Stem Length as an Estimator of Muskmelon Growth

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Introduction

Measurement of growth parameters is an essential component of plant science research. In order to determine stem and root growth response to various cultural, management, and insect-pest control practices, plant scientists sacrifice live plants from their experimental plots. This direct measurement of top or root growth, a universally accepted criterion for growth measurement, is costly, laborious, and time consuming. It inflates the error variance because intact plants are permanently lost from experimental plots. Furthermore, this permanent loss of plants reduces plant population and does not allow repeated observations for measurement of plant growth and development on the same plant.

Because of these implications, the melon working group consisting of USDA-ARS and Purdue University horticulturists, entomologists, plant pathologists, and plant physiologists was looking for an alternative method for muskmelon growth measurement. This study was undertaken as part of a team approach for determining and documenting a rapid, reproducible, and practically acceptable method for muskmelon growth measurement, which is as reliable as the top weight method and allows repeated observations on the same plant. The main objective of this greenhouse study was to obtain the closest fit regression equations between total stem length and stem and root weight, which could be used to estimate muskmelon growth with minimal error.

Materials and Methods

Muskmelon cv. Burpee Hybrid seeds were sown on February 2, 1983 and cv. Saticoy on January 4, 1984 in no. 38 growing trays (Growing Systems, Inc., Milwaukee, WI 53213) containing Jiffy-Mix (composed of shredded sphagnum peat moss and horticultural-grade vemiculite) growing medium. The seedlings were grown under greenhouse conditions at day/night temperature of approximately $30/21 \pm 3\,^{\circ}C$ and 16-hr. light from 20-watt Luxor, Vita-Lite lamps suspended 27 cm above the plants with one bulb per 0.28 m^2 of bench space.

Fifteen-day old seedlings (3 to 4 true leaf stage) of cvs. Burpee Hybrid and Saticoy were transplanted into one-liter black plastic pots using 'Flint shot' sand as growing medium. Because of difficulties in separation of roots from growing medium for muskmelon cultivars sown in Jiffy-Mix, 'Classic' muskmelon was direct seeded into one-liter black plastic pots containing 'Flint shot' sand on March 8, 1984. Plants were fed daily with Hoagland's solution (1) containing various levels of nitrogen (up to 200 ppm) to achieve wide range of variation in stem and root growth rates. Iron chelate was added to the Hoagland's solution twice a week.

Muskmelon plants were harvested five weeks after seeding or 3 weeks after transplanting. Data on total stem length and stem fresh/wet weight were recorded during harvest. Muskmelon cv. Classic roots were separated from the growing medium (sand) by gently washing with tap water over a screen and blotted. The stem and root samples were dried in a forced air oven for 48-hr at about 50°C and then weighed.

Results and Discussion

In this study, we found highly significant positive relationships between stem length and top growth (Figure 1). The coefficients of determination for muskmelon cvs. Saticoy, Burpee Hybrid and Classic were 0.95, 0.98, and 0.98 for top fresh weight, and 0.96, 0.97 and 0.99 for top dry weight, respectively. Interestingly, highly significant correlations were also obtained between stem length and total (top plus root) dry weight ($R^2 = 0.99$) and root dry weight ($R^2 = 0.71$) for muskmelon cv. Classic. Complete separation of entire root system from Jiffy-Mix for muskmelon cvs. Saticoy and Burpee Hybrid was not achieved, thus, their results are not reported. These highly significant

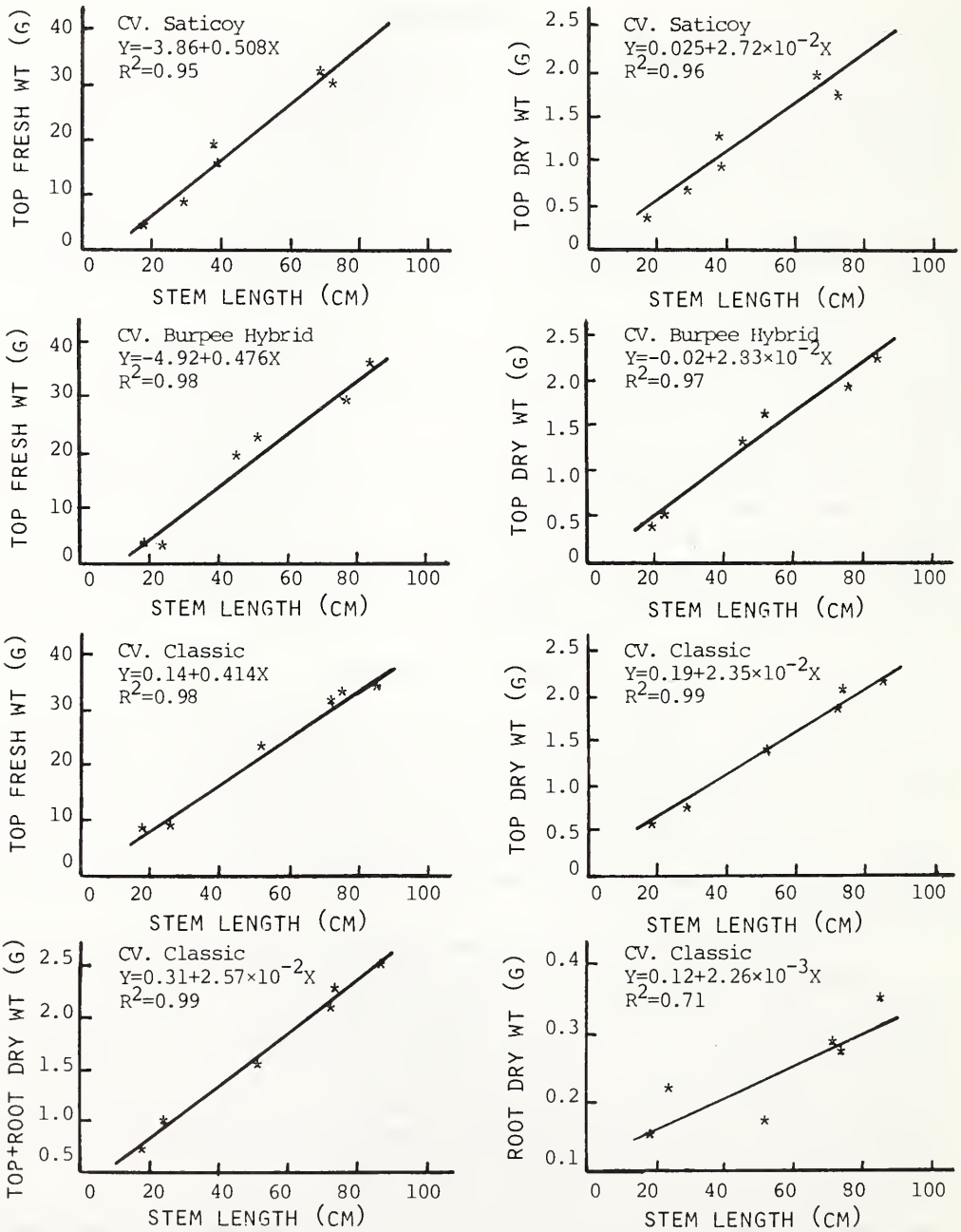

FIGURE 1. *Relationships between various growth parameters of muskmelon. All coefficients of determination significant at 0.01 level of probability.*

correlation coefficients and regression equations support the hypothesis that stem length is as reliable an indicator of growth as is the destructive harvest for dry weight measurement of top growth.

The results of this study establishes a direct relationship between stem length and top growth and root growth that can be used to evaluate top and root limiting conditions in muskmelon. Furthermore, this study demonstrates that stem and root weights can be indirectly predicted with high degree of accuracy by entering stem length in the regression equations, as well as for the inverse problem of estimating stem length from stem and root weights.

Highly significant correlations between various growth parameters for three muskmelon cultivars suggest the stem length method is reproducible. In terms of simplicity, practicality, and rapidity, both methods are useful means of determining muskmelon growth. However, the stem weight method has a serious drawback because of permanent loss of plants from experiment. The stem length method has important advantages because it allows repeated observations on the same plant. This method should be useful to plant scientists measuring growth of vine crops.

Summary

A rapid, reproducible, and practically acceptable method for measuring muskmelon growth, without destroying intact plants was developed. We tested the hypothesis that total stem/vine length measurement of muskmelon provides the same indications of growth as does stem/top weight, a universally accepted criterion for plant growth measurement. Total stem length was found to be highly correlated with top fresh ($R^2 = 0.95$, 0.98 and 0.98) and dry ($R^2 = 0.96$, 0.97, and 0.99) weights for muskmelon cvs. Saticoy, Burpee Hybrid, and Classic, respectively. Total dry matter (top plus root; $R^2 = 0.99$) and root dry weight ($R^2 = 0.71$) were also found to be highly correlated with stem length for cv. Classic. These highly significant coefficients of determination suggest that stem length in the early stages of plant development is a reliable and reproducible estimator of muskmelon growth.

Note

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Literature Cited

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