, Fertigation, Staking, Precision farming, Spike number, Dry spike yield.

## INTRODUCTION

*Piper longum*, popularly known as thippali or long pepper, is an economically important medicinal plant well adapted to the agro climatic situations prevailing in the state. Apart from the spikes, the roots and thicker parts of the stem are cut, dried and used as an important drug (piplamool) in the above systems of medicines against diseases of respiratory tracts, cardiac and splenic disorders. In long pepper, vegetative and reproductive growth stages overlap throughout its life cycle and maintenance of an optimum oxygen-nutrient-moisture balance is essential to trigger spike initiation in every leaf axil. Fertigation with liquid organic manures through micro irrigation systems, *viz*, drip, microsprinkler or mist ensures proper modulation of rhizosphere to sustain optimum vegetative and reproductive growth. Foliar fertilization has been used as a means of supplying supplement doses of minor and major nutrients, plant hormones, stimulants and other beneficial substances. Observed effects of foliar fertilization include yield increase, resistance to disease and insect pests, improved drought tolerance and plant growth. One of the key factors influencing spike yield is the number of fruiting branches which is influenced by plant population and disposition of leaves. A spike is produced in the axil of every productive leaf. Increasing planting density and proper disposition of leaves by proper staking / trailing may lead to higher spike production. With this background, the present investigation was undertaken to develop cost effective agro techniques for improving the productivity and profitability of long pepper.

## MATERIALS & METHODS

Investigations on "Precision farming techniques in long pepper (*Piper longum* L.) under protected cultivation" was carried out at the College of Agriculture, Padannakkad, Kerala Agricultural University during 2013-2014 in the interspaces of a mature coconut garden. *Piper longum* L. variety 'Viswam' released from Kerala Agriculture University was used for the study. The experiment consisted of 14 treatments laid out in RBD with two replications. The treatments were, T1 - Planting in trenches filled with enriched rooting medium + Staking + Fertigation

through drip system; T2- Planting in trenches filled with enriched rooting medium + Staking + Fertigation through micro sprinkler; T3- Planting in trenches filled with enriched rooting medium + Without Staking + Fertigation through drip system; T4- Planting in trenches filled with enriched rooting medium + Without Staking + Fertigation through micro sprinkler; T5 - T1 + Planting in hanging pots and fertigation through mist;T6 - T2 +Planting in hanging pots and fertigation through mist; T7-T3 + Planting in hanging pots and fertigation through mist; T8-T4+ Planting in hanging pots and fertigation through mist; T9 - Planting in trenches filled with potting mixture + Without staking + Life saving irrigation (Control); T10 - T1 Under partial shade; T11- T2 Under partial shade; T12- T3 Under partial shade, T13- T4 Under partial shade; and T14- Planting in trenches filled with potting mixture + Without staking + Life saving irrigation under partial shade (control).

Long pepper vines were cut into pieces of 20 cm length and planted in polythene bags filled with potting mixture (1:1:1 mixture of sand: soil: cowdung). Polythene bags were kept under partial shade for two months and watered once in two days. Saplings attained four leaf stage at the time of planting in the main field. Trenches of 3.6 m length, 30 cm width and 45 cm depth were taken, mulched the bottom with dry leaves to a height of 10 cm, filled with enriched growth medium and mixed with surface soil. Long pepper saplings were planted in the trenches at a spacing of 60 x 40 cm @ one sapling per hill. A cassava stem of one metre length was erected at a distance of 15 cm from the base of each long pepper plant and the growing vine was trailed on to it. Cassava was defoliated at fortnightly intervals to avoid competition with long pepper. A shade house was erected in the interspaces of two rows of coconut palms standing at row distance 7.5 m and plant to plant distance of 7.5 m. 50 per cent shade net was used to ensure proper shade for the crop. A fertilizer applicator was installed in the system to discharge liquid organic manures, such as vermiwash, panchagavya and jeevamrutha was effected. The experiment was continued for one year.

## RESULTS & DISCUSSION

Spike number per plant and dry spike yield as influenced by precision farming techniques under protected cultivation are furnished in Tables 1 and 2 respectively. Spike number at 7, 8, 9, 10, 11 and 12 MAP per plant was found to be significantly influenced by treatments effects at all stages of growth. At 7 MAP the treatment T1 on par with T5, T11 and T10 recorded the highest spike number and it was 54.16 per cent higher compared to control. At 7 MAP the treatment T1 on par with T5, T11, and T10 recorded the highest spike number which was 37.66 per cent higher compared to control. However, the trend was slightly different at all other stages. The treatment T5 recorded the highest spike number at 8, 9, 10 and 12 MAP where as T6 was found to be superior at 11 MAP. T14 registered the lowest value at all stages of growth. T5 on par with T12 and T2 at 8 MAP registered 59.52 per cent higher spike number compared to control. T5 recorded 6.78 number of spikes at 9 MAP, which was 59.43 per cent higher compared to control. The treatment showed significant superiority when compared to all other treatments. The same treatment T5, again showed significant superiority at 10 MAP but was on par with T4, T3, T7 and recorded 60.05 per cent higher spike number compared to control. T6 on par with T5 and T4 showed significant superiority at 11 MAP compared to all other treatments and increase in spike number was the tune of 68.31 per cent compared to control T14. Similar to treatment effects at 8, 9, 10 MAP, T5 again showed highest spike number at 12 MAP which was on par with T6 and T11 and 65.67per cent higher compared to control. The highest total spike number was recorded by the treatment $T_5$ and it was found to be on par with $T_6$.

**TABLE 1:** Spike number as influenced by precision farming techniques under protected cultivation

| Treatments | 7MAP | 8MAP | 9MAP | 10MAP | 11MAP | 12MAP | Total |
|---|---|---|---|---|---|---|---|
| T1 | 3.00 | 3.50 | 4.99 | 11.05 | 22.90 | 33.85 | 79.29 |
| T2 | 2.05 | 4.00 | 4.61 | 12.15 | 21.05 | 29.00 | 72.86 |
| T3 | 1.80 | 2.50 | 5.25 | 15.40 | 24.00 | 29.65 | 78.60 |
| T4 | 1.75 | 2.12 | 4.83 | 17.50 | 26.30 | 32.10 | 84.60 |
| T5 | 2.75 | 4.625 | 6.77 | 19.65 | 29.85 | 38.75 | 102.40 |
| T6 | 1.75 | 3.45 | 3.68 | 13.31 | 30.30 | 34.50 | 87.00 |
| T7 | 2.00 | 2.50 | 3.89 | 15.05 | 19.95 | 26.95 | 70.34 |
| T8 | 1.37 | 2.75 | 4.17 | 13.05 | 18.05 | 26.15 | 65.55 |
| T9 | 1.87 | 2.87 | 5.20 | 11.69 | 19.00 | 23.70 | 64.35 |
| T10 | 2.50 | 2.87 | 4.78 | 12.51 | 14.65 | 20.55 | 57.87 |
| T11 | 2.62 | 3.30 | 4.12 | 11.73 | 14.25 | 22.25 | 58.35 |
| T12 | 1.87 | 4.37 | 5.12 | 11.65 | 14.15 | 21.00 | 58.17 |
| T13 | 1.62 | 2.60 | 3.62 | 10.70 | 10.31 | 16.80 | 45.66 |
| T14 | 1.87 | 1.87 | 2.75 | 7.85 | 9.60 | 13.30 | 37.25 |
| SE | 0.69 | 0.68 | 1.25 | 4.77 | 5.64 | 7.50 | 14.13 |
| CD | 0.103 | 0.315 | 0.582 | 2.20 | 2.61 | 3.47 | 6.54 |

The percent increase in spike number in treatment $T_5$ was 63.69 per cent over the control, $T_{14}$. Wide variation was observed with respect to spike number per plant at all harvests and the number ranged from 37 to 102. Planting in trenches filled with enriched growth medium + staking + fertigation through drip or microsprinkler system along with growing of a second storey long pepper crop above the ground planted ones in hanging pots with mist irrigation was found beneficial for increasing total spike number from all harvests. Spike yield per plant also showed a similar

trend. The spike number per plant is an important yield attribute governing the final yield. Long pepper requires heavy manuring for its growth and production. The slow growth of plants in control plots resulted in subsequent delay in bearing. Plant productivity is influenced by the metabolic activities which require adequate amount of nutrients and moisture. Growth characters and canopy attributes reveal that long pepper crop responded very well to management practices. Nutrient and moisture supplying power of enriched growth medium along with proper leaf display created suitable habitats for improving plant productivity. Foliar fertilization has been tried as a means of supplying supplement doses of minor and major nutrients, plant hormones, stimulants and other beneficial substances. Observed effects of foliar fertilization include yield increases, resistance to disease and insect pests, improved drought tolerance and plant growth.

**TABLE 2:** Dry spike yield (kg $ha^{-1}$) as influenced by precision farming techniques under protected cultivation

| Treatments | 6 MAP | 8 MAP | 10 MAP | 12 MAP | Total |
|---|---|---|---|---|---|
| T1 | 35.445 | 79.23 | 145.78 | 202.88 | 463.33 |
| T2 | 30.995 | 68.34 | 131.90 | 189.70 | 420.93 |
| T3 | 31.34 | 66.435 | 132.83 | 181.44 | 412.04 |
| T4 | 29.98 | 64.635 | 130.95 | 181.09 | 406.65 |
| T5 | 51.635 | 91.9 | 169.28 | 211.21 | 524.03 |
| T6 | 50.445 | 82.7 | 157.86 | 201.83 | 492.83 |
| T7 | 51.865 | 87.71 | 164.70 | 202.51 | 506.78 |
| T8 | 48.72 | 77.525 | 160.33 | 195.545 | 482.12 |
| T9 | 45.87 | 67.23 | 124.09 | 173.73 | 410.92 |
| T10 | 41.875 | 61.245 | 111.30 | 160.09 | 374.51 |
| T11 | 40.445 | 60.985 | 113.55 | 156.38 | 371.36 |
| T12 | 38.535 | 59.485 | 111.785 | 152.295 | 362.10 |
| T13 | 36.08 | 53.235 | 102.68 | 141.865 | 333.86 |
| T14 | 32.735 | 48.655 | 77.40 | 113.905 | 272.69 |
| SE | 1.79 | 2.94 | 4.55 | 7.39 | 12.70 |
| CD | 3.873 | 6.362 | 9.840 | 15.977 | 27.64 |

Vermiwash application is reported to increase the growth and yield of crops such as marigold, chrysanthemum and tomato (Sebastian, *et al*. 2007). Yield increase might be due to supplementation of organic N, P & K along with micronutrients besides growth promoting effect of both solid and liquid organic manures (Sundaram and Udayakumar, 2002). Protected cultivation and precision farming techniques significantly influenced dry spike yield per plant at all stages of harvest. T7 at 6 MAP and T5 at all other stages of harvest i.e. 8, 10 & 12 MAP showed the highest values. At 6 MAP T7 on par with T5, T6 and T8 registered highest value which was 38.30 per cent higher compared to T14. The trend was slightly different at all the stages of harvest. At 8 MAP, T5 was significantly different from all other treatments and increase in yield was 50.83 per cent over the control. Though $T_5$ showed higher yield at 10 MAP it was on par with T7 and T8 and the percent increase in yield recorded was tune of 56.58 per cent over control. T5 which was on par with T7, T6, T1 and T8 at 12 MAP showed significantly higher yield and the increase was 48.1 per cent compared to control. Protected cultivation enhanced spike number and yield. Similar results have been reported on *Piper longum* plants grown under 50% shade (maximum instantaneous light intensity 850 micromol $m^{-2}s^{-1}$) compared to plants 25-75% shade respectively (Etampawala *et al*., 2002). Staking also enhanced spike number and spike yield per plant. Productivity increase due to staking has been reported in several crops. Okonmah (2011) reported that plant growth, yield and yield components were better under staking in cucumber than no staking and best with five meter raised platform staking method since the number of leaves, flowering, pollination and fruiting were well enhanced due to better display to receive more sunlight. In African yam bean, highest seed yield was observed due to staking compared to nonstaking (Ogah, 2003). The yield increase might probably be due to the advantageous effects of staking which provided support for the numerous branches of the crop. Similar results have been reported by (Adeniyan *et al*. 2007).

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