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# Evaluation of Agricultural Sunflower Plants as Drought Tolerant Option For New Mexico Growers

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# Evaluation of Agricultural Sunflower Plants as Drought Tolerant Option For New Mexico Growers

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## Abstract

The progressive drought in New Mexico has led farmers to consider crops that use less water yet maintain potential profit margins. Sunflower, a crop traditionally grown from Kansas to North Dakota, has recently been shown to be profitable in West Texas. The majority of sunflower is grown under dryland conditions due to its drought tolerance and deep root system. Sunflower was investigated as a new crop alternative for NM growers. Two organic, non-GMO seed varieties selected for the NM climate were planted at seven different farms across the state. Results from five of the farms were evaluated for biomass yield, oil yield, and oil characteristics. Results show promise for sunflower as a viable alternative for NM farmers to rotate into their crops.

# ACKNOWLEDGEMENTS

This report was made possible through funding from the New Mexico Small Business Administration (NMSBA) Program at Sandia National Laboratories. Special thanks to Juan Martinez and Genaro Montoya for guidance and support from project inception to completion. Also, special thanks to Asaera Cote, owner of EarthGift Herbals, and NMSBA point of contact for the project.

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# 1. INTRODUCTION

In fiscal years 2012 and 2013, the New Mexico Small Business Administration (NMSBA) Program funded evaluation of sunflower oil as an ingredient in soap. The work was completed under individual assistance projects. The Point of Contact (POC), Asaera Cote was very excited with the results and subsequently saw the opportunity for a larger market for sunflowers. At present, sunflower oil is imported from surrounding states (North Dakota to Texas) because New Mexico does not commercially produce sunflower. Asaera's relationships with the farming community and the specialty product industry (aromatherapy soaps) provided her insight into the opportunity to grow sunflower regionally in New Mexico as a high value specialty crop. Asaera and Sandia National Laboratories assembled a team of farmers and specialty product retailers to create a 2014 leveraged project evaluating sunflower as a New Mexico crop.

## 2. BACKGROUND

The progressive drought in the semi-arid regions of North America has led to an emerging concept to utilize crops that maintain yields while saving scarce water resources. This provides an opportunity for sunflower. During the last decade the insatiable demand for corn used in ethanol, cattle feed, grocers and food processors doubled corn prices. During this rush, the water production from the Ogallala aquifer (the primary aquifer for the US Heartland) dropped so much that many wells have become low capacity (< 350 gpm).[1] Sunflower uses less water, fertilizer, herbicide, and pesticide than most crops. [1]

The majority of sunflower is grown under dryland conditions due to its drought tolerance and deep root system. Growers have stated that sunflower can survive extended dry conditions and can thrive in saline soil conditions better than other crops making it an ideal crop for NM.

The scope of this project was to develop, implement and evaluate the growth of sunflower crops in NM. Optimal sunflower seeds were identified and grown by multiple farmers across NM. Input parameters such as water, fertilizer, herbicide, and pesticide usage were measured for direct comparison to known crops such as cotton, alfalfa, and corn. Sandia in conjunction with project participants from the Institute for Sustainable Agricultural Research (ISAR) at New Mexico State University (NMSU) incorporated new crop management and operational technologies developed during their partnership on another project the last two years. No-till or minimum-tillage practices enhance SOM (soil organic matter), which is the key to lowering input parameters. In addition, research indicates that no-till crop management has reduced greenhouse gas emissions by 50% due to soil carbon storage (CSA). Sunflower crop output characteristics such as yield, oil quality and content were measured and can be compared with data from crops grown in the Dakotas, Colorado, Kansas, and Texas. Figure 1 shows the extent of sunflower crop production during the 2000-2004 time period. Historically sunflowers have been grown in Kansas and north; however, during the last decade sunflower planting has extended south into West Texas and has been shown to be economically viable for West Texas farmers. Lubbock area farmer Ken Gallaway stated “We’re just losing our water, so we’ve got

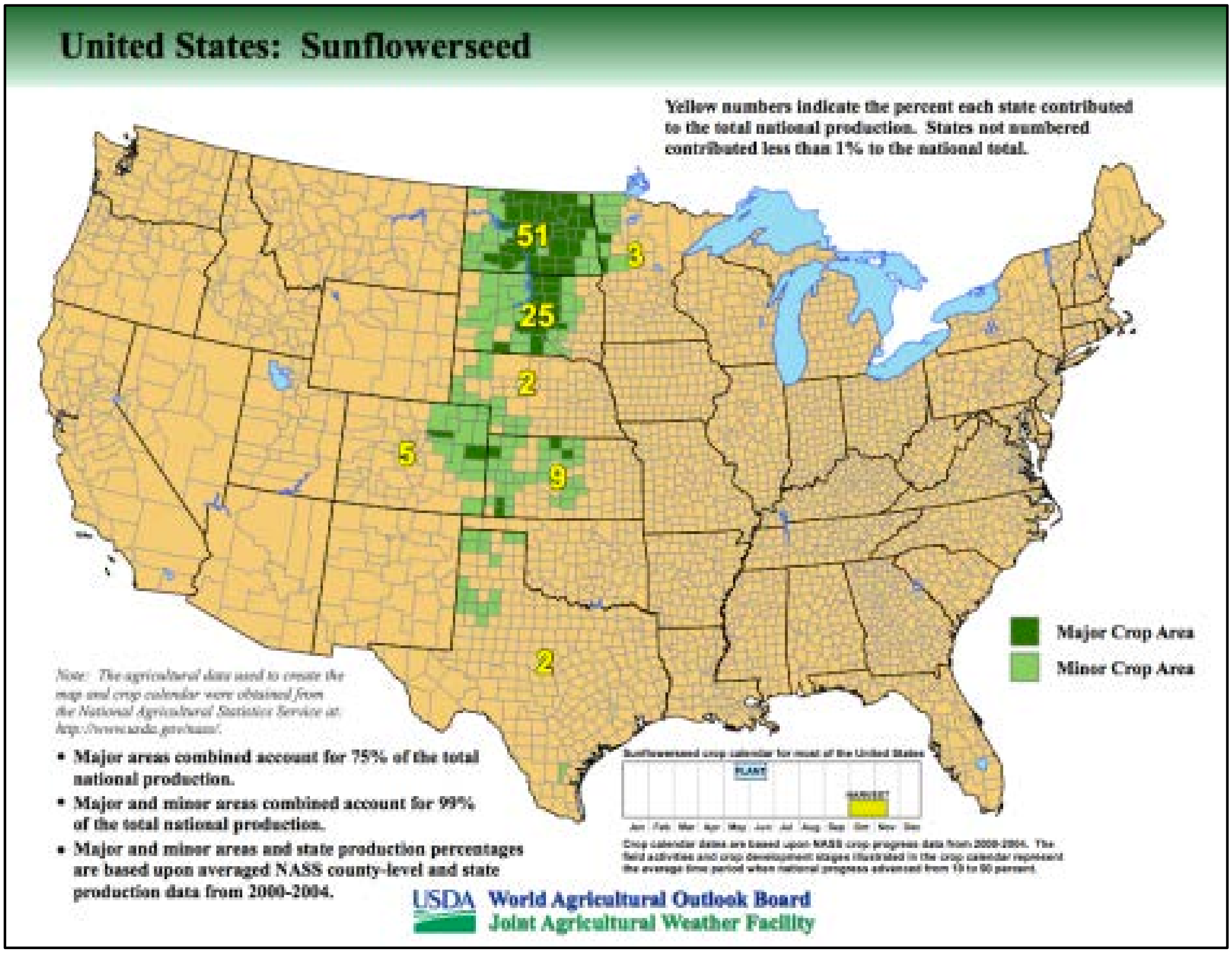

Figure 1. United States sunflower regional production [11]

to come up with a profitable alternative to corn." The sunflowers he planted in June used half the water corn demanded and about a quarter less that he put on his cotton, Gallaway said. Grower Preston Huguley said: "he could make a sunflower crop spending half the money per acre that cotton or corn may require". "You're risking less money out there all year". [2]

Table 1 compares input parameters for competing crops. The table presents a semi-quantitative approach to comparing potential crops in NM. Generally in drought conditions where alkali soil persists, sunflower appears to be a viable crop option.

| | CROP INPUT PARAMETER COMPARISONS | | | |
|---|---|---|---|---|
| | Currently Grown | | | |
| | COTTON | ALFALFA | CORN | SUNFLOWERS* |
| Relative Cost/acre | 1 | 1 | 1 | 0.5 |
| Water Usage | .75 | 1 | 1 | 0.5 (drought tolerant) |
| Fertilizer, herbicide & pesticide usage | Med-high | Med | Med-high | Low |
| Alkali and/or saline soil conditions | Requires more water | Requires more water | Requires more water | Thrives |
| Root Depth | < 3 ft. | < 3 ft. | < 3 ft. | 6 ft. |
| Increased yield with increased water | Yes | Yes | Yes | No |

Table 1. Relative comparison of crop input parameters

### 2.1. Sunflower and Sustainability

In determining which crops to grow the next year, farmers evaluate which ones provide the best combination of the following: (1) the best profit potential; (2) a good fit into the crop rotation; and (3) the least financial risk.[3] Sunflowers meet all three criteria. Furthermore, in New Mexico as in much of the United States, there is a growing concern about the increase of saline soils. Saline soils can greatly impact crop growth and yield.[4] Sunflower is one of the few crops that can survive and thrive on slight to moderate saline soils.[4] The deep taproot of sunflowers is one of the likely reasons for the plant's success on saline soils.[5] When used in crop rotation the deep roots penetrate the hard-packed "caliche" layers helping break this nasty caliche layer up. The deep roots also scavenge and access water and nutrients deeper than other crops.

3. SUNFLOWER SEED SELECTION

The NM Small Business farmers participating in this project were polled to determine what characteristics they felt were most important for seed selection on their New Mexico plots. First and foremost, all participating farmers grow "organic only crops" so it was a given that all seeds had to be organic and non-GMO. Asaera Cote, the project POC felt this was essential for development of a "Specialty Industry" for sunflower in NM. Another positive development that could aid in developing a "specialty industry" based on organic sunflower farming is the recent expansion of the 2014 Farm Act. The following points summarize the positive changes:

- U.S. consumer demand for organic food has outpaced domestic production since the late 1990s, and recent retailer initiatives could further boost demand.
- Congress boosted funding for a number of organic programs in the 2008 and 2014 Farm Acts.
- Organic program provisions in the 2014 Farm Act cover a broad set of objectives—assisting with organic certification costs, expanding organic research and data collection, improving technical assistance and crop insurance, strengthening enforcement of organic regulations, and expanding market opportunities for producers. [10]

Table 2 is a summary of the other agronomic characteristic criterion and the farmer's selections.

| Agronomic Characteristic | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | ***TOTALS*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emergence | | | | | | 1 | 1 | 2 | | | | 25 |
| Standability (stature) | | | 1 | | | | 2 | 2 | | | | 29 |
| Drought Tolerance | | 1 | | | | | | | | 1 | 5 | 61 |
| Test Weight | | | | | | 3 | | 1 | | | | 22 |
| Dry-Down | | | | | | 2 | | 1 | 1 | | | 25 |
| Oil Content | | | | | | | | 1 | 1 | | 5 | 65 |
| Yield | | | | | | | | 1 | 1 | | 5 | 65 |

1 least desirable 10 most desirable

Table 2. Farmer's seed selection results

The totals were determined by multiplying the number of selections in each row by corresponding desirable weighting (1-10) and adding the result for each row. For example, the Emergence Total is determined as (1x5) + (1x6) + (2x7) = 25. The farmers are smart folks as evidenced by their selections. Yield, oil content and drought tolerance were clearly the desired characteristics. Next was to find sunflower seeds that best met those characteristics and simultaneously were likely to fair well at the elevations and climate in New Mexico.

### 3.1. Seed Companies

In addition to the seed selection criteria above, the seed companies must also have verifiable organic certification. The number of companies that met the initial criteria was surprisingly small. The following is a list of those companies:

- Triumph Seed
- SEEDS OF CHANGE
- Johnny Selected Seeds
- Blue River Hybrids
- Southern Exposure Seed Exchange
- High Mowing Organic Seeds
- Native Seeds/SEARCH
- Meadowlark Hearth
- SEEDSNOW.com
- Siskiyou Seeds
- SunOpta

Two seed companies were chosen to purchase seeds from: (1) Blue River Hybrids; and (2) High Mowing Organic Seeds. These two companies were the only two that readily produced organic and non-GMO certificates. In addition each company had a high oil content, high yielding, drought tolerant variety that was notably short in stature – typical mature heights of 4 to 6 feet. The farmers all agreed that this shorter height was a better choice considering the winds in NM, and the relative ease of harvesting compared to many of the other varieties that grow between 8 and 12 feet tall.

### 3.2. Potential Sunflower End Use Industries

Numerous businesses could benefit from sunflower cultivation in NM.
The most notable are:

- Oil
  - Restaurants, retail
  - Personal care products
- Feed stock for other food products
- Livestock feed – range cake
- Bird feed
- Pulp/paper stock
- Mulch, livestock bedding

Participating and "interested party" businesses range from growers to restaurants. The following is a list of NM businesses that assisted with this project:

<u>NM business / County location</u>

1. EarthGift Group / Torrance & Bernalillo
2. Martha's Body Bueno / Bernalillo

3. NM Tree and Garden Center / Sandoval
4. Sunsmiths Organic Greenhouses & Gardens / Bernalillo
5. Rose Farms / Santa Fe
6. Thompson Farms / Bernalillo
7. Dandy Designs, Inc. / Sandoval
8. Estancia Valley Kitchen / Torrance
9. The Greenside Café / Bernalillo
10. South Valley Soaps / Bernalillo
11. Dosi Alvarez Farms / Dona Ana
12. Granja Para Manana / Valencia
13. Tramperos Land & Cattle, LLC / Union

4. SUNFLOWER PLANTING THROUGH PROCESSING

Sunflowers were planted at seven different farms across four counties in NM.

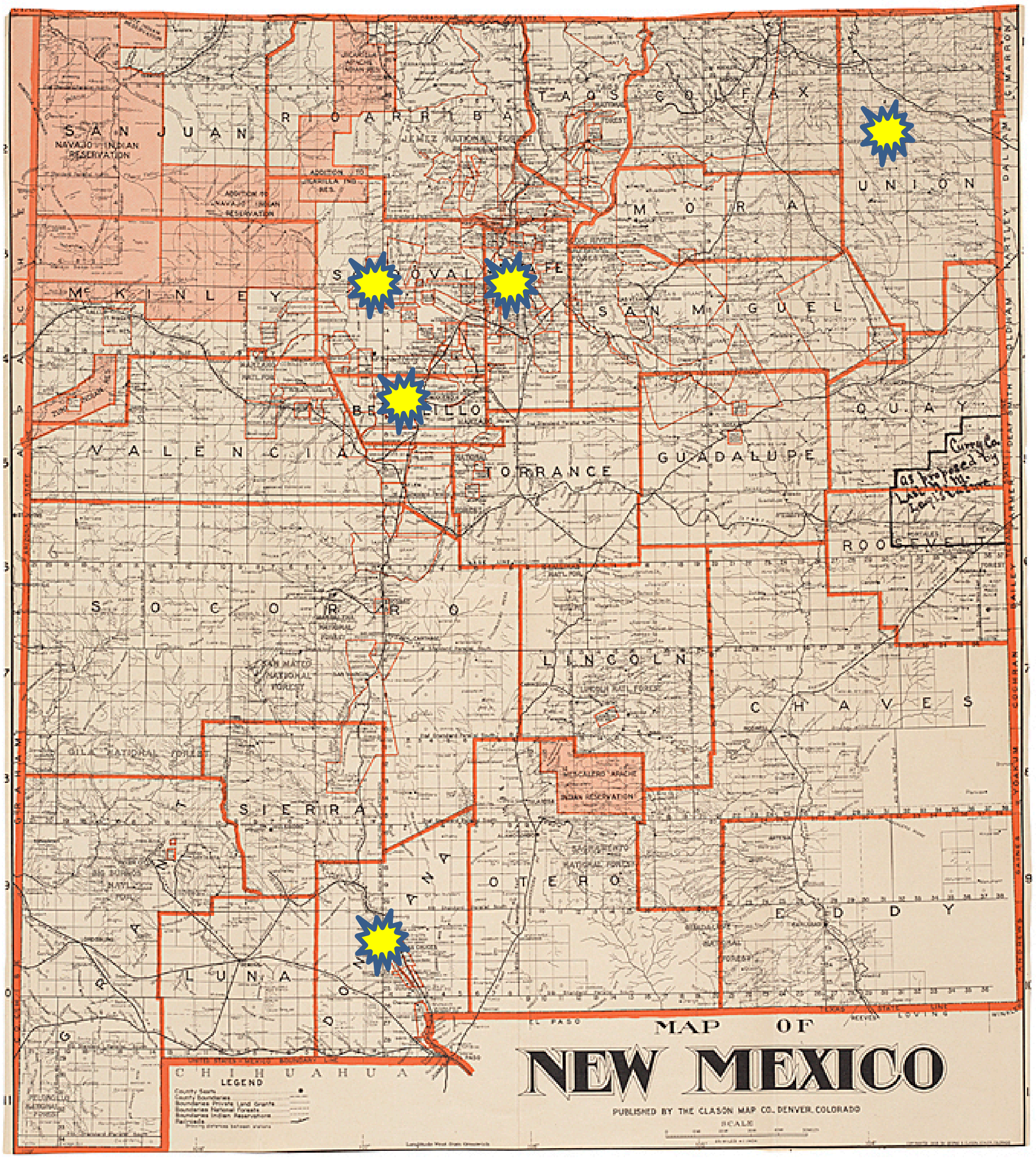


Figure 2. Sunflower planting locations

## 4.1. Sunflower Planting & Growth

Prior to planting sunflower seeds at the farms, soil samples were collected and analyzed for the purpose of evaluating changes in the soil characteristics before and after planting. The soil analyses measuring “Routine Soil Fertility” were conducted by Colorado State University’s (CSUs) Soil, Water and Plant Testing Laboratory in Fort Collins, Colorado.

| SOIL FERTILITY ANALYSIS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FARM | SOIL ANALYTE | | | | | | | | | | | |
| | pH | EC mmhos/cm | Lime Estimate | % OM | $NO_3$-N (ppm) | P (ppm) | K (ppm) | Zn (ppm) | Fe (ppm) | Mn (ppm) | Cu (ppm) | Texture Estimate |
| Sunsmiths-D | 6.8 | 0.5 | Low | 1.6 | 6.6 | 21 | 629 | 0.94 | 5.91 | 8.23 | 1.59 | Sandy Clay Loam |
| Sunsmiths-I | 7.7 | 1.3 | Low | 3.8 | 26.5 | 130 | 1431 | 4.06 | 5.68 | 12.5 | 1.20 | Sandy Loam |
| Rose-D | 7.8 | 1.8 | Very high | 2.1 | 6.3 | 45 | 904 | 3.11 | 6.43 | 11.2 | 2.00 | Sandy Loam |
| Rose-I | 7.8 | 0.7 | Medium | 1.4 | 3.8 | 16 | 366 | 1.44 | 4.66 | 9.71 | 1.79 | Sandy Loam |
| Dosi Alvarez GPM-I | 7.8 | 2.8 | Very high | 2.6 | 60.1 | 60 | 945 | 3.39 | 4.59 | 14.1 | 1.26 | Sandy Clay Loam |
| Dosi Alvarez GPM-North | 8.1 | 2.9 | Very high | 4.6 | 97.4 | 130 | 1070 | 3.71 | 7.02 | 10.1 | 2.08 | Sandy Clay Loam |
| Dosi Alvarez PSRC-1 (near rd.) | 7.9 | 1.1 | Very high | 2.2 | 2.9 | 27 | 533 | 1.91 | 13.6 | 3.73 | 3.22 | Clay |
| Dosi Alvarez PSRC-2 East | 8.0 | 0.8 | Very high | 1.7 | 5.3 | 22 | 456 | 1.78 | 10.3 | 1.37 | 3.20 | Clay |
| Dosi Alvarez PSRC-3 | 8.0 | 0.8 | Very high | 2.1 | 3.8 | 20 | 486 | 1.76 | 10.8 | 1.68 | 2.93 | Clay |
| Dosi Alvarez PSRC-4 | 7.9 | 0.9 | Very high | 2.3 | 6.2 | 25 | 469 | 1.99 | 8.76 | 1.66 | 2.38 | Clay |
| Dosi Alvarez H7 California | 8.4 | 1.9 | Very high | 1.1 | 12.9 | 14 | 392 | 1.14 | 2.28 | 0.62 | 1.54 | Sandy Clay Loam |
| Dosi Alvarez H8 Daytona | 8.3 | 2.1 | Very high | 1.3 | 13.4 | 14 | 418 | 1.07 | 2.50 | 0.61 | 1.63 | Sandy Clay Loam |
| Thompson | 8.1 | 0.6 | Very high | 2.1 | 8.7 | 32 | 501 | 3.43 | 6.71 | 13.9 | 1.78 | Sandy Clay Loam |
| Dandy | 7.9 | 0.6 | Very High | 3.7 | 38 | 50 | 764 | 4.6 | 4.1 | 10.7 | 2.6 | Sandy Clay Loam |
| NM Tree | 8.1 | 0.6 | Very High | 2.7 | 19 | 42 | 449.5 | 2.7 | 2.7 | 6.2 | 1.1 | Sandy Clay Loam |
| Tramperos | 7.8 | 0.4 | Medium | 2.8 | 23 | 3.0 | 268.5 | 0.6 | 1.8 | 1.2 | 1.0 | Sandy Clay Loam |

Table 3. Routine soil analyses results

Table 3 summarizes the results. Soil samples were collected in accordance with CSUs sampling procedure found at the following website: http://www.soiltestinglab.colostate.edu

Although seeds were planted at seven different farms, five grower plots were chosen for evaluation due to time constraints associated with planting dates, weather and harvest duration. The five small business farm’s sunflower plantings evaluated were Sunsmiths, Dosi Alvarez (New Mexico State University Sustainable), Dandy Design, Inc., Thompson Farms and Rose Farms.

| | | NM Small Business Farmers | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sunsmiths | | Dandy Design | | Dosi Alvarez–Sustainable Ag. | | Rose Farms | | Thompson Farms | |
| Production Inputs | Seed Variety | Vermont | Daytona | Vermont | Daytona | Vermont | Daytona | Daytona | Hopi/Tarahumara | Vermont | Daytona |
| | Planting Date | 5/6/14 | 5/6/14 | 6/8/14 | 6/8/14 | 4/28/14 | 4/28/14 | 5/23/14 | 6/30/14 | 7/4/14 | 7/4/14 |
| | Seed (lbs./acre) | | | | | | | | | | |
| | Irrigated Area planted (sq. ft.) | 173 | 173 | 475 | 550 | 504 | 504 | | | 750 | 250 |
| | Irrigation Schedule | 37 gal/day | 37 gal/day | | | 4-28-14 5-19-14 6-9-14 6-30-14 | | | | Every 3 days (330 gal total) | Every 3 days (330 gal total |
| | Non-irrigated Area planted (sq. ft.) | 126 | 126 | 0 | 0 | 0 | 0 | | | | 125 |
| | Fertilization | Initially organic compost | Initially organic compost | Initially organic compost | Initially organic compost | | | Tilled, raked, manure - compost | Tilled, raked, manure - compost | Tilled and top compost | Tilled and top compost |
| | Insecticide | none | none | none | none | none | none | none | none | none | none |
| | Herbicide | none | none | none | none | none | none | none | none | none | None |
| | | | | | | | | | | | |
| Harvest | Irrigated crops Harvest Date | 8/11/14 | N/A | 9/3/14 | 9/8/14 | 8/7/14 | 8/7/14 | 9/15/14 | N/A | 10/29/14 | 10/29/14 |
| | Growth Duration (days) | 95 | - | 85 | 90 | 99 | 99 | 112 | N/A | 115 | 115 |
| | Harvested Irrigated Area (sq. ft.) | 173 | 173 | 16 | | | | | N/A | 750 | 250 |
| | Non-irrigated crop harvest date | Not harvested | N/A | N/A | N/A | N/A | N/A | | N/A | | 10/29/14 |
| | Harvested non-irrigated area (sq. ft.) | 0 | 0 | N/A | N/A | N/A | N/A | | | | 125 |
| | Seed Yield Level (lbs./acre) | 863 | 610 | | | | | | | | |
| | Oil Yield (oz./acre) | | | | | | | | | | |

Table 4. Summary of sunflower growth and harvesting

- ***Sunsmiths Organic Greenhouses and Gardens (Bernalillo County, NM)***

Sunsmiths planted two varieties of sunflower, Daytona and Vermont, on May 6, 2014. Irrigated and non-irrigated rows were planted. Two-65 ft. long rows, 16” center to center (approximately 175 $ft^2$/variety) were planted for each irrigated variety. The non-irrigated sunflowers were planted in single 95 ft. long rows (one row/variety) for a total area of 126 $ft^2$/row. The dryland seeds did germinate reaching 3 to 4 inches in height; however, due to lack of early growth stage rain the non-irrigated crop did not survive. The irrigated sunflowers were harvested on August 11, 2014. Harvested heads were weighed just after harvesting, dried and seeds removed. Figures 3-8 show early, pre, mid and late stage sunflower crop growth. The crops received an average of 260 gallons of water per week via drip irrigation.

Figure 3. Sunsmiths prepared for planting

Figure 4. Sunsmiths early stage sunflower growth


Figure 5.  Sunsmiths early-stage sunflower growth


Figure 6.  Sunsmiths mid-stage sunflower growth


Figure 7. Sunsmiths mid-stage sunflower growth


Figure 8. Sunsmiths sunflowers late-stage growth

➢ ***Dosi Alvarez (Dona Ana County, NM)***

Two varieties of sunflower, Daytona and Vermont, were planted at the Dosi Alvarez Farm on April 28, 2014. All plantings were irrigated via flood irrigation approximately every two weeks until harvesting. Figure 9 shows the field prior to planting and planting. Figure 10 shows early and mid-stage growth.

Figure 9. Dosi Alvarez Farm prior to and during planting

Figure 10. Dosi Alvarez Farm sunflower growth early stages

Figure 11.  Dosi Alvarez Farm sunflower growth mid-stage

Figure 12.  Dosi Alvarez mid- and late-stage sunflower growth

The irrigated sunflowers were harvested on July 22, 2014.

- ***Dandy Design, Inc.***

Dandy Design also planted two varieties of sunflower, Daytona and Vermont, on June 8 and 9, 2014. All plantings were irrigated daily until during sprouting stage and as needed (when dry) until harvesting.  The total areas planted were:  Vermont – 495 $ft^2$, and Daytona – 475 $ft^2$. Sunflowers bloomed from mid-July through August.  Seeds were harvested during the first week of September and dried for about 10 days on a screened-in porch.  Most of the stalks were in the 4.5 to 6 ft. height range.  The average head diameter at harvesting was about 4 inches (range was 3-6 inches).  Figure 13 represents early stage growth.  Figure 14 shows a fully developed sunflower head prior to harvesting.

Figure 13.  Dandy Design Vermont sunflower early-stage growth

Figure 14.  Dandy Design Daytona sunflower late-stage growth

- ***Thompson Farm***

Initial June, 2014, plantings were eaten by grasshoppers. Figure 15 shows the plots prior to planting. Thompson Farms re-planted two varieties of sunflowers, Daytona, and Vermont, on July 4, 2014. Six irrigated rows of Vermont seeds were planted (750 sq. ft.). Two irrigated (250 sq. ft.) and one non-irrigated row (125 sq. ft.) of Daytona were planted. All row dimensions were 50 ft. long X 2.5 ft. wide. Irrigated crops were provided 330 gallons of water every three days via drip irrigation tubing. Crops were harvested on October 29, 2014. The crops were not completely developed but were harvested due to freezing conditions setting in.

Figure 15. Thompson Farms sunflower plots prior to planting

- ***Rose Farm***

Rose Farm planted three varieties of sunflower on May 13, 2014: Daytona, Hope Black Dye, and Tarahumara White. Irrigated and non-irrigated rows were planted. However, due to lack of rain in the early growth stages the non-irrigated crop did not survive. Figures 16 and 17 display the plots prior to planting. The irrigated rows were watered for 30 minutes on June 13, 17, and 19. Watering was supplemented with rain on June 18 and July 3. The sunflowers were harvested on multiple days – first harvest on September 15, second harvest on September 26, third harvest on October 2, and the final harvest on October 4. Harvested heads were dried and delivered for processing on October 8, 2014.

Figure 16.  Rose Farm non-irrigated plot prior to planting

Figure 17.  Rose Farms irrigated plot prior to planting

- ***New Mexico Tree & Garden, LLC***

NM Tree & Garden, LLC noted that the first two plantings of Daytona sunflower seeds were eaten by grasshoppers in the early growth stage. Next small amounts of Hopi Black and Tarahumara White sunflower seeds were planted. The Hopi Black variety grew to about 2.5 ft. in height and produced enough seeds to plant again next year. The Tarahumara White seeds grew into about 20 plants that were six feet tall. They produced huge heads providing a large increase in seeds for planting the next year. Neither of the seed varieties were evaluated for yield or oil content/quality.

### 4.2. Harvesting

The growth duration (days from planting to harvesting) of the sunflowers varied slightly among farmers – from 85 to 112 days. Results are listed in Table 4 above. This is similar to growth cycles discussed in the literature. A potential advantage of the warm NM climate is the possibility of having an additional crop of sunflower because of the longer growing season.

The general procedure the farmers followed for harvesting the sunflower heads and seeds was as follows:

1. Wait for the heads to drop (face downward), all the sunflower petals have fallen off, and the backside of the sunflower has turned yellow or even brown.
2. May have to protect from birds.
3. Cut about a foot of stalk off the top.
4. Again protect heads from birds and other wildlife.
5. Scrape the seeds out with a spoon or butter knife, or if you're more patient, put a net or brown paper bag over the flower head and wait for the seeds to drop on their own.
6. Air dry for future processing.
7. Prior to oil seed pressing be careful to store heads and seeds in breathable bags to mitigate mold formation.


Figure 18.  Sunsmiths weighing harvested sunflower heads

Figure 19.  Sunsmiths preparing to dry heads

Figure 20.  Sunsmiths drying sunflower heads protected from birds with netting

### 4.3. Processing Seed Oil

Processing sunflower seeds requires a two-step process. Step one is removal of the seeds from the sunflower heads, and step 2 is pressing the seeds to separate oil from the solid matter (cake). Table 5 is a summary of processing of the seeds harvested from the small farms. The yields (% oil / % seed by weight) are shown in Table 5. Yields ranged from 0.28 to 0.37%. These yield ranges are similar to what the large scale sunflower farms achieve. Seed pressing was completed by:

Alan Brewis
Bellingham, WA
www.Seed2Oil.com
(360) 224 4106

Figure 21 is a picture of the crude sunflower oil processed from each farm prior to oil analysis.

Figure 21. Processed sunflower seed oil

Figures 22 and 23 exhibit the filter cake (solid matter) left over from the seed pressing to remove oil. This material has the potential to be used as livestock feed, birdseed, or fertilizer.

Figure 22. Sunflower seed oil processing cake


Figure 23. Sunflower seed oil processing cake

Table 5. Seed processing data

| | | Seed Processing Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Raw seed weight (g) | Oil weight (g) | Cake weight (g) | Oil yield (oil wt. /seed wt.) | Trash (%) (a) | Yield adjusted for trash (b) | Moisture content (%) | Yield adjusted for moisture (c) | Comments |
| FARMS | Rose Farms | 1867 | 505 | 1362 | 0.27 | 7 | 0.29 | 6.4 | 0.31 | |
| | Dandy Design Daytona | 1133 | 285 | 848 | 0.25 | 5 | 0.26 | 9 | 0.28 | |
| | Dandy Design Vermont | 517 | 181 | 336 | 0.35 | 5 | 0.37 | 7.5 | 0.37 | |
| | Sunsmiths Daytona | 1097 | 212 | 885 | 0.19 | 6 | 0.21 | 13 | - | Moisture content high, moldy, far from optimum |
| | Sunsmiths Vermont | 1559 | 508 | 1051 | 0.33 | 12 | 0.37 | 7 | 0.37 | |
| | Dosi Alvarez Daytona | 1691 | 390 | 1301 | 0.23 | 18 | 0.28 | 7.3 | 0.28 | |
| | Dosi Alvarez Vermont | 348 | 102 | 246 | 0.29 | 10 | 0.33 | 6.8 | 0.34 | |
| | Thompson Farms | Unable to press -moisture content out of range, moldy, damp | | | | | | | | |

(a) Trash – estimate of the amount of extra non seed material (AKA admix)
(b) Yield calculated after deducting the estimated quantity of trash from the seed weight
(c) Adjustment of moisture content. Ideal moisture content for sunflower is 7-9% (best is 7.5%)

### 4.4. Oil Analysis

The sunflower oils collected during this project were analyzed by BioDiagnostics, Inc. The analysis focused on fatty acid profiling (also known as the analysis of fatty acid methyl esters, or FAME). This determines the quality of oil seeds and processed oil by identifying and quantifying the fatty acids present in a sample. The resulting fatty acid composition profile provides critical assistance in valuing oil seeds and processed oil for the marketplace. The analysis (FAME) was done in accordance with the guidelines found at the following website. http://www.biodiagnostics.net/fatty-acid-profiling-fame-analysis/

For a farmer, the end use will dictate the type of sunflower seed planted. This project utilized two non-GMO, organic seeds that were both deemed high oil content seeds. Figure 24 provides an example of the variation in the fatty acid profile of different oils from sunflower types.

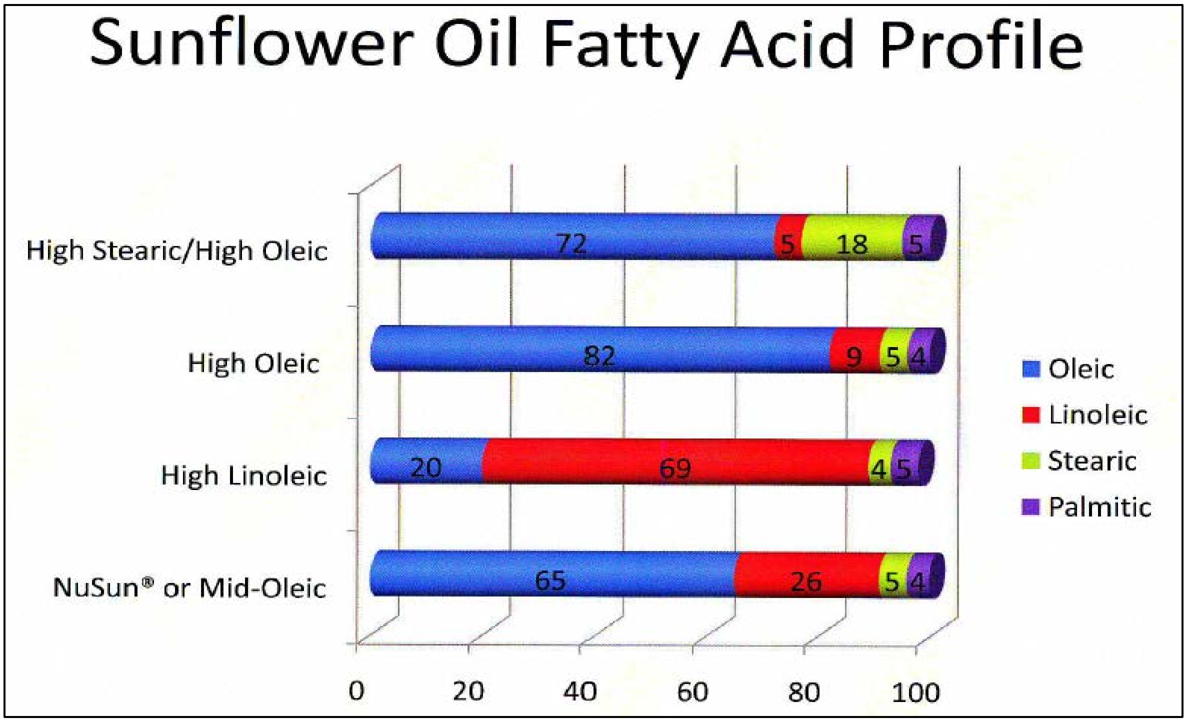


Figure 24. Sunflower oil fatty acid profile

Table 6 includes the results from FAME oil analysis on all samples analyzed as part of this project. The bottom two rows provide some general range numbers for comparison.

Table 6. FAME oil analysis data

| Seed Variety | Farm | Iodine Value | Saponification Value | Myristic Acid | Palmitic Acid | Stearic Acid | Oleic Acid | Linoleic Acid | Linolenic Acid | Arachidate Acid | Eicosenoic Acid | Behenic Acid | Euric Acid | Lignoceric Acid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | C14:0 | C16:0 | C18:0 | C18:1 | C18:2 | C18:3 | C20:0 | C20:1 | C22:0 | C22:1 | C24:0 |
| Daytona | Rose Farms | 84.59 | 190.06 | 0.0% | 3.8% | 4.3% | 81.8% | 7.9% | 0.1% | 0.4% | 0.2% | 1.1% | 0.0% | 0.3% |
| Daytona | Dandy Design | 85.53 | 190.19 | 0.1% | 4.3% | 3.9% | 80.1% | 9.6% | 0.1% | 0.4% | 0.2% | 1.1% | 0.0% | 0.3% |
| Vermont | Dandy Design | 120.37 | 191.13 | 0.1% | 6.1% | 4.7% | 35.7% | 51.6% | 0.1% | 0.4% | 0.2% | 0.9% | 0.0% | 0.3% |
| Daytona | Sunsmiths | 86.73 | 190.01 | 0.0% | 3.6% | 4.1% | 79.7% | 10.2% | 0.1% | 0.4% | 0.2% | 1.2% | 0.0% | 0.3% |
| Vermont | Sunsmiths | 123.62 | 191.21 | 0.1 | 6.0% | 5.7% | 30.6% | 56.0% | 0.1% | 0.4% | 0.1% | 0.9% | 0.0% | 0.2% |
| Daytona | Dosi Alvarez | 84.57 | 190.35 | 0.1% | 4.3% | 3.1% | 84.1% | 6.9% | 0.1% | 0.3% | 0.2% | 0.8% | 0.0% | 0.2% |
| Vermont | Dosi Alvarez | 109.58 | 191.4 | 0.1% | 6.1% | 3.9% | 50.6% | 38.0% | 0.1% | 0.3% | 0.1% | 0.6% | 0.0% | 0.1% |
| High-Oleic Sunflower Oil: crude | | | | | | | >82% | | | | | | | |
| Mid-Oleic Sunflower Oil: Crude | | 88-115 | 188-194 | | | | 55-75% | | <1% | | | | | |

Results expressed as % (by area) of the total fatty acids
General specifications for sunflower oil are provided by the American Fats and Oils Association at the following website:
http://www.sunflowernsa.com/oil/product-specifications/linoleic-sunflower-oil-refined/

Additional information regarding sunflower oil properties and comparison to other types of oils is available at the following website: http://www.sunflowernsa.com/oil/oil-profiles/

The following is a description of some of the parameters analyzed in the FAME oil analysis:
**Iodine value,** also called Iodine Number, in analytical chemistry, measure of the degree of unsaturation of an oil, fat, or wax; the amount of iodine, in grams, that is taken up by 100 grams of the oil, fat, or wax. Saturated oils, fats, and waxes take up no iodine; therefore their iodine value is zero; but unsaturated oils, fats, and waxes take up iodine. (Unsaturated compounds contain molecules with double or triple bonds, which are very reactive toward iodine.) The more iodine is attached, the higher is the iodine value, and the more reactive, less stable, softer, and more susceptible to oxidation and rancidification is the oil, fat, or wax. In performing the test, a known excess of iodine, usually in the form of iodine monochloride, is allowed to react with a known weight of the oil, fat, or wax, and then the amount of iodine remaining unreacted is determined by titration.

Drying oils used in the paint and varnish industry have relatively high iodine values (about 190). Semidrying oils, such as soybean oil, have intermediate iodine values (about 130). Nondrying oils, such as olive oil, used for soapmaking and in food products, have relatively low iodine values (about 80). [8]

**Saponification value** (or "saponification number"/"Koettstorfer number", also referred to as "sap" in short) represents the number of milligrams of potassium hydroxide required to saponify 1g of fat under the conditions specified. It is a measure of the average molecular weight (or chain length) of all the fatty acids present. As most of the mass of a fat/tri-ester is in the 3 fatty acids, it allows for comparison of the average fatty acid chain length. The long chain fatty acids found in fats have a low saponification value because they have a relatively fewer number of carboxylic functional groups per unit mass of the fat as compared to short chain fatty acids. If more moles of base are required to saponify N grams of fat then there are more moles of the fat and the chain lengths are relatively small, given the following relation:

Number of moles = mass of oil/relative atomic mass

The calculated molar mass is not applicable to fats and oils containing high amounts of unsaponifiable material, free fatty acids (>0.1%), or mono- and diacylglycerols (>0.1%).
Handmade soap makers who aim for bar soap use NaOH (sodium hydroxide, lye). Because saponification values are listed in KOH (potassium hydroxide) the value must be converted from potassium to sodium to make bar soap; potassium soaps make a paste, gel or liquid soap. To convert KOH values to NaOH values, divide the KOH values by the ratio of the molecular weights of KOH and NaOH (1.403). [7]

**Oleic acid** is a fatty acid that occurs naturally in various animal and vegetable fats and oils. It is an odorless, colourless oil, although commercial samples may be yellowish. In chemical terms, oleic acid is classified as a monounsaturated omega-9 fatty acid, abbreviated with a lipid number of 18:1 cis-9. It has the formula $CH_3(CH_2)_7CH{=}CH(CH_2)_7COOH$. The term "oleic" means related to, or derived from, oil of olive, the oil that is predominantly composed of oleic acid.

Oleic acid is a common monounsaturated fat in human diet. Monounsaturated fat consumption has been associated with decreased low-density lipoprotein (LDL) cholesterol, and possibly increased high-density lipoprotein (HDL) cholesterol. However, its ability to raise HDL is still debated. [9]

**Linoleic acid** (LA) is a polyunsaturated omega-6 fatty acid. It is a colorless liquid at room temperature. In physiological literature, it has a lipid number of 18:2 *cis,cis*-9,12. Chemically, linoleic acid is a carboxylic acid with an 18-carbon chain and two *cis* double bonds; with the first double bond located at the sixth carbon from the methyl end.

Linoleic acid belongs to one of the two families of essential fatty acids, which means that the human body cannot synthesize it from other food components.[12]

**Stearic acid** (*STAIR-ik* or *STEER-ik*) is a saturated fatty acid with an 18-carbon chain and has the IUPAC name octadecanoic acid. It is a waxy solid, and its chemical formula is $CH_3(CH_2)_{16}CO_2H$. Its name comes from the Greek word στέαρ *"stéar"*, which means tallow. The salts and esters of stearic acid are called stearates. Stearic acid is one of the most common saturated fatty acids found in nature following palmitic acid.

Stearic acid is mainly used in the production of detergents, soaps, and cosmetics such as shampoos and shaving cream products. Soaps are not made directly from stearic acid, but indirectly by saponification of triglycerides consisting of stearic acid esters. Esters of stearic acid with ethylene glycol, glycol stearate, and glycol distearate are used to produce a pearly effect in shampoos, soaps, and other cosmetic products. They are added to the product in molten form and allowed to crystallize under controlled conditions. Detergents are obtained from amides and quaternary alkylammonium derivatives of stearic acid.

In view of the soft texture of the sodium salt, which is the main component of soap, other salts are also useful for their lubricating properties. Lithium stearate is an important component of grease. The stearate salts of zinc, calcium, cadmium, and lead are used to soften PVC. Stearic acid is used along with castor oil for preparing softeners in textile sizing. They are heated and mixed with caustic potash or caustic soda. Related salts are also commonly used as release agents, e.g. in the production of automobile tires.[13]

**Palmitic acid**, or hexadecanoic acid in IUPAC nomenclature, is the most common fatty acid (saturated) found in animals, plants and microorganisms. Its chemical formula is $CH_3(CH_2)_{14}COOH$. As its name indicates, it is a major component of the oil from palm trees (palm oil, palm kernel, and palm kernel oil), but can also be found in meats, cheeses, butter, and dairy products. Palmitate is a term for the salts and esters of palmitic acid. The palmitate anion is the observed form of palmitic acid at physiologic pH (7.4).

Palmitic acid is mainly used to produce soaps, cosmetics, and release agents. These applications utilize sodium palmitate, which is commonly obtained by saponification of palm oil. To this end, palm oil, rendered from the coconut palm nut, is treated with sodium hydroxide (in the form of caustic soda or lye), which causes hydrolysis of the ester groups. This procedure affords glycerol and sodium palmitate.

Because it is inexpensive and adds texture to processed foods (convenience food), palmitic acid and its sodium salt find wide use including foodstuffs. Sodium palmitate is permitted as a natural additive in organic products.  Salt of Aluminum is a thickening agent of napalm used in military actions.

Hydrogenation of palmitic acid yields cetyl alcohol, which is used to produce detergents and cosmetics.

Recently, a long-acting antipsychotic medication, paliperidone palmitate (marketed as INVEGA Sustenna), used in the treatment of schizophrenia, has been synthesized using the oily palmitate ester as a long-acting release carrier medium when injected intramuscularly. The underlying method of drug delivery is similar to that used with decanoic acid to deliver long-acting depot medication, in particular, neuroleptics such as haloperidol decanoate.

According to the World Health Organization, evidence is "convincing" that consumption of palmitic acid increases risk of developing cardiovascular diseases, placing it in the same evidence category as trans fatty acids. Retinyl palmitate is an antioxidant and a source of vitamin A added to low fat milk to replace the vitamin content lost through the removal of milk fat. Palmitate is attached to the alcohol form of vitamin A, retinol, to make vitamin A stable in milk.

Rats fed a diet of 20% palmitic acid and 80% carbohydrate for extended periods showed alterations in central nervous system control of insulin secretion, and suppression of the body's natural appetite-suppressing signals from leptin and insulin (the key hormones involved in weight regulation).[14]

## 5. ECONOMIC ANALYSIS

Sunflower is an economically viable crop alternative for growers in the High Plains region, ranging from North Dakota to Kansas, and more recently in Texas. In the more geographically southern states (Kansas, Texas) sunflowers are being used in wheat-summer crop-fallow or even more intensive crop rotations. Sunflower is a viable “double crop” option following wheat in western Kansas where growing season permits. (Dumler and O’Brien, 2012)

Considering the climate in New Mexico, sunflower should certainly provide an economically viable crop for farmers. “The profitability of dryland sunflower production has been comparable in recent years to other no-till summer crops in High Plains cropping systems, including corn, grain sorghum, soybeans, and cane hay-type forages. (Dumler and O’Brien, 2012)

Tables 7-11 below provide examples of estimated budgets of oil-type and confectionary sunflower crop production. Crop production costs per unit and net returns are highly dependent on yields.[1] The budgets below used three different yield levels to represent different land production level. The methodology used in these examples can provide the small NM farmers an idea of what to consider when evaluating the potential economic benefits of growing sunflower in NM. In developing these budgets, the prices per hundred weight (cwt) used represent an expected harvest price in Goodland, KS. Also the existence of several major sunflower processing plants in the High Plains region provides area sunflower producers with local market outlets for the crop.[1]

New Mexico growers will have to evaluate the market value of the sunflower oil and other processing material such as the cake, and also the input costs for their farming practices, land, equipment, etc. to develop a meaningful budget. New Mexico has the opportunity to provide a “Specialty Industry” crop for local businesses such as restaurants and soap manufacturers.

Table 7a. Production inputs – oil-type

| | Yield Level (lbs/a) | | | |
|---|---|---|---|---|
| Item | 1,200 | 1,600 | 2,000 | |
| Seed, 1,000/a | 20 | 20 | 20 | $1.52/1,000 |
| Fertilizer: | | | | |
| N (anhydrous) | 0 | 0 | 0 | $0.39/lb |
| N | 37 | 50 | 62 | $0.55/lb |
| P | 12 | 16 | 19 | $0.52/lb |
| K | 0 | 0 | 0 | $0.45/lb |
| Lime | 0 | 0 | 0 | $0.015/lb |
| Herbicide | | | | |
| Burndown | 1 | 1 | 1 | $14.14/a |
| Preemergence | 1 | 1 | 1 | $45.74/a |
| Postemergence | 0.3 | 0.3 | 0.3 | $18.00/a |
| Insecticide / Fungicide | | | | |
| Insecticide | 1 | 1 | 1 | $5.85/a |

Table 7b. Production inputs – confectionary

| | Yield Level (lbs/a) | | | |
|---|---|---|---|---|
| Item | 1,050 | 1,350 | 1,650 | |
| Seed, 1,000/a | 16 | 16 | 16 | $1.87/1,000 |
| Fertilizer: | | | | |
| N (anhydrous) | 0 | 0 | 0 | $0.39/lb |
| N | 33 | 42 | 51 | $0.55/lb |
| P | 10 | 13 | 16 | $0.52/lb |
| K | 0 | 0 | 0 | $0.45/lb |
| Lime | 0 | 0 | 0 | $0.015/lb |
| Herbicide | | | | |
| Burndown | 1 | 1 | 1 | $14.14/a |
| Preemergence | 1 | 1 | 1 | $45.74/a |
| Postemergence | 0.3 | 0.3 | 0.3 | $18.00/a |
| Insecticide / Fungicide | | | | |
| Insecticide | 1.5 | 1.5 | 1.5 | $5.85/a |

Table 8. Machinery and land resources – oil-type sunflower

| Item | Yield Level (lbs/a) 1,200 | 1,600 | 2,000 | Custom Rate |
|---|---|---|---|---|
| Tillage/Planting/Chemical Applications: | | | | |
| Sweep | 0 | 0 | 0 | $8.05/a |
| Disk | 0 | 0 | 0 | $10.39/a |
| Field cultivate | 0 | 0 | 0 | $10.18/a |
| No-till plant | 1 | 1 | 1 | $17.28/a |
| Anhydrous application | 0 | 0 | 0 | $12.47/a |
| Fertilizer application | 1 | 1 | 1 | $6.25/a |
| Herbicide application | 2.3 | 2.3 | 2.3 | $5.87/a |
| Insecticide application (aerial) | 1 | 1 | 1 | $7.13/a |
| Harvest | | | | |
| Base charge | 1 | 1 | 1 | $28.27/a |
| Extra charge for yields exceeding | 15 | 15 | 15 | $0.0032/lb |
| Hauling | 1,200 | 1,600 | 2,000 | $0.0044/lb |
| Non-machinery labor | 1.00 | 1.00 | 1.00 | $15.00/hr |
| Land charge/rent | $57.00 | $75.00 | $94.50 | |
| Interest on capital | | | | 6.5% |

Table 9. Machinery and land resources – confectionary-type sunflower

| Item | Yield Level (lbs/a) 1,050 | 1,350 | 1,650 | Custom Rate |
|---|---|---|---|---|
| Tillage/Planting/Chemical Applications: | | | | |
| Sweep | 0 | 0 | 0 | $8.05/a |
| Disk | 0 | 0 | 0 | $10.39/a |
| Field cultivate | 0 | 0 | 0 | $10.18/a |
| No-till plant | 1 | 1 | 1 | $17.28/a |
| Anhydrous application | 0 | 0 | 0 | $12.47/a |
| Fertilizer application | 1 | 1 | 1 | $6.25/a |
| Herbicide application | 2.3 | 2.3 | 2.3 | $5.87/a |
| Insecticide application (aerial) | 1.5 | 1.5 | 1.5 | $7.13/a |
| Harvest | | | | |
| Base charge | 1 | 1 | 1 | $28.27/a |
| Extra charge for yields exceeding | 15 | 15 | 15 | $0.0032/lb |
| Hauling | 1,050 | 1,350 | 1,650 | $0.0044/lb |
| Non-machinery labor | 1.00 | 1.00 | 1.00 | $15.00/hr |
| Land charge/rent | $57.00 | $75.00 | $94.50 | |
| Interest on capital | | | | 6.5% |

**COST-RETURN PROJECTION — OIL-TYPE SUNFLOWERS (W-SF-F ROTATION) — WESTERN KANSAS**

| | Yield Level (lbs/a) | | | Your |
|---|---|---|---|---|
| | 1,200 | 1,600 | 2,000 | Farm |
| INCOME PER ACRE | | | | |
| A. Yield per acre | 1,200 | 1,600 | 2,000 | ______ |
| B. Price per cwt | $ 19.35 | $ 19.35 | $ 19.35 | ______ |
| C. Net government payment | $ ______ | $ ______ | $ ______ | ______ |
| D. Indemnity payments | $ ______ | $ ______ | $ ______ | ______ |
| E. Miscellaneous income | $ ______ | $ ______ | $ ______ | ______ |
| F. Returns/acre ((A × B) + C + D + E) | $ 232.20 | $ 309.60 | $ 387.00 | ______ |
| COSTS PER ACRE | | | | |
| 1. Seed | $ 30.40 | $ 30.40 | $ 30.40 | ______ |
| 2. Herbicide | 65.28 | 65.28 | 65.28 | ______ |
| 3. Insecticide / Fungicide | 5.85 | 5.85 | 5.85 | ______ |
| 4. Fertilizer and Lime | 26.59 | 35.82 | 43.98 | ______ |
| 5. Crop Consulting | ______ | ______ | ______ | ______ |
| 6. Crop Insurance* | 3.19 | 6.33 | 9.47 | ______ |
| 7. Drying | ______ | ______ | ______ | ______ |
| 8. Miscellaneous | 5.50 | 5.50 | 5.50 | ______ |
| 9. Custom Hire / Machinery Expense | 81.50 | 84.53 | 87.57 | ______ |
| 10. Non-machinery Labor | 15.00 | 15.00 | 15.00 | ______ |
| 11. Irrigation | ______ | ______ | ______ | ______ |
| a. Labor | ______ | ______ | ______ | ______ |
| b. Fuel and Oil | ______ | ______ | ______ | ______ |
| c. Repairs and Maintenance | ______ | ______ | ______ | ______ |
| d. Depreciation on Equipment and Well | ______ | ______ | ______ | ______ |
| e. Interest on Equipment | ______ | ______ | ______ | ______ |
| 12. Land Charge / Rent | 57.00 | 75.00 | 94.50 | ______ |
| G. SUB TOTAL | $ 290.32 | $ 323.73 | $ 357.56 | ______ |
| 13. Interest on ½ Nonland Costs | 7.58 | 8.08 | 8.55 | ______ |
| H. TOTAL COSTS | $ 297.90 | $ 331.81 | $ 366.11 | ______ |
| I. RETURNS OVER COSTS (F - H) | $ -65.70 | $ -22.21 | $ 20.89 | ______ |
| J. TOTAL COSTS/BUSHEL (H ÷ A) | $ 24.83 | $ 20.74 | $ 18.31 | ______ |
| K. RETURN TO ANNUAL COST (I + 13) ÷ G | -20.02% | -4.36% | 8.23% | ______ |

* *Reflects expected net premium paid.*

Table 10. Example of cost return projection input parameters for oil-type sunflower

## COST-RETURN PROJECTION — CONFECTIONARY SUNFLOWERS (W-SF-F ROTATION) — WESTERN KANSAS

| | Yield Level (lbs/a) | | | Your |
|---|---|---|---|---|
| | 1,050 | 1,350 | 1,650 | Farm |
| INCOME PER ACRE | | | | |
| A. Yield per acre | 1,050 | 1,350 | 1,650 | |
| B. Price per cwt | $ 33.25 | $ 33.25 | $ 33.25 | |
| C. Net government payment | $ | $ | $ | |
| D. Indemnity payments | $ | $ | $ | |
| E. Miscellaneous income | $ | $ | $ | |
| F. Returns/acre ((A × B) + C + D + E) | $ 349.13 | $ 448.88 | $ 548.63 | |
| COSTS PER ACRE | | | | |
| 1. Seed | $ 29.92 | $ 29.92 | $ 29.92 | |
| 2. Herbicide | 65.28 | 65.28 | 65.28 | |
| 3. Insecticide / Fungicide | 8.78 | 8.78 | 8.78 | |
| 4. Fertilizer and Lime | 23.35 | 29.86 | 36.37 | |
| 5. Crop Consulting | | | | |
| 6. Crop Insurance* | 9.04 | 13.30 | 17.55 | |
| 7. Drying | | | | |
| 8. Miscellaneous | 5.50 | 5.50 | 5.50 | |
| 9. Custom Hire / Machinery Expense | 83.92 | 86.20 | 88.48 | |
| 10. Non-machinery Labor | 15.00 | 15.00 | 15.00 | |
| 11. Irrigation | | | | |
| a. Labor | | | | |
| b. Fuel and Oil | | | | |
| c. Repairs and Maintenance | | | | |
| d. Depreciation on Equipment and Well | | | | |
| e. Interest on Equipment | | | | |
| 12. Land Charge / Rent | 57.00 | 75.00 | 94.50 | |
| G. SUB TOTAL | $ 297.80 | $ 328.84 | $ 361.39 | |
| 13. Interest on ½ Nonland Costs | 7.83 | 8.25 | 8.67 | |
| H. TOTAL COSTS | $ 305.63 | $ 337.09 | $ 370.06 | |
| I. RETURNS OVER COSTS (F - H) | $ 43.50 | $ 111.78 | $ 178.56 | |
| J. TOTAL COSTS/CWT ((H ÷ A) × 100) | $ 29.11 | $ 24.97 | $ 22.43 | |
| K. RETURN TO ANNUAL COST (I + 13) ÷ G | 17.23% | 36.50% | 51.81% | |

** Reflects expected net premium paid.*

Table 11. Example of cost return projection input parameters for confectionary-type sunflower

## 6. LESSONS LEARNED/RECOMMENDATIONS

In general, the literature describing sunflower crop growth and harvesting is appropriate for any New Mexico farmer considering growing sunflowers. However, during this project a few lessons learned should be noted. The following is a list of observations collected by the growers this past year:

- Dryland (non-irrigated) sunflower crops that do not receive water from rain or other will likely not survive the early growth stages.
- Grasshoppers can be devastating to crops, especially young crops.
- Wildlife, such as deer and elk, prefer sunflower plants over traditional livestock feed crops such as alfalfa. One of the farmers planted the sunflower crops surrounded by alfalfa and the wildlife still sought out the sunflower. This could be investigated further to identify why wildlife choose the sunflowers – protein content, or other?
- The number of seeds planted per acre (unit area) needs to be optimal. Planting seeds too close together does not benefit the crop. Instead some farmers had success with planting other shallow root cover crops in between the sunflowers.
- Harvesting time is critical. Harvest too early and seeds are undeveloped and have too much water to process, harvest too late and the seeds are difficult to process. There are rules of thumb available in the literature.

## 7. CONCLUSIONS

Sunflowers grow well in New Mexico with limited water. Only one farmer (Sunsmiths) was able to collect all sunflower heads grown, providing insight into potential yield (lbs./acre). The yield at Sunsmiths was 863 lbs./acre for the Vermont and 610 lbs./acre for the Daytona. This is about 50-60% of the yield expected at large scale farms. The lower yield is likely due to lower seed planting/acre.

Two seed varieties were planted and evaluated – Daytona and Vermont. Both seeds had respectable yields within the expected range; however, the Daytona seeds produced significantly more high-oleic oil content (80-84%). The Daytona seeds could provide a relative short stature, drought tolerant, high oleic oil yield option for a New Mexico farmer considering sunflower as a "Specialty Industry" crop.

8. REFERENCES


1. Dumler, Troy J., O'Brien, Daniel M., "Sunflower Cost-Return Budget in Western Kansas", Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Farm Management
2. Lubbock Avalanche-Journal, lubbockonline.com. "Keep on the Sunny Side: Lubbock area farmers turn to sunflowers to save water, money. Published Sunday, September 07, 2008.
3. WWDL Central Plains Irrigation short course and exposition proceedings, Proceedings of the 2003 Central Plains Irrigation short course and exposition, 2003 CPIA proceedings. Stockton, Roger, O'Brien, Dan, Belshe, Dana. Kansas State University Northwest Research and Extension Center, Colby, KS. "Living With Limited Water Sunflowers and Cotton As Alternative Crops".
4. Holkup, Mark. Sunflower Magazine, "Profit Potential for Sunflower Very Promising". January 2008.
5. "Sunflower Sustainability: The substance behind the seed." National Sunflower Association. www.sunflowernsa.com.
6. Lilleboe, Don. 2008. "Saline Soils Assist." The Sunflower, 35(2): 24-25.
7. http://en.wikipedia.org/wiki/Saponification_value
8. http://www.britannica.com/EBchecked/topic/292677/iodine-value
9. "You Can Control Your Cholesterol: A Guide to Low-Cholesterol Living". Merck & Co. Inc. Retrieved 2009-03-14.
10. Green, Catherine, "Support for the Organic Sector Expands in the 2014 Farm Act". http://www.ers.usda.gov/amber-waves/2014-july/support-for-the-organic-sector-expands-in-the-2014-farm-act.aspx#.VIiFGKNBeYJ
11. http://www.usda.gov/oce/weather/pubs/Other/MWCACP/Graphs/USA/sunflowerseed.pdf
12. http://en.wikipedia.org/wiki/Linoleic_acid
13. http://en.wikipedia.org/wiki/Stearic_acid
14. http://en.wikipedia.org/wiki/Palmitic_acid

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