THE EFFECT OF TEMPERATURE, SOIL MOISTURE, AND PHYSICAL IMPEDANCE ON COTTON SEED GERMINATION AND EMERGENCE

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A study was conducted to assess the effect of soil temperature, moisture, and physical impedance on the rate of cottonseed germination and emergence. The experiments were conducted in temperature-controlled water baths in the greenhouse of the University of Arizona, Tucson.

The study was divided into two phases: (1) from planting until the radicle extended 3 mm (1/8-inch) outside the seed coat (germination), and (2) from 3 mm radicle extension until the hypocotyl emerged from the soil (emergence). Deltapine 16 acid-delinted seed with a germination of 91% was used. The seed were visually examined and seed with cracked seed coats, small in size, or irregular in shape were discarded.

Radicle Emergence Test

For this test ten seed were placed in soil in plastic cups with an amount of water added to air-dry soil to produce the desired moisture content. The cups were covered with Saran Wrap and placed on racks in the water-bath tanks to maintain the desired temperature.

The experiment contained six replications. Table 1 shows the time required for radicles to reach approximately 3 mm. Radicle emergence did not occur in the treatment combination of 60 F and 10 bars, nor in any soil moisture level at 55 F.

Table 1. Radicle-emergence time in hours for the conditions indicated.

	Moisture, bars				
Temperature, F	.3	1.0	3.0	10.0	Average
60	81.3	82.1	92.6	--*	
70	40.5	41.2	46.0	52.3	45.0
80	25.6	27.0	27.2	34.0	28.5
90	19.8	20.5	21.8	25.1	21.8
100	18.2	18.6	18.7	22.8	19.6
Average	37.1	37.9	41.3		

*Radicle emergence did not occur in this treatment.

Within the range of environment investigated, temperature was much more important than soil moisture in affecting time required for radicle emergence.

Hypocotyl Elongation Test

Pregerminated seed with radicle lengths of approximately 3 mm were used in this study. Plexiglass growth boxes constructed in a manner which forced seedlings to grow against the soil-plexiglass interface were used. Soil conditioned to the proper moisture was placed in layers and compacted to a specific physical-impedance level. Fifteen seed were placed along the side of each box and soil was placed over the seed. This soil was conditioned to the same physical impedance and moisture level as the soil below the seed. The growth boxes were placed in the water-bath tanks to provide the constant-temperature regime.

Table 2 shows the effect of the soil environment on rate of hypocotyl elongation.

Table 2. Approximate time in hours required for the hypocotyl to elongate to 1 inch with the conditions indicated.

	Soil moisture, bars					
	.3		3.0		10.0	
Temperature, F	3*	16	3	16	3	16
60	486	--+	--	--	--	--
70	114	153	196	231	--	--
80	68	121	171	181	375	--
90	54	76	118	198	209	--
100	67	161	--	--	--	--

*Physical impedance in pounds per square inch (psi).

+Hypocotyls in these treatments did not elongate to 1 inch.

Increasing soil temperature from 60 to 90 F decreased the time required for hypocotyl length to reach 1 inch. A temperature stress was indicated by prolonged exposure to 100 F. No hypocotyl elongation was observed at 100 F with a soil-moisture tension of 10 bars. High soil-moisture tension and compaction increased the time required for hypocotyls to reach 1 inch. To obtain an estimate of the total time required for hypocotyls to reach a length of 1 inch after planting, the values in Table 1 and Table 2 should be added together.

Maximum hypocotyl potential lengths obtained under the various soil conditions are shown in Table 3. Increasing compaction or decreasing soil moistures reduced the potential length of the hypocotyls. Temperature increasing from 60 to 90 F increased the length potentials, but a decline was noted when the temperature was raised to 100 F. This has important implications about the depth from which cotton can emerge under marginal conditions.

Table 3. Maximum hypocotyl lengths in inches obtained with the condition indicated.

Temperature, F	Soil moisture, bars	Physical impedance, psi			
		3	16	32	48
60	.3	1.1	.5	.3	.2
	3.0	.6	.3	.2	.1
	10.0	.3	.1	0.0	.1
70	.3	3.1	1.2	.6	.5
	3.0	1.9	1.1	.5	.4
	10.0	.4	.3	.1	0.0
80	.3	3.2	1.4	.9	.6
	3.0	2.4	1.1	.6	.4
	10.0	1.1	.2	.1	.1
90	.3	3.9	1.6	.9	.5
	3.0	3.0	1.1	.6	.2
	10.0	1.4	.4	.1	0.0
100	.3	2.8	1.1	.6	.3
	3.0	.2	.1	0.0	0.0
	10.0	0.0	0.0	0.0	0.0