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Response of 'Raritan' and 'Surecrop' Strawberry Plants to Drought Stress[1]

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Abstract

In a greenhouse experiment, drought stress reduced the net photosynthesis, transpiration, and leaf dry matter accumulation of 'Raritan' and 'Surecrop' strawberry plants. Drought stress also reduced the fruit yield of 'Raritan,' but not of 'Surecrop.' 'Surecrop' plants had significantly larger root systems than 'Raritan' plants.

Introduction

Scott et al. (4) mentioned that 'Raritan' is "not so drought resistant as some varieties" and 'Surecrop' is "resistant to . . . drought." In an attempt to determine why these two strawberry cultivars differ in response to drought, a study was conducted in the greenhouse at OARDC, Wooster, Ohio. The results of this research are presented in this report.

Materials and Methods

Dormant plants of 'Raritan' and 'Surecrop' strawberry were potted in 13 cm plastic pots in January. The potting mixture consisted of 2 parts silt loam soil, 1 part sphagnum peat, and 3 parts coarse sand. Each plant received 5 g of controlled-release fertilizer (18-6-12). The potted plants were placed under supplemental light (high pressure sodium lamps from 0700 to 1900 hr) in a heated greenhouse (24°C day; 16°C night). All flowers were hand pollinated at anthesis to ensure fruit set. Runners were removed as soon as they appeared.

Plants were watered to field capacity, as needed, for one month following potting. Then, plants were subjected to one of two watering regimes for a period of 42 days. Non-stressed plants were given 250 ml of water per pot when the pots reached 95% of their weight at field capacity. Stressed plants were given 60 ml of water per pot when pots reached 90% of their weight at field capacity. Pots were never allowed to reach the weight that induced wilting (85% of the weight at field capacity). Soil moisture tension varied from -2 to -10 centibars in the non-stressed treatment and from -28 to -74 centibars in the stressed treatment. The plants were grown in a randomized block design with treatments arranged as a 2 (cultivars) × 2 (stress) factorial with 5 single-plant replications.

Net photosynthesis (Pn) and transpiration (Tr) were measured 2 weeks after the watering regimes had been initiated. Pn was measured with an infrared gas analyzer (Lira 200 MSA) under saturated (800 $\mu mols^{-1}m^{-2}$) light and at a flow rate of 3 liters min^{-1}. Tr was measured with a dew point hygrometer (EGG Int. Model 800) following previously described techniques (2). These measurements were made on the center leaflet of the most recently expanded leaf. Approximately 4 weeks after the watering regimes had been initiated, leaf water potential was measured using a pressure bomb (PMS Model 1000). At the end of the experiment, the dry weight of leaves, crowns, and roots was determined.

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Table 1. Comparison of net photosynthesis, transpiration, leaf water potential, fruit yield, and dry weights between non-stressed and stressed 'Raritan' and 'Surecrop' strawberry plants.

Treatment	Pn mg CO_2 $dm^{-2}h^{-1}$	Tr g H_2O $dm^{-2}h^{-1}$	Fruit Yield (g/plant)	Water potential (bars)	Dry Weight (g/plant) leaf	crown	root
Non-stressed							
Raritan	21.1b[z]	1.43b	62.8a	-16.8ab	10.0a	2.9a	4.7ab
Surecrop	24.7a	1.86a	46.6b	-13.1c	9.7a	1.6a	14.6a
Stressed							
Raritan	16.0c	0.89c	47.1b	-18.5a	5.9b	1.9a	3.3b
Surecrop	20.5b	1.27b	43.8b	-15.1bc	7.1b	1.9a	10.2ab

[z]Means within columns separated by Fisher's LSD, 5% level.

Results and Discussion

Drought stress reduced the Pn and Tr of both cultivars, although the rates for 'Surecrop' were higher than for 'Raritan' under both watering regimes (Table 1). The higher rates for 'Surecrop' may be due at least partially to its more extensive root system. The average root dry weight for the 'Surecrop' plants was over three times greater than for the 'Raritan' plants, although there was considerable plant-to-plant variation (Table 1). 'Surecrop,' with its large root system, may utilize available soil moisture, and therefore maintain leaf water potentials more favorable for photosynthesis. Significantly higher leaf water potentials were measured in 'Surecrop' than in 'Raritan' (Table 1). Parsons (3) in his review on breeding for drought resistance, notes that most crop plants enduring drought usually possess mechanisms such as large root systems which help maintain high leaf water potentials and delay desiccation.

However, avoiding drought stress through development of a large root system, as in 'Surecrop,' may not be physiologically efficient. Non-stressed 'Raritan' plants had higher fruit yield than non-stressed 'Surecrop' plants (Table 1), and in a long-term (irrigated) field study (1) 'Raritan' was significantly more productive than 'Surecrop.'

Strawberry cultivars producing a large root system at the expense of fruit production generally may not be advantageous. Many strawberry plantings in the United States and other parts of the world are irrigated to obtain maximum yields. Strawberry cultivars such as 'Surecrop' could be useful, however, in situations where a low input production system must be used, or when the savings from reduced irrigation would more than compensate for lower yields.

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