Agriculture

EXTENSION
UtahStateUniversity

extension.usu.edu

February 2015 AG/OilseedCrops/2015-01pr

Dryland Safflower Response to Dormant Seeding in Utah

C. E. Israelsen, Agriculture Agent
M. G. Pace, Agriculture/Horticulture Agent
E. Creech, Extension Agronomist
N. Allen, Extension Irrigation Specialist

Introduction

Safflower (*Carthamus tinctorius* L.) is a member of the sunflower family and is a highly branched, herbaceous, thistle-like annual with many long sharp spines on the leaves. Safflower is an oilseed crop that produces edible oil. Much of the safflower grown in Utah is used for the birdseed market. The crop has been grown in experimental test plots in the United States since 1928 (Berglund et al., 2007) and on a commercial basis in Utah since 1957 by area farmers for Pacific Vegetable Oils (PVO) (Smith, 1996). Safflower is well-adapted to a high desert climate and has been grown successfully in areas receiving 10 to 20 inches of annual precipitation. As a result, safflower is considered the most heat and drought tolerant of the alternative agronomic crops commercially available (Kephart et al., 1990).

Safflower has become popular on Utah dryland farms in rotation with winter wheat for two major reasons. First, troublesome weeds like jointed goatgrass can be controlled with herbicides registered for safflower. Secondly, safflower has the ability to extract deep moisture from the soil profile with its long taproot. Northern Utah and southern Idaho growers now produce approximately 13 million pounds of safflower annually. On Utah dryland farms, a wheat-safflower-fallow rotation is often followed in order to allow soil moisture to recharge prior to the wheat production year. This rotation allows growers to harvest two crops in 3 years. Before the inclusion of safflower, dryland growers usually followed a wheat-fallow rotation. Safflower is also grown on some irrigated land.

In recent years, we have conducted a series of dryland and irrigated trials, such as testing new safflower varieties, modifying seeding rates, adjusting row spacings and experimenting with irrigation strategies. The purpose of these studies is to learn best management practices so we can assist growers in maximizing profits when producing safflower under growing conditions in northern Utah and southern Idaho.

Typical Planting Dates on Utah Dryland Farms

Dryland farmers in Utah typically plant winter wheat in September and October. Seasonal rains usually come during these months which leads to the germination of fall seeded crops. Germinated wheat is then ordinarily insulated by a covering of snow from December through the end of March. Spring rains in April and May give fall planted crops much needed surface moisture followed by dry summer months. Spring wheat is planted as early as planting conditions allow. This is usually throughout April or early May, although occasionally spring rains last longer than desired and the planting of spring crops is delayed until late May or early June. This type of seasonal weather

pattern makes it extremely important for growers to have their dryland crops planted as early as possible to take advantage of limited moisture when it is available. Dryland wheat yields in Utah can be severely limited by missing the planting window that utilizes that much needed soil moisture. Experience shows that higher yields always occur in years with plenty of winter and spring moisture versus dry years or delayed plantings.

Safflower is usually planted in the spring, but growers and researchers have experimented with the feasibility of dormant seedings late in the season (November through early January), just before the ground freezes and is covered with snow. These delayed plantings don't sprout prior to the arrival of cold weather, which minimizes winter kill, but allows the plant to get an earlier start growing than spring planted safflower. Earlier planting dates allow safflower plants to more effectively utilize Utah's winter/early spring precipitation patterns. Some winter hardy safflower variety lines have been developed which permit safflower seed to be sown in late August or September, much like winter wheat. Yields of fall sown safflower in Northeastern Oregon were as high as 1,900 lb/acre (Petrie et al., 2010). Utah researchers have planted the standard S-208 safflower variety as a dormant planting in November and December, hoping the plant would not germinate before the ground was covered with snow.

Strategies to Enhance Safflower Production on Utah Dryfarms

For 5 continuous years, experiments have been conducted at the Blue Creek Research Farm located in Box Elder County, Utah, (GPS 41º56'08.94" N 112º26'18.62" W at 5200 feet elevation) on a Timpanogos Silt Loam soil. Additional studies have been conducted on a nearby commercial farm in Pocatello Valley, Idaho. The objective of this research was to compare the performance of dormant versus spring seeded safflower under northern Utah and southern Idaho dryland conditions.

Soil samples were analyzed annually for nitrogen (N), phosphorus (P), and potassium (K) and other essential elements for proper safflower growth. Only N was identified as being low and was applied in the spring at about 40 to 50 lb/acre. The seedbed was prepared as if it were to be planted into winter wheat during the fall. No pre or post-plant herbicides were applied to the plots and, though not feasible in commercial production, weeds were controlled by hand rogueing the plots the following spring and summer. The dormant plots were planted as early as November 5 and as late as January 5. One year (2011) snow and cold weather came before the dormant seeding could be planted so seed was planted as early as possible, April 7. The research plots were planted using a small-plot cone seeder and a 12-inch row spacing (Figure 1) at 12 lb/acre. Individual plots measured 4 feet wide by 30 feet long with four replications and were arranged in a Randomized Complete Block split-plot design. Plots on the commercial farm were planted with a commercial grain drill at the same seeding rate and row spacing.

Figure 1. Planting safflower plots with a small-plot cone seeder.

In some years, the safflower germinated before snow cover, which resulted in some winter kill. In most cases, however, no germination occurred until early spring. This earlier than normal planting and spring germination allowed the plants to utilize the spring rains for seed germination and growth (Figure 2). Moisture was not lost in the dormant seeded plots due to soil preparation in the spring. Seedbed preparation for the spring planted plots was completed as early as possible, between May 4 and June 1 (Figure 3). The plots received approximately 2 inches of rain during the spring and early summer. The late summer months were hot and dry. The dormant seeded safflower plants usually flowered by late June (Figure 4) and were ready to harvest in late August or early September. The spring seeded plots flowered about the middle of July and were ready to harvest in late September or early October.

Figure 2. Dormant seeded safflower. Note pen used as a visual reference to determine the height of the plant. Photo taken late May.

Figure 3. Spring seeded safflower. Note pen used as a visual reference to determine the height of the plant. Photo taken late May.

Figure 4. Dormant seeded safflower in bloom on the left and right sides with spring planted safflower in the center.

The research plots and commercial plots were harvested with a small research plot combine equipped with a yield monitor system. During early studies a sub sample of each plot was bagged and labeled with the plot number and sent to a private safflower buyer for color scoring. The color score is a visual rating from 1 to 10 (1 being the whitest and 10 being a tan/brown color). The whiter the seed the more valuable it is for the bird seed market. An additional sub sample was collected from each plot and assessed at a private certified lab for oil content. The percent oil is the amount of oil relative to the total seed weight. The percent oil content was determined by measuring seed that has been cleaned and is at 0% moisture after drying at 105^{o}C for 24 hours in a forced-air drying oven. Oil content ranged from the high 30s to the low 40s. Since yield was the major consideration of these studies, later years of the study did not include percent oil. The safflower yields were analyzed by ANOVA (NCSS 8.0.13 version) with yield means separated with Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

The safflower yield results (Table 1) show that over a 5 year period, with 4 years useable data, the dormant plantings out yielded the spring seeded plots by an average of 8.6 percent. Readers will note that during the second year of the study plots did not get seeded before snow. The plots were prepared as they had been the previous year but winter came earlier than expected. Researchers were unable to plant the safflower in late November or early December due to deep snow and freezing temperatures that made it impossible to insert the seed openers into the frozen ground.

Figure 5. Dormant seeded plant on the left (34 seed pods). Spring seeded plant on the right (8 seed pods).

Table 1. 2009-2014 Dryland safflower results for dormant versus spring planted safflower, Blue Creek, Utah (Box Elder County). Data from the 2010-2011 growing season were not included because early snow and frozen ground did not allow a dormant planting.

	Dormant	Seeded	Spring	Seeded		
Year Planted	Date Planted	Yield (lbs/acre)	Date Planted	Yield (lbs/acre)	Difference (lbs/acre)	% yield difference
2009-2010	1-Dec	960	4-May	832	128	15.0%
2010-2011						
2011-2012	5-Jan	1222	11-Apr	1502	-280	-19.0%
2012-2013	7-Nov	1019	12-Apr	852	167	20.0%
2013-2014	5-Nov	1214	9-May	880	334	38.0%
Averages		**1104**		**1016**	**88**	**8.6 %**

Concerns for Adopting the Practice of Dormant Seedings

The data suggests that a dormant safflower planting usually results in substantial yield gains by taking advantage of early spring moisture. Despite the positive yield response, the decision to dormant seed safflower is complicated by the lack of weed control options in this management system (Figure 6). Most approved herbicides are applied in the spring, pre-plant and incorporated into the soil before planting safflower. This combination of spring tillage and pre-plant herbicide has provided excellent weed control in spring seeded plots. (Figures 7). Additionally, being able to break the lifecycle of jointed goatgrass with spring tillage or spring pre-plant chemical burn down is one of the desirable weed management control practices for this crop. Fall or dormant planted safflower takes away the options for these management practices.

Researchers and commercial growers have experienced significant weed problems with dormant seeded stands when compared to spring seeded fields (Figure 8). The application of herbicide impregnated on fertilizer or the challenge of finding a broadleaf herbicide that can be applied post emergent on safflower will be important if growers are to successfully adopt this practice of growing safflower from a dormant seeding.

Figure 6. Weeds in a safflower field planted late November. Photo taken late May 2013.

Figure 7. A relatively weed-free safflower field planted mid May. Photo taken late May 2013.

Figure 8. Dormant seeded safflower on the right with marginal weed control. Spring seeded safflower on the left with excellent weed control. Photo taken early October 2013.

Summary and Conclusions

The dormant seeding of safflower on dryfarms has shown great potential in northern Utah and southern Idaho, but acceptable weed control is a major concern before this practice can be recommended on a larger commercial scale. Another area for future study is the impact of a hard frost early in the growing season after the safflower plants have started to grow. Safflower tolerates temperatures as low as 20^{o} F while in the rosette stage (Berglund et al., 2007). Researchers have not experienced temperatures this low in any years of the study, but producers could potentially find this to be a major problem. Soil temperature readings at planting will also help determine an ideal planting time. Assessing the potential of early spring planting is another area for additional research.

References

Berglund, D. R., Riveland, N., & Bergman, J. (2007). Safflower Production. North Dakota State University Agricultural Extension Bulletin A-870.

Kephart, K. D., Murray, G. A., & Auld, D. L. (1990). Alternative crops for dryland production systems in Northern Idaho. p. 62-67. In: J. Janick and F.E. Simons (eds.), Advances in new crops. Timber Press, Portland, OR.

Petrie, S., Machado, D., Johnson, R., Prichett, L., Rhinhart, K., & Tuck. (2010). Adaptation and Yield of Spring and Fall Sown Safflower in Northeastern Oregon. Columbia Basin Agricultural Research Center Dryland Research Report 101. Oregon State University. http://cbarc.aes.oregonstate.edu/sites/default/files/adaptation_and_yield_of_spring_and_fall_sown_safflower_in_northeastern_oregon.pdf

Smith, J. R. (1996). Safflower. p 77. The American Oil Chemists Society (AOCS). The Development of the PVO Strategy. By AOCS Press http://www.crcnetbase.com/doi/abs/10.1201/9781439832080.ch4

This publication is issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth L. White, Vice President for Extension and Agriculture, Utah State University

.