

## Research Note

### DRY WEIGHT ACCUMULATION IN ARRACACHA PLANT PARTS<sup>1</sup>

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Knowledge of the dry weight accumulation pattern of a crop is crucial in order to develop adequate management strategies and to assess their impact on productivity and economic return. Assessment of growth is available for many major crops in different environments. However, description of dry weight accumulation pattern is lacking for many minor crops such as arracacha (*Arracacia xanthorrhiza* Banc.). In Puerto Rico, arracacha is a specialty tuber planted on limited acreage. During the 1990s this crop has been primarily restricted to the Barranquitas municipality (U.S. Dept. of Com., 1994), where it is grown under rain fed conditions. Attempts to perform growth analysis under such conditions have failed because plants have either suffered water stress or had a poor stand. The objective of this study was to gather baseline information on arracacha's dry weight accumulation throughout the growing season.

The field activities were conducted on the Agricultural Experiment Station farm of the University of Puerto Rico at Adjuntas, 549 m above sea level. Cultivar Criolla was used. Two growing conditions were used in this study: controlled conditions and field conditions. For controlled conditions, the planting was performed 3 May 1995. Corm buds (setts), 45 to 50 g of fresh weight each, were planted in a double row approximately 30 cm apart in two 12.2 × 1.2-m concrete boxes filled with a 10:1 mixture of topsoil and filter-mud cake of a sugarcane mill. This mixture had a pH of 6.47 and 3.34% organic matter. The planted area was divided into four replications. To assure adequate stand and growth, the plants were irrigated manually as needed. Emergence occurred 20 days after planting. Fertilizer 14-3-13 formulation was side-dressed at a rate of 28 g per plant per application at two and four months after planting. The experimental area was maintained weed-free throughout the season by hand weeding. Each replication contained eight plots, five to six plants each. Plots within replications were assigned randomly to dates of sampling. Dates of sampling were at 28-day intervals from 30 to 198 days after emergence (DAE). At each sampling, either one or two plants of the center of the plot were pulled from the soil mixture as samples. The remaining plants within the plot were guard plants. Not all roots were obtained by pulling the plants; therefore, roots attached to the corm were discarded. Samples were cleaned with water and allowed to dry at room temperature, then divided into leaf lamina, leaf petiole and corm. For dry weight determinations, each part was dried separately at 54° C to a constant weight.

The second planting was performed under field conditions 26 February 1997. Corm buds were planted approximately 0.30 m apart in a double row within a 1.9-m-wide bed. The soil was from the Toa series (Fluventic Hapludolls) with pH 6.05 and 1.44% organic

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matter. Fertilization and weed control were as for the previous planting. Water was also applied as needed but with a sprinkler irrigation system. Emergence occurred 30 days after planting. The planted area was divided into eight plots (1.9 m wide  $\times$  5.3 m long) containing 16 to 18 plants each. Each plot was assigned randomly to a date of sampling. Sampling dates were extended to 226 DAE. At each date of sampling, eight plants were randomly chosen from the plot as samples and managed as explained above.

Dry weight of the plant parts and the combined dry weight (lamina + petiole + corm) were regressed to DAE. Preliminary analyses indicated that the relationships lamina dry weight vs. DAE, and petiole dry weight vs. DAE were best fitted by cubic equations, whereas the relationships corm dry weight vs. DAE and combined dry weight vs. DAE were linear. Covariance analyses were used to evaluate these relationships as to their dependence on the growing condition (controlled vs. field conditions). In the covariance analyses, growing condition was incorporated into the models as a qualitative variable. Results from the covariance analyses revealed that the relationships: lamina dry weight vs. DAE, petiole dry weight vs. DAE, and corm dry weight vs. DAE depended on the growing conditions. Therefore, data were analyzed separately by growing condition.

Plants grown under the conditions used for this study were similar in size to those successfully grown commercially. Plants, however, grew faster when planted under controlled conditions. The basic dry weight accumulation pattern consisted in the accumulation of assimilates on the leaves early in the crop cycle accompanied by a steady increase in corm dry weight. Under controlled conditions the dry weight accumulation throughout the season for the lamina and petiole was best described ( $P \leq 0.01$ ) by cubic equations (Figure 1). Average maximum dry weight for these parts was at 86 DAE; then dry weight decreased up to 170 DAE, but increased again by 198 DAE. This last increase appeared to be as a response of over maturation of the corm. Under these conditions the petiole was always heavier than the lamina. Dry weight accumulation in the corm increased linearly ( $P \leq 0.01$ ) throughout the season at a rate of 1.01 g/plant/day (Figure 1).

Under field conditions the dry weight accumulation in the lamina and petiole were best described ( $P \leq 0.01$ ) by quadratic equations (Figure 1). As for controlled conditions, maximum dry weight for the lamina occurred at 86 DAE. The petiole was heavier than the lamina from 114 to 226 DAE. Dry weight accumulation in the corm increased linearly ( $P \leq 0.01$ ) throughout the season at 0.38 g/plant/day, a slower rate than that of controlled conditions (Figure 1).

The combined weight increased linearly throughout the season in both controlled and field conditions (Figure 2). This pattern of dry weight accumulation was directly dependent on the dry weight accumulation pattern of the corm (Figures 1 and 2). Correlation coefficients for combined dry weight and corm dry weight were  $r = 0.96$  ( $P \leq 0.01$ ) under controlled conditions, and  $r = 0.94$  ( $P \leq 0.01$ ) under field conditions.

The results of this study suggest three major stages in the dry weight accumulation pattern for arracacha. The first stage, from 30 to 86 DAE, was characterized by relatively high dry weight partitioning into the aerial parts (Figure 2). In controlled conditions, percentages of dry weight partitioning into the top (lamina + petiole) were 56 to 60%, whereas partitioning into the corm was 40 to 44%. There was a transition stage from 114 to 142 DAE. In this transition stage, the percentage of dry weight accumulated in the top or the corm depended on the growing condition. In controlled conditions, from 114 to 142 DAE, percentage of dry weight in the corm was 61 to 81%, whereas in field conditions this percentage was 51 to 55%. The third major stage occurred after 142 DAE, and was characterized by a significant increase in the dry weight partitioning into the corm. After 142 DAE, dry weight percentage into the corm was more than 75% under controlled conditions and more than 70% in the field (Figure 2). In a study conducted under standard growing conditions arracacha had 81% of the dry weight accumulated in the corm at har-

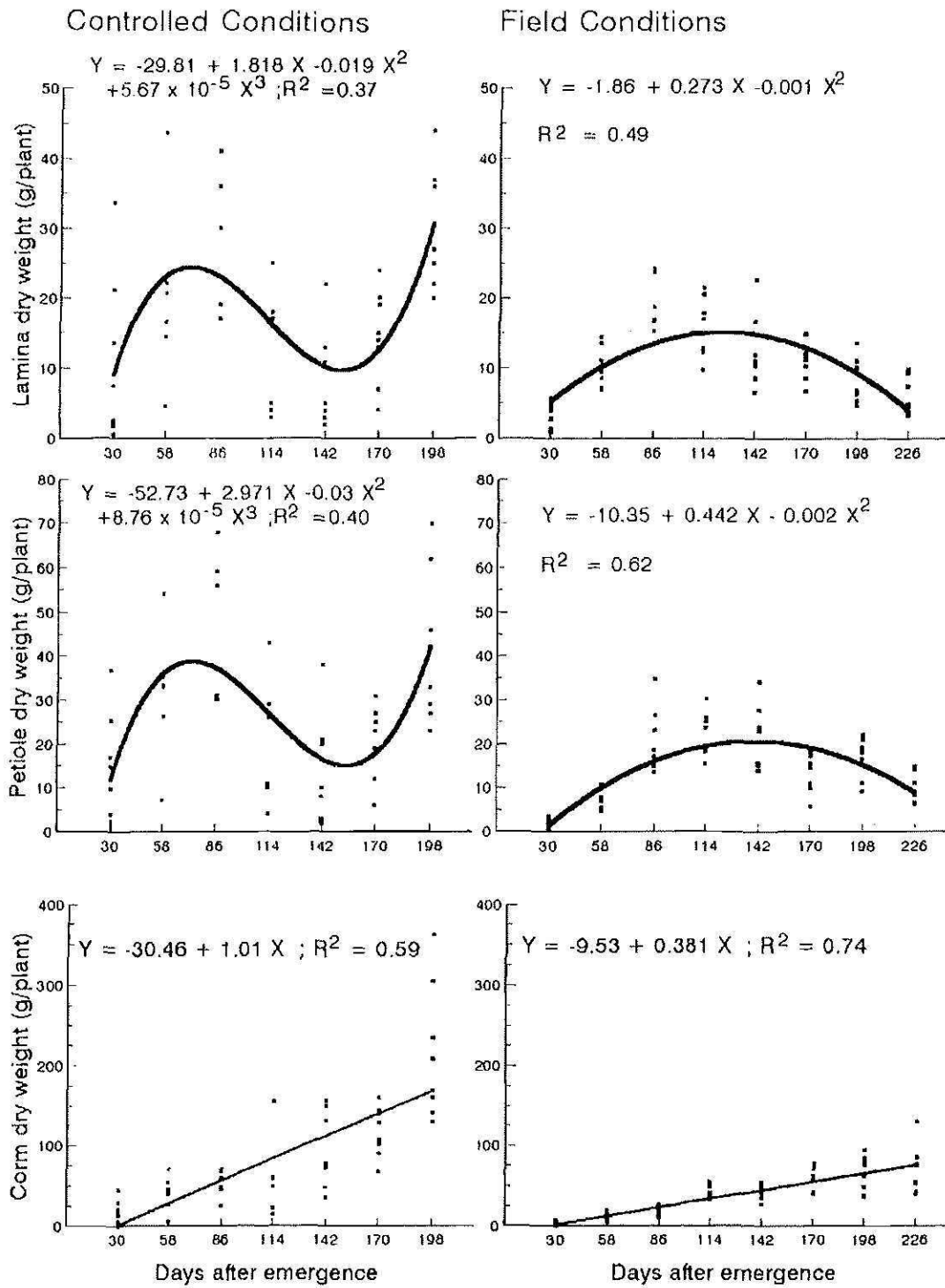


FIGURE 1. Dry weight of arracacha's plant parts as influenced by number of days after emergence in two growing conditions.

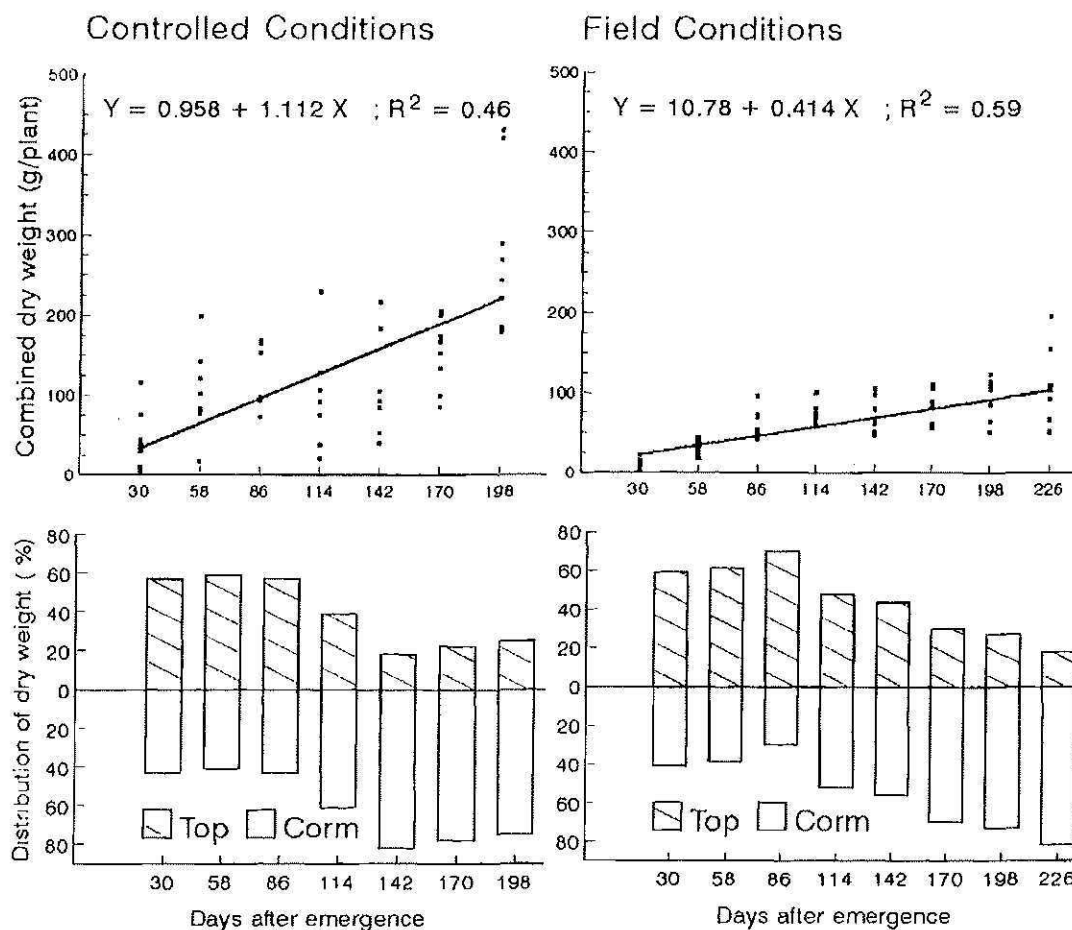


FIGURE 2. Combined (lamina + petiole + corm) dry weight and distribution of the combined dry weight as influenced by number of days after emergence in two growing conditions.

vest, although roots were not considered (Ortiz and Acín, 1998). Results of this study suggest that the corm bulking period of arracacha is not as well defined as that of other root and tuber crops, and that this crop possesses a relatively high harvest index.

#### LITERATURE CITED

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