
Performance evaluation of sweet potato (*Ipomoea batatas* L. LAM) in different irrigation regimes using a drip irrigation system

Batoon, G. A., Bartolome, C. A.* , Panlasigui, P. D. and Salvador, M. G.

Campus Research and Development Office, Isabela State University, Echague, Isabela, Philippines.

Batoon, G. A., Bartolome, C. A., Panlasigui, P. D. and Salvador, M. G. (2026). Performance evaluation of sweet potato (*Ipomoea batatas* L. LAM) in different irrigation regimes using a drip irrigation system. International Journal of Agricultural Technology 22(5):2049-2060.

Abstract Results revealed that agronomic characteristics of sweet potatoes, such as length of vine and number of leaves, obtained a significant result at 2 months after treatment (2 MAT), 3 MAT and 4 MAT. Sweet potatoes under rainfed conditions, Treatment 1 (T₁), managed to yield a considerable number of tubers (21,428.57 kg/ha) but the treatments with irrigation, T₂ (75% of evaporation), T₃ (100% of evaporation) and T₄ (125% of evaporation) produced significantly higher yield (39,523.81kg/ha, 40,952.38 kg/ha and 41,428.57 kg/ha, respectively). However, irrigation regimes at different stages mostly did not significantly affect other parameters, such as the diameter of leaves and the number of branches. A comparison of the means for yield under treatments with irrigation obtained a comparable result. Hence, T₂ (75% of evaporation) is recommended as the basis for weekly irrigation. T₂ obtained the highest water productivity of 8.73 kg/cu-m (irrigation and rainfall). There was a more or less 100% increase in yield if supplementary irrigation was provided. The study suggested that supplementary irrigation using drip irrigation could improve the present sweet potato farming situation in Isabela, considering its potential to sustain farming during dry seasons and drought.

Keywords: Agronomic, Drought, Growth, Water productivity, Yield

Introduction

Sweet potato, scientifically known as *Ipomoea batatas*, is a vital root and tuber crop cultivated extensively in tropical and warm temperate climates. Locally referred to as “*camote*” in the Philippines, this crop is a staple in many households and plays a significant role in the agricultural economy.

In the Philippines, sweet potato is one of the most widely grown crops, and its cultivation is favoured for several reasons. One of the primary advantages of sweet potatoes is their ability to be planted throughout the year, providing farmers with the flexibility to cultivate in various seasons. This perennial availability is crucial in ensuring a steady food supply, especially in rural areas

* **Corresponding Author:** Bartolome, C. A.; **Email:** cathy06.bartolome@gmail.com

where other crops may have more stringent growing conditions. Moreover, sweet potato has lower requirements for fertilizers and agricultural inputs than many other crops. This characteristic reduces production costs for farmers and makes it an attractive option for smallholder farmers who may not have access to modern agricultural technology or substantial financial resources. Due to these factors, sweet potato is often categorized as a food security crop. Its ease of production and high nutritional content, rich in vitamins, minerals, and dietary fiber, contributes to its reputation as a staple food source.

Sweet potatoes have a variety of applications, further solidifying their importance in agriculture and the economy. Besides being consumed directly as food, they are used as raw materials for the commercial production of animal feeds. This aspect is particularly relevant in regions where livestock farming is prevalent, as sweet potatoes can provide an affordable source of nutrition for animals. In addition to animal feed, sweet potatoes serve as a crucial ingredient in the manufacturing of industrial goods such as flour and starch. The versatility of sweet potatoes allows them to be processed into numerous food products, including snacks, desserts, and even beverages. These processed goods often hold greater economic value than fresh roots, thereby enhancing the income potential for farmers and producers. Sweet potatoes are typically propagated through vegetative means, either by using sprouts that arise from the roots, known as slips, or by cuttings of the vine. This method of propagation is advantageous because it ensures that the new plants retain the desirable traits of the parent plant, including flavor, texture, and nutritional quality. The crop is adaptable to a variety of soil types; however, it thrives best in moderately fertile, well-drained, and deep soils with a medium texture. The ideal pH range for sweet potatoes is between 4.5 and 7.0, which allows for optimal nutrient availability and uptake (Abidin *et al.*, 2017). Sweet potatoes require a warm growing season of at least four to five months to achieve large yields. Although they are considered mildly drought-tolerant, prolonged periods of drought can severely impact their growth and yield. Drought conditions can lead to soil moisture stress, which is one of the critical factors limiting the production of sweet potatoes.

Despite their drought tolerance, sweet potatoes can suffer significantly during extended dry spells, especially during the establishment phase of the crop. The economic return from sweet potato farming is adversely affected by soil moisture stress, which impacts storage root production and yield (Gajanayake *et al.*, 2013). The research investigation reported that evapotranspiration during drought periods can exceed the available soil water supply, leading to further stress on the plants. Consequently, the quality of sweet potatoes declines under low humidity conditions, which poses challenges for farmers aiming to maintain

both yield and marketability. The demand for sweet potatoes has surged in recent years, driven by their numerous applications and the increasing global population. However, this rising demand has not been met adequately due to low farm productivity and recurrent challenges faced by farmers (Department of Agriculture-Regional Field Office 02, 2012). In 2023, the country produced approximately 523,290 metric tons of sweet potatoes, indicating a decrease in production compared to the previous year (Philippine Statistics Authority, 2024). This decline highlights the issues related to irrigation and water management in sweet potato cultivation. Effective irrigation scheduling and the appropriate amount of water application are critical for ensuring optimal sweet potato production (Felix *et al.*, 2015). The ideal rainfall for sweet potatoes is between 750 and 1500 mm, distributed evenly throughout the growing season (Lebot, 2009). However, the crop is found to be tolerant to waterlogging, which can lead to tuber rot and hinder the growth of storage roots due to poor aeration (Makini *et al.*, 2018).

The study aimed to assess the performance of sweet potatoes under different irrigation regimes and to determine the water productivity.

Materials and methods

The study was conducted at the research and development experimental area of Isabela State University, Echague, Isabela, from March to July 7, 2024. Sweet potato cuttings were taken from a reliable source. Land preparation involved ploughing or rotovating, followed by harrowing and levelling dry and friable soil. The study was laid out in a Randomized Complete Block Design (RCBD) with three replications. The area was divided into three equal plots, consisting of 12 rows that were 8.0 m long and 0.5 m apart. Planting was done manually by planting the cuttings with a spacing of 28 cm and a depth of 10 cm, based on the recommended planting depth.

The treatments were based on the different irrigation regimes as follows: T_1 = No irrigation (*depends on the occurrence of rainfall*) T_2 = 75% pan evaporation; T_3 = 100% pan evaporation and T_4 = 125% pan evaporation.

When heavy rainfall provided adequate moisture to plants during the day, there was no need to irrigate. However, if management-allowable depletion reached 60%, drip irrigation was provided according to the different irrigation treatments.

Before the application of treatments, daily irrigation was done for up to 14 days after planting until the root system of the sweet potato was fully developed. When the treatments were imposed, irrigation was based on 75%, 100%, and 125% evaporation.

Inorganic fertilizer was applied through the dibble method. The recommended fertilizer application was based on the package of technology for sweet potatoes. Each plant was mounted with one compensated dripper, with 5 li/hr discharge per dripper. A solar-powered water system with a 2 hp submersible pump and 1,000-liter tank capacity was used.

Periodic monitoring of the growth of plants was done during the entire duration to observe any indication or occurrence of pests and diseases.

Various data were collected and computed, which include the following:

Climatic data were collected from the PAGASA Station.

Soil bulk density (BD) determination was done per replication. Soil samples were taken by pressing a core sampler into the pot at a depth of 15 cm and were oven-dried for 24 hours at a temperature of 105-110°C. The computation was done using the formula,

$$BD = \frac{W_s}{V_t}$$

where: BD = bulk density of the soil, gram/cc; Ws = dry weight of the soil sample, gram; Vt = total volume of the soil sample, which is equal to the volume of the core sampler, cc

Soil moisture was determined using a digital moisture meter. It was taken from the plots at a depth of 0 – 20 cm and done as needed.

The field capacity of the soil samples was obtained using core samplers and was gathered 2-3 days after heavy rainfall. The soil samples were oven-dried for at least 24 hours at temperatures ranging from 105°C to 110°C. The field capacity was computed using the formula,

$$FC = \frac{FW - ODW}{ODW} \times 100$$

where: FC = Field capacity; FW = Fresh weight of the soil sample, gram; ODW = Dry weight of the soil sample, gram

In the absence of tools, the permanent wilting point (PWP) of the soil was determined using the formula,

$$PWP = \frac{FC}{2-2.4}$$

In this study, the formula used was $PWP = FC / 2.2$

The available moisture was computed using the formula,

$$AM = FC - PWP$$

where: AM = Available moisture

The management allowable deficit (MAD) for sweet potato is 50% to 70% of available moisture (Villordon and Smith, 2023). In this study, MAD is computed using 60% of AM with the formula, $MAD = 60\% \text{ of } AM$.

Irrigation frequency refers to the number of days between irrigations during periods without rainfall. Irrigation was imposed every seven days.

The agronomic characteristics of sweet potato, such as vine length, diameter of leaves, number of branches, number of leaves and yield, were gathered, recorded, tabulated, and analysed using a Randomized Complete Block Design (RCBD).

Water productivity (WP) was calculated as tuber yield divided by the total water input from rainfall (R) plus irrigation (i),

$$\text{WP, kg yield/cu-m water} = \frac{\text{Tuber yield}}{\text{Water input (R+i)}}$$

Results

General stand and vigor of the plant

There were no apparent differences in the growth and vigor of the different treatments during the vegetative stage (1-25 days) because the residual moisture was able to sustain the growth and development of the plants. However, T₁ (left to the natural supply of rainfall) showed signs of temporary wilting during the middle month of April due to the non-occurrence of rainfall and high temperatures ranging from 37°C – 40°C but was able to recover due to heavy rainfall occurring in the last week of the said month. The rest of the treatments with irrigation were able to withstand the high temperature.

Climatological data

The daily weather from the ISU-PAGASA agrometeorological station during the conduct of the study, which included the minimum temperature, maximum temperature, rainfall, and evaporation are shown in Figure 1. The highest maximum temperature recorded during the conduct of the study was 40°C in April, which is considered the hottest month, and the minimum temperature was 19.2°C. Seldom occurrence of rainfall was recorded in March and April, and frequent rainfall was recorded in May and June. However, during the last week of April, the highest rainfall of 63.9 mm was recorded. The average evaporation for March, April, May, and June was 4.3mm, 6.8mm, 5.4mm, and 5.0mm, respectively.

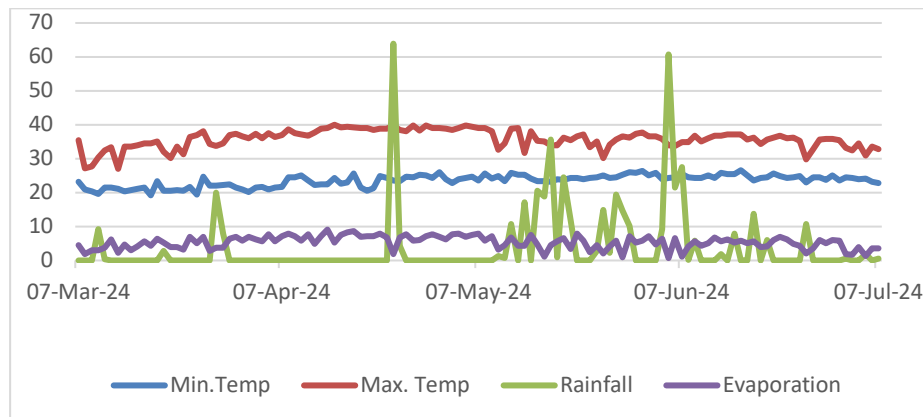


Figure 1. Daily weather data gathered from ISU-PAGASA

Soil characteristics of the experimental area

The computed physical properties of the soil were FC = 22.01%; BD = 1.53%; AM = 11.99%; MAD = 7.19%; PWP = 10%; and Apparent Specific Gravity = 1.53.

The chemical properties of the soil are shown in Table 1. Based on the soil analysis results, the soil in the experimental area was slightly acidic, with medium organic matter (OM) content, moderately high phosphorus, and very high potassium.

Table 1. Soil chemical properties of the soil in the experimental area

Soil sample	pH	Organic Matter (OM), %	Available Phosphorus (P), ppm	Exchangeable Potassium (K), ppm
ISU	5.91	2.87	13.80	91.51

Water productivity

T₂ was the highest water productivity with 8.73 kg/cu-m, and followed by T₃, T₄, and T₁ with 8.24 kg/cu-m, 7.65 kg/cu-m, and 6.71 kg/cu-m, respectively.

Vine length

The average vine length (cm) per treatment at different ages is shown in Table 2. A non-significant difference was obtained between treatments at age 1 MAT. This could be accounted for by the initial moisture content of the soil,

which was quite adequate to satisfy the crop water requirement of the different treatments, particularly during the vegetative stage, which consequently resulted in a uniform length of the vine. However, significant differences were observed at ages 2 MAT, 3 MAT, and 4 MAT. The comparison of means showed that T₁ was significantly different from T₂, T₃, and T₄, while T₂, T₃, and T₄ were not significantly differed.

Table 2. Vine Length (cm) of sweet potato at different ages for various treatments

Treatment	Month(s) after Transplanting (MAT)			
	1	2	3	4
T ₁ (control)	67.33	76.43 ^b	81.32 ^b	89.00 ^b
T ₂ (75% pan evaporation)	70.37	95.53 ^a	98.98 ^a	107.70 ^a
T ₃ (100% pan evaporation)	78.93	98.20 ^a	102.13 ^a	105.50 ^a
T ₄ (125% pan evaporation)	80.87	99.80 ^a	109.41 ^a	116.27 ^a
Probability Value	0.12 ^{ns}	0.002 ^{**}	0.03 [*]	0.032 [*]
CV%	8.87	9.08	8.46	1.06

^{ns} not significant at 5% level; ^{*}significant at 5% level; ^{**}significant at 1% level

Diameter of leaves

Samples of leaves from each replicate per treatment were measured using the caliper. The average diameter of leaves as influenced by the different irrigation regimes is shown in Table 3. Except at 2 MAT, the diameter of the leaves was not significantly affected by the various treatments. At 1 MAT, the findings aligned with the observation that irrigation was an insignificant effect on the length of the vine. The residual moisture content in each plot was enough to sustain the uniform vegetative development of the plants. Moreover, the same result was obtained at 3 MAT and 4 MAT. This could be due to the frequent rainfall recorded in the last 2 months of the study, which caused comparable results in the development of the plants.

Number of branches

The branches of each plant from the three replicates per treatment were counted. There was no difference in the number of branches per treatment at ages 1 MAT, 2 MAT, 3 MAT, and 4 MAT, as shown in Table 4. It indicated that the different irrigation regimes did not significantly affect the number of branches.

Table 3. Diameter of Leaves (cm.) at different ages for various treatments

Treatment	Month(s) after Transplanting (MAT)			
	1	2	3	4
T ₁ (control)	6.33	6.43 ^b	7.84	8.16
T ₂ (75% pan evaporation)	7.06	7.57 ^a	7.87	7.99
T ₃ (100% pan evaporation)	7.09	7.49 ^a	7.92	8.14
T ₄ (125% pan evaporation)	6.89	7.55 ^a	7.99	8.13
Probability Value	0.17 ^{ns}	0.002 ^{**}	0.63 ^{ns}	0.15 ^{ns}
CV%	5.79	3.04	1.79	1.06

^{ns} not significant at 5% level; ^{**}significant at 1% level; Means with the same letter are not significantly different

Table 4. Number of Branches at different ages for various treatments

Treatment	Month(s) after Transplanting (MAT)			
	1	2	3	4
T ₁ (control)	3.47	4.43	5.33	7.67
T ₂ (75% pan evaporation)	3.40	5.60	5.93	8.27
T ₃ (100% pan evaporation)	3.53	5.40	5.73	7.73
T ₄ (125% pan evaporation)	4.00	5.00	5.80	8.07
Probability Value	0.502 ^{ns}	0.10 ^{ns}	0.07 ^{ns}	0.35 ^{ns}
CV%	13.95	9.74	3.92	5.40

^{ns} not significant at 5% level

Number of leaves per plant

The number of leaves per plant was determined by counting the leaves gathered from the main branch of the plants of each replicate per treatment. The number of leaves for the different treatments is shown in Table 5. The analysis of variance was not significantly differed in the means at 1 MAT. However, at ages 2 MAT, 3 MAT, and 4 MAT, they obtained significant results. Further analysis of the means showed that T₁ was significantly differed from T₂, T₃, and T₄. Moreover, the means of T₂, T₃, and T₄ were not significantly differed.

Yield

Irrigated plots yielded significantly higher where in T₄ was the highest yield, and followed by T₃, T₂, and T₁, which were the lowest yield respectively (Table 6). Further comparison of treatment means showed that the yield for T₂, T₃, and T₄ were not significantly differed.

Table 5. Number of leaves at different ages for various treatments

Treatment	Month(s) after Transplanting (MAT)			
	1	2	3	4
T ₁ (control)	21.00	23.27 ^b	27.20 ^b	33.20 ^b
T ₂ (75% pan evaporation)	22.40	28.07 ^a	31.47 ^a	37.87 ^a
T ₃ (100% pan evaporation)	23.07	29.13 ^a	31.80 ^a	37.40 ^a
T ₄ (125% pan evaporation)	24.20	29.53 ^a	33.67 ^a	40.13 ^a
Probability Value	0.54 ^{ns}	0.015*	0.023*	0.035*
CV%	11.46	6.39	5.84	5.66

^{ns} not significant at 5% level; *significant at 5% level; Means with the same letter are not significantly different.

Table 6. Yield per hill and Projected Yield per Hectare, kg/ha

Treatment	Yield per Hill, kg	Projected Yield per ha
T ₁ (control)	0.45 ^a	21,428.57 ^a
T ₂ (75% pan evaporation)	0.83 ^b	39,523.81 ^b
T ₃ (100% pan evaporation)	0.86 ^b	40,952.38 ^b
T ₄ (125% pan evaporation)	0.87 ^b	41,428.57 ^b
Probability Value	0.0025**	0.0025**
CV%	11.19	11.19

**significant at 1% level; Means with the same letter are not significantly different

Discussion

Agronomic characteristics of sweet potatoes, such as the diameter of leaves and number of branches, were not significantly affected by irrigation regimes at different stages. However, other parameters, such as vine length and number of leaves, except for 1 MAT, obtained significant results at ages 2 MAT, 3 MAT, and 4 MAT. The result conforms to the study of Biswal *et al.* (2017) and Peninah *et al.* (2022), which found that the application of a higher level of irrigation

resulted in longer vine length. In addition, plants under well-watered conditions had more leaves than those under moderate and severe stress (Peninah *et al.*, 2022).

Sweet potatoes under rainfed conditions had lower tuber yield but treatments with irrigation: T₂ (75% of evaporation), T₃ (100% of evaporation), and T₄ (125% of evaporation), produced significantly higher yield. Yield was proportionally lower when deficit irrigation was imposed (Önder *et al.*, 2015) and plants under well-irrigated conditions had significantly greater yield compared to those under moderate and severe stress (Peninah *et al.*, 2022). However, comparison of the means for yield under treatments with irrigation obtained a comparable result. Hence, T₂ (75% of evaporation) is recommended as a basis for weekly irrigation for sweet potatoes.

Consistent with the above findings, T₂ obtained the highest water productivity of 8.73 kg/cu-m_{i+R}. Compared to rainfed conditions, an increase of more or less 100% in yield if supplementary irrigation is provided. The results suggest that the effects of drip irrigation on yield and quality could improve the farming situation of local farmers who still rely on rainfed conditions (Gonzaga *et al.*, 2017).

Understanding the relationship between irrigation and sweet potato yield is essential for developing practices that can enhance production and meet the growing demand for sweet potato. As we look to the future, innovative approaches to water management and improved cultivation practices will be crucial in addressing the challenges faced by sweet potato farmers. By optimizing irrigation and ensuring sustainable practices, the economic viability of sweet potato production can be enhanced, ultimately contributing to food security and the welfare of communities reliant on this important crop.

Acknowledgements

The authors would like to thank the Isabela State University – Echague Campus for the funding support, which led to the smooth implementation of the project.

Conflicts of interest

The authors declare no conflict of interest.

References

- Abidin, P. E., Carey, E., Mallubhotla, S. and Sones, K. (2017). Sweetpotato cropping guide. Nairobi (Kenya). Africa Soil Health Consortium. ISBN 978-1-78639-315-9. 62 p.

- Biswal, S., Nedunchezhiyan, M. and Mohapatra, P. K. (2017). Effect of Irrigation Schedule and Fertilizer levels on Growth and Yield of Sweet Potato (*Ipomoea batatas* L.). Journal of Root Crops, 2017, Vol. 43 No. 1, pp 44-51. Indian Society for Root Crops. ISSN 0378-2409, ISSN 2454-9053 (online)
- Department of Agriculture – Regional Field Office 02 (2012). Sweet Potato Production Guide. Retried from https://cagayanvalley.da.gov.ph/wp-content/uploads/2018/02/sweet_potato.pdf
- Felix, J., Shock, C., Ishida, J., Feibert, E. and Saunders, L. (2015). Irrigation Criteria and Sweetpotato Cultivar Performance in the Treasure Valley of Eastern Oregon. HortScience, 50:1011-1017. DOI: 10.21273/HORTSCI.50.7.1011
- Gajanayake, B., Reddy, K.R., Shankle R. W. and Arancibia. R. A. (2013). Early-season soil moisture deficit reduces sweetpotato storage root initiation and development. HortScience, 48:1457-1462. DOI:10.21273/HORTSCI.48.12.1457
- Gonzaga, N. R., Pepito, S. L. A., Octavio, R. P., Gonzaga, A. B. Jr. and Rogers, G. S. (2017). Growth and yield response of lettuce and tomato grown under drip and manual irrigation. Annals of Tropical Research, 39:168-173. DOI: 10.32945/atr39sb14.2017.
- Lebot, V. (2009). Tropical Root and Tuber Crops: Cassava, Sweet Potato, Yams and Aroids. Crop Production Science in Horticulture No. 17, CABI Publishing.
- Makini, F. W., Mose, L. O., Kamau, G. K., Salasya, B., Malinge, W. W., Ongala, J., Makelo, M. N. and Fatunbi, A. O. (2018). Innovation opportunities in Sweet Potato Production in Kenya. Forum for Agricultural Research in Africa (FARA) Accra Ghana.
- Önder, D., Caliskan, M. E., Önder, S. and Çalışkan, S. (2015). Influence of Different Irrigation Methods and Irrigation Levels on Water Use Efficiency, Yield, and Yield Attributes of Sweet Potatoes. Retried from <https://www.researchgate.net/publication/291349495>
- Peninah, A. N., Msinde, P. and Mworio, Eric. (2022). Growth, yield and quality of selected sweet potato (*Ipomoea batatas* [L.] Lam.), lines under varying soil moisture conditions. African Journal of Science, Technology and Social Sciences, 2:36-45. DOI: 10.58506/ajstss.v1i2.116
- Philippine Statistics Authority (2024). Agriculture and fisheries indicators system: Output and productivity, 2019 to 2023. ISSN-2012-0435. https://psa.gov.ph/system/files/main-publication/AFIS_Output%20and%20Productivity_Signed.pdf

Villordon, A. and Smith, T. (2023). Next-Generation Wireless Soil Moisture Sensors for Enhanced Water Use Efficiency and Sustainable Yields in Sweet Potato Production. Louisiana Agriculture. Retrieved from <https://www.lsuagcenter.com/articles/page1678824372516>

(Received: 13 March 2025, Revised: 6 July 2026, Accepted: 13 September 2026)