Influence of *Aloe Vera* Gel on Germination and Early Growth of Tomato (*Solanum lycopersicum*) Seedlings in the Nursery

Abstract

Tomato (*Solanum lycopersicum* L.) nursery production often relies heavily on chemical inputs to ensure vigorous seedling growth, which may have environmental and economic drawbacks. This study aimed to evaluate the efficacy of *Aloe vera* gel as a natural alternative to chemical treatments for improving germination and early seedling growth of Cobra 26 tomato seeds. The study used a factorial block design to compare the effects of seed treatments (*Aloe vera* gel coating, mancozeb, and untreated control) and substrate types (unfertilised topsoil, NPK-fertilised topsoil, and *Aloe vera* gel mixed with topsoil) on seed germination and seedling growth over three nursery cycles. Seeds coated with *Aloe vera* gel demonstrated the highest germination rate (90.53%) and fastest germination time (3 days), outperforming both mancozeb-treated and control seeds in germination kinetics. Growth parameters such as seedling height and leaf number were significantly influenced by substrate type ($p<0.03$), with no notable differences between NPK and *Aloe vera*-treated substrates.

The study suggests that *Aloe vera* gel, both as a seed coating and soil additive, offers a promising, eco-friendly alternative to chemical treatments, enhancing seed germination and early seedling growth in tomatoes.

Keywords: Solanum lycopersicumL.; Aloe vera; coating; germination rate; chemical inputs

1. INTRODUCTION

The tomato (*Solanum lycopersicum* L.) is one of the most widely produced vegetables in the world, both in the field and in vegetable gardens. According to some authors [1], global production has grown significantly between 1961 and 2018, from 27.6 million tonnes to 182.3 million tonnes. In addition to its economic importance, the tomato contributes to a healthy, balanced diet. Indeed, some studies have shown that regular consumption of tomatoes or tomato derivatives reduces the risk of cancer, cardiovascular disease, diabetes and osteoporosis [2].

Tomatoes are grown in many areas of Côte d'Ivoire, including the locality of Daloa[3]. For many smallholders in this town in central western Côte d'Ivoire, its production and sale represent a lucrative activity in rural, urban and peri-urban areas [4]. However, local tomato yields cover less than 60% of needs in Côte d'Ivoire. Annual yields in Côte d'Ivoire fluctuate between 22,000 and 35,000 tonnes for an estimated requirement of over 100,000 tonnes [5]. Moreover, national production, at 52,000 tonnes per year, is still far below the level needed to cover this demand [6,7]. According to several authors [8], low tomato production is due to increased pest pressure during the crop cycle and post-harvest losses. In addition, poor soil organic matter is also a constraint to intensifying tomato production [9].

Faced with these constraints, farmers resort to chemical fertilisers and pesticides to increase crop growth and yield. However, these farming practices pollute the environment, cause cancer in growers and, above all, lead to a considerable drop in soil fertility [10,11], which hampers the sustainability of the tomato sector. In order to reduce the negative impact of chemical inputs, plants with antifungal, antibacterial and biostimulant properties offer an alternative to chemical products. One such plant is *Aloe vera*[12,13].

Aloe vera, belonging to the Liliaceae family, is a succulent, perennial plant with fleshy leaves containing a colourless gel that is widely used in the food and pharmaceutical industries [14]. *Aloe vera* gel has beneficial properties for plant growth, playing an important role in cell elongation and promoting stem growth. It is considered a biostimulant for plants and can be used as a source of hormones in place of artificial growth regulators[15]. It is said to be rich in mineral elements and phytohormones such as gibberellin, indoleacetic acid, acetic acid and abscisic acid [16]. Application of *Aloe vera* gel diluted in water is reported to improve the growth and yield of Salvia officinalis L. [17].

In recent years, a research program on *Aloe vera* has been conducted at the Jean Lorougnon Guédé University to explore its immense potential for use in agriculture as a biopesticide [18,19]. The aim of this study is to assess the effect of freezing *Aloe vera* on the germination and growth of tomato seeds in the nursery.

2. MATERIAL AND METHODS

2.1Presentation of the study area

The experimental plot is located at the University Jean Lorougnon Guédé in Daloa. The town of Daloa is located in the Haut-Sassandra region, in central-western Côte d'Ivoire, between latitudes 6° and 7° north and 7° and 8° west. Daloa's soil substratum is part of the old Precambrian basement composed of granites and migmatites. The soils, leached and 20 m deep, are the result of heavy

rainfall and rapid weathering of the rocks. The region's soils are predominantly ferralitic. They are generally very deep, with a high organic matter content [20].

2.2Hardware

The material used in this study consisted of tomato seeds of the Cobra 26 variety, gel extracted from mature *Aloe vera* leaves harvested from the experimental field at the Jean Lorougnon Guédé University, a fungicide, mancozeb, commonly used for seed treatment, and NPK 15-15-15. The Cobra 26 tomato variety is produced by the Technisem seed company.

2.3Methods

2.2.1 Constitution of the growing medium and the gel of *Aloe vera*

The culture substrate consisted of topsoil taken from the University's experimental plot, then sterilised in a container placed over a fire for one hour. After cooling, 1200 cm^2 (48 cm x 25 cm) pots were filled with the resulting growing medium.

The *Aloe vera* gel was obtained from mature leaves, harvested and transported to the Plant Production Improvement Laboratory at the University Jean Lorougnon Guédé. The leaves were cleaned with water and detergent to remove all impurities. The thorns on either side were then removed. They were then laid flat on a cutting board and the thin layer on the underside was removed with a knife. The exposed gel was gently scraped off with a spatula, stored in a jar and ground to a liquid.

2.2.2Constitution of tomato seed lots

For the experiment, two (02) grams of seeds divided into three (03) batches of tomato seeds were used as treatments. These were the following batches:

- STM (tomato seeds treated with Mancozeb),
- STG (tomato seeds treated with Gel),
- SNT (batch of control seeds).

The STM batch consisted of tomato seeds treated with mancozeb, while the STG batch consisted of seeds coated with *Aloe vera* gel. Coating consisted of immersing the tomato seeds in the liquid gel to ensure complete adhesion. The SNT batch consisted of seeds that had not received any treatment.

2.2.3Setting up the experimental system

The experiment was carried out over three cycles: December to January 2022, April to May 2023 and June to July 2024. A wooden shelter covered with palm leaves was used to shade the tomato nurseries. A mosquito net was placed over the shelter to protect the seedlings from pests. Next, 18 labelled pots were filled with sterilised soil. These pots were placed under the shelter using a factorial block design (Fig. 1) with two factors (seed and substrate quality) and three replications. The tomato seed quality factor had three levels (2.2.2) and the substrate quality factor had three levels, namely:

- Sterilised, unfertilisedsubstrate (TS),
- Substrate sterilised and amended with gel (TG),
- Substrate sterilised and fertilised with NPK 15-15-15 (TNPK).

Once the pots had been placed in the shadehouse, six lines (06) of 10 pots were planted in each pot. Then, one tomato seed was sown per pot, giving sixty seeds per treatment and a total of 540 seeds for the experiment. Finally, the pots were covered with oil palm leaves.

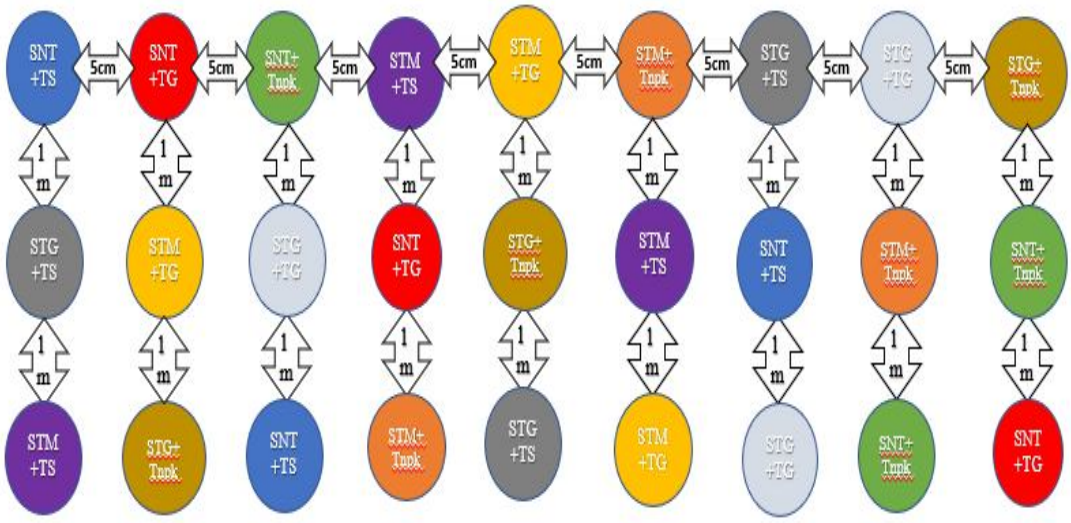

Fig. 1: Experimental design

SNT+TS : batch of control seeds on sterilised and unfertilised substrate, SNT+TG: batch of control seeds on sterilised substrate and amended with gel, SNT+Tnpk: batch of control seeds on sterilised substrate and fertilised with NPK, STG+TS: tomato seeds Treated with Gel on sterilised substrate and not fertilised, STG+TG: tomato seeds Treated with Gel on sterilised substrate and amended with Gel, STG+Tnpk: tomato seeds treated with Gel on sterilised substrate and fertilised with NPK, STM+TS: tomato seeds treated with Mancozeb on sterilised substrate and not fertilised, STM+TG: tomato seeds treated with Mancozeb on sterilised substrate and amended with Gel, STM+Tnpk: tomato seeds treated with Mancozeb on sterilised substrate and fertilised with NPK.

2.2.4Monitoring and data collection

The experiment lasted 21 days during the three (03) nursery cycles. In fact, the tomato nursery lasts twenty-one days before the young plants are transplanted to the field [21]. Monitoring consisted of watering the plants once a day (every morning before 8 a.m.) and regularly weeding the weeds in and around the pots. The parameters measured for the three cycles were the germination rate, the height of the seedlings and the total number of leaves produced. In addition to these parameters, germination kinetics were added for the June to July 2024 cycle.

2.2.4.1 Germination kinetics

Germination kinetics is a germination curve that describes the germination progress of the tomato seed batches tested. It represents the number of seeds germinated daily until the last day of the experiment [22].

2.2.4.2Average germination rate

The average germination rate is the ratio of the number of germinated seeds to the total number of seeds sown 14 days after sowing [23].

$$\text{Average germination rate} = \frac{\text{Number of seeds sprout}}{\text{Total number of seeds sown}} \times 100$$

2.2.4.3. Average seedling height

The average height of the seedlings was measured on the twenty-first day after sowing using a ruler graduated from the crown to the apex. This average height was estimated according to the formula below:

$$\text{Average height of seedlings} = \frac{\sum \text{length of seedlings}}{\text{Total number of sedlings}} \times 100$$

2.2.4.4Total number of leaves produced per seedling

The total number of leaves on each seedling was counted on the twenty-first day after sowing in order to estimate the degree of vegetative development of the seedlings. The average number of leaves produced by the seedlings was obtained using the formula below:

$$\text{Average total number of leaves emitted} = \frac{\sum \text{Total number of leaves enitted per seedling}}{\text{Total number of seedlings}}$$

2.2.5Data processing and statistical analysis

The data collected on the various parameters were subjected to a two-factor Analysis of Variance or ANOVA 2. The two factors were seed quality and growing medium quality. The ANOVA was completed by the Newman-Keuls multiple comparison test at the 5% threshold if the hypothesis of equality of means was rejected. This test was used to classify the means into homogeneous groups according to the mean values of the parameters analysed. All these analyses were carried out using Statistica 7.1 software.

3.Results

3.1Germination kinetics

Fig. 2 shows the curves for tomato seed germination kinetics as a function of the treatments and concerns the cycle from June to July 2024. The curves all have a sigmoid shape with three phases. A first phase which is the latent phase, a second exponential phase characterised by an acceleration of germination and finally a third phase characterised by a plateau indicating the cessation of germination.

The seeds coated with *Aloe vera* gel were all above the other curves, whatever the quality of the substrate, and showed a very short latent phase lasting 3 days, whereas this phase lasted between 4 and 5 days for the other treatments. As for the exponential germination phase, the seeds coated with gel reached maximum germination in 5 days. As for the seeds treated with mancozeb and the untreated seeds, they reached their maximum germination speed in 7 days before reaching the plateau. The treatment of seeds with *Aloe vera* gel reduced the lag time and accelerated seed germination, unlike the other treatments.

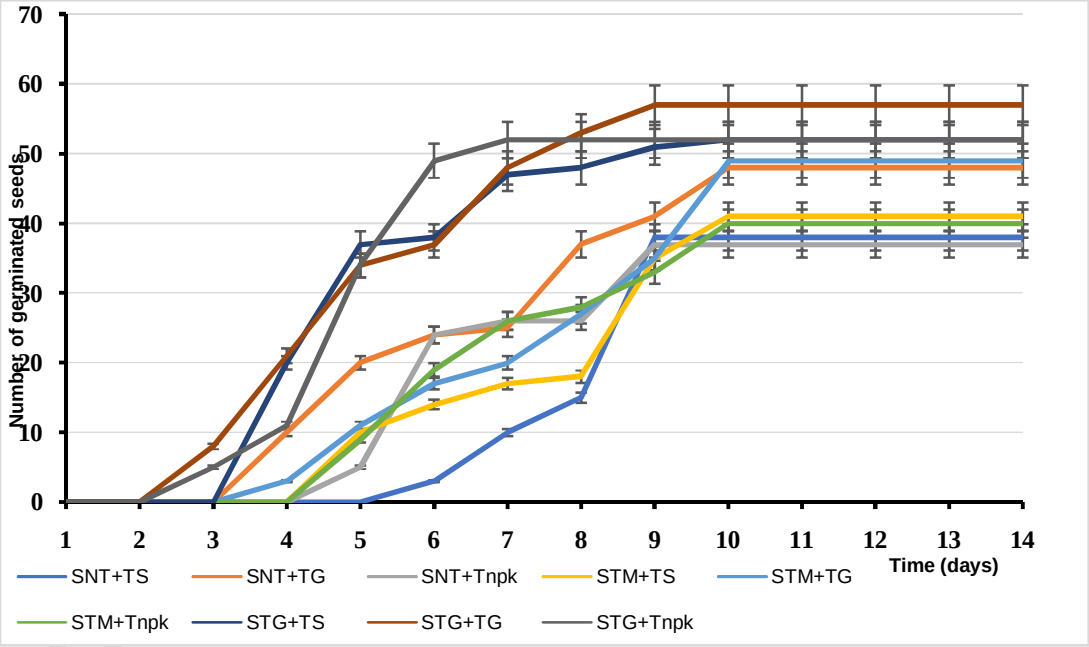

Fig. 2: Seed germination kinetics under the effect of the treatments.

SNT+TS: batch of control seeds on sterilised and unfertilised substrate, SNT+TG: batch of control seeds on sterilised substrate and amended with gel, SNT+Tnpk: batch of control seeds on sterilised substrate and fertilised with NPK, STG+TS: tomato seeds Treated with Gel on sterilised and unfertilised substrate, STG+TG: tomato seeds Treated with Gel on sterilised substrate and amended with Gel, STG+Tnpk: tomato seeds treated with Gel on sterilised substrate and fertilised with NPK, STM+TS: tomato seeds treated with Mancozeb on sterilised substrate and not fertilised, STM+TG: tomato seeds treated with Mancozeb on sterilised substrate and amended with Gel, STM+Tnpk: tomato seeds treated with Mancozeb on sterilised substrate and fertilised with NPK.

3.2 Effect of the interaction between substrate quality and seed quality on the average germination rate

The germinative capacity of tomato seeds was not influenced by the interaction between seed quality and substrate quality (Table 1) in any of the three nursery cycles. In fact, the analysis of variance of the results of the three cycles showed no significant difference between the treatments ($p > 0.05$).

Similarly, the quality of the substrates did not significantly influence the average seed germination rate after statistical analysis (Table 2) because the probability obtained with the three growing cycles was greater than 0.05. Substrates amended with gel and NPK had the same effect on the average germination rate compared with the unfertilised substrate.

However, seed germination capacity was significantly influenced by seed quality (Table 3) for all three cycles ($P<0.05$). Seeds coated with *Aloe vera* gel had a higher average germination rate (90.53%) than seeds treated with mancozeb (80.52%) and the control (66.63%).

Table 1: Effect of the interaction between seed quality and substrate quality on the average germination rate

	Substratequality		
	Cycle 1	Cycle 2	Cycle 3
Seedquality	December-January 2022	April-may 2023	June-july 2024
Probability	0.35	0.18	0.23

Table 2: Effect of substrate quality on average germination rate

	Average rate of germination		
	Cycle 1	Cycle 2	Cycle 3
Seedqualitys	December-January 2022	April- may 2023	June- july 2024
Probability	0.06	0.12	0.09

Table 3: Effect of seed quality on the average germination rate for the three cycles

	Averagerate of germination			
	Cycle 1	Cycle 2	Cycle 3	
Seedquality	December-January 2022	April- may 2023	June- july 2024	**Average**
SNT	58.10 ± 8.44^{c}	75.18 ± 6.30^{c}	66.60 ± 7.24^{b}	66.63 ± 7.32^{c}
STG	87.89 ± 4.96^{a}	93.00 ± 8.82^{a}	90.70 ± 3.53^{a}	90.53 ± 5.77^{a}
STM	71.56 ± 6.14^{b}	83.33 ± 5.47^{b}	86.67 ± 5.31^{a}	80.52 ± 5.64^{b}
Probability	0.00	0.00	0.00	0.00

Means followed by different letters are significantly different at the 5% level.

SNT: control seeds; STG: tomato seeds treated with gel; STM: tomato seeds treated with mancozeb.

3.3 Effect of the interaction between substrate quality and seed quality on the average height of seedlings

Table 4 shows the effect of the interaction of seed quality and substrate quality on mean seedling height after 21 days for the three nursery cycles. It was noted that the statistical analysis of mean seedling height was not significantly influenced by the interaction effect in any of the growing cycles. Substrate quality and seed quality had the same effect on seedling height ($p > 0.05$).

Table 4: Effect of the interaction between substrate quality and seed quality on the average height of seedlings in the three cycles

	Substratequality		
	Cycle 1	Cycle 2	Cycle 3
Seedquality	December-January 2022	April- may 2023	June- july 2024
Probability	0.49	0.28	0.37

Nevertheless, the analysis of variance of seed quality on average seedling height reveals a significant difference between treatments (Table 5) whatever the cycle. The greatest average height, compared with the control, was obtained with seeds coated with *Aloe vera* gel (12.32 ± 1.39 cm). This was followed by seedlings from seeds treated with mancozeb, which had an average height of 11.55 ± 1.40 cm. However, statistical analysis showed no difference. Finally, the lowest average height of the seedlings was obtained with the control seed lot and was 10.48 ± 1.29 cm on average.

Table 5: Effect of seed quality on average seedling height (cm) obtained during the three growing cycles**.**

	Averageheight of seedlings			
	Cycle 1	Cycle 2	Cycle 3	
Seedquality	December-January 2022	April-may 2023	June-julyt 2024	**Average**
SNT	10.75 ± 1.39^{b}	10.50 ± 1.06^{c}	10.19 ± 1.44^{b}	10.48 ± 1.29^{b}
STG	12.21 ± 1.60^{a}	13.50 ± 0.65^{a}	11.25 ± 1.92^{a}	12.32 ± 1.39^{a}
STM	11.11 ± 1.45^{a}	12.50 ± 0.87^{b}	11.03 ± 1.88^{a}	11.55 ± 1.40^{a}
Probability	0.00	0.00	0.01	0.00

Means followed by different letters are significantly different at the 5% level.

SNT: control seeds; STG: tomato seeds treated with gel; STM: tomato seeds treated with mancozeb.

As for the quality of the substrates on the average height of the seedlings (Table 6), statistical analysis also showed a significant difference ($P < 0.05$) between the substrates tested in the three cycles. Substrates amended with *Aloe vera* gel (10.49 ± 1.29 cm) and those fertilised with NPK (10.53 ± 1.36 cm) produced higher mean heights over the 3 cycles and were statistically identical. The lowest average height obtained over the 3 nursery cycles was with unfertilized substrates (7.81 ± 1.60 cm).

Table 6:Effect of substrate quality on average seedling height (in centimetres) over three cycles

	Averageheight of seedlings			
Substratequality	Cycle 1 December-January 2022	Cycle 2 April- may 2023	Cycle 3 June- july 2024	Average
TS	10.17 ± 0.85^{b}	5.93 ± 1.92^{c}	7.33 ± 2.03^{b}	7.81 ± 1.60^{b}
TG	11.27 ± 1.22^{a}	9.69 ± 0.87^{a}	10.52 ± 1.79^{a}	10.49 ± 1.29^{a}
TNPK	12.61 ± 1.54^{a}	7.95 ± 0.77^{b}	11.03 ± 1.78^{a}	10.53 ± 1.36^{a}
Probability	0.03	0.00	0.00	0.01

Means on the same line followed by different letters are significantly different at the 5% threshold.
TG: Substrate sterilised and amended with gel; TS: Substrate sterilised and not fertilised; TNPK: Substrate sterilised and fertilised with NPK.

3.4Effect of the interaction of seed quality and substrate quality on the total number of leaves produced by seedlings

Whatever the crop cycle, the interaction effect of seed quality and substrate quality on the total number of leaves produced by the seedlings showed no significant difference between treatments ($p > 0.05$) after statistical analysis (Table 7). Substrate quality and seed quality based on Aloe vera, mancozeb and NPK had the same effect on tomato seedling leaf emission.

Similarly, the effect of seed quality on the total number of leaves produced during the three cycles showed no significant difference between treatments (Table 8).

Table7: Effect of the interaction of substrate quality and seed quality on the total number of leaves produced during the three cycles

	Substratquality		
Seedquality	Cycle 1 December-January 2022	Cycle 2 April- may 2023	Cycle 3 June- july 2024
Probability	0.81	0.92	0.51

Table 8: Effect of seed quality on the total number of leaves produced

	Total number of sheets produced		
Seedquality	Cycle 1 December-January 2022	Cycle 2 April- may 2023	Cycle 3 June- july 2024
Probability	0.20	0.08	0.17

Table 9 shows the quality of the substrates in terms of the total number of leaves produced by the seedlings during the three growing cycles. Statistical analysis reveals a significant difference between treatments for all cycles. The highest number of leaves was obtained with substrates amended with *Aloe vera* gel (5.24 ± 0.52 leaves). This value was followed by seedlings whose

substrates were fertilised with NPK (4.80 ± 0.59 leaves). The lowest number of leaves was recorded with seedlings from control substrates (3.95 ± 0.78 leaves).

Table 9: Effect of substrate quality on the total number of leaves produced over three growing cycles

	Total number of sheets produced			
	Cycle 1	Cycle 2	Cycle 3	
Substratequality	December-January 2022	April-may 2023	June-july 2024	**Average**
TS	3.88 ± 0.60[b]	4.00 ± 0.79[b]	3.98 ± 0.95[c]	3.95 ± 0.78[c]
TG	4.58 ± 0.51[a]	6.00 ± 0.45[a]	5.15 ± 0.61[b]	5.24 ± 0.52[a]
TNPK	4.11 ± 0.60[a]	5.30 ± 0.49[a]	5.00 ± 0.68[a]	4.80 ± 0.59[b]
Probability	0.02	0.00	0.03	0.01

Means of the same line followed by different letters are significantly different at the 5% threshold.TS: substrate sterilised and not fertilised; TG: substrate sterilised and amended with gel; TNPK: substrate sterilised and fertilised with NPK.

4. DISCUSSION

Tomato cultivation faces many challenges, among which the choice of variety adapted to a given region according to the season, germination rate and yield per hectare are key criteria [24,25]. Tomatoes can be grown semi-directly, but given the extensive care required for young plants, it is advisable to use a nursery. This should be done in the shade using light soil rich in organic matter. However, because of the shortage of humus-rich topsoil, growers resort to risky chemical inputs to obtain vigorous seedlings ready for transplanting to the field. This study therefore aims to find an alternative to the use of chemical inputs in tomato nursery growth.

In this study, tomato seeds coated with *Aloe vera* gel showed a reduced lag time, an acceleration of their germination process and a maximum germination rate reached 5 days after sowing. These results are similar to those of Suleiman *et al.*[26], who showed that pre-treating *Nitraria retusa* seeds with *Aloe vera* gel improved germination. These authors attributed their results to the presence of gibberellic acid in the gel. Furthermore, Kaur *et al*. [27] showed that *Aloe vera* gel is a very favourable source of active oxygen for the germination process due to the presence of hydrogen peroxide (H_2O_2). The latter is a source of oxygen for seeds as they have an increased need for oxygen during the metabolic processes of germination [28]. In this context, the hydrogen peroxide contained in *Aloe vera* gel, adhered to the seeds by coating, would release oxygen when it decomposes [29]. This extra oxygen can penetrate the tomato seed coat more easily, giving it a better chance of germinating.

During the germination process of tomato seeds, three physiological phases have been observed. The first, known as the latency phase, includes the imbibition phase corresponding to the absorption of water by the seed. This is followed by the stage of intense metabolic activity for the expression of genes and the synthesis of enzymes capables of hydrolysing nutrient reserves destined for the development of the future seedling [30]. This phase takes place in the presence of oxygen and the presence of hydrogen peroxide in the gel could stimulate it [27]. The second is the exponential phase corresponding to the emergence of the radicle, which precedes the establishment of the seedlings and is materialised by an acceleration in germination. This phase requires a reduction in the mechanical resistance of the covering tissues and an increase in the internal force resulting from the expansion of the embryo [31,32]. The addition of *Aloe vera* gel to the seeds therefore helped to activate the hormones and enzymes contained in the seed reserves that are essential for germination.

Aloe vera gel therefore plays a vital role in increasing the germination rate as a natural regulator of plant growth [33]. *Aloe vera* gel therefore accelerates germination and increases the germination percentage of seeds [34]. These conclusions justify the better germination rates obtained with the batch of tomato seeds coated with *Aloe vera* gel than those treated with mancozeb and the control. Moreover, as mancozeb is a fungicide, it had a protective rather than a stimulating effect on the seeds, probably against fungi harboured by the seeds, as the culture substrates used in this study were heat sterilised. This protection was also provided by *Aloe vera* gel, whose biocidal properties, according to Michayewicz[14], inhibit the growth of certain micro-organisms. In addition, the hydrogen peroxide (H_2O_2) contained in the gel could help prevent the growth of moulds and bacteria while supplying oxygen to the seeds[35].

In general, the quality of tomato plants ready to be transplanted to the field is assessed on the basis of morphological criteria such as plant height and number of leaves. The study of the growth of young

tomato plants showed us that there is a remarkable effect of the substrate treatment fertilised with NPK and with *Aloe vera* gel on the plant height parameter. This can be explained by the physico-chemical properties of these two substrates. In fact, these two types of substrate contain mineral elements that promote good soil porosity and are essential for seedling growth. The tomato, like most cultivated plants, needs various mineral elements to ensure its growth throughout its cycle [36].

Tomato plants need to be fertilised with fertilisers rich in nitrogen, phosphorus and potassium in the early stages of development to encourage strong growth. The fact that tomato plants growing on substrates containing gel behave in the same way as those growing on substrates fertilised with NPK suggests that NPK is present in *Aloe vera* gel and in sufficient quantity to enable better growth of the seedlings. The mineral content of gel has already been documented. According to Dagne *et al.*[37], the gel contains minerals such as calcium, iron, magnesium, potassium, phosphorus and zinc. These minerals work in synergy to improve soil fertility and ensure energy transfer and protein synthesis, promoting the growth of young roots. In addition to its physico-chemical properties, *Aloe vera* gel contains biological properties favourable to optimal seedling growth, hence the greater number of leaves on tomato plants growing on substrates amended with gel compared with those amended with NPK or the zero-fertiliser control.

Erection of leaves and leaf segments involves changes in the frequency and polarity of cell divisions [38,39]. Growth hormones are thought to be involved in this process and auxin appears to be a universal inducer of organogenesis in plants. Hormones contained in aloe gel [40] have been shown to stimulate cell division, cell proliferation and organ elongation [41]. Hormones such as gibberellin, auxin and cytokinin have been reported in aloe gel. These results are in line with those of [42] who showed that *Aloe vera* gel increases the height and number of leaves of common evening primrose (*oenotherabiennis*).

5. CONCLUSION

This study assessed the effect of *Aloe vera* gel on the germination of tomato seeds and the growth vigour of seedlings as measured by their height and the total number of leaves produced at the end of the experiment at the nursery stage. The results show that treating tomato seeds with *Aloe vera* gel accelerated seed germination and improved their germination rate. The use of a substrate composed of soil mixed with gel accelerated plant height growth and the number of tomato leaves. So, to produce vigorous tomato seedlings that can be transplanted to the field, the seeds need to be treated and the growing medium amended with *Aloe vera* gel. This gel is rich in minerals and growth hormones, which are useful for good growth in the tomato nursery phase. *Aloe vera* gel could therefore be an alternative to the use of chemical inputs in tomato cultivation at a young age.

Disclaimer (Artificial intelligence)

Author(s) herebydeclarethat NO generative AI technologies such as Large LanguageModels (ChatGPT, COPILOT, etc.) and text-to-image generators have been usedduring the writing or editing of thismanuscript.

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