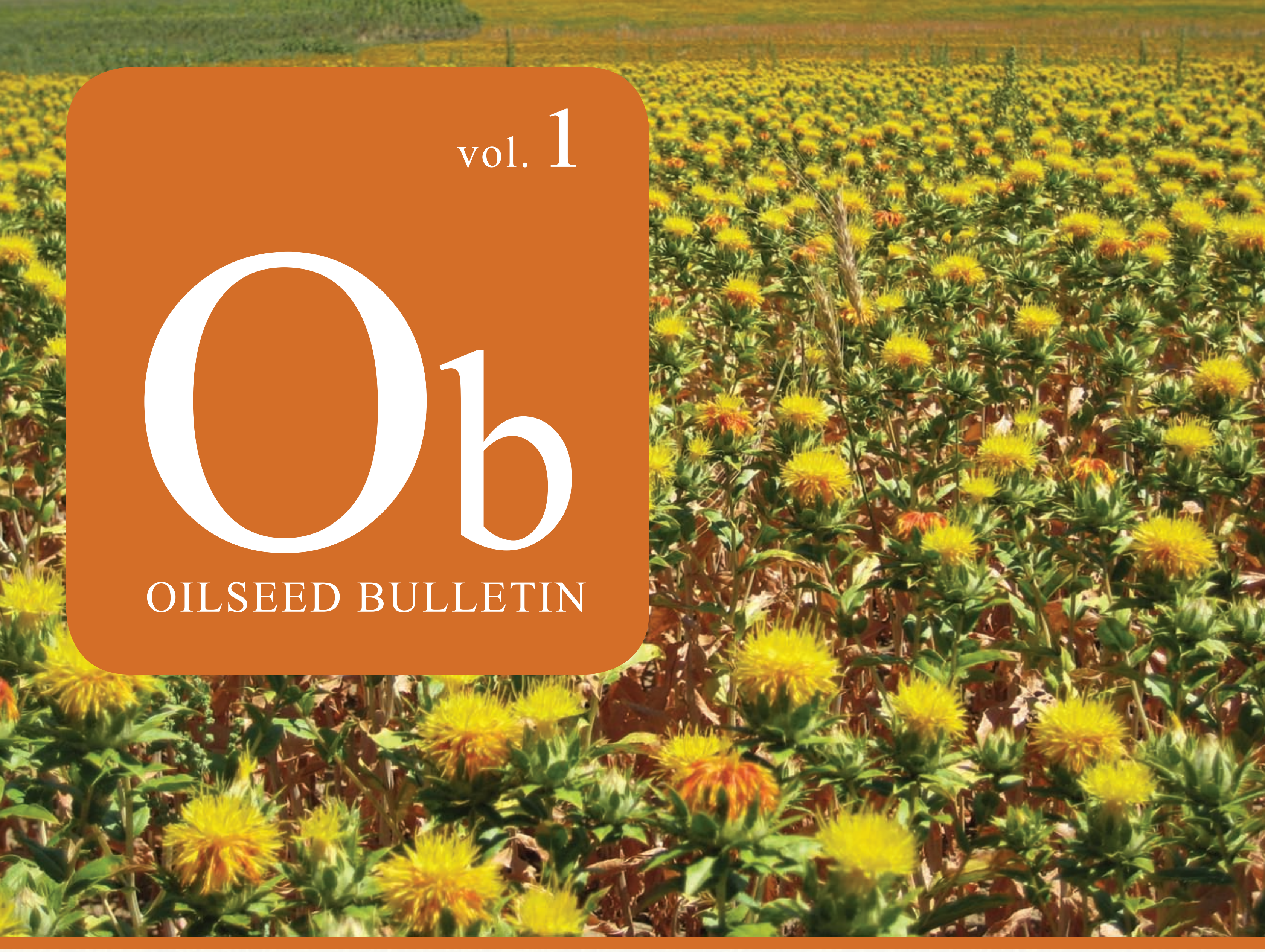


vol. 1

Ob

OILSEED BULLETIN

OILSEED OPPORTUNITIES FOR WYOMING

GROWING ROTATIONAL CROPS FOR BIODIESEL AND LIVESTOCK FEED

Wyoming Business Council Agribusiness Division
in partnership with
USDA/Natural Resources Conservation Service
Northeastern Wyoming Resource Conservation & Development Area

CONTENTS:

Waller, Aaron[1], *Donn Randall[2] & Tom Foulke3, Eds. *"Oilseed Opportunities for Wyoming – Growing Rotational Crops for Biodiesel and Livestock Feed." Cheyenne: Wyoming Business Council. 2010.*

1- Resource Conservation and Development Coordinator, USDA- Natural Resources Conservation Service

2- Crop and Forage Program Manager, Wyoming Business Council *(publication contact) donn.randall@wybusiness.org

Funded through the grant support of Western Sustainable Agriculture Research and Education (SARE).

Acknowledgement - Without the generous and thoughtful contribution of the following this publication would not have been possible:

Lindsay Taylor - Gillette, Wyo.

Producer Cooperators
Cam Forbes, Beckton Angus - Sheridan, Wyo.
Tom Stanley - Gillette, Wyo.
Ross Peterson – Sheridan, Wyo.
Phil and Kate Boreen – Otto, Wyo.
Jon and Sonja Becker-Schickel – Thermopolis, Wyo.

Layout and Publication
Matt Cox, Wyoming Business Council

LOCAL OPPORTUNITIES IN VALUE-ADDED AGRICULTURE

Farmers and ranchers in Wyoming are growing some new crops and improving their diversity. Many of these changes are being brought about by rising energy and crop prices and the need to become more self-sufficient. Oilseeds such as canola, sunflower and safflower are part of this change and are being grown successfully as agriculture seeks a local and low cost source of fuel and livestock feed.

A century ago a farm or ranch would not have thought twice about growing their own food and fuel. It was just the way to make sure you had what you needed. However, with the improvements made to transportation networks, commodities moved easier both to the market and back to the farm and ranch.

Productive agriculture and low energy prices meant agricultural producers could specialize and purchase their inputs to production.

*In 2005 a structural shift to energy prices occurred brought on by the realization that the supply of new petroleum was limited globally, while demand was increasing. A barrel of oil was now at least $70. At this time, the price of diesel fuel began to trade significantly higher than gasoline, on a relative basis.

Commodity prices went up and stayed in this a new higher range.

These shifts presented both opportunities and challenges for the bottom-line of American agriculture.

Producers in Wyoming became interested in what they could grow that was responsive to new markets and the need to produce fuel on the farm.

Biodiesel made from vegetable oils was one area of interest. Livestock producers and feeders saw that oilseeds such as canola and sunflowers also produced high-protein livestock feed as well as oil.

Cooperatives began assisting their membership to plant new crops and began investing in the equipment to process oilseeds.

*2009. Federal Reserve Bank of Dallas. What Drives Diesel Prices? Economic Letter, Vol. 4 #9

THIS BULLETIN IS INTENDED AS A GUIDE TO PRODUCERS

who are considering growing oilseeds in Wyoming and/or working with their local co-op to add value to oilseed crops.

The information included comes from lessons learned in Wyoming and from neighboring states.

It is published through a partnership between the Wyoming Business Council Agribusiness program; University of Wyoming Cooperative Extension Service and Experiment Stations; U.S. Department of Agriculture, Natural Resource Conservation Service and Northeastern Wyoming Resource Conservation and Development Area.

Producer PROFILE

Beckton Angus, Sheridan, Wyo.

Beckton Angus has been producing high quality Red Angus cattle for 65 years and is considered the foundation herd for the breed. As with any large ranch, forage production is big part of annual operations. Recently, owner Cam Forbes began planting oilseeds when old hay fields needed to be replanted to alfalfa. Safflower, sunflowers and canola have provided an excellent transition crop and have produced excellent yields under irrigation. The ranch purchased used Gleaner L2 combines as a cost-effective harvest solution. Beckton works closely with the oilseed crushing facility housed at the Sheridan Farmers Co-op.

"My main business is still cattle. I just need to be able to incorporate some new crops in the rotation and make my whole operation more productive."

Cam Forbes, Beckton Angus
Sheridan, Wyo.

WHY BIODIESEL?

The United States consumes about 60 billion gallons of diesel, refined from petroleum, every year – more than 70 percent of this is used in the transportation sector. Nearly two-thirds of the oil used to make diesel is imported from other countries, like Canada, Mexico, Venezuela, Nigeria and Saudi Arabia.

Diesel is a vital fuel for economic activity, agriculture, industry and for residential heating. All of these uses have the potential for replacement with biodiesel use.

The very first "diesel" engine was invented in Germany by Rudolf Diesel in 1892 to run on peanut oil. Later, fossil fuels became plentiful (and cheap) and biodiesel use became less common.

Biodiesel is attractive for both blending with petroleum and as a pure fuel because it is easy to refine from renewable resources such as vegetable and animal oils. Large industrial plants or small on-farm systems are equally viable production systems and use essentially the same technology.

Biodiesel is commonly made from Soybeans and Canola in the Midwest and Northern Plains States. However, any oil can be used. Animal fats from meat processing facilities, tallow, recycled oils and yellow grease are increasingly being used in multi-feedstock operations.

Multi feedstock is a term used to describe operations that can use a variety of inputs according to market prices and availability.

Most biodiesel is currently sold in a blend with petroleum – 2 percent, 5 percent or 20 percent biodiesel (i.e. B2, B5, or B20). Biodiesel reduces tailpipe emissions while improving engine life, performance and mileage. As a result, there is a high demand for biodiesel blends from farmers, ranchers, truckers, bus fleets and anyone with a diesel pickup who wants American-made fuel.

Small scale biodiesel producers and farmer cooperatives have found that by using local feedstocks they are able to produce lower cost fuel, that may be blended or used as a 100 percent biodiesel (B100). For example, 1,000 gallons of refined oil can make 20,000 gallons of B5 (i.e. 5 perent).

Biodiesel is a quality fuel that has shown potential to reduce engine wear and enhance performance by adding lubricity when blended with low-sulfur diesel. It is also a product that supports American jobs and our energy security.

Wherever you find biodiesel you will find local farmers and workers making it possible. Biodiesel is truly a product that reduces our reliance on foreign oil and stimulates our rural economy.

Oil Producing Crops - Comparison

Plant	*Seed Yield lbs/acre	**Biodiesel gal/ acre**	Seed % oil
Soybean	2000	**38**	18%
Camelina	800	**29**	34%
Safflower	1500	**66**	42%
Sunflower	1800	**92**	48%
Canola	2000	**86**	40%

*Note: Gallon per acre is a function of yield and oil content. Values shown are commonly observed, but may be higher or lower depending on plant varieties or growing conditions. Cold press expeller assumed - 80% net oil recovery.

EQUIPMENT

Biodiesel is an attractive renewable fuel because it is relatively simple to make at all scales of production. Once you have an oilseed crop in storage, the main steps are to crush the seed and then refine the oil through transesterification. Large scale producers use technology and large equipment to save labor but essentially it is the same process, regardless of scale.

Oilseed presses are commonly manufactured in Germany, India and China and can process as little as 100 lbs/day or as much as 20 tons/day. The standard is a "cold press" that crushes the oilseed using a exertion of force and pressure to pulverize the feedstock into oil and meal.

With cold pressing, some oil remains in the meal. Hot presses use introduced heat to improve the efficiency of the press, while acids can be used to strip even more oil from the feedstock. The use of acid based crushing will produce the most oil per unit of feedstock, but has higher costs and safety considerations.

The cost of equipment varies and may be a significant upfront cost, but is usually not a significant part of the per gallon cost. Labor, supplies and equipment costs are usually 20 percent or less of the cost to produce biodiesel, on a per gallon basis. If a small scale producer can grow their own oilseed and does not have high labor costs, biodiesel can be produced for a fraction of #2 diesel. If feedstock is purchased at market prices, the production process needs to be fairly efficient in order to be cost effective.

Don't Forget About Storage:

Storage facilities for feedstocks and oil are perhaps the most important pieces of equipment that are needed to produce biodiesel - and are sometimes overlooked during facility planning. Augers for oilseeds going to the press, piping for oil and conveyors for meal coming off the press are critical. Vegetable oil, chemicals and refined biodiesel all need separate storage tanks. Multi-feedstock systems will need additional considerations. A well planned configuration will reduce labor significantly and keep your equipment running continuously. Continuous operation is one key to efficient and low cost production.

Equipment Continued

Some small scale producers are content to realize the highest benefits of "self-sufficiency" on-farm through the use of livestock meal byproducts from oilseed crushing. Likewise, a cooperative allows multiple producers to share capital investments and byproducts.

The transesterification process has lower equipment costs relative to oilseed presses but does require mixing of chemicals such as methanol.

The basic pieces of equipment are tanks and valves to mix the oil and methanol and then to remove the glycerol once it has fallen to the bottom of the tank. Additional tanks for chemicals and for oil storage can help speed up the bioreaction process. Automated systems can be installed to reduce labor and create continuous-flow systems.

BIODIESEL FACT

Transesterification:

is the process by which glycerin (a sugar) is removed from vegetable and animal oils to make pure biodiesel. Methanol and potassium hydroxide are mixed with filtered oil and cause the glycerin to separate and form glycerol. Glycerol is heavier than oil and can be drawn off the bottom of the oil tank. Glycerin from processed glycerol is used in cosmetics, soaps and animal feed.

Biodiesel Production Cost - Sensitivity Analysis

	Price Change	Biodiesel Change
Seed Cost	$0.01/lbs.	$0.27/gallon
Meal Revenue	$10/ton	$0.09/gallon
Crushing Cost	$10/ton	$0.14/gallon
**Labor Cost change of $1 equals a $0.03/gallon change*		
Labor Cost*	$1/hour	$0.07/gallon
*Biodiesel Labor only		
Methanol Cost	$0.50/gallon	$0.10/gallon

Schumacher, Joel. 2009. SVO & Sustainability, Economics and Co-products. Harvesting Clean Energy Conference, Billings MT., January 2009. Montana State University.

LIVESTOCK CONSIDERATIONS

Most oilseeds produce twice as much protein rich meal as oil by volume. For many agricultural producers the meal is the primary product they are looking for.

High protein soybean and cottonseed meal have always been the standard protein source in feeder rations, show feed, range cake and many other livestock supplements.

Canola and sunflower meal are becoming equally common sources of protein and are valued according to their protein and nutritional content.

Recently, the strong worldwide demand for protein has made on-farm production of oilseeds a cost effective way to get supplemental protein for livestock. Farmer cooperatives are increasingly processing their oilseeds locally and adding value by mixing feed for the farm or ranch.

*Analysis by Dr. Greg Lardy at North Dakota State University has looked at the amount of certain oilseeds that would be needed to support a 300 cow ranch. Sixty to seventy acres of Canola or Sunflower would provide enough protein rich meal supplement to support the herd on winter range from December thru February.

The oilseed in this example would also provide around 3000 gallons of oil suitable for sale or conversion into biodiesel. The opportunity to integrate oilseed byproducts into cattle operations has the potential to diversify operations, reduce winter feed costs and generate value-added income opportunities.

Additionally, oilseeds have been shown to provide an excellent transition crop when old hayfields are replanted.

*Lardy, Greg. 2008. Biodiesel Benefits for Cattle Producers. Western Organization of Resource Councils.

Grain or Oilseed	Protein*
Soy Meal	48%
Camelina Meal	37%
Canola Meal	36%
Sunflower Meal	24%
Safflower Meal	24%
Corn Gluten Meal	66%
Peanut Meal	50%
Barley Protein Meal	42%
Cottonseed Meal	41%
Linseed (Flax)Meal	34%
Dried (Corn) Distillers Grains	31%
Corn Gluten Feed	20%
Alfalfa Hay	17%

**(Typical protein content of meals for livestock feed)*

***Glycerin** – As a byproduct of the manufacture of biodiesel, glycerin is used in soaps, cosmetics, pharmaceuticals and food products.

Many livestock producers have asked: "can I feed Glycerin to my livestock." Research has shown that the sweet-tasting, colorless, viscous liquid is rapidly fermented in rumen of cattle and has a high energy value as a feedstuff. Feedlot experiments conducted by Kansas State University have shown that beef rations with up to 8 percent glycerin improved daily weight gains. A 2 percent inclusion rate was the optimal level for feed mixing, carcass quality and weight gain benefits, as long as potassium hydroxide (KOH) is used as the catalyst in making biodiesel. Sodium Hydroxide (NAOH) should be avoided as a catalyst due to high salt residue in glycerol.

*Kelzer, Joelene. Including Glycerol, a byproduct of biodiesel production, in feedlot diets. Farm and Ranch Guide. February 14, 2010.

vol. 1
Ob
OILSEED BULLETIN

WHAT OILSEED CROPS CAN BE GROWN IN WYOMING

Growing Safflower *(Carthamus tinctorius)*

Nationally, soybeans are the king of oilseeds with nearly 80 million acres planted in the Midwestern states. In Wyoming's arid high plains climate, three oilseed crops have shown potential for good production in Wyoming: sunflowers, canola and safflower. All three produce good oil and meal and tolerate cool temperatures and/or dry conditions. Camelina sativa is a fourth crop that has been the subject of ongoing research and field trials in Wyoming, but does not yet have fully established agronomic guidelines or markets in Wyoming.

**Safflower is an exceptionally hardy dryland crop that is currently grown in California, Montana and other Northern Plains States. 165,000 acres of safflower were grown in the US in 2009. It is marketed primarily to the birdseed and specialty oil markets. Safflower oil can be both the oleic or linoleic type depending on variety. A number of new varieties have recently been developed in the Northern Plains region. Safflower oil is of the highest grade for salad oils and many other products. Surplus (or non-food grade) safflower oil also makes the finest quality biodiesel.

Climate

Safflower is tolerant of hot and dry conditions once established. Supplemental irrigation can be used to establish the crop. Safflower has a deep tap root that can extend 8 ft or deeper, in good soil conditions, and utilizes subsoil moisture and nutrients well. Many varieties of safflower develop stiff spines on the leaf margins once the plant begins to mature in the field. These spines limit animal browse and require skin protection for persons entering fields.

Safflower production is not recommended for areas with more than 15 in. of annual precipitation, growing seasons with fewer than 120 frost-free days, and less than 2,200 growing degree days. Temperatures as low as 20°F are tolerated while in the rosette stage, but safflower is very sensitive to frost injury after stem elongation, and though crop maturity. This crop does best in areas with warm tem-

*Oelke et al. 1992. Safflower. Alternative Crops Field Manual. Universities of Wisconsin Cooperative Extension Service, University of Minnesota Center for Alternative Plant and Animal Products & Minnesota Extension Service. http://www.hort.purdue.edu/newcrop/afcm/safflower.html

**Crop Production Annual Summary, National Ag Statistics Service (NASS), USDA, 2010.

peratures and sunny, dry conditions during the flowering and seed-filling periods. Yields are lower under humid or rainy conditions as seed set is reduced and the occurrence of leaf spot and head rot diseases increases. Consequently, this crop is adapted to semiarid regions.

Soils and Fertility

Deep, fertile, well-drained soils that have a high waterholding capacity and high levels of stored moisture are ideal for safflower. This crop is also productive on coarse-textured soils with low water-holding capacity when adequate rainfall or irrigation is available.

Soils that crust easily can prevent good stand establishment. High levels of soil salinity can decrease the frequency of seed germination and lower seed yield and oil content. Safflower has approximately the same tolerance to soil salinity as barley. High yields result when safflower has 100 lbs/acre of nitrogen available. The ability of safflower to effectively use nutrients left from past crops, and at significant soil depth, should be considered when planning fertilizer applications. Phosphorous (P) and potassium (K) should be applied when soil tests show very low levels of these nutrients.

Seeding Safflower

One of the most attractive aspects of safflower is the ability to use a small grain drill with adjusted barley seeding rates. Seed safflower once soil temperatures are 40°F. Safflower is usually planted in late April or early May.

This crop may not mature if planted after mid-May. Seedlings emerge in 8 to 15 days. Sowing the crop after mid-May increases the possibility of lower seed yield and quality due to injury from fall frost and disease. Late planting usually results in shorter plants, less branching, and lower seed yield and oil content, even if damage from frost or disease does not occur.

Use a grain drill to plant seed at depths of 1 to 1 1/2 in., at a rate of 20 to 25 lb/acre. A shallow planting depth promotes a uniform emergence that is important when planting early. Dryland rows are usually spaced at 6, 8 or 10 in, with 3, 4 , or 5 plants per linear foot, respectively; however, rows spaced up to 14 in. apart are sometimes used. Wider row spacing may decrease disease incidence, but can promote more weed competition, less branching, delayed maturity and lower oil content of seed. Seeding rates for irrigated crops should be 25 to 35 lb/acre. Seed is similar in size to barley and weighs about 38 lb/bushel. Drill settings for planting safflower usually agree with settings for similar seeding rates of barley.

Harvest

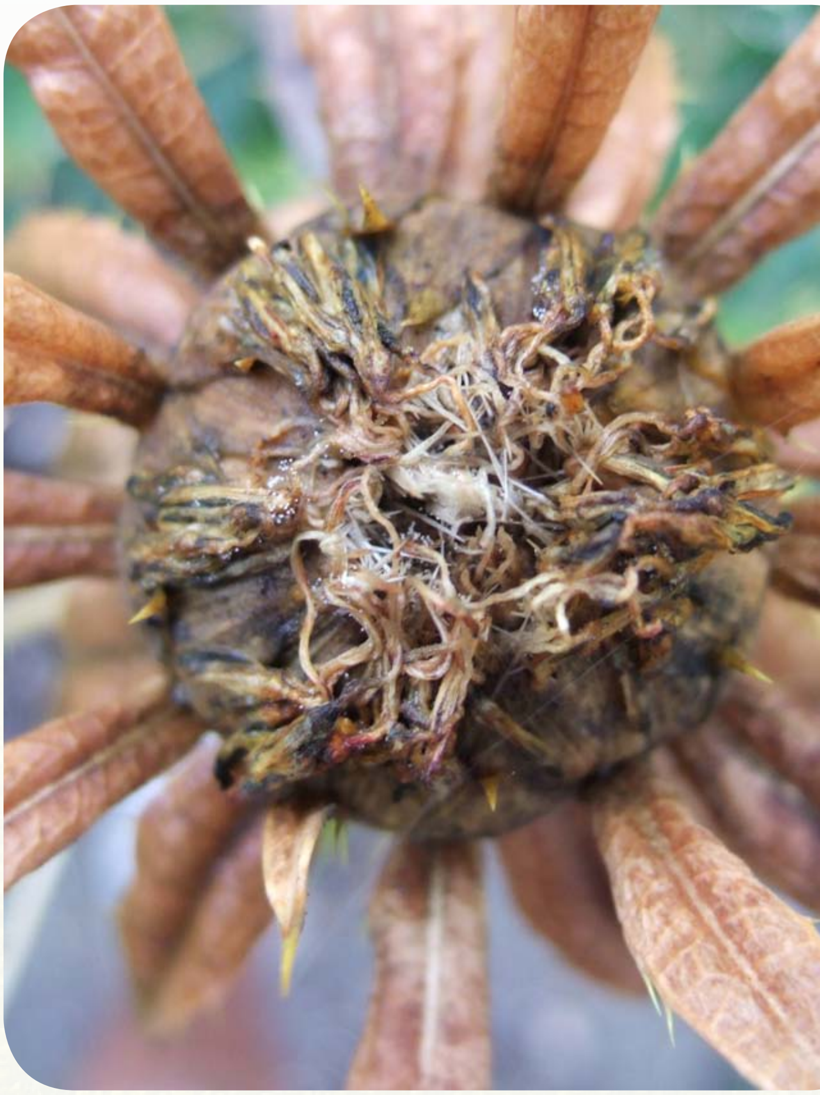
Safflower is ready to harvest when most of the leaves turn a brown color and very little green remains on the bracts of the latest flowering heads.

The stems should be dry, but not brittle, and the seeds should hand thresh easily. This crop should be harvested as soon as it matures in order to avoid the seed discoloration or sprouting in the head that can occur with fall rains. Some varieties of safflower produce white seed while others are more brown. Safflower is an excellent crop for direct combining since it stands well and does not shatter easily. The time for harvesting safflower can vary from late August to September, depending on environmental conditions during the growing season.

The combine cylinder speed should be set low at 550 RPM for a 22 in. cylinder, to avoid cracking seed. Peripheral speed should be approximately 3,000 ft/minute. Concave clearance should be set at approximately 5/8 in. at the front and 1/2 in. at the back.

The reel speed should be about 25 percent faster than the ground speed. To prevent clogging of the machine from plant residue, the shaker speed must be greater than speeds used for small grains. Air speed should be sufficient to remove most unfilled seeds, straw, and bulls.

The combine radiator and air intake should be checked regularly to avoid blockages from the white fuzz of seed heads. Accumulations of this white fuzz can be a fire hazard.



In ideal conditions safflower can yield up to 2000 lbs/acre or higher. Poorer sites, with weed pressure, will yield much less. Quality safflower seed should have a bushel weight over 38 lb, no uncleanable admixtures, no sprouting, no heated seeds and exhibit the correct color for the variety grown. Safflower seed should have an oil content from 36-40 percent.

Oil content above these levels has become more common-with newly introduced varieties. (The 'Nutrasaff' variety grown in Sidney, Mont., has tested nearly 50% oil content.) Moisture content of cleaned safflower seed should not exceed 8 percent for safe, long-term storage.

Growing Canola *(Brassica napus)*

*Canola is an attractive oilseed crop option for Wyoming due to its marketability, high oil content and ease of crushing. Canola is a specific variety of rapeseed that is low in erucic acid and glucosinolates which are undesirable for human or livestock consumption. Canola is widely grown in Canada, Europe and South America and is the third most common oilseed grown worldwide. 814,000 acres of Canola were grown in the US in 2009, mostly in North Dakota. Both spring and winter varieties are available and green canola is excellent forage for cattle. 'Round-up ready' varieties are also available. Hot and dry conditions - over 90°F during flowering, can significantly reduce yield. Canola flowers for up to 21 days and is less tolerant of dry conditions than either safflower or sunflower. It is normally planted in early spring, as soon as the soil can be worked.

Climate

Canola is widely adapted, particularly to the cool extremes of the temperate zones. Minimum temperatures for growth have been reported to be near 32°F. The crop will germinate and emerge with soil temperatures at 41°F but the optimum is 50°F. Winter annual varieties are grown where adequate snow covers or mild winters are common. Canola is predominantly an irrigated crop in Wyoming. Winter canola has been successfully grown in southeast Wyoming near Torrington, while spring varieties are more widely adapted with early spring planting.

Soils and Fertility

Canola does best on medium textured, well drained soils. The crop is tolerant of soil pH as low as 5.5 and saline conditions. Because of its tolerance to salinity, canola has been used as a first crop on newly drained dikes in the Netherlands. Canola requires approximately 16 to 18 inches of water throughout its growing season, with 8 to 8.3 inches used, by annual varieties, in the flower and pod fill stages.

Canola responds well to nitrogen fertilizer, with optimum yields occurring around 80-100 lbs acre. For spring canola, it should be broadcast and incorporated at seeding time along with the P and K. For winter canola, nitrogen may be best applied as a split application using a starter nitro-

Oplinger et al. 1989. Canola (Rapeseed). Alternative Crops Field Manual. Universities of Wisconsin Cooperative Extension Service, University of Minnesota Center for Alternative Plant and Animal Products & Minnesota Extension Service. http://www.hort.purdue.edu/newcrop/afcm/canola.html

*Crop Production Annual Summary, National Ag Statistics Service (NASS), USDA, 2010.

gen application of about 10-20 lbs/acre, followed by the remainder in the spring prior to re-growth. A general recommendation is that P and K should be applied on the basis of soil test recommendations similar to winter wheat. Because canola is sensitive to direct seed contact with fertilizer, applications should be banded at least 2 inches to the side and below the seed or broadcast.

Seeding Canola

Stand establishment is very important with canola because of its lack of early competitiveness. Seeding into a smooth, firm seedbed helps maintain a uniform seeding depth and even emergence. Seedbed preparation is usually done with a shallow (4-5 inch) tillage operation. Recent research, however, has shown some success establishing canola with reduced tillage. Canola can be seeded in either the fall or the spring depending on the variety type.

Fall dates need to be timed to achieve approximately six true leaves and good root reserves before the killing frost. Fall planting between August 1 and August 20 should accomplish this in most areas in Wyoming. Spring planting should begin as early as the soil is dry and weather permits. Like spring small grains, spring canola generally yields the best with early planting.

Canola is usually seeded with the grain drill small seed attachment to a depth of 1/2 to 1 inch. Rows should be spaced 7 inches or less. Research has shown highest yields with 3-inch row spacings.

Canola should be seeded at 4-5 lb/acre if drilled and 7-8 lb/acre if broadcast depending on seed size and soil texture. Stands should be around 6-8 plants/ft2 for highest yields. Canola stands of this density can withstand up to a 2/3 kill before reseeding is more profitable than maintaining the existing crop.

BIODIESEL FACT

What is SVO?

Straight Vegetable Oil or SVO is exactly what it sounds like, but should not be confused with biodiesel. SVO uses filtered vegetable oil, including the glycerin, as a diesel substitute. Most systems include a second fuel tank that allows a tractor or vehicle to start and stop on #2 diesel and utilize SVO only when the engine is hot. This allows a farmer to produce fuel on-farm but avoids having to go through the transesterification proces . Burning fuels that include glycerin can be risky as this can cause considerable deposits in the combustion chamber if not done properly.

Harvest and Storage

Direct combining of canola is possible, but not common, due to the potential for shatter. Canola is usually swathed when less than half the pods have turned brown, and then left in the windrow for up to ten days before combining. Timely harvest of canola is critical to prevent shattering.

When pods first begin to yellow, the crop needs to be checked on a 3 to 4 day schedule. Harvest maturity can only be determined by observing the color of the seed. In canola that stands well, 30 to 40 percent of the seed on the main stem needs to be brownish-red in color prior to swathing.

This corresponds to about 30 to 35 percent seed moisture. Canola does have a tendency to lodge, particularly with over-fertilization of some varieties. In severely lodged canola, swathing should be done when 40 to 50 percent of the seed in exposed pods has turned color.

Shattering can account for significant crop losses, therefore harvesting must not be delayed. Canola should be cut high on the stem and lightly pushed into the stubble with a windrower to prevent blowing. The crop is ideally combined when it has dried to near 10 percent moisture. The cylinder speed should be set at 450-1000 RPM and the cylinder concave clearance at 3/16 to 1/2 inch. Losses should be evaluated for further refinement of these adjustments. Canola that is to be stored for six months or more must be dried to near 8 percent moisture.

Rapeseeds must be handled and stored carefully. Tight storage bins are required. Seed can sweat in storage even at 9 to 20 percent moisture content. Inspection is required to prevent heating and spoilage in the bin. The small seed restricts air flow, so thin layers are necessary for drying wet seed. If much straw is present a scalper should be used to clean the crop. A U.S. standard bushel of canola is 50 lbs.

Producer PROFILE

Tom Stanley, Gillette, Wyo.

Tom Stanley grows small grains and hay on a third generation family farm. When energy prices spiked in 2007, Tom looked for creative solutions to his high diesel costs and began working with the Wyoming Oilseed Team. Tom has grown camelina, sunflowers and safflower in rotation with wheat, barley and hay – all dryland. As a small grain producer, he was able to use existing equipment with only a few adjustments. He looks forward to when more grain elevators and processors are bidding for oilseeds in Northeastern Wyoming.

"At some point, you might as well just park your tractor. You are just not making any money with $4 diesel."

**Tom Stanley,
Gillette, Wyo.**

*Growing Sunflowers *(Helianthus annuus)*

Sunflowers are common in crop rotations in Laramie County, Wyo., where several thousand acres are grown annually. Sunflowers are grown in many semi-arid regions of the world, from Argentina to Canada and from central Africa into the Soviet Union, as a mid to late season crop, in rotation with small grains. New markets for high quality oils that are low in saturated fat, have increased the acres of oil type sunflowers, grown in the US, to 1,653,000 acres in 2009. North and South Dakota and Kansas are leading sunflower oil producers. Non-oil 'confectioner' varieties are also grown in many states. Sunflowers are hardy and tolerant of variable conditions. Oil yield approaches 50% for some varieties, making it the fourth most common vegetable oil source worldwide. Sunflowers have provided an excellent diversification of income for farmers in the Northern Plains because planting and harvest times are later than other crops.

Climate

**Sunflowers are tolerant of both low and high temperatures, but more tolerant of low temperatures. Sunflower seeds will germinate at 39°F, but temperatures of at least 46 to 50°F are required for satisfactory germination. Seeds are not affected by vernalization (cold) in the early germination stages. Seedlings in the cotyledon stage have survived temperatures down to 23°F. At later stages freezing temperatures may injure the crop. Temperatures less than 28°F are required to kill maturing sunflower plants. Optimum temperatures for growth are 70 to 78°F, but a wider range of temperatures (64 to 91°F) show little effect on productivity. Extremely high temperatures have been shown to lower oil percentage, seed fill and germination.

Sunflowers are efficient users of water and often produce satisfactory results when other crops are damaged during drought. Its extensively branched taproot, penetrating to 6.5 ft., aids the plant during water stress. A critical time for water stress is the period 20 days before and 20 days after flowering. If stress is likely during this period, irrigation will increase yields, oil percentage and test weight, but decrease protein percentage.

*Putnam et al. 1990. Sunflower. Alternative Crops Field Manual. Universities of Wisconsin Cooperative Extension Service, University of Minnesota Center for Alternative Plant and Animal Products & Minnesota Extension Service. http://www.hort.purdue.edu/newcrop/afcm/sunflower.html
**Crop Production Annual Summary, National Ag Statistics Service (NASS), USDA, 2010.

Soils and Fertility

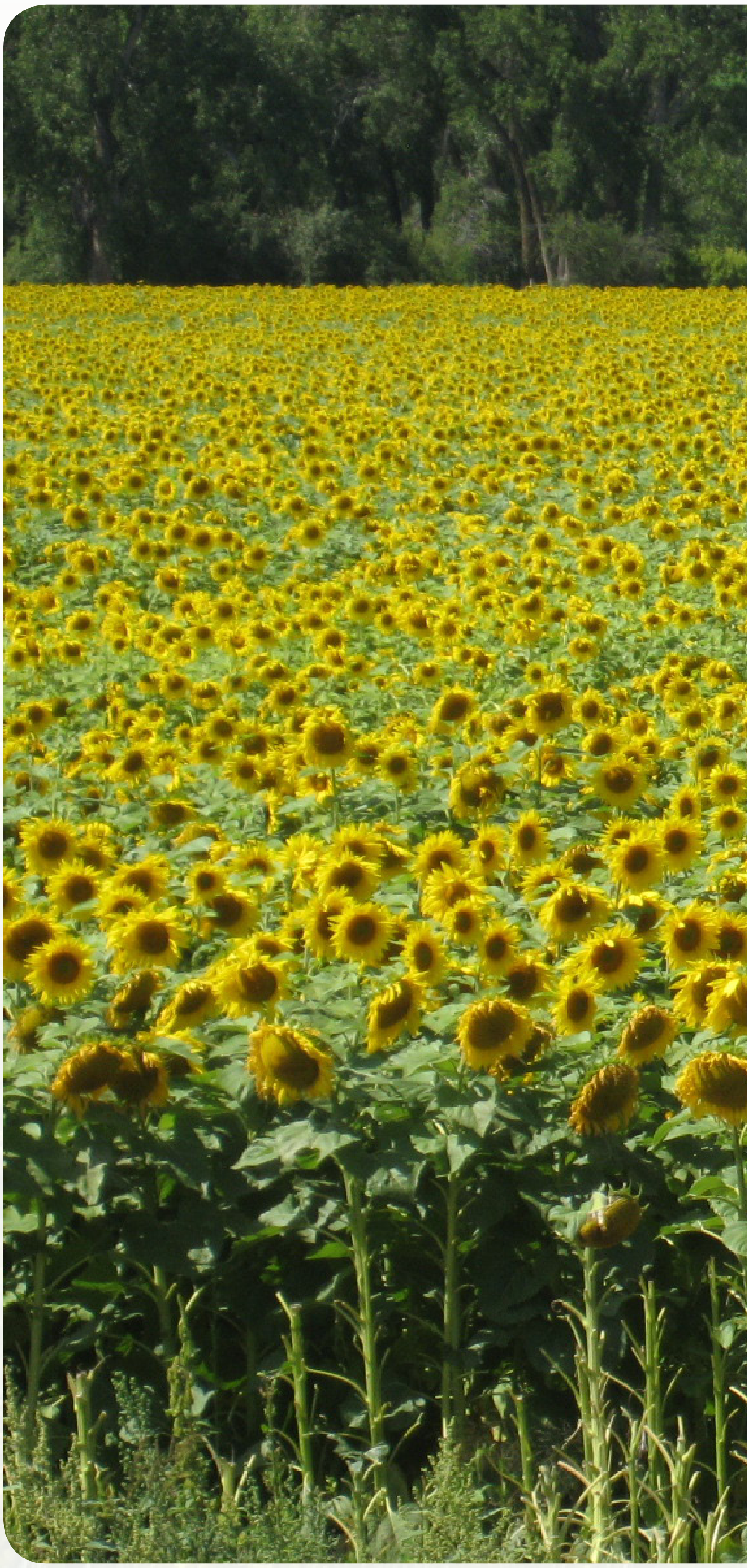
Sunflowers will grow in a wide range of soil types, from sandy to clay, but has low salt tolerance. Good soil drainage is required for sunflower production, but this crop does not differ substantially from other field crops in flooding tolerance. Research has shown that sunflowers responds to N, P and K. Nitrogen is usually the most common limiting factor to yields, but excess N tends to reduce oil percentage of the seed and increase leaf area of the plant. Recommendations of approximately 18 lb N/acre after fallow or legume sod, 60 lb N/acre after small grain or soybean and 80 to 100 lb N/acre after corn or sugarbeets are common. Greater yield increases are reported as a result of applications of P than from K.

Recommendations range from 40 to 70 lbs P2O5 and 60 to 140 lbs K2O /acre for soils testing very low in P or K, depending on soil yield potential. Sunflowers are not highly sensitive to soil pH. The crop is grown commercially on soils ranging in pH from 5.7 to over 8. The optimum depends upon other properties of the soil; no pH is considered optimum for all soil conditions. However, the 6.0 to 7.2 range may be optimal for many soils.

Seeding Sunflower

In northern regions, highest yields and oil percentages are obtained by planting early - as soon after the spring-sown small grain crops as possible. In the northern midwest and Canada this is often May 1 through May 20 and mid-March through early April in the southern USA. Resistance to frost damage decreases as the seedlings develop into the 6-leaf stage, so too-early sowings in the northern USA or Canada can be risky. Wyoming producers commonly plant sunflowers from May 15 to June 15.

Many different tillage systems can be used effectively for sunflower production. Conventional systems of seedbed preparation consist of moldboard plowing or chisel plowing to invert residue and several cultivation operations. Conventional systems have been shown to increase the availability and improve the distribution of potassium and nitrogen and to increase the seed zone temperatures. However, the risk of erosion and expense of multiple tillage operations has led to greater interest in minimum or ridge tillage systems.



Both germination percentage and lodging have been shown to increase in ridge-till systems vs. level plantings. Several tillage systems have been used with some success in specific environments. Major considerations are: 1) firm placement of seed near moist soil, 2) absence of green vegetation during emergence, 3) maintaining an option to cultivate and 4) reducing the risk of soil erosion.

A planting depth of 1 to 3.5 in. allows sunflower seeds to reach available moisture and gives satisfactory stands. Deeper plantings have resulted in reduced stands and yields. If crusting or packing of the soil is expected, as with silt loam or clay soils, a shallower planting depth is recommended.

Sunflower row spacing is most often determined by machinery available, which might be 30 or 36 in., with an adapted corn planter. In trials, sunflower yield, oil percentage, seed weight, test weight, height, and flowering date did not differ at narrow vs. wide rows. Hence, row spacings can be chosen to fit available equipment. Row spacing of 30 in. is most common. Sunflower stands have the capacity to produce the same yield over a wide range of plant densities. The plants adjust head diameter, seed number per plant and seed size, to lower or higher populations, so yield is relatively constant over a wide range of plant populations.

Harvest

Sunflowers are generally mature long before they are dry enough for combining. Seed maturity occurs when the backs of the heads are yellow, but the fleshy sunflower head, takes a long time to dry. Often, there are only a few good combining days in October when the seed is dry enough for storage. Seeds should be below 12 percent moisture for temporary storage and below 10 percent for long term storage. Seed with up to 15 percent moisture is satisfactory for temporary storage in freezing weather, but spoilage is likely after a few days of warm weather.

Commercially available sunflower headers are useful in decreasing loss of seed as the crop is direct combined. This equipment usually includes 9 to 36 in. width metal pans for catching matured seed and a three-armed or similar reel. A narrower (9 in.) pan width enables harvesting diagonal to the row, which produces fewer harvest losses in some situations. Grain and corn headers can be adapted with pans and guards to prevent seed loss.

Open concave settings (3/4 to 1 inch), low airspeed and slow cylinder speed (250-400 rpm) are common settings for sunflowers. The overall goal of the threshing is to pass the head through the combine fairly intact or in several smaller pieces. This more gentle treatment will help keep excessive trash out of the bin. US grade standard for sunflowers is only 25 lbs/bushel, with typical weights up to 32 lb/bu.

Ongoing Research -- *Camelina (Camelina sativa)*

Wyoming producers have joined their Great Plains neighbors and experimented with a new oilseed related to canola called camelina. Camelina is a crop that has been grown in Europe for centuries and was introduced to Wyoming and Montana due to its hardiness on dryland sites. Camelina produces about 34 percent oil and is high in omega-3 fatty acids which are desirable in human and animal diets.

Camelina can be seeded in February or March and is very cold tolerant. Harvestable yields (400 lbs/ac) can be reached under very dry conditions and increase with moisture and fertility. A clean, firm seedbed is essential for camelina. Harvest and handling of camelina has proven to be a challenge, since the seed is very small (375,000 seeds/lb). Timing of harvest is key, as camelina can shatter if left in the field too long.

The U.S. Food and drug Administration has approved feed containing up to 10 percent camelina meal for poultry and cattle. Camelina makes excellent biodiesel and is currently being tested for commercial and military aviation. Wyoming trials of camelina continue.

Recent interest in camelina production, in the western United States, has been generated by interest in establishing this oilseed as a rotational crop in a dry land system. Part of the interest lies in the ability to make biodiesel from the oil and use the meal as livestock feed.

The economics of an on-farm bio-diesel production system are being investigated by a researcher at the University of Wyoming (UW) Department of Agricultural & Applied Economics.

UW Researchers are using a systems approach, to size a production system for on-farm feeding and fuel produc-

tion. Tom Foulke has created a spreadsheet model he calls, the "camelina calculator" that estimates the bio-diesel cost of production from an on-farm growing, feeding and biodiesel production system.

The calculator estimates production costs for feed and fuel and can be adjusted for different yields and herd size from which estimates of profitability can be obtained.

The results show that in the eastern part of Wyoming, yields are not high enough to make this an economically viable prospect. For example, on 90 harvested acres that yielded 500 pounds per acre, total biodiesel production is estimated to be 1,590 gallons and total meal production is estimated to be 32,760 pounds.

The cost of camelina biodiesel production was estimated to be $4.84 per gallon for ownership and operating costs. The cost per gallon using operating costs only was estimated to be $1.97 per gallon (labor not included). Higher yields could clearly improve the economic viability.

An interesting observation is that the cost avoided of feeding camelina meal instead of a corn/soybean ration provides the bulk of the savings in this system. The biodiesel production system itself, though apparently capable of producing a sufficient quantity and quality of biodiesel appears capital, labor and skill intensive for the individual producer.

The above research is part of a wider project funded by a Western Sustainable Agriculture and Research Education (W-SARE) grant and headed by Dr. Bret Hess at UW. The overall project is evaluating dryland camelina as a suitable crop for growing, feeding and producing biodiesel for Wyoming and Montana.

Test plots have been grown in multiple locations in Wyoming and Montana for the past three years. Feeding trials were conducted at the University of Wyoming with 100 heifers, both in 2008 and 2009. Trial results are expected later in 2010.

BIODIESEL FACT

What about using recycled oil?

Restaurants can be a good source of vegetable oil suitable for biodiesel. Fuel made exclusively from restaurant oil is termed "recycled diesel." Often used vegetable oils are blended with other feedstocks to keep costs low in a multi-feedstock approach.

Crop Budgets

The following crop budget is a basic comparison of the costs to produce alfalfa and three different oilseeds under irrigation. Per acre equipment costs for tillage and harvest are based on the most recent published averages for the Great Plains region. While actual costs and returns will depend on a specific situation, the numbers below should give some relative comparisons.

Sample Oilseed Budget

Costs	Alfalfa (5 yr stand) Annualized	Canola	Sunflower	Safflower
Seed Rate	15 lb/ac	5 lb/ac	#24K/ac	20 lb/ac
Inputs (seed and fertilizer)	$ 43.97	$ 62.40	$ 66.80	$ 42.00
Tillage (chisel, disk, cultivate, drill, fertilize)	$ 12.94	$ 47.33	$ 39.51	$ 39.51
Irrigation (pump, water, labor @ $3.41/ac-inch)	$ 61.38	$ 47.74	$ 54.56	$ 40.92
Harvest (haying or combine)	$ 107.64	$ 42.41	$ 32.07	$ 32.07
Total Costs per Acre	*$ 226*	*$ 200*	*$ 193*	*$ 155*
Revenue				
Yield	4 tons/ac/yr	2100 lbs	2400 lbs	1800 lbs
Price	$ 85	$ 0.14	$ 0.11	$ 0.17
Gross Return per Acre	*$ 340*	*$ 294*	*$ 264*	*$ 306*
Net return/ac to land & management	**$ 114**	**$ 94**	**$ 71**	**$ 152**

Notes		Alfalfa	Canola	Sunflower	Safflower
Applied Water (w/6" soil moisture)		18"	14"	16"	12"
Annual Nitrogen/ac	$0.39/#	3#	80#	80#	60#
Annual Phosphorous/ac	$0.44/#	70#	30#	30#	15#
Tillage Notes		2 cuttings	Cultivate 2x Swath Combine	Direct cut	Direct cut

Sources:

i) Troy J Dumler et al., A) *Center Pivot Irrigated Sunflowers, B) Center Pivot-Irrigated Alfalfa & C) Canola Cost Return Budgets in Western and South-Central Kansas,* Kansas State University, December 2009.

ii) A. Swenson & R. Haugen, *Projected 2009 Crop Budgets in North West North Dakota*, North Dakota State University, December 2008.

iii) Clark Israelsen et al., *Costs and Returns per Acre from Growing Irrigated Safflower - 2004*, Utah State University Extension.

iv) Paul W. Brown, *Flood vs. Pivot Irrigation for Forage Crop: What are the Advantages and Disadvantages?,* University of Arizona, December 2008.

v) *Irrigated Alfalfa Production - Agronomy Note #103*, Montana State University, 1997.

vi) Robert Hogan et al., *Estimating Irrigation Costs*, University of Arkansas, 2007

vii) *Energy Costs to Pump Water*, North Dakota State University. http://www.ag.ndsu.nodak.edu/abeng/pdffiles/Energycosts.pdf

WHAT OIL DO YOU WANT IN YOUR DIET… OR YOUR TANK?

The best and highest use and marketing of all vegetable oils is for human consumption. Oilseed growers set up to maintain food quality handling facilities can access the most profitable value-added markets.

Various oilseeds have specific uses for frying, cooking or in confections. Biodiesel comes into play with lower quality oils or when oils are produced in surplus. The potential for local or regional surplus is significant. Biodiesel allows the producer to maintain alternative value streams for their crops.

Oil health characteristics are complex and relate to whether the oil is predominantly saturated (bad) or unsaturated (good). 'Omega 3' characteristics are another indicator that has been shown to improve health.

The most interesting fact might be that the best oils for human consumption also make the best biodiesel – canola, sunflower, safflower. Palm kernel oil is the source for more vegetable oil consumption worldwide than any other oil.

Soybeans are a close second. However palm is much heavier and more saturated oil than most oilseeds grown in the US.

Americans are fortunate to be able to grow the best oilseeds for food and fuel.

BIODIESEL FACT

US Biodiesel Production:

The U.S. has more than 140 commercial biodiesel plants with an annual production capacity of 2.8 million gallons. Most plants operate at variable rates of their full capacity according to market conditions and mandates for blending with petroleum diesel. Certain states require 2 percent or 5 percent biodiesel blends while petroleum wholesalers receive a tax credit for blending.

BIODIESEL FACT

How does biodiesel respond to the price of #2 diesel?

Recent trends have shown that when #2 diesel is over $3/gal, B100 can be an attractive replacement fuel. Oilseed feedstock cost is generally 80 percent of the cost of producing biodiesel and is by far the most important factor. Using recycled oils and yellow grease can reduce these costs. A federal blending tax credit of $1/gallon is an excellent incentive, if the credit is in effect and the blender is licensed. Blends like B5 are less sensitive to relative prices since these are usually sold at a premium to regular diesel and contain only 5 percent biodiesel.

Initiatives to increase Wyoming's stake in energy crops started in 2005.

These efforts have reflected national trends to produce more domestic energy, environmentally-friendly fuels and spur rural economic development.

vol. 1

Ob

OILSEED BULLETIN

Wyoming OILSEED TEAM

Wyoming BUSINESS COUNCIL

Northeastern Wyoming Resource Conservation & Development

UNIVERSITY OF WYOMING COOPERATIVE EXTENSION SERVICE

NRCS Natural Resources Conservation Service

WESTERN SARE Sustainable Agriculture Research & Education

OILSEED OPPORTUNITIES FOR WYOMING

GROWING ROTATIONAL CROPS FOR BIODIESEL AND LIVESTOCK FEED