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Current Report

Adjusting Seeding Rates to Optimize Stands of Cotton[1]

Laval M. Verhalen
Professor

O. H. Williams
Former Extension Area Agronomist
(now retired)

Bruce E. Greenhagen
Senior Agriculturist

Cottonseed are irregularly pearshaped and about three-eighths of an inch long. They number on the average about 4,500 per pound. However, seed size is influenced by variety, and it ranges from large in some varieties to small in others. The higher-yielding varieties developed and released in recent times have tended toward smaller seed. Thus, the seeding rates employed in the past (in terms of pounds per acre) can be too high for many modern cotton varieties.

Cotton was formerly planted at rates now considered excessive. The higher rates were thought necessary because of the unknown germination percentage of producer-saved seed. Also, skippy stands frequently resulted from planting fuzzy seed, and the poor control methods then available for seedling disease often meant reduced stands. Germination tests are now commonly available; seed are typically delinted (which with improvements in planters allows for more accurate seed metering); and the routine application of fungicides to planting seed reduces, though does not eliminate, the hazard of seedling disease. In the past, cotton stands after emergence were often excessive, and the extra seedlings were removed with a hoe. However, the labor and cost required to thin stands are intolerable in modern agriculture. The person thinning cotton seedlings has to walk nearly 2.5 miles and make approximately 20,000 strokes with a hoe per acre. "Planting to a stand" has become a major goal for the producer who is trying to reduce costs. Today, even if stands are too thick, cotton is rarely thinned.

For efficient mechanical harvest, the optimum plant population for cotton in conventionally spaced rows (36 to 42 inches wide) at the end of the season should be in the range of 30,000 to 50,000 uniformly spaced plants per acre. Yield and harvester performance are acceptable with populations between 20,000 and 60,000 plants per acre. However, outside that range, lint yield and harvesting efficiency decline. Excessive plant populations also cause increased preharvest loss, height of the first fruiting branch, and small leaf trash; they decrease boll size, rooting depth, plant height and width, and fiber length. At very high plant populations, probably the worst weed in cotton is cotton itself. Experience in Oklahoma suggests that populations nearer the lower end of the range are more suitable for dryland production, whereas those nearer the upper end perform better under irrigation.

With 40-inch rows, there are 13,069 feet of row per acre (43,560 square feet per acre divided by 3.333 feet row width). Plant populations of 20,000, 30,000, 40,000, 50,000, and 60,000 per acre are equivalent to 1.5, 2.3, 3.1, 3.8, and 4.6 plants per foot of row, respectively. Yet, in many Oklahoma cotton fields, it is not uncommon to see a dozen or more plants per row foot. Twelve plants per row foot equal 157,000 plants per acre! Those higher populations not only increase seed costs unnecessarily, but they also reduce lint yield, fiber quality, and net income. The producer should first determine the number of seed per pound for each cotton variety he intends to plant. Rather than count the number in an entire pound, he could count the seed in a fraction of a pound and then convert that number to a pound basis. We will assume that has been done and that the variety in question is average in seed size, i.e., it had 4,500 seed per pound. Because growing conditions during seed development (and other factors) can influence seed size, the number of seed per pound should probably be determined for each variety each year it is planted.

Not all cottonseed in the bag are viable. Assuming germination is 80%, one seed in five is useless even before it is planted. Most analysis tags claim 80% germination to satisfy state and federal seed laws. The germination was at least 80% at the time of testing. It probably was somewhat higher to assure compliance with the tag and the law. How much more is the question. The fewer assumptions that have to be made, the greater confidence the producer can have in his decisions. To check the analysis tag claim for germination, multiple samples of commercial cottonseed were submitted to the Oklahoma Crop Improvement Association for standard germination testing in 1994 through 1998 inclusive. Table 1 summarizes those results.

[1] Research in this report was conducted under Oklahoma Agricultural Experiment Station Project H-2225 (Cultural Solutions to Cotton Production Problems in Oklahoma).

Table 1. Germination Percentages for Samples of Commercial Cottonseed, 1994-1998.

Year	Varieties	Germination (by Variety)		
		Minimum	Maximum	Average
	no.		%	
1994	10	85	96	90
1995	11	95	99	97
1996	11	90	98	94
1997	11	86	99	93
1998	11	82	97	91

Clearly, if a producer assumes 80% germination for the seed he plants and it's actually 82 to 99% (averaging 93% over years), a major contributor toward overplanting has been identified. A more accurate germination percentage for each variety should enable the producer more consistently to achieve stands within the optimum range.

Not all cottonseed that germinate under "ideal" laboratory conditions will germinate under "less than ideal" field conditions nor will all that germinate emerge. Seedling disease, soil-borne insects, nematodes, cooler than optimum temperatures, soil drying, spot flooding, etc. will from time to time exact their toll. The estimate of emergence is probably the most inexact number in the equation. In good years, it may be quite high; in poor years, it may be so low that replanting is necessary. The exact percentage obtained depends largely upon weather conditions following planting. For estimation purposes, we'll assume 80% emergence.

Not all cotton seedlings that emerge will survive until harvest or will contribute to yield. However, except under extreme circumstances (wind-blown sand, hail, lightning, some diseases, etc.), most will. Again, for estimation purposes, we'll assume 95% survival to harvest.

Of the 4,500 cottonseed per pound, 0.93 germination times 0.80 emergence times 0.95 survival to harvest (or about 3,181 seed) will be present as plants with one or more bolls in the field at harvest. If the producer irrigates and is aiming for 50,000 plants per acre, he will need to plant 15.7 pounds of seed per acre (50,000 divided by 3,181). Conversely, if the producer grows dryland cotton and is aiming for 30,000 plants per acre, he will need to plant only 9.4 pounds of seed per acre (30,000 divided by 3,181). The amount to be planted depends on number of seed per pound (known), percent germination (known reasonably well, especially if the actual germination is determined), percent emergence (not known very well), and survival to harvest (known reasonably well). In the above examples, 50,000 and 30,000 plants per acre were deliberately chosen because final stands would have had to differ by more than 10,000 plants per acre before yield and harvester performance would suffer significantly.

Postscript

Those wanting more accurate germination counts for their varieties can send a one-half pound sample of delinted, treated cottonseed in separate, labeled containers for each variety to the Oklahoma Crop Improvement Association, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078 [(405) 624-7117]. Include with the shipment the name and address where the results and the bill are to be sent. About two weeks are required for the tests. Current costs are $8 per sample.

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