*Original Research Article*

# Assessing the Production Potentials of Tomato (*Solanum lycopersicum*) using Two Seed Systems (Formal and Informal) in the Buea Municipality, Cameroon


## ABSTRACT

Tomato (*Solanum lycopersicum*) is the most extensively cultivated fruity vegetable in Cameroon, as its production has the potential to improve food security, as well as income stability for small-scale subsistence farming communities. Most studies on Tomato seed have focused on its response to environmental variations but there exist inadequate information on a comparative study of the use of formal and informal seed systems. This study was thus aimed at assessing the production potentials of two tomato seed systems (T1: Informal seeds, T2: Formal non-hybrid seeds and T3: formal hybrid seeds). Randomized CompleteDesign was used, with three treatments replicated thrice. A sample size of 20 plants were randomly selected from each experimental unit for data collection. T3 had the highest % germination (93%), while T2 had the least (72%). 4WAP, T3 had the tallest plants (69.53 ± 3.07 cm) and T2 had the shortest (50.03 ± 4.31cm), while T1 had the highest girth (8.40±0.75cm) and produced the most leaves (35.93± 6.14). T1 produced the most flowers (73.83 flowers) while T2 and T3 produced 19.83 and 62.93 flowers respectively with T1 producing the most fruits 27.6 as opposed to 4.23 fruits for T3 and 24.43 fruits for T2. T2 had a fruit weight 0.09 ± 0.14 Kg when compared to T1 (6.35 ± 5.67 Kg) and T2 (6.04 ± 4.29) with T1 having the highest fruit diameter (34.97 ± 3.54mm) and highest yield per ha (18.16 ± 16.20 ton/ha). This study showed that the informal seed system performed better germination percentage, growth and yield component than the formal seed system of tomato.



***Keywords:****germination performance, seed systems, yield components, formal hybrid seeds, informal seeds.*




## 1. INTRODUCTION

Tomato (*Solanum lycopersicum*L.) is a widely cultivated flowering plant in the Solanaceae family, known for its edible red berry. Although botanically classified as a fruit, it is commonly consumed as a vegetable [1, 2]. Tomatoes are versatile and consumed in various forms, including raw, as ingredients in dishes and sauces, and even in beverages [1]. Globally, tomatoes are among the most highly produced and important vegetables, with a significant presence in Cameroon, where they are extensively cultivated across all five ecological zones [3].

With approximately 5.2 million hectares of land dedicated to tomato cultivation worldwide, the global yield in 2021 was estimated at 189.1 million tons [4]. Vegetables, both traditional and indigenous, play a crucial role in diets worldwide and are recommended for their nutritional value [3, 5]. Tomatoes, in particular, are the second most consumed vegetable globally due to their rich nutritional content, including sugar, organic acids, minerals, and vitamin C [6,7].

In Africa, Cameroon ranks fifth in tomato production, with an estimated annual production of 889,800 tons and a growth rate of 9.4% [7, 8]. Tomato production in Cameroon plays a vital role in addressing food security and income stability for small-scale subsistence farming communities [9]. However, Cameroon's average energy consumption falls below the global average, with approximately 2300 Kcal/person/day [10]. Given the nutritional benefits of tomatoes, increasing their production can contribute to improving the nutritional status of the population.

Tomatoes are rich in vitamins, minerals, and antioxidants, such as lycopene, which has been associated with reducing the incidence of chronic diseases like prostate, breast, and cervical cancer, as well as cardiovascular disorders [1, 11, 12]. These health benefits, coupled with their versatility, have contributed to the global cultivation and consumption of tomatoes in various forms, including fresh in salads, cooked, and as snacks [1, 13].

The tomato food supply chain in Cameroon is a lucrative business involving multiple stakeholders, including producers, middlemen, wholesalers, retailers ("*bayamsellam*"), and consumers (hotels and restaurants) [9]. While a small percentage of tomatoes is exported to neighboring countries like Equatorial Guinea, Nigeria, and Gabon, the majority is consumed locally. Therefore, optimizing tomato production in Cameroon is crucial for enhancing food security and economic development.

The choice of seed system represents a significant challenge in tomato production, requiring careful decision-making. While tomatoes can be propagated vegetatively through tissue culture or grafting, seed propagation is considered the safest and most reliable method due to the transmission of virus diseases through vegetative propagation. Tomato seeds are available in various types of seed systems, broadly classified as formal or informal seeds. It is important to note that the anatomy, weight, composition, and metabolism of tomato seeds can significantly vary between different systems [14].

There is a prevailing misconception that all seed from the informal system is of low quality, while all seed from the formal system is of high quality. However, both high- and low-quality seeds can be found in any seed production system. Additionally, it cannot be assumed that all seeds obtained through the informal system are of good quality solely based on the mutual trust between the supplier and the consumer. Similarly, seed from the formal system cannot be assumed to be of high quality simply because it is labeled and packaged attractively. Thus, assessing the production potentials of both formal and informal seed systems is essential.

While previous studies have focused on the response of tomato plants to environmental variations, there is limited information available on the comparative study of formal and informal seed systems. Furthermore, the rising cost and limited supply of formal seeds, coupled with their seasonal availability, have led some farmers to prefer informal seeds due to their accessibility and availability.

Therefore, this study aims to assess the production potentials of tomato using two seed systems, namely formal and informal, in the Buea Municipality, Cameroon. By evaluating the performance of these seed systems, this research seeks to provide insights into optimizing tomato production methods and inform decision-making for farmers and stakeholders in the tomato industry.

## 2. MATERIAL AND METHODS

### 2.1 Study Site

The study was conducted at the Capuchin Organic Farm (TCOF) in Buea, South West Region of Cameroon. Buea municipality is located on the leeward side of Mount Cameroon, at coordinates 247.789˚N, 58.24˚S, with an elevation of approximately 530 m above sea level. The temperature ranges from 17-32˚C. The rainy season occurs from late March to September, with an annual rainfall exceeding 4000 mm. There is a short dry season from October to March. Tomato cultivation is predominantly carried out during the dry season due to favorable climatic conditions. The soil's volcanic nature, which makes it highly fertile.

### 2.2 Planting Material (Seeds)

Formal hybrid seeds (Cobra F1) and formal non-hybrid seeds (Rio Grande) were purchased from a certified seed seller, while informal seeds were obtained from healthy and ripe Cobra tomato fruits.

### 2.3 Nursery Preparation

A plot measuring 24 $m^2$ was cleared and left fallow for three weeks to allow for maximum weed germination and partial decomposition of green manure. The undecomposed grass was then removed and placed at the edge of the field. The soil was tilled to a depth of approximately 10 cm to eliminate and uproot deep-rooted weeds. This was followed by deep tilling to a depth of 30-40 cm to facilitate stone and shrub root removal. Two nursery beds, each measuring 8m long, 1m wide, and 30 cm high, were raised. Three parallel lines, spaced 30 cm apart, were created on the beds for the application of 16 kg of fowl droppings per bed. The manure was thoroughly mixed with the soil, and the beds were watered. The prepared nursery beds were watered daily for three weeks to ensure proper mineralization of the manure. Afterward, the soil along the three parallel lines was softened. Drilling was then performed along these lines, and each line was labeled. Both nursery beds were watered in the morning to ensure adequate soil moisture content before seed nursing at 5 pm.

### 2.4 Nursery Management

Weeding and softening of the nursery beds were carried out weekly to control weed infestation. COTZEB 80WP, a contact fungicide containing 80% Mancozeb as the active ingredient, was applied once a week for the first three weeks at a dose of 50ml per 16L of water. BANKO PLUS, a systemic fungicide containing Chlorothalonil and carbendazim as active ingredients, was applied at a dose of 50ml per 16L of water. LAMIDO GOLD 90EC, an insecticide containing 30g/L Imidacloprid and 60g/L Lambda cyhalothrin as active ingredients, was applied to the nursery three days before transplanting at a dose of 50 ml per 16L of water. Seedling hardening was performed by gradually reducing the shade once every week, with complete shade removal occurring one week before transplanting.

### 2.5 Germination Trial

For the germination trial, a 1 $m^2$ plot was designated in the nursery. One hundred seeds from each tomato seed system were counted and broadcasted along the three drilled lines. The remaining seeds (5g per treatment) were also broadcasted along the lines, covered with a 0.5 cm layer of fine soil, and lightly watered. A shade was then constructed over the nursery using wood and palm fronds to protect the seeds from excessive sunlight and rainfall. Germination of the seeds began on the 3rd day. After one week, pricking out was performed, and the experimental site was labeled. Seedlings were transplanted to the experimental field in the 4th week.

### 2.6 Field Preparation

The experimental site was cleared and left fallow for three weeks to allow weed germination and partial decomposition of green manure. The plot was then marked and squared to obtain right angles. One month later, the undecomposed grass was removed from the field. Shallow tillage, approximately 10 cm deep, was done out to eliminate and uproot deep-rooted weeds, followed by deep tillage, ranging from 30-40 cm deep, to facilitate stone and shrub root removal.

### 2.7 Experimental Design and Field Layout

The experimental design employed was a Randomized Complete Design (RCD) with three treatments (formal hybrid, informal, and formal non-hybrid), each replicated three times. Each experimental unit measured 16 $m^2$ (16m x 1m), resulting in a total of 9 experimental units within the entire plot. A 0.5 m alley separated each experimental unit, while a 1m alley surrounded the entire field. The three treatments were randomly assigned to the field.

### 2.8 Manure Application and Transplanting

Fowl droppings were applied to each bed at a rate of 32 kg/bed. The manure was thoroughly mixed with the soil and watered daily to ensure proper mineralization before transplanting the tomato seedlings. After two weeks of manure application, transplanting was done at dimensions of 50 x 70cm, by forming small holes at each point where a seedling was transplanted.

The nursery was watered thoroughly one hour before uprooting the seedlings. This stepwas aimed to ensure hydration of the seedlings and facilitate their uprooting with minimal root damage. The planting holes were then watered, and the uprooted seedlings were carefully placed in the holes. Soil was added to hold the seedlings firmly and erect. All transplanting activities were performed in the evening after 5:30 pm to minimize dehydration of the seedlings. The seedlings were watered after transplanting, and watering continued every evening and morning for two weeks to promote root system development.

### 2.9 Farm Management

The experimental field was regularly weeded to reduce competition between the crops and weeds. Manual weed removal was employed throughout the entire field. Pest and disease management techniques focused on integrated approaches to minimize the use of pesticides and promote eco-friendly agriculture. The following practices were implemented: constant monitoring of the field for pests and diseases, maintaining seedlings and plants' health through regular watering, weeding, and soil softening to enhance root growth and nutrients uptake for the plants' natural immune defense mechanism development, regular weeding to eliminate insect hiding places, and pruning to prevent moisture accumulation that favours fungal growth. Additionally, treatments with fungicide and insecticide were applied once a week. BANKO PLUS, a systemic fungicide containing Chlorothalonil and carbendazim as active ingredients, was used at a dose of 50ml per 16L of water. LAMIDO GOLD 90EC, an insecticide containing 30g/L Imidacloprid and 60g/L Lambda cyhalothrin as active ingredients, was used at a dose of 50ml per 16L of water.

Staking was carried out by attaching bamboo stakes to each plant using banana pseudo-stem cords to keep the plants upright. Regular pruning of old leaves and excessive branches was performed on a weekly basis to reduce moisture buildup around the plants and minimize the spread of diseases.

### 2.10 Data Collection

Twenty plants were randomly selected and tagged per experimental unit for data collection. The following parameters were measured as primary data:

**Final Germination Percentage** (FGP) was calculated by counting the number of germinated seeds each day from the first day of germination to the last day and expressing it as a percentage using the formula:

$$FGP = \frac{\text{Total number of germinated seeds}}{\text{number of seeds sown}} x100$$

**Mean germination time (MGT)** was calculated using the formula developed by Ellis and Roberts [15]:

$$MGT = \Sigma\ (\text{dn})/\Sigma\text{n}$$

*Where n = number of germinated seeds in a day and d = number of days*

Growth parameters were measured weekly and included the following:

- Plant height: Measured from the base of the plant to the apical shoot using a meter ruler.
- Number of leaves:number of fully formed leaves on each plant.
- Stem diameter: Measured at 2 cm above the soil using a Vernier caliper.
- Number of flowers per plant: Counted when the tomatoes started flowering.

Yield parameters were collected as follows:

- Days to 50% fruiting and 75% fruiting: Recorded from the start of fruiting.
- Number of fruits per plant: Counted from the tagged plants when they were 75% fruiting.
- Fruit weight: Determined by weighing the harvested tomatoes using an electronic weighing balance.
- Fruit diameter: Measured using a Vernier caliper on ten randomly selected healthy fruits per treatment.

### 2.11 Data Analysis

The collected data was entered into Microsoft Excel version 2016 and analyzed using the Minitab statistical software package version 16 at a significance level of 1-5%. Treatment means were compared and separated using Tukey's method at a 5% significance level. The results were presented in tables and figures. The relationship between variables was determined through Pearson correlation analysis (*P=0.05*).

## 3. RESULTS AND DISCUSSION

### 3.1 Assessing the germination potentials of tomato seed systems

Germination percentage is a commonly used parameter to evaluate seed efficacy. In this study, the informal and formal hybrid seeds exhibited FGP of 85 and 93, respectively (Fig. 2). The MGT of the different tomato seed systems revealed variations in the number of seeds that germinated per day. The formal hybrid tomato seeds exhibited the highest (28.15 seeds/day) daily MGT, while the informal seeds had the lowest (5.38 seeds/day) (Fig. 2).

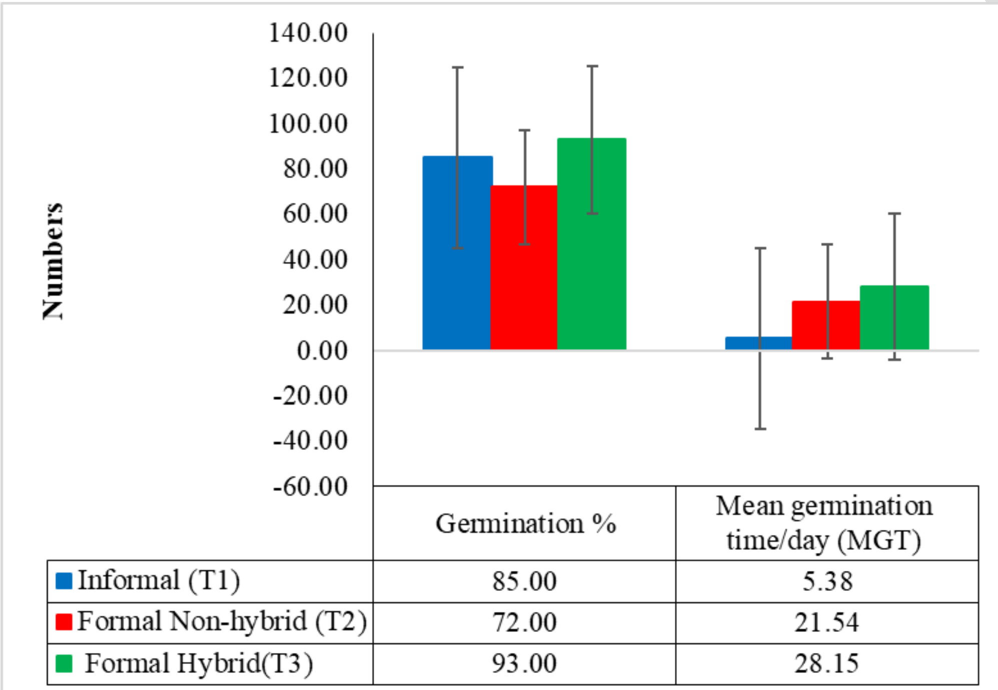



**Figure 1. Mean percentage germination and mean daily germination**

### 3.2 Assessing the Growth Potentials of Tomato Seed Systems

At 2 weeks after planting (WAP), the mean plant height of the formal hybrid seed (31.73±1.33cm) was significantly different (*P=0.001*) from the mean plant height of the informal and formal non-hybrid seeds (29.52±1.14cm, 26.42±1.57cm, respectively). However, at 3 WAP, there was no significant difference in the mean plant height among all the treatments. At 4 WAP, a significant difference (*P=0.001*) in the mean plant heightwas observed, with the plants from the formal hybrid seed being the tallest (69.53±3.07 cm), and the plants from the formal non-hybrid seeds being the shortest (50.03±4.31 cm) (Table 1).

The girth of plants from the informal seed system was significantly different (*P=0.001*) from that of the formal non-hybrid seed and formal hybrid seeds at 2, 3, and 4 WAP (Table 1). At 2 WAP, the plant girth of the informal seeds (5.03±0.51) was significantly different (*P=0.001*) from the formal non-hybrid seed and formal hybrid seeds (4.23±0.42 and 4.60±0.26, respectively), which were not significantly different from each other. At 3 WAP, there was no significant difference between the informal seeds and the formal hybrid seeds (7.67±0.82 and 7.17±0.36, respectively), but they were significantly different (*P=0.001*) from the formal non-hybrid seeds (6.13±0.69). At 4 WAP, the plant girth of the informal seeds (8.40±0.75) was significantly different (P=0.001) from that of the formal non-hybrid and formal hybrid seeds (7.40±0.49 and 7.97±0.66, respectively), which were not significantly different from each other.

The number of leaves produced was significantly different (*P =0.001*) for all treatments at 2, 3, and 4 WAP. In the informal seed system, 9.60±0.56 leaves were produced at 2 WAP, 20.17±2.36 at 3 WAP, and 35.93±6.14 at 4 WAP. In the non-formal hybrid seed system, 7.37±0.58, 11.97±1.62, and 16.17±3.11 leaves were produced at 2, 3, and 4 WAP respectively. In the formal hybrid seed system, 8.30±0.37 2, 17.87±1.75, and 29.97±4.26leaves were produced at 2, 3, and 4 WAP respectively (Table 1).

**Table 1.The mean growth and development of different tomato seed systems (± Standard Deviation)**

| Treatment | Plant Height (cm) | | | Plant Girth (mm) | | | No of Leaves | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2WAP | 3WAP | 4WAP | 2WAP | 3WAP | 4WAP | 2WAP | 3WAP | 4WAP |
| **Informal seed** | $29.52 \pm 1.14^{b}$ | $51.57 \pm 3.72^{a}$ | $64.43 \pm 4.66^{b}$ | $5.03 \pm 0.51^{a}$ | $7.67 \pm 0.82^{a}$ | $8.40 \pm 0.75^{a}$ | $9.60 \pm 0.56^{a}$ | $20.17 \pm 2.36^{a}$ | $35.93 \pm 6.14^{a}$ |
| **Formal non-hybrid seed** | $26.42 \pm 1.57^{c}$ | $40.53 \pm 1.99^{b}$ | $50.03 \pm 4.31^{c}$ | $4.23 \pm 0.42^{b}$ | $6.13 \pm 0.69^{b}$ | $7.40 \pm 0.49^{b}$ | $7.37 \pm 0.58^{c}$ | $11.97 \pm 1.62^{c}$ | $16.17 \pm 3.11^{c}$ |
| **Formal hybrid seed** | $31.73 \pm 1.33^{a}$ | $54.18 \pm 2.86^{a}$ | $69.53 \pm 3.07^{a}$ | $4.60 \pm 0.26^{ab}$ | $7.17 \pm 0.36^{a}$ | $7.97 \pm 0.66^{ab}$ | $8.30 \pm 0.37^{b}$ | $17.87 \pm 1.75^{b}$ | $29.97 \pm 4.26^{b}$ |

*Values represent Means were separated using Tukey HSD = 0.05.*

*Mean with similar letters within column indicate no significant differences among treatments*

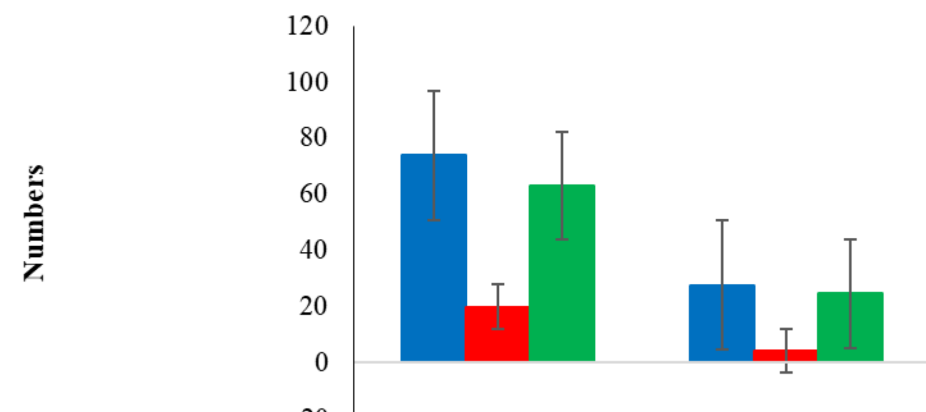
### 3.3 Assessing Flowering and Yield Potentials of Tomato Seed Systems

#### 3.3.1 Flowering Potentials of Tomato Seed Systems

Tomato plants from the formal hybrid seed system exhibited the highest number of flowers (73.83 flowers), while the formal non-hybrid tomato plants produced the fewest number of flowers (19.83 flowers), and the formal hybrid plants produced 62.93 flowers (Figure 2).

#### 3.3.2 Yield Potentials of Tomato Seed Systems

The number of fruits also differed significantly among the different tomato seed systems (Figure 2). The tomato plants from the informal seed system produced 3 and 23 more fruits compared to the plants grown from formal non-hybrid seeds and formal hybrid seeds, respectively (Figure 2).




| | No of Flowers | No of Fruits |
|---|---|---|
| Informal (T1) | 73.83 | 27.6 |
| Formal Non-hybrid (T2) | 19.83 | 4.23 |
| Formal Hybrid(T3) | 62.93 | 24.43 |

**Figure 2. The mean number of flowers and fruits of different tomato seed systems**

#### 3.3.3 Assessing Yield Components of Tomato Seed Systems

Mean fruit diameter from formal non-hybrid seeds (34.97±3.54 mm) was significantly lower (*P=0.001*) than the mean fruit diameter from informal and formal hybrid seed systems, which were not significantly different from each other (48.86±1.17 mm and 48.12±0.61 mm, respectively) (Table 2).

There was a significant difference (*P=0.001*) in fruit weight among the different seed systems. Mean fruit weight from formal non-hybrid seeds (0.09±0.14 kg) was significantly different (*P=0.001*) from the mean fruit weight of informal and formal hybrid seed systems, which were not significantly different from each other (6.35±5.67 kg and 6.04±4.29 kg, respectively) (Table 2).

The yield also showed a significant increase (P=0.001) across the different tomato seed systems (Table 2). Tomato yield from the informal seed system (18.16±16.20 ton/ha) and formal hybrid seed system (17.26±12.26 ton/ha) exhibited a significant increase compared to the formal non-hybrid seed system (0.26±0.39 ton/ha).

This result differs from that of Olaniyi *et al.* [16], who reported a low marketable yield for some tomato varieties used, possibly due to the non-development of flowers into fruits, as approximately 50% of the flowers developed into fruits.

**Table 2. The yield components of different tomato seed systems**

| Treatment | Fruit Weight (Kg) | Yield(ton/ha) | Fruit Diameter (mm) |
|---|---|---|---|
| Informal (T1) | 6.35 ± 5.67[a] | 18.16 ± 16.20[a] | 48.86 ± 1.17[a] |
| Formal Non-hybrid (T2) | 0.09 ± 0.14[b] | 0.26 ± 0.39[b] | 34.97 ± 3.54[b] |
| Formal Hybrid(T3) | 6.04 ± 4.29[a] | 17.26 ± 12.26[a] | 48.12 ± 0.61[a] |

*Values represent Means were separated using Tukey HSD = 0.05.*

*Mean with similar letters within column indicate no significant differences among treatments*

### 3.4 Relationships Among Different Variables of Tomato

To explore the relationships between the various variables assessed in this experiment, Pearson correlation analysis was conducted. The study revealed significant correlations among several growth, development, and yield component variables of tomatoes (Table 3). The number of leaves (0.72), number of flowers (0.79), and fruit diameter (0.81) exhibited a very strong positive correlation with plant height (*P = 0.001*). Furthermore, the number of leaves demonstrated a significantly high positive correlation (*P=0.001*) with the number of fruits (0.74) and fruit diameter (0.82). Additionally, fruit weight displayed a highly significant positive correlation (*P=0.001*) with yield (0.98).

**Table 3. Relationships among different variables of tomato**

| | PH | PG | NL | NF | FW | Y | FD |
|---|---|---|---|---|---|---|---|
| **PH** | 1.00 | | | | | | |
| **PG** | 0.43 | 1.00 | | | | | |
| **NL** | 0.72** | 0.67* | 1.00 | | | | |
| **NF** | 0.79** | 0.44 | 0.74** | 1.00 | | | |
| **FW** | 0.51* | 0.39 | 0.41 | 0.33 | 1.00 | | |
| **Y** | 0.50* | 0.40 | 0.42 | 0.33 | 0.98** | 1.00 | |
| **FD** | 0.81** | 0.53* | 0.82** | 0.88** | 0.43 | 0.42 | 1.00 |

*Pearson Correlation * Significance (p = 0.001); ** Strongly Significance (p = 0.001)*

*PH = Plant Height, PG = Plant Girth, NL = Number of Leaves, NF = Number of Fruit, FW = Fruit Weight, Y= Yield, FD =Fruit Diameter*

## 5. DISCUSSION

The results of this study indicate that formal hybrid and informal seed systems exhibited high Final Germination Percentages (FGP) and low Mean Germination Times (MGT). The lower mean germination time observed in formal non-hybrid seeds may be attributed to the maternal environment's influence on seed dormancy and germination, which could be mediated through seed size. Previous studies have shown that seed size can affect the chemical composition and provisioning of seeds, including minerals, photosynthates, and phytohormones, which in turn affect germination [17, 18]. The presence of germination inhibitors inside the seed may also contribute to the physiological conditions causing internal dormancy [19].

The decrease in plant height, plant girth, and number of leaves observed in formal non-hybrid seeds in this research may be attributed to low-potential environments characterized by variable soil and climate conditions or infection by seed-borne pathogens, including notorious soil-borne pathogens. Seed producers in the formal seed system are expected to provide samples free of seed-borne pathogens through seed health testing [20].

The study indicates that there was no significant difference in the number of flowers, number of fruits, fruit weight, yield, and fruit diameter between informal and formal seed systems. The increase in yield and yield components observed in both systems may be attributed to the adaptation of seeds from informal systems to local stress conditions, as they correspond to farmers' preferences and possess genetic diversity within varieties developed over time [21]. The poor performance of formal seed systems could be due to the use of out-growers for seed multiplication, who may employ similar agronomic practices as farmers but lack incentives to remove diseased plants. Another possible explanation is the lack of seed testing throughout the production cycle by seed companies [20].

The relationships among different variables of tomato revealed a strong positive correlation between the number of leaves (0.72), number of flowers (0.79), and fruit diameter (0.81) with plant height (P=0.001). This indicates that an increase in the number of leaves leads to an increase in plant height. The aerial shoot, comprising growth meristematic tissue and growth hormones such as cytokinin and auxin, plays a crucial role in this relationship. The increase in the number of leaves results in a larger leaf surface area per unit weight available for light interception and photosynthetic assimilation [22, 23]. Furthermore, fruit weight showed a highly significant positive correlation (*P=0.001*) with yield (0.98), suggesting that an increase in fruit weight leads to an increase in yield.

## 6. CONCLUSION

In conclusion, this scientific article explored the germination performance, seed system characteristics, and yield components of formal hybrid and informal seed systems in tomato production. The findings revealed that both formal hybrid and informal seed systems exhibited high germination percentages and low mean germination times, indicating good seed quality overall. The lower performance of formal non-hybrid seeds in terms of plant height, plant girth, and number of leaves could be attributed to environmental factors or seed-borne pathogens.

Interestingly, there was no significant difference in yield and yield components between the informal and formal seed systems, suggesting that the informal system, with its genetic diversity and adaptation to local stress conditions, performs comparably to the formal system. However, the formal seed system may face challenges in maintaining seed quality due to certain practices and inadequate seed testing.

Furthermore, the study identified positive correlations between variables such as the number of leaves, number of flowers, and fruit diameter with plant height, indicating their interdependency. An increase in the number of leaves led to greater plant height, allowing for increased leaf surface area and photosynthetic assimilation. Additionally, fruit weight exhibited a highly significant positive correlation with yield, indicating that larger fruits contribute to higher overall yield.

These findings emphasize the importance of seed quality, seed system management, and the interrelationships among different variables in tomato production. They provide valuable insights for farmers, seed producers, and researchers in optimizing seed systems and improving crop yield. Further research and measures to enhance seed quality and address the challenges faced by the formal seed system can contribute to sustainable and productive tomato production.

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