



WEED MANAGEMENT IN SAINFOIN

Andrew R. Kniss (Professor), Albert T. Adjesiwor (Postdoctoral Research Associate),
Jared C. Unverzagt (Former Graduate Research Assistant), Ryan E. Rapp (Former Research Assistant)

Sainfoin (*Onobrychis viciifolia* Scop.) is an ancient perennial forage legume introduced into the United States about a century ago.

Sainfoin is promoted as a good forage alternative to alfalfa because of its many desirable attributes: high nutritional content, resistance to alfalfa weevil [*Hypera postica* (Gyllenhal)], and it does not cause bloat problem in cattle. Sainfoin prefers calcareous soils with pH of 6.6 - 8.0 and seems well-adapted to Wyoming, particularly to the Big Horn Basin.

Some sources have shown that sainfoin (especially cultivars such as “Molrose”, “Nova”, “Remont”, and “Renumex”) is drought tolerant and performs well under dryland conditions; however, recent research comparing alfalfa to sainfoin has shown alfalfa forage production to be greater than sainfoin even under limited moisture conditions.

The University of Wyoming, Montana State University, and USDA-Natural Resources Conservation Service



B-1333 | June 2019

released two varieties of sainfoin that are well adapted to the region: ‘Shoshone’ and ‘Delaney’. Sainfoin is increasingly being promoted as a good alternative forage crop, especially where alfalfa weevil is prevalent, and a bloat-free forage is desired.

The numerous desirable attributes of sainfoin and its adaptation to a wide range of growing conditions has generated a great deal of interest from potential and current sainfoin growers. Even as sainfoin acres increase, there is one glaring absence from nearly all of the current recommendations for establishing and managing sainfoin: How do we manage weeds in sainfoin?

HERBICIDE OPTIONS

Whether there are any herbicides that can be used to control weeds after establishment is one of the most common questions about sainfoin. Unfortunately, very few herbicide options (only six different active ingredients) are currently registered for use in sainfoin. Table 1 lists all herbicide active ingredients currently registered for use on sainfoin in Wyoming.

Table 1. Herbicides registered for use on sainfoin

Herbicide	Trade name(s)	Comments
Sethoxydim	Poast	For postemergence grass control. 14-day pre-harvest interval.
Paraquat	Gramoxone, Firestorm, Para-Shot, Parazone, others	Pre-plant or dormant applications for control of emerged weeds. 60-day pre-harvest interval. DO NOT APPLY TO ACTIVELY GROWING SAINFOIN.
Glyphosate	Roundup Powermax, Touchdown, Buccaneer, Cornerstone, Duramax, Gly Star, Honcho, Makaze, Wise Up Plus, others	Dormant or preemergence burndown applications for emerged weeds only. DO NOT APPLY TO ACTIVELY GROWING SAINFOIN. SEVERE CROP INJURY MAY RESULT.

Effect of Glyphosate on Seedling Sainfoin

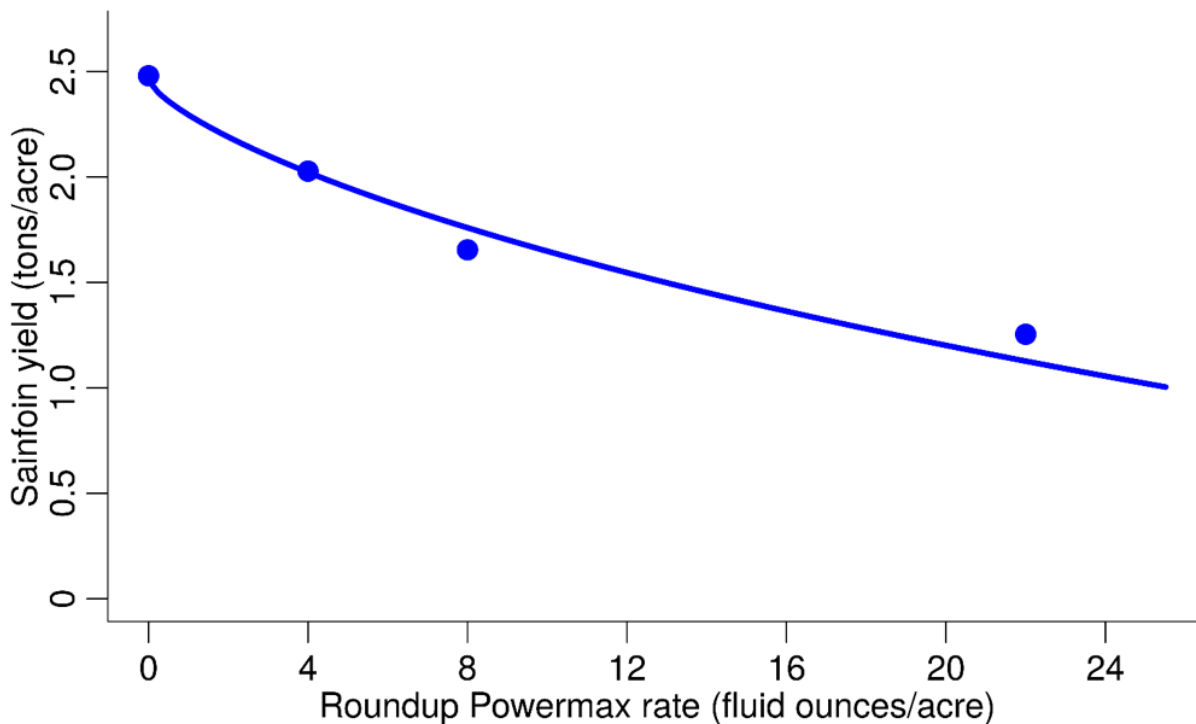


Figure 1. Effect of glyphosate application at sainfoin seedling stage (3- to 5-leaf stage) on forage yield

Two active ingredients (clethodim and sethoxydim) can be applied to actively growing sainfoin, but these products will only control grass weeds. There are currently no herbicides that control broadleaf weeds that can be legally applied to actively growing sainfoin. Glyphosate and paraquat can be applied to control green, actively growing weeds early in the spring prior to sainfoin green-up (dormant crop applications), but the application window is very narrow or non-existent if targeting summer annual weeds.

Winter annual weeds like some mustards and downy brome (cheatgrass) may be controlled well with dormant crop applications. Metribuzin can provide limited residual weed control at higher rates, but must also be applied when the sainfoin is dormant. Metribuzin has a 28-day pre-harvest interval, which means sainfoin cannot be cut or grazed until at least 28 days after metribuzin application. Pronamide can be applied for control of some broadleaf weeds, but to be effective must be applied in the fall or winter before soil freeze-up to control spring-emerging weeds.

What about glyphosate?

There have been suggestions sainfoin has a natural tolerance to glyphosate (the active ingredient in the herbicide Roundup). Many anecdotal reports exist from growers and researchers that have used glyphosate on sainfoin with little or no observable injury. There are a number of resources on the web that recommend glyphosate for weed control in established sainfoin; however, there has been very little replicated research showing glyphosate can be safely used on sainfoin. One published study from New Mexico has claimed sainfoin possesses a natural tolerance to glyphosate, but this study did not quantify the effect of glyphosate on sainfoin forage or seed yield, and so these results are of limited value.

To test the effects of postemergence herbicides on sainfoin forage yield, studies were conducted at the Powell Research and Extension Center by applying varied rates of glyphosate to sainfoin. Roundup PowerMax (active ingredient glyphosate) was applied to seedling and established stands of sainfoin at spring and fall

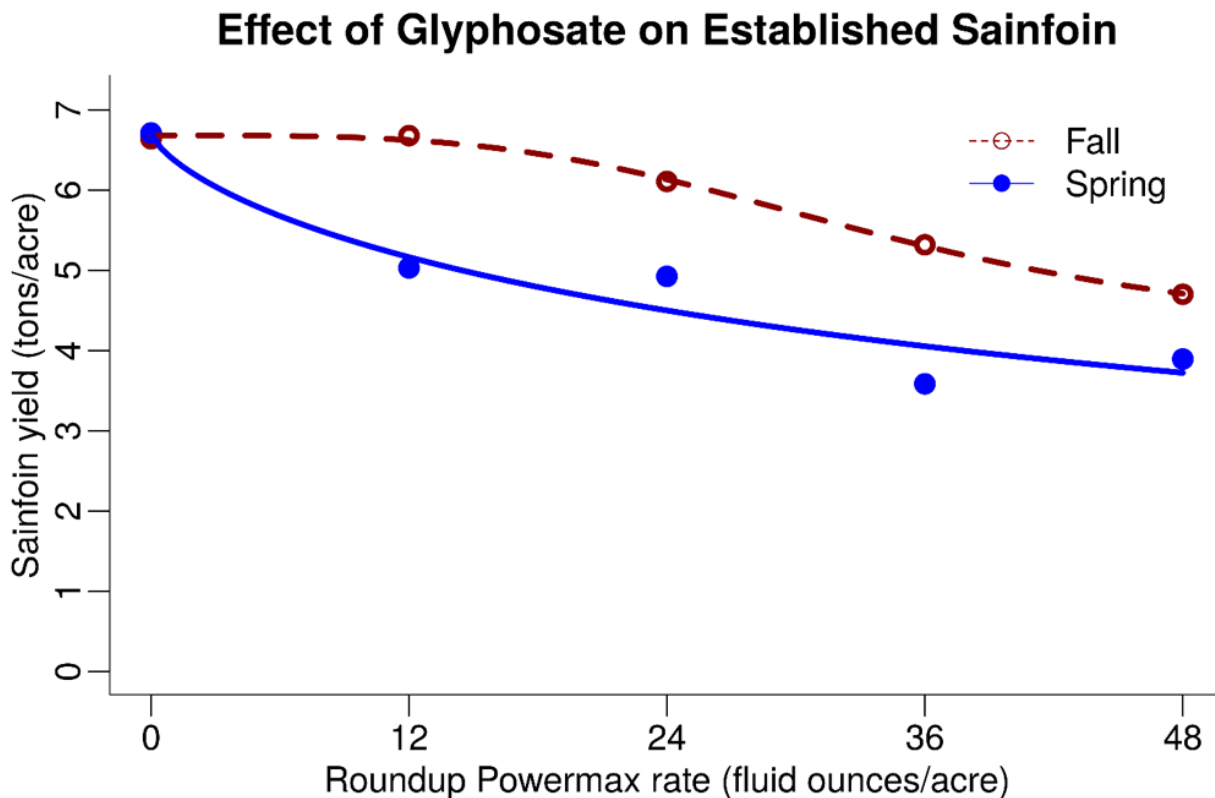


Figure 2. Effect of spring- and fall-applied glyphosate on forage yield of an established sainfoin stand.

timings. In all instances, sainfoin forage yield was decreased significantly at even low rates of Roundup. When Roundup was applied at only 4 ounces per acre to a newly seeded stand (3- to 5-leaf stage), sainfoin yield was reduced by 18 percent (0.5 tons per acre) over the next two cuttings (Figure 1). Roundup will not provide effective weed control of most annual weeds at that low rate. At the recommended rate for controlling annual weeds, 22 fluid ounces per acre, sainfoin yield was reduced by 54 percent (nearly 1.5 tons per acre) in two cuttings the year of establishment.

Established sainfoin is more tolerant to glyphosate compared to seedling sainfoin; however, yield reduction from spring-applied glyphosate in the established sainfoin was also substantial (Figure 2). Roundup applied to new spring growth at 12 ounces per acre reduced sainfoin yield by 24 percent (more than 1.5 tons per acre) over the next three cuttings. Applying glyphosate in the fall had less effect on sainfoin yield the following year, but yield losses were still significant the year after application if Roundup was applied at a recommended rate of 22 ounces per acre or more. Recent research from the USDA-Agricultural Research Service and Utah State University found similar results. In the Utah study, application of 11 fluid ounces per acre of Roundup to established sainfoin resulted in over 8 percent reduction in sainfoin yield compared to the nontreated, and the recommended rate of 22 fluid ounces per acre caused an 18 percent yield loss. The economic impact from lost sainfoin yield will certainly outweigh any weed control benefit that might be obtained from glyphosate applications to actively growing sainfoin.

AN INTEGRATED APPROACH

To maximize the effectiveness of non-herbicide approaches to weed management and because there are few herbicide options for weed control in sainfoin, planning an integrated weed management program is important. Because sainfoin is a perennial forage legume like alfalfa, a similar three-phase approach to weed management should be considered; however, important differences exist between alfalfa and sainfoin, so one

must be careful to consider these differences when managing sainfoin.

Phase I: Pre-Crop Approach

The pre-crop management period is critically important because there are no herbicides available to rescue a sainfoin crop from heavy weed densities after crop establishment. There are many options for controlling weeds before sainfoin is planted, and this is perhaps the most underappreciated phase for weed management in forage crop production. The weed population can be decreased in the year or two prior to sainfoin establishment by growing crops with effective herbicide and cultural practice options. For example, corn, small grains, and many grass forage crops allow the use of some very effective herbicides that cannot be used in sainfoin and can reduce the amount of weed seeds in the soil. Non-selective herbicides like glyphosate can also be used prior to sainfoin establishment to control many annual and perennial weeds. Reading the label is important for any herbicide used prior to sainfoin establishment to ensure there will be no residual effects on the sainfoin crop. Tillage can also be used effectively in the fall or spring to bury weed seeds prior to sainfoin seeding.

Consider a **stale-seedbed** approach for weed management if planting sainfoin in the spring. The stale seedbed is a practice employed by many organic farmers (and many conventional growers in certain crops) that involves preparing the field for planting well in advance of the actual planting date. In doing so, many weed seeds are stimulated to germinate and emerge. Once emerged, weeds can be controlled with either light, shallow tillage, flaming, or non-selective herbicides.

If light tillage is used, care should be taken not to bring soil (and weed seeds) up to the surface – the goal is to deplete the top inch or two of as many weed seeds as possible. This process may be repeated several times during the spring before planting. By doing this, most of the germinable weed seeds in the top layer of soil will have already germinated and killed by the time the crop is actually planted. Once the crop emerges, there will be far fewer weeds emerge to compete with the crop.

Phase II: Seedling Establishment Approach

Sainfoin is a relatively poor competitor with weeds the first year because of slow growth and establishment, and getting a healthy stand of sainfoin requires good weed management during this phase. All practices the first year of establishment should aim to increase crop establishment and vigor. Weed competition (or herbicide injury) in the year of establishment is likely to have a long-term impact on the yield potential (Figure 2).

Purchase only certified weed-free sainfoin seed to avoid adding weeds to a field. Using a sainfoin variety well adapted to your growing area is also important, since vigorous crop growth is an important part of reducing weed competition. Seeding rate can also influence crop competitiveness; optimal seeding rates should be used. For irrigated conditions, plant 25 to 34 pounds of pure live seed (PLS) per acre, and for dryland conditions use 15 to 20 pounds PLS per acre. Seed should be planted between 0.25 and 0.75 inches deep and should be inoculated with the appropriate rhizobium to ensure proper nitrogen fixation during the life of the stand.

Although sainfoin can be planted in the spring or fall, spring plantings tend to result in the greatest emergence. Unfortunately, spring plantings are also likely to result in the heaviest weed pressure during the establishment phase. Once sainfoin emerges, only grasses can be controlled with the herbicides clethodim or sethoxydim, and pre-plant weed control with the stale-seedbed approach or burndown herbicides is extremely important.

If weed density is high the year of establishment, harvesting the sainfoin crop early to remove weed biomass may be possible. Because many annual weeds are not well-adapted to cutting, the sainfoin regrowth after the first cutting may grow more vigorously than most of the weeds, and the impact of annual weeds will be reduced.

For example, mowing a fall-seeded sainfoin in late spring (May) effectively controlled field pennycress; however, for mowing to be effective for controlling annual weeds, ensure sainfoin is well established at the time of mowing



and there are auxiliary buds on the stubble for regrowth. Sainfoin re-grows much more slowly after cutting compared with alfalfa, and annual weeds well adapted to cutting will be more competitive with sainfoin compared to alfalfa. This is especially true during periods of cooler temperatures, when sainfoin regrowth will be slow (especially compared with alfalfa) and mowing may give some weeds a competitive advantage. Perennial weeds like quackgrass and Canada thistle, however, are also well-adapted to repeated cutting, so early harvest will be less effective.

Phase III: Established Sainfoin Approach.

The best option for managing weeds in sainfoin is to maintain a healthy, competitive stand. Sainfoin has relatively poor regrowth and persistence (Tilley et al., 2008), so stand thinning and stand loss are common within a few years of establishment (Lauriault et al. 2009). Improper irrigation and root rot diseases are primary causes of sainfoin stand decline, and proper water and disease management is a prerequisite for good weed control in sainfoin.

Grazing and haying should commence when plants are at least 8 inches tall to ensure a healthy and prolonged stand life. Although sainfoin can be harvested about three times in a year, two cuts in a year with the last cut in late August or early September allows enough frost-free growing days for accumulation of carbohydrates in the fall, which are essential for winter survival and healthy spring regrowth. Also, planting sainfoin in mixtures with meadow brome grass, orchardgrass, alfalfa, or birdsfoot trefoil can help ensure a healthy stand (Cash et al. 1993); however, crop mixtures may even further limit herbicide options, as not all of the herbicides registered for sainfoin will allow application to grass forages.

Harvest timing of established sainfoin can be managed to deal with annual weeds as in the establishment year. This can be particularly effective with the first cutting of each year by timing harvest to remove annual weed growth. Subsequent regrowth should be less affected by weeds; however, for mowing to be effective for controlling annual weeds, several factors (as described under Phase II: Seedling Establishment Approach) must be taken into consideration.

SUMMARY

Successful weed management in sainfoin will rely on:

- Establishing and maintaining a healthy, competitive crop because few herbicide options are available.
- Weed control in sainfoin must begin long before the crop is planted. Well-planned establishment and proper crop management for the life of the stand are the best tools for weed management.
- Glyphosate application to seedling and established sainfoin stands resulted in significant yield and revenue losses and is not a registered use of this herbicide.
- Glyphosate should not be applied to actively growing sainfoin and should be limited to dormant crop applications for perennial and winter annual weed control.

REFERENCES:

- Adjesiwor, A.T., M.A. Islam, V.D. Zheljzkov, J. P. Ritten, A. Garcia y Garcia. 2017. Grass-Legume Seed Mass Ratios and Nitrogen Rates Affect Forage Accumulation, Nutritive Value, and Profitability. *Crop Sci.* 57:1–13.
- Carbonero, C.H., I. Mueller-Harvey, T.A. Brown, and L. Smith. 2011. Sainfoin (*Onobrychis viciifolia*): a beneficial forage legume. *Plant Genetic Resources: Characterization and Utilization* 9:70–85.
- Cash, D., H. Bowman, and R. L. Ditterline. 1993. Sainfoin. Montguide, MT9321. Montana State University Extension. URL: <http://www.msuextension.org/park/Images/Ag/pdfs/sainfoin.pdf>
- Gray, F.A., T. Shigaki, D.W. Koch, R.D. Delaney, F. Hruby, A.M. Gray et al. 2006. Registration of ‘Shoshone’ sainfoin. *Crop Sci.* 46:988. doi:10.2135/cropsci2005.07-0190
- Gray, F. A., D. W. Koch, and M. J. Killen. 2008. ‘Shoshone’ Sainfoin. *Plant Sciences Timely Information Series*. No. 2. URL: <http://www.wyomingextension.org/agpubs/pubs/sainfoin.pdf>
- Hannaway, B.D. and W.S. McGuire. 1982. Growing sainfoin for forage. Oregon State University Extension. FS 283 2 pp. Available online: <http://forages.oregonstate.edu/resources/publications/fs/sainfoin.pdf>. Accessed: January 8, 2015.
- Hooks, C.R.R., A.L. Buchanan, and G. Chen. 2014. The Stale Seedbed Technique: A Relatively Underused Alternative Weed Management Tactic for Vegetable Production. URL: <https://extension.umd.edu/learn/stale-seedbed-technique-relatively-underused-alternative-weed-management-tactic-vegetable>
- Hybner, R. M. 2013. Sainfoin: An Introduced legume for Conservation use in Montana and Wyoming. USDA-NRCS Plant Materials Technical Note No. MT-91. URL: http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mtpmctn12043.pdf
- Koch, D.W., A.D. Dotzenko, and G.O. Hinze. 1972. Influence of three cutting systems on the yield, water use efficiency, and forage quality of sainfoin. *Agron. J.* 64:463–467.
- Lauriault, L. M., F. Contreras, D. M. VanLeeuwen, and R. E. Kirksey. 2009. Sainfoin has a natural tolerance to glyphosate. Online. *Forage and Grazinglands* doi:10.1094/FG-2009-0821-01-BR.
- Miller, S. D., C. M. Alford, and P. J. Ogg. 2002. Weed Control in Alfalfa. B1126. University of Wyoming Cooperative Extension Service. URL: <http://www.wyomingextension.org/agpubs/pubs/B1126.pdf>
- Morrill, W.L., R.L. Ditterline, and S.D. Cash. 1998. Insect pests and associated root pathogens of sainfoin in western USA. *Field Crop Res.* 59:129–134.
- Peel, M. D., C. V. Ransom, and I. W. Mott. 2014. Natural glyphosate tolerance in sainfoin (*Onobrychis viciifolia*). *Crop Science*. DOI: 10.2135/cropsci2012.10.0612.
- Peel, M. D., K. H. Asay, D. A. Johnson, and B. L. Waldron. 2004. Forage production of sainfoin across an irrigation gradient. *Crop Science*. 44:614-619.
- Rochon, J.J., C.J. Doyle, J.M. Greef, A. Hopkins, G. Molle, M. Sitzia, D. Scholefield, and C.J. Smith. 2004. Grazing legumes in Europe: a review of their status, management, benefits, research needs and future prospects. *Grass For. Sci.* 59:197–214.
- Sintim, H.Y., A.T. Adjesiwor, V.D. Zheljzkov, M.A. Islam, and A.K. Obour. 2016. Nitrogen application in sainfoin under rain-fed conditions in Wyoming: Productivity and cost implications. *Agron. J.* 108:294–300.
- Smith, T. 2007. New interest in sainfoin. *Western producers are considering the potential of this old forage legume.* *ANGUS J.* 142-143.
- Tilley, D. D. Ogle, and L. St. John. 2008. Sainfoin Plant Guide. USDA-NRCS. URL: http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpg7792.pdf



B-1333 • June 2019

Editor: Steve Miller. Graphic design: Tanya Engel.

Issued in furtherance of extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. University of Wyoming Extension, University of Wyoming, Laramie, Wyoming 82071.

Persons seeking admission, employment, or access to programs of the University of Wyoming shall be considered without regard to race, color, religion, sex, national origin, disability, age, political belief, veteran status, sexual orientation, and marital or familial status. Persons with disabilities who require alternative means for communication or program information (Braille, large print, audiotape, etc.) should contact their local UW Extension office. To file a complaint, write to the UW Employment Practices/Affirmative Action Office, University of Wyoming, Department 3434, 1000 E. University Avenue, Laramie, WY 82071. Photos: Natalya Bozadzhy and Nikilev, Shutterstock.