# Effect of Soil Ameliorators on Plant Growth in Capsicum *(Capsicum annum* L.*)* and their Influence on Soil Moisture Retention

R.T.S.N.K. GALKADUWA AND S. J.B. A. JAYASEKERA

*Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka. Makandura, Gonawila (NWP).*

## ABSTRACT

**An experiment was conducted to find out better soil ameliorators to conserve soil moisture in order to reduce irrigation frequency in Capsicum (*Capsicum annum* L.) cultivation. Performance of 4 treatments( 25% sand + 25% soil + 25% coir dust + 25% fytocell by volume, 25% sand + 25% soil + 50% fytocell by volume, 50% soil + 50% coir dust by volume and 25% sand + 25% soil + 50% coir dust by volume) were compared with a control treatment (33.3% sand + 33.3% soil + 33.3% coir dust by volume) along with three irrigation frequencies (daily, once in two days and once in three days). Plant height, number of branches, number of pods per plant, yield per plant (weight), pod length, pod diameter, pod color, final yield per plant, soil moisture at 10 cm depth and root and shoot dry weight were recorded.**

**50% coir dust + 25% sand +25% soil by volume treatment resulted higher moisture retention in the media up to 72 hours after irrigation(18.16% and 13.75%) at 1 month and 2 months after transplanting when compared to control. 25% fytocell +25% sand +25% soil+ 25% coir dust by volume treatment recorded second highest moisture retention in the media up to 72 hours after irrigation at 2 months after transplanting (10.18%). 25% fytocell clearly affected the yield giving higher value (522.8 g/plant) than control (427.7 g/plant).**

**KEYWORDS: Capsicum, Fytocell, Coir dust, Irrigation, Yield.**

## INTRODUCTION

The genus Capsicum is a member of the family solanaceae. There are many cultivars and types differing from each other in shape, color, pungency and position of fruits (Bose.2002).

The cultivated extent of Capsicum in Sri Lanka was 2,808 ha in 2003 with an average production of 4.45 mt/ha (Anon, 2004a). More than 68% of the crop was produced in Badulla, Nuwara Eliya, Kurunegala, Matale and Moneragala districts. The variety Hungarian Yellow Wax (HYW) is one of the popular varieties cultivated by the farmers, and according to the Department of Agriculture (DOA, 2004), the productivity of HYW is around 10-15 t/ha under field conditions.

The demand for growing this variety has increased over the years due to its favorable characters such as attractiveness of the pods, export quality, moderately resistant to diseases like anthracnose, fruit rot and cercospora leaf spot. However, the cost of production is a problem in Capsicum cultivation. Therefore it is required to introduce possible technology to minimize the cost of production.

Drought always stands as a formidable constraint in the dry and intermediate zones of Sri Lanka. This has adversely affected the expansion of capsicum cultivation in the drier parts of the country. The farmers generally irrigate the crop to minimize the drought effect on cultivation. However, daily irrigation contributes to the high cost of production and problem has further aggravated in areas where availability of irrigation water is limited. Further, daily irrigation methods practiced by the farmers result in severe loss of water. Therefore, introduction of new methods to reduce irrigation frequency and to restore soil moisture will affect in reducing the cost of production of capsicum and wastage of irrigation water.

One of such methods is to use soil ameliorators, through which the retention of moisture in the substrate can be improved. Two such ameliorators are fytocell, which is an imported product, and coir dust which is available locally.

Fytocell is a product from an aminoplast resin, (urea melamine formaldehyde) which is mixed with a hardener under a pressure of 5 bars. This results in a light but very stable spongy substrate and water absorption capacity of 60% by volume. Addition of fytocell to the growing media has shown improvements in the quality of roots, number of branches and improvements in the complete plant system (Anon, 2004b).

On the other hand coir dust is a natural, biodegradable by- product from the coir fiber industry. It also has capacity to increase root growth and plant growth when the plants are grown in coir dust medium (Anon, 2004c).

Therefore, the objective of this study is to evaluate the use of two ameliorators, fytocell and coir dust, in Capsicum cultivation to reduce irrigation frequency thus cutting the cost of production and waste.

## MATERIALS AND METHODS

An experiment was conducted to test the effect of two soil ameliorators in Capsicum, at the Faculty of Agriculture and Plantation Management of Wayamba University of Sri Lanka, Makandura, Gonawila situated in the Low Country Intermediate Zone (LCIZ).

It was conducted from December 2004 to May 2005. Three removable barrel shaped rain shelters (12 ft x 5 ft each in size) were constructed using 300 gauge transparent polythene to protect Capsicum from rain and placed in the field 3.5 ft over the Capsicum plants, which were raised in poly bags.

300 gauge black poly bags of 30 x 40 cm were filled with following treatment combinations. A total of 180 bags were used to raise the plants.

| Treatment | Media combination by volume | | | |
|---|---|---|---|---|
| | Sand% | Soil% | Coir dust% | Fytocell% |
| $T_1$(control) | 33.3 | 33.3 | 33.3 | - |
| $T_2$ | 25 | 25 | 25 | 25 |
| $T_3$ | 25 | 25 | - | 50 |
| $T_4$ | - | 50 | 50 | - |
| $T_5$ | 25 | 25 | 50 | - |

Thirty six bags were filled with each treatment and two days prior to transplanting basal dressing recommended by the DOA was applied evenly to all poly bags. Four week old healthy, uniform seedlings of Capsicum, variety HYW, were transplanted (one seedling per bag). Bags were replicated thrice with 12 bags per treatment in each replicate. Bags (60) in each replicate were laid in a split plot design under a rain shelter and maintained a spacing of 30 x 15 cm when placing the bags under the rain shelter.

Three irrigation frequencies were used as follows.

I-1: Daily irrigation.

I-2: Irrigation at two day intervals.

I-3: Irrigation at three day intervals.

12 bags of each treatment under rain shelters were sub divided into three groups having 4 bags each, to supplement three irrigation frequencies. Irrigation schedule (I-1, I-2 and I-3) was started after well establishment of seedlings. At the initial stage (seedling to flowering) 500 ml of water per bag was applied per irrigation and later (flowering to harvesting) the amount of water was increased up to 800 ml per application per bag. Regular pesticide, fungicide and foliar fertilizer applications were done weekly and other crop management practices were carried out as recommended by the DOA.

Following parameters were recorded.

1) Plant height (cm) from first node to the apex of the plant: At one month and two months after transplanting.
2) Number of branches : Primary branches of the main stem were counted at two months after transplanting
3) Root and shoot dry weight (gm): At the end of the experiment plants from each treatment were uprooted and shoot dry weight and root dry weight were measured after drying the plants in an oven at 105 °C for 48 hours.
4) Pod length (cm), diameter (cm) and pod color were measured using randomly picked 5 pods from each treatment using a Verneer caliper. Pod color was measured using Royal Horticultural Society Color Chart(RHS color chart).
5) Number of pods per plant.
6) Pod weight (gm): average weight per pod.
7) Final yield per plant (gm).
8) Soil moisture: Soil samples from the three irrigation treatments were obtained 24, 48 and 72 hours after one cycle of irrigation and just prior to the next irrigation cycle at 10 cm depth. Soil samples were obtained from each treatment into moisture cans at one month and two months after transplanting. Soil moisture was calculated using oven dry method and was expressed as a percentage on dry basis.

The data were statistically analyzed by using Statistical Analytical Software (SAS).

## RESULTS AND DISCUSSION

### *1. Plant Height*

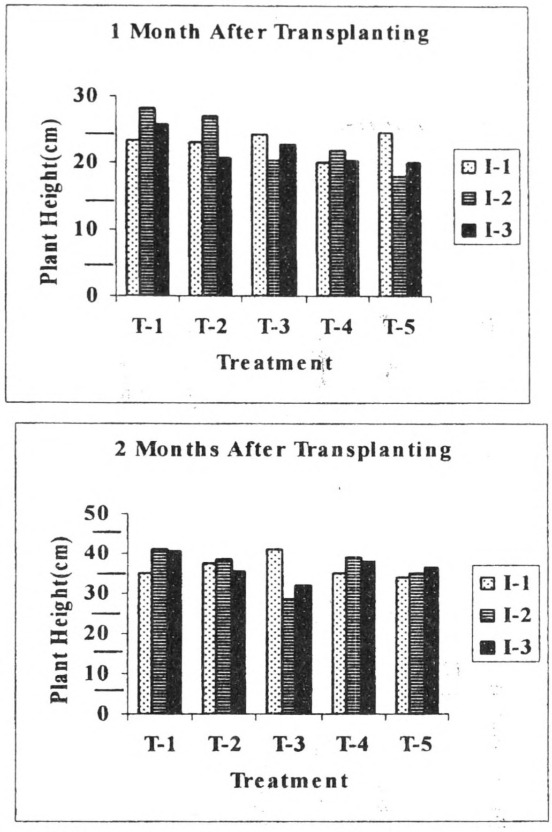



**Figure 1. Effect of ameliorators and irrigation frequencies on plant height in *Capsicum annum* at 1 and 2 months after transplanting**

Plant height recorded from all treatments was not significantly different from each other. Therefore, no significant effect was observed from irrigation frequencies and ameliorators on plant height (Figure 1). However, rate of plant height increment was higher in $T_4$ (35.10 cm, 39.14cm and 38.12 cm) under three irrigation frequencies than control. $T_2$ recorded the second highest plant height increment (37.50 cm and 35.67 cm) under irrigation frequencies in I-1 and I-3.

### *2. Number of Branches.*

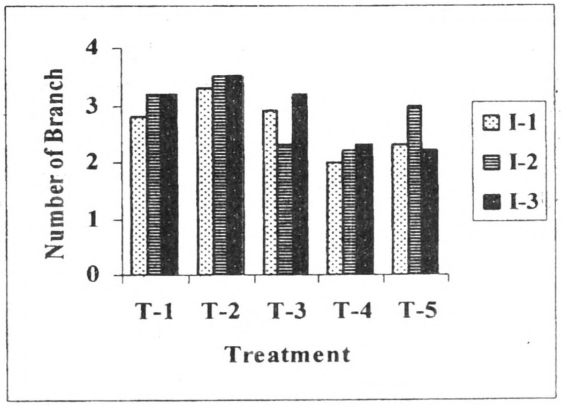



**Figure 2. Effect of ameliorators and irrigation frequencies on number of branches in *Capsicum annum***

Highest number of branches were recorded in $T_2$ (3.33, 3.58 and 3.50) while the lowest number of branches were obtained from $T_4$ (2.00, 2.16 and 2.32) treatment in three irrigation frequencies when compared to control (Figure 2). Therefore, fytocell has ability to improve the number of branches. No significant differences were observed in irrigation frequencies on the number of branches

### *3. Root and Shoot Dry Weight (g)*

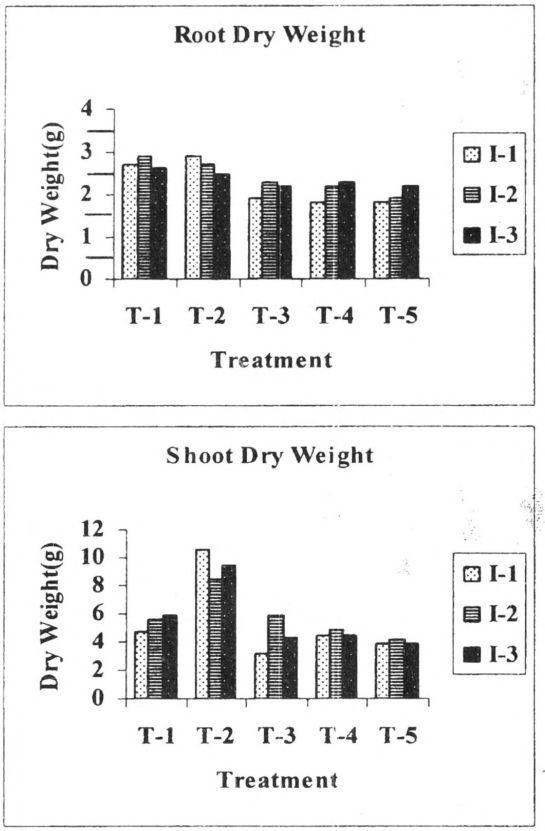



**Figure3. Effect of ameliorators and irrigation frequencies on root and shoot dry weight in** *Capsicum annum*

Root dry weight recorded from all treatments was not significantly different from each other indicating that neither irrigation intervals nor ameliorators have any influence on root dry weight (Figure 3).

$T_2$ treatment recorded the highest shoot dry weight (10.58g, 8.50g and 9.50g) while the lowest was obtained in $T_4$ (4.52g, 4.75g and 4.50g)compared to control under three irrigation frequencies .No significant differences were observed in irrigation frequencies on the shoot dry weight.

Therefore, addition of fytocell to the growing media has shown improvements in the quality of roots and in the complete plant system.

### *4. Pod length and Diameter*

The irrigation intervals and ameliorators have not influenced on neither pod length nor pod diameter (Figure 4). Therefore, pod length and pod diameter recorded from all treatments were not significantly different from each other.

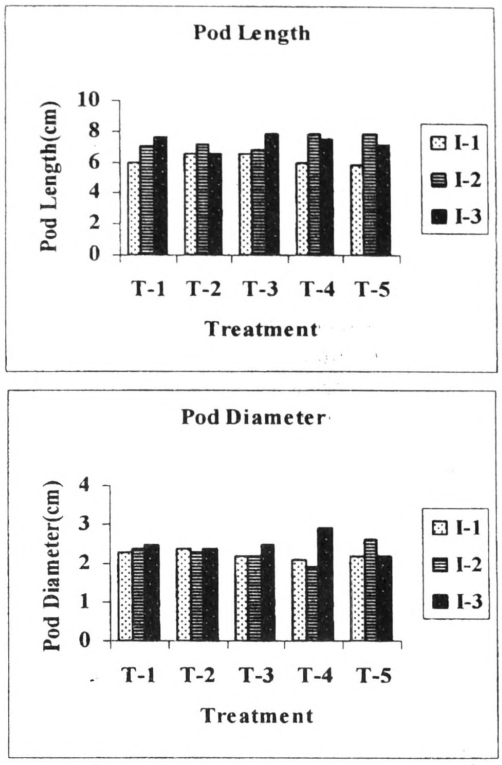
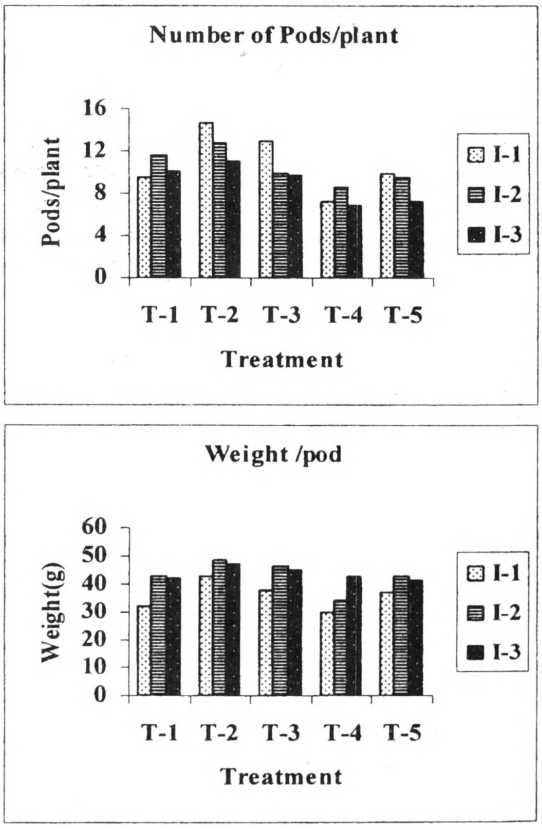



**Figure 4. Effect of ameliorators and irrigation frequencies on pod length and diameter**

### 4:1 *Pod Color*

There was no difference among irrigation frequencies and ameliorators for color. Color belonged to group yellow green 151 B (By using RHS color chart)

### *5. Number of Pods/plant, Pod Weight and Final Yield/plant*



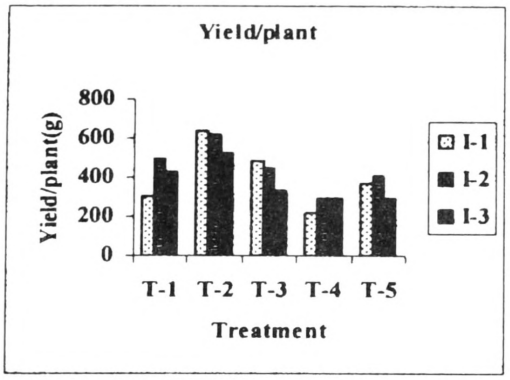


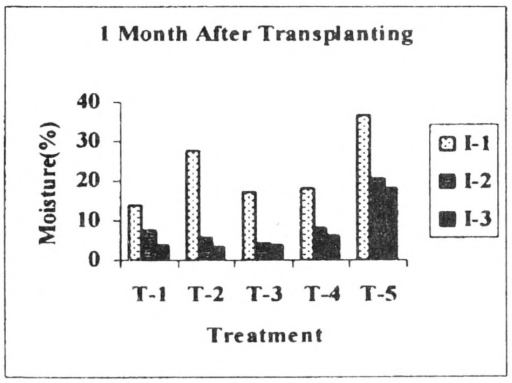

**Figure 5.Effect of ameliorators and irrigation frequencies on number of pods/plant, pod weight and yield/plant**

Highest number of pods/plant was obtained from $T_2$ (14.68, 12.68 and 11.11) treatment and lowest number was recorded in $T_4$ (7.33, 8.65 and 6.90) treatment compared to the control (9.49, 11.66 and 10.16) in three irrigation frequencies. No significant difference was observed among irrigation frequencies for number of pods/plant (Figure 5).

The differences were not significant indicating that neither irrigation intervals nor ameliorators have any influence on pod weight.

Highest yield/plant was obtained from $T_2$ (522.9g) treatment while $T_4$ (294.9g) recorded the lowest yield/plant compared to control (427.7g) in irrigation at 3 day intervals .No significant difference was observed among irrigation frequencies on yield /plant. Therefore, media with 25% fytocell can be recommended with irrigation at three day intervals to obtain high yield and reducing the irrigation frequency.

### 6. *Soil Moisture at 10 cm Depth*



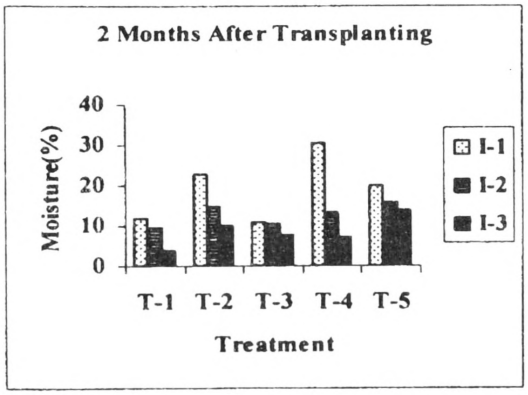




**Figure 6 .Soil moisture percentage at different intervals in 1 and 2 months after transplanting**

Highest soil moisture was recorded in $T_5$ (36.62%, 20.62% and 18.16%) treatment (Figure 6) under 3 irrigation frequencies at early stage of vegetative growth (seedling to flowering). Soil moisture level has reduced with the time in all treatments under irrigation in 2 day intervals and 3 day intervals.

$T_5$ (25% sand +25% soil + 50% coir dust) treatment resulted in higher moisture retention (18.16%) in the media up to 72 hours after irrigation compared to control (3.73%). Similar trend was observed at later stage while second highest moisture retention in the media up to 72 hours after irrigation was observed from $T_2$ treatment (10.18%). Therefore fytocell and coir dust have ability to retain soil moisture up to 72 hours.

## CONCLUSIONS

The use of fytocell as a substrate speeds up the vegetative growth of plants and gives higher yield. Therefore, 25% sand + 25% soil + 25% coir dust + 25% fytocell can be recommended with an irrigation cycle of once in 3 days. The performance of 50% coir dust with 50% soil was poor than 33.3% sand +33.3% soil +33.3% coir dust treatment.

Daily irrigation is not suitable for capsicum cultivation. This may leach out nutrients from the growing medium. Therefore, yellowing of plants, reduction of plant growth and yield per plant may occur.

The results revealed that, media with 50% coir dust and media with 25% fytocell can be used to reduce the irrigation frequency.

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