A Preliminary Study of Pot Plunging for Planting *Plumeria rubra*

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Abstract

Pot plunging when planting plumerias in the ground (where the plant is not removed from the pot when planting) is done for a number of reasons, one of which is that it purportedly results in more root and above-ground growth. In a preliminary study substituting larger containers for the ground, we randomly assigned six plants each to three treatments: 1. Traditional planting where the plant is removed from the nursery pot prior to planting; 2. Pot plunging; and 3. Control, plant remained in the nursery pot. After one year all 18 plants were measured for stem height and diameter, quantity of leaves, and root dry weight. Traditional planting produced significantly more stem height and diameter and quantity of new leaves than pot plunging or the control. Treatments did not significantly affect root dry weight. Traditional replanting appears to be the preferred method for encouraging plant growth.

Introduction

Some plumeria hobbyists and collectors highly tout pot plunging or pot planting when planting in the ground. Pot plunging refers to the practice of taking a potted plant and planting it in the ground without removing the plant from its pot. The plunged-potted plant is grown in the ground for a season, and the following year it is dug up, the pot removed, and the plant minus the pot is replanted in the ground.

The purported advantage of pot plunging is that the plumeria plant grows better due to less root disturbance because the plant was not removed from its pot when planted in the ground. The pot-plunged plant purportedly grows larger and sturdier, and its root system is more extensive than a similar plant that was removed from its pot and planted in the ground.

Nonetheless, pot plunging seems contrary to standard horticultural principles and practices. The digging up of the potted plant after a year's growth and then removal of the pot prior to replanting will likely to damage roots that that have exited the pot's drainage holes and entered the site soil, negating any perceived advantages of pot plunging.

Thus, we conducted a preliminary study investigating pot plunging plumerias. Here we describe the study and report its results.

Materials and Methods

We conducted our study at The Los Angeles County Arboretum and Botanic Garden in Arcadia, California. Because of a lack of space at a suitable site in The Arboretum, we decided to conduct the preliminary study entirely in containers in The Arboretum's nursery. In September, 2022, we selected 18 uniformly sized plants of *Plumeria rubra* 'Synchronicity' grown in 3.8 ℓ nursery pots at a commercial nursery in Vista, California.

At the Arboretum we randomly assigned the 18 plants into three treatment groups of six plants each. Treatment 1: traditional planting, we removed the six plants from their nursery pots and planted them into 7.6 ℓ nursery pots using a well-drained, custom-blended, soilless potting medium consisting of two equal parts by volume of Patio Plus Outdoor Potting Mix (Kellogg Garden Products, Ontario, California) and Vigoro Perlite (horticultural grade, Vigoro Corporation, Chicago, Illinois) (**Figs. 1–2**). Treatment 2: pot plunging, we left the six plants in their nursery pots and plunged the pots into 7.6 ℓ nursery pots, using the same type of soilless potting medium as in Treatment 1 (**Fig. 3**). Treatment 3: control, we simply left the six plants in their original 3.8 ℓ nursery pots (**Fig. 4**).

After planting, we measured stem diameter at 15 cm above the soil line, stem height, and quantity of leaves (only fully expanded leaves) for all 18 plants and then placed them in a completely randomized arrangement on an outdoor bench under 70% shade (**Fig. 5**). The plants received regular nursery care, mostly simply periodic irrigation. Fertilizer was not added. In December, 2022, the plants were moved inside a temperature-controlled greenhouse for the duration of the study, maintaining the completely randomized arrangement. Unfortunately, greenhouse temperature and light levels were unavailable but, based on condition of adjacent tropical plants, both environmental parameters were sufficient for cultivating these plants.

After one year, in September, 2023 (**Fig. 6**), we again measured stem diameter and height and quantity of leaves and removed the plants from their pots, washed the potting medium from the roots, and harvested, dried, and weighed the roots.

Figure 1. We used a custom-blended, soilless potting medium (center) consisting of two equal parts by volume of a commercially available potting mix (left) and horticultural perlite (right).

Figure 2. In Treatment 1 (traditional planting), we removed the plant from its 3.8 ℓ nursery pot and planted it into a 7.6 ℓ nursery pot.

Figure 3. In Treatment 2 (pot plunging), we left the plant in its 3.8 ℓ nursery pot and plunged the pot into a 7.6 ℓ nursery pot.

Figure 4. In Treatment 3 (control), we simply left the plant in its original 3.8 ℓ nursery pot.

Figure 5. Treated plants were randomly arranged on a bench in the nursery of the Los Angeles County Arboretum and Botanic Garden, Arcadia, CA, September, 2022.

Figure 6. A year later, September, 2023, the randomly arranged plants were on a bench in the greenhouse at the Los Angeles County Arboretum and Botanic Garden, Arcadia, CA.

We conducted a one-way analysis of variance (ANOVA) to analyze the data and to determine if treatments differed significantly. Means by treatment are presented with level of significance.

Results

Mean stem height and diameter and quantity of leaves per plant varied little at the start of the study in September, 2022 (**Table 1A**), indicating that our plants were fairly uniform in the measured growth parameters and that random assignment was successful. Only mean stem height differed slightly, with Treatment 2 (pot plunging) ending up with slightly shorter stems (29.7 vs. 31.0 cm, $P<0.10$). Mean stem diameter and quantity of leaves per plant did not vary significantly.

By the end of the study a year later, in September 2023 (**Table 1A**), mean stem height and quantity of leaves per plant differed significantly among the treatments while stem diameter did not vary significantly. Treatment 1 (traditional planting) had the tallest stems and most leaves per plant (69.8 cm and 15.8 leaves, $P<0.01$) followed in descending order by Treatment 2 (pot plunging) with stems 65.2 cm tall and 8.0 leaves per plant and Treatment 3 (control) with stems 54.5 cm tall and 6.2 leaves per plant.

After washing the potting medium from the roots and visually assessing them, we could see no significant differences in the root systems. Representative plants of the traditional potting (Treatment 1) and the control (Treatment 3) had roots confined to a tight, neat root ball while the pot-plunging (Treatment 2) had a few roots exiting the pot through the drainage holes and growing into the surrounding potting medium (**Figs. 7–8**). Nonetheless, root mass did not vary significantly among the three treatments (**Table 1A**).

Another way to measure the effect of treatments is to measure the absolute differences in mean stem height and diameter and quantity of leaves per plant produced between September, 2022 and September, 2023. When doing so, mean stem height and diameter and quantity of leaves per plant varied significantly among the three treatments (**Table 1B**). Treatment 1 (traditional planting) produced the greatest stem height (38.8 cm, $P<0.01$), stem diameter (0.3 cm, $P<0.05$), and leaves per plant (8.3, $P<0.01$). Treatments 2 (pot plunging) and 3 (control) followed in descending order. Treatment 2 produced mean stem height of 35.5 cm, mean stem diameter of 0.1 cm, and 0.2 mean leaves per plant while Treatment 3 produced mean stem height of 23.5 cm, mean stem diameter of 0.1 cm, and -1.8 mean leaves per plant (Treatment 3 actually had fewer leaves at the end of the study than at the beginning).

Figure 7. Root systems of the *Plumeria* plants after one year, September, 2023: the control (left); traditional planting (center); and pot plunging (right).

Figure 8. Washed root systems of the *Plumeria* plants after one year, September, 2023: the control (left); traditional planting (center); and pot plunging (right).

Table 1A. Mean stem height and diameter and quantity of leaves per plant in September 2022 and September 2023, and mean dry root weight in September 23 among three treatments in the pot-plunging trial of *Plumeria rubra* 'Synchronicity', The Los Angeles County Arboretum and Botanic Garden, Arcadia, CA.

	----------2022----------			----------2023----------			
Treatment	**Stem ht. (cm)**	**Stem diam. (cm)[Z]**	**Quantity of leaves[Y]**	**Stem ht. (cm)**	**Stem diam. (cm)[Z]**	**Quantity of leaves[Y]**	**Root mass (g)[X]**
	P<0.10	**NS**	**NS**	**P<0.01**	**NS**	**P<0.01**	**NS**
1 (traditional planting)	31.0	1.8	7.5	69.8	2.1	15.8	3.8
2 (pot plunging)	29.7	1.8	7.8	65.2	1.9	8.0	3.1
3 (control, no planting)	31.0	1.9	8	54.5	2.0	6.2	3.6

[Z]@ 15 cm above soil line.

[Y]Only fully expanded leaves.

[X]Dried weight.

Differences among means compared using one-way ANOVA and standard probability levels used.

NS = no significant differences among the means.

Table 1B. Absolute differences in mean stem height and diameter and quantity of leaves per plant between September 2022 and September 2023 among three treatments in the pot-plunging trial of *Plumeria rubra* 'Synchronicity', The Los Angeles County Arboretum and Botanic Garden, Arcadia, CA.

Treatment	**Stem ht. (cm)**	**Stem diam. (cm)[Z]**	**Quantity of leaves[Y]**
	P<.01	**P<0.05**	**P<0.01**
1 (traditional planting)	38.8	0.3	8.3
2 (pot plunging)	35.5	0.1	0.2
3 (control, no planting)	23.5	0.1	-1.8

[Z]@ 15 cm above soil line.

[Y]Only fully expanded leaves.

Differences among means compared using one-way ANOVA and standard probability levels used.

Discussion

The results of this preliminary study did not favor pot plunging (Treatment 2) as a preferred planting method for plumerias. The traditional planting method (Treatment 1) produced significantly more stem height and diameter and quantity of new leaves per plant than pot plunging (Treatment 2) and the control (Treatment 3, simply leaving the plant in the original 3.8 ℓ nursery pot) (**Tables 1A, 1B**). Pot plunging was somewhat intermediate between Treatments 1 and 3 but in a few instances was no better than Treatment 3 (for example, stem diameter produced and perhaps quantity of leaves produced per plant).

These results are in line with basic horticultural principles relating to plant root growth and above-ground growth. Plants tend to grow better when roots have unrestricted access to nutrients and water (Harris et al. 2004), and pot plunging restricts root access, at least temporarily, to these essential growth requirements because the pot retained around the root ball initially acts as a barrier and restricts root access to additional nutrients and water in the surrounding site soil. Pot plunging means the plant will have to rely on the nutrients and water within the confines of the pot until a sufficient quantity of roots can exit the drainage holes in the bottom of the pot and grow into the surrounding site soil to access additional supplies of nutrients and water. Planted in the traditional manner with the pot removed, plants can immediately access the additional supplies of nutrients and water in the surrounding site soil. While the root growth among traditional planting, pot plunging, and not planting did not vary significantly, the immediate increased access to additional nutrients and water did lead to more significant above-ground growth.

Conclusions

Our preliminary study does not support or lend credence to pot plunging for plumerias, at least for the purported reasons of increased or enhanced growth. However, if increased or optimal growth is not a critical objective, pot plunging might be useful in several ways (Anders 2001). It can be used to allow the plant to be dug and lifted more easily for indoor storage in cold-winter climates. In extremely hot climates, by plunging the pots in the soil, it can be used to moderate root zone temperatures, which can also lessen plant water demands. It is also an effective way to keep plants from falling over in the wind. Finally, esthetic considerations support pot plunging because the pots are mostly covered with soil and mulch, eliminating numerous plastic pots sitting on top of the soil as an eye-sore. However, keep in mind that pot planting will likely lead to less-than-optimal growth. A second study, this time planting in the ground, would be an interesting follow-up project.

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Literature Cited

Anders, M. 2001. Plunging plumerias. Sinking pots in the ground, can you dig it? Plumeria Potpourri 18(2): 8-9.

Harris, R. W., J. R. Clark, and N. P Matheny. 2004. Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines. 4th edition. Pearson, Upper Saddle River, New Jersey.

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