A Novel Approach for Determining Root Biomass in Plant Based Research

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Introduction

In plant-based research, root biomass is often recorded. To determine root dry weight, roots are traditionally separated from substrate. Despite use of screens, a portion of roots are typically lost. Additionally, typical root washing methods are time-consuming. If plants are potted with a known mass of dry substrate, root dry weight at experiment termination could be extrapolated by drying and weighing intact root balls.

Objective

To determine differences in measured root weight using a typical root washing techniques and a novel method.

Materials and Methods

On 5 October 2015, thirty-five 15-cm containers were filled with 380 g Fafard 3B substrate per container (Fig. 1). Five containers were randomly selected and placed in a forced-air drying oven at 60˚C for one week to determine average dry mass of substrate per container (143.8 g).

Lantana camara 'Chapel Hill Gold' plugs were transplanted from a 60 count flat one each into 20 containers and top-dressed with six grams of Osmocote Plus 15-9-12 3-4 month CRF. The remaining ten filled containers were maintained with no plant to determine if substrate was lost during the experiment due to hand watering which was applied as needed (Fig. 2).

Figure 1. All containers were filled with a similar mass of Fafard 3B at potting.

Figure 2. The experiment consisted of 30 containers. Twenty containers contained a single Lantana plant. Ten containers were maintained without plants.

Materials and Methods

On 1 December 2015, shoots were separated from root balls. Roots from ten randomly selected plants were separated from substrate by washing root balls in 5-gallon buckets filled with water until roots were relatively clean of substrate (Fig. 3). Harvested shoots and roots were dried in a forced-air oven at 60 ºC and weighed. The ten remaining root balls and ten filled containers with no plants were placed in a forced-air oven at 60 ºC for five days and weighed (Fig. 4).

Figure 3. Ten root balls were washed in 5-gallon buckets and placed in a forced-air oven at 60 ºC until dry and weighed.

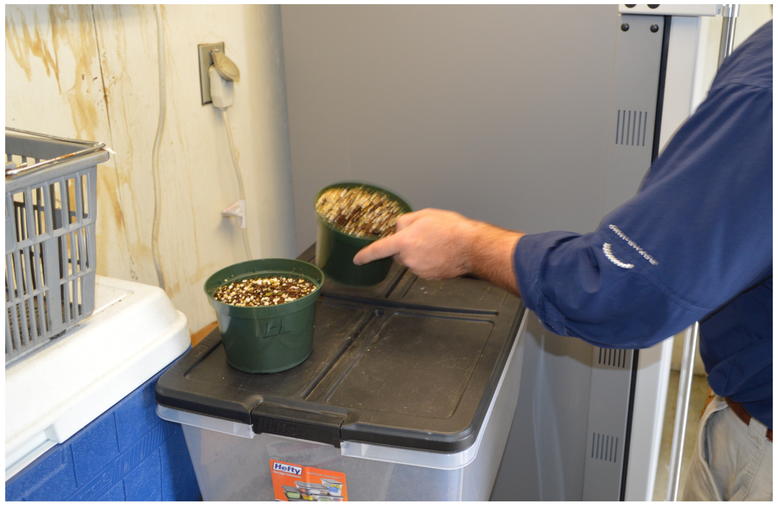

Figure 4. Ten root balls were placed in a forced-air oven at 60 ºC until dry and weighed. Root dry weight was calculated by subtracting the initial average mass of dry substrate (143.8 g) from the dry root ball weight at experiment termination.

Results

Shoot dry weight was similar among both groups ($p = 0.8809$). Root dry weight harvested by washing averaged 4.29 g, while root dry weight calculated by drying root balls averaged 9.35 g ($p < 0.0001$).

While it was calculated that an average dry substrate mass of 143.8 g was added to each container at potting, containers maintained with no plants contained an average dry substrate mass of 141.4 g (std dev = 2.5 g).

Figure 5. Shoot dry weight was similar among both groups.

Conclusions

Although plants in both groups had similar shoot biomass, root biomass calculated by drying root balls was 2.2 times greater than root biomass harvested and washed.

Containers filled with substrate and maintained with no plants contained an average of 2.4 g less dry substrate than the calculated average dry substrate mass added to containers at potting. It can be assumed that less substrate is lost from containers with plants. Further research is being conducted to confirm this assumption. Substrate type and experiment longevity are also expected to be important factors in substrate loss.

The portion of roots lost when separating roots from substrate can vary greatly depending on method. Further research is being conducted to compare the accuracy of several methods.

These data suggest significant root loss due to washing. Starting with a known mass of dry substrate and weighing root balls at experiment termination may improve accuracy when determining root biomass.

Figure 6. Roots lost during washing process.