

EFFECT OF SUBSTRATE TYPES ON THE SURVIVAL OF TOMATO VINE CUTTING TECHNOLOGY IN NIGERIA

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ABSTRACT

Due to the high cost of tomato seeds, it is important to fully exploit the seeds for economic gains. This has necessitated the use of vine cutting technology in tomato production from vegetative parts. However, the vine acclimatization substrates type plays important role in the survival of the cut vines. Hence, this study investigates three different substrate types (cocopeat, water and loamy soil) for their suitability for vines cutting. Seeds of three tomato genotypes were raised in hydroponics system containing dissolved cocopeat. At one month after planting, vines were cut from the plants into the three substrates in a Completely Randomized Design with three replicates. Data were collected on vine survival, days to new shoot formation, number of fruits per plant and the average fruit weight at harvest. Data collected were analyzed using ANOVA

and differences in the treatment means were separated using the Least Significant Differences at 5 % level of significance. Results obtained showed that the percentage vine survival across the substrates was insignificant with a success rate of up to 77 % in the loamy soil. However, new shoot formation was fastest in the cocopeat substrate (12.56 ± 0.53), while San marzano had the heaviest fruit size (20.73 ± 1.33).

Keywords: Vine cutting, Cocopeat, Vine Survival, Tomato, Acclimatization.

JEL Classification Codes: Q16

INTRODUCTION

Background Information

Tomato (*Solanum lycopersicum* L.) is an important vegetable that has gained much recognition because of its economic (Nasir et al., 2015) and nutritive properties in terms of protein, carbohydrate, vitamins etc (Vinha et al., 2014). However, the downside of this worldwide recognition is reflected in the high cost of tomato seeds which is usual means of its cultivation, as many farmers are interested in the production, which has placed more pressure in the demand for seeds for planting (Heder et al., 2010).

Although, tomato plants are usually cultivated through the zygotic seeds, it can also be propagated through the vegetative parts (vine cutting technology) (Ossai et al., 2020). In order to ease the pressure on the seed purchase, an alternative means of vegetative propagation needs to be considered. However, reports on the vine cutting technology system of propagating tomato are limited to the use of cocopeat substrate (Suvo et al., 2016; Ossai et al., 2020)..

Since nearness to raw material is an important factor to consider in choosing the substrate type to carryout vine cutting in an area, and owing to Nigerians dependence on the importation of cocopeat, it is then necessary to evaluate other plant anchor media along with the topsoil which can easily be found for free to carryout tomato vine cutting, hence, the purpose of this experiment.

Materials and Methods

Seeds of three genotypes of tomato (Red cherry large, Roma and San marzano) and hydroponic troughs were purchased from the soilless farmlab seed company, Abeokuta. The seeds (four per trough) were raised in hydroponics troughs containing dissolved cocopeat substrates (8 litres per trough). At one month after planting, the tomato vines were cut and planted in three different substrates (loamy soil, cocopeat and water) arranged in a completely randomized design (CRD) with four replicates. The vines were checked daily for the emergence of new shoots before being transferred to the hydroponics set up containing the cocopeat substrates also in a CRD with three replicates. The transferred vines were watered every three days interval and fertigated weekly with 100 ml cured and dissolved poultry manure in water solution (1 g / L). Data were taken on the percentage vine survival, days to the formation of new shoots, number of leaves at 3 and 5 weeks after vine transfer, days to 50 % flowering, number of fruits per plant and the average fruit weight per genotype. Data collected were analyzed using ANOVA (SAS 9.0 version) and differences in the treatment means were separated using the Least Significant Differences (LSD) at 5 % level of significance.

RESULTS AND DISCUSSION

The results obtained from this study shows that there were no significant differences among the genotypes, substrates and the genotype by substrate interactions in terms of the vines survival (%) and the number of fruits obtained from the survived vines at harvest. However, the substrates was significant in the number of days taken by the vines to form new shoots and the average fruit weight respectively, while the genotypes was significant in the number of days to new shoot formation and 50 % flowering respectively (Table 1).

Table 1. Effect of genotypes, substrates and their interactions on the survival, growth and yield of tomato plants propagated through vine cutting technology

Source of variation	Survival (%)	DTNSF	Number of new shoots		DT50%F	NOF	AFW(g)
			Week 3	Week5			
Genotypes	162.04ns	93.59**	0.78ns	0.11ns	36.70*	10.04ns	39.47ns
Substrates	162.04ns	12.70*	1.44*	2.11ns	16.93ns	4.15ns	178.92**
Genotype*substrates	92.59ns	10.37*	1.39*	3.89*	12.81ns	5.15ns	230.20**

DTNSF: Days to new shoot formation, DT50%F: Days to 50 percent flowering, NOF: Number of fruits and AFW: Average fruit weight

It took the roma tomato a period of 10.33±0.53 days to produce new shoot. This was significantly lower than the 14.56±0.53 and 16.67±0.53 days taken by Red cherry large and San marzano genotypes respectively. However, the roma tomato took significantly longer number of days (37.00±0.73) to reach 50 % flowering than both San marzano (34.11±0.73) and Red cherry large (33.11±0.73) which were significantly same. Then, the average fruit weight of San marzano (20.73±1.33) was not statistically different from the roma plant (19.73±1.33) but was significantly higher than the Red cherry large (16.71±1.33) (Table 2).

Table 2. Survival, agronomic and yield performance of three genotypes of tomato plants propagated through vine cutting technology

Genotypes	Survival (%)	DTNSF	Number of new shoots		DT50%F	NOF	AFW (g)
			Week 3	Week5			
Roma	77.78a	10.33c	3.22a	6.11a	37.00a	6.22a	19.73ab
SM	75.00a	16.67a	2.67a	6.00a	34.11b	7.33a	20.73a
RCL	69.44a	14.56b	2.78a	5.89a	33.11b	8.33a	16.71b
LSD _(0.05)	19.65	1.57	0.6	0.93	2.17	2.39	3.95
SE	6.61	0.53	0.2	0.31	0.73	0.8	1.33

LSD: Least significant differences, SE: Standard error, DTNSF: Days to new shoot formation, DT50%F: Days to 50 percent flowering, NOF: Number of fruits and AFW: Average fruit weight, SM: San marzano, RCL: Red Cherry Large

The cocopeat substrate took an average of 12.56±0.53 number of days to form new shoots, which was not significantly different from the use of water (14.11±0.53), but was significantly lower than the 14.89±0.53 days taken to form new shoot in the loamy soil. However, the average number of days taken by the vines rose using the water substrate

(33.22±0.73) to reach 50 % flowering was significantly lower than the 35.89±0.73 taken by the vines raised in the cocopeat substrate. Also, the average fruit weight of the tomato plants raised through vine cutting in the loamy soil (24.13±1.33) was significantly higher than the ones raised in water (17.28±1.33) and cocopeat (15.77±1.33) substrates respectively (Table 3).

Table 3. Effect of substrate types on the survival, growth and yield of tomato plants propagated through the vine cutting technology

Substrates	Survival (%)	DTNSF	Number of new shoots			NOF	AFW (g)
			Week 3	Week5	DT50%F		
Loamy soil	77.78a	14.89a	2.44b	5.44a	35.11ab	7.89a	24.13a
Cocopeat	75.00a	12.56b	3.22a	6.22a	35.89a	7.44a	15.77b
Water	69.44a	14.11ab	3.00ab	6.33a	33.22b	6.56a	17.28b
LSD _(0.05)	19.65	1.57	0.6	0.93	2.17	2.39	3.95
SE	6.61	0.53	0.2	0.31	0.73	0.8	1.33

LSD: Least significant differences, SE: Standard error, DTNSF: Days to new shoot formation, DT50%F: Days to 50 percent flowering, NOF: Number of fruits and AFW: Average fruit weight

Though not significant, the percentage survival of the cut vines was highest in the loamy soil and was above 75 % as obtained in cocopeat substrate which was imported into the country as its not produced locally. The cocopeat substrate has been reported as a good source of nursing cut tomato vines (Ossai et al., 2020). However, considering the economic implication of using the cocopeat substrate, the use of locally available substrate like the loamy soil and water which are gift of nature is important, although, water alone gave less than 70 % survival. Like the survival rate, the number of leaves produced by the vines after being transferred to the cocopeat substrate 5 weeks after cutting was also not significant, but the vines raised in water substrate had the highest number of vines. Although the vines did not complete their life cycle in the water system, the high biomass produced is in line with the work of Khan et al., (2011).

A loose substrate is very important in vine rooting and the subsequent adaptation in an environment and peats has been the standard substrates used for nurseries (Pascual et al., 2018). This supports the findings of this study, where the cocopeat substrate developed new shoots within the shortest day interval to the use of loamy soil. However, the days taken was similar to the vines in water. The production of new shoot is an indication that the vines has fully developed functional rooting system, and the lose nature of cocopeat allows the quick root development comparable to the loamy soil.

However, despite the early formation of shoots from the vines raised in cocopeat substrate, it was the ones raised in loamy soil that developed flower earliest, had the highest number of fruits and the fruits were also heavier. This could be a result of additional organic matters present in the loamy soil which complemented the poultry manure used in fertigating the plants. Hence, more essential nutrients could be made available to the plants which enhance the physiological development of the plants in the hydroponics system. Different hydroponics systems has been effectively used in the cultivation of tomato (Ednut et al., 2011), hence the reason behind the adaptive nature of the tomato genotypes evaluated in this study.

The survival rate of the three different genotypes was also high and insignificant, however, the roma tomato adapted faster to the environment as it developed new shoots at a quicker rate than the rest genotypes, but the early shoot formation was not reflective in the days

it took the genotype to produce flower. A similar report on improved agronomic parameters of roma tomato has also been reported by Suvo et al. (2016). However, the average fruit weight of the San marzano genotype was the heaviest among the genotypes. The above differences in the survival, agronomic and yield parameters of the three genotypes are a reflection of the inherent genetic differences among them.

CONCLUSION AND RECOMMENDATIONS

Reports on tomato vine cutting in Nigeria have been limited to the use of cocopeat substrate. However, the cost of purchasing the substrate is high as the substrate is sourced outside the country. The findings of this study have shown that the use of topsoil which can be easily sourced in the country can give as much success as the cocopeat substrate in the vine cuttings of tomato in Nigeria, and thus recommended as a suitable substrate for tomato vine cutting.

REFERENCES

- Endut, A., Jusoh, A., Ali, N., & Wan Nik, W. B. (2011). Nutrient removal from aquaculture wastewater by vegetable production in aquaponics recirculation system. *Desalination Water Treat*, 32, 422–430.
- Heder, B., Paulo, C. C., José, A. T. D., José, F. T. D., & Edvaldo, F. D. (2010). Tomato seedling production by cuttings rooted in different substrates. *IDESIA*, 28(1), 9-15.
- Khan, M., Jan, M., Farhatullah, D., Khan, D. N., Arif, M., Perveen, S., Khan, S., Abbas, A. & Jan, A. (2011). The effect of using waste water for tomato. *Pakistan Journal of Botany*, 43, 1033-1044.
- Nasir, M. U., Hussain, S., & Jabba, S. (2015). Tomato processing, lycopene and health benefits: a review. *Science Letters*, 3(1), 1-5.
- Ossai, C. O., Ogbale, S., Balogun, M. O., Akpeji, S. C., Olorode, E. M., & Taiwo, J. O. (2020). Tomato Production through Vine Cutting Technology in Hydroponics System. *Journal of Environmental and Agricultural Studies*, 1(2), 1-5.
- Pascual, J., Ceglie, F., Tuzel, Y., Koller, M., Koren, A., Hitchings, R., & Tittarelli, F. (2018). Organic substrate for transplant production in organic nurseries. A review. *Agronomy for Sustainable Development*. 38. 10.1007/s13593-018-0508-4
- Suvo, T. P., Biswas, H., Jewel, M. H., Islam, M. S., & Khan, M. S. I. (2016). Impact of substrates on soilless tomato cultivation. *Int. J. Agric. Res. Innov. and Tech*, 6(2), 82-86.
- Vinha, A. F., Barreira, S. V. P., Costa, A. S. G., Alves, R. C., & Oliveira, M. B. P. P. (2014). Organic versus conventional tomatoes: Influence on physicochemical parameters, bioactive compounds and sensorial attributes. *Food and Chemical Toxicology*, 67, 139–144.

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