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Cutting Tubers During Planting Significantly Influences the Yield of Potato *Solanum Tuberosum* L.

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Abstract

This study, conducted in the Niayes region of Senegal, evaluated the effect of cutting potato (*Solanum tuberosum* L.) tubers on growth and yield. Two treatments, each repeated three times, were used: 50 g tubers cut in half (T1) and whole 50 g tubers (T2). Parameters such as plant emergence, plant height, number of shoots and yield were measured. The results demonstrate that using whole tubers significantly improves all measured agronomic parameters compared to cut tubers: emergence rate (92% vs. 85.7%), plants height (71 cm vs. 64.3 cm), number of shoots per plant (4.98 vs. 4.17), and yield (39.33 T/ha vs. 30.33 T/ha). These differences are statistically significant. This shows that, under the soil and climate conditions of the trial, planting whole, pre-germinated tubers is the most advisable option. It allows for better initial vigor, reduces physiological stress and disease risks, thus maximizing productivity. Although cutting can be considered to save planting material, it then requires specific practices to mitigate its drawbacks.

Keywords: Solanum Tuberosum, Tuber Cutting, Number of Shoots, Emergence of Plants, Plant Height, Yield

1. Introduction

The Niayes region is a unique environment characterized by dunes and depressions often flooded by the rising water table, and by a climate quite favorable to market gardening. The Niayes are characterized by two alternating seasons: a wet season concentrated over three months (July, August, and September) and a dry season lasting the remaining nine months, during which two cycles of market gardening take place (Diop *et al*. 2022) [6].

It is also characterized by physical conditions and a socio-economic context favorable to intensive agropastoral activities (Baldé *et al*. 2024) [1]. Horticultural activities in this area are largely dominated by market gardening (Cisse *et al*. 2021) [3].

The Niayes constitute an agro-ecological zone of vital importance to the Senegalese economy, producing 80% of the marketed vegetable production and 40% of the fruit (Baldé *et al*. 2024) [1].

Among the market garden crops grown, the potato (*Solanum tuberosum* L.) occupies a prominent place in the income-generating activities of family farms.

The potato is one of the most important cash crops contributing to global food security, due to its high yield per unit of cultivated land and time. Globally, it ranks fourth in importance among food crops after rice, wheat, and maize (Das *et al*. 2021) [4]. It is also an important source of protein, vitamins, potassium, as well as iron and zinc, which are important for breastfeeding women and children's growth (Tiozang *et al*. 2021) [19]. In the Niayes region, potatoes represent 17% of vegetable production (Lo *et al*. 2025) [12].

In this area, producers have developed and perpetuated a practice in potato cultivation, particularly the method of seed preparation. This involves cutting the mother tubers into several pieces, pre-germinating them, before planting. This practice is believed to conserve planting material and provide a better yield.

Although this practice is empirically established, its effect on yield, tuber quality and growth dynamics, compared to other planting methods, particularly sowing whole tubers, remains very poorly documented scientifically in the specific context of the Niayes.

The objective of this research is to study the effect of the method of preparing the potato plant on certain growth parameters and yield under the pedoclimatic conditions of the Niayes area.

2. Materials and Methods

2.1 Experimental Site

The study was conducted in the Niayes area at the Racines SA company farm (14°58'41.71"N, 17° 1'0.78"O) during the cool off-season campaign (November to March), a period conducive to potato cultivation.

The Niayes are a strip of land stretching from Saint-Louis to Dakar, nearly 180 km long and 30 to 35 km wide. The Niayes gave their name to the entire region of the northern Senegalese coast extending from Dakar to the southern edge of the Senegal River Delta. Administratively, this area falls within the four regions bordering the northern coast of the country: Dakar, Thiès, Louga, and Saint-Louis (Lo *et al.* 2025) [12].

2.2 Experimental Setup

Two treatments, each repeated three times, were used:

- T1: Whole 50g tubers
- T2: 50g tubers cut into two parts

Each treatment consists of a plank 10 m long by 1 m wide.

2.3 Plant Material

The potato is conventionally classified as a cold-season crop (Rozentsvet *et al.* 2022) [17]. Its optimal growth temperature is between 15 and 25°C (Vanderhofstadt and Jouan 2009) [20]. The tube-making temperature varies between 10 and 27 °C (Ngué *et al.* 2007) [15].

Variety: The Atlas variety was used. It is characterized by an upright growth habit and oblong fruit. The skin and flesh are yellow (ISRA 2012) [11].

For this purpose, tubers with an average weight of 50 g (35 mm caliber) were chosen.

2.4 Plant preparation

2.4.1 Pre-germination

The tubers were placed on a layer of damp sand with the crowns facing upwards and covered with a burlap sack. After a week, the ambient humidity encouraged sprouting.

2.4.2 Cutting tubers

The sections were cut the day before planting. The sections of tubers were left in the open air overnight to dry.

2.5 Cultural Management

The technical itinerary of the Horticultural Development Center of Senegal has been adopted for cultivation management (CDH 1997) [2].

2.5.1 Ground preparation

Regarding soil preparation, well-decomposed compost was spread at a rate of 10 kg per m². A 30 cm deep tillage was carried out for each bed.

2.5.2 Planting

Planting took place on November 2, 2023. The spacing was 0.6 meters between rows and 0.2 meters within the row. The pre-germinated tubers were placed 30 cm deep with the sprout facing upwards.

2.5.3 Fertilisation

A base fertilization consisting of 18 kg of well-decomposed compost, 0.4 kg of 10-10-20 fertilizer, and 0.4 g of superphosphate was applied by treatment. It was thoroughly incorporated by digging.

Maintenance fertilizer at a dose of 0.5 kg per treatment was applied on the 21st day after planting, and on the 42th day after planting. All treatments were followed by a humping.

2.5.4 Plant protection

Two preventative fungal treatments with Amistar (Azoxystrobin) and copper oxychloride were applied on the 30th and 50th days respectively after planting.

On the same dates, insecticide treatments with respectively Karate (Imidacloprid) and Decis (Deltamethrin) were sprayed.

2.6 Test Procedures

All the plots were planted on the same day. They received the same care with regard to fertilization, irrigation, hilling, weeding, and the same phytosanitary treatments.

2.7 Measured Parameters

- The plant emergence rate
- Plant height
- Number of shoots per plant
- Total yield

2.8 Data Analysis

Statistical analyses were performed using the R software. Means were compared using Student's t-test at a significance level of α = 5%. Normality tests were performed using the Shapiro-Wilk test.

3. Results and Discussion

The results of the statistical analysis of the effect of cutting on potato yield are presented in Table 1.

Analysis of the results shows that cutting the tubers (T1) significantly reduces emergence, height, number of shoots and yield compared to using whole tubers (T2).

Painting1Statistical analysis comparing T1 and T2

Observed parameter	T1 average ± standard deviation	T2 average ± standard deviation	p-value (Test t)	Meaning
Emergence (%)	85.73 ± 2.13	92.00 ± 2.00	0.008	**
Height (cm)	64.33 ± 1.53	71.00 ± 1.00	0.001	***
Number of shoots	4.17 ± 0.21	4.98 ± 0.14	0.001	***
Yield (T/ha)	30.33 ± 1.53	39.33 ± 1.53	0.001	***

*** = p < 0.01 (very significant), ** = p < 0.05 (significant), NS = not significant (p ≥ 0.05)

3.1 Plant Emergence

The treatment with whole tubers (T2) showed a mean emergence rate of 92.0% (standard deviation = 2.0%), significantly higher than that of the treatment with cut tubers (T1), which was 85.7% (standard deviation = 2.1%). The t-test indicates a significant difference between the two groups (p = 0.008). This trend is largely supported by the literature. Diop *et al.* (2019) [7] point out that whole tubers, especially if pre-sprouted, ensure rapid and uniform emergence (approximately 97–100%), while cut tubers exhibit slower and less regular emergence. Similarly, Nayak *et al.* (2023) [13] observed a higher emergence rate with whole tubers (about 90.5%) compared to cut tubers (79.8–87.9%). This delay or reduction in emergence is often attributed to cutting-induced physiological stress, moisture loss, and increased susceptibility to soil pathogens (Hirpa *et al.* 2010) [9]. However, some studies, such as that of Dayok *et al.* (2021) [5], do not report any significant difference, suggesting that the performance of cut tubers can be comparable to that of whole ones if each fragment contains at least two or three eyes and planting conditions are optimal.

3.2 Plant Height

The average height of plants under treatment T2 was 71.0 cm (standard deviation = 1.0 cm), compared to 64.3 cm (standard deviation = 1.5 cm) for T1. This difference is highly significant (p = 0.001). This observation is consistent with several studies. Nayak *et al*. (2023) [13] note that whole tubers produce taller plants (80.5 cm) than cut tubers (57 cm). Similarly, Nayem *et al*. (2024) [14] report a maximum height with whole tubers (approximately 53.1 cm) compared to reduced values for cut tubers (36.2–42.7 cm). This difference in vigor is explained by the fact that whole tubers have greater energy reserves and preserved tissue integrity, promoting more robust initial growth (Diop *et al*. 2019) [7]. Conversely, cut tubers must mobilize resources to heal the wound, which can delay and reduce vegetative development.

3.3 Number of Shoots per Plant

The average number of shoots was higher under T2 (4.98 ± 0.14) than under T1 (4.17 ± 0.21). The treatment effect was highly significant (p = 0.001). This trend is supported by (Hossain *et al*. 2011) [10] who observe that large whole tubers produce up to 8.4 shoots per plant, while tubers cut lengthwise into quarters produce only 1.6. Similarly, Nayak *et al*. (2023) [13] report a higher number of stems with whole tubers (approximately 6.34) than with cut tubers (approximately 4.2–5.6). Although cutting could theoretically break apical dominance and stimulate shoot multiplication Su *et al*. (2013) [18], the stress experienced and the reduction of nutrient reserves per fragment often limit bud development, resulting in a lower final number of stems.

3.4 Yield (T/ha)

The average yield is significantly higher with whole tubers (39.33 ± 1.53 T/ha) than with cut tubers (30.33 ± 1.53 T/ha). The difference is highly significant (p = 0.001). This superiority is consistently reported in the literature. For example, Diop *et al*. (2022) [6] find that whole pre-germinated tubers reach approximately 16.9 T/ha, compared to approximately 10–12.6 T/ha for cut tubers. Patrick and Nyamweha (2021) [16] have observed a yield more than double with whole tubers (approximately 1470.1 g/m²) compared to cut tubers (approximately 590.2 g/m²). Several mechanisms explain this difference: better initial vigor, more extensive tillering, a larger leaf surface area, and therefore increased photosynthetic capacity (Engels *et al*. 1993) [8]. Cutting not only reduces the individual growth potential of plants, but can also increase the proportion of small, unmarketable tubers, thus decreasing the marketable yield (Nayem *et al*. 2024) [14].

4. Conclusion

Our results confirm that, under the conditions of this study, the use of whole tubers is beneficial for all measured agronomic parameters. However, the literature shows that the performance of cut tubers can be improved by certain practices, such as controlled drying of the cut surface Su *et al*. (2013) [18] microbial inoculation Xu *et al*. (2014) [21] or reduced spacing Nayak *et al*. (2023) [13]. These techniques mitigate the risk of rot, stimulate physiological defenses, and optimize the use of tubers. In a context of reduced seed costs or a shortage of planting material, cut tubers can therefore be a viable alternative, provided these factors are controlled. Nevertheless, to maximize productivity and harvest quality, whole tubers remain recommended, particularly when seed availability is not a limiting factor.

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