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SPIKE YIELD AND ALKALOID PRODUCTION IN LONG PEPPER AS INFLUENCED BY PRECISION FARMING TECHNIQUES UNDER PROTECTED CULTIVATION

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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 in the interspaces of coconut garden. 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). The highest dry spike yield of 524 kg per hectare was recorded by the treatment T5 and it was found to be on par with T7. The increase in spike production in T5 was 47.96 per cent higher over the control. The alkaloid content ranged from 5.12 to 6.05 per cent. Total alkaloid production per hectare was found to be significantly influenced by treatment effects and it varied from 15.58 to 29.58 kg ha^{-1}. The highest alkaloid production of 29.5 kg ha^{-1} was recorded by treatment T_5 which was 47.32 per cent higher compared to the control. T_5 was found to be on par with T_7, T_6, T8, and T_1.

KEY WORDS: *Piper longum. L, precision* farming, alkaloid content, dry spike yield.

INTRODUCTION

Long pepper is chosen by progressive farmers for commercial mediculture owing to its ever increasing demand and export potential. It is also amenable for introduction into the existing cropping systems of the humid tropics for augmenting total income on unit area basis. Even though, large quantities of dry spikes of long pepper is required every year for meeting the demand of Ayurvedic industries in Kerala, domestic production is quite insufficient to meet the ever increasing demand. Scope for sole cropping of long pepper is limited in Kerala due to high population density and intensive cultivation. Long pepper grows well under partial shade (25 to 50 %) in irrigated coconut gardens (Jessykutty and Kiran, 2001). Trials conducted to evaluate the performance of selected geographical races of long pepper resulted in the release of the variety, 'Viswam' for intercropping in irrigated coconut gardens (KAU, 2001). Introduction of long pepper in coconut gardens as an intercrop is feasible and remunerative. It helps to augment income from coconut gardens. In order to get optimum yield of spikes, nutrients should be provided in adequate quantities through various sources. Long pepper gardens have to be continuously replenished through periodical application of organic manures, inorganic fertilizers and bio inoculants (Bijily, 2003). The quality of long pepper is decided based on the alkaloid content which in turn is governed by the piperine content. With this background, an experiment was conducted to develop sustainable farming practices to enhance dry spike yield in long pepper without affecting its quality

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 to develop cost effective agro techniques for improving both spike and alkaloid production in long pepper. *Piper longum* L. variety 'Viswam' released from Kerala Agriculture University was used for the study. The experiment was laid out in RBD with 14 treatments replicated twice. 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).

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. Total number of spikes per plant was counted from four random plants and mean worked out. The dry weight of spikes was recorded immediately after every harvest. The spikes were air dried for 1-2 weeks and dry weight recorded. Spike yield was expressed in kg ha^{-1}. The total alkaloid content in the spikes was determined using the Soxhlet extraction method (Harbone, 1973).

$$\text{The alkaloid content (g)} = \text{Weight of soxhlet flask along with residue (g)} - \text{Weight of empty soxhlet flask (g)}$$

$$\text{Total alkaloid content (\%)} = \frac{\text{Weight of residue in grams}}{\text{Weight dried sample used for extraction}} \times 100$$

RESULT AND DISCUSSION

Total dry spike yield and alkaloid production in long pepper as influenced by precision farming techniques under protected cultivation are presented in Table 1. Total dry spike production ranged from 272-524 kg ha^{-1}. The highest dry spike yield of 524 kg per hectare was recorded by the treatment T5 and it was found to be on par with T7.

TABLE 1: Total dry spike yield and alkaloid production in long pepper

Treatments	Total dry spike yield (kg ha^{-1})	Alkaloid %	Total alkaloid % kg/ha
T1	463.33	5.90	27.32
T2	420.93	5.90	24.77
T3	412.04	6.05	24.90
T4	406.65	5.77	23.45
T5	524.03	5.65	29.57
T6	492.83	5.65	27.90
T7	506.78	5.76	29.20
T8	482.12	5.70	27.45
T9	410.92	5.57	22.87
T10	374.51	5.50	20.61
T11	371.36	5.98	22.20
T12	362.10	5.59	20.25
T13	333.86	5.69	19.01
T14	272.69	5.71	15.58
SE	12.70	0.46	1.184
CD	27.69	NS	2.55

The increase in spike production in T5 was 47.96 per cent higher over the control. The highest dry spike yield of 524 kg ha^{-1} was recorded when long pepper was planted in trenches filled with enriched growth medium + staking + fertigation through drip system along with growing of a second storey long pepper crop above the ground planted ones in hanging pots with mist irrigation. Integrated management of long pepper involving enriched growth medium, staking, fertigation with drip system and maintenance of a second storey long pepper crop with mist irrigation under protected cultivation was found favourable for enhancing spike production to the tune of 48 per cent compared to the control.

The alkaloid content ranged from 5.12 to 6.05 per cent. Total alkaloid production per hectare was found to be significantly influenced by treatment effects and it varied

from 15.58 to 29.58 kg ha^{-1}. The highest alkaloid production of 29.5 kg ha^{-1} was recorded by treatment T_5 which was 47.32 percent higher compared to the control. T_5 was found to be on par with T_7, T_6, T8, and T_1. The alkaloid content ranged from 5.1-6.05 per cent. Total alkaloid production per hectare was found to be significantly influenced by treatment effects and it varied from 15.58 to 29.58 kg ha^{-1}. Fertigation enhances crop yield in several respects. It permits application of various nutrients and fertilizer formulations directly at the site of active roots in desired concentration and thus improves the nutrient use efficiency (Asokaraja, 1998). The improved fertilizer application efficiency in drip fertigation was as a result of small and controlled amount of fertilizers applied as per the crop requirement in contrast to large amount of fertilizer placed on the bed at the beginning of the season (Dangler and Locascio, 1990). Mohan and Arumugam (1994) stated that application of 50 per cent recommended dose of N through biwall subsurface irrigation system recorded the highest nitrogen use efficiency. Rajput and Patel (2003) revealed that drip fertigation was superior over broadcasting in terms of enhancing yield attributes and yield. Application of 60 % recommended N through drip fertigation recorded comparable pod yield with that of 80 and100 percent recommended N, which indicates a saving of nitrogen to the tune of 40 per cent. The highest alkaloid production of 29.5 kg ha^{-1} was recorded when integrated management was practiced as above. Higher production of alkaloid was due to higher spike yield per hectare.

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