

Germination and Respiration of Cotton Seed Produced in Arizona

Albert K. Dobrenz, Jeffrey C. Silvertooth and Jill Martin

Abstract

The germination percentage and seedling respiration were evaluated on 11 cultivars of Cotton produced in Arizona. Respiration rates of 5-day old seedlings ranged from 6.0 to 16.9 mg/g⁻¹ hr⁻¹ for DP-5690 and KC-311, respectively. Germination percentage ranged from 31 to 87% for KC-311 and DP-51, respectively. A significant negative correlation ($r = -.90$) between respiration rates and the germination percentage indicates that seed quality is closely associated with early seedling metabolic rates.

Introduction

Seed quality has always been an important factor for successful stand establishment. Woodstock, et al., (1985) evaluated several aspects of weathered seed of 6 cotton cultivars and reported a 11 to 33% reduction in germination. He concluded that weathering caused membrane deterioration in the seed and the loss of Ca and K during imbibition was significantly related to seed quality. Tupper (1969) found a highly positive relationship between seed density and the speed of cotton seed germination. Bartee and Kreig (1974) also reported that seed density was a good indication of seed maturity and the quantity of organic and inorganic metabolites for the germinating seed increased with increasing seed density. Kittock and Law (1975) reported a significant correlation between seedling emergency and respiration rates in wheat seed. This relationship has also been reported in corn (Woodstock and Feeley, 1965). Woodstock, et al., (1985) found that in-field weathering caused a reduction in respiration of cottonseed and suggested that their data agrees with earlier reports of the association between seedling vigor and respiration rates. The objective of this study was to compare germination and seedling respiration rates of 11 cotton cultivars grown in Arizona and determine the relationship of these two parameters.

Materials and Methods

The cultivars 'Stoneville-453', 'C-40', 'DP-5690', 'KC-311', 'DP-90', 'DP-77', 'Stoneville-907', 'DP-51', 'DP-5816', 'DP-20', and 'DP-5415' were used in this study. Seed of each cultivar was placed on filter paper saturated with distilled water and germinated at 27 C. Germination counts were made at 5 days. Respiration rates were evaluated on four replications of 20 seedlings from each cultivar. Only seedlings that displayed active hypocotyls and had radicles that were 2-5 cm long were used for respiration measurements. The testa was removed from each seedling prior to measurement and dry weight determination. An infra-red gas analyzer was used to determine the amount of CO₂ evolved during respiration. Data was analyzed with the statistical program 'Costat' and differences among means was determined with Duncan's New Multiple Range Test.

Results and Discussion

Percentage germination was significantly different among the 11 cotton cultivars used in this study. DP-51 had the highest germination (87%) and KC-11 has the lowest (31%). The top eight cultivars were not significantly different (Table 1) and their germination ranged from 71 to 87%.

Average dry seed weight ranged from 9.395 to 7.245 g/100 seed for Stoneville-453 and DP-5415, respectively (Table 2). The dry seed weight fell into 5 distinct and significantly different classes among the cultivars.

Respiration rates of the 5-day old seedlings was significantly higher for KC-311 than any of the other cultivars (Table 3). Respiration ranged from 6.0 for DP-590 to 16.9 mg CO₂ g⁻¹ hr⁻¹ for KC-311 seedlings.

Correlation coefficients were used to evaluate the association between the individual parameters measured on the seed and seedlings of the different cotton cultivars. Respiration rate of the seedlings had a significant negative relationship ($r = -.90$) with germination percentage. Cultivars which has the highest germination had the lowest seedling respiration. A non-significant relationship ($r = .27$) was found between seedling respiration rate and seed dry weight. Our results suggest that respiration rates of seedlings could be a useful tool for evaluating seed quality.

Literature Cited

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Table 1. Germination of 11 cotton cultivars at 27 C. Counts were made at day 5.

Cultivar	Germination %
DP-51	87 a
Stoneville-453	84 a
DP-5415	83 a
DP-5816	82 a
DP-5690	76 ab
DP-20	73 ab
DP-90	72 ab
DP-77	71 ab
C-40	60 bc
Stoneville-907	55 c
KC-311	31 d

Table 2. Dry Weight (G/100 seed) of 11 different cotton cultivars.

Cultivar	G/100 seed
Stoneville-453	9.395 a
C-40	9.165 a
DP-5690	8.640 b
KC-311	8.395 c
DP-90	8.315 c
DP-77	7.995 d
Stoneville-907	7.860 d
DP-51	7.535 e
DP-5816	7.525 e
DP-20	7.510 e
DP-5415	7.245 f

Table 3. Respiration rates of 5-day old cotton seedlings germinated and measured at 25C.

Cultivar	Respiration mg g ⁻¹ hr ⁻¹
KC-311	16.9 a
C-40	10.9 b
Stoneville-907	10.1 bc
DP-20	9.3 bcd
DP-90	8.3 cde
DP-51	7.7 de
DP-5415	7.6 de
DP-5816	6.7 e
Stoneville-453	6.3 e
DP-77	6.1 e
DP-5690	6.0 e