Optimizing Alfalfa Cutting Management

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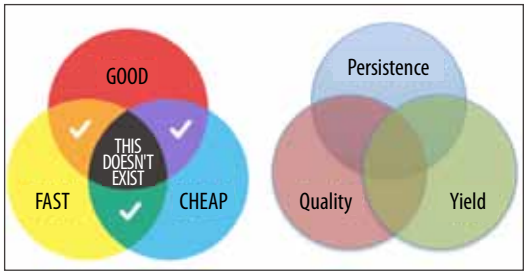
Balancing alfalfa tradeoffs between yield, quality, and persistence reminds me of the "Good," "Fast," and "Cheap" paradigm where only two can be selected (Figure 1; Dev. 2018). Cheap and fast typically corresponds to lower-quality work, whereas fast and good tends to be expensive. But what about good and cheap? From my experiences, good and cheap are seldom in alignment. Substituting good, fast, and cheap with alfalfa yield, quality, and persistence (Figure 1), it is easy to see alfalfa management priorities also fit the project management paradigm with a few caveats.

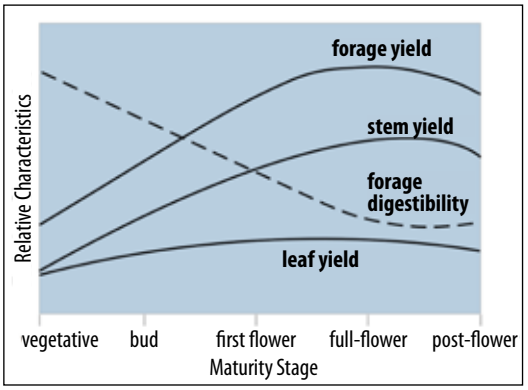
Figure 1. Project management dilemma of picking two priorities (left), and alfalfa tradeoff priorities (right).



Adapted from the Developer Society (April 5, 2018).

Optimizing alfalfa tradeoffs is a bit more challenging than picking project management priorities. In the management paradigm, we are assured any two priorities are selectable; however, in alfalfa, there may be a way to pick all three pairs. Before we explore the "pick-three" option, let's discuss "pick-two" options. Yield and persistence are a logical pairing since delaying harvest does increase forage yields while potentially lessening the year-to-year stress, thus increasing persistence. Yield and quality, another pick-two pairing, are related, where both must be fully optimized (Figure 2). Historically, the last pairing, quality and persistence, are contradictory much like good and cheap. For example, let's assume an alfalfa farmer needs high-quality alfalfa and plans to reseed after four production years. This means the farmer needs the stand to deliver high-quality alfalfa each year for the four-year duration consistently. The dilemma is when the farmer increases cutting frequency to harvest less mature plants, subsequently reducing lignin which improves quality. The stands are less able to build up root reserves and are at a higher risk of reduced persistence (Brink and Marten, 1989). On the surface, the pick-three option isn't apparent.

Figure 2. Tradeoffs between alfalfa yield and quality as impacted by alfalfa maturity stage.



Adapted from the *Alfalfa Management Guide*.

Recent advances in alfalfa breeding suggest emerging opportunities to attenuate these tradeoffs, potentially allowing for simultaneous improvements to quality, yield, and persistence (i.e., the pick-three). Modern alfalfa cultivars regrowth potential (i.e., Fall Dormancy rating) has been primarily decoupled from winter hardiness, which may allow for both higher yields and persistence. Also, new alfalfa traits have directly improved alfalfa forage quality through the reduction of lignin which may accumulate greater yield while limiting reductions in relative feed value (Lamb et al., 2012; Grev et al., 2017). Can modern alfalfa cultivars, along with intensive management, provide farmers with a pick-three solution? A recent study evaluated eight modern cultivars of a range of fall dormancies (only two shown for brevity) for forage yield, quality, and persistence across four-, five-, and six-annual harvests corresponding to 21-, 28-, and 45-day cutting intervals in Minnesota.

In spring 2014, the experiment was initiated at Minnesota Research and Outreach centers located at Becker and St. Paul, MN. The project continued until spring 2017 at both locations. Alfalfa cultivars with Fall Dormancy (FD) ratings 2.1 ($FD_{2.1}$) and 5.0 ($FD_{5.0}$) were established into prepared seedbeds at 13 lbs live seed/ac. Raptor and Poast were applied for broadleaf and grass control, respectively. Arctic 3.2 EC was applied when potato leafhoppers exceeded thresholds. Alfalfa cultivars were harvested via a Carter forage harvester, and bulk yield samples were weighed fresh and subsampled for quality. Forage quality was determined using near infrared reflectance spectroscopy. Each spring, plant densities were measured in two locations within each plot using a frequency grid.

Alfalfa total season-long yields were impacted by cultivar and harvest intervals. On average, the $FD_{5.0}$ cultivar produced 9% more biomass dry matter (DM) than the $FD_{2.1}$, and increasing harvest intervals increased alfalfa

DM yield (Figure 3). The 21-day harvest interval (5.0 ± 0.82 tons/ac) produced less alfalfa DM than both the 28- and 45-day treatments (6.3 and 6.2 ± 0.82 tons/ac), respectively. Both the cultivar and harvest interval impacts on alfalfa DM yield production are not surprising. The $FD_{5.0}$ has a fall dormancy rating 5, which may have contributed to greater regrowth potential when compared to the $FD_{2.1}$.

Figure 3. Total season alfalfa forage yield as influenced by alfalfa FD rating and harvest intervals.

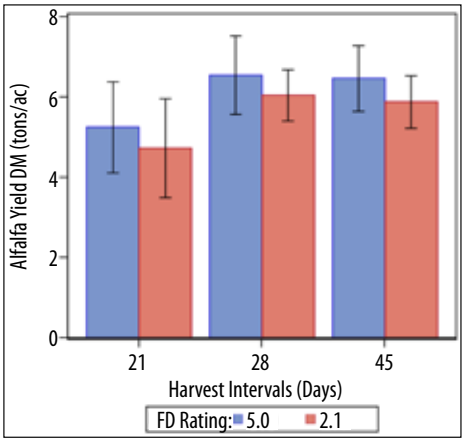
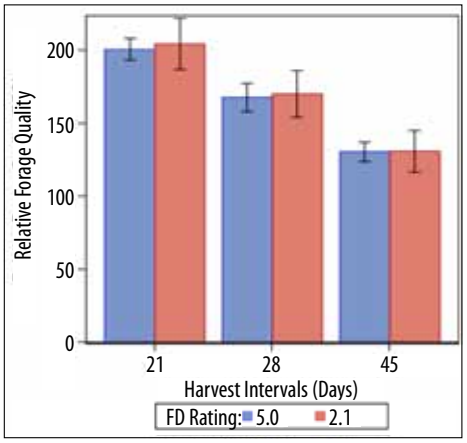


Figure 4. Relative Forage Quality as impacted by alfalfa FD rating and harvest interval.



Unlike forage DM yield, alfalfa Relative Forage Quality (RFQ) was not impacted by alfalfa cultivar with the average RFQ of 167.3 ± 7.6 for $FD_{5.0}$ and $FD_{2.1}$. Although cultivars did not differ, RFQ was inversely proportional to harvest intervals (Figure 4). For each day increase in harvest interval, there was a -2.9 point decrease in RFQ. Although increasing harvest intervals (e.g., 21- to 45-day) did improve alfalfa DM yield (Figure 3), the delay in harvest negatively impacted RFQ with nearly a 40% reduction in RFQ between the 21- and 45-day harvest intervals (Figure 4). The decrease in RFQ associated with harvesting older plants was no surprise, nor was the impact of higher-quality alfalfa on milk production (Figure 5). Both alfalfa cultivar and harvest interval impacted milk production where the $FD_{2.1}$ cultivar produced slightly more (~1.6%) milk per ton of alfalfa than the $FD_{5.0}$ cultivar. Forage quality reductions as a consequence of delaying harvest or increasing the interval between harvest did impact milk production at every level with nearly a 17% reduction in milk production between the 21 and 45-day harvest intervals. Cutting alfalfa more frequently may reduce yield, but does improve forage quality, which can directly result in more milk production. But what about the pick-three option?

Figure 5. Milk production (lbs milk per ton of alfalfa) as determined by alfalfa FD rating and harvest intervals.

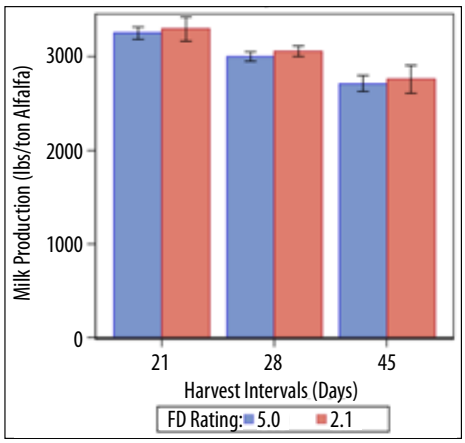
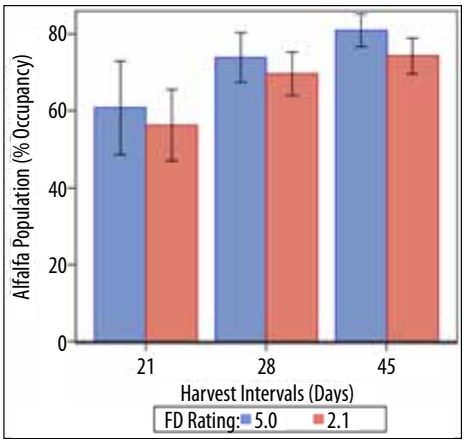


Figure 6. Alfalfa persistence in the third production year as impacted by alfalfa FD rating and harvest intervals.



Recall the "pick-three" option was persistence, yield, and quality. Fortunately, neither alfalfa fall dormancy rating or alfalfa harvest interval influenced the alfalfa persistence in the third production year (Figure 6). There was a visible trend of increasing persistence with a widening of harvest intervals; however, variation across treatments was relatively high, preventing detection of differences. Based on this snapshot, picking all three is possible in alfalfa production.

Predicting alfalfa persistence is not easy. There are many factors (e.g., management, weather) impacting the life and productivity of an alfalfa stand. We have little control of weather; however, management can play an essential role in maintaining highly productive stands that persist year after year. Even with the best management, Mother Nature has the final word, and stands should be assessed every year. When evaluating a stand, ask yourself, do I have enough alfalfa in this field to meet my forage demands? There are several resources to help decide if there is sufficient high-quality alfalfa to meet production goals. Visit extension.umn.edu for more information.

References:

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