

## **Effect of planting geometry on yield of capsicum (*Capsicum annum* L.) intercropped with vegetable cowpea (*Vigna unguiculata* L.)**

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### **Abstract**

*Capsicum* (*Capsicum annum*) and vegetable cowpea (*Vigna unguiculata*) are two important vegetable crops grown throughout the year in the Eastern region of Sri Lanka and is a suitable combination for intercropping. Modification of planting pattern of capsicum would make intercropping of cowpea feasible. Therefore, this study was done to determine the effect of planting pattern on the yield of capsicum intercropped with vegetable cowpea. A Randomized Complete Block Design with six treatments was used and size of each plot was 1.7 m x 1.7 m. Sole cropping and intercropping (alternate row planting and paired row planting) of capsicum and vegetable cowpea were evaluated. The results showed that number of pods per plant and pod weight of capsicum per plot were slightly high in sole cropping however yield of capsicum did not significantly differ among the treatments when increased plant population per unit area. The additional yield of vegetable cowpea obtained in intercropping system. Further, Land equivalent ratio of all intercrops was greater than one. It indicated that productivity per unit land area was more in intercropping than monocropping. In the economical point of view, 30/60 cm-paired row planting of capsicum is the best productive and profitable system in the sandy regosol.

**Key words:** *Capsicum*, intercropping, planting geometry, vegetable cowpea

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### **INTRODUCTION**

In Sri Lanka, crop production can be achieved by several ways such as expanding the cropping area, raising the productivity per unit area by intercropping rather than sole cropping, increasing the number of cultivating season per year or selection of superior cultivars.

However, availability of cultivable lands is becoming limited due to the urbanization and other activities of human. In addition, an increase in yield of a single crop beyond a limit is cumbersome in a short period without a crop improvement programme. Therefore, increasing the number of crops grown per year by intercropping is feasible and crop intensification is in both time and space dimensions. Farmers manage more than one crop at a time in the same field. Crops that mature at different times, thereby separating their periods of maximum demand for nutrient, moisture, aerial space and light could be suitably intercropped [1].

Intercropping is prevalent in most areas in Sri Lanka. Choosing of the crop combination plays an important role in intercropping system. Plant density, shading and nutrition competition between plants reduce the yield of sole crop. Cropping systems mostly influence to efficient use of soil nitrogen [2]. In this system, one of the crops would be a legume that has the ability to fix atmospheric nitrogen. Cowpea is thus an integral component of crop and livestock farming systems in the world and it grows in polycultures with cassava, corn, sorghum, millets, peanuts, or soybeans [3]. Cowpea gives good yield under adverse climatic conditions and poor fertility soils. The plant's ability to fix atmospheric nitrogen helps to maintain soil fertility; its deep roots improve soil structure while its tolerance to drought extends adaptation to drier areas considered marginal for most other crops [4]. The annual rainfall determines the crops associated with the cowpea as an intercrop. In higher rainfall regions, cowpea is intercropped with maize, cassava, and yam whereas under irrigation condition it can be intercropped with capsicum. Commonly small farmers prefer the improved intercropping system over sole crops because it provides them sufficient sorghum and cowpea for home use and additional cowpea for cash income [5].

In Sri Lanka, capsicum is cultivated in all parts of the country throughout the year. Cowpea and capsicum are in suitable combination for intercropping because both crops have the outstanding potential for heat-loving, drought-tolerant, shade tolerant and lower soil fertility requirements than many other crops [6]. These characteristics and the presence of nodular bacteria specific to cowpea (*Bradyrhizobium* spp.), make it suitable for cultivation in the hot, marginal cropping areas like Batticaloa district where both crops are successfully cultivated through out the year. To obtain a better yield of the above combination, cowpea can be planted as a companion crop within the capsicum rows or alternative rows due to their exceptional shade tolerance and their deep roots systems [7]. Recently more attention has been devoted to investigate intercropping and its interrelationship to multiple cropping [8]. Therefore, this study was carried out to determine the effect of planting geometry on yield of capsicum intercropped with vegetable cowpea.

## **MATERIALS AND METHODS**

This experiment was conducted at the Agronomy farm, Eastern University of Sri Lanka. It was laid out in a Randomized Complete Block Design with six treatments and four replications. Size of the plot was 1.7 m x 1.7 m. Capsicum variety, CA 8 and vegetable cowpea variety, bushitao were used in this study. The six treatments were as follows:

- T1:** Uniform row of capsicum as a sole crop with the spacing of 40 cm x 40 cm
- T2:** Uniform row of vegetable cowpea with the spacing of 40 cm x 15 cm
- T3:** Alternate row of capsicum and vegetable cowpea (capsicum with the spacing of 60 cm x 40 cm; vegetable cowpea with the spacing of 60 cm x 40 cm between the two rows of capsicum; two seedlings per hill)
- T4:** 30/60 cm paired row planting of capsicum (30 cm space between rows in the pair and 60 cm interspace between two pair of capsicum); one row vegetable cowpea (two seedlings per hill) between two pairs of capsicum.
- T5:** 25/70 cm paired row planting of capsicum; two rows of vegetable cowpea (two seedlings per hill) between two pairs of capsicum (30 cm space between rows of vegetable cowpea).
- T6:** 25/70 cm paired row planting of capsicum; two rows of vegetable cowpea between two pairs of capsicum (30 cm space between rows of vegetable cowpea).

Four weeks old seedlings of capsicum collected from nursery bed were transplanted at the specified spacing as mentioned above. Soon after transplanting, shade was provided until well established. Thereafter, vegetable cowpea seeds were sown at the specified spacing. Seven days after transplanting of capsicum, all gaps were filled with seedlings. Seedlings were irrigated daily initially and then watering was done twice a day. Agronomic practices were done as recommended by Department of Agriculture.

Pods of capsicum were picked separately from each plant and number of fruits was counted. Fresh weight of pods was recorded using an electronic balance. Five pickings were done during the period of 45-80 days after planting. Pods of vegetable cowpea were picked from each plant separately and their fresh weights were recorded. Further, Land Equivalent Ratio (LER) was calculated to assess the efficiency of intercropping system in comparison to monocropping. The data were analyzed using SAS. The means were compared using Duncan's Multiple Range Test at 5% level.

## RESULTS AND DISCUSSION

The subsistence farmers commonly use age-old farming practices such as multiple cropping and intercropping worldwide. In these systems, crops of varying maturity duration have to be chosen so that a rapidly maturing crop completes its life cycle before the major growth period of other crops starts. Stability is achieved by using crops that have a wide range of adaptability and improved management practices. Low plant population is one of the causes for low yields.

### Flowering %

The results showed that number of days to 50% flowering of capsicum or vegetable cowpea was not significant among the treatments (Figure 1 and 2). Days to 50% flowering directly related to the days to maturity. A wide range of duration to maturity exists in capsicum germplasm and is very important to select the correct combination for the adaptation to various plant populations and cropping system. Days to flowering to its direct effect also influenced yield of mungbean pods [9].

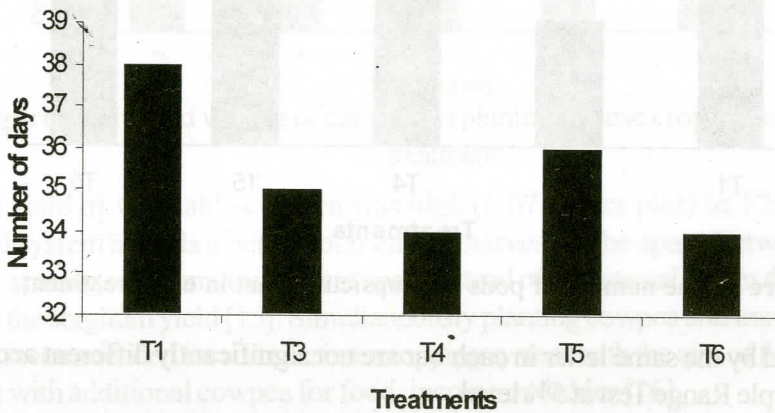


Figure 1: The number of days to 50 % flowering of capsicum in each treatment.

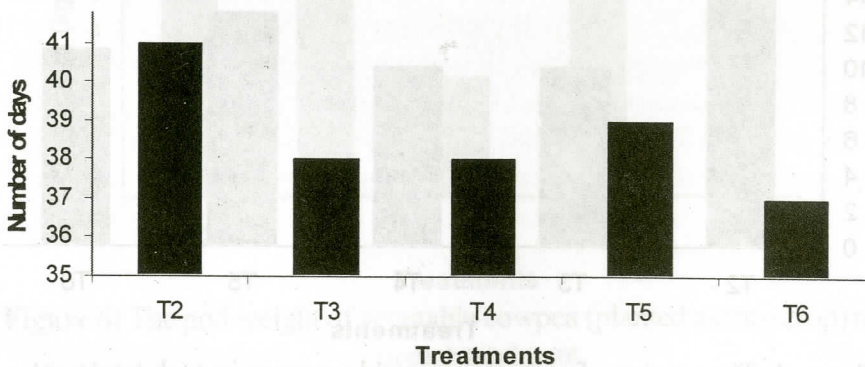
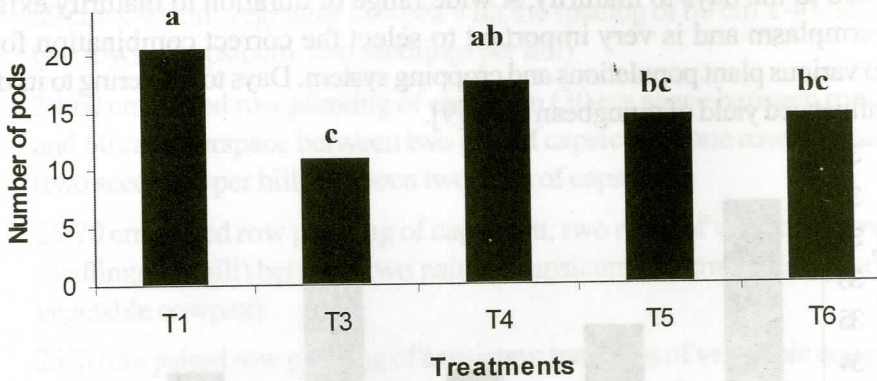


Figure 2: The number of days to 50 % flowering of vegetable cowpea in each treatment.

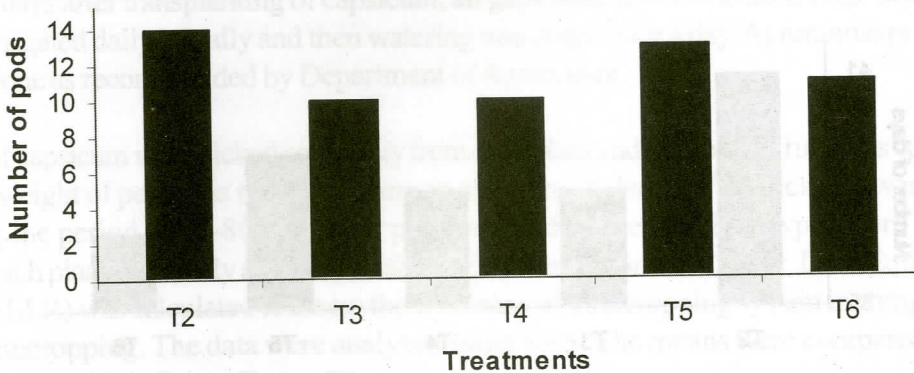
**Number of pods**

The number of pods per capsicum plant significantly varied ( $P < 0.01$ ) among the treatments (Figure 3). The pod number of capsicum in sole crop (T1) was slight high compared to other treatments. This may be due to the competition for nutrition and light, which may reduce the pod number of capsicum in other treatments. The number of pods per capsicum plant ranged from 11.0 - 20.5. In vegetable cowpea, number of pods per plant was from 10 to 14 (Figure 4). Relative yields of crops in most mixtures depend on the crop species or cultivars on stand geometry and most importantly on the relative size of the component populations [10].



**Figure 3:** The number of pods per capsicum plant in each treatment.

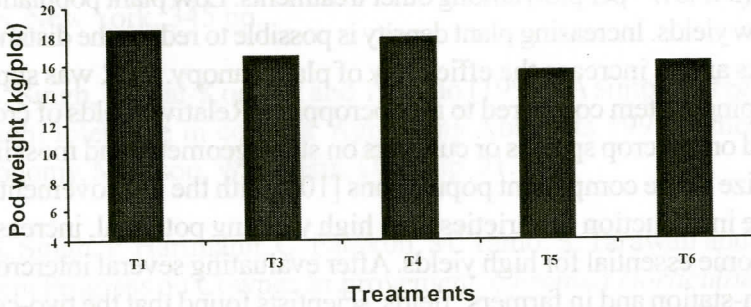
Means followed by the same letter in each bar are not significantly different according to Duncan's Multiple Range Test at 5% level



**Figure 4:** The number of pods per vegetable cowpea in each treatment.

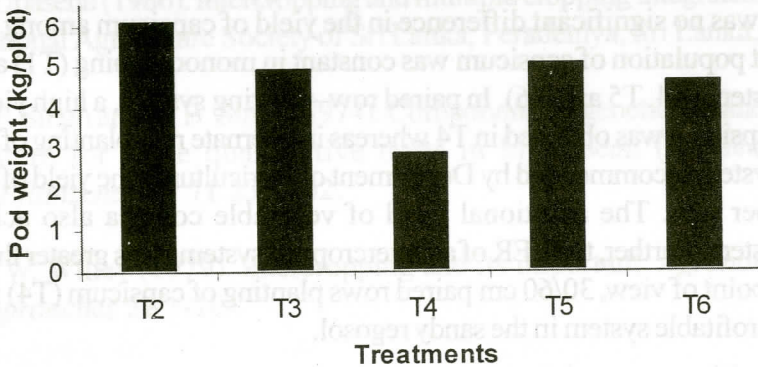
### Pod yield

The results indicated that there was not significant difference in the pod yield of capsicum among the tested treatments. Average pod yield of capsicum ranged from 15.61 to 18.5 kg per plot (Figure 5). The pod yield of capsicum in pure stand showed slight increase compared to other treatments. Considerable variations in planting patterns have relatively little influence on yield per unit area for a wide range of crops [11]. With broad beans at equal number of plant per unit area, row spacing of 17, 34 and 51 cm had no influence on yield per ha [12]. Several experiments conducted all over India showed that paired row planting of sorghum gave similar yield as normal planting [13] and [14].



**Figure 5:** The pod weight of capsicum (planted as base crop) recorded in each treatment.

The pod yield of vegetable cowpea was high (6.07 kg per plot) in T2 (Figure 6). The modified system affords a better solar energy harvest in the space between two pairs of rows. By spacing sorghum rows 90 cm apart instead of the normal 45 cm did not notice any effect on the sorghum yield [15]. Simultaneously planting cowpea and transplanting scarlet eggplant recommended for additive intercropping system with the aim of full yield of scarlet eggplant with additional cowpea for food, income or fodder [16].



**Figure 6:** The pod weight of vegetable cowpea (planted as intercrop) recorded in each treatment.

Crops grown in intercrop combination may be able to make better overall use of resources than when growing separately [17]. The biggest complementary effects and thus biggest yield advantages have been seen to occur when combination crops have different growing periods and therefore make their main demands on resources at different times [18].

### **Cost profit analysis**

An economic cost-profit analysis of capsicum and vegetable cowpea intercropping system showed that profit was high in intercropping system than that monocropping. In the present study, T4 (paired row planting system) recorded low variable cost (59.23/= per plot) and gave high profit (345.37/= per plot) among other treatments. Low plant population is one of the causes for low yields. Increasing plant density is possible to reduce the distance between individual plants and to increase the efficiency of plant canopy. LER was superior in all tested intercropping system compared to monocropping. Relative yields of crops in most mixtures depend on the crop species or cultivars on stand geometry and most importantly on the relative size of the component populations [10]. With the improvement in cultural practices and the introduction in varieties with high yielding potential, increase the plant populations become essential for high yields. After evaluating several intercropping row arrangements on-station and in farmers' fields, scientists found that the two-cereal: four-cowpea intercrop system gave 100% to 300% gross economic superiority over the traditional intercropping systems [5].

### **CONCLUSION**

The present study showed that when increased plant population per unit area (by reducing the interrow spacing between capsicum) yield of capsicum was not changed by closer spacing. The yield of capsicum in T1 was slightly higher (18.5 kg per plot) than other treatments. However, there was no significant difference in the yield of capsicum among the tested treatments. Plant population of capsicum was constant in monocropping (T1) and paired row-planting system (T4, T5 and T6). In paired row-planting system, a high yield (17.92 kg per plot) of capsicum was obtained in T4 whereas in alternate row planting of capsicum (intercropping system recommended by Department of Agriculture), the yield of capsicum was 16.76 kg per plot. The additional yield of vegetable cowpea also achieved in intercropping system. Further, the LER of all intercropped systems was greater than one. In the economical point of view, 30/60 cm paired rows planting of capsicum (T4) is the best productive and profitable system in the sandy regosol.

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