

# SOILS 2015



## SOIL SCIENCE CONFERENCE OF MALAYSIA

### SOIL SECURITY FOR SUSTAINABLE FOOD PRODUCTION



2015

International  
Year of Soils

**APRIL 7 - 9, 2015**

**THE EVERLY HOTEL, PUTRAJAYA**

Editors

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Christopher Teh Boon Sung  
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Rosazlin Abdullah  
Rosenani Abu Bakar  
Shamsuddin Jusop  
Qurban Ali Panhwar  
Wan Rasidah Kadir

## PROCEEDINGS

Jointly Organized





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**"Soil Security for Sustainable Food Production"**

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**Organized by:**

**Malaysian Society of Soil Science (MSSS)  
Universiti Putra Malaysia (UPM)**

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ISBN

978-967-9945-37-9

Published by:

Malaysian Society of Soil Science

Department of Land Management

Faculty of Agriculture

43400 UPM Serdang

Selangor Darul Ehsan, Malaysia

<http://www.msos.com.my>



# GROWTH, WATER PRODUCTIVITY, AND WATER USE EFFICIENCY OF KANGKUNG (*Ipomoea Reptans*) GROWN UNDER THREE IRRIGATION SYSTEMS

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## INTRODUCTION

The Rb 900 planting tubes and BX-1 media is a new planting system introduced by Humibox Sdn. Bhd. to replace growing plants in polybags filled with soils. The main objective of this study was to compare three water irrigation systems (overhead sprinkler, drip irrigation, and the capillary wick system) and to determine the best water delivery system for the Rb 900 and BX-1 media system. The test crop was kangkung (*Ipomoea reptans*), and the performance of these three irrigation systems was compared with one another in terms of their effect on plant growth, amount of water and nutrient losses via leaching, and the water productivity and water use efficiency of kangkung.

## MATERIALS AND METHODS

The field experiment was carried out under a rain shelter at the Field No. 15, Agrobio Complex, Uni. Putra Malaysia (2° 59' 4.96" N, 101° 44' 0.70"E). Kangkung (*Ipomoea reptans*) was planted in 710 cm<sup>3</sup> Rb 900 tube filled with 180 g of BX-1 media. Each tube was planted with four plants, after which two were removed (leaving two plants) at one week after germination. The field experiment was carried out for five weeks from July to August 2014. The field experimental design was the RCB (Randomized Complete Block), with three treatments with three replicates per treatment. Each experimental plot consisted of a single tray or tube stand (1.5m long, 0.5 m wide and 1 m high) that accommodated ten Rb 900 tubes. The three treatments were the three irrigation systems: water supply by overhead sprinkler (SPR), drip (DRP), and wick system (WCK). Water as much as 45 ml per day was supplied to each Rb 900 tube for the SPR and DRP treatments, whereas the WCK treatment received an average of 53 ml per day per tube. Each week for five weeks, leachate was collected from each tube, pooled, and then analyzed for volume of leachate and N, P, K, Ca, Mg nutrient content. Each week, as well, plant samples for one tube in each experimental unit was destructively measured for their fresh and dry weights (leaves, stem, and roots), leaf area, plant height, and plant nutrient content (N, P, K, Ca, and Mg). The BX-1 media was also analyzed (done only once) for its chemical and physical characteristics. All chemical and physical analyses follow the standard procedure as outlined in Isnar (2015) and Jaafar (2015).

## RESULTS AND DISCUSSION

BX-1 media shows two to three times higher nutrient content than tropical mineral soils in general (Table 1). However, its C:N ratio is nearly 30:1 which could lead to the unavailability of N to the plant despite its high N content in the media. The BX-1 media also has rather high EC (nearly 1 dS m<sup>-1</sup>). The BX-1 media has a very low bulk density (0.106 Mg m<sup>-3</sup>) which makes it very light and easy to handle in particular when filling in the media into pots, polybags, or the Rb 900 tubes. Nearly 60% of the media is water and its water retention shows saturation at 60% volumetric water content, field capacity at 27% and permanent wilting point at 23%. The available water content of this media is only 3%.



Table 1: Chemical and physical characteristics of the BX-1 media

Physical property	Value	Chemical property	Value
Bulk density ( $\text{Mg m}^{-3}$ )	0.106	pH	5.54
Moisture content ( $\text{g g}^{-1}$ )	0.582	EC ( $\text{dS m}^{-1}$ )	0.90
Saturation ( $\text{m}^3 \text{m}^{-3}$ )	0.59	CEC ( $\text{cmol}_+ \text{kg}^{-1}$ )	15.5
Field capacity ( $\text{m}^3 \text{m}^{-3}$ )	0.27	C (%)	41.48
Permanent wilting point ( $\text{m}^3 \text{m}^{-3}$ )	0.23	N (%)	1.41
		C:N	29.42
		P (%)	0.32
		K (%)	0.66
		Ca (%)	1.02
		Mg (%)	0.35

Analysis of variance (ANOVA) showed that Treatment x Week interaction was significant at 5% level for only the total plant weight, roots dry weight, and leaf area. The Treatment main effect was not significant at 5% level for the other plant parameters. Fig. 1 showed that WCK treatment gave the highest total plant dry weight. This is due to the highest roots dry weight in the WCK treatment. Both WCK and DRP treatments gave similar effect on leaf area. The lowest leaf area was in the SPR treatment. The better growth in the WCK treatment was due to the highest plant nutrient content of N, P, and K in the WCK treatment (Fig. 2). WCK treatment also had the lowest amount of leachate; thus, the lowest loss of all measured nutrients (Fig. 3). WCK consumed the most amount of water which also why it produced the highest growth. Nonetheless, there was no difference in water productivity (amount of biomass produced per unit water consumed) between the three treatments (Fig. 4). However, the water use efficiency (amount of water used per unit water applied) for the WCK was the highest. There was a huge amount of water loss in the SPR treatment, where water wastage was a startling 98%.

### CONCLUSIONS

Wick (WCK) system gave the highest growth for roots dry weight and leaf area. This was because the WCK treatment had the lowest amount of leachate and nutrient losses, so it had the highest nutrient content in the plant for N, P, and K. WCK also had the highest water use efficiency, but there was no difference in water productivity between the three treatments. WCK consumed the highest amount of water (but had least water wastage) to produce the highest amount of roots biomass and leaf area compared to DRP and SPR treatments.

### REFERENCES

- Isnar, M.S. 2015. Growth rate and yield of water spinach (*Ipomoea reptans*) under three irrigation systems. Bac. of Agric. Sc. Final year report. Uni. Putra Malaysia, Serdang.
- Jaafar, A.H. 2015. Water spinach (*Ipomoea reptans*) nutrient leaching and water loss in three irrigation systems. Bac. of Agric. Sc. Final year report. Uni. Putra Malaysia, Serdang.

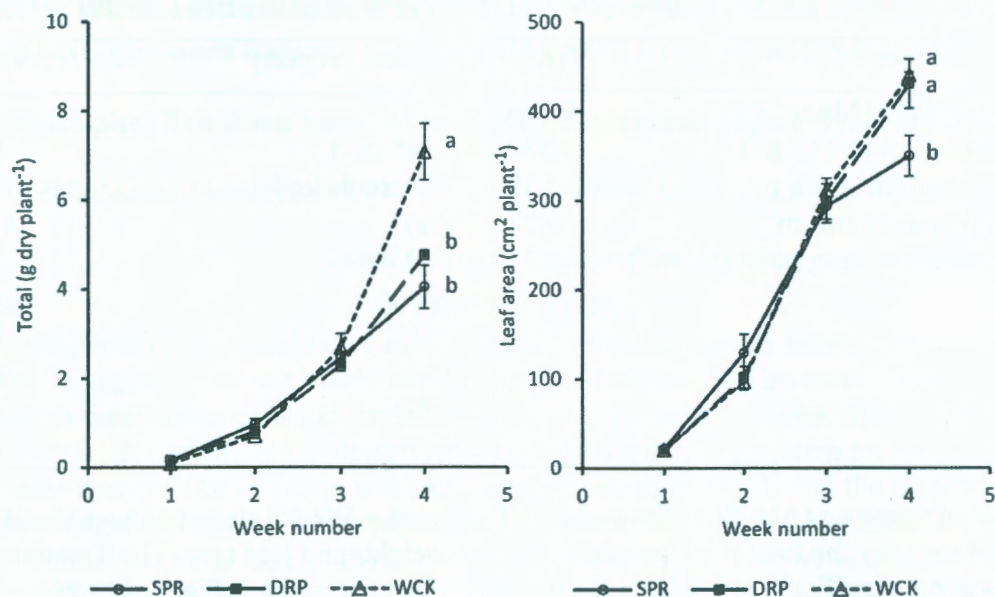


Figure 1: Wick system gave the highest total plant biomass and leaf area. Note: SPR is the overhead sprinkler, DRP the drip irrigation, and WCK the wick system.

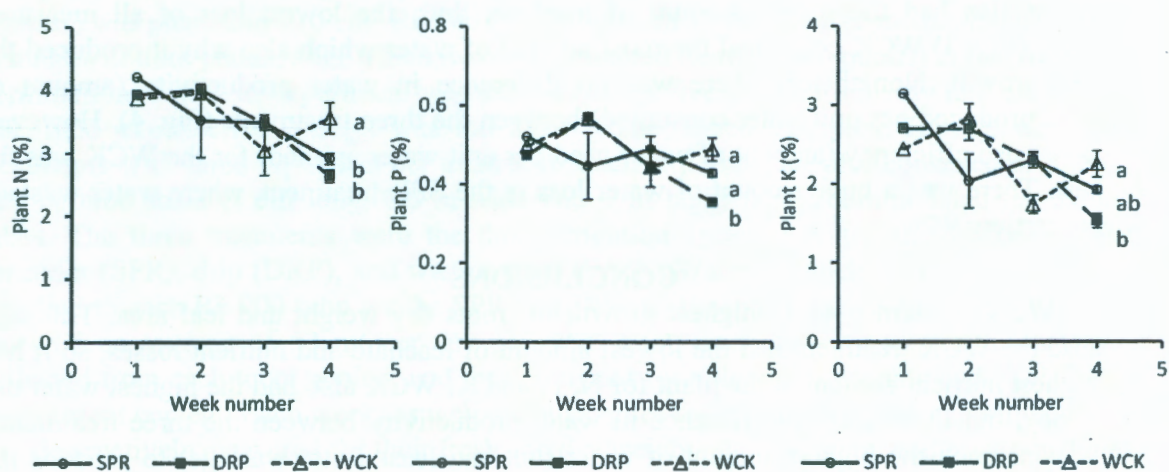


Figure 2: Wick system also had the highest plant content for N, P, and K nutrients. Note: SPR is the overhead sprinkler, DRP the drip irrigation, and WCK the wick system.



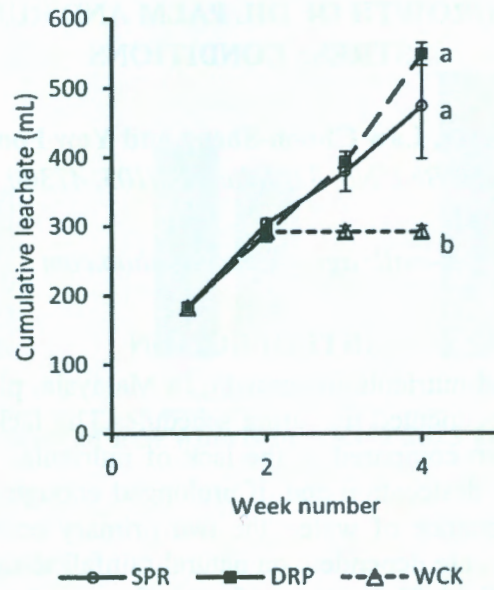


Figure 3: Wick system had the lowest amount of leachate. So, the lowest nutrient losses as well. Note: SPR is the overhead sprinkler, DRP the drip irrigation, and WCK the wick system.

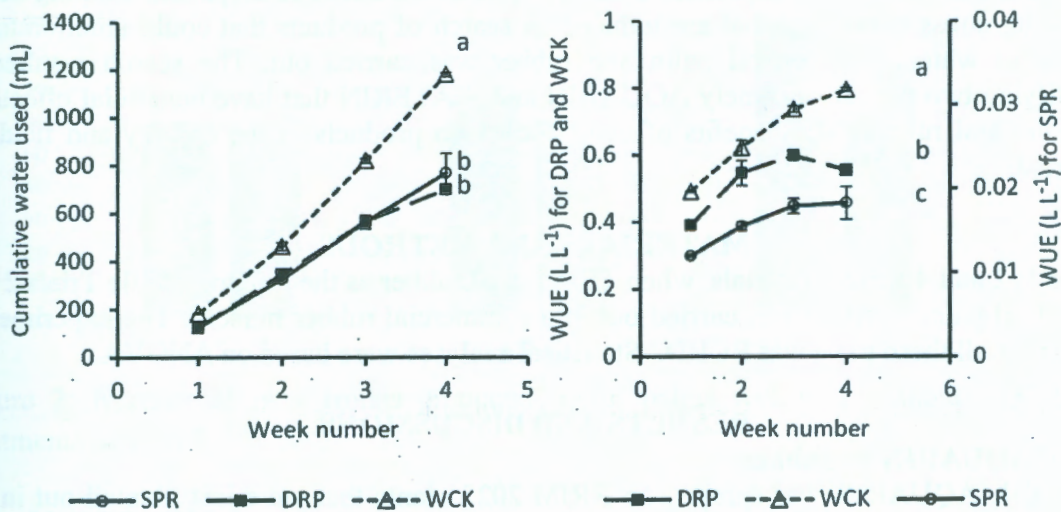


Figure 4: Wick system consumed the highest amount of water to produce the highest amount of root biomass and leaf area. Wick system also had the highest water use efficiency (WUE). Note: SPR is the overhead sprinkler, DRP the drip irrigation, and WCK the wick system.