An Update to Corn Plant Populations in Central North Dakota

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Many surrounding states have recently conducted research to update recommendations for corn plant populations using modern hybrids. Much of that research has come to the similar conclusion that recommendations haven't changed much from the 1980s-1990s. Yet with ever increasing input costs, including seed, managing to the optimum economic advantage needs to be considered rather than yield alone. Purdue University did a nice job of examining plant populations economically (https://www.agry.purdue.edu/ext/corn/news/timeless/CornPopulations.pdf). Using this as a template, a similar table can be generated for North Dakota with local data.

From 2012-2014 a plant population study was conducted at the Carrington Research Extension Center. Each year of the study was conducted under dryland management. The study was arranged as a split-plot randomized complete block design with four replicates. Hybrid maturity and plant population were the two factors being evaluated. The four relative maturities (RM) in the trial were 83, 85, 87, and 90 day. Hybrids were chosen based on the best performing hybrid within each maturity from the previous season hybrid trial. Each hybrid was tested from 20K to 44kK established plants per acre, with 4K plant increments (seven populations total). Plots were hand thinned to ensure optimum spacing of plants.

For simplicity, the first comparison will be about yield alone. Table 1 shows the plant population that resulted in the maximum yield within each maturity group. Importantly, the trend is that with longer maturities, maximum yield is reached at a lower population than shorter maturities. In fact if population were plotted from maturities of 85-90, it would show that for each day increase in maturity, roughly 1000 less plants were needed to maximize yield. Table 2 is a complimentary dataset that emphasizes the effect of plant maturity on needed population. In this case, *average* yield is considered rather than maximum. It took only 19K plants/ac to reach the average yield at RM 90 (16K plants/ac less than max), while it took 31kK plants to reach average yields at RM 83 (5K plants/ac less than max). This indicates strong diminishing returns of increases in plant density at longer maturities. Statistically, the maturities separated into two groups. The RM 83 and 85 hybrids performed similarly and will be herein termed short maturity while the RM 87 and 90 hybrids formed a second group herein called long maturity.

Table 1. The plant population that resulted in maximum yield for each maturity.

RM	pop
83	36000
85	39040
87	33650
90	35100
average	35640

Table 2. The plant population that resulted in an average yield for each maturity.

RM	pop
83	31000
85	33100
87	25200
90	19250
average	26450

Marginal return was calculated for short (Table 3) and long (Table 4) maturity hybrids. Each table describes the economically optimum plant population, based on the price of corn grain and the cost of seed corn. Generally, the short maturity hybrids required 2 to 4K more plants/ac compared to the long maturity hybrids. As the seed cost goes down and the grain price goes up, we approach the plant population that provided the highest yield for both groups. However, in most 'typical' scenarios the optimum plant population is much lower and deviated by as much as 10K plants per acre within the tables. The staple recommendation of 28K established plants per acre appears to still be fairly accurate with long maturity hybrids. For shorter maturing hybrids, those numbers may need to be adjusted up somewhat, depending on prices.

Table 3. The plant population that gives maximum economic return based on seed cost / unit (80,000 seeds) and grain price for corn varieties ranging from RM 83-RM 85. 95% stand establishment is assumed.

Cost of seed	Price/bushel of grain							
$ / unit	2.5	3	3.5	4	4.5	5	5.5	6
150	32,230	33,070	33,660	34,100	34,440	34,710	34,930	35,120
175	31,390	32,370	33,070	33,580	33,980	34,300	34,560	34,780
200	30,530	31,670	32,470	33,070	33,530	33,870	34,190	34,440
225	29,650	30,960	31,870	32,550	33,070	33,480	33,820	34,100
250	28,760	30,240	31,270	32,020	32,600	33,070	33,440	33,750
275	27,840	29,500	30,650	31,490	32,140	32,650	33,070	33,410
300	26,900	28,760	30,030	30,960	31,670	32,230	32,700	33,070
325	25,920	28,000	29,400	30,420	31,200	31,810	32,310	32,730

Table 4. The plant population that gives maximum economic return based on seed cost / unit (80,000 seeds) and grain price for corn varieties ranging from RM 87-RM 90. 95% stand establishment is assumed.

Cost of seed	Price/bushel of grain							
$ / unit	2.5	3	3.5	4	4.5	5	5.5	6
150	29,490	30,320	30,910	31,340	31,680	31,950	32,170	32,360
175	28,640	29,630	30,320	30,830	31,230	31,550	31,800	32,020
200	27,810	28,940	29,730	30,320	30,780	31,140	31,430	31,680
225	26,950	28,230	29,140	29,800	30,320	30,730	31,060	31,340
250	26,070	27,520	28,530	29,280	29,860	30,320	30,690	31,000
275	25,170	26,800	27,930	28,760	29,400	29,910	30,320	30,660
300	24,250	26,070	27,320	28,230	28,940	29,490	29,940	30,320
325	23,300	25,320	26,700	27,700	28,470	29,080	29,570	29,980