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# Growth and yield of vegetable cowpea (*Vigna unguiculata*. L) in bucket lysimeters for crop coefficient determination

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## Introduction

- Climate variability resulting in unreliable rainfall has forced a shift to irrigated farming causing a strain on natural water resources in Kenya
- Irrigation is often based on farmer experience rather than crop water requirements, more often leading to over-irrigation.
- Recent increase in water tariffs have made water even more inaccessible for farming.
- Locally validated stage-specific (Figure 1) crop coefficient values are required to ensure precise scheduling of irrigation based on crop stage water requirements.
- Simple low-cost bucket lysimeters offers opportunity for determination of crop coefficients.
- This study assessed the suitability of bucket lysimeters for determination of crop coefficients by assessing the growth and yield of vegetable cowpea.

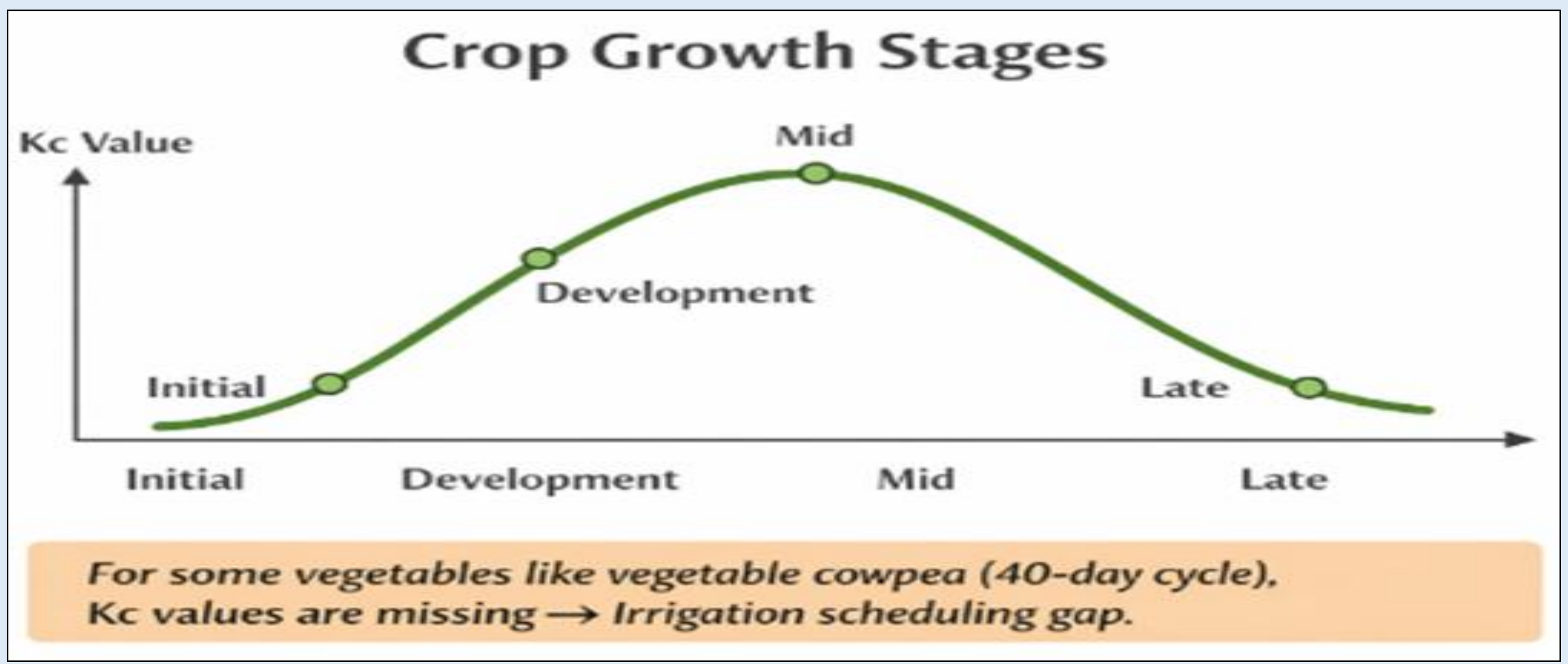
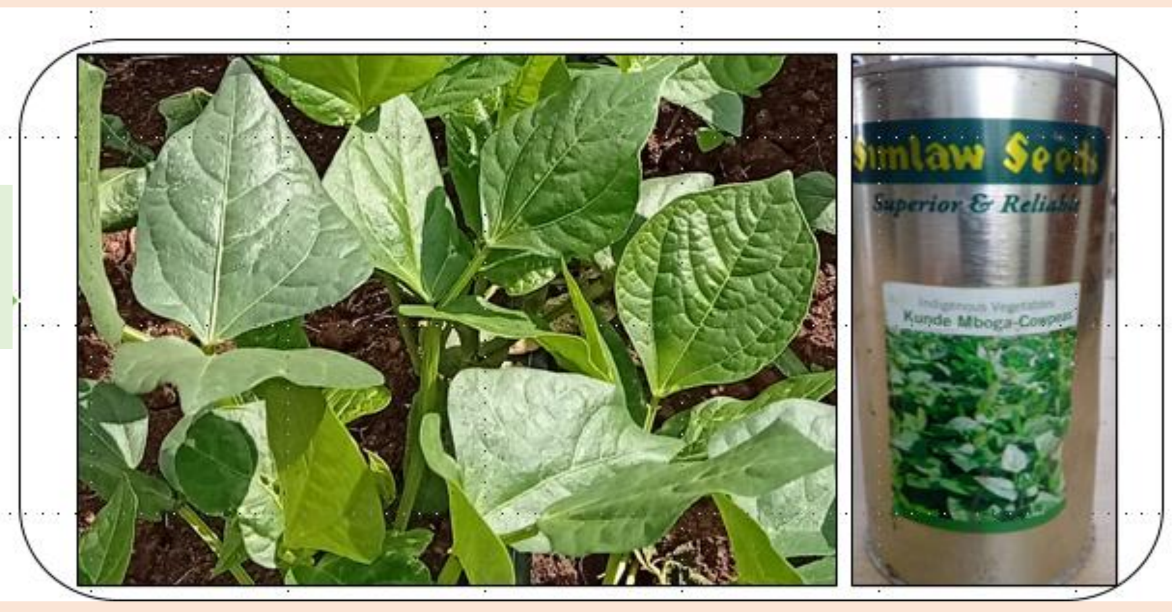



**Figure 1:** Generalized crop growth stages with corresponding crop coefficients for precise irrigation scheduling.

## Materials and Methods

- Vegetable cowpea seeds (Simlaw, Kenya) were used for the field trial carried out from 7 November 2025 to 18 December 2025.
- A simplified lysimeter was made using two buckets (Figure 3).
- Lysimeters were installed flush with the soil surface and surrounded with rows of plants to allow normal crop growth.

**Figure 2:** Vegetable cowpea crop (left) in field and the tin package (right) of certified seeds from Simlaw Seeds Company.



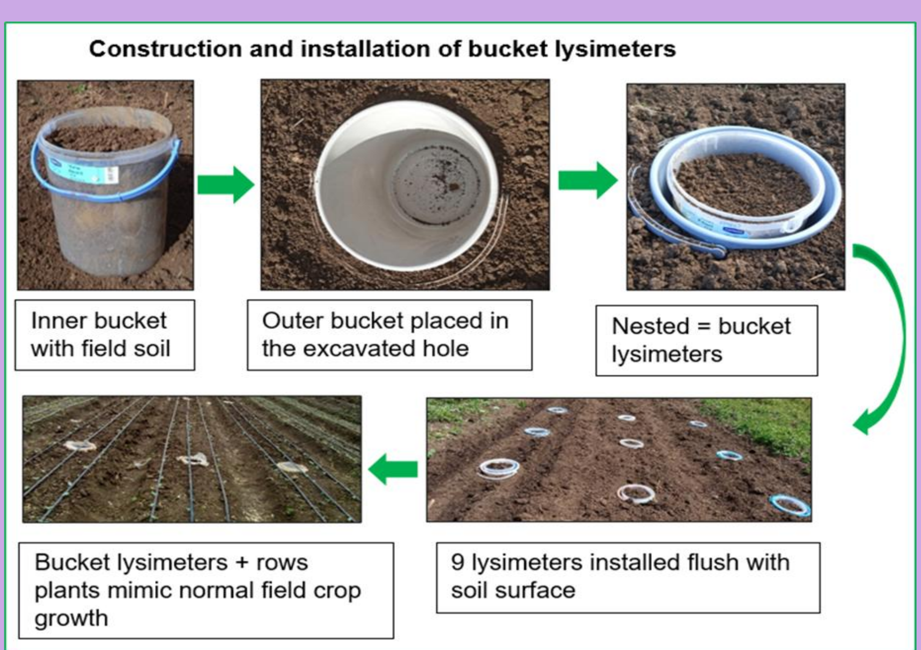




**Figure 3:** Excavation, filling and nesting of buckets (upper three pictures) and installation of lysimeters flush with soil surface and planting of vegetable cowpea (lower two pictures) in the field.

- Plants in lysimeters and surrounding were allowed to grow optimally.
- A comparison between plants growing within the lysimeter and those outside was done using the growth and yield parameters (Table 1).
- Computations were done to determine the effect of the lysimeter on cowpea plant growth and yield.

**Table 1:** Growth and yield parameters, measurement methods, frequency and equipment

| Parameter | Measurement description | Frequency | Equipment |
|---|---|---|---|
| Plant height (cm) | Measured from ground surface to tip of terminal node | Weekly | Calibrated measuring tape |
| Number of leaves | Count manually per sampled plant | Weekly | None |
| Number of Branches | Count manually per sampled plant | Weekly | None |
| Total fresh weight (g) | Above ground biomass immediately after harvesting | at harvest | Digital weighing balance |
| Total dry weight (g) | Above ground biomass after drying at 73°C for 3 days | after drying | Oven, Digital weighing balance |

## Results

- The crop canopy cover expanded across the different crop growth stages (Figure 4).
- There was no significant difference observed in the growth and yield between lysimeter and non-lysimeter plants (Table 2).
- Bucket lysimeters showed no adverse effects on crop growth and yield

Initial (14 days) Development (21 days) Mid (35 days) Late (49 days)

**Figure 4:** Vegetable cowpea at various stages of growth.

**Table 2:** Growth and yield of cowpea for non-lysimeter and lysimeter plants

| Parameter | Non-lysimeter plants | Lysimeter plants | p |
|---|---|---|---|
| Relative change in height | 3.62 a | 3.62 a | 0.987 |
| Relative change in leaves | 0.907 a | 0.907 a | 0.653 |
| Relative change in branches | 9.75 a | 9.148 a | 0.118 |
| Fresh weight (g) | 60 a | 40 a | 0.069 |
| Dry weight (g) | 8 a | 6 a | 0.191 |

*Means followed by the same letter within a row are not significantly different*

## Conclusion

- Growth and yield of vegetable cowpea is not affected by simple bucket lysimeters
- The simple bucket lysimeter can be utilized for crop coefficients determination of vegetable cowpea in order to improve irrigation scheduling
- The work will contribute to enhancement of food and nutrition security and climate resilience.

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