Corn Plant Density Effects on Silage Quality

Guide A-416

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Recently, there has been interest among corn silage producers in raising plant density to increase dry matter (DM) yield of silage crops. Corn (*Zea mays* L.) for silage is the most important energy crop for dairy and beef cattle rations. Corn silage energy value ranges from 0.5 to 0.7 mcal/lb DM (NRC, 2001). Typically, corn plant densities for silage range between 30,000 and 35,000 plants/ac. Although increasing corn plant density may increase DM yield in some situations, it will potentially affect other constituents related to silage nutritive value.

The following questions should be addressed when planning to increase corn plant density.

1. What is the economically maximum corn plant density for silage?

Regardless of the crop, farmers constantly evaluate how much extra yield can be attained per inch of water or pound of nitrogen. With corn silage production, seeding rate is another factor that farmers often examine for potential yield increases. Typical recommended plant densities for corn silage range from 30,000 to 35,000 plants/ac. With these plant densities, a reasonable DM yield is about 8.0 to 10.0 tons/ac under adequate irrigation (Marsalis et al., 2009b). Research in New Mexico was conducted in 2007 and 2008 to assess the effects of seeding rate and nitrogen rate on corn and sorghum silage grown under limited irrigation. This work showed that there was no difference in DM yield among 22,500, 27,000, and 30,000 plants/ac when corn was irrigated with 20 inches of water (Marsalis et al., 2009a). Dry matter yields were maintained at over 10.5 tons/ac and wet yields exceeded 25.0 tons/ac, even at 22,500 plants/ac. This research is important because as irrigation well capacities diminish in New Mexico, growers will have to begin reducing other inputs such as plant populations in order to remain productive and profitable. In Wisconsin, Cusicanqui and Lauer (1999) conducted a study to assess the effect of plant density and corn hybrid on forage yield and nutritive value. Corn plant densities ranged from 18,000 to 42,300 plants/ac. They found a maximum DM yield at around 35,000 plants/ac and declining DM yield at greater plant densities. They also mentioned that the different corn hybrids responded similarly to plant density. In a separate study, Cox and Cherney (2001) assessed corn DM yield at two plant densities, 32,000 and 47,000 plants/ac. In this study, increasing plant density increased DM yield, but the difference in DM yield between the two plant densities was only 3.7%. The question growers must answer is, "Will the increase in DM yield pay for the 10,000 to 15,000 extra seeds per acre?"

2. Do corn hybrids respond differently to high plant density?

Several studies have been conducted in multiple locations assessing the effect of plant density on different corn hybrids. Overall, there were no differences among corn hybrids under plant density treatments. Aside from rare exceptions, corn hybrids for grain or silage respond similarly to plant density (Widdicombe and Thelen, 2002; Cusicanqui and Lauer, 1999; Stanger and Lauer, 2006).

3. Do I need to apply more nitrogen?

The study conducted in New Mexico also investigated the effect of nitrogen rate on yield and nutritive value when combined with three seeding rates. Findings indicate that there is no yield difference or change in

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forage quality among any of the seeding rates when grown with either 195 or 250 lb N/ac when seasonal applied irrigation was 20 inches or less. Cutting nitrogen by 20% had no negative effect on yield or nutritive value. Future studies in New Mexico will evaluate even lower plant populations and nitrogen rates. Cox and Cherney (2001) evaluated corn silage DM yield and nutritive value at two plant densities (32,400 and 47,000 plants/ac) and six nitrogen rates (from 0 to 223 lb N/ac). Maximum corn DM yield (8.5 tons/ac) was found at 134 lb N/ac, regardless of plant density. There was no response in DM yield above this N rate. Moreover, corn silage nutritive value did not change above this N rate. They concluded that corn silage should be produced at 32,400 plants/ac and 134 lb N/ac to combine yield and nutritive value. Shapiro and Wortmann (2006) also conducted a study to assess the effect of N rate, row spacing, and plant density on grain and DM yield. They found the greatest DM yield at 134 lb N/ac, but the optimum grain yield was between 178 and 214 lb N/ac.

4. Does plant density affect corn silage nutritive value?

Marsalis et al. (2009a) demonstrated that none of the quality parameters of corn (e.g., crude protein, net energy, fiber, fiber digestibility) were affected by reducing seeding rate from 30,000 to 22,500 plants/ac or nitrogen rate from 250 to 195 lb N/ac. Basically, there was no advantage or disadvantage to increasing plant density or N fertility with respect to feed value. Cusicanqui and Lauer (1999) found that increasing plant density negatively affects corn nutritive value. *In vitro* digestibility decreased 2.0% as plant density increased, which could be due to increasing fiber concentration. In addition, neutral detergent fiber (NDF) and acid detergent fiber (ADF) concentrations increased an average of 2.6% as plant density increased, potentially reducing feed value. Maximum milk per acre was found at plant densities from 30,400 to 34,400 plants/ac. Similar trends in nutritive value were reported by Cox and Cherney (2001) evaluating two corn plant densities, 32,400 and 47,000 plants/ac, at different N rates. In this study, *in vitro* digestibility decreased 0.7% and NDF increased 1.3% with the increase in plant density. They also did not find any advantage in potential milk yield by planting high corn density.

Valdez et al. (1989) conducted two separate experiments assessing corn silage planted at two densities, 30,000 and 60,000 plants/ac. Similar to previous results, NDF and ADF concentrations increased and net energy for lactation decreased by increasing corn plant density. However, contrary to other results, milk yield was not affected by corn plant density. In addition, they found differences in nutritive value and milk yield between corn hybrids, indicating that some corn hybrids can potentially produce more milk yield than others.

5. Do I need to modify row spacing if I increase plant density?

Increasing corn plant density does not necessarily mean row spacing must be reduced. Several studies reported that differences in DM yield for silage or grain yield were similar between row spacings of 15 in. and 30 in. (Cox and Cherney, 2001; Widdicombe and Thelen, 2002; Shapiro and Wortmann, 2006).

6. Do I need to add more water with higher corn density?

The results of Marsalis et al. (2009a) indicated that corn planted at 30,000 plants/ac and irrigated with 20 inches of water, which is anywhere from 10 to 33% lower than the amount often applied, tended to decrease DM yield and nutritive value compared to corn planted at 22,500 and 27,000 plants/ac and irrigated with same amount of water. However, we do not have enough information at this time to support that increasing corn plant density will increase water demand. It is important to conduct further research on this topic.

The bottom line is that increasing corn plant density does not necessarily increase DM yield enough to justify the extra seed, especially in situations where water may be limiting. An economic analysis and irrigation capacity assessment should be conducted before deciding to increase corn plant density. In addition, increasing corn plant density may have an effect on forage nutritive value, although two studies indicated no effect on energy of silage or milk yield between densities.

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