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Water Management of Organic-Based Pineapple in Upland Sloping Production Areas

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Abstract

Irrigation of crops in the upland is one major problem in crop production because of water availability during the dry season which includes the right irrigation water method, one of major factors in crop production. The main objectives of the study were to assess the growth and yield of organically grown pineapple at different water management; and to evaluate the cost and economic returns of organically grown pineapple at different water management. Study conducted at BPSU Bangkal, Abucay, Bataan (N 14°46' East 120°30'). The total rainfall depth at BPSU-AWS Station for July 2020 to June 2022 was 5,002.4 mm during the study period. The micro-sprinkler irrigation system (90 lph, 5.5 m – 12.5 m WD) was used to supplement the irrigation water. Four treatments were subjected for verification (T1 – no supplemented water, T2 – Irrigate up to 30% soil MC, T3 - Irrigate up to 50% soil MC, and T4 – Irrigate up to 70% soil MC) with the aid of an Atmometer and Soil Moisture Meter. Pineapple (T4) has 72.7 cm high, 109.5 cm crown diameter with 25.7 leaves, and T4 has the most number of large size (126/179). Pineapple production has a good return in terms of income, and ROI, and has a short payback period compared with other commodities. With the application of supplemented irrigation water to upland and rolling production areas, the farmer's income could increase with the right irrigation method for specific and selected crops to be raised.

Keywords: Micro sprinkler, irrigation, double-row-triangular, Bataan Philippines

1. Introduction

Climate change is a significant change in climate in the regions which is the result of careless human activities that were observed on common measurements like rainfall, temperature, and air. The Philippines had excessive rainfall but was not uniformly distributed within the country. The unpredictable distribution results in runoff, flooding and soil erosion, and water deficit during the dry season. Therefore, a need to impound part of excessive rainfall water for supplemental purposes during scarce water supply specifically for crop production.

Water system in the upland is one major problem in crop production because of irregular soil surface configuration and source of irrigation water. Soil surface configuration is one factor in the selection of production area which includes water the major factor for crop production. Because of this soil aspect, few areas are productive. In Bataan province however crop are produced even in sloping and upland areas such as pineapple, cassava, sweet potato, banana, taro, and other high value crops.

During the second quarter of 2020, the production of pineapple increased to 712.26 thousand metric tons or by 1.4 percent from 702.25 thousand metric tons in the same quarter of 2019. Northern Mindanao, which contributed 50.5 percent to the total production this quarter, was the top pineapple producer with 359.72 thousand metric tons. This was followed by SOCCSKSARGEN with 184.41 thousand metric tons or 25.9 percent share (https://psa.gov.ph/fruits-crops-bulletin/pineapple).

In Bataan upland areas, pineapple were also produced. Production of these crops relies on the rainfall occurrence for its irrigation without any other means of watering the plants. Because of the unpredictable occurrence of rains, insurance of high production cannot be projected and it was not maximized. And when a small amount of rainfall,

surely losses for the farmer. However, if there is a source of irrigation water, proper irrigation method, and timing of application, maximum crop production will be expected.

The main objective of the study was to establish the irrigation management of organic-based pineapple in sloping production areas, specifically: assessing the growth and yield of organically grown pineapple and evaluating the cost and economic returns of organically grown pineapple at different water management.

Application of irrigation water at the proper time will sustain the growth development of crops and giving all nutrient requirements of pineapple will result in high production. Establishment of water management for pineapple, considering nutrient management and crop maintenance.

The establishment of irrigation requirements and irrigation intervals for specific soil types for pineapple will increase the product quality resulting in increasing the income of the farmer.

2. Methodology

Includes and present the materials used, the crop used in the study, the site identified, the preparation of the experimental area, data gathered and monitored, the experimental design, and data analysis.

2.1 Conceptual Framework

The framework (Figure 1) illustrated and discussed the input, process, and output of the study. The identified area was cleared, crop establishment, instrumentation, and organic materials for crop production including agro-climatic data to be used (INPUTS). During crop development, the pineapple was maintained through scheduled irrigation, fertilization, and pest management including the gathering of crop growth parameters. Soil moisture was also monitored (PROCESS). As a result, there was established water management for pineapple production, growth parameters and yield, and economic benefit of the study (OUTPUT).

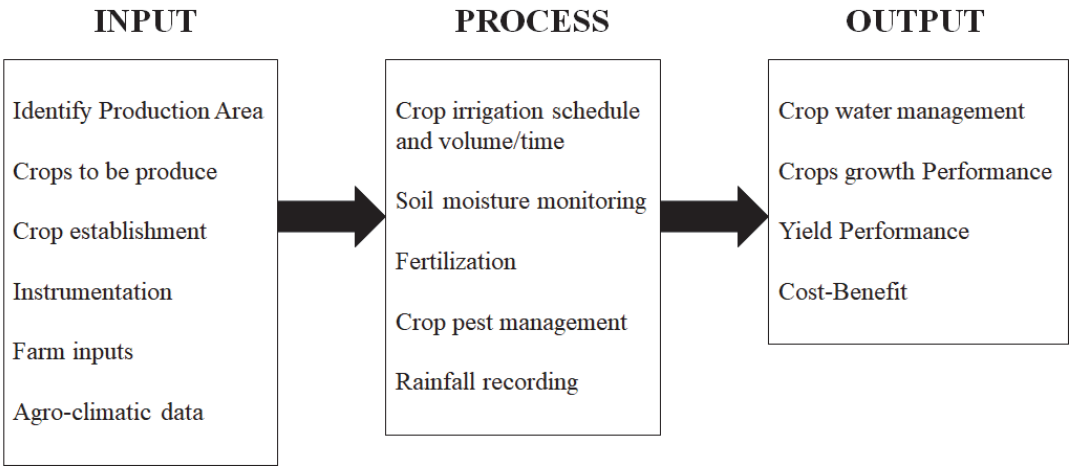

Figure 1. Conceptual Framework

2.2 Materials

a. *Pressurized Sprinkler and attachments.* This was established to water the crops at specific conditions. Sprinkler has 90 lph with 5.5-15.5 m wetted diameter.

b. *Crops*. Pineapple was raised and produced using foliar organic fertilizer.

c. *HDPE Pipe.* This was laid out in the production area where irrigation equipment was established.

d. *Soil Moisture Meter.* Used to measure and monitor the soil moisture for irrigation scheduling (Figure 2).

e. *Atmometer.* Use to measure the daily evapotranspiration of a specific crop (Figure 2).

f. *Pineapple Sucker.* Planting material for production.

g. *Foliar Organic Fertilizer.* Used as a nutrient supplement for crop production. Crops was applied with foliar organic fertilizers every two weeks.

h. *Automatic weather station.* Instrument where agro-climatic data are recorded and to be used for analysis specifically rainfall.

Figure 2. Moisture Meter, Sprinkler and Atmometer

2.3 Identified Site

Upland and rolling area was identified within the Campus for the study probably with 17%-30% slope for the agro-forestry development. The area has more or less 1,200 square meter demonstration site located in the Organic Crop Demonstration Area, BPSU Abucay.

2.4 Crop Production Establishment

The identified area was cleared. Remove the vegetative covers through manual hoeing. Pineapple was planted along the contour lines established in a triangular-double row at 0.5 m per plant and 1.0 m between double rows. The area was added with rice hull up to 5 cm thick after planting to reduce the occurrence of unwanted plants and serve as organic fertilizers upon decomposition.

2.5 Crop Management and Maintenance

The crop established was maintained. Regular weeding was done including irrigation based on the crop water requirement and soil moisture content. Pest and disease management was observed and control.

Two sprinklers (90 lph, 5.5-12.0 m wetted diameter) were established in every replication of pineapple treatment for 100 m^2 per replication (Figure 3).

Figure 3. Watering (Sprinkler irrigation)

2.6 Data Gathered and Collected

Data gathered and collected were depth of rainfall, soil moisture, irrigation volume and irrigation time, crop growth parameters, and yield. Changes in soil physical and chemical properties were also observed.

Rainfall. It was collected every 8 AM and 2 PM every day at the AGROMET Station.

Soil moisture. It was measured, monitored, and recorded using a digital soil moisture meter at the depth of 10 cm.

Irrigation time and frequency. It was dependent on the atmometer reading every 10-day irrigation interval.

Growth parameters. Height, number of leaves, and crown diameter were gathered and measured from the pineapple.

Yield. Harvested pineapple based on sizes (extra small, small, medium, and large) and prices were recorded from each treatment.

2.7 Experimental Design and Data Analysis

The compiled data from the study were analyzed (Figure 4), statistical analysis for mean differences, and using F-Test for the significance of the gathered data. Economic analysis was presented using the Cost and Return Analysis.

Layout: Treatment 1, T1 – No irrigation

Treatment 2, T2 – Irrigate up to 30% Soil MC

Treatment 3, T3 – Irrigate up to 50% Soil MC

Treatment 4, T4 – Irrigate up to 70% Soil MC

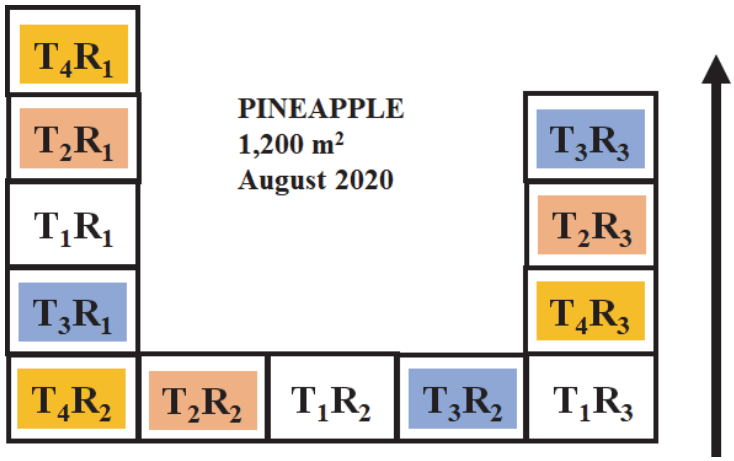

Figure 4. Experimental Layout

3. Result and Discussion

3.1 Rainfall

The area has two distinct seasons, dry season which starts from November to May, and the rainy season from June to October of year. Table 1 illustrated the depth of rainfall in BPSU-AWS Station from July – December 2020, January – December 2021 and January – June 2022.

Table 1. Rainfall depth (mm) during the study period

	2020	RF (mm)	2021	RF (mm)	2022	RF (mm)
			Jan	87.8	Jan	21.6
			Feb	11.0	Feb	10.2
			Mar	59.4	Mar	43.4
			Apr	5.2	Apr	39.2
			May	17.6	May	167.6
			Jun	206.0	Jun	31.2
	Jul	244.6	Jul	1,430.6		
	Aug	444.0	Aug	615.8		
	Sep	191.6	Sep	468.8		
	Oct	518.8	Oct	211.8		
	Nov	412.6	Nov	10.2		
	Dec	84.0	Dec	56.4		
Sub-Total		**1,895.6**		**2,793.6**		**313.2**
Total						**5,002.40**

3.2 Growth and Yield Performances

In the production of pineapple (Sweet Cayenne), the evapotranspiration reading from atmometer (Figure 7) was the basis for irrigation including the soil moisture level using a soil Moisture Meter. The daily evapotranspiration rate was from 1.0 mm/day to 6.0 mm/day.

Pineapple has more than 72.7 cm average height and has a wider crown diameter (Treatment 4), however it has 26 least number of leaves (Table 7).

The harvested pineapple has extra small (XS – 6.3 cm height and 4.8 cm diameter), small (S – 7.3 cm height and 5.5 cm diameter), medium (M – 8.1 cm height and 5.8 cm diameter), and large (L – 8.8 cm height and 5.9 cm diameter). The percentages of pineapple harvested in terms of sizes were 13.2, 24.0, 27.1, and 35.6 for XS, S, M, and L, respectively. On the other hand, in terms of production per treatment were 19.0, 30.6, 20.6, and 29.7 for Treatment 1, Treatment 2, Treatment 3, and Treatment 4, respectively (Table 8).

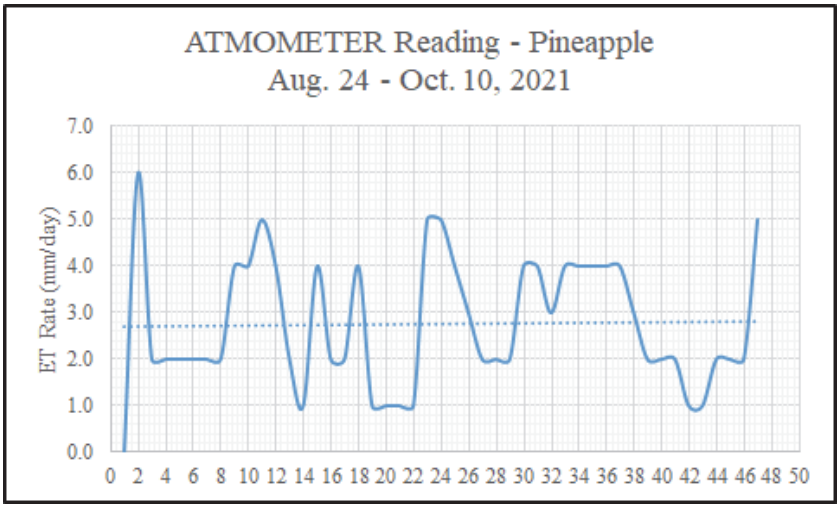

Figure 7. Atmometer reading in Pineapple area

Table 7. Growth performance of Pineapple

Pineapple	Height (cm)	Crown Diameter (cm)	Number of Leaves
Treatment 1	69.7	108.1	29.3
Treatment 2	68.3	100.3	29.7
Treatment 3	67.3	103.1	27.7
Treatment 4	72.7	109.5	25.7

Table 8. Yield performance of Pineapple

Treatment	Sizes				Sub-Total	Percentage
	XS	S	M	L		
T1	24	51	53	51	179	19.0
T2	36	62	82	108	288	30.6
T3	32	63	49	50	194	20.6
T4	32	50	71	126	279	29.7
Sub-Total	124	226	255	335		
TOTAL					940	
Percentage	13.2	24.0	27.1	35.6		

3.3 Cost and Benefit

Initial cost covered the materials which includes irrigation facilities like PE pipes, sprinklers, valves, filters, etc. Depreciation, interest on investment, repair, and maintenance were included in the fixed cost while variable costs were farm inputs and labor costs for crop production. Gross income (Table 4) comes from sales of different crops. Pineapple has higher ROI because of high demand sales of products due to supply and demand.

Table 4. Cost and Benefit Analysis

BASIC COMPUTATION (PhP)	Pineapple
I. Initial	49,040.00
II. Fixed cost	
a. Depreciation cost (5 % of initial cost)	2,452.00
b. Interest on Investment (5 % of initial cost)	2,452.00
c. Repair and Maintenance (2 % of initial cost)	980.80
Useful Life, years	5
Total Annual fixed cost	5,884.80
III. Variable Cost	
a. Planting materials, fertilizers, etc.	18,700.00
b. Labor Cost	16,000.00
Total Variable Cost	34,700.00
Total Annual Cost	40,584.80
IV. Gross Income	78,640.00
V. Net Income	38,055.20
VI. ROI (%)	0.776
VII. Payback Period (years)	1.3

4. Summary and Conclusion

In the production of pineapple, the evapotranspiration reading from the atmometer was the basis for irrigation including the soil moisture level. The daily evapotranspiration rate was from 1.0 mm/day to 6.0 mm/day. Pineapple has more than 72.7 cm average height and has a wider crown diameter (Treatment 4), however it has 26 least

number of leaves. The harvested pineapple fruit has extra small (XS – 6.3 cm height and 4.8 cm diameter), small (S – 7.3 cm height and 5.5 cm diameter), medium (M – 8.1 cm height and 5.8 cm diameter), and large (L – 8.8 cm height and 5.9 cm diameter). The percentages of pineapple harvested in terms of sizes were 13.2, 24.0, 27.1, and 35.6 for XS, S, M, and L, respectively. On the other hand, in terms of production per treatment were 19.0, 30.6, 20.6, and 29.7 for Treatment 1, Treatment 2, Treatment 3 and Treatment 4, respectively.

Initial cost covered which includes irrigation materials like PE pipes, sprinklers, valves, filters, etc. Depreciation, interest on investment, repair, and maintenance were included in the fixed cost while variable costs were farm inputs and labor costs for crop production.

Recommendation

Crop production in the upland rolling area crop considers elevation, land configuration, weather data, crop characteristics and planting materials, farmer's management, planting method, and timing of planting/transplanting.

Pineapple has better yield as long regular maintenance like weeding, regular application of foliar organic fertilizers, and monitoring of ET, especially during the season for proper timing of supplemented irrigation water.

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