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RESEARCH ARTICLE

NURSERY GROWTH OF TWO VARIETIES (PURPLE AND YELLOW) OF PASSION FRUIT [PASSIFLORA EDULIS L. (PASSIFLORACEAE)] GROWN ON VARIOUS SUBSTRATES

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ABSTRACT

The arable part of the land has often been used for the propagation of planting material for plants in general and passiflora in particular. Unfortunately, the growth of these plants is still not optimal on this substrate. It is therefore necessary to evaluate the growth of passiflora in nurseries on various substrates. The objective of this study is to evaluate the effect of various substrates on the growth of passion fruit in nurseries in order to improve its production. Seeds from purple and yellow varieties of passion fruit were sown on five substrates (composted sawdust (S1), forest topsoil (S2), a mixture of forest topsoil and sawdust ash (S3), soil from the experimental plot (S4), and a mixture of soil from the experimental plot and composted sawdust (S5) in polyethylene bags) using a split-plot design. The main results showed that the strongest growth was induced by S3, with a height of 24 cm, a diameter of 3.6 mm, and 10 leaves. In contrast, S1 and S5 induced the weakest growth, with lengths of 7 and 12 cm, diameters of 1.3 mm, and six leaves. However, this growth was optimal with the purple variety.

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INTRODUCTION

Agriculture plays a predominant role in Côte d'Ivoire's economy, accounting for more than 20% of gross domestic product (MAAF, 2015) and providing more than 60% of jobs (FAO, 2022). In order to meet growing needs in terms of nutrition, employment and income, the diversification of agricultural production is being encouraged, in particular through the introduction of fruit crops with high added value. These include passion fruit (*Passiflora edulis*). Native to South America, *Passiflora edulis* (Passifloraceae) is recognised for its richness in vitamins and antioxidants and for its many applications in the agri-food sector (Freitas et al., 2018). In West Africa, and more specifically in Côte d'Ivoire, however, its cultivation remains marginal, or even absent. The absence of *Passiflora* cultivation is due to several factors, including a lack of planting material. The little semen on the market is inaccessible to farmers because of its high price (12.000 CFA francs per 100g) (Nanti et al, 2025). Moreover, in Côte d'Ivoire, there are virtually no reports on *Passiflora* cultivation in general and its nursery in particular (Kouamé et al., 2020). Yet passion fruit cultivation represents a significant economic opportunity for local producers. For the mass production of planting material for plants in general and passiflora in particular, forest soil is often used as a growing medium in nurseries (Walser et al., 2021). Unfortunately, growth with this substrate is often unsatisfactory. It is therefore imperative to evaluate other substrates. The use of a large number of substrates would not only increase the production of plant

material, but also the productivity of passiflora. The general aim of this study is to assess the effect of substrates on the growth of passiflora plants in the nursery in order to obtain the quantity and quality of plant material required for its production.

MATERIALS AND METHODS

Study site: The trials were carried out on a plot within Nangui Abrogoua University (UNA) in Abidjan (Côte d'Ivoire). The average monthly temperature ranged from 25°C (August) to 29°C (December), while the maximum average rainfall was recorded in October (272 mm) and the minimum in February (29 mm) in the city of Abidjan. The vegetation of the UNA is typical of the rainforest zone. It is a continuation of the Banco National Park. The rainforest zone is home to hydrophilic or rainforest forests that are rich in lianas and epiphytes (Avit et al., 2009) [6].

Plant materials: Plant material consists of seeds from two varieties of passion fruit: purple and yellow (Figure 1).

METHODS

Basic constituents of substrates: Four basic constituents were used to formulate nursery substrates. These were forest topsoil, composted sawdust, soil from the experimental plot and sawdust ash.



Figure 1. passion fruit seeds. (A) purple; (B) yellow



Figure 2. Experimental design

Composition of nursery substrates: Five substrates have been formulated. Substrate S1 is made up entirely of composted sawdust, while substrate S2 is essentially made up of UNA forest topsoil. Substrate S3 is a mixture of forest topsoil and wood ash (v/v). Substrate S4 is composed solely of soil from the UNA experimental plot. Finally, substrate S5 is a mixture of composted sawdust and soil from the experimental plot (v/v).

Sowing seeds: The seeds were sown in 25.5 cm × 23 cm bags filled with substrates to a depth of 1 cm. The substrates in the nursery bags had been abundantly watered the day before and placed in the shade. In order to assess germination capacity and to have a sufficient number of seedlings to evaluate, two seeds were sown in each plastic bag. After emergence, the seedlings were separated to allow them to develop.

Experimental design: Split-plot system used consists of 3 blocks (Figures 2). Each block is made up of two sub-blocks: the varieties (main factor) and the substrates (5 substrates). Treatments from the second factor are randomly assigned to each sub-block (subsidiary factor). The blocks were spaced 50 cm apart, and the sub-blocks 25 cm apart. Within the same sub-block, batches of bags of one substrate (treatment) were separated by 20 cm. Twenty bags were used per treatment in each sub-block. That's 2 varieties X 5 substrates X 20 bags, so two hundred young plants were evaluated per block.

Statistical analysis of the data: STATISTICA version 7.1 software was used for statistical analysis of the data. One- or two-factor analysis of variance (ANOVA) was performed to assess the effect of different substrates on germination, rooting and biomass parameters.

Where a difference was observed, Tukey's multiple rank test at the 5% threshold was performed to separate the means. For percentage and index, an arc-sine-square root transformation of the proportion was first performed before analysis of variance.

RESULTS

The germinated passiflora seeds produced seedlings. These have now started to grow (Figure 3).

S1: composted sawdust; S2: forest topsoil; S3: combination of forest topsoil and sawdust ash; S4: soil from the UNA experimental plot; S5: combination of soil from the experimental plot and composted sawdust.

Effects of variety and substrate on the number of leaves on passiflora plants in the nursery: Figure 4 shows the number of leaves as a function of variety and substrate interaction in passion fruit plants. The results showed a significant difference ($p < 0.001$) in the number of leaves. Variété purple produced more leaves (10 leaves) on the forest topsoil (S2) and topsoil + ash (S3) substrates. Whereas the number of leaves of the Yellow variety was statistically similar on almost all substrates (varying between 7 and 9 leaves). The values of the bars surmounted by the same letter are statistically identical at the $\alpha = 5\%$ threshold (Tukey test; mean \pm standard error). S1: composted sawdust; S2: UNA forest topsoil; S3: forest topsoil + wood ash; S4: UNA experimental plot soil; S5: composted sawdust + experimental plot soil.



Figure 3. 65-day-old passion fruit plants on different substrates

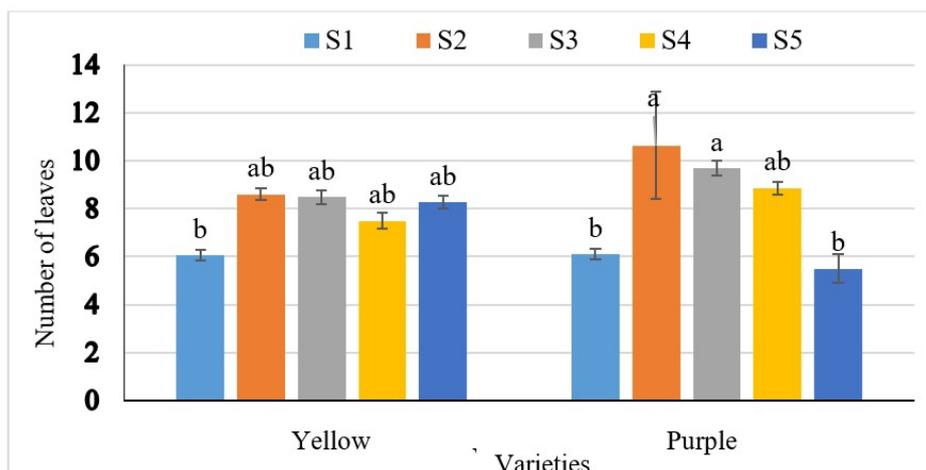


Figure 4. Number of leaves on six-week-old plants of two passiflora varieties growing on various substrates

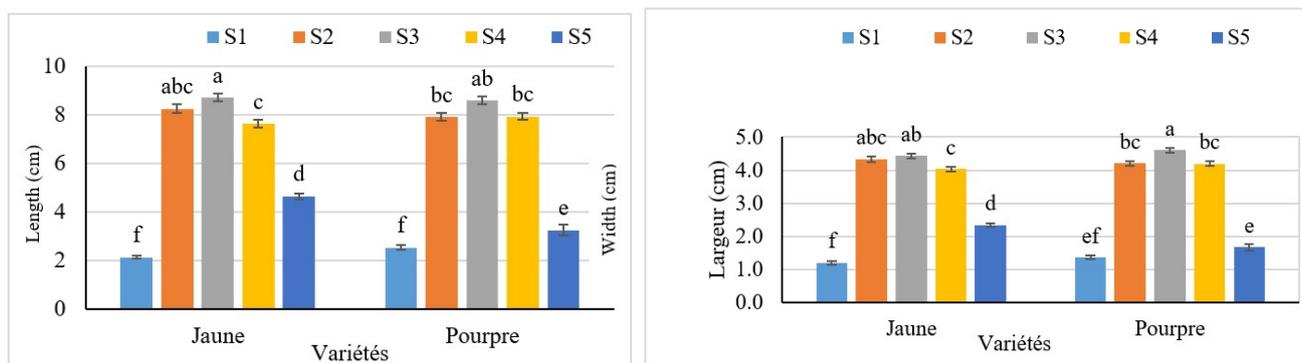


Figure 5. Leaf length and width of six-week-old plants of two passion fruit accessions growing on various substrates

Effects of variety and substrate on passiflora leaf growth in the nursery:

Figure 5 shows the variation in leaf dimensions of passiflora plants as a function of variety and substrate interaction. The results showed that leaf length and width were significantly influenced by the interaction ($p < 0.001$) between variety and substrate. The longest leaves (9 cm) were produced by the yellow variety on the combination of forest topsoil and wood ash (S3) and the widest (4.5 cm) by the purple variety on the same substrate 3. However, the substrates consisting solely of sawdust (S1) and the combination of composted sawdust + soil from the experimental plot (S5) produced the smallest leaves, regardless of variety. The values of the bars surmounted by the same letter are statistically identical at the $\alpha = 5\%$ threshold (Tukey test; mean \pm standard error). S1: composted sawdust; S2: UNA forest topsoil; S3: forest topsoil + wood ash; S4: UNA experimental plot soil; S5: composted sawdust + experimental plot soil.

Effects of variety and substrate on crown diameter of passiflora plants in the nursery: The collar diameters of six-week-old plants of the yellow and purple passionflower accessions growing on different substrates are shown in Figure 6.

Analysis of the values in this figure reveals that the interaction between these two factors was significant for plant collar diameter ($p < 0.001$). The largest diameters were obtained from the Yellow variety grown on substrates consisting of topsoil (S2) and a mixture of topsoil + ash (S3) and from the Purple variety grown on substrates S2, S3 and S4 (soil from the fallow plot). On the other hand, small-diameter seedlings were obtained in both varieties on the composted sawdust substrate (S1) and the combination of composted sawdust and soil from the experimental plot (S5). The values of the bars surmounted by the same letter are statistically identical at the $\alpha = 5\%$ threshold (Tukey test; mean \pm standard error). S1: composted sawdust; S2: UNA forest topsoil; S3: forest topsoil + wood ash; S4: UNA experimental plot soil; S5: composted sawdust + experimental plot soil.

Effects of variety and substrate on the growth of passion fruit seedlings in nurseries:

The values relating to the height of the passion fruit were used to construct the histogram in Figure 7. Analysis of these values reveals a highly significant difference ($P < 0.001$) between the different heights.

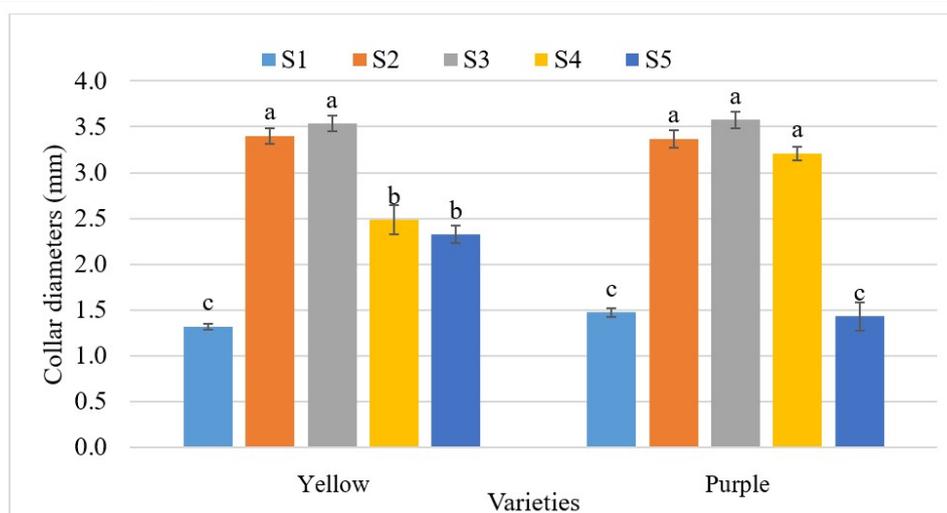


Figure 6. Neck diameter of six-week-old plants of two passion fruit varieties growing on different substrates

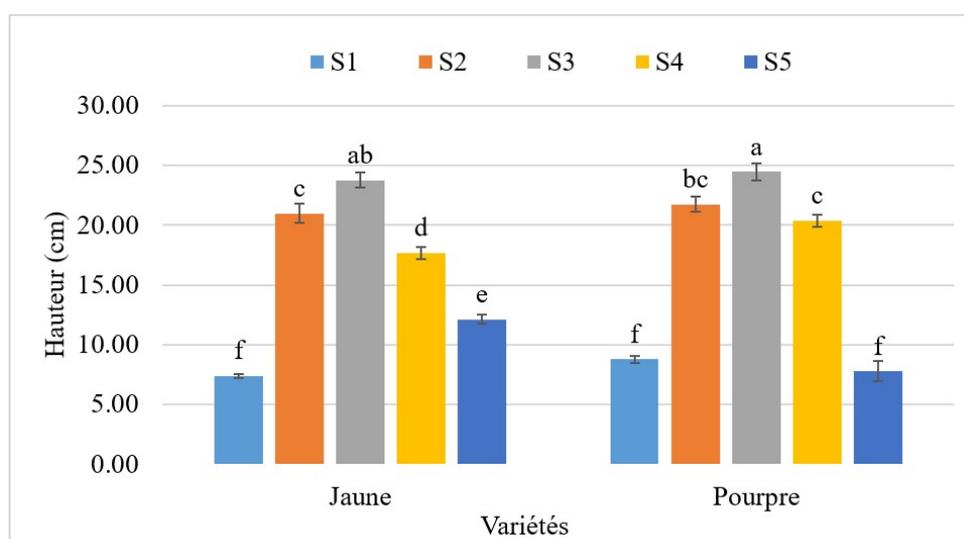


Figure 7. Height of six-week-old plants of two passion fruit varieties growing on different substrates



Figure 8. 3-month-old passiflora plant

The greatest heights were obtained with the two varieties on the substrate mixture of forest topsoil and wood ash (S3), while low growth was induced by the Yellow variety on the composted sawdust substrate (S1) and the Purple variety on substrates S1 and S5.

Effects of variety and substrate on tendrils formation of passiflora plants in the nursery: The analysis of variance carried out beforehand and taking into account the variety and substrate factors did not reveal any accession effect or interaction, but only a substrate effect ($P < 0.001$).

The results relating to the time taken for tendrils to appear (Figure 8) for the two varieties are given in Table 1. Analysis of these results indicates that substrates have a significant effect on tendril emergence time. Tendrils appeared earlier (46 days) on the plot soil substrate (S4) and later (90 days) on the forest topsoil (S2) and mixed topsoil and wood ash (S3) substrates. However, at 100 days of observation, no tendrils were observed on plants grown on S1 and S2.

Table 1. Effect of substrate on the appearance of passiflora tendrils

Substrates	Délai d'apparition des vrilles
S1	Pas de vrilles c
S2	90 ± 4.31 a
S3	91.5 ± 4.30 a
S4	46.66 ± 48.82 b
S5	Pas de vrilles c
P	< 0.001

In the same column, figures followed by the same letter are not significantly different at the $\alpha = 5\%$ threshold (Tukey test; mean \pm standard error).

S1: composted sawdust; S2: UNA forest topsoil; S3: forest topsoil + wood ash; S4: UNA experimental plot soil; S5: composted sawdust + experimental plot soil.

DISCUSSION

Our investigations into the growth of passiflora plants in the nursery have shown that the growth of passiflora depends on the variety and the growing medium. Growth was most influenced by substrate composition. Strong growth was stimulated by substrate S3 compared with substrates S1, S2, S4 and S5. These results could be explained by the composition of these different substrates. The S3 substrate is made up of a combination of forest topsoil and wood ash. Forest topsoil is very rich in humus and micro-organisms. The sawdust ash may contain mineral elements released by the incineration of the sawdust. Substrate S3, with its composition of forest topsoil, would be well aerated and rich in organic matter. The ash would also be rich in minerals of all kinds, such as potassium, phosphorus, magnesium and trace elements (Renaud, 2012). It would therefore make these immediately absorbable mineral elements available to the plant. These results are in line with those of Nguema *et al* (2014), who studied the effect of growing substrates on the growth parameters of *Gambeya lacourtiana* in the nursery. They found that a substrate made up of 70% forest soil was better for the growth of this species. Weigel (1994) and Ammari *et al* (2003) have shown that the most suitable substrate for agroforestry nurseries is forest topsoil. However, substrates S1 and S5 induced poor growth in both varieties. These results may be linked to the constituent elements of these substrates. Substrate S1 consists solely of composted sawdust. Sawdust is rich in calcium. This high calcium content could inhibit the absorption of magnesium, boron, potassium and iron. In addition, sawdust is compact and therefore retains water (Schippers, 2007). Koua (2015) also observed poor growth in plantain vivoplants during acclimatisation on sawdust. Substrate S5 consists of soil from the experimental plot at Nangui Abrogoua University and composted sawdust. According to Zainab (2020), this plot, which has long been overexploited, is low in macroelements such as nitrogen. Nitrogen plays an essential role in plant growth. The symptoms of a nitrogen deficiency are reduced leaf growth and reduced rhizogenesis. In addition, the calcium contained in sawdust may have an antagonistic effect on minerals such as magnesium, boron, potassium and iron. Nitrogen deficiency coupled with a high calcium content would result in poor growth in passionflower plants (Schippers, 2007).

CONCLUSION

The aim of this study was to evaluate the effect of substrates on the growth of two varieties of *Passiflora edulis* (purple and yellow). The main results showed that growth was dependent on variety, substrate and accession-substrate interaction. Both varieties performed better on the S3 substrate (a mixture of forest topsoil and sawdust ash). However, the strong growth was induced by the purple variety.

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