African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 31-51)
www.abjournals.org

COMPARATIVE AGRONOMIC EVALUATION OF ORGANIC AND MINERAL FERTILIZERS APPLIED TO TOMATO (*LYCOPERSICON ESCULENTUM* MILL.) PLOTS WITH OR WITHOUT PRIOR SOIL ANALYSIS

Mvondo Nganti Dorothée[1,2*], Nchange Kouotou Adamou[2],

Mefire Nchouwat Youssouf[1,2], and Manga Essouma François[1,3]

[1]Laboratory of Phytopathology, Department of Plant Biology, University of Yaoundé 1, Yaoundé, Cameroon.

[2]Agrix Tech Sarl Cameroon

[3]Cameroon Laboratory of Phytopathology, Department of Plant Biology, University of Yaoundé 1, Yaoundé, Cameroon

[*]Corresponding Author's Email: mvondonganti@gmail.com

Cite this article:

D. N. Mvondo, A. K. Nchange, Y. N. Mefire, F. E. Manga (2025), Comparative Agronomic Evaluation of Organic and Mineral Fertilizers Applied to Tomato (Lycopersicon Esculentum Mill.) Plots with or without Prior Soil Analysis. African Journal of Agriculture and Food Science 8(2), 31-51. DOI: 10.52589/AJAFS-WRNIW7O4

Manuscript History

Received: 9 Apr 2025

Accepted: 12 May 2025

Published: 26 May 2025

ABSTRACT: *This study compares the agronomic and economic efficiency of organic (poultry manure, cow dung) and mineral (NPK) fertilizers on tomato (Lycopersicon esculentum) cultivation in Cameroon, with or without prior soil analysis. Results show that poultry manure significantly enhances vegetative growth (plant height, number of leaves/flowers/fruits) and yield (up to 18.15 t/ha), outperforming mineral fertilizers and cow dung. Plots with pre-fertilization soil analysis achieved optimized yields with precise nutrient application, reducing costs. Economically, poultry manure delivered the highest profitability (up to 306% return), while unanalyzed NPK plots were the least efficient. Favorable climatic conditions and volcanic soil fertility in the West region further improved outcomes. The study recommends adopting organic fertilizers combined with soil testing for sustainable and profitable agriculture.*

KEYWORDS: Tomato (*Lycopersicon esculentum*); organic fertilizers; poultry manure; soil analysis; agronomic yield; sustainability; economic profitability.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most widely cultivated and consumed vegetables globally, particularly due to its significance in human nutrition. According to FAO, it is grown in over 170 countries, with a global net production of 186.11 million metric tons in 2022. In Africa, production reached 22.92 million metric tons, with Cameroon ranking among the top 10 tomato-producing countries. It is the most important vegetable in terms of quantity and the most widely cultivated crop in market gardening, with 39% of production originating from the West region. Cameroon cultivates 93,762 hectares, producing 1,068,495 metric tons annually, yielding 11,395.8 kg/ha (FAOSTAT, 2020). Over 329,000 smallholder farmers in the West, Centre, and Northwest regions depend on this crop.

Tomato cultivation is typically practiced on fallow land (Centre) but increasingly on the same plots in the West region, where arable land scarcity is becoming more pronounced. Farmers often compensate for declining soil fertility by overusing chemical fertilizers, which contribute to climate change through the release of nitrous oxide (N_2O), a greenhouse gas 300 times more potent than carbon dioxide (Matt Fisher, 2018). Recent studies indicate that soil productivity in tropical regions declines with continuous chemical fertilizer use (Biaou et *al.*, 2017). Excessive chemical fertilizer application can degrade soil structure and disrupt biological balance by harming beneficial microorganisms (bacteria and fungi).

No standardized fertilization program exists. To maximize yields and income, farmers often apply chemical fertilizers indiscriminately, disregarding their environmental and human health impacts. However, excessive fertilization is unnecessary for some soils, and optimal rates depend on crop variety and local climate conditions. Soil analysis is critical to determine nutrient availability and tailor fertilization for optimal plant development. Thus, assessing soil status through pre-fertilization analysis is indispensable. For sustainable soil fertility management, leveraging local organic matter sources is essential.

Organic fertilizers such as farmyard manure, sheep manure, poultry manure, goat manure, cattle manure, and compost have been used in crop production for centuries. Their use predates chemical (mineral) fertilizers, which were developed more recently (Mowa et *al.*, 2017). Organic fertilizers are environmentally friendly, being derived from natural sources. They contain organic matter, nutrients, microorganisms, and amino acids that enhance plant metabolism, growth, and yield (Mayele & Abu, 2023; Coulibaly *et al.*, 2022; Aguessin *et al.*, 2021; Sawadogo *et al.*, 2021).

LITERATURE REVIEW

Organic fertilizers, particularly chicken and cow manure are soil amendments that provide nutrients and organic matter to the soil, improve its firmness and structure, and can enhance the physical, chemical, and biological properties of degraded or low-fertility soils. They also serve as a source of nitrogen, phosphorus, and potassium for plants (Agbede *et al.*, 2017).

Poultry manure is a valuable agricultural resource, composed of a mixture of organic and inorganic compounds essential for plant growth. Rich in nitrogen, phosphorus, and potassium, it not only supplies vital nutrients but also improves soil structure, water retention, and microbial activity (Mayele & Abu, 2023). Despite its benefits, its availability remains a

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

significant challenge due to its bulkiness, and widespread adoption is hindered by logistical difficulties such as transportation, storage, and odor management (Ghimire *et al.*, 2022).

Cow dung is rich in organic matter and nutrients, containing approximately 3% nitrogen, 2% phosphorus, and 1% potassium (NPK 3-2-1). Composting cow manure offers numerous advantages (Thakur, 2017). In addition to eliminating ammonia, pathogens, and weed seeds, composted cow manure enriches the soil with large amounts of organic matter.

Both poultry and cow manure can replace synthetic fertilizers. Their application supplies essential nutrients; improves soil structure, water-holding capacity, porosity, bulk density, and moisture retention; increases microbial populations; and preserves crop quality (Agbede *et al*., 2013; Mayele & Abu, 2023). Despite the higher concentrations of plant nutrients in synthetic fertilizers compared to organic ones, the presence of growth-promoting agents in organic fertilizers makes them crucial for enhancing soil fertility and productivity (Sanwal *et al*., 2007).

MATERIALS AND METHODS

Study Areas

The studies were conducted in Bibe (Center Region) and Bafoussam (West Region), two agricultural localities belonging to Agro-Ecological Zone V and Agro-Ecological Zone III respectively. The main characteristics of the two agro-ecological zones are presented in Table I.

- Bibe is located in the forest zone with a bimodal rainfall pattern (Agro-Ecological Zone V), with geographic coordinates 3°43’19.4’’N, 11°25’15.2’’E.
- Bafoussam is situated in the highlands zone (Agro-Ecological Zone III), with geographic coordinates 5°29’49.1’’N, 10°23’16.2’’E.

Table I: Main characteristics of Agro-Ecological Zones III and V (Eramus et al., 2022)

Characteristics	**Agro-Ecological Zone III**	**Agro-Ecological Zone V**
Area	31,192 km²	165,770 km²
Rainfall	1500–2000 mm, 180 rainy days	1500–2000 mm, two rainy seasons
Soil	Highly fertile, suitable for agriculture, young on steep slopes, enriched with volcanic materials	Ferralitic, acidic, clayey, low water and nutrient retention capacity
Main Crops	Cocoa, coffee, maize, dry beans, potatoes, vegetables	Cocoa, coffee, cassava, plantain, maize, oil palm, pineapple

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

MATERIALS

Plant Material

The Rio Grande tomato, a hardy Roma-type variety, was used due to its high yield, producing numerous medium-sized (60-100 g) elongated bright-red fruits. It has an indeterminate growth habit and is resistant to diseases, particularly viral infections.

Nutrient Sources

The organic materials used were:

- Poultry manure (layer chicken droppings): A common organic amendment in the Center and West regions of Cameroon, especially for vegetable crops. It consists of a mixture of droppings and bedding residues from intensive poultry farming, partially decomposed.
- Cow dung: Collected from a cattle breeder in the Center Region.

The same fertilizers were applied in both sites. A mineral fertilizer (NPK 20-10-10) was used as the chemical fertilizer, as it is the most widely available and commonly used by Cameroonian farmers.

Phytosanitary Products

- Fungicide: *Mancomax 80 WP* (active ingredient: Mancozeb) was used to control fungal diseases in tomatoes.
- Insecticide: *Cypercal* (active ingredient: Cypermethrin) was applied against insect pests. These products were selected based on their efficacy against tomato pests and diseases and their availability in local markets.

Soil Analysis

Soil analysis for plots T2, T3, and T4 was conducted using the Dr. Soil Recorder Kit. Four samples were taken per plot, and the average value was calculated. This kit provides instantaneous measurements of N, P, K, and pH.

Based on the soil analysis, the required quantities of poultry manure, cow dung, and mineral fertilizer were calculated.

Table II: Soil analysis results in Bibe and Bafoussam

DATA TAKEN FROM 1KG OF SOIL at BIBE (mg)									
	T3 AFP	**T4 ACD**	**T4 ACD**	**T3 AFP**	**T2 ANPK**	**T4 ACD**	**T3 AFP**	**T2 ANPK**	**T2 ANPK**
N	0	0	0	0	0	0	0	0	0
P	18	37	18	20	18	25	18	17	17
K	10	29	10	12	11	17	10	9	9
PH	5,7	5,9	5,9	6,2	6	6,7	6,8	6,2	6,3

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 31-51)
www.abjournals.org

DATA TAKEN FROM 1KG OF SOIL at BAFOUSSAM (mg)									
	T2 ANPK	**T4 ACD**	**T3 AFD**	**T2 ANPK**	**T4 ACD**	**T4 ACD**	**T3 AFP**	**T2 ANPK**	**T3 AFP**
N	13	12	0	3	9	2	3	8	4
P	77	74	42	54	67	52	53	66	55
K	69	66	34	46	60	44	45	55	47
PH	6,6	6,6	6,6	6,8	6,6	6,6	6,5	6,4	6

Organic Fertilizer Analysis

The poultry manure and cow dung used in this study were analyzed at the Soil Analysis Laboratory of the University of Dschang. The results (Table III) were interpreted to determine the appropriate quantities to apply in each plot, also considering soil analysis data.

Key findings:

- Poultry manure: High in phosphorus and potassium, with a suitable PH and can be incorporated before planting to enhance fruiting.
- Cow dung: High in nitrogen and organic matter and best used as a long-term soil amendment.

Table III: Analysis results of layer chicken manure and cow dung

Lab Code	1(Poultry Manure)	2(Cow Dung)
PH	7,2	8,6
%MO	67,200	86,300
%CO	33,600	43,150
C/N	19,725	21,026
%NT	1,703	2,052
%PT	0,494	0,264
%Na	0,225	0,061
%K	1,539	0,629
%Ca	0,080	0,015
%Mg	0,018	0,015

Experimental Design

A completely randomized design with 7 treatments (T1–T7) and 3 replications was used.

- Primary factor: Soil amendment (poultry manure, cow dung, NPK, or no amendment).
- Secondary factor: Soil analysis (plots analyzed and amended with NPK, poultry manure, or cow dung vs. non-analyzed plots).

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 31-51)
www.abjournals.org

Treatments:

1. T1 (Negative control): No soil analysis, no fertilization.
2. T2: Soil analysis + exact NPK application based on plant needs.
3. T3: Soil analysis + exact poultry manure application based on plant needs.
4. T4: Soil analysis + exact cow dung application based on plant needs.
5. T5: No soil analysis, but NPK applied (standard farmer practice).
6. T6: No soil analysis, but poultry manure applied.
7. T7: No soil analysis, but cow dung applied.

The trial consisted of 21 elementary plots (PE), each measuring 7.5 m² (5m × 1.5m).

- Distance between plots: 90 cm
- Distance between plants: 45 cm
- Row spacing: 100 cm
- Planting density: ~22,200 plants per hectare

Plot marking was done for fertilizer application and seedling transplantation.

T1 1	T3 2	T4 3	T2 4
T2 5	T6 6	T1 7	T6 8
T4 9	T7 10	T3 11	T7 12
T3 13	T2 14	T6 15	T5 16
T5 17	T1 18	T5 19	T4 20
T7 21			

Figure 1: Experimental design

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

Calculation of Fertilizer Application Rates

Plots with Soil Analysis

In living soil, the nutrient requirements per hectare for the Rio Grande tomato variety are:

- Nitrogen (N): 200 units
- Phosphorus (P): 100 units
- Potassium (K): 300 units

To determine the required NPK quantities (from soil analysis and poultry manure):

1. Calculated NPK needs by subtracting current soil NPK levels from plant requirements.
2. Calculated poultry manure quantities by dividing NPK needs by the NPK content of poultry manure.

Formula: **Quantity of NPK to add in kg/m² or kg/Ha = (NPK requirement of the plant – Current NPK level in the soil) / NPK content of poultry manure**.

For chemical fertilizer (NPK 20-10-10), the amount applied was adjusted to supply 300 units of potassium.

Plots Without Soil Analysis (T5, T6, T7)

For plots without soil analysis, fertilizer application followed common farmer practices:

- Organic fertilizers (poultry/cow manure): 30 tons/ha
- Chemical fertilizers (NPK + urea): 3 tons/ha

Plot Establishment

- Nursery preparation: Seedlings were transplanted after 3 weeks onto ridges where fertilizers had been applied one week earlier.
- Maintenance: Included weeding and phytosanitary treatments (fungicides/insecticides) for all treatments.

Morphological Parameter Observations

From the 10^{th} day after transplanting, weekly observations were recorded until harvest, including:

- Vegetative growth: Number of leaves, plant height, number of flowers, number of fruits.
- Pest infestations.
- Yield parameters and fruit quality post-harvest.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

Environmental Parameter Measurements

Each pilot site was equipped with a SynField module containing sensors to monitor:

- Rainfall, temperature, soil moisture.
- Data were automatically recorded and analyzed (see results).

Yield Assessment

Yield was calculated by extrapolating the **average fruit weight per plot to a hectare**:

Yield Gain Calculation:

- Treatment Yield (ha) = Average weight of fruits per plot x 10,000 (m^2) / Plot size (treatment).

Production Cost Evaluation

- Harvesting began 60 days after transplanting and lasted 5 weeks (one harvest per week).
- Economic analysis considered:
  - **Total Production cost** = Total cost of fertilizers + Total cost of labor + Cost of plant protection products + Harvesting cost + Setup cost
  - **Gross Revenue (GR)** = Yield (kg) × Market price per kg.
  - **Net Profit (NP)** = GR − Total Production Cost.
  - **Profitability Rate:** Total Revenue / Total Cost (Madegnan *et al.*, 2022).

Climate Data Collection

Sensors from April 19 (transplanting) to July 24 (final harvest) recorded environmental data (temperature, rainfall, soil moisture, wind speed).

Data Processing and Statistical Analysis

- Software: XLSTAT 2019.2 and Microsoft Excel 2016 (Pivot Tables).
- Methods:
  - ANOVA (Analysis of Variance).
  - Tukey’s test ($p < 0.05$) for treatment comparisons.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 31-51)

RESULTS

Calculation of Organic Matter and NPK Application Rates

The calculation of application rates took into account the potassium content of each organic matter, as this is the element most required by tomatoes. The protocol based on application according to potassium content also led to variable inputs of phosphorus and nitrogen depending on the composition of different organic materials. Excess nitrogen was compensated by gradual mineralization of poultry and cow manure.

Analyzed Plots

Table IV: Quantity of poultry manure to add after soil analysis

	Bibe		Bafoussam	
	Dose/Ridge	Dose/ha	Dose/Ridge	Dose/ha
Poultry manure	13,06 kg	17,4 t/ha	8,5 kg	11,3 t/ha
Cow dung	29,1 kg	38,8 t/ha	15,4 kg	20,5 t/ha
NPK	2,2 kg	2,94t/ha	2 kg	2,7t/ha

Non-analyzed Plots

Table V: Quantity of poultry manure to add without soil analysis

	Bibe		Bafoussam	
	Dose/Ridge	Dose/ha	Dose/Ridge	Dose/ha
Poultry manure	22,5 kg/	30 t/ha	22,5 kg	30 t/ha
Cow dung	22,5 kg	30 t/ha	22,5 kg	30 t/ha
NPK	2,25 kg	3 t/ha	2,25 kg	3 t/ha

Agro Morphological ParametersEffect of Different Treatments on Plant Height

Plant growth was regular and became more or less stable after fruiting. The results revealed that the application of different fertilizers led to better plant height growth compared to the two absolute controls from the Center and West regions, which showed the smallest plant heights (43.72 cm and 40.83 cm respectively). In general, a height difference was noted between plants from Bibe and those from Bafoussam. However, Tukey's test at the 5% threshold showed no significant difference between the majority of treatments. Only treatment T3 (poultry manure with soil analysis) from the West region stood out from all other treatments with a height of 74 cm and was significantly different from all other treatments.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

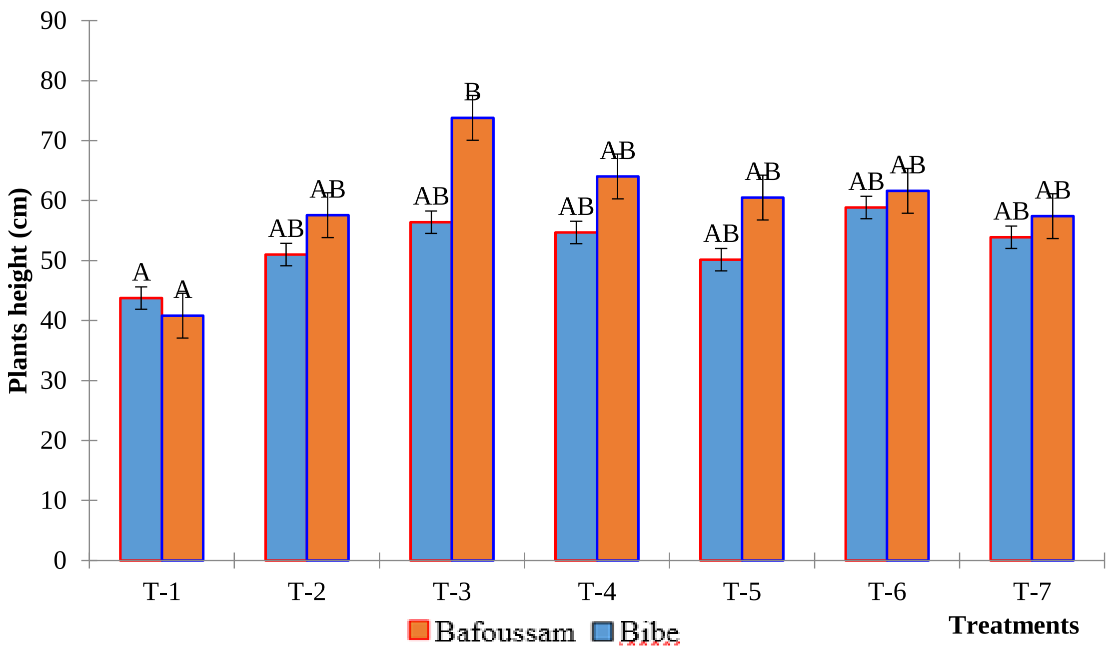

Figure 2: Effect of different treatments on tomato plant height

Effect of Different Treatments on Leaf Number

The results showed that all treatments from the West region had a higher number of leaves than treatments from the Center region.

In plots where soil was analyzed: Treatment T3 from Bafoussam (poultry manure with soil analysis) obtained the highest average number of leaves (24.66 leaves/plant). Followed by treatment T4 from the West region (cow dung with soil analysis) with 22.88 leaves/plant. The lowest average number of leaves was obtained by treatment T2 from the Center region (soil analysis with NPK) with 15.94 leaves/plant.

In plots without soil analysis: Treatment T5 (NPK without soil analysis) from the West region obtained the highest average number of leaves (22.16 leaves/plant). Followed by treatment T6 from the West region (poultry manure without soil analysis) with 21.72 leaves/plant. The lowest average number of leaves was obtained by treatment T7 from the Center region (cow dung without soil analysis) with 16.5 leaves/plant.

The control treatments (T1) from both locations obtained the lowest average number of leaves (15.11 leaves/plant for Bafoussam and 12.88 leaves/plant for Bibe). Tukey's test at the 5% threshold revealed that treatment T3 from the West region (poultry manure with soil analysis) was significantly different from other treatments in both locations.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

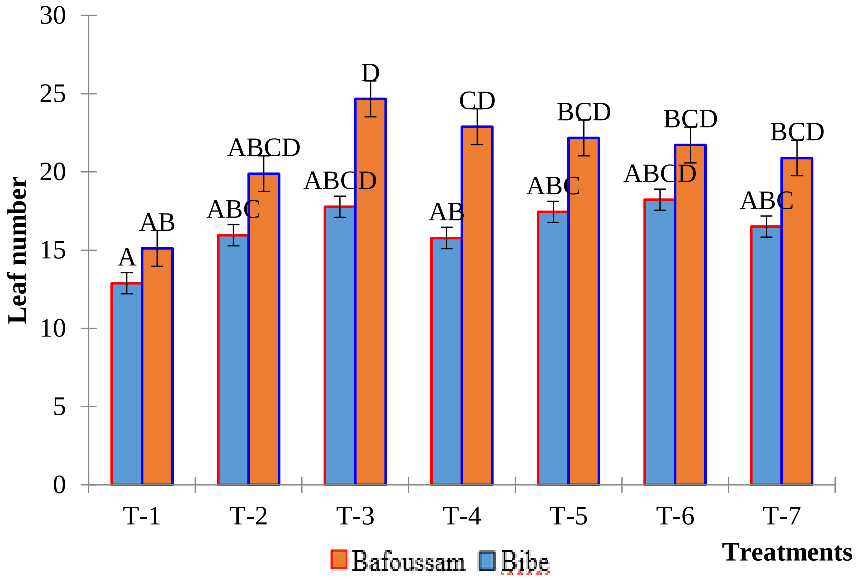

Figure 3: Effect of different treatments on leaf number

Effect of Different Treatments on Average Number of Flowers per Plant

The first flowers appeared three to four weeks after transplantation. Results revealed that the average number of flowers per plant was higher in all treatments from the West region compared to those from the Center region. The highest average number of flowers per plant was observed in treatment T6 (poultry manure without soil analysis) in both locations: 8.83 flowers/plant in the West and 7.77 flowers/plant in the Center. However, Tukey's test at the 5% threshold showed no significant difference between the different treatments in either location.

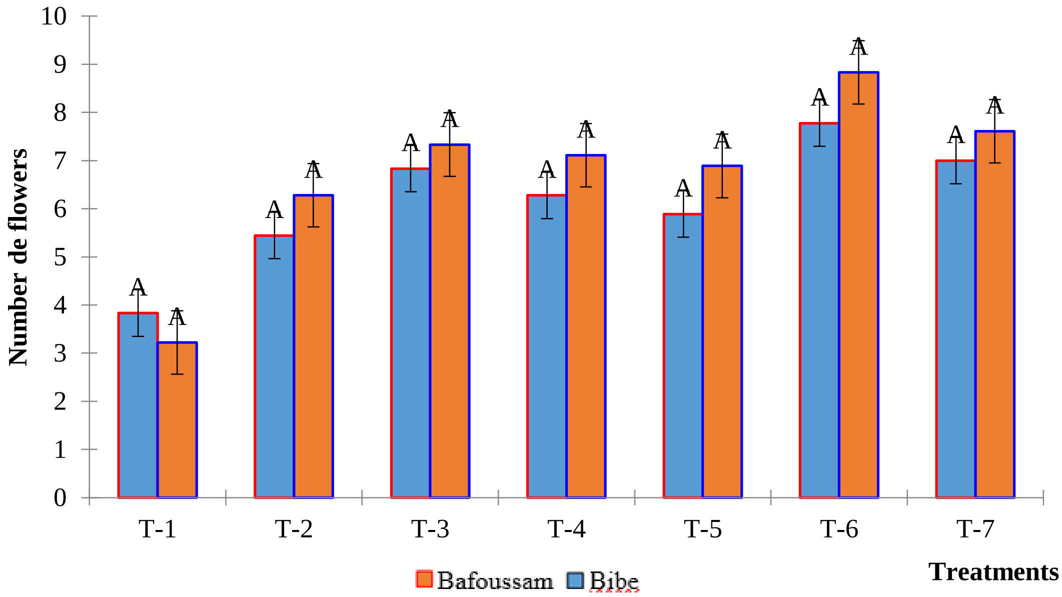

Figure 4: Effect of different treatments on average number of flowers per plant

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 31-51)

Effect of Different Treatments on Average Number of Mature Fruits

The average number of fruits harvested per treatment was generally higher for treatments in the West region. Treatments using poultry manure T6 (poultry manure without soil analysis) and T3 (poultry manure with soil analysis) in the West showed the highest average number of fruits (34 and 32 fruits respectively). The lowest average numbers of fruits were obtained in the control treatments from both locations (14.80 fruits/plant at Bibe and 16.33 fruits/plant at Bafoussam), followed by treatment T5 in the Center (NPK application without soil analysis) with 19.07 fruits/plant. Tukey's test at the 5% threshold showed a significant difference between the controls from both locations and all other treatments, as well as between T6 and T3 in the West.

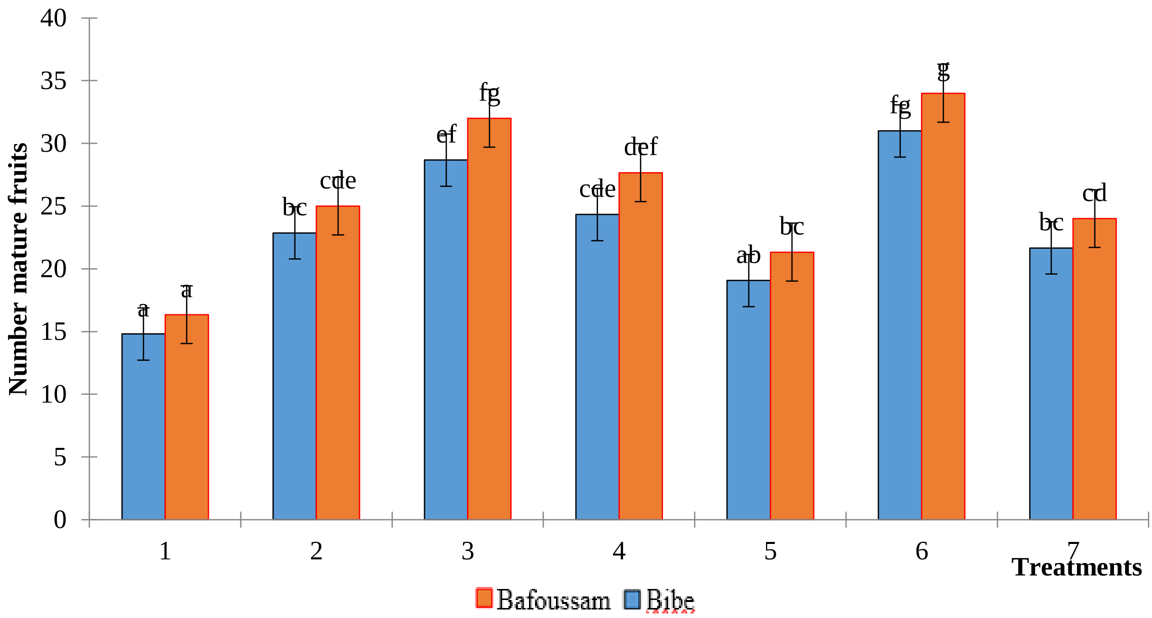

Figure 5: Effect of different treatments on average number of fruits per plant

Yield

Statistical analyses revealed that all treatments showed significantly higher yields compared to the control treatments in both locations, with significant differences, according to Tukey's test at the 5% threshold. All treatments in the West region had higher yields than the same treatments in the Center region.

- **By Location (Center and West):**

The highest yields were obtained by: Treatment T6 (poultry manure without analysis): 18.15 t/ha in the West and 16.54 t/ha in the Center, followed by treatment T3 (poultry manure with soil analysis): 17.20 t/ha in the West and 15.37 t/ha in the Center.

The lowest yields were obtained by: Control treatments T1 in both locations: 4.08 t/ha in the Center and 5.19 t/ha in the West, followed by treatment T5 (NPK fertilizer without soil analysis): 9.17 t/ha in the Center and 10.85 t/ha in the West.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 31-51)
www.abjournals.org

- **Regarding Soil Analysis:**

Plots that were analyzed and fertilized with NPK or cow manure obtained higher yields than non-analyzed plots in both locations. Treatment T2 (NPK with soil analysis) obtained yields of 12.81 tons in Bafoussam and 11.24 tons in Bibe, compared to treatment T5 (NPK without analysis): 10.85 tons in Bafoussam and 9.15 tons in Bibe. And Treatment T4 (cow manure wiith soil analysis) obtained yields of 14.44 tons in Bafoussam and 12.73 tons in Bibe, compared to treatment T7 (cow manure without analysis): 11.69 tons in Bafoussam and 10.15 tons in Bibe.

Plots that were analyzed and amended with poultry manure (T3) obtained lower yields than non-analyzed plots (T6). Treatment T3 obtained yields of 16.54 tons in Bafoussam and 15.37 tons in Bibe, compared to treatment T6: 18.15 tons in Bafoussam and 17.20 tons in Bibe.

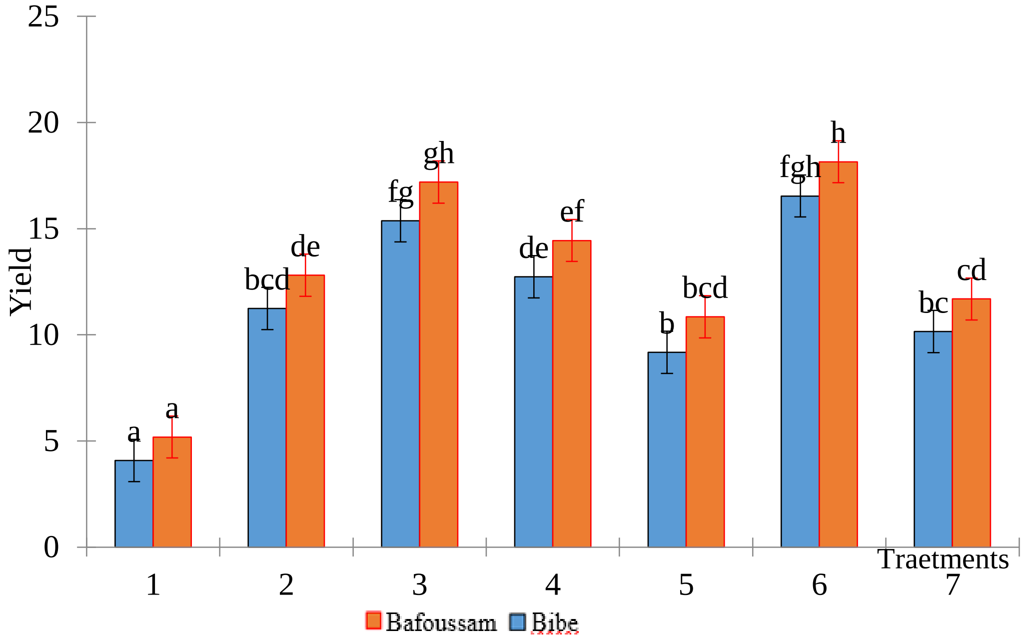

Figure 6: Impact of various treatments on yield

Effect of Climatic Parameters on Tomato Growth and Yield

Statistical analyses revealed that all treatments showed significantly higher yields compared to the control treatments in both locations, with significant differences according to Tukey's test at the 5% threshold.

Results for climatic parameters showed that:

- The average air temperature during the entire experiment was 23.86°C in the Center region and 21.59°C in the West region.
- Total rainfall during the experiment was 300.0 mm in the Center region (with some dry periods) and 633.0 mm in the West region.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

- Average soil moisture was 9.57% in the Center region and 30.25% in the West region.
- Average solar radiation was 151.84 W/m² in the Center region and 171.74 W/m² in the West region.

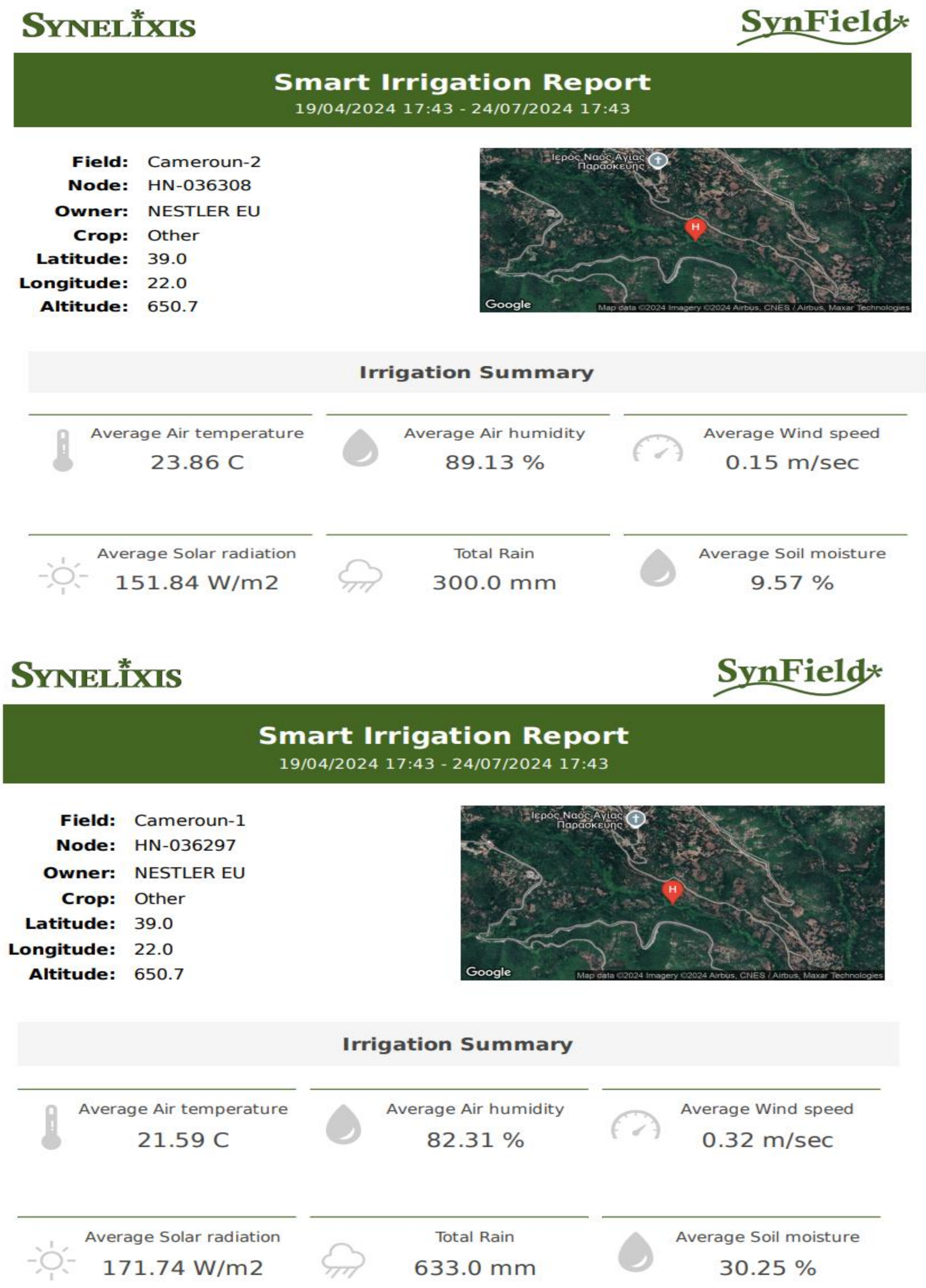

Figure 7: Weather parameters recorded throughout the experimental period in the two locations (1 - Bibe; 2 - Bafoussam)

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

Economic Evaluation of Different Treatments

The data concerning variable costs and economic evaluations are shown in Tables VI and VII below. We note generally that all treatments allowed coverage of all expenses related to tomato cultivation.

The results show that the highest gross revenues were obtained by treatment T6 (Poultry manure without soil analysis) in both locations (9 100 000 FCFA for the West and 8 250 000 FCFA for the Center). However, the highest net profits were obtained by treatment T3 (Poultry manure with soil analysis) in both locations (6 484 500 FCFA for Bafoussam and 5 218 500 FCFA for Bibe). Treatment T5 (NPK fertilizer without soil analysis) obtained the lowest net profits of all applied treatments (2 211 700 FCFA for Bafoussam and 1,362,500 FCFA for Bibe).

The effect of fertilizer application on the economic profitability of tomato cultivation in the Bibe location shows that only the value-cost ratios of treatments T3 (poultry manure with soil analysis), T4 (cow manure with soil analysis) and T6 (poultry manure without soil analysis) are greater than 2 (being 3.10 for T3; 2.12 for T4 and 2.55 for T6). The lowest VCR was obtained by mineral fertilizer treatment T5 (NPK without soil analysis) followed by treatment T2 (NPK after soil analysis), being 1.42 and 1.75 respectively.

In the West location, only treatment T5 (NPK without analysis) showed the lowest VCR, thus less than 2, being 1.68. All other treatments had VCRs greater than 2, and the highest VCRs were obtained by treatments where the soil was analyzed: T3 (poultry manure with analysis) and T4 (cow manure with soil analysis), being 4.02 for T3 and 3.19 for T4.

Regarding the profitability rate, it appears that treatment T3 showed the highest profitability rate in both locations (being 306.52% for Bafoussam and 210.30% for Bibe), followed by treatment T4 of Bafoussam (218.94%) and T6 (being 181.08% for Bafoussam and 154.83% for Bibe).

If we take the case of the Bafoussam location, the best PRs were obtained on plots where soils were analyzed. T3 with a profitability rate of 306.52% was exceptional, followed by T4 which also had a very high PR (218.94%). T6 and T7 were also excellent with PRs of 181.08% and 121.80% respectively. T5 showed the lowest PR (68.34%) which was even lower than that of the control T1 (106.06%).

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

Table VI: Economic evaluation of different treatments in Bibe

Treatment	Yield (t)	Selling price per kg (FCFA)	Gross Revenue FCFA	Fertilizer purchase cost (FCFA)	Total labor cost (FCFA)	Pesticide purchase cost (FCFA)	Plot establishment cost (FCFA)	Harvest-related costs (FCFA)	Total production cost (FCFA)	Net Profit (FCFA)	VCR	Profitability Rate (%)
T1	4	500	**2000000**	0	300 000	337 500	100 000	500 000	1 237 500	762 500	1,62	61,62
T2	11,2	500	**5600000**	1 770 000	400 000	337 500	100 000	600 000	3 207 500	2 392 500	1,75	74,59
T3	15,4	500	**7700000**	**1 044 000**	400 000	337 500	100 000	600 000	2 481 500	5 218 500	3,10	210,30
T4	12,7	500	**6350000**	1 552 000	400 000	337 500	100 000	600 000	2 989 500	3 360 500	2,12	112,41
T5	9,2	500	**4600000**	1 800 000	400 000	337 500	100 000	600 000	3 237 500	1 362 500	1,42	42,08
T6	16,5	500	**8250000**	1 800 000	400 000	337 500	100 000	600 000	3 237 500	5 012 500	2,55	154,83
T7	10,2	500	**5100000**	1 200 000	400 000	337 500	100 000	600 000	2 637 500	2 462 500	1,93	93,36

Table VII: Economic evaluation of different treatments in Bafoussam

Treatment	Yield (t)	Selling price per kg (FCFA)	Gross Revenue FCFA	Fertilizer purchase cost (FCFA)	Total labor cost (FCFA)	Pesticide purchase cost (FCFA)	Plot establishment cost (FCFA)	Harvest-related costs (FCFA)	Total production cost (FCFA)	Net Profit (FCFA)	VCR	Profitability Rate (%)
T1	5,1	500	2550000	0	300 000	337 500	100 000	**500 000**	**1 237 500**	1 312 500	2,06	106,06
T2	12,8	500	6400000	**1 620 000**	400 000	337 500	100 000	**600 000**	**3 057 500**	3 342 500	2,09	109,32
T3	17,2	500	8600000	**678 000**	400 000	337 500	100 000	**600 000**	**2 115 500**	6 484 500	4,07	306,52
T4	14,4	500	7200000	**820 000**	400 000	337 500	100 000	**600 000**	**2 257 500**	4 942 500	3,19	218,94
T5	10,9	500	5450000	1 800 000	400 000	337 500	100 000	**600 000**	**3 237 500**	2 212 500	1,68	68,34
T6	18,2	500	9100000	1 800 000	400 000	337 500	100 000	**600 000**	**3 237 500**	5 862 500	2,81	181,08
T7	11,7	500	5850000	1 200 000	400 000	337 500	100 000	**600 000**	**2 637 500**	3 212 500	2,22	121,80

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

DISCUSSION

The application of different treatments (poultry manure, NPK, and cow dung) in analyzed or non-analyzed plots significantly promoted the vegetative growth of tomato plants compared to the controls in both locations. Treatments based on layer chicken manure showed the highest values for agro morphological parameters (plant height, number of leaves, flowers and fruits).

Treatment T3 in the West region showed the greatest average plant height (73 cm) and the highest average number of leaves (24.66 leaves/plant). Treatment T6 in the West region showed the highest average number of flowers (8.83 flowers/plant) and the highest average number of fruits (34 fruits). The morphological parameters were higher due to the nutrients contained in poultry manure, which decomposes gradually and provides the plant with the nutrients it needs at all different stages of plant development. Unlike chemical fertilizers (NPK) which mineralize rapidly and cow dung which has slower mineralization time, layer chicken manure has the advantage of gradually releasing mineral elements to the plant, hence this higher vegetative growth and fruiting. These results are similar to those of Obabire (2024) and Agaba *et al.* (2023) who showed that poultry manure significantly improved vegetative growth parameters such as plant height, number of leaves and leaf area, flowers and fruits compared to other treatments. This would also be due to the high potassium content in poultry manure compared to cow dung. Coulibaly *et al*. (2022) showed that a good nitrogen-potassium combination contributes to improved plant vegetative growth, abundant flowering and fruiting with consequent yield increases. Mayele and Abu (2023) also showed that chicken manure readily releases essential nutrients such as nitrogen, phosphorus and potassium (NPK), which are crucial for tomato vegetative growth, and plants from manure-amended soil directly absorb these nutrients.

All treatments (NPK, poultry manure and cow dung) showed significantly higher yields compared to the control treatments in both locations and were significantly different, according to Tukey's test at the 5% threshold. The highest yields were obtained by treatment T6 (Poultry manure without analysis): 18.15 t/ha for the West and 16.54 t/ha for the Center, followed by treatment T3 (poultry manure after analysis): 17.20 t/ha for the West and 15.37 t/ha for the Center. Plots analyzed and amended with cow dung (T4) and NPK (T2) also obtained higher yields than treatments with NPK without soil analysis. The low yield observed in non-analyzed plots amended with NPK would be due to rapid mineralization of nutrients, particularly nitrogen (Obabire, 2024), on one hand, and nitrogen (N) inputs that are often overestimated without analysis, leading to unnecessary surpluses (pollution risk), on the other hand. Hartz et al. (2005) thus obtained a 10-15 % increase in tomato yields in plots managed with soil tests, thanks to precise nutrient balancing. Indeed, fertilizer application occurred at the start of the experiment, which allowed plots amended with poultry manure to gradually release mineral elements at all plant development stages. Similar results were obtained by Mayele and Abu (2023) who showed that poultry manure was a highly soluble fertilizer that improves plant growth and root development, leading to increased yields of Rio Grande tomatoes compared to goat and cow manure.

Furthermore, the C/N ratio of poultry manure is 19.725, indicating moderately rapid decomposition, good carbon/nitrogen balance and gradual N release, unlike cow dung with a C/N of 21.026, indicating slightly slower decomposition, somewhat higher carbon content and slower mineralization than poultry manure. These results are similar to Sawadogo et *al*. (2021) who demonstrated that the low yield obtained in the Bokashi treatment compared to the

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 8, Issue 2, 2025 (pp. 31-51)

Trichoderma harzianum-enriched compost treatment was due to the high C/N ratio in Bokashi, indicating low mineralization and nutrient release by this compost.

Overall, the applied treatments were more effective in Agro-ecological Zone III (Bafoussam) than in Zone V (Bibe). The results showed that all treatments applied in Bafoussam (Zone III) obtained higher agro morphological parameters (plant height, number of leaves, number of fruits per plant) and yields than those applied in Bibe (Zone V). This would be due to more favorable climatic conditions (Temperature: 21.59°C; Rainfall: 633.0 mm; Soil Moisture 30.25%) for tomato cultivation in Zone III than in Zone V (Temperature: 23.86°C; Rainfall: 300.0 mm; Soil Moisture: 9.57%). Indeed, ICRAF (2019) and Sonou et *al.* (2016) showed in their various studies on tomato cultivation that ideal conditions for optimal tomato production are Temperature: 22-28°C, Rainfall: 400-600 mm/cycle depending on varieties, and soil moisture 60-80%. Moreover, Bafoussam belongs to the West Cameroon region where soils are volcanic and very suitable for agriculture, particularly for vegetable crops (IRAD, 2018).

The highest yields and consequently the highest gross revenues were obtained by treatment T6 (Poultry manure without soil analysis) in both locations (9 100 000 FCFA for Bafoussam and 8 250 000 FCFA for Bibe). However, the highest net profits were obtained by treatment T3 in both locations (6 484 500 FCFA for West and 5 218 500 FCFA for Center) with VCRs of 4.07 and 3.10 respectively for Bafoussam and Bibe, followed by treatment T4 in Bafoussam which had a VCR of 3.19. Treatment T3 thus showed the best net profits and highest VCRs because production costs are lower than in T6 treatments. Indeed, T3 plots having been analyzed allowed the use of exact quantities of organic fertilizers unlike T6 treatments where fertilizers were used without considering nutrient quantities in soil and organic fertilizers. The results obtained are similar to those of several authors who showed in their work that the lower the production costs, the more profitable the treatments (Upite *et al.*, 2019; Alla *et al.*, 2021; Sawadogo *et al.*, 2021).

The value/cost ratio was greater than 2 for treatments T3, T4 and T6 in both locations; this implies that Rio Grande tomato cultivation was profitable according to standards defined by Delville (1996) and that these treatments can be recommended to farmers. Indeed, according to Fovo et *al.* (2016), an amendment with VCR greater than 2 in humid zones is considered profitable and can be disseminated to producers. Moreover, the profitability rates of these three treatments in Bafoussam, for example, indicate that T3 returns 3.06 FCFA per invested franc; T4: 2.18 FCFA versus 1.81 FCFA for T6. Treatment T5 showed the lowest profitability rate (68.34% in Bafoussam and 42.08% in Bibe). Although technically profitable in Bafoussam for example, the return is lower than control T1 (106%). Thus, each invested franc returns only 0.68 FCFA versus 1.06 FCFA for T1. This treatment is the least recommended to farmers because its VCR in Bafoussam for example is 1.68.

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

CONCLUSION

The study showed that all fertilizers (poultry manure, cow dung and NPK) applied increased the agronomic potential of Rio Grande tomatoes. Indeed, all agro morphological parameters (plant height, number of leaves, flowers and fruits) as well as yield were significantly improved by all treatments compared to the different controls. However, among the three fertilizers, poultry manure proved most effective for both vegetative growth and production, followed by cow dung.

The economic study showed that one hectare of Rio Grande tomato production was profitable for all studied fertilizers, especially in analyzed plots. T3 treatments induced the best financial returns while T5 treatments (NPK application without soil analysis) recorded the lowest yields and profitability rates.

Considering the results obtained, using poultry manure-based organic fertilizer could be an interesting alternative to conventional fertilizers, particularly chemical fertilizers (NPK + urea). This alternative based on using low-cost local natural resources that are ecologically sustainable could help reduce market gardener expenses, preserve the environment, sustainably manage soil fertility and guarantee harvest quality.

Key Priorities

- Policy: Financial incentives + soil testing access.
- Science: Optimizing organic formulations + long-term monitoring.
- Field adoption: Poultry manure + precision nutrient management.

These evidence-based recommendations aim to balance productivity, profitability, and soil conservation.

FUTURE RESEARCH AND FUNDING

"Assessing the synergies between precision irrigation and early disease diagnostic tools will be a promising research avenue for optimizing tomato production."

Horizon Europe provided financial support for this research (NESTLER - Project: 101060762 - HORIZON-CL6-2021-FARM2FORK-01).

REFERENCES

Agaba J., Osiru D. S. and Ndizihiwe D. (2023). Effect of Different Poultry Manure on the Performance of Tomatoes (*Lycopersicon esculentum* mill) *American Journal of Agriculture*. Vol.5, Issue 1, pp 1- 21

Agbede T.M., Adekiya A.O., Ogeh J.S. (2013). Effects of organic fertilizers on yam productivity and some soil properties of a nutrient-depleted tropical Alfisol. *Archives of Agronomy and Soil Science* 59(4–6): 803–822. DOI: 10.1080/03650340.2012.683423.

Agbede M. T., Adekiya A. O. and Eifediyi E. K. (2017). Impact of poultry manure and npk fertilizer on soil physical properties and growth and yield of carrot. *Journal of Horticultural Research*, vol. 25(1): 81–88 DOI: 10.1515/johr-2017-0009

Anguessin B., Mapongmetsem P. M., Ibrahima A. et Fawa G. (2021). Effet de la fertilisation organique à base de litière foliaire de *Jatropha curcas* L. et *Jatropha gossypifolia* L. sur la culture de tomate *(Lycopersicon esculentum* Mill.) à Guider (Nord/Cameroun). *Int. J. Biol. Chem. Sci.* 15(2): 524-535

Akande M.O., Oluwatoyinbo F.I., Makinde E.A., Adepoju A.S. and Adepoju I.S. (2010) Response of Okra to Organic and Inorganic Fertilization. *Nature and Science*, 8, 261-266.

Alla T.K., Bomisso L.E., Seydou T., Dick E.A., 2021. Effets de la fertilisation organique à base de pelure de banane plantain et de fiente de poulet sur les paramètres agronomiques et la rentabilité financière de l'aubergine N'drowa (*Solanum aethiopicum* L.) en Côte d'Ivoire, *Afrique Science* 18 (6): 25-38

Biaou O. D. B., Saidou A., Bachabi F. X., Padonou G. E. I., Balogoun. (2017). Effet de l'apport de différents types d'engrais organiques sur la fertilité du sol et la production de la carotte (*Daucus carota* L.) sur sol ferralitique au sud Bénin. *International Journal of Biological and Chemical Sciences,* 11(5): 2315-2326. DOI: https://dx.doi.org/10.4314/ijbcs.v11i5.29

Coulibaly A., Ouédraogo J., Nacro S. R., 4 and Serme I. (2022). Effets des fertilisants organiques sur la production de la tomate et les paramètres chimiques du sol au Centre Nord du Burkina Faso. *Afrique SCIENCE* 21(4): 10 – 27. http://www.afriquescience.net

Delville P.L. (1996). Gérer la fertilité des terres dans les pays du sahel: Diagnostic et conseil aux paysans. *Collection "le point sur"*. 201 pages

FAO Food and Agriculture Organization (2020). FAOSTAT. http://faostat3.fao.org

Fovo D. J., Tchatchouang T. M. C., Nkouankwi M. D. et Linda Sob Djougne S. L., 2016. Evaluation expérimentale de trois protocoles de traitement phytosanitaire et de l'effet de la fertilisation organo-minérale sur le mildiou et la rentabilité de la culture de tomate (*Solanum lycopersicum L.*) à l'Est- Cameroun. *Revue Agriculture.* 11: 69 - 79

Ghimire, R., Acharya, B. S., Bista, P., McDonald, L. M., & Poudel, D. D. (2022). Poultry manure as a sustainable organic fertilizer: Effect on soil properties and crop productivity. Agronomy Journal, 114(2), 1-15.

Hartz, T.K., Miyao, G., Mullen, R.J., Cahn, M.D., & Valencia, J. (2005). Soil testing and fertilizer recommendations for tomato production. *HortTechnology*, *15*(3), 462–468.

ICRAF (World Agroforestry Centre), (2019). Water requierement for vegetable crops in Central Africa

Institut de Recherche Agricole pour le Développement (IRAD, Cameroun). (2018). *Guide des sols pour cultures maraîchères en zone CEMAC*

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4

Madegnan D., Yabi J., Nouatin G. (2022). Rentabilité financière de la production de la tomate fraîche dans les communes de Klouékanmè et de Lalo. ISSN : 2728 *Revue Française d'Economie et de Gestion*. Volume 3 : Numéro 11, 24p

Matt Fisher (2018). La réduction des émissions de gaz à effet de serre dans l'agriculture grâce aux techniques nucléaires. *Bulletin de l'AIEA*, Vienne, Autriche, 2 p

Mayele Mayindo J. and Abu Rufas F., (2023). Determining the Effects of Selected Organic Fertilizer on Growth and Yields of Tomato (*Lycopersicon esculentum*: Var. Rio Grande Tomatoes) in Mundri West County, Western Equatoria State, South Sudan. *Agricultural Sciences*, 14, 1343-1374. DOI: 10.4236/as.2023.149089

Mowa E., Akundabweni L., Chimwamurombe P., Oku E. and Mupambwa H.A. (2017). The Influence of Organic Manure Formulated from Goat Manure on Growth and Yield of Tomato (*Lycopersicum esculentum*). *African Journal of Agricultural Research*, 12, 3061-3067. https://doi.org/10.5897/AJAR2017.12657

Obabire Sadiq Ola (2024). Effect of Poultry Manure and NPK (15: 15: 15) Fertilizer on The Growth and Yield of Tomato (*Lycopersicon esculentum* L.). *American Journal of BioScience*. Vol. 12, No. 4, pp. 133-138. https://doi.org/10.11648/j.ajbio.20241204.15

Ouedraogo J., Sawadogo A., Ouya M.B., Ouedraogo M. And Serme I., (2023). Performances agro-économiques du NPK super granule sur la productivité de la tomate sous irrigation en zone semi-aride du Burkina Faso. *Agronomie Africaine* 35 (3) : 413 – 425

Sawadogo J., Coulibaly J. D.P., Traore B., Bassole M. S. D., Cl Savadogo C. A., Legmaj. B. (2021). Effets des fertilisants biologiques sur la productivité de la tomate en zone semi-aride du Burkina Faso. *Journal of Applied Biosciences* 167: 17375 – 17390. https://doi.org/10.35759/JABs.167.8

Sawadogo J., Coulibaly J. D.P., Traore B., Bassole M. S. D., Kabore A. et Legma B. J. (2021). Amélioration des propriétés physico-chimiques et microbiologiques des sols par des fertilisants biologiques sous cultures de la tomate en zone Soudano-sahélienne. *Afrique SCIENCE* 19(4) : 189 - 202. http://www.afriquescience.net

Sonou, M., Amani, A., & Zougmoré, R. (2006). Smart irrigation systems for tropical agriculture: Case studies from West and Central Africa. *Agricultural Water Management*, 174, 28-39.

Thakur N. (2017) Organic Farming, Food Quality, and Human Health: A Trisec tion of Sustainability and a Move from Pesticides to Eco-Friendly Biofertilizers. In: Kumar, V., Kumar, M., Sharma, S. and Prasad, R., *Eds., Probiotics in Agroecosys tem, Springer*, Berlin, 491-515. https://doi.org/10.1007/978-981-10-4059-7_26

Upite J.T., Misonga A.K., Lenge E.K.M., Kimuni L.N. (2019). Effets des composts ménagers sur les propriétés du sol et sur la productivité des cultures légumières: cas de la tomate (*Lycopersicon Esculentum* Mill), *International Journal of Biological and Chemical Sciences* 13 (7): 3411-3428

Article DOI: 10.52589/AJAFS-WRNIW7O4
DOI URL: https://doi.org/10.52589/AJAFS-WRNIW7O4