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BEST MANAGEMENT PRACTICES

CHAPTER 8

Corn Seeding Rates in South Dakota

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Optimum seeding rate depends upon the variety, the yield potential, the grain selling price, and seed cost. Generally, seeding rates increase with rainfall and yield expectations. Optimal corn target populations in South Dakota vary from ~ 15,000 to 36,000 plants per acre. Highly productive soils with sufficient drainage and available water can support higher populations. New corn planters provide the option to vary the seeding rate across the field. This chapter provides directions for calculating a seeding rate and guidelines for optimizing seeding rates are provided in Table 8.1.

Table 8.1 Guidelines for optimizing seeding rates:

1. Set seeding rates higher than target population to account for less than 100% germination and seedling mortality (Chapter 6). Different tillage systems may have different germination rates.
2. Match the seeding rate to your yield potential.
3. Increase seeding rate by ≈ 2000 seeds/acre in no-till systems.
4. Increase the desired populations by approximately 10% for silage crops.
5. Consider seeding lower populations in lower-yielding areas and higher populations in more productive areas.

Introduction

The optimal seeding rate for corn grain production is ultimately determined by the interplay of nutrient and water availability and competition between the developing plants. The relationship between corn yield and plant population follows a nonlinear response and generally yield increases with population until it levels off (plateau). At this point, additional increases in population can reduce yields (Tokatlidis and Koutroubas, 2004; Boomsma et al., 2009). The economic optimum rate is the point where seed inputs equal the economic increase in yield. Yield decreases at very high population levels may result from increased lodging or increased yield reductions resulting from increased abiotic (water and light) and biotic (insects, weeds, and diseases) stressors (Clay et al., 2009; Ciampitti and Vyn, 2011).

Determining the Corn Seeding Rate

Determining the Ratio Between the Seed Cost and Commodity Price

Determining the seeding rate is a three-step process. First the ratio between the seed cost and expected selling price must be determined (Table 8.2). The data in Table 8.2 provides calculated values for the ratio between the investment (costs) and returns (prices). For example, if the cost of a bag of seed is $300 or $3.75/1000 kernels and the expected selling price is $4/bu then the ratio between the purchasing price for

1000 kernels and the selling price per bushel is 0.94. This value when combined with the yield response function and expected yield is then used to calculate the seeding rate.

Table 8.2 The ratio between the cost of seed and the value of corn as a commodity.				
	Seed Cost ($/80,000 kernel bag)			
	200.00	250.00	300.00	350.00
	Seed Cost ($/1000 kernels)			
	2.50	3.13	3.75	4.38
Corn Commodity Price ($/bu)	**Ratio of Seed Cost to Commodity Value ($/1000 kernels:$/bu)**			
3.00	0.83	1.04	1.25	1.46
4.00	0.63	0.78	0.94	1.10
5.00	0.50	0.63	0.75	0.88
6.00	0.42	0.52	0.63	0.73
7.00	0.36	0.45	0.54	0.63

Estimating the Yield Potential

Corn yields are a function of many factors, including the location in a field and where the farm is located in the state. In many fields, yields routinely vary across the field (Fig. 8.1). Topography has a large effect on yield in a relatively short distance. To account for this variability, seeding rates can be selected for the whole field or portions of the field. When selecting a single rate, planting a high population in the lowest-yielding areas can reduce the yields, and planting a low population in the highest-yielding areas can result in lower yields. The analysis of yield monitor data can provide information needed to account for this variability (Butzen et al., 2014).

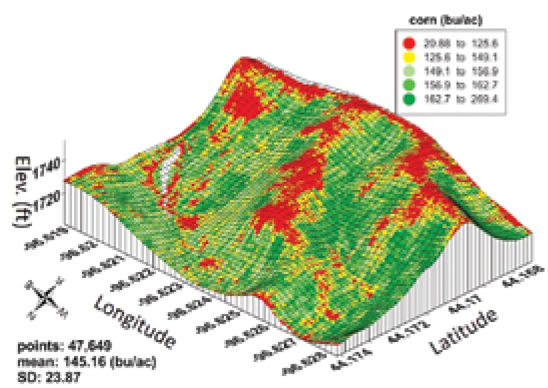

Figure 8.1 Corn yields in a South Dakota field in 2006 (Courtesy of the authors)

When selecting a yield, it is important to consider regional variability. Yield generally decreases from east to west across South Dakota (Table 8.3). This variability is predictable. For example, in the east-central region, the average yield was 162 bu/acre in 2014, whereas in the west-central region of South Dakota the yield was 81 bu/acre.

Table 8.3 Average regional corn yields in 2014 in South Dakota. The South Dakota regions were southeast (SE), east-central (EC), northeast (NE), south-central (SC), central (C), north-central (NC), southwest (SW), west-central (WC), and northwest (NW).								
East			Central			West		
SE	EC	NE	SC	C	NC	SW	WC	NW
bu/acre								
165	162	156	102	132	145	99	81	91

Determining the Seeding Rate

Once the cost-to-return ratios and yield potentials are calculated, the optimum plant population can be determined based on data provided in Table 8.4. The seeding rate is then determined by accounting for germination. For example, if the optimum seeding rate is 29,000 plants per acre, then the seeding rate should be 32,000 plants per acre (29,000/0.9) if the germination rate is 90%.

Table 8.4 The optimum plant population based on ratio between seed cost and selling price of corn and the yield estimate. The cost of seed/seed cost per bushel is provided in Table 8.2. These seeding rates need to be adjusted for the germination rate (Chapter 34). The seeding rates were based on coefficients developed using the equation: seeding rate = [1000•yield• A • ($e^{n \cdot yield}$)]. The coefficients for this equation are provided. The values of n and A are defined below.								
	$ cost seed/$ per bu							
Equations coefficient	0.5		0.75		1.0		1.5	
	n	A	n	A	n	A	n	A
	-0.00383	0.377919	-0.00357	0.346804	-0.00329	0.316176	-0.00261	0.256593
Yield estimates bu/acre	Optimum planting rate (*1000)/acre							
50	15.6		14.5		13.4		11.3	
100	25.8		24.3		22.8		19.8	
150	31.9		30.4		29.0		26.0	
200	35.1		33.9		32.8		30.5	
250	36.2		35.5		34.8		33.4	

Defining Seeding Rates Based on Soil Characteristics

Seeding rates can also be defined using soil characteristics (Table 8.5). Generally, highly productive soils with adequate drainage and available water can support higher populations. In the drier, western portion of the state, hybrids with a longer maturity rating (> 100 days) are a risky choice. A rule of thumb is that 1 inch of rain is needed for a four-day increase in hybrid maturity (Klein and Lyon, 2011). For example, a hybrid with a relative maturity of 100 days would require 3 additional inches of water than an 88-day hybrid. In South Dakota, 8-11 inches of water is the minimum requirement to produce a corn crop (Klein and Lyon, 2011).

Table 8.5 Relationship between the yield potential and soil characteristics on the target population in no-tilled and tilled systems. Influence of soil type and yield potential on target population and seeding rate. These calculations were based on corn seed selling for $240/bag and corn grain selling for $6/bu.			
Yield potential by soil type	Target population (1,000 plants/acre)	Planting rate[1] (1,000 seeds/acre)	
		No-till	Tilled
High Yield Potential (200 bu/acre)	33-35	35 – 37	34-36
• deep loams			
• well-drained			
Moderate Yield Potential (150 bu/acre)	27-29	30 – 32	28 – 30
• clays – sandy loams			
• well-drained to moderately well-drained			
Low Yield Potential (120 bu/acre)	19-22	21-24	20-23
• droughty soils			
• somewhat poorly drained to poorly drained			
• excessively drained			
[1]Increase population by 10% for silage corn.			

Corn Hybrid Specific Responses

Different corn hybrids have different yield vs. plant population responses. When possible, use hybrid-specific information. Over the past 50 years, genetic changes have produced plants that have the capacity to increase yields in response to intense crowding (Boomsma et al., 2009). However, in response to increasing populations, per plant yields are lower (Clay et al., 2009). Lower per plant yields with increasing population are the result of the down expression of many critical genes. A plant's ability to respond to increasing crowding generally decreases as the plant matures, which in turn accounts for corn's weed-free period (V2-V6). Hybrids are being developed with improved water-use efficiency (Chang et al., 2014). Many of these hybrids increase yields only under water-stressed conditions. These hybrids have been developed using traditional and transgenic techniques. The impact of improved water-use efficient hybrids on South Dakota seeding rates has yet to be determined.

Example 8.1 Use the data in Tables 8.2 and 8.4 to calculate the economically optimum seeding rate if corn is selling for $5/bu, the desired yield is 200 bu/acre and a bag of seed costs $300.

Answer
From Table 8.2 the seed cost is $3.75/1000 seeds (=$300/80), and the ratio between the seed cost and corn value is 0.75

From Table 8.4 the optimum plant population is 33,900 plants/acre.

If the germination rate is 95%, then the germination-adjusted seeding rate should be 35,700 seeds/acre (=33,900/0.95).

Corn Seeding Rate for Silage

Generally, corn-seeding rates are 10% higher for silage than grain seeding rates. It may be possible to increase silage yields further by planting narrow rows. See Chapter 18 for more information.

References and Additional Information

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Acknowledgements

Support for this document was provided by South Dakota State University, SDSU Extension, and the South Dakota Corn Utilization Council.

Graham, C. and G. Carlson. 2016. Chapter 8: Corn Seeding Rates in South Dakota. In Clay, D.E., C.G. Carlson, S.A. Clay, and E. Byamukama (eds). iGrow Corn: Best Management Practices. South Dakota State University.

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