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Incorporating Targeted Grazing into Farming Systems

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CHAPTER 14: Incorporating Targeted Grazing into Farming Systems

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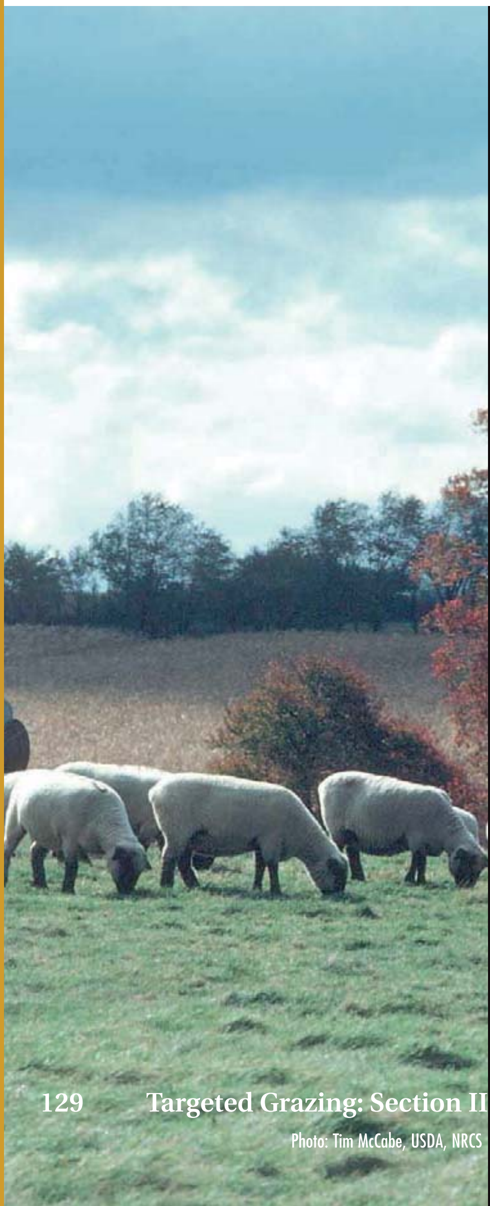

Photo: Tim McCabe, USDA, NRCS

10 KEY POINTS

- Cropping systems historically were wholly integrated with livestock production.
- Incorporating grazing into cropping systems could reverse the decline in organic carbon levels.
- Many summer fallow weeds are palatable making them susceptible to grazing.
- Grazing can remove excess crop residue that hinders crop production.
- Sheep grazing grain residue can reduce wheat stem sawfly populations.
- Grazing may inhibit cereal leaf beetle, Hessian fly, wheat stem maggot, and certain aphids and mites.
- Alfalfa weevil is susceptible to grazing with sheep.
- Volunteer weeds and crop residues can provide nutritious livestock forages.
- Grazing cropland may cause some soil compaction but not enough to hinder crop production.
- Integrating livestock into farming operations can provide low-capital business opportunities.

INTRODUCTION

When incorporating targeted grazing into farming systems, livestock producers and farm operators need assurance that the benefits from their activities are worth their investments. This chapter will focus on how integrating grazing, particularly with sheep and goats, into farming systems can offer those benefits. The concepts are not new. Cropping systems were once integrated with livestock production: Livestock gained forage value from crop aftermath, crops were grown to sustain livestock, and livestock were used as implements to produce crops. Today, few cropping systems include livestock.

Sheep and goats are traditionally produced on rangelands or pasture forages and supplemented during winter with harvested feeds. In recent years, sheep and goat producers have made great strides using commercial-scale grazing to control unwanted vegetation like noxious weeds and excess fire fuels. Incorporating grazing into hay and dryland grain production to control weeds and insects has received far less attention. However, such practices not only may increase yield, they can reduce costs, offer new business opportunities, and improve public perception of production agriculture.

On some Great Plains soils, organic carbon levels have declined up to 60% since their initial cultivation.[17] This trend could be reversed by incorporating livestock grazing into cropping systems, a practice currently used on less than 10% of agricultural land. Integrated crop and livestock systems could reduce reliance on synthetic fertilizers to maintain soil fertility, pesticides to control weed and insect pests, and depreciable equipment, fossil fuel, and burning to remove crop residues. These cropping inputs are becoming less feasible for both economic and environmental reasons. Integrated low-input systems that optimize output per unit of input may be preferred over systems that simply strive to maximize output. Reducing production costs while creating opportunities in the form of low cost livestock production could dramatically alter grain and forage production, at the same time filling increasing consumer demand for food and fiber produced in an environmentally sound manner.

This chapter highlights several techniques for integrating livestock grazing into grain and forage systems, potentially improving profitability and sustainability for crop producers and creating a profitable service industry for livestock producers. It examines the use of livestock to manage fallow, weeds, and insect pests by grazing grain and forage residue, practices that could help farmers reduce pesticides and tillage, allow livestock producers to tap into valuable feed sources, and enable rural communities to embrace new opportunities.

Vegetation Management Opportunities

Presented here are three example settings of opportunities to integrate livestock into cropping systems:

1. Grazing summer fallowed ground on dryland grain systems that rotate each year between fallow and crop production to control weeds and conserve soil moisture and nutrients.
2. Grazing grain crop residues after harvest to facilitate tillage, control unwanted plants, and reduce insect pest populations.
3. Grazing alfalfa with a major emphasis on insect pest control.

Grazing Fallow Ground

In fallow, weeds and volunteer crop plants deplete soil moisture and nutrient reserves. Their unwanted growth on wheat fields can reduce grain yield the following year by 500 to 1,500 pounds per acre.[8, 24] On the Northern Great Plains, about 15 million acres of farmland are rotated into summer fallow annually[26] with up to four herbicide applications to control weeds, making herbicides the most costly input for the system. On fallow ground, pesticide costs averaged $6.08 an acre with minimum tillage and $9.29 an acre with chemical fallow.[16]

Tillage is the most common alternative to herbicides now used to control weeds in summer fallow or fallow management in organic farming. However, tillage can bury crop residue, which decreases soil cover and

Figure 1. Sheep grazing to control weeds in a fallow field in Montana.

increases the potential for erosion. Incorporating grazing could reduce these tillage impacts and offer an alternative to herbicides while being able to control the amount of residue that remains for ground cover.

Many weeds found in summer fallow, like volunteer grain, kochia, Russian thistle, wild oats, and cheatgrass, are highly palatable to ruminants, particularly when plants are in the green leafy stage. Marten and Andersen (1975) documented that several broadleaf and grassy weeds have high forage quality and are as palatable as oats to grazing sheep, suggesting that grazing animals may be effective tools to manage weeds.

Selecting Animals and Management Strategies

Given that sheep prefer forbs and broadleaf plants and their established role in controlling range weeds, they may work better than cattle when the primary goal is to reduce weeds in summer fallow. However, cattle may also be an effective tool when the goal is to reduce biomass or remove volunteer grain. Current work at Montana State University clearly shows that volunteer wheat is an excellent forage resource for any class of ruminant. Goats may also be effective in removing weeds or volunteer crop plants from stubble. Any breed, age, or background of sheep will work for summer fallow grazing if weeds are at an immature stage or the predominant weed is volunteer grain.

The animal's nutritional needs should be aligned with land management goals. Current research by Hatfleld and co-workers at Montana State University indicates that cull ewes, yearling rams, and wethers do an excellent job of removing weeds and volunteer crop plants. With the potential high nutrient content of young weeds, lactating ewes could be incorporated into fallow management. However, when weeds become scarce during the end of fallow grazing, the animals may need supplements, particularly protein, to meet nutrient demands, or animals with low requirements, like dry open ewes, could be used. If land management is the primary task and source of income, wethers, with their relatively low nutrient demands, may be appropriate, especially when combining fallow management with other vegetation management jobs. It should be noted that using fine-wooled breeds of wethers on a low but consistent nutrient program also has the potential for producing fine, high quality wool.

Soil compaction may be a concern when integrating livestock into cropping systems. Studies have shown that cattle grazing wheat fields do compact the soil to some degree,[28] while sheep have less impact. Murphy et al. (1995) compared cattle and sheep grazing on smooth-stalked meadowgrass-dominant white clover sward. At similar stock densities (32 animal units per acre), soil compaction was 81% greater with cattle than with sheep. They speculated that the shape and small size of the sheep hoof might churn and till up the soil rather than compress it. Plants grew more vigorously under sheep, probably because they cycled higher levels of nutrients and created less soil compaction.

Grazing may cause slightly more compaction than chemical and mechanical summer fallow. But even if grazing does cause some compaction, freezing and thawing over winter and pre-planting tillage can alleviate the impact.[23]

When grazing summer fallow, timing is critical. The crop producer wants weeds and volunteer crop plants removed before they consume too much water and soil nutrients. The livestock producer wants the animals to consume weeds and volunteer grain plants while they are still palatable and nutritious (Figure 1). Fortunately, the time of grazing for optimum fallow management generally coincides with the time when plants are most nutritious and palatable. When plants mature and initiate flowering and seed production, they begin to use large amounts of soil moisture and nutrients. At this stage, most have relatively low fiber content and crude protein values in the mid-teen to low 20% range, providing excellent feed. However, many also accumulate unpalatable compounds (i.e., tannins, oxalates, or terpenes) and become less desirable to grazing animals. Current research at Montana State University by Hatfield and co-workers indicates that some fallow weeds, like common mallow, have a fairly short period for aggressive consumption by sheep. But when the target weed is the only green, lush forage available, consumption is generally high.

The best time to initiate grazing for fallow management typically coincides with the best time for herbicide application for fallow management. As with mechanical and chemical fallow, the number and timing of grazing applications per season will vary with weed type, soil moisture, and weather conditions. In two years of work at the Fort Ellis Experiment Station by Hatfield and co-workers (Figure 2) the number of grazing applications typically was similar to or slightly greater than the number of chemical and mechanical fallow applications.

Reducing Crop Residue

Cereal crop residues are primarily fibrous carbohydrates, unusable as feed for non-ruminants, like pigs and chickens, and lacking the energy density to warrant processing or transport. Small grain residue, particularly in high production settings, is often considered a hindrance to the primary production of grain. Targeted grazing offers managers another way to handle residue in response to market and environmental goals and restrictions. In the future, burning crop residue may be banned, leaving spreading, baling, and grazing as the only options.

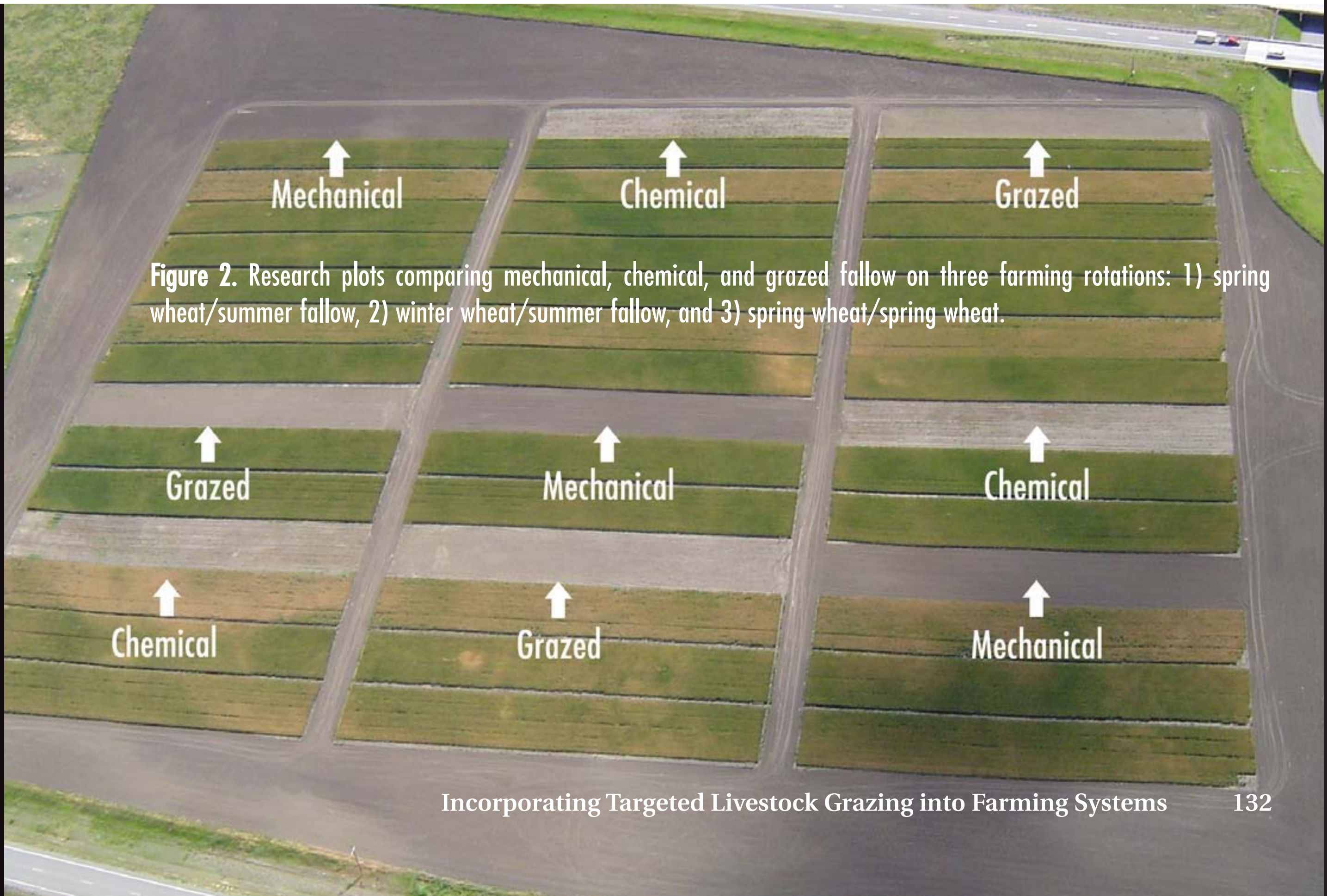

Figure 2. Research plots comparing mechanical, chemical, and grazed fallow on three farming rotations: 1) spring wheat/summer fallow, 2) winter wheat/summer fallow, and 3) spring wheat/spring wheat.

Each year in the United States, nearly 800 million tons of crop residues are produced above the amount needed to prevent soil erosion.[18] In some situations, these residues can hinder grain production and profitability and provide habitat for insect and weed pests.

In dryland operations, spreading straw may work when residue levels are low, but it may not be an option in high production areas or as a sole method of managing residue in dryland operations because of residue buildup. Windrowing and baling can remove the residue, but income from the sale of straw may not always cover the cost of harvest. Livestock can graze spread or windrowed straw. Windrowing the straw before grazing may increase the amount available for consumption, with less loss to trampling, while spreading the straw provides a more uniform biomass cover to help prevent erosion. Depending on farming goals, targeted grazing may be the most economical method of removing residue, particularly if the benefits of insect control and residue processing are considered. Windrowed straw may also expand grazing seasons, although protein supplements may be needed if no volunteer grain or other palatable green material is available. Further, grazing residues may improve soil tilth by incorporating ruminally processed organic matter into the soil. Baling, burning, tillage, and grazing all remove residue, but only grazing can add beneficial material back to the soil.

Many producers view burning grain stubble as an inexpensive, labor-efficient way to remove unwanted crop residue before tillage and seedbed preparation. However, long-term burning can decrease cereal grain yields, reductions that cannot be offset with fertilization.[4] This research also found that while total nitrogen decreased on burned fields compared to normal tillage without burning, nitrate levels actually increased in the burned fields. Many producers also see burning as a viable method of controlling weed, insect, bacterial, and fungal populations. However, Biederbeck and colleagues (1980) reported that the heat from burning only penetrated one-half inch into the soil, offering minimal effects on weed seeds, unwanted insects, and soil-based pathogens.

Field burning can cost up to $4 per acre[25] and, by removing biomass, can preclude potential income from grazing. Mulholland and colleagues (1976) noted that cereal stubble with some green plant growth was a reasonable grazing resource for sheep at stocking rates up to 10.5 animals per acre for 11 weeks. Thomas and colleagues (1990) reported that barley stubble provided a suitable feed resource for weaned lambs stocked at four lambs per acre for 42 days in the fall. Calculated returns range from $5 to $40 per acre in this research. The costly impacts of burning stubble – yield loss, increased fertilizer cost, the cost of burning, loss of grazing revenue, and compromised air quality – increase the potential opportunities for grazing as an alternative.

On some irrigated farms gaining access to fields in the spring may be more important than conserving soil moisture. To facilitate drying, producers may remove residues that hold moisture, as in eastern Idaho, where some potato/grain growers burn excess small grain stubble or cut it close and bale the straw. Burning incurs the costs listed above, and the value of the straw is subject to fluctuating local markets. In addition, burning crop residues releases particulate matter and several gases, including carbon dioxide, methane, carbon monoxide, and nitrous oxide, which can impair air and visual quality.[6] Some producers irrigate or use a rotary harrow or similar implement after fall harvest to encourage remnant spring wheat seed to sprout and fall victim to winter freezing instead of becoming a weed in the next year's rotation crop. Livestock grazing could provide an alternative. In studies with sheep grazing irrigated crop residue, the sheep removed the green and growing volunteer grain along with the cut residue and the standing stubble, subsequently trampling the plant residue into the soils.[9]

Grazing has also been used as an alterative to field burning in the management of bluegrass seed fields.[15] It is important to remove straw and stubble to destroy disease host residue to control disease, insect, and rodent pest populations. Burning, mowing, and grazing also reduce volunteer plant establishment, which could reduce seed quality and cause seed contamination. Finally, removing stubble after seed is harvested reduces thatch accumulation, prevents "sod bound" stand development, and facilitates nutrient cycling. Research at the University of Idaho has shown that seed yield increased with greater residue removal. The highest yielding treatments removed at least 80% of the post-harvest residue, and it was possible to accomplish this level of residue removal by grazing cattle.[15] Grazing post-harvest residue resulted in higher yields than mowing and baling but resulted in lower subsequent seed yield than post-harvest field burning.

Selecting Animals and Management Strategies

Sheep that commonly graze dormant forage during the winter will likely graze grain residue more readily than sheep commonly fed hay. Also, research suggests that

Figure 4. Wheat stem sawfly depositing eggs in a mature wheat stem.

Photo: University of Nebraska, Entomology Department

Figure 3. Sheep grazing crop stubble in Montana, reducing excess crop residue and incorporating organic matter into the soil.

Photo: Patrick Hatfield, Montana State University

rangeland breeds like Targhee possess greater abilities for conserving and recycling nitrogen than breeds like Suffolk, which were developed in a more nutrient-rich environment.[10]

Mature range ewes with nitrogen supplementation or adequate levels of green weeds and volunteer plants can dramatically reduce both cut residue and standing stubble (Figure 3). However, when the goal is to remove weeds without significantly reducing residue cover, the authors speculate that younger sheep like replacement ewe lambs may be preferred.

Grazing to Control Insects In Cereal Grains

Wheat stem sawfly is the most damaging pest, insect or disease, in the Northern Great Plains. In Montana's $1 billion a year grain industry, the economic impact of this insect is estimated at more than $30 million a year.[2] Originally a pest of spring wheat, the sawfly's adult emergence period has gradually shifted earlier, making it a significant winter wheat pest.[20] Adults emerge in early summer, and females lay single eggs within an elongating wheat stem (Figure 4). Eggs hatch and larvae feed on the stem. As wheat matures, the larva completes its feeding and travels to the base of the stem, where it cuts and plugs the stem behind it, forming a sheltered stub for overwintering. Larval cutting weakens the wheat stem, resulting in lodged stems. The wheat stem sawfly passes most of its life – egg through pupae – within a single wheat stem, protecting it from environmental influences and control practices. Insecticides have minimal success because it is difficult in a single application to target a non-feeding mobile insect population that emerges over four to six weeks. Tillage or burning typically have mixed or minimal impact on sawfly mortality, and both are costly and may cause ecological problems (i.e erosion and pollution). In a two-year study using four different farm sites each year, Hatfield and co-workers (in-press) reported higher mortality with grazing than either tillage or burning. Solid stem varieties of wheat have been developed with varying levels of resistance depending on growing conditions, but their yields can be 10 to 25% lower than susceptible varieties. Newer varieties are being developed with improved yield and resistance and higher forage value, but resistance may vary depending on growing conditions and adaptation by the sawfly.

Wheat-fallow production systems, particularly those managed with zero tillage, leave wheat stem sawfly overwintering sites undisturbed. Research has been conducted with the idea that grazing sheep may disrupt the overwintering environment, exposing sawflies to extreme winter conditions that will increase overwintering larval mortality.

Sheep grazing wheat stubble in the fall and spring killed 75% of wheat stem sawfly compared with a no-input control (42% sawfly mortality), tillage (40% mortality), and burning (45% mortality).[11] Hoof action may be as important as consumption on wheat stem sawfly mortality,[11] which means producers can reduce sawfly numbers by extending the period sheep are on the stubble field, initially offering a protein or energy supplement and eventually feeding hay.

Another consideration is insect movement. Burning, insecticides, tillage, and resistant varieties are site specific so they have limited impact on insects that migrate in from other areas. This creates a potential for using strategic grazing to create "buffer zones" around target fields. However, this research has not been conducted and consideration must be given to native plants that might harbor wheat stem sawflies and distances that sawflies are capable of traveling to spread infestations.

Cereal leaf beetle is a major pest of barley, particularly in irrigated systems, in several areas of the West. A large portion of cereal leaf beetle adults overwinter in the standing stubble of harvested fields. The percentage is unknown, however, because many leave the fields and hibernate in riparian areas. Livestock strategically grazing stubble may inadvertently consume adult cereal leaf beetles hibernating there. Depending on the proportion of adult beetles overwintering in the stubble, grazing may reduce the survivors enough to reduce adult and larval damage the following growing season.

The Hessian fly produces two generations annually, one in the spring and another in the fall. In September, the fly lays eggs in seedling wheat or volunteer wheat. The second generation emerges the next spring after overwintering larvae develop into adults. The insect survives the summer in the flaxseed stage in wheat stubble. At this stage, the insect forms a shiny brown, seed-like puparium found at the base of old plant crowns or in the straw near the nodes under the leaf sheaths. Volunteer wheat or wheat planted early will be in the seedling stage when adults emerge. Grazing after harvest can reduce the volunteer crop plants before the fall generation of Hessian flies emerge.

Wheat stem maggot passes the winter in the larval stage in the lower parts of the stems of wheat and other hosts. They pupate in the spring, and adults emerge in June, ovipositing on volunteer and other grasses. The newly hatched maggots enter the leaf sheaths and tunnel into the tender tissues of the stem. Maggots feed for about three weeks before pupating. A smaller fall generation emerges in late August to early September and lays eggs in the new winter wheat crop. Strategic grazing to reduce the abundance of volunteer and susceptible grasses could help to reduce oviposition sites during the mid-summer egg-laying period and significantly reduce the subsequent fall generation.

Grazing volunteer wheat may reduce overwintering populations of brown wheat mite, Russian wheat aphid, and wheat curl mite. Volunteer wheat provides a green bridge for arthropods, and grazing can break the bridge, reducing populations of these damaging pests. Grazing stubble may also reduce wheat jointworm and wheat strawworm.

A variety of insects feed and reproduce in alfalfa fields, decreasing crop quality and quantity. The alfalfa weevil is the most economically damaging insect pest of alfalfa in the United States.[3] In Montana, alfalfa weevil adults aestivate during summer, emerge in fall, and hibernate during winter in leaf litter and around plant crowns. The weevils become active in spring before the first cutting, damaging plant crowns and retarding green-up on subsequent cuttings.

Several management tactics have been tried with varied results. The weevil-tolerant cultivars of alfalfa currently available seldom provide enough protection from damage to justify their use. Biological agents developed to reduce weevil populations below economic thresholds are generally ineffective or too expensive to implement, particularly in the Western United States. Insecticides that target alfalfa weevil larvae, used on a third of U.S. alfalfa acreage, are also costly and require intensive field monitoring to determine when a treatment is economically justified.[7] Dowdy et al. (1992) reported reductions of 67% in weevil eggs and 25% in spring larval numbers in grazed compared to ungrazed plots in Oklahoma. In the Montana research, grazing most likely reduces alfalfa weevil numbers by reducing biomass or significantly changing relative humidity or temperature, making the grazed areas less attractive for ovipositing alfalfa weevil females moving into the fields after hibernation.

The clover root curculio is a weevil affecting alfalfa and clover root systems in the Pacific Northwest. Its life cycle is somewhat similar to that of the alfalfa weevil, suggesting that it would be susceptible to the same cultural control tactics, but only at specific times given the larval feeding strategy. Adults become active in the spring and deposit eggs on the soil surface or on the undersides of leaves of host plants. By May or early June, newly hatched larvae move into the soil where they begin to feed on roots, which means control would likely be most effective during the spring when the female deposits eggs on the soil surface.

Lygus bugs infest alfalfa grown for forage or seed. They overwinter as adults except in the Southwest, where they may be active year round in annual and perennial grasses, broadleaf weeds, some overwintering crops, and plant debris in areas adjacent to agricultural fields. Because of lygus bugs' wide host range, these grasses and broadleaf weeds help to build insect populations early in the spring, causing more damage to alfalfa during the growing period. Suppressing weed hosts in and around alfalfa fields can help to slow lygus bug population buildup. Sheep can graze the weeds that serve as a green bridge, helping to curtail lygus bug populations.

Animal Selection and Management Strategies

Any farming practice that disrupts a vital component of an insect's life cycle has the potential to decrease its population. Correctly implemented livestock grazing has the potential to manage a variety of insects infesting a variety of crops. Cereal stubble with green weedy material was an acceptable grazing resource for sheep stocked at 135 sheep days per acre (Mulholland et al. 1976), and 170 sheep days per acre (Thomas et al. 1990). In fall and spring treatments, at 183 sheep days per acre, a level within the realm of reasonable stocking rates, wheat stem sawfly numbers were reduced on grain stubble used for sheep production.[11] In addition, Hatfield and co-workers also reported significant reduction in crop residues without adversely affecting soil bulk density,[13] The question of similar stocking rates at different durations and intensities of grazing has yet to be addressed.

Grazing to Manage Insect Pests in Alfalfa

On alfalfa, Dowdy et al. (1992) reported an overall 25% reduction of alfalfa weevil larvae in grazed compared to ungrazed plots. In another study, adult weevils were reduced in grazed plots by 35 to 100%, and larva were reduced by 40 to 70% in grazed vs. ungrazed plots, depending on sampling date and study year.[7] The reduction may have resulted from reduced biomass, relative humidity, or temperature, making the grazed areas less attractive for ovipositing adults moving into the fields after hibernation. Further, any alfalfa weevil eggs successfully laid in grazed areas would be quickly consumed by grazing sheep, further reducing weevil densities.

These data show the potential for grazing alfalfa regrowth for winter pasture and weevil management. However, the impacts of grazing on alfalfa must be also considered, including 1) optimum season and time of grazing to enhance insect mortality, 2) grazing at the appropriate season and time to avoid adversely impacting stand longevity, and 3) grazing at the appropriate season and time to avoid bloat. Although forage biomass was reduced 73 to 98% by the end of the grazing period in the study by Goosey et al. (2004), hay yields at harvest did not differ between grazed and ungrazed plots (Figure 5). In addition, crude protein, acid detergent fiber, and neutral detergent fiber did not differ between grazed and ungrazed plots. Canadian scientists suggest that after the stand has been exposed to three days of 20°F lows, grazing or cutting will not impact stand longevity. This coincides with recommendations for preventing bloat in animals grazing alfalfa.

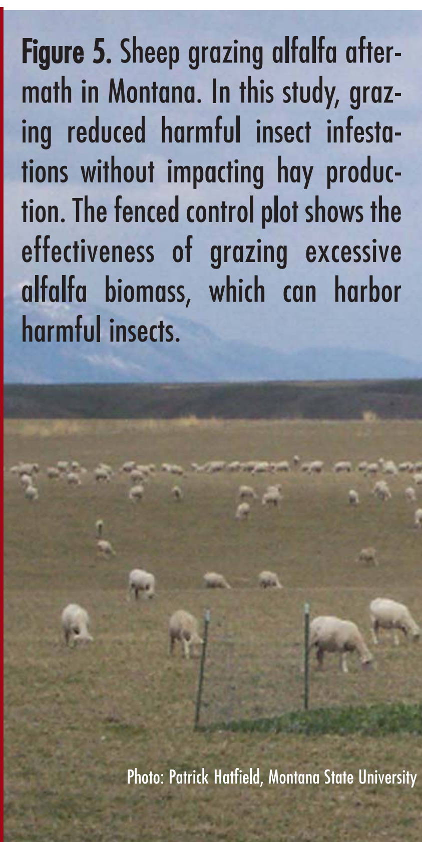

Figure 5. Sheep grazing alfalfa aftermath in Montana. In this study, grazing reduced harmful insect infestations without impacting hay production. The fenced control plot shows the effectiveness of grazing excessive alfalfa biomass, which can harbor harmful insects.

Photo: Patrick Hatfield, Montana State University

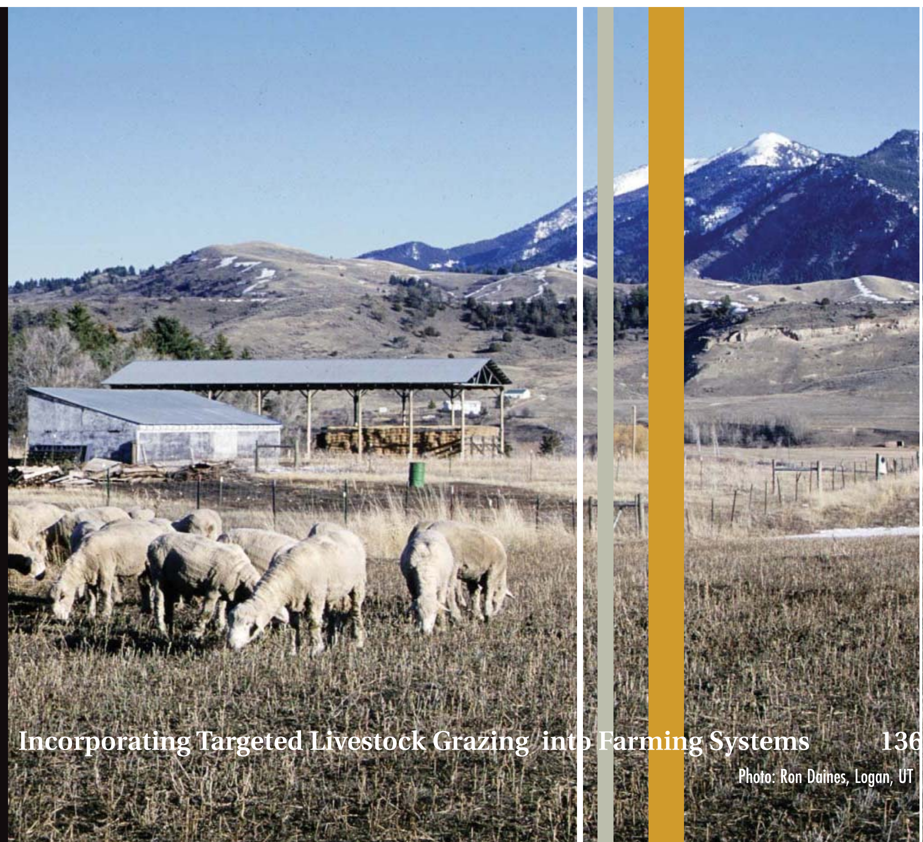

Photo: Ron Daines, Logan, UT

Animal Selection and Management

Alfalfa residue has high nutritive value, so adapting animals and breeds suited to low-nutrient and high-fiber diets may not be an issue. Any class of sheep, goats, or cattle will likely be effective. Timing to maintain stand longevity, minimize risk of bloat, and limit soil compaction is more important than animal selection. Likewise, stocking duration and intensity are more important than breed or class of animal for grazing crop residue to control insect pests.

Animal Production Considerations

An excellent feed resource can be provided when fall rains or irrigation and sufficiently high temperatures germinate volunteer grain and stimulate weed growth. Likewise, small grain residue can be an excellent feed resource, but it's important to watch for bloat and acidosis in sheep that eat spilled grain. Sheep and goats can also be returned to fields that have enough snow to supply drinking water to graze stubble and residue, although a protein supplement may be required. The longer the sheep spend in a field, the greater the chance for killing insects. Adding harvested feeds to stubble fields can increase that time.

A ewe's cycle can be used to advantage in grazing to manage resources. The period of high nutrient demand runs from the last six weeks of a five-month gestation through the first six weeks of lactation. Outside this period of high nutrient demand, when the ewe is at or near maintenance requirements, she can be used to manipulate low quality forage without hindering performance.

Research at the U.S. Sheep Station compared stubble grazing with confinement hay feeding.[9] Ewes in average to slightly better than average body condition were grazed on residue during early and mid gestation. For late gestation and early lactation, ewes were moved to native range and lambed starting in mid May. Ewes grazing alfalfa and grain residues maintained adequate body weight and had the same reproductive performance as their confined counterparts (Figure 6). If green weeds and volunteer grain plants are absent, protein and non-protein nitrogen supplements, like urea or biurette, can enhance grain residue intake and digestibility.[14]

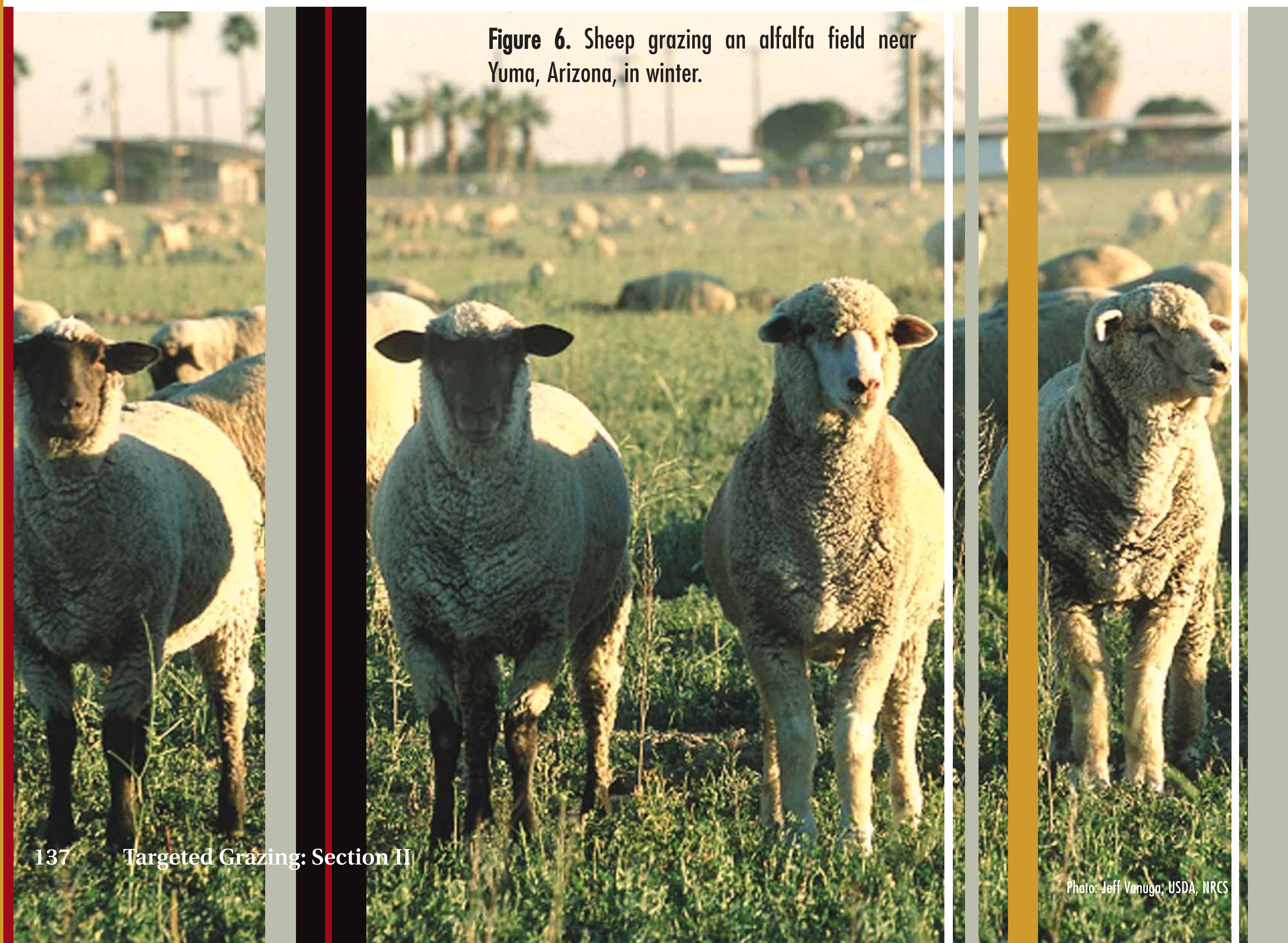

Figure 6. Sheep grazing an alfalfa field near Yuma, Arizona, in winter.

Photo: Jeff Vanuga, USDA, NRCS

CONCLUSION

Integrating livestock into farming and natural resource management may have the added benefit of enhancing rural development through low-capital entrepreneurial opportunities based as much on the concept of landscape management as on traditional meat and wool production. The largest constraint to entering a land-based agricultural industry is often the purchase of land. Integrating livestock into farming systems for residue, weed, and insect control may allow entry for new and existing entrepreneurs by generating income through residue harvest and landscape management. Success in this arena will require that operators view themselves as vegetation managers as much as meat and fiber producers and develop an expanded view of the resources they need. For example, those involved in fallow and range weed management may also need to own and operate a spray rig. A stubble management enterprise may also own a baler as a way to remove residue in addition to grazing. The point is to view the enterprise more broadly than that of a commodity producer to provide the full service a client is seeking in a timely manner.

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