INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 21, No. 5, p. 185-189, 2022
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Influence of defoliation on survival and growth of rooted *Magallanes* Pummelo [*Citrus maxima* (Burm.) Merr.]

Analyn V. Sagun*, Virgilio M. Libunao

College of Agriculture, Don Mariano Marcos Memorial State University, North La Union Campus, Bacnotan, La Union, Philippines

Article published on November 20, 2022

Key words: Defoliation, Foliage, Clones, Shoot initiation, *Magallanes* pummelo

Abstract

The study determined the influence of defoliation on the survival and growth of rooted '*Magallanes*' Pummelo marcots at the Don Mariano Marcos Memorial State University-North La Union Campus, La Union, Philippines. Employing the Randomized Complete Block Design (CRBD) with three blocks, 10 sample plants or marcottage were used per treatment. Three treatments were used including complete removal of all leaves (T_1), removal of half the number of leaves (T_2), and no removal of leaves (T_3). Three *'Magallanes'* Pummelo trees at fruit bearing stage were used as parent stocks. Results indicated that removal of half the number of leaves and no removal of leaves comparably gained 100% survival of rooted pummelo marcots as compared to complete removal of leaves which recorded lower survival rate. All other parameters were found having insignificant differences.

***Corresponding Author:** Analyn V. Sagun ✉ esagun@dmmmsu.edu.ph

Introduction

Marcotting is the most common type of layerage in nurseries around the Philippines. It is employed to produce a new crop of young proportioned foliage plants from old ones that have too much stem or grown too tall and lanky. The principal advantage of marcotting is the success with which stem will develop roots. Many clones whose cutting will not root easily can be propagated by marcotting, enabling the plants to be established on its own roots. Leaves play an important role in determining photosynthetic potential and have significant effect on yield responses (Lawlor, 2001). Any modification in plant canopy (the above ground portion of plants) affects photons absorbed by plants and their photosynthesis of individual leaves (Beadle *et al.*, 1985). Defoliation has been practiced worldwide involving the complete or partial removal of leaves to provide an opportunity for the photosynthetically active younger leaves to grow, efficiently utilize available water and mineral nutrients and influence source-sink relations (Iqbal *et al.*, 2012).

Ryle and Powell, (1975) explained that after defoliation, the rate of photosynthesis of the remaining two older leaves fell to 90–95 per cent of that of control leaves, but they exported more of their assimilated carbon to meristems elsewhere in the plant during the first 48 h after the defoliation. Defoliation basically consists of removing part of the shoot organs of plants and is primarily characterized by its intensity (or severity) and its frequency (or its inverse, the defoliation interval).

In several instances, defoliation also needs to be characterized by additional parameters, such as its spatial heterogeneity or its timing in relation to plant development. Hence, this study was conducted to determine the influence of defoliation on the survival and growth of rooted marcots.

Materials and methods

Research Design

This study was laid out employing the Randomized Complete Block Design (RCBD) in three blocks.

There were 10 sample plants or marcottage per treatment. The different treatments are as follows: T_1- Complete removal of all leaves; T_2 – Removal of half of the number of leaves; and T_3 – No removal of leaves.

Three '*Magallanes*' pummelo trees at fruit bearing stage were used as parent stocks. Other materials used such as sharp knife, hyaline film, slightly moistened coconut husk, plastic strains for tying and ANAA was procured at DMMMSU-NLUC, Bacnotan, La Union, Philippines.

The parent stocks were applied with complete fertilizer (14-14-14) + muriate of potash (0-0-60) + Urea (46-0-0) of equal portion per tree. One week after fertilization, marcotting was done. The coconut husks as marcotting media was soaked in clean water for 24 hours. On the following day, sample twigs of the Magallanes pummelo trees with an approximate pencil size diameter were tagged. The tagged twigs were then marcotted following standard procedures i.e.; a ring of bark around the base of the twigs were removed based on the circumference of the stem. The cambium layer was scraped but not too deep into the wood and applied with the commercial strength of ANAA with the use of ordinary paint brush. The cut surface was wrapped with soaked coconut husk. Marcottage were properly tied to avoid spillage of the rooting medium and water. Marcots were injected with 10 ml *Dithane* solution at the rate of 1 tbsp/li to prevent occurrence of pathogenic fungi.

The marcots were harvested 90 days after marcotting. The leaves were removed based on the treatment recommendations. The wrapping materials were removed then the marcots were soaked in *Dithane* solution at the rate of 3 tbsp/li for 24 hours, then potting media were prepared. The standard operation practices in growing potted marcots such as watering regularly and the like were employed.

Data Gathered

Mean number of roots

This was done by removing carefully the rooting medium followed by counting individually the developed roots from the sample plants.

Mean length of longest root (cm)

This was done by measuring the longest root with the use of ruler from the base up to the tip.

Percentage Survival (%)

This was taken at 45 days after transplanting and computed by dividing the number of survived potted marcots by the total number of potted marcots multiplied by 100%.

Days to shoot initiation

This was taken by counting the number of days from potting to shoot initiation.

Number of shoots developed

This was taken by counting the number of shoots developed from potting.

Root shoot ratio

This was taken by dividing the weight of shoots developed by the weight of roots produced. Destructive sampling was done.

Analysis of Data

All data gathered was tabulated and statistically analyzed using the Analysis of Variance (ANOVA) in Randomized Complete Block Design. The significant differences among treatment means were further tested using the Duncan's Multiple Range Test (DMRT). The Statistical Tool for Agricultural Research (STAR) (20.1, 2013 version) analysis was used in the analysis of data.

Results and discussions

Table 1 presents the mean number of roots, length of roots (cm) days to shoot initiation and number of shoot developed of rooted 'Magallanes' pummelo.

Number of Roots and Length of Roots (cm)

Results revealed that there were no significant differences observed on the mean number and length of roots of rooted marcots with means ranging from 12.36 to 16.13 roots and 11.50 to 18.00 cm, respectively. This implies that irrespective of defoliation the results were comparable.

According to Briske & Richards (2014) root respiration and nutrient acquisition are reduced following defoliation, but to a lesser extent than root growth.

Table 1. Mean number of roots, Length of roots (cm) Days to shoot initiation and number of shoot developed of rooted 'Magallanes' pummel.

Treatment	No. of Roots	Length of Roots (cm)	Days to Shoot Initiation	No. of Shoot Developed
T_1- Complete removal of all leaves	14.46	13.33	47.00	3.67
T_2- Removal of half of the number of leaves	16.13	18.00	45.00	4.67
T_3- No removal of leaves	12.36	11.50	43.33	3.67
Significance	ns	ns	ns	ns
C.V. (%)	16.87	30.56	8.52	33.85

Root respiration begins to decline within hours of defoliation and it may decrease substantially within 24 hours (Li *et al.*, 2021).

Days to Shoot Initiation

As to the days to shoot initiation with means ranging from 43.33 to 47.00 days and number of shoots developed with means ranges from 3.67 to 4.67 shoots, same observation was recorded.

Briske and Richards (2014) states that concomitant with the reduction in root respiration following defoliation is a rapid reduction in nutrient absorption. Steady state plant growth is immediately disrupted by defoliation in response to a state limitation imposed by a reduction in photosynthetic area.

Number of Shoot Developed of Rooted 'Magallanes' Pummelo

As to the days to shoot initiation with means ranging from 43.33 to 47.00 days and number of shoots developed with means ranges from 3.67 to 4.67 shoots, same observation was recorded.

Briske & Richards (2014) stated that concomitant with the reduction in root respiration following defoliation is a rapid reduction in nutrient absorption.

Steady state plant growth is immediately disrupted by defoliation in response to a state limitation imposed by a reduction in photosynthetic area. Further, Gastal & Lemaire (2015) explained that defoliation affects these morphogenetical components, depending on its frequency and its intensity, through several direct and indirect physiological and environmental processes.

Due to the implications of leaf area removal, defoliation has a direct effect on the mobilization of C and N reserves and their supply to growing leaves. In addition, defoliation has an indirect effect on leaf and tiller morphogenesis, due to its impact on the light environment within the canopy as well as plant responses to light signals (blue light, red far red ratio). Defoliation may also in some cases have a direct negative effect on leaf growth by damaging leaf meristems. Understanding the respective role of these various physiological and environmental processes requires studies where defoliation, photosynthetic active radiation and light signals are manipulated independently.

Root Shoot and Percentage Survival

Table 2 presents the mean root shoot ratio and percentage survival of rooted 'Magallanes' pummelo. Results revealed that there is no significant difference was observed. This might be due that there is equal development on the root and shoot part of the marcots.

Table 2. Root Shoot ratio and Percentage Survival of rooted '*Magallanes*' Pummelo.

Treatment	Root Shoot Ratio	Percentage Survival (%)
T_1- Complete removal of all leaves	1.0	26.67 b
T_2- Removal of half of the number of leaves	1.0	100.00 a
T_3- No removal of leaves	1.0	100.00 a
Significance	ns	**
c.v.(%)	28.87	8.82

However, in terms of percentage survival, results revealed that (T_3) no removal of leaves was comparable to the (T_2) removal of half of the number of leaves with a mean of 100% survival. While complete removal of leaves recorded lesser percentage survival with a mean of 26.67%. This could possibly be attributed to (Briske & Richards, 2014) that the root growth, respiration, and nutrient absorption in rapidly growing plants are all dependent upon a continuous supply of carbohydrates produced in the shoot system. Photosynthetic rates of foliage on defoliated plants are often higher than those of foliage of the same age on undefoliated plants.

Leaves on defoliated plants which do not rejuvenate may still exhibit higher photosynthetic rates than comparable leaves on undefoliated plants because the normal decline in photosynthetic capacity associated with aging is inhibited (Gifford & Marshall, 1973). A reduced rate of leaf senescence is also expressed as an increase in mean leaf lifespan on defoliated plants (Jones *et al*., 1982; Nowak & Caldwell, 1984) as cited by Li, *et al*., 2021).

However, Ryle & Powell (1975) explained that after defoliation, which removed all leaf tissue above the ligule of leaf 3, the rate of photosynthesis of the remaining two older leaves fell to 90–95 per cent of that of control leaves, but they exported more of their assimilated carbon to meristems elsewhere in the plant during the first 48 h after the defoliation. He further explained that the level of export from the two older leaves began to decline when new leaf tissue regrew from the shoot apex, and fell below that of the control leaves 4 days after defoliation. The two older leaves supplied the assimilated use in the regrowth of new leaf tissue immediately after defoliation: previously they had exported most of their assimilated to root.

Conclusions

The study determined the influence of defoliation on the survival and growth of rooted '*Magallanes*' Pummelo marcots. Higher survival percentage was observed in rooted pummelos where leaves were half defoliated and leaves were not removed.

Acknowledgment

We take this opportunity to express our sincere gratitude to all DMMMSU officials for the support extended in the realization of the study. We would like also to express our thanks to our family members who inspired us to put in our best efforts for this study.

Finally, to our Almighty GOD for the wisdom, strength and knowledge in the fulfillment of the study.

References

Anegbeh P., Ichoundjeu Z., Iruka C., Nkirika C. 2006. Vegetative propagation of indigenous fruit trees: Influence of defoliation on survival of rooted marcots (air-layered plants) of *Irvingia gobonensis* and *Dacryodes edulis* in Onne, Niger Delta Region of Nigeria. International Journal of Agriculture and Rural Development **6(1)**.
http://doi.org/10.4314/ijard.v6il.2597.

Beadles CL, Long P. 1985. Photosynthesis-is it limiting to biomass production? Biomass **8(2),** 119-168. DOI: 10.1016/0144-4565(85)90022-8.

Briske DD, Richards JH. 2014. Plant responses to defoliation: A physiological, morphological and demographic evaluation. Department of Rangeland Ecology and Management, Texas A & M University, College Station, TX 77843-2126 and Department of Land, Air and Water Resources, University of California, Davis, CA 95616-8627, 107.

Gastal F, Lemaire G. 2015. Defoliation, shoot plasticity, sward structure and herbage utilization in pasture: Review of the underlying ecophysiological processes. Agriculture **5,** 1146-1171.
DOI: 10.3390/ agriculture 5041146.

Gifford R, Marshall C. 1973. Photosynthesis and assimilate distribution in *Lolium multiflorum* Lam. following differential tiller defoliation. Australian Journal of Biological Sciences **26,** 517-526.

Iqbal N, Masood A. Khan NA. 2012. Analyzing the significance of defoliation in growth, photosynthetic compensation and source-sink relations. Photosynthetica **50(2),** 161-170.
DOI: 10.1007/s11099-012-0029-3#page-1.

Lawlor DW. 2001. Photosynthesis. 3rd Editionn. Annals of Botany **87(6),** 852-853.
DOI: 10.1006/ anbo. 2001.1418.

Li X, Zhang Z, Guo F, Duan J, Sun J. 2021. Shoot-root interplay mediates defoliation-induced plant legacy effect . Frontiers in Plant Science **12,** 684503.
DOI: 10.3389/fpls 2021.684503

Nowak RS, Caldwell MM. 1984. A test of compensatory photosynthesis in the field: implications for herbivory tolerance. Oecologia **61,** 311-318.

Ryle GJA, Powell CE. 1975. Annals of Botany 39(2), 297-310. DOI: 10.1093/oxfordnals.