COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

Managing Alfalfa During Drought

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Water is the most important limiting factor for alfalfa production in New Mexico and the western US, and ground water withdrawals and lack of rainfall and snowpack over extended periods reduce water available for irrigation. When prolonged dry conditions occur in New Mexico and water for irrigation is in short supply, alfalfa growers should consider strategies to protect their alfalfa stands for future years. Since the shortage of water may be alleviated at any time by significant precipitation replenishing the state's rivers and lakes, the goal is to preserve the health of the stand during drought so as to optimize growth once irrigation can be resumed.

Unlike many other crops where total loss is possible due to drought and no irrigation, alfalfa is quite resilient to such conditions and can even produce economic yields with partial irrigation or timely precipitation. Because alfalfa can go dormant during extended dry periods, it is one of the few legumes that can withstand long-term drought[13] (Figure 1) and still recover once adequate precipitation or irrigation occurs.[4,10] Alfalfa plants can survive as long as their crown and roots remain viable—indicated by a lack of splitting or other external damage and a uniform white color with minimal internal discoloration[14] (Figure 2). If enough plants survive for the stand to remain productive (5 plants per square foot or 40 stems per square foot),[14] the field should become fully productive again when it recovers from the drought. Unlike shallow-rooted plants, alfalfa can secure moisture from lower depths in the soil.[13] Thus, even when producers have less than optimum irrigation capabilities or no water for irrigation, alfalfa often can produce harvestable forage—whether harvested as stored feed or by grazing—whenever significant precipitation occurs (Figure 3).

Some key strategies to consider during drought conditions in alfalfa include harvest management, irrigation management (if water is available), insect control, and fertilization.

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***Figure 1*. Alfalfa (far left) was the only one of seven perennial legumes to survive for five years without irrigation in a study at New Mexico State University's Agricultural Science Center at Tucumcari. The average annual precipitation at Tucumcari is approximately 16 inches. Photo courtesy of Leonard Lauriault.**

***Figure 2*. Healthy alfalfa crowns (left) have multiple branches and little or no evidence of splitting. Healthy alfalfa roots (right) will be uniformly off-white or have less than one-third of their diameter discolored. (Images by Dan Undersander, Wisconsin Cooperative Extension Service [fyi.extension.wisc.edu/forage/], used with permission.)**

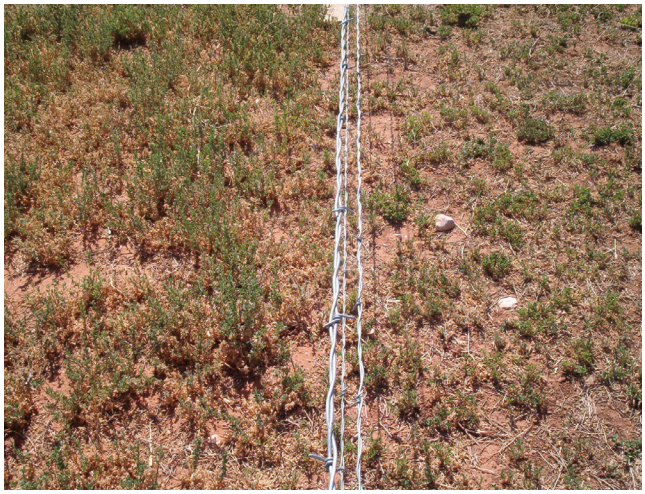

***Figure 3*. Rainfed alfalfa in June 2003 near Tucumcari, NM. A major portion of the ungrazed alfalfa on the left was approximately 12 inches tall. Photo courtesy of Leonard Lauriault.**

HARVEST MANAGEMENT

Harvest management during drought is similar in purpose to fall harvest management. The goal in fall harvest management is to allow a sufficient autumn rest period for plants to restock root energy for winter survival and spring green up.[12] The goal in drought harvest management is maintenance of leaf area for photosynthesis—this provides continuous energy to sustain plant functions without depleting root reserves, so that the alfalfa can survive.

If harvesting top growth above 6 inches is economically feasible, cuttings or grazing should be scheduled to minimize plant stress. During periods of drought, if growth is sufficient, the alfalfa should be allowed to reach at least 10% bloom before harvesting, enabling plants to better handle the dry weather and cutting stresses.[12] At the same time, a stubble height of at least 6 inches should be left to maintain energy for regrowth. Continuous light grazing that maintains sufficient leaf area also is feasible, but the pasture should be monitored closely.[7]

Drought-stressed alfalfa will initiate flowering earlier than non-stressed alfalfa (Figure 4). Plants will, therefore, be shorter with less leaf growth to help replenish root energy needed for regrowth.[5] Although leaf growth is restricted compared to a non-drought year, stem growth is even more restricted, leading to a higher leaf-to-stem ratio and, therefore, higher quality of the more mature alfalfa forage. Consequently, delaying harvest to greater than 10% bloom does not lead to a quality reduction in drought-stressed alfalfa as it does for alfalfa that is watered well.[5]

***Figure 4*. Drought-stressed alfalfa flowering with shortened stature. Photo courtesy of Mark Marsalis.**

Regrowth from crown buds will begin after alfalfa has initiated flowering, likely resulting in two different growth stages. This complicates harvest decisions because the regrowth from the crown uses energy stored in the roots that the plant will not have had time to re- plenish. Harvesting all leaf material will cause the plant to use even more of its energy reserves for regrowth.

Maintaining a minimum 6-inch stubble will minimize the drain of root energy, saving it for future needs such as winter survival. Delaying cutting may decrease forage quality and the number of cuttings; however, it will promote stand persistence by supporting plant survival during the drought, and it will save on harvest costs. If areas of the field vary in maturity, base harvest timing on the least mature plants in the field.

IRRIGATION MANAGEMENT

Alfalfa uses water more efficiently during the spring when temperatures are more moderate.[2,8] Consequently, if water is available but limited in supply for season-long irrigation, yields will be maximized by concentrating the water on the early cuttings and then terminating irrigation to allow the alfalfa to enter drought-induced dormancy.[4,5,8] This is one method of a 'deficit irrigation' strategy known as 'partial season irrigation/termination'.

Irrigation termination for more than one cutting will reduce total annual yield, and recovery will be delayed until the second or later regrowth after drought-induced dormancy is broken.[4,10] Studies have shown that annual yield reductions during the deficit irrigation year range from minimal (25% or less; late-season termination) to significant (50-75%; early to mid-season termination).[11] Consequently, if water becomes available later in the season, producers should consider irrigating as soon as possible as many acres as can be fully irrigated for the remainder of the season—if water will be available for that long— after harvesting the standing crop on that acreage. If the water will only be available for the current cutting, irrigate as many acres as possible at the typical full irrigation rate for that location. Any remaining acreage that cannot be adequately irrigated should be allowed to remain dormant and managed to minimize drought stress. Deficit irrigation strategies should be targeted to the least productive fields first, focusing water to those fields with the highest yield potential.

Results from research conducted at Tucumcari, New Mexico and other parts of the west have shown that while yields can be severely reduced in the termination year, subsequent year yields can return to normal once full irrigation resumes and stand density may not be negatively impacted.[4,9]

Another deficit irrigation strategy is what is referred to as 'continual deficit' or 'starvation' irrigation. This technique applies reduced amounts of water over the course of the season that are less than what the alfalfa crop requires, thereby stressing the plant in a chronic manner (e.g., 50-75% of alfalfa evapotranspiration demand). This scenario is more common in sprinkler or drip irrigation systems where well capacity is declining or too many acres are being irrigated for a particular well output. However, continual deficit may be achieved in flood irrigation systems also by reducing number of irrigations per cutting cycle (e.g., 1 vs 2 irrigations per cut). While yields may not be reduced as much as expected, especially early in the season or in mild environments, it is generally considered to be a more stressful management strategy for the alfalfa. This strategy will likely result in significant yield reductions in the hotter, drier regions of New Mexico as the season progresses into the heat of the summer. Stand loss under these environments may be more severe as well especially if deficits are applied over multiple years.

Irrigations at any time, even when water is plentiful, should be applied between cuttings after the canopy has closed, if possible, to reduce evaporation and minimize germination of weeds that can outcompete the already weakened alfalfa plants.[2] Salinity exacerbates problems associated with drought. If salinity of the soil or available irrigation water increases due to drought, water applied is less available to the plant, and the water requirement of alfalfa may also increase. Alfalfa yields can be reduced when poor quality irrigation water is used, and the weakened plants become even more susceptible to drought stress. Consequently, irrigation water should be tested occasionally to monitor for changes in quality. Applying full irrigation the following season after a deficit irrigation season can help flush accumulated salts and prevent further buildup.[9]

Figure 5. **The effect of irrigation management on alfalfa growth at Tucumcari in 2007 as indicated by well- irrigated alfalfa on the left and unirrigated alfalfa on the right. Photo courtesy of Leonard Lauriault.**

INSECT CONTROL

Another issue during drought is insect pests. During dry periods, rangeland insects such as grasshoppers may migrate into alfalfa fields, adding additional stress to the crop. With hot and dry conditions, insect populations also increase rapidly; hence, more frequent scouting is necessary, especially when regrowth is initiated after harvest or when the alfalfa begins blooming. Aphid populations should be of specific concern. Producers should pay particular attention to new growth, even if a standing hay crop remains in the field, because the new growth will be more readily consumed or infested by insects. Producers should also note that blister beetles, which are toxic to livestock, are attracted by grasshoppers and by alfalfa flowers.[3] Hence, if alfalfa is allowed to bloom before harvest (as it should be during drought), fields should be monitored for these insects just prior to harvest.

FERTILIZATION

Plants under drought stress allocate resources to survival over biomass production, resulting in lower forage production (Figure 5); however, nutrient availability remains critical during drought. Soil testing every 3 years is sufficient to determine nutrient needs of alfalfa. Fertilizer should be applied prior to the initiation of growth in spring to minimize traffic on actively growing alfalfa so that stems are not damaged. Always apply fertilizer based on soil test recommendations for alfalfa at a lower level of production. Although boron deficiencies are rare in New Mexico, producers should pay close attention to that nutrient because deficiencies can be enhanced during dry weather. Typical symptoms of boron deficiency include a yellowing and red/purple coloration of the newer, upper leaves. Always verify plant deficiencies for boron and other micronutrients with plant tissue analysis in combination with concurrent soil analysis (see NMSU Guide A-123 Sampling for Plant Tissue Analysis available at: https://pubs.nmsu.edu/_a/A123/index.html). Over-fertilization should always be avoided. If for some reason nitrate (N) is elevated in the field, the alfalfa forage should be evaluated for nitrate content to avoid toxicity to livestock.[1]

These key management practices should be followed to help alfalfa to persist during drought years and recover under more favorable conditions. For further information about alfalfa management, contact your County Cooperative Extension office or visit the NMSU Cooperative Extension Service publications website agronomy page (https://pubs.nmsu.edu/_a/index.html) or the NMSU Forages publication page at: https://forages.nmsu.edu/publications.html.

VARIETY SELECTION

Alfalfa breeding efforts at NMSU have extensively evaluated the performance of many lines of alfalfa under varying drought stress and limited irrigation conditions. Recent drought-resilient variety releases include ‘NuMex Bill Melton’, ‘NuMex 801’, ‘NuMex 802’, and ‘NuMex 501’. These varieties were developed to recover from prolonged water stress and maintain high yields under subsequent adequate irrigation. The NMSU breeding program will continue to put drought-resilience at the forefront of research efforts and variety selection in the future. For more information on the NM Alfalfa Variety Testing Program (along with reports), visit: https://pubs.nmsu.edu/specialty/index.html.

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