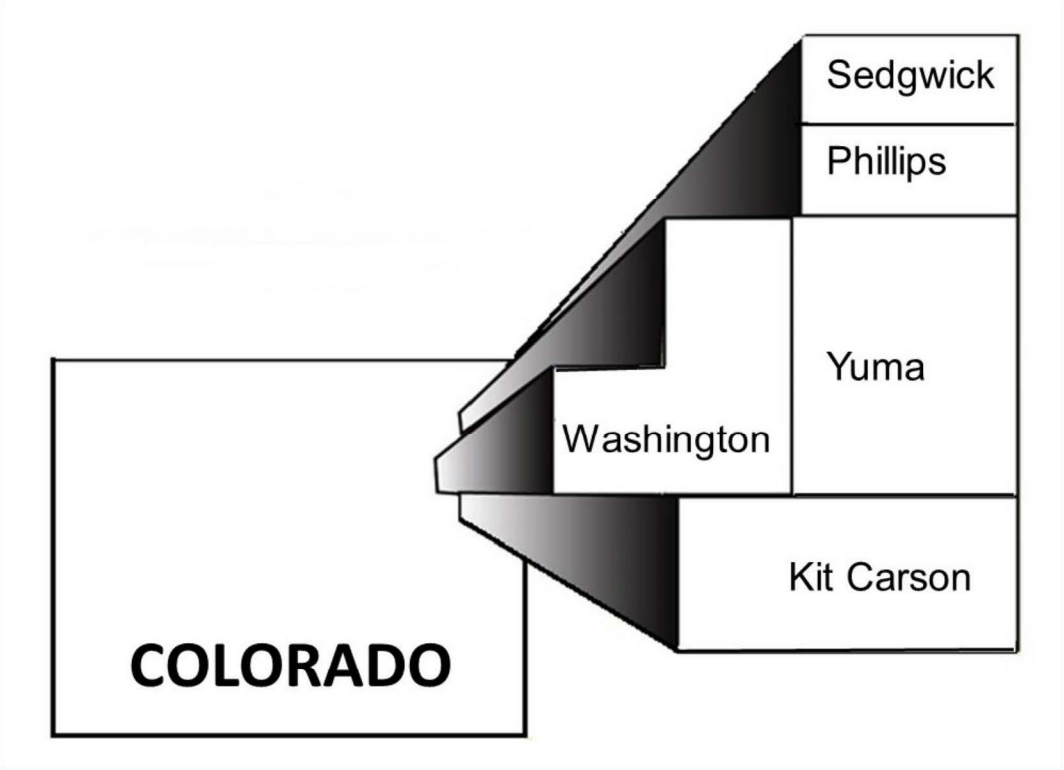
Golden Plains Area

Agricultural Handbook



2019 | Volume XVI

GOLDEN PLAINS AREA
COLORADO STATE UNIVERSITY
EXTENSION

Colorado State University Extension

GOLDEN PLAINS AREA

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Golden Plains Area

AGRICULTURAL HANDBOOK

2019 | Volume XVI

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COLORADO STATE UNIVERSITY EXTENSION

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PLANT SELECT ® PROGRAM IN THE GOLDEN PLAINS AREA

Linda Langelo, Horticultural Agent, Colorado State University Extension,

Colorado Master Gardeners Jessica Rodriquez and Ellen Figueroa

Golden Plain Area Master Gardener[SM] Volunteer Demonstration Gardens

Golden Plains Area Master Gardener[SM] volunteers are fostering successful gardening by providing research-based information to area residents through Plant Select® demonstration gardens. Gardens are located at the Washington County Events Center in Akron and Phillips County Event Center. Other Plant Select® gardens are located in Julesburg at the Town Hall Office and Thompson Park.

Plant Select®

Plant Select® is a cooperative program administered by Denver Botanic Gardens and Colorado State University in collaboration with horticulturists and nurseries throughout the Rocky Mountain region and beyond. The purpose of Plant Select® is to locate, identify and distribute the very best plants for landscapes and gardens from the intermountain region to the high plains.

Several plants are chosen each year that thrive in the sunny, variable conditions of Rocky Mountain gardens. These can be plants that have grown here for years and have not yet attained the popularity they deserve, known as recommended plants. Introductions represent taxa that are discovered by our cooperators. Superior forms or hybrids carefully tested over time are known as originals. Plant Select® is at the vanguard of a bold, new plant palette that is revolutionizing the way we garden. Here are plants that thrive in both our variable winters and our hot summers. These plants are helping to forge a truly American style of horticulture.

To determine which of the recommended plants do the best in Eastern Colorado, Master Gardener Volunteers in the Golden Plains Area record success and failures in area demonstration gardens. Volunteers replant the plant varieties that do not survive. After three successful years a plant variety will be recommended for planting in the Golden Plains Area. The plants listed in the following lists have successfully endured a three-year period or more.

There is also a listing of vegetable varieties that have been tried in our area community gardens. This list has been narrowed to the best selections which have performed well in the Golden Plains.

In addition, there is information on the continued results of the Earth-Kind® Rose Demonstration Garden, tree recommendations for the eastern plains based on site visit observations along with added suggestions based on Dr. Jim Klett's CSU nursery trial work, CSU Annual 2018 and Perennial Trials of 2018. The Perennial Trials is a two year trial. The new 2020 trial plantings will be underway over the next 2 year.

Washington County Plant Select Garden

Colorado Master Gardener volunteers Jessica Rodriguez, Ellen Figueroa, and Rita Campbell planted at the Washington County Events Center in Akron, Colorado in June of 2004. Pea gravel is used for mulch on this garden.

*Turkish Veronica	Veronica liwanensis
Sunset Hyssop	Agastache rupestris
Colorado Gold™ Gazania	Gazania linearis
*Red Rocks™ Penstemon &	
Pikes Peak Purple™ Penstemon	Penstemon x mexicali & Penstemon x mexicali
Coral Canyon Twinspur	Diascia integerrima
*Prairie Jewel™ Penstemon	Penstemon grandiflorus
Sonoran Sunset Hyssop	Agastache cana 'Sinning'
Snow Angel Coral Bells	Heuchera sanguine 'Snow Angel'
Hopflower Oregano	Origanum libanoticum
Mojave Sage	Salvia pachyphylla
Snow Angel Coral Bells	Heuchera sanguine 'Snow Angel'
La Veta Lace® Geranium	Geranium magniflorum
Corsican Violet	Viola Corsica
Ferman's Red Sage	Salvia greggii
Wild Thing Sage	Salvia greggii
Mesa Verde® Ice Plant	Delasperma 'Kelaidis'
Table Mountain® Ice Plant	Delasperma 'John Proffitt'
Winecups	Callirhoe involucrata

All performed well except the Snow Angel Coral Bells and Coriscan Violets. These plants prefer dry shade. They were chosen by a Colorado Master Gardener to see how they would perform with some shading of nearby plants. The Winecups have been growing steadily in this garden as the Hopflower Oregano. These plants continually are weeded out. The Penstemons reseed themselves and also need to be weeded.

In addition to the Washington County Event Center Garden, there is a new garden on the southwest corner with a windmill as a central feature. There are a handful of plants being trialed in this garden. The location is open to high winds. The is a Tatarian Maple tree along with the Prairie Jewel Penstemon plants did well in the drought summer of 2012. Irises have been added along the outer edge of the garden to block some of the wind and suppress of the weeds. In 2014 the Tatarian Maple was knocked by equipment. It seems to still be growing. In 2015, we had a tremendous number of weeds because of the heavy spring rains and early summer rains. Additional gravel is planned to help suppress the weeds. In 2016 and 2017, this garden was well established and has a good mix of durable plants for our area.

Phillips County Event Center Plant Select Garden

Holyoke, Colorado started a Plant Select® Garden in 2010. The following is a list of plants found in the garden:

Acer tartarium 'GarAnn'	Hot Wings® Tatarian Maple
Agastache cana 'Sinning'	Sunset® Hyssop
Amsonia jonesii	Colorado Desert Bluestar
Arctostaphylos x coloradoensis	Panchito Manzanita
Buddleia Lo & Behold	Blue Chip
Calamagrostis brachytricha	Korean Feather Reed Grass
Callirhoe involucrate	Winecups
Ceratostigma plumbaginoides	Leadwort
Epilobium fleischeri	Alpine Willowherb
Erigonium umbellatum var. aureum 'Psdowns'	Kannah Creek® Buckwheat
Hesperaloe parviflora	Red Yucca
Marrubium rotundifolium	Silver Horehound
Nepeta 'Psfike'	Little Trudy® Catnip
Penstemon x Mexicali 'Psmyers'	Red Rocks Penstemon
Philadelphus lewisii	Cheyenne® Mock Orange
Origano vulgare	Oregano
Salvia daghestanica	Platinum® Sage
Veronica liwanensis	Turkish Veronica
Zauschneria garrettii	Orange Carpet® Hummingbird Trumpet

New Additions 2016/2017

Heterotheca jonesii	Creeping Golden Aster
Penstemon virens	Blue Mist Beard Tongue
Salvia sylvestris cv. 'Blue Hill'	Blue Hill Sage
Salvia Raspberry Delight	Raspberry Delight Bush Sage
Salvia nemorosa 'Lyrical Rose'	Lyrical Rose Sage

The best performers in this garden for drought tolerance have been Silver Horehound, Red Yucca, Platinum® Sage and Colorado Desert Bluestar. The grasses listed as Korean Feather Reed Grass have needed some supplemental water through 2011 and 2012. As a shrub Cheyenne Mock Orange is not only hardy but has wonderful blossoms in spring. However, it did suffer without supplemental watering in this garden during 2012. There are two of these shrubs and one is in partial sun and the other in full-sun. Both did suffer from drought stress late in summer. The Buckwheat species, as in all the other gardens did extremely well in the drought along with a low ground cover shrub Panchito Manzanita. The Orange Carpet® Hummingbird Trumpet groundcover suffered through the drought. It produced substantially less flowers. The Alpine Willowherb also did not flower as well along with Little Trudy® Catnip. In 2014 during the November cold snap several plants suffered during the following spring and summer. Alpine Willowherb, Orange Carpet® Hummingbird Trumpet, Avalanche White Sun Daisy and some of the Platium® Sage all had severe dieback or did not generate new growth in spring. During the wet spring and early summer of 2015, the Cheyenne®

Mock Orange and Silver Horehound have had severe dieback. However, the Turkish Veronica has expanded. Oregano was placed in the garden in 2012 and is seeding itself to help fill in areas. During 2015, some of the oregano and winecup needed to be thinned. The leadwort, one of the plants not labeled Plant Select is seeding itself in other areas of the garden as are the Sunset® Hyssop and Silver Horehound.

In 2017, all the plants thrived due to good moisture from the previous season. The Willowherb and Avalanche White Sun Daisy have not overwintered. The Colorado Desert Bluestar and Penstemon Blue Mist, Red Yucca have seeded throughout the garden. All the Salvia species have endured the extreme drought. There are no new additional plants added in 2018. or 2019

High and Dry Demonstration Gardens in Washington County

The High and Dry Demonstration Garden at Washington County was planted in response to the continuing drought in Northeast Colorado. The garden was initiated by the previous Extension Horticulturist, Joanne Jones. Rita Campbell, a Colorado Master Gardener and Joanne Jones planted this demonstration garden. These are plants which are both xeric and native. This garden explores the possibility of becoming established and surviving with only natural rainfall. The results from this garden will serve as an ongoing study about which plant species thrive on little, or no supplemental water.

The initial preparation of the garden was to measure a 400 square foot area and design the layout. Other than some grass cuttings for mulching around the roots, there were no other amendments added to the soil. The garden soil is a sandy loam. This garden is on a slight slope at the curve of the walking path around the fairgrounds.

Prior to planting of the High and Dry Garden, the plants were housed in a greenhouse. The plants were planted Saturday, June 10th, 2006 and watered well the same day. After this initial watering, there was no rainfall. Approximately three weeks after their planting they were given some supplemental water. The soil was not amended with any organic matter to help with water retention and no mulch was initially provided around the root zone. The plants were attempting to adapt to their new environment.

Most of the plants were not responding well to the drought even as xeric plants. It appeared that we would have only had a third of the plants we started with. Jian-Kang Zhu from the University of Arizona states in his research of drought tolerance in plants that xerophytes have a thicker cuticle layer in the epidermis as a coping mechanism for drought. He adds that the water status of a plant is a function of water uptake by roots and loss via stomata and cuticle. No matter how well plants manage to absorb and conserve water, prolonged drought will damage cells sooner or later. Water deficit leads to the accumulation of toxic oxygen free radicals in plant cells. The toxic radicals have to be removed, for survival and continued growth. Stress proteins are made by metabolites such as trehalose, mannitol, praline, or glycine betaine.

However, Wraith, Baker and Blake in their research from Montana State University studied the varying ability of water uptake after drought in barley genotypes. The periods of water deficit in this study were 10 to 14 days, less than our period of drought in this demonstration garden. When the barley was watered at the soil surface it took the roots two to three days to resume water uptake. And after subsequent rewetting periods, the roots resumed a quicker period of water uptake. To solve the lack of moisture at the soil surface level, grass cuttings were acquired and used as mulch for the plants. Some plants are significantly damaged by the lack of supplemental water. With the current amount of snow during this winter season, this will help both insulate and provide needed moisture for these xeric and native plants.

Without the second supplement and other subsequent supplements, very little seems as though it would have remained in the High and Dry garden, only demonstrating that because of a severe drought their root systems were not able to maintain the proteins to uptake water.

Among the hardiest of plants were buffalo grass, blue grama, western and Utah serviceberry, slender wheatgrass, aspen fleabane, James' buckwheat, sulphur-flower buckwheat, Rocky Mountain Fescue and Iris species.

The various species of penstemon which did the best were Firecracker, Rydberg's and Bluemist. The other species had varying degrees of success. Those penstemon are listed in order as best survival to least from Grand Mesa penstemon, littleflower, sidebells's, whipple's and upright blue beardtongue as the worst.

The complete list of plants chosen in this High and Dry Garden are listed as follows:

Indian ricegrass *Achnatherum/Oryzopsis hymenoides*
Netleaf Horsemint *Agastache urticifolia*
Nodding Onion *Allium cernuum*
Western Serviceberry *Amelanchier alnifolia*
Utah Serviceberry *Amelanchier utahensis*
Big Bluestem *Andropogon gerardii*
Small-leaf pussytoes *Antennaria parvifolia*
Golden columbine *Aquilegia chrysantha*
Fringed Sage *Artemisia frigida*
Blue Grama *Bouteloua gracilis*
Buffalograss *Buchloe dactyloides*
Bluejoint reedgrass *Calamagrostis Canadensis*
Bluebell bellflower *Campanula rotundifolia*
Curl-leaf Mountain Mahogany *Cercocarpus ledifolius*
Tufted Hairgrass *Deschampsia caespitosa*
Slender Wheatgrass *Elymus trachycaulus*
Aspen Fleabane *Erigeron speciosus*
James' Buckwheat *Erigonum jamesii*
Sulphur-flower Buckwheat *Erigonum umbellatum*
Rocky Mountain Fescue *Festuca saximontana*
Woodland Strawberry *Fragaria vesca*
Common Gaillardia *Gaillardia aristata*
Sticky purple Geranium *Geranium viscosissimum*
Scarlet Gilia *Ipomopsis aggregate*
Fivepetal Cliffbush *Jamesia Americana*
Dotted Blazing Star *Liatris punctata*
Oregon-grape *Mahonia repens*
Colorado Four O'clock *Mirabilis multiflora*
Prairie Jewel® Penstemon *Penstemon grandiflorus*
Firecracker Penstemon *Penstemon eatonii*
Grand Mesa Penstemon *Penstemon mensarum*
Pineneedle Beardtongue *Penstemon pinifolius*
Littleflower Penstemon *Penstemon procerus*
Rydberg's Penstemon *Penstemon rydbergii*
Sidebells's Penstemon *Penstemon secundiflorus*
Upright Blue Penstemon *Penstemon virgatus*
Whipple's Penstemon *Penstemon whippleanus*
Shrubby Cinquefoil *Potentilla floribunda*
Squaw apple *Peraphyllum ramosissimum*
Pawnee Buttes® Sand Cherry *Prunus besseyi*
Golden Currant *Ribes aureum*
Wax Currant *Ribes cereum*
Western Coneflower *Rudbeckia occidentalis*
Little Bluestem *Andropogon scoparium*
Canada Goldenrod *Solidago Canadensis*
Scarlet Globemallow *Sphaeralcea coccinea*
Swamp Verbena *Verbena hastate*

The High and and Dry Garden was renovated because of all the noxious and aggressive weeds taking over. A lot of the original plants were no longer surviving well. This list was put together based on several years of observation from other gardens in the Golden Plains Area. These plants demonstrated drought and environmental weather conditions on the plains better than most other plants. These were planted in April of 2019 and had their first summer with supplemental watering to get the root systems developed. We will see what over winters and continues establishing in 2020 with no continued watering. The reasons for initial watering are mentioned in the previous material on the High and Dry Garden. We also placed a free library at the garden to house brochures on the garden and other literature for the public. The renovation was made possible by Colorado Garden Show, Inc.

The complete list of plant renovations in this High and Dry Garden are listed as follows:

Apache Plume *Fallugia paradoxa*
Slender Wheatgrass Elymus trachycaulus
Buffalograss *Buchloe dactyloides*
Common Gaillardia *Gaillardia aristate*
Wild Four O'Clock *Marabilis multiflora*
Oregon-grape *Mahonia repens*
Squaw apple *Peraphyllum ramosissimum*
Curl-leaf Mountain Mahogany *Carcocarpus ledifolius*
Nodding Onion *Allium cernuum*
Golden Columbine *Aquilegia chrysantha*
Nettleleaf Giant Horsemint *Agastahe urticifolia*
Utah Service Berry *Amelanchier utahensis*
Chocolate Flower *Berlandiera lyrate*
Provence Broom *Cytisus purgans*
Snow Mesa Buckwheat *Eriogonum wrightii var. wrightii*
Bearded Iris *Iris germanica*
Silver Edged Horehound *Marrubium rotundifolium*
Dark Knight Blue Mist Spirea *Caryopteris clandonensis Dark Knight*
Fembush *Chamaebatiaria millifolium*
Sonoran Sunset Hyssop *Agastache cana "Sinning"*
Russian Sage *Perovskia atriplicifolia*
Utah Service Berry *Amelanchier utahensis*
Rocky Mountain Blue Penstemon *Penstemon Strictus*
Upright Blue Penstemon *Penstemon virgatus*

Vegetable Varieties Recommended for the Plains

Varieties which are bolded have produced well no matter what the season's extremes.

Tomato - ..... **Better Boy, Early Girl**, Tomato Primo Red
Tomato – Heirlooms - ..... Cherokee Purple, Mortgage Lifter, **Giant Beefsteak,** Brandywine
Swiss chard - ..... **Bright Lights**, Fordhook Giant, **Magenta Sunset, Neon**
Squash winter - ..... **Spaghetti**, **Acorn -Honey Bear**, **Sugar Hubbard**, Red Kuri,
..... Butternut Hunter, Royal Ace PM
Squash – Heirloom - ..... **Waltham Butternut**
Squash summer - ..... Black Beauty, Emerald Delight, Delta, Patty Pan
Spinach - ..... **Malabar- a vining spinach**, New Zealand, Hellcat
Radish - ..... Easter Egg
Potato - ..... Yukon Gold
Pepper – Hot - ..... Anaheim, **Highlander—Anaheim,** Big Chile, Jalapeno
Pepper – Sweet - ..... Red Bell, Green Bell, Mini Red Bell, **Lunch Box**
Peas - ..... **SugarSnap**
Lettuce- Leaf - ..... Baby Star, New Red Fire, **Merlot, Cimmaron**
Lettuce- Small Heads - ..... **Little Gem, Devil's Tongue** –loose head/red leaves
Lettuce- Romaine - ..... **Defender**
Kohlrabi - ..... **Express Forcer Hybrid**
Onions - ..... Yellow –Walla Walla Sweet and white variety – Snow White
Garlic - ..... **Chesnok Red**
Eggplant - ..... **White-Casper; Black-Big Dragon, Black King, Black Beauty**
Cucumber - ..... **Burpless Varieties, General Lee, Armenian, Raider F1 – g**reat slicing cucumber
Corn – Sweet - ..... Yellow Corn-Golden Bantam, Honey & Cream
Carrots - ..... Danvers Half Long
Cabbage - ..... **Chinese Varieties**
Broccoli - ..... Pacman
Brussel Sprouts - ..... Jade Cross
Beets-..... **Kestrel, Detroit Dark Red, Bulls Blood, Chioggia**
Beans- Pole – Heirloom – ..... **Kentucky Blue,** Bush variety -**Best producer is Provider**

Earth-Kind® Roses Demonstration Garden

By Linda Langelo, Horticulture Program Associate

Texas AgriLife Extension Service designates select rose cultivars as Earth-Kind® Roses through the Earth-Kind® Landscape Program. Any rose cultivar that gains this designated title has been through eight years of research and field trial data. A seven-member team of doctorate individuals including horticulturists, plant pathologists, soil scientist and an entomologist select the roses. No pesticides, chemical fertilizer or organic materials are ever applied to the roses during the trial and research period of eight years. The idea is to have landscape roses which are low-maintenance, remain beautiful throughout the season and the homeowner

can be environmentally-responsible in caring for the landscape. This is similar to the idea of growing natives in your landscape. The idea being the reduction of the homeowners' input of resources. By making this one change, homeowners can conserve water, fertilizer and reduce their impact on the environment.

In Sedgwick County at the courthouse, we tested some of the Earth-Kind®Roses since 2013. We are testing four polyantha roses listed as follows:

- Cecile Brunner
- La Marne
- Marie Daly
- Sea Foam

The requirements for growing Earth-Kind Roses successfully are placing them in a full day of direct sun or at least eight hours. They must have good air movement around the leaves to prevent foliar diseases. Good drainage is also recommended. They do well in a variety of soil types including poorly aerated, highly alkaline clay soils. To help your roses in any soil type, add three inches of plant-derived compost. Watering from the soil level with drip irrigation keeps water off the leaves and conserves water by lessening the amount lost to evaporation. Also watering from the ground level keeps the leaves clean of "salty" water and here in Sedgwick County we add salt to improve the water quality, but we would add to burning the foliage of the roses if overhead watering were done. Lastly, mulching roses is also recommended which keeps the weeds down, conserves more water, can add nitrogen as it breaks down and mitigates the drastic temperature fluctuations in the soil. Mulch acts as an insulator like a blanket on the soil. Mulch should only be placed around the roses at a depth of 3- inches. Placing the mulch too deep can become a barrier to needed oxygen in the soil.

The Earth-Kind Rose bed which we have at the southwest side of the building follows most of the recommended requirements for their success. They get plenty of air movement, but they do get only about 6 hours of direct sun and about an hour of indirect sun. They also received plenty of compost before planting. There were signs of thrips after they were initially planted. We suspect thrips came in on these plants. Other than the initial insect problem there was some dieback after the first winter. We did purchase roses from what we thought was a reputable grower. Be sure to purchase healthy roses. We ordered on-line, so we had to totally rely on the grower to pick healthy product. We pruned out the dead stems and they bloomed well through the first season. They have received regular watering from the ground level.

In the second growing season, we went into the winter after a brutal cold snap in November 2014. The daytime temperature started at 75 degrees and ended up at minus 7 in a matter of a few hours. This kind of a drop is too sudden for plants to acclimate to the change. The roses looked like they were frozen in place. We had a significant amount of dieback going into the spring and the new growth was slow to appear. Of the Earth-Kind Roses that we did tested, Cecil Brunner and La Marne were the hardest hit with significant dieback. It mid to late June before new growth appeared. This was partly due to a wet and cold spring which continued into late May. Overall, other than the initial thrips, these roses have had no other disease or pest issues.

In both 2015 and 2016, the roses were slow to start growing due to the colder springs. They ended in the fall blooming until a hard frost and had no disease or insect issues.

In 2017, the roses came out all well except Cecile Brunner. Cecile Brunner was slow to start. Eventually, all were very prolific during this season. There were no disease or insect issues this year. In 2018 we had the same results overall. In 2019, we are looking to replace Cecile Brunner and try another Earth Kind Rose. We kept Cecil Brunner in 2019, the season was a better season, but it yielded the same result of disease issues. We have concluded that this rose really needs more fertilization and care. Yet, it is still classified as an Earth Kind Rose.

Roses are a high maintenance plant. They need to be deadheaded. Their blossoms need to be cleaned out of the bed every day to prevent fungal diseases such as black spot. They are heavy feeders. They prefer ground level irrigation. To have a rose type that can do well with less input, helps to conserve water and reduce pesticides in our soil.

I would recommend giving them a try. There are other types of roses other than polyantha shrubs which are dwarf and medium. There are small shrubs and climbers within the list of choices. Plenty of different types to add to your landscape.

Recommended Trees for the Golden Plains Area

This is a listing of some underused trees that would do well here based on trials in the Colorado State University Arboretum by Jim Klett Ph.D., CSU Ornamental Specialist, published in **Dependable Landscape Trees**. Added to this list are my tree suggestions are added to this list based on area wide county site visit observations.

Acer nigrum 'Greencolumn' Greencolumn Black Maple, Maple Family, Aceraceae

No pest or disease problems; good heat tolerance. 40 high x 35 wide

Amelanchier x grandiflora 'Autumn Brillance' Autumn Brilliance Serviceberry, Rose Family, Rosaceae

Some tendency toward suckering, but overall outstanding specimens with a fall color mix of orange, red and purple, lasting two weeks. No disease and pest problems observed in the arboretum trees. 25 high x 30 wide

Catalpa speciosa Northern Catalpa, Bignoniaceae Family

Tolerates hot weather, drought tolerant and grows in a wide range of soils including alkaline. Early summer flowers, white with purple markings. Fast-growing tree which can attract powdery mildew, leaf spot and verticillium wilt. 40 to 60 high x 20 to 40 wide.

Gleditsia triacanthos inermis 'Shademaster' Shademaster Thornless Honeylocust

Minor insect problems; a 1979 specimen has stayed in good health in the CSU arboretum. 45 high x 40 wide, Pea Family, Fabaceae Family

Heptacodium miconioides Seven-son flower Plant Select Introduction

Can be a small shrub or tall tree to 25 feet. Fast-growing and very adaptable to many soils. Flowers are white with moderate to dry water requirements. Has exfoliating bark. Member of the Honeysuckle Family. 25 high x 15 wide. Caprioliaceae Family, Honeysuckle Family

Malus sargentii 'Select A' Firebird Flowering Crabapple (white flowering)

Highly resistant to mildew, apple scab, fireblight and cedar apple rust. 8 high x 7 wide, Rose Family, Rosaceae

Malus 'Thunderbird' Thunderbird Flowering Crabapple (pink flowering)

Resistant to fireblight. No pest problems have been observed. 16 high x 10 wide, Rose Family, Rosaceae

Ostrya virginiana American Hophornbeam, Ironwood

Gray-brown bark attractive; some minor leaf spot in recent years.

40 high x 30 wide, Betulaceae Family, Birch Family

Phellodendron amurense Amur Corktree,

No disease or insect problems; no cultural problems such as chlorosis and dieback. 45 high x 45 wide, Cork Tree Family, Rutaceae

Prunus x 'Accolade' Accolade Flowering Cherry, Rose Family, Rosaceae

This tree is fruitless. When these trees suffer from stress they attract borers and gummosis. One out of three samples in the arboretum have suffered from stress. The others are in good health. 50 high x 25 wide

Quercus macrocarpa Bur Oak, Beech Family, Fagaceae

Adapts to different soil types, urban conditions and dry conditions. Difficult to transplant, but once established will be a long-lived, slow-growing tree with no pest or disease problems except slight injury from galls. 55 high x 45 wide.

Quercus muchlenbergii Chinkapin Oak, Yellow Chestnut Oak, Beech Family

Adaptable to alkaline soils, no chlorosis or dieback, no problems with pests or disease. Recently planted in **Plant Select®** mulit site trials throughout Colorado and has done well. 50 high x 60 wide

Syringa reticulate 'Summer Snow' Summer Snow Japanese Tree Lilac

No disease or insect problems. Yellow fall color. 18 high x 14 wide, Oleaceae, Olive Family

Syringa pekinensis 'Peking Tree Lilac'

Light creamy white flowers with a light fragrance appear in early summer. Winter hardy plants and have adapted well to alkaline soil. 25 high x 20

wide, Oleaceae, Olive Family

Tilia cordata 'June Bride' June Bride Littleleaf Linden

The best Tilia cultivar. Minor pest problems such as aphids and sooty mold. 30 high x 25 wide. Malvaceae Family

Tilia americana 'Redmond' Redmond American Linden

Overwintering feature of red buds and twigs; attracts aphids and sooty mold follows – inconsistent with each season. 50 high x 40 wide. Malvaceae Family

Tilia cordata 'Chancole' Chancellor Littleleaf Linden

Pyramidal growth habit that is very attractive and uniform, no dieback or chlorosis and minor problems with leaf spot and aphids. Malvaceae Family

Ulmus parvifolia, Chinese or Lacebark Elm

Resistant to Dutch elm disease. This has been proven to be a pest-free tree. 40 high x 50 wide. It has exfoliating bark. Ulmaceae Family

Ulmus x 'Mortan Stalwart' Commendation Elm

A mix of many elm species; resistant to Dutch elm disease with some leaf minor and leaf tatter. 25 high x 25 wide. Ulmaceae Family

Ulmus x Frontier Frontier Elm

Resistant to Dutch elm disease. Prefers moist, rich soils but adaptable to poor soils; full sun; very tolerant of urban conditions and drought tolerant. Fall color is red-purple-burgundy and summer leaves are glossy, dark green. 35 high x 25 wide. Ulmaceae Family

Ulmus x 'Triumph' Triumph™ Elm

Excellent disease and pest resistance to Dutch elm disease, Elm Yellows and Elm Leaf Beetle; arching branches with aggressive roots to be planted away from sidewalks; adapt easily to extremes in pH, moisture, wind and heat. 50 high x 40 wide – elliptical form. Ulmaceae Family

Xanthoceras sorbifolium Yellowhorn (white flowers with red & yellow centers)

This does have pea-sized edible seeds. Looks good all summer. No pest problems; likes colder climates. Soapberry Family, Sapindaceae Family

Plant select: Clear Creek® Golden Yellowhorn

Spring white flowers with yellow centers turning maroon and leathery seedpods through winter; can be small tree or large shrub to 22 feet; moderate to xeric water requirements.

One final note when selecting trees for your landscape based on Morton Arboretum and the Arbor Day foundation:

The more closely related tree species are, the more likely they are to be vulnerable to the same pests and damage. Keep the following 30/20/10 rule in mind when making tree selections. In your community, plant trees with no more than 30 percent of species within the same family, no more than 20 percent should be from the same genus, and no more than 10 percent should be the same species.

Collaboration with NRCS in Kit Carson County and Extension

Native Plant Garden within Community Garden in Burlington

The NRCS is committed to a three-year project which has started as of spring 2016. Their goal was to sample the new Flow-Hives from Australia. These hives are non-invasive because you can see through them and know when the honey is going to be available. There is a spigot attached to the hives so that you can turn the Flow Key™ when the honey is ready. This is meant to be no lifting, no mess, no expense honey extraction. To attract bees to the hives, the NRCS designed and implemented a native plant garden. To do this properly, they needed to supplement a spring, summer and fall food supply to the bees. Something must always be in bloom. The list below is what was planted:

Species	Scientific Name	Bloom Time
Alfalfa	*Medicago sativa*	Early Mid Late
Small burnet	*Sanguisorba minor*	Early Mid
Western Yarrow	*Achilea lanulosa*	Early Mid
Maxmilian sunflower	*Helianthus maximilianii*	Late
Purple coneflower	*Echinacea angustifolia*	Mid Late
Blue Flax	*Linum lewisii*	Early Mid
Purple prairie clover	*Dalea purpurea purpurea*	Mid Late
Black-eyed Susan	*Rudbeckia hirta*	Mid Late
Yellow sweetclover	*Melitotus officinale*	Mid Late
Showy milkweed	*Asclepias speciosa*	Mid
Rocky Mountain Penstemon	*Penstemon strictus*	Early Mid
Plains coreopsis	*Coreopsis tinctoria*	Early Mid
Large Beardtongue	*Penstemon grandiflorus*	Mid

Hives and Pollinator Plots

By Linda Langelo, CSU Horticulture Program Associate

Are you looking for a way to increase your crop yield? Pollinators these days are in shorter supply. There is a decline of honey bees and other native pollinators. Natural Resources Conservation Service (NRCS) Dori Seamans, Program Support Specialist and a private beekeeper and Steve Benson, owner of Papi's Honey, reached out to partner with Burlington Conservation District in Burlington, Colorado, Pheasants Forever and Colorado State University Extension- Golden Plains Area. This partnership helped provide funding for a three year project. The title of the project is "The Burlington Community Garden Pollinator Project."

The vision for this project is to:

1. Educate families, youth and agricultural producers in Kit Carson County about the importance of pollination and the need to create pollinator habitats.
2. Engage youth outreach and education by including youth in planting pollinator demonstration plots to showcase plants that attract honeybees, butterflies, other native bees, and insects.
3. Demonstrate the Flow Hive next to a traditional hive to teach beekeeping principles and raise awareness about the decline of honeybees and other native pollinators.
4. Harvest honey using new techniques that reduce disruption and stress to the beehive.

Now in the second year, the demonstration pollinator plot is going strong. Pollinator plants include a diversity of blooming plants throughout the season. Yellow and white sweetclover, blue flax, alfalfa, penstemons and coneflower are among the plants used. Pollinator plants that are favored for their longevity were coreopsis, Coreopsis palmate, blanket flower, Gaillardia aristata, and western yarrow, Achillea millefolium lanulosa . There are 12 different species of pollinators attracted to the garden, including our Colorado Hairstreak butterfly, Fritillaries and bumblebees. Later in the season, Monarchs arrive in mid-September. Waiting for the Monarchs are three milkweeds: 1) Prairie Milkweed, Asclepias sullivantii, 2) Rose Milkweed, Asclepias incarnate, 3) Butterfly Milkweed, Asclepias tuberosa.

However, within the first year of the project, Seaman was able to connect with the Burlington FFA students who assisted by growing wildflower seed and the Bethune High School students transferred the wildflowers to larger pots before planting them out in the garden. The Burlington High School seventh graders with the NRCS staff planted shrubs while learning about soil health and conservation.

The new Flow Hive invented by Stuart and Cedar Anderson, from Australia, which was invented to stop bees from being crushed in the harvesting of honey. It proved to be more challenging for Seamans and Benson as beekeepers. The Flow Hive was designed to be able to see into the hive and instead of removing the honey comb frames when the honey is ready for harvesting, there is a trough at the bottom of the honey comb frames, and by simply inserting a honey tube and a Flow Key in the bottom turning 90 degrees downward, honey flows into your jar.

Seamans and Benson learned the following:

1. When it came time to remove the plugs and drain the honey at the bottom of each frame, there was a glitch. The Flow key needed to be turned slowly. Turning it too hard or too quickly caused the cappings to rupture and the honey to leak out the sides.
2. Any leaking honey went into the brood boxes and drove the bees out of the hive.
3. There was more propolis on the frames than expected. Bees use propolis to seal any unwanted open spaces in the hive. This is a mix of saliva and beeswax. In Australia, this does not happen to this extent because the bloom season is longer and they overwinter their hives differently. The Andersons stated that it is important to have convex wax cappings over the cured honey, meaning that the bees need to have each honeycomb cell filled completely to the top before they cap the cells.
4. The bees in the Flow Hive became overly defensive of the pollinator plot at season's end, so the hive was removed due to liability issues being a community garden.
5. The honey that was harvested had a wonderful taste.

The end result being that collecting honey is not the same in other regions in the world. However, one general rule prevails with attracting pollinators, a diversity of blooming plants throughout the season to help feed the pollinators. In turn, farmers increase their opportunity for increasing crop yields on crops that need pollinators.

Colorado State University Trial Plant Gardens

By Linda Langelo, CSU Horticulture Agent

There are several trials that take place each season at the Colorado State University Trial Garden located at 1401 Remington Street, Fort Collins, CO. Each season it is open to the public from May to October.

These trials are conducted to determine how well these various plants perform in our Rocky Mountain environmental conditions. They are evaluated on the following conditions: high altitude, intense solar radiation, drying winds, severe hailstorms, large fluctuations between day and night temperatures and a season-long need for irrigation.

Within the trial garden are three separate trial gardens: Annual, Perennial and Plant Select. The annual trial garden is planted each year trialing new annuals. The perennial trial garden is planted every third season. The trial lasts for two years to allow the plants to overwinter twice before new perennials are introduced.

Trial team participants are seed breeders and/or growers from around the United States, Holland, Netherlands and Israel. You can access any of these trial garden results at the following link: http://www.flowertrials.colostate.edu.

Colorado State University 2019 Trials for Top Performing Perennials

Two-year Trial Period

By Dr. Jim Klett

According to Dr. Klett: "The following seven perennials were recently selected by the Perennial Trial Garden Sub-committee as being superior after 3 years of growth and two winters. Plans are to utilize these in your designs and home gardens in 2019 and I think you will be happy with the results." The two-year Perennial Trial program at Colorado State University is designed to test newer perennial cultivars that have been introduced in the past three years or less.

Allium 'Millenium' from Eason Horticulture Resources/Stone Nursery, LLC (Allium hybrid 'ALLMIG1')

This was described as a plant having an "insane" amount of blooms. Flowers were nice shade of pink and a favorite for bees and butterflies. Blooming lasted a long time and flowers did not lodge even with overhead irrigation. Deadheading the blossoms resulted in repeat blooming.

Delosperma Granita® Orange from Plant Select® (previously Stireman Orange) (Delosperma 'PJSo2S)

Bright, iridescent orange flowers blanket the plant creating and impressive show of flower power. Large flowers bloom over a long period. Plants make a very attractive ground cover with green foliage forms a nice dense mat. It is a vigorous plant and good spreader.

Dianthus 'Kahori Scarlet' from Dummen Orange (Dianthus x hybrida Kahorie® 'Scarlet')

Very showy in the spring with a very vibrant color and attractive plants. Flower color was not a true scarlet but a beautiful shade of hot rose or cherry. Plants had superior winter hardiness that was consistent over three years and did not die out in the center as did many other Dianthus. Plants were attractive even when not in bloom with a nice tidy, compact growth habit.

Hibiscus 'Summerific Cherry Choco Latte' from Walters Gardens, Inc. (Hibiscus x hybrida 'Cherry Choco Latte' PPAF)

Large, two tone blooms were captivating with a striking combination of pink and white. It makes a great choice for providing color late in the season. Plants were relatively low maintenance as the old blooms were self-cleaning. Foliage had shades of dark red that was maintained throughout the season. Plants also had a nice growth habit that did not lodge and the mid-size height made a good balance with the flower size.

Lamium 'Lami Dark Purple' from Danziger (Lamium maculatum 'Dark Purple')

Dark purple flowers combined with dark green foliage and a very uniform growth habit a make a very impressive groundcover. This versatile plant did not burn in the sun and did well in the shade. It has also been reported to look great even at 8,000 feet elevation. Plants have superior vigor and provide a long period of bloom.

Miscanthus 'Bandwidth' from Darwin Perennials (Miscanthus sinensis 'NCMS2B' PP29460)

This is good selection for today's smaller gardens and landscapes as the plant maintains a nice uniform growth habit that is only 3-4' in height. Plants did not bloom but foliage is very attractive with yellow stripes running across the blade. The variegated foliage did not revert and was impressive all three seasons. Flowers are not needed for interest as yellow and green contrast in the leaves is very showy.

Pepper Trial 2019

By Linda Langelo, CSU Horticulture Agent

This is a replicated pepper trial based on the work of Dr. Michael Bartolo. Dr. Michael Bartolo, CSU-Ag Experiment Station, Rocky Ford, CO states "that growing sweet peppers can be an enormous challenge in Colorado" in his research report titled, Shading Improves Colored Pepper Yield and Quality. Over the past five years, varieties of sweet peppers and colored bell peppers were grown under two different shade cloth values and the control was grown without shade cloth as part of a study to see how they each performed.

In Sedgwick County in our community garden we replicated the study by using a sweet pepper, Canario and a hot pepper, Anaheim as our varieties. We used a black shade cloth of 30 percent. Dr. Bartolo used 20 and 30 percent shade cloth, both black and white.

Our results on both varieties of peppers showed no sign of sunscald and/or any other diseases. The size of the Anaheims and Canario grown under shade-cloth were twice that of those exposed to full sunlight. The Canarios were somewhat rounder. An Anaheim under the 30% shade cloth measured 10 and 11 inches long. Those not under the black shade cloth were about 7 inches. The colors were richer on both varieties under the black shade cloth over those exposed to the sunlight.

We plan on continuing the pepper trial through 2020. In 2019 since we could not purchase Canario which is no longer on the market, we used Lunch Box and Highlander.

Lunch Box is a small pepper in red, yellow and orange color with a very sweet and flavorful taste. Lunch Box was bred to be a snack food. Highlander is an Anaheim type that we added. Highlander is an elongated hot chile pepper with a subtle acidic taste and moderate spice. They can turn red or stay green. They are also crunchy.

The results were the same as the previous varieties in 2018. The peppers were longer and weighed more under the shade cloth. Shading them makes a big difference. We recommend shading them and also providing hail protection. The shade cloth helps with hail, but if

Colorado Welcome Center Pollinator Garden Plant List

By Linda Langelo, CSU Horticulture Agent

Native Plants

Coneflower *Echinacea purpurea*

Non-Native– Cultivated Varieties

Western Spiderwort .....*Tradescantia* 'Concord Grape'
Penstemon Blue Buckle .....*Penstemon virgatus* cv. 'Blue Buckle '
Perennial Sunflower .....*Helianthus* 'Lemon Queen'
Goldenrod .....*Solidago* R. 'Fireworks'
New England Aster.....*Symphyotrichum novae-angliae* 'Andenken an Alma Pötschke'

Pollinators are responsible for pollinating 30 percent of agriculture crops. The process of pollination is transferring pollen and seeds from one flower to another, fertilizing the plant so it can grow and produce food. Insect pollinators include bees, (honey bees, solitary species, bumblebees); pollen wasps (Masarinae); ants; flies including bee flies, hoverflies and mosquitoes; lepidopterans, both butterflies and moths; and flower beetles. Since bees are particularly difficult to identify, our Citizen Scientist Project will focus on common butterflies and moths that visit Colorado.

Other animals act as pollinators in the world. Birds and bats are among a 1,000 vertebrates out of 200,000 species of animals of which the rest are invertebrates.

In a May 13, 2018 article by the Genetic Literacy Project, the Environmental Protection Agency's top pesticide regulator, Jim Jones said, "As you well know, pollinators are responsible for nearly one in every three bites of food you eat. In addition, they contribute nearly $15 billion to the nation's economy."

Julesburg Library Pollinator Garden

By Linda Langelo, CSU Horticulture Agent

The reasoning behind creating a second pollinator garden is to decrease the distance between interrupted spaces for pollinators to travel for nectar and shelter. Both urban and rural development disrupts habitat for pollinators. This is called interrupted space.

The second reason for creating a pollinator garden in the town of Julesburg is to drive traffic into town. Tourists interested in seeing other types of pollinator gardens and seeing the town.

There is a Citizen Scientist Project that is connected with both the Julesburg Library and Welcome Center pollinator gardens. Students and local residents are going to observe through the season what pollinators visit the garden and on what plants. We hope to conduct this project over at least three seasons. Tourists will also be able to participate by filling out either a paper or on-line survey.

Plant List of Julesburg Library Pollinator Garden:

Native Plants

Wine Cups ..... *Callirhoe involucrate*

Mexican Hat ..... *Ratibida columnifera*

Rocky Mountain Penstemon ..... *Penstemon strictus*

Lemon Beebalm..... *Mondarda citriodora*

Shrubby Cinquefoil ..... *Potentilla fruitcosa*

Non-natives

Big Betony Superba ..... *Stachys macrantha* cv. 'Superba'

Research Summary: Screening pre-emergence herbicides for control of glyphosate-resistant kochia in chemical fallow.

John Spring, Area Extension Agent, Julesburg CO

Overview:

Field trials were conducted to screen 13 different pre-emergent herbicides from 6 separate modes-of-action for potential use to improve control of glyphosate-resistant kochia in chemical fallow in eastern Colorado. Of the herbicides tested, the PSII inhibitors metribuzin and atrazine (Group 5), the PPO inhibitors sulfentrazone and flumioxazin (Group 14), and the HPPD inhibitor isoxaflutole (Group 27) all controlled kochia and Russian-thistle for at least 12 weeks after application (from early March to early June). To prevent selection of kochia populations resistant to these currently effective herbicides, they should be used in multiple-mode-of-action tank mixes in production fields. (Group 14 or 27 + Group 5 mixes highly recommended). Trials have been established to further test these herbicides under a range of realistic use patterns in the 2019 growing season. Financial support for the project from the Colorado Wheat Research Foundation is gratefully acknowledged.

Methods:

Field trials were established in early March, 2018 at two sites: on the USDA-ARS Central Great Plains Research Station near Akron, CO, and the UNL High Plains Ag Lab near Sidney, NE. Trials were established in a randomized complete block design with 5 replications and individual plot size of 10x20 ft. Herbicide treatments (Table 1) were applied with a CO_2 powered hand sprayer on March 8 (Akron) and March 12 (Sidney). Both sites had naturally occurring populations of glyphosate-resistant kochia, and the Sidney site also had heavy Russian-thistle pressure. Weed emergence began much later than anticipated, with no substantial emergence of kochia or Russian-thistle noted until late April (kochia emergence begins by mid to late March in most years). Counts of emerged weeds were taken on a whole-plot basis at 12 weeks after application. The data was then analyzed for treatment differences using generalized linear mixed models with a negative binomial distribution and log link function in the *lme4* package in R. Overall model significance was confirmed with Wald chi-square tests in the R package *car*, and multiple comparisons conducted with Tukey's procedure with the package *lsmeans*.

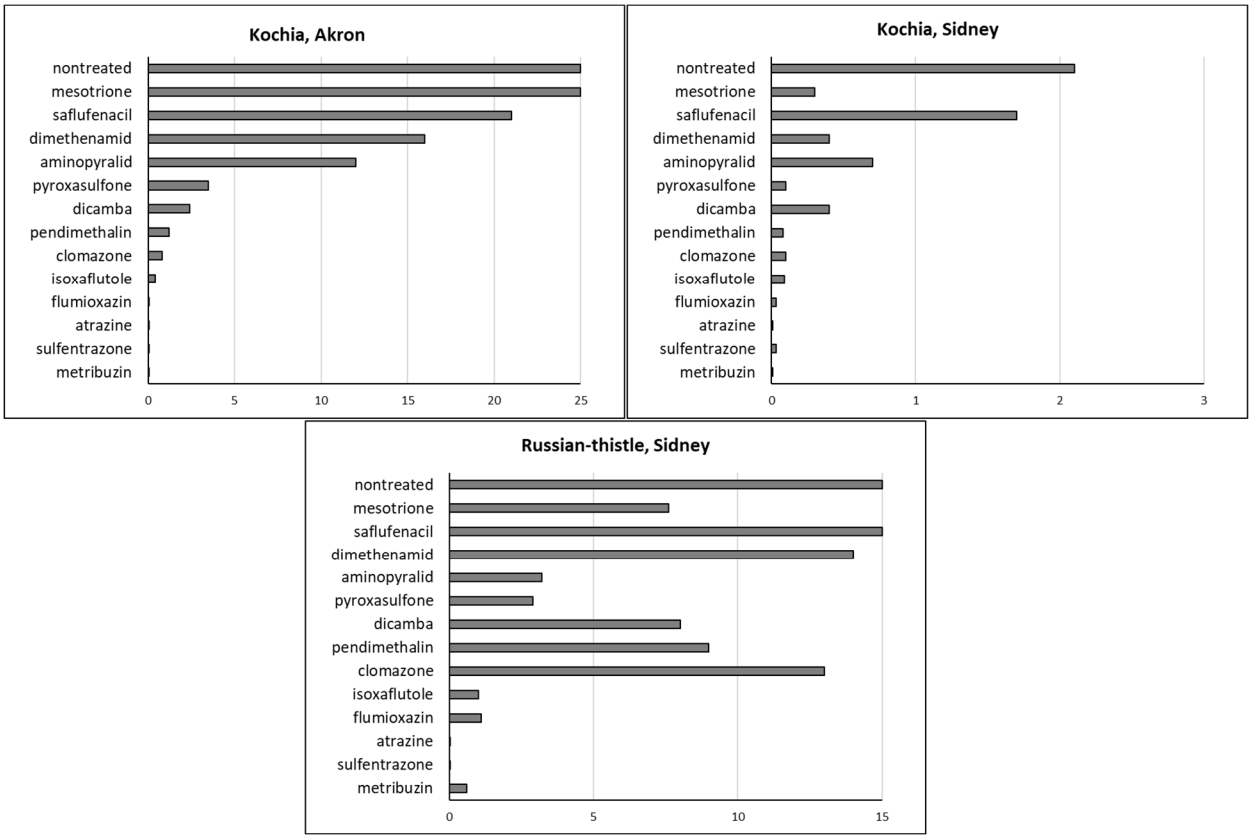
Table 1. Herbicide treatments and mean density of emerged kochia and Russian-thistle plants in early June 2018, 12 weeks after application. Numbers shown are plants per square meter.

Product	Active Ingredient	lb/ac	Rate (oz/ac)	MOA	Kochia (plants/m^2) Akron		Kochia (plants/m^2) Sidney		Russian-thistle Sidney (plants/m^2)	
Glory	*metribuzin*	0.5	11	5	0.01	a ‡	0.01	a	0.6	b
Spartan Charge	*sulfentrazone*	0.16	6.5	14	0.02	a	0.03	a	0.01	a
Atrazine 4L	*atrazine*	1	32	5	0.03	a	0.01	a	0.02	a
Valor SX	*flumioxazin*	0.06	2	14	0.06	ab	0.03	a	1.1	bc
Scoparia	*isoxaflutole*	0.08	5	27	0.4	abc	0.09	ab	1.0	bc
Command	*clomazone*	0.5	21	13	0.8	abcd	0.1	abc	13	de
Prowl H_20	*pendimethalin*	1.9	64	3	1.2	bcde	0.08	ab	9	de
Clarity	*dicamba*	0.5	16	4	2.4	cdef	0.4	bcd	8	de
Zidua	*pyroxasulfone*	0.21	4	15	3.5	cdef	0.1	abc	2.9	bcd
Milestone	*aminopyralid*	0.02	1	4	12	def	0.7	cd	3.2	cde
Outlook	*dimethenamid*	0.85	18	15	16	ef	0.4	bcd	14	de
Sharpen	*salflufenacil*	0.09	4	14	21	f	1.7	d	15	de
Callisto	*mesotrione*	0.09	3	27	25	f	0.3	abc	7.6	de
nontreated	*na*	na	na	na	25	f	2.1	d	15	e

‡ Within the same column, means followed by the same letter are not significantly different.

Results and Discussion:

Figure 1. Mean density of emerged kochia and Russian-thistle plants in early June 2018, 12 weeks after application. Numbers shown are plants per square meter.



Several herbicides provided good control of kochia for at least 12 weeks after application at both sites (Table 1, Figure 1). The Group 5 herbicides atrazine and metribuzin, the Group 14 herbicides sulfentrazone and flumioxazin, and the Group 27 herbicide isoxaflutole provided the best control, and will be tested further. Other herbicides generally reduced emergence relative to the non-treated control, but not enough to be viable options for use in chemical fallow. In contrast to the poor performance of dicamba observed in these trials, previous research and grower experience in western Kansas has generally reported good pre-emergent control of kochia with dicamba at the rate tested. The length of residual activity of dicamba is relatively short (typically 4-8 weeks), and it is assumed that the later-than-expected kochia emergence in 2018 began after dicamba activity had started to dissipate in these trials, resulting in poor control. While this pattern would be unlikely to present problems in every year, it suggests limitations to pre-emergence use of dicamba in eastern Colorado chemical fallow. If dicamba is used, it should be tank-mixed with longer-lasting products. Similarly, saflufenacil shows good activity on emerged kochia, but has a very short period of residual activity and is not a good fit for pre-emergence use in fallow.

Kochia is well known for its ability to develop herbicide resistance. While resistance to Group 14 (e.g. sulfentrazone, flumioxazin) and 27 herbicides (e.g. isoxaflutole) is not currently known in kochia, it has been found in other weed species, and is a relatively high risk in kochia as well. Group 5 (e.g. atrazine, metribuzin) resistance has been found in kochia in Colorado, but is not currently wide-spread. In both cases, continued efficacy of these products for kochia control depends on good stewardship practices. Tank-mixing multiple

modes-of-action is the best herbicide use strategy for preventing resistance, and is essential for responsible use of these products. In chemical-fallow, tank-mixes of a Group 14 herbicide (sulfentrazone or flumioxazin) plus a Group 5 herbicide (atrazine or metribuzin) or a Group 27 herbicide (isoxaflutole) plus a Group 5 are synergistic, and highly recommended. Which particular herbicides are best will depend on rotation plans and other factors. Recent market availability of generic versions of both sulfentrazone and flumioxazin has substantially reduced the cost of these active ingredients over the last 2 years.

Trials have been established to compare various tank-mix combinations and both fall and spring application timings in the 2019 growing season. For questions regarding either of these trials, please contact John Spring, (970)474-3479, or john.spring@colostate.edu.

Acknowledgments:
The Colorado Wheat Research Foundation provided grant funding to support this project, which is gratefully acknowledged. Dr. Merle Vigil (ARS Akron), and Dr. Cody Creech (UNL Sidney) are acknowledged for providing trial space and supporting the project.

CSU Crops Testing is an Extension program within the Department of Soil and Crop Sciences. The Crops Testing group is housed in the Plant Sciences Building on the CSU Main campus in Fort Collins, CO. Our principal field location is at the USDA/ARS Central Great Plains Research Center at Akron, CO.

Crop Variety Performance Trials are conducted by Colorado State University's Crops Testing to provide unbiased and reliable information to Colorado crop producers to help them make better variety decisions.

Each crop in our program has a report generated and is posted to our web site. That web address is www.csucrops.agsci.colostate.edu. Technical reports are also available for each crop.

The following tables include crop testing data and results for crops of interest in the Golden Plains Area.

2019 Wheat Variety Decision Tree for Dryland Production

Jerry Johnson and Sally Jones-Diamond

The decision tree on the following page helps Colorado growers make variety selection decisions based on important traits. Under each variety name are the scores, YR for stripe rust and WSMV for wheat streak mosaic virus, with '1' being very resistant and '9' being very susceptible.

HWW

In addition to high yields in high and low yielding conditions, Antero has good test weight, moderate sprouting tolerance and fair straw strength. Monarch, a 2018 release, is a viable non-premium dryland wheat variety choice but is mainly targeted for irrigated conditions with good stripe rust resistance, excellent straw strength, and excellent yields. Snowmass 2.0, Sunshine, and Breck are in the Ultragrain Premium Program. Snowmass 2.0, expected to replace Snowmass, is better for yield, grain protein deviation, and straw strength. Sunshine has excellent quality, good sprouting tolerance and straw strength but is susceptible to viruses. Breck, is a high-yielding variety with good sprouting tolerance, and straw strength. It also has very high test weight and low polyphenol oxidase (PPO) activity for improved whole grain bread and noodle quality.

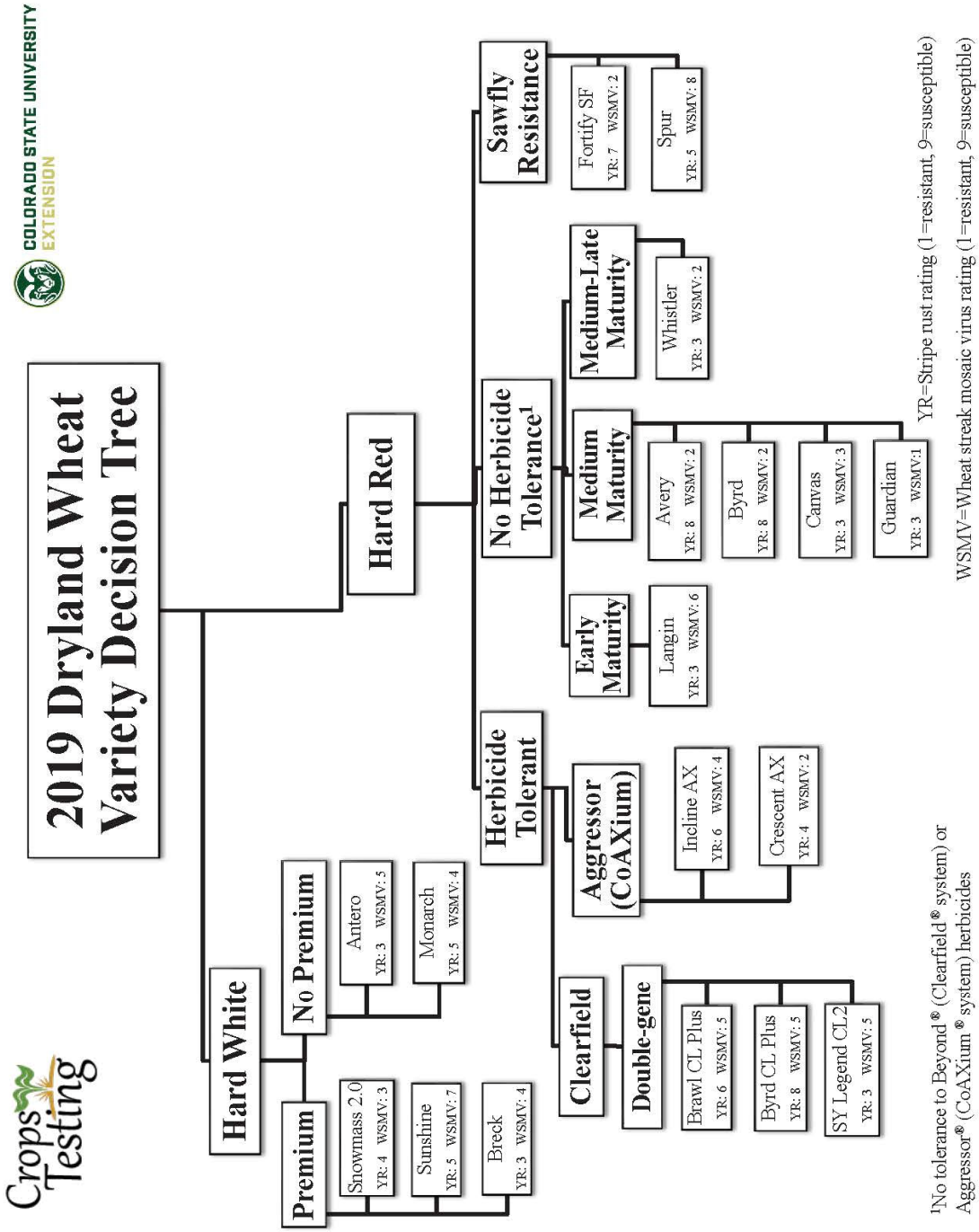
HRW

There are more choices for growers planting a two-gene Clearfield® variety. Brawl CL Plus, Byrd CL Plus and SY Legend CL2 (latter two are 2018 releases) are recommended for good control of winter annual grasses. Brawl CL Plus has good test weight, quality, grain protein content, and is early-maturing but has below-average yield. Byrd CL Plus is among the top yielding varieties in 2019 trials and very similar to the familiar Byrd parent. SY Legend CL2, from Agripro Syngenta, provides weed control and has good overall disease tolerance while yielding 92% of 2019 trial yield average.

The new CoAXium® Wheat Production System based on Aggressor® herbicide, a different class of compounds from Beyond, is an option for excellent control of winter annual grasses. Incline AX provides good weed control but has lower test weight and yield. Crescent AX (2018), is much higher yielding than Incline AX yet retains excellent control of winter annual grasses.

Although there are no wheat stem sawfly resistant varieties, there are some varieties that exhibit acceptable yield in the presence of strong sawfly pressure: Fortify SF has above trial average yields in 2018 and 2019. Spur, a 2016 Montana release marketed by Agripro Syngenta, was highest yielding in the Orchard trial this year in the face of very heavy sawfly infestation.

Most producers will plant high-yielding HRW varieties. The recommended early-maturing HRW variety is Langin (2016 release) from CSU, which is a top yielder. For the high-yielding, medium-maturing varieties, there are four recommendations: Avery, Byrd, Canvas, and Guardian. Byrd is well-known and Avery is similar to Byrd with a higher yield potential, larger kernels, slightly improved quality, and above-average test weight. Like Byrd, Avery carries wheat curl mite resistance. Canvas (2018 release) is better yielding than Byrd with a complete package of disease resistance and other traits. Guardian (2019) also has a good disease resistance package and good quality. The recommended high-yielding medium-to-late maturity HRW variety is a newcomer, Whistler, which has excellent yield and good stripe rust and WSMV resistance.


Crops Testing
COLORADO STATE UNIVERSITY
EXTENSION
2019 Dryland Wheat Variety Decision Tree
Hard White
Premium
Snowmass 2.0 YR: 4 WSMV: 3
Sunshine YR: 5 WSMV: 7
Breck YR: 3 WSMV: 4
No Premium
Antero YR: 3 WSMV: 5
Monarch YR: 5 WSMV: 4
Hard Red
Herbicide Tolerant
Clearfield
Double-gene
Brawl CL Plus YR: 6 WSMV: 5
Byrd CL Plus YR: 8 WSMV: 5
SY Legend CL2 YR: 3 WSMV: 5
Aggressor (CoAXium)
Incline AX YR: 6 WSMV: 4
Crescent AX YR: 4 WSMV: 2
No Herbicide Tolerance1
Early Maturity
Langin YR: 3 WSMV: 6
Medium Maturity
Avery YR: 8 WSMV: 2
Byrd YR: 8 WSMV: 2
Canvas YR: 3 WSMV: 3
Guardian YR: 3 WSMV:1
Medium-Late Maturity
Whistler YR: 3 WSMV: 2
Sawfly Resistance
Fortify SF YR: 7 WSMV: 2
Spur YR: 5 WSMV: 8
YR=Stripe rust rating (1=resistant, 9=susceptible)
WSMV=Wheat streak mosaic virus rating (1=resistant, 9=susceptible)
1No tolerance to Beyond ® (Clearfield ® system) or Aggressor® (CoAXium ® system) herbicides

Important Variety Selection Considerations

It is not possible to accurately predict which variety will perform best in each field every year. However, there are some selection guidelines to improve the ability to select superior varieties. The variety performance summary tables and decision trees in this report provide useful information to farmers for improving variety selections. Other guidelines that improve selections are below.

Focus on multi-year and location yield summary results when selecting a variety – use results from the three-year variety performance trials and from the collaborative on-farm tests.

Pay attention to ratings for maturity, plant height, coleoptile length, disease and insect resistance, and end-use quality characteristics. Refer to the Description of Winter Wheat Varieties in Eastern Colorado Dryland and Irrigated Trials (2019) for variety-specific information.

Use the wheat variety database, a great resource, at http://ramwheatdb.com/ to aid in variety selection. Head to head comparisons are easily made between varieties at http://ramwheatdb. com/

Some other factors that influence the success of a wheat crop that should not be neglected:

Control volunteer wheat and weeds to avoid loss of valuable soil moisture and to avoid creating a green bridge that could lead to serious virus disease infections vectored by the wheat curl mite (wheat streak mosaic virus, high plains wheat mosaic virus, and triticum mosaic virus) or vectored by aphids (barley yellow dwarf virus and cereal yellow dwarf virus).

Be aware of current ratings for stripe rust resistance as well as the potential of new races of stripe rust to develop unexpectedly. If variety susceptibility, market prices, expected yield, and fungicide and application costs warrant an application, consult the North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) fungicide efficacy chart. Updates to this chart can be found on the CSU Wheat Breeding Program "Wheat Links" page (wheat.colostate.edu/links.html).

Plant treated seed for protection against common bunt (stinking smut) and other seed-borne diseases. Information on seed treatments is available from Michigan State University and Kansas State University at: tinyurl.com/hv5m9js and tinyurl.com/jgeznub

Soil sample to determine optimum fertilizer application rates. Sampling should be done prior to planting. Information on fertilizing winter wheat is available from Colorado State University Extension at: bit.ly/2Kn8egF

Plant seeds per acre and not pounds per acre. Different varieties and seed lots can vary widely in seed size. Refer to How to Calibrate Your Drill available online at csucrops.com (click on the winter wheat tab) or at this URL: bit.ly/1MS5Hdh

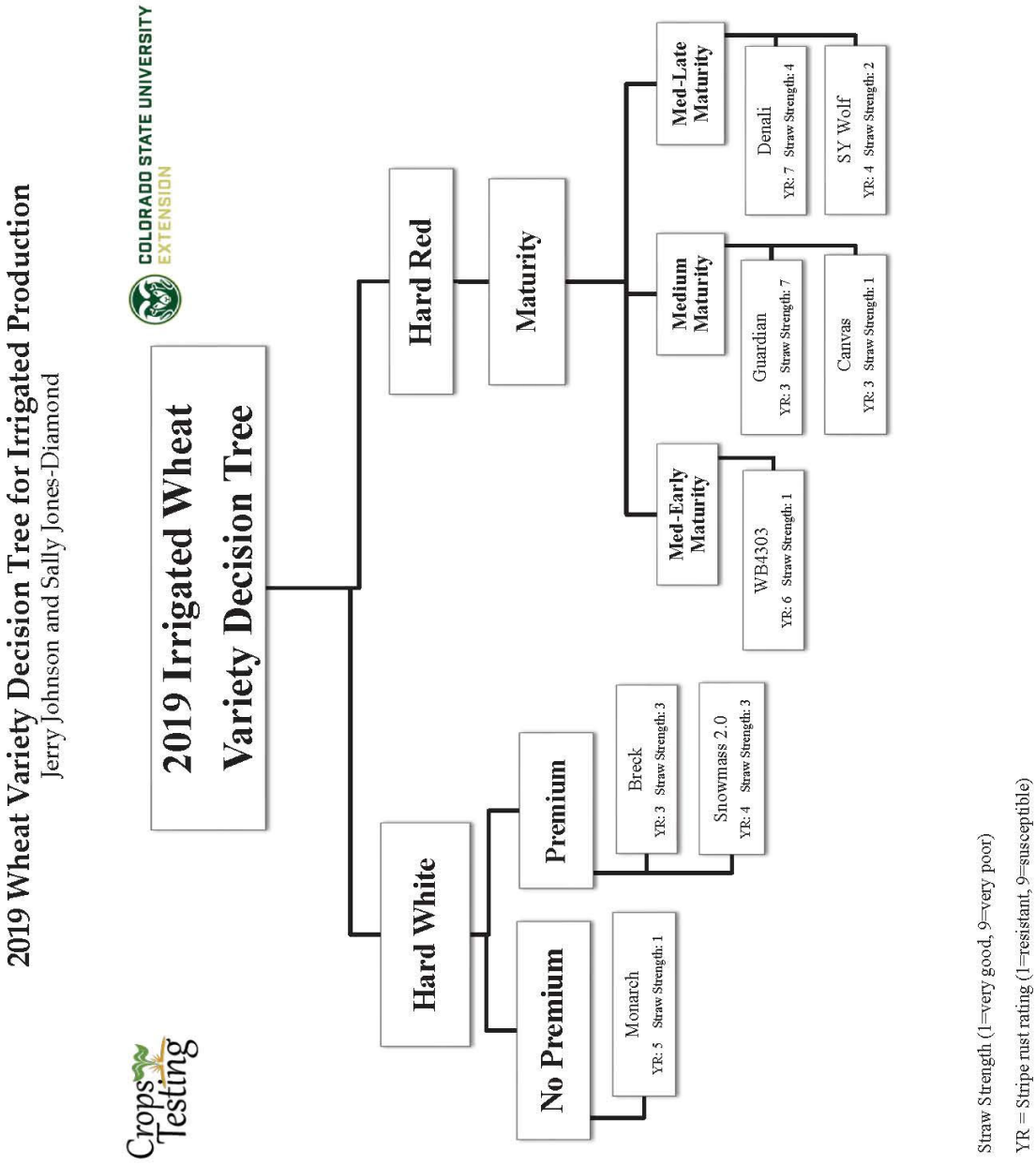

2019 Wheat Variety Decision Tree for Irrigated Production
Jerry Johnson and Sally Jones-Diamond
Crops Testing
COLORADO STATE UNIVERSITY
EXTENSION
2019 Irrigated Wheat
Variety Decision Tree
Hard White
Hard Red
No Premium
Premium
Monarch
YR: 5 Straw Strength: 1
Breck
YR: 3 Straw Strength: 3
Snowmass 2.0
YR: 4 Straw Strength: 3
Maturity
Med-Early Maturity
Medium Maturity
Med-Late Maturity
WB4303
YR: 6 Straw Strength: 1
Guardian
YR: 3 Straw Strength: 7
Canvas
YR: 3 Straw Strength: 1
Denali
YR: 7 Straw Strength: 4
SY Wolf
YR: 4 Straw Strength: 2
Straw Strength (1=very good, 9=very poor)
YR = Stripe rust rating (1=resistant, 9=susceptible)

Table 1. Summary of 2019 Dryland Winter Wheat Variety Performance Results

by Jerry Johnson, Scott Haley, Sally Jones-Diamond, and Ed Asfeld

	2019 Individual Trial Yield[a]											2019 Multi-Location Average			
Variety[b]	Akron	Arapahoe	Burlington	Genoa	Julesburg	Lamar	Orchard	Roggen	Sheridan Lake	Walsh	Yuma	Yield	Yield	Test Weight	Heading[c]
	bu/ac											bu/ac	% of avg	lb/bu	days from avg.
CO15D098R	**73.7**	**118.1**	**111.2**	**81.3**	57.5	58.5	52.3	**82.1**	62.7	91.7	**96.3**	80.5	110%	62.2	0
Antero	71.1	112.3	**109.5**	**78.5**	57.4	**66.3**	52.0	78.9	64.5	96.9	**95.8**	80.3	110%	61.1	-1
Sunshine	**73.2**	103.9	**107.4**	76.7	57.2	**66.3**	52.7	76.5	66.9	**101.8**	90.2	79.3	108%	61.3	-1
Langin	**74.6**	110.6	**109.7**	72.9	56.6	54.1	43.8	77.9	64.4	**99.7**	**95.1**	78.1	107%	60.5	-3
Byrd CL Plus	69.0	111.6	105.3	**77.1**	49.7	60.0	58.3	77.1	65.2	96.0	89.6	78.1	107%	60.8	0
Avery	68.9	110.8	103.7	76.3	51.9	59.3	51.0	77.3	61.1	**101.4**	92.2	77.6	106%	60.3	1
Whistler	64.1	112.4	96.8	74.3	57.3	**65.5**	46.6	79.4	70.5	98.4	84.7	77.3	106%	60.3	2
Guardian	66.2	113.6	95.6	**77.7**	40.2	**66.8**	44.2	75.9	**78.9**	90.9	86.4	76.0	104%	61.8	1
Snowmass 2.0	64.8	108.5	**107.4**	68.5	55.5	**66.2**	45.9	76.8	65.0	86.8	88.6	75.8	104%	61.3	-1
CO13D1479	67.4	106.6	105.1	73.1	57.5	59.1	47.1	75.1	62.7	89.6	87.3	75.5	103%	61.2	1
Breck	67.3	112.2	103.8	69.0	58.8	61.4	42.9	72.3	59.4	94.0	89.3	75.5	103%	62.6	0
Crescent AX	66.8	108.2	102.5	74.2	52.1	50.1	56.9	76.1	59.9	90.8	91.7	75.4	103%	61.7	-1
WB4595	69.2	98.3	100.6	75.9	60.7	54.2	55.0	77.0	62.6	92.8	82.7	75.4	103%	62.2	1
Denali	61.3	107.9	**108.6**	74.1	57.3	59.2	46.4	70.5	62.8	90.5	89.3	75.3	103%	61.9	2
Monarch	65.3	108.1	106.2	74.5	55.8	59.6	40.5	73.5	60.6	90.7	91.6	75.1	103%	61.1	1
Canvas	68.7	105.4	101.5	75.1	51.6	61.8	40.4	72.2	69.4	89.8	86.2	74.7	102%	61.8	1
CO13D0346	64.3	107.4	98.9	69.4	60.2	43.9	47.4	72.4	66.5	93.7	**93.4**	74.3	102%	60.6	-1
Byrd	63.5	113.0	97.0	69.6	46.3	61.6	46.3	72.2	63.4	94.5	89.6	74.3	101%	60.7	-1

Table 1 Continued

	2019 Individual Trial Yield[a]											2019 Multi-Location Average			
Variety[b]	Akron	Arapahoe	Burlington	Genoa	Julesburg	Lamar	Orchard	Roggen	Sheridan Lake	Walsh	Yuma	Yield	Yield	Test Weight	Heading[c]
	bu/ac											bu/ac	% of avg	lb/bu	days from avg.
WB4462	**72.8**	101.9	103.5	**77.2**	**62.6**	42.6	55.4	73.5	46.7	87.1	86.1	73.6	101%	62.0	-1
WB4792	64.6	97.1	95.9	75.5	57.1	55.8	46.2	74.0	62.9	89.7	89.0	73.4	100%	61.7	3
Fortify SF	**72.3**	108.4	93.2	70.5	51.2	50.2	59.4	75.2	58.4	81.8	85.5	73.3	100%	61.4	0
SY Monument	65.6	102.6	103.6	68.1	58.2	57.1	50.0	73.2	49.4	89.3	84.9	72.9	100%	60.5	2
WB-Grainfield	67.4	109.1	103.3	66.0	59.6	42.9	43.0	69.2	51.8	92.5	88.7	72.1	99%	61.6	-3
SY Rugged	69.1	101.9	96.4	70.7	**65.6**	47.3	46.0	70.1	55.0	87.7	80.0	71.8	98%	61.1	-1
Hatcher	70.7	100.8	94.2	74.7	41.6	48.2	48.1	77.4	62.5	88.0	80.7	71.5	98%	60.7	0
CO15SFD092	69.5	107.2	98.1	63.1	50.5	42.1	53.0	74.2	51.6	86.2	85.8	71.0	97%	61.2	-1
LCH15ACC-7-7	63.8	98.4	101.3	72.5	58.4	41.3	43.0	67.8	58.5	81.5	91.6	70.7	97%	61.5	-3
SY Wolverine	64.9	101.3	101.9	68.0	45.4	52.1	36.5	69.7	56.3	94.5	87.0	70.7	97%	60.7	-1
SY Wolf	63.6	98.5	99.2	69.7	56.2	49.6	44.4	72.6	50.6	90.3	81.4	70.6	96%	61.2	2
AM Eastwood	71.0	93.1	95.2	62.9	57.0	44.5	45.2	68.5	48.2	85.9	87.1	69.0	94%	61.1	-1
Spur	67.5	-	81.4	74.0	60.2	-	**66.8**	71.8	-	-	76.8	68.7	94%	58.8	4
Incline AX	55.7	98.5	90.8	**78.0**	41.6	**65.8**	41.1	68.5	59.9	85.2	69.8	68.6	94%	59.6	2
Long Branch	64.2	96.6	91.6	69.3	44.8	51.0	39.1	72.3	58.3	85.9	81.7	68.6	94%	60.8	0
Brawl CL Plus	64.5	95.8	94.2	61.7	51.6	37.2	57.6	66.1	49.2	84.9	84.4	67.9	93%	62.1	-2
SY Legend CL2	61.1	96.9	95.5	66.7	61.9	45.1	37.9	68.3	52.1	83.9	75.6	67.7	93%	61.4	-1
WB4418	64.7	95.8	97.4	71.5	58.6	31.0	47.1	65.5	47.3	90.6	71.1	67.3	92%	60.4	-1
Snowmass	57.8	95.3	90.7	65.9	36.7	53.6	34.3	73.0	64.9	81.0	75.9	66.3	91%	61.3	0
LCS Valiant	60.0	90.1	99.0	67.7	47.5	35.2	45.1	67.3	49.5	81.7	84.3	66.1	90%	61.4	-1
Average	**66.6**	**104.3**	**99.9**	**71.9**	**53.9**	**53.2**	**47.6**	**73.2**	**59.5**	**90.2**	**86.0**	**73.2**		**61.2**	**5/27/2019**
[d]LSD (P<0.30)	3.2	4.2	5.0	4.5	3.6	3.0	5.0	2.5	3.5	2.7	2.9				

[a]Varieties in the top LSD yield group in each location are in bold.

[b]Varieties ranked according to average yield across eleven trials in 2019.

[c]Varieties with positive values headed later than the trial average and varieties with negative values headed earlier than the multi-location trial averages.

[d]If the difference between two variety yields equals or exceeds the LSD value then they are significantly different with less than 30% probability that the difference is due to random error.

Table 2. 2019 Dryland Wheat Trial Management and Characteristics

By Roger Tyler, Danica Kluth, Jerry Johnson, Scott Haley, and Sally Jones-Diamond

		Akron	Arapahoe	Burlington	Genoa	Julesburg
	Average Yield (bu/ac)	67	104	100	72	54
Location	GPS Coordinates (Lat/Long)	40.1493	39.0015	39.2852	39.3516	40.8356
		-103.1373	-102.2461	-102.2795	-103.5093	-102.3429
	County	Washington	Cheyenne	Kit Carson	Lincoln	Sedgwick
Soil	Soil Type	Rago Silt Loam	Keith-Richfield silt loam	Kuma-Keith silt loam	Weld silt loam	Keith-Kuma silt loams
	Sand-Silt-Clay %	29-50-21	29-52-19	29-54-17	31-50-19	31-50-19
	Soil Organic Matter	1.5 %	1.6 %	1.9 %	2.0 %	1.6 %
	Soil pH	6.3	7.9	7.5	7.2	6.3
	Soil Nutrients at planting (N-P lb/ac)	111-15	166-7	182-10	123-20	102-27
Management	Applied Fertilizer in Season (N-P-K lb/ac)	8-28-0	73-46-0-7S-0.5Z	92-49-0	62-38-0-1S	23-28-0-1Zn
	Tillage	No-Till	Verticle Tillage	Tilled	2x Tilled	No-Till
	Previous Crop 2017/2018	Proso millet/ Chemfallow	Corn/ Chemfallow	Corn/ Chemfallow	Oil Sunflowers/ Fallow	Corn/ Fallow
Development	Planting Date	3-Oct-2018	13-Sep-2018	13-Sep-2018	18-Sep-2018	2-Oct-2018
	Harvest Date	26-Jul-2019	16-Jul-2019	17-Jul-2019	18-Jul-2019	30-Jul-2019
	Heading Date (Avg)	4-Jun-2019	26-May-2019	28-May-2019	2-Jun-2019	8-Jun-2019
	Days from Planting to Heading (Avg)	244	255	257	257	249
Environment	Biotic Stress	Minor sawfly, trace stripe rust, tansy mustard present in May	Some WSMV noted mid-May	Sprayed for stripe rust June 1	-	Tan Spot, Cephalosporium stripe, WSMV, stripe rust present
	Abiotic Stress	Freeze - possible* Some lodging	-	-	Freeze- minor*	Freeze - suspected**
	Total Rain: April 1 to Harvest	9.25 in	6.99 in	7.56 in	8.22 in	7.46 in**
	Last Spring Freeze Dates	**May 22:** 2 hr < 30 F Temp to 29 F	No Freeze Events	No Freeze Events	**May 22:** 2 hr < 30 F Temp to 29 F	**May 22:** Suspected**

*Freeze severity estimated from Kansas State Wheat Freeze Damage Publication (https://www.sunflower.k-state.edu/agronomy/docs/c646_Whole_Wheat_Freeze_Publication.pdf)

**Weather station limited data: Missing rain prior to May 17, missing Temp - May 22 midnight to 6:20 am

WSMV: Wheat streak mosiac virus

Table 2 continued

Lamar	Orchard	Roggen	Sheridan Lake	Walsh	Yuma
53	48	73	60	90	86
38.0026	40.4817	40.0727	38.5345	37.4312	40.1907
-102.6135	-104.1099	-104.3019	-102.4712	-102.3104	-102.6611
Prowers	Morgan	Weld	Kiowa	Baca	Yuma
Wilid silt loam	Briggsdale clay loam	Weld loam	Wiley loam	Wiley loam	Haxtun sandy loam
39-44-17	51-26-23	31-44-25	41-40-19	21-60-19	49-32-19
1.1 %	1.2 %	1.4 %	1.3 %	1.7 %	1.4 %
8.1	7.6	7.6	7.4	7.9	7.3
80-5	70-5	82-10	87-10	137-11	117-18
45-36-0	59-37-0-2S-0.25Z	8-28-0	54-28-0-8.25S	56-20-0	37-28-0-2S
No-Till	No-Till	No-Till	No-Till	Tilled	Min-Tilled
Wheat/ Chemfallow	Proso Millet/ Chemfallow	Corn/ Fallow	Grain Sorghum/ Chemfallow	Wheat / Fallow	Proso Millet / Fallow
12-Sep-2018	2-Oct-2018	1-Oct-2018	12-Sep-2018	18-Sep-2018	19-Sep-2018
8-Jul-2019	29-Jul-2019	25-Jul-2019	12-Jul-2019	8-Jul-2019	13-Jul-2019
16-May-2019	9-Jun-2019	5-Jun-2019	20-May-2019	19-May-2019	30-May-2019
246	250	247	250	243	253
-	Severe sawfly	Low level stripe rust noted June; sprayed for rust in June	-	Minor leaf and stripe rust, barley yellow dwarf virus, tan spot	Low levels stripe and leaf rust
Freeze - severe*	Freeze - moderate* Slight hail damage in June	Freeze - moderate*	Freeze - severe*	-	Leaf rolling mid-May indicated drought stress 2.8" rain late May
5.76 in	8.42 in	7.4 in	9.07 in	6.89 in	5.97 in
May 19: 15 min <31 F Temp to 30.6 F **May 22:** 3 hr < 30 F Temp to 28.2 F	**May 22:** 1 hr < 30 F Temp to 28.5 F	**May 22:** 1hr < 30 F Temp to 28.7 F	**May 22:** 3 hrs < 30 F Temp to 28 F	No Freeze Events	No Freeze Events

Table 3. Summary of Three-Year (2017-2019) Dryland Winter Wheat Variety Performance Results

by Jerry Johnson, Scott Haley, Sally Jones-Diamond, and Ed Asfeld

			3-Year Average[a]				
Variety[b]	Brand/Source	Market Class[c]	Yield	Yield	Test Weight	Test Weight	Plant Height
			bu/ac	% trial	lb/bu	% trial	in
Langin	PlainsGold	HRW	75.5	108%	60.2	100%	31
Antero	PlainsGold	**HWW**	74.7	107%	60.1	100%	34
Whistler	PlainsGold	HRW	74.6	107%	59.3	98%	34
Snowmass 2.0	PlainsGold	**HWW**	73.2	105%	60.6	100%	32
Avery	PlainsGold	HRW	72.6	104%	60.1	100%	34
Canvas	PlainsGold	HRW	72.1	103%	61.0	101%	31
Sunshine	PlainsGold	**HWW**	72.1	103%	59.8	99%	32
Breck	PlainsGold	**HWW**	71.9	103%	61.9	103%	33
Byrd CL Plus	PlainsGold	HRW	71.8	103%	59.9	99%	34
Guardian	PlainsGold	HRW	71.7	103%	61.5	102%	33
Monarch	PlainsGold	**HWW**	71.3	102%	60.5	100%	31
Byrd	PlainsGold	HRW	71.1	102%	60.4	100%	33
CO13D1479	Colorado State University Exp	**HWW**	70.4	101%	60.4	100%	33
Denali	PlainsGold	HRW	68.9	99%	60.7	101%	34
WB-Grainfield	WestBred Bayer	HRW	68.0	97%	60.6	100%	33
SY Monument	AgriPro Syngenta	HRW	67.5	97%	59.6	99%	32
WB4462	WestBred Bayer	HRW	67.3	96%	61.0	101%	35
SY Rugged	AgriPro Syngenta	HRW	66.8	96%	59.7	99%	30
Hatcher	PlainsGold	HRW	66.1	95%	60.0	99%	32
SY Wolf	AgriPro Syngenta	HRW	65.9	94%	60.3	100%	31
Snowmass	PlainsGold	**HWW**	65.8	94%	60.6	101%	34
Brawl CL Plus	PlainsGold	HRW	64.7	93%	60.9	101%	33
Incline AX	PlainsGold	HRW	62.9	90%	58.0	96%	32
		Average	**69.9**		**60.3**		**33**

[a]The 3-year average yield and test weights are based on 28 trials (eleven 2019, nine 2018, and eight 2017 trials). Plant heights are based on 26 trials (ten 2019, eight 2018, and eight 2017 trials).

[b]Varieties ranked according to average 3-year yield.

[c]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.

Table 4. Summary of 2019 COFT (Collaborative On-Farm Tests) Winter Wheat Variety Performance Results

By Jerry Johnson, Sally Jones-Diamond, Dennis Kaan, Ron Meyer, John Spring, Kelly Roesch, and Wilma Trujillo

Variety	Yield[a]	Test Weight	Protein
	Bu/ac	Lb/bu	Percent
Langin	65.8	59.8	10.2
Avery	64.5	60.0	9.9
Byrd	63.1	60.3	10.1
Breek	62.3	62.2	10.5
Long Branch	60.3	59.9	10.3
Average	**63.2**	**60.4**	**10.2**
LSD	1.2	0.3	0.1

[a]Yield corrected to 12% moisture.

Averaged across 24 on-farm tests

Table 5. Summary of 2019 Irrigated Winter Wheat Variety Performance Results

by Jerry Johnson, Scott Haley, Sally Jones-Diamond, and Ed Asfeld

	2019 Individual Trial Yield[a]			2019 Multi-Location Average				
Variety[b]	Burlington	Fort Collins	Haxtun	Yield	Yield	Test Weight	Height	Lodging
	bu/ac			bu/ac	% of avg	lb/bu	in	score (1-9)[c]
CO13D0346	**90.6**	81.2	84.3	85.4	112%	60.2	30	3
Guardian	**91.6**	89.7	73.8	85.1	112%	61.6	28	4
Monarch	68.8	**94.0**	**90.8**	84.5	111%	59.5	32	1
WB4303	63.0	**98.0**	86.0	82.3	108%	57.5	28	1
Breck	74.7	79.4	**92.3**	82.1	108%	60.9	32	2
WB4792	66.1	**97.5**	81.4	81.7	107%	59.8	34	1
Crescent AX	80.7	86.4	76.4	81.2	107%	60.8	35	6
WB4595	71.3	86.3	85.3	81.0	106%	61.3	30	1
Denali	66.7	84.4	86.7	79.3	104%	59.6	30	1
Canvas	77.6	83.2	75.4	78.7	103%	60.5	30	1
CO15D098R	78.2	75.3	81.2	78.2	103%	60.6	32	5
Snowmass 2.0	73.0	79.9	81.4	78.1	103%	59.7	30	4
SY Wolverine	68.1	**93.7**	72.3	78.0	103%	59.4	25	1
Sunshine	73.4	78.0	79.9	77.1	101%	59.9	28	5
Long Branch	62.9	86.9	79.1	76.3	100%	58.8	28	6
SY Wolf	64.0	85.0	77.6	75.5	99%	59.1	30	1
SY Sunrise	69.4	76.4	71.1	72.3	95%	60.1	26	1
AM Eastwood	57.2	76.8	73.4	69.1	91%	58.9	26	1
WB4418	57.1	82.0	65.9	68.4	90%	58.3	29	1
WB4699	51.6	81.0	70.0	67.6	89%	57.8	28	1
WB-Grainfield	51.8	71.0	77.7	66.8	88%	60.4	32	3
Brawl CL Plus	67.0	64.3	67.6	66.3	87%	60.6	31	1
WB4269	42.7	84.0	71.7	66.1	87%	59.4	28	1
Thunder CL	42.3	76.7	74.3	64.4	85%	59.5	33	1
Average	**67.1**	**83.0**	**78.2**	**76.1**		**59.8**	**30**	**2**
[d]LSD (P<0.30)	3.6	4.5	4.6					

[a]Varieties in the top LSD yield group in each location are in bold.

[b]Varieties ranked according to multi-location average yield in 2019.

[c]Lodging score: 1 equals no lodging and 9 is severe lodging.

[d]If the difference between two variety yields equals or exceeds the LSD value then they are significantly different with less than 30% probability that the difference is due to random error.

Table 6. 2019 Dryland Corn Hybrid Performance Trial Results at Dailey

by Jerry Johnson, Sally Jones-Diamond, Danica Kluth, and Ed Asfeld

Brand	Hybrid	Insect and Herbicide Technology Traits[a]	Yield[b]	Relative Maturity[c]	Moisture	Test Weight	Ear Height	Population
			bu/ac		percent	lb/bu	in	plants/ac
Dyna-Gro Seed	D48VC76	VT2PRIB, RR2	**128.9**	108	17.1	55.3	38	17,206
Rob-See-Co	RC 4343-3220A-EZ	AV3220, RR2, LL	**125.1**	93	15.4	58.3	43	14,012
Dekalb	DKC47-55RIB	VT2PRIB, RR2	123.9	107	15.2	60.3	36	15,899
Mycogen Seeds	MY05U05 RA	PCRA, RR2, LL	123.2	105	17.6	55.3	38	15,682
Dekalb	DKC45-66RIB	VT2PRIB, RR2	122.5	105	15.0	58.7	35	15,899
LG Seeds	LG5470VT2ProRIB	VT2PRIB, RR2	121.7	98	14.6	58.2	38	15,246
Dekalb	DKC51-20RIB	VT2PRIB, RR2	121.6	101	15.4	57.5	37	17,424
Rob-See-Co	RC 4915-3120-EZ1	AV3120A, RR2	120.8	99	14.6	55.9	40	13,794
Pioneer	P0622AML	AML, RR2, LL	120.1	106	16.0	57.9	39	14,302
Dyna-Gro Seed	D39VC40	VT2PRIB, RR2	117.8	99	15.0	60.1	39	13,068
Dyna-Gro Seed	D50VC30	VT2PRIB, RR2	117.2	110	16.3	56.5	45	15,827
Dyna-Gro Seed	D43VC81	VT2PRIB, RR2	116.6	103	14.4	58.4	35	16,771
Average			**121.6**	**103**	**15.5**	**57.7**	**38**	**15,428**
[d]LSD (P<0.30)			4.9					

[a]Technology trait designations: AML=AcreMax Leptra; AV3120=Agrisure 3120 E-Z Refuge; AV3220A=Agrisure Viptera 3220 E-Z Refuge Artesian; LL=LibertyLink tolerant; PCRA=PowerCore Trait Technology with Refuge Advanced; RR2=Roundup Ready 2 tolerant; VT2PRIB=Genuity VecTran Double Protection Refuge in the Bag Complete.

[b]Yields corrected to 15.5% moisture.

[c]Relative maturity is provided by the respective companies and is the approximate time from planting to harvest maturity. The method of calculation of the relative maturity ratings may vary among companies.

[d]If the difference between two hybrid yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Site Information

Collaborator:	Mark and Neal Lambert
Planting Date:	June 5, 2019
Harvest Date:	November 5, 2019
Fertilizer:	Pre-plant: N at 45, P at 27 lb/ac applied as compost. Starter: N at 30, P at 10, and Zn at 0.5 lb/ac
Herbicide:	Post-emerge: Roundup PowerMAX and DiFlexx at labeled rates and 1 lb/ac of Atrazine on July 3
Soil Type:	Haxtun Sandy Loam
Trial Coordinates:	40.6617, -102.7407

Table 7. 2019 Dryland Corn Hybrid Performance Trial Results at Akron

by Jerry Johnson, Sally Jones-Diamond, and Ed Asfeld

Brand	Hybrid	Insect and Herbicide Technology Traits[a]	Yield[b]	Relative Maturity[c]	Moisture	Test Weight	Ear Height	Population
			bu/ac		percent	lb/bu	in	plants/ac
Dekalb	DKC51-20RIB	VT2PRIB, RR2	**98.8**	101	16.3	52.7	36	14,520
Dyna-Gro Seed	D43VC81	VT2PRIB, RR2	**96.4**	103	18.1	51.4	38	15,101
Dyna-Gro Seed	D39VC40	VT2PRIB, RR2	91.5	99	17.1	53.0	39	12,923
Pioneer	P0622AML	AML, RR2, LL	88.5	106	19.3	51.2	41	14,810
Dekalb	DKC45-66RIB	VT2PRIB, RR2	84.6	105	15.6	52.8	38	13,504
Augusta Seed	A2651	GTA, RR2	83.2	101	18.5	51.7	41	14,810
Rob-See-Co	RC 4343-3220A	AV3220A, RR2	81.2	93	19.0	50.8	41	13,867
Dyna-Gro Seed	D48VC76	VT2PRIB, RR2	79.8	108	23.7	47.7	41	14,810
Rob-See-Co	RC 4915-3120-EZ1	AV3120, RR2, LL	72.7	99	18.2	48.4	42	13,649
Dekalb	DKC47-55RIB	VT2PRIB, RR2	72.4	107	18.4	52.8	37	14,665
Augusta Seed	A5658	3000GT, RR2, LL	71.7	108	28.9	46.7	43	14,738
Dyna-Gro Seed	D50VC30	VT2PRIB, RR2	70.0	110	20.5	50.5	46	15,173
Average			**82.6**	**103**	**19.4**	**50.8**	**40**	**14,381**
[d]LSD (P<0.30)			5.8					

[a]Technology trait designations: 3000GT=Agrisure 3000GT; AML=AcreMax Leptra; AV3120=Agrisure 3120 E-Z Refuge; AV3220A=Agrisure Viptera 3220 E-Z Refuge Artesian; GTA=Agrisure Glyphosate Tolerant Artesian; LL=LibertyLink tolerant; RR2=Roundup Ready 2 tolerant; VT2PRIB=Genuity VecTran Double Protection Refuge in the Bag Complete.

[b]Yields corrected to 15.5% moisture. Hybrid yields in bold are in the top LSD group.

[c]Relative maturity is provided by the respective companies and is the approximate time from planting to harvest maturity. The method of calculation of the relative maturity ratings may vary among companies.

[d]If the difference between two hybrid yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Site Information

Collaborator:	USDA Central Great Plains Research Center
Planting Date:	June 6, 2019
Harvest Date:	October 26, 2019
Fertilizer:	Pre-plant: N at 50 and S at 10 lb/ac; Starter: N at 5, P at 18, and Zn at 0.25 lb/ac
Herbicide:	May 24: Lumax EZ at 1.7 qt/ac, Cornerstone Plus at 1 qt/ac, 2,4-D LV6 at 1 pt/ac
Soil Type:	Rago silt loam
Trial Coordinates:	40.1564, -103.14

Table 8. 2019 Irrigated Corn Hybrid Performance Trial Results at Holyoke

by Jerry Johnson, Sally Jones-Diamond, and Ed Asfeld

Brand	Hybrid	Insect and Herbicide Technology Traits[a]	Yield[b]	Relative Maturity[c]	Moisture	Test Weight	Plant Height	Population	Lodging
			bu/ac		percent	lb/bu	in	plants/ac	percent
NK Seed	NK1082	AV3330, RR2, LL	**250.2**	110	16.5	60.0	122	31,508	40
Augusta Seed	A4559	AV3010, RR2, LL	**243.4**	109	16.9	57.1	113	31,508	3
NK Seed	NK1205	AV3120, RR2, LL	239.1	112	17.4	59.5	121	33,614	57
Augusta Seed	A4658	AV3220, RR2, LL	231.7	108	15.8	58.3	117	34,267	63
NK Seed	NK0821	AV3120, RR2, LL	227.8	108	15.0	59.9	117	34,267	10
Pioneer	P1370AMXT	AMXT, RR2, LL	224.7	113	18.2	58.1	129	34,848	27
Augusta Seed	A3058	AV3120, RR2	222.4	108	14.8	59.8	122	32,307	13
Pioneer	P0805AM	AM, RR2, LL	221.7	108	17.4	62.0	127	28,096	7
Pioneer	P0622AML	AML, RR2, LL	221.1	106	15.2	60.8	109	30,855	30
Augusta Seed	A4760	VT2Pro, RR2	220.2	110	15.0	60.5	123	32,525	33
Augusta Seed	A4959	AV3110, RR2, LL	219.0	109	18.3	60.4	120	32,162	50
NK Seed	NK0472	AV3110, RR2, LL	217.8	104	16.5	62.0	120	34,049	0
Augusta Seed	A2856	AV3220, RR2	217.6	106	15.9	59.5	118	34,122	87
LG Seeds	LG60C33VT2Pro	VT2Pro, RR2	209.0	110	16.8	59.9	112	34,340	57
Dekalb	DKC56-45RIB	STXRIB, RR2, LL	208.0	106	16.3	60.4	110	28,750	13
LG Seeds	LG62C35VT2Pro	VT2Pro, RR2	207.0	112	16.3	59.5	117	34,412	23
Dekalb	DKC60-87RIB	STXRIB, RR2, LL	202.6	110	16.6	61.2	115	32,307	10
NK Seed	NK0624	AV3220, RR2, LL	202.5	106	16.3	59.3	119	34,412	82
NK Seed	NK1364	AV3111, RR2, LL	195.0	113	16.4	57.1	123	22,796	7
LG Seeds	LG59C72VT2Pro	VT2Pro, RR2	180.8	109	15.3	59.0	123	32,452	40
Average			**218.1**	**109**	**16.3**	**59.7**	**119**	**32,180**	**33**
[d]LSD (P<0.30)			10.8						

[a]Technology trait designations: AM=Optimum AcreMax; AML=AcreMax Leptra; AMXT=Optimum AcreMax Xtreme; AV3010=Agrisure Viptera 3010; AV3110=Agrisure Viptera 3110; AV3111=Agrisure Viptera 3111; AV3120=Agrisure Viptera 3120 EZ Refuge; AV3220=Agrisure Viptera 3220 EZ Refuge; AV3330=Agrisure Viptera 3330 EZ Refuge; LL=LibertyLink; RR2=Roundup Ready 2; STXRIB=Genuity SmartStax Refuge in the Bag Complete; VT2Pro=Genuity VecTran Double Protection.

[b]Yields corrected to 15.5% moisture. Hybrid yields in bold are in the top LSD group.

[c]Relative maturity is provided by the respective companies and is the approximate time from planting to harvest maturity.

[d]If the difference between two hybrid yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Site Information

Collaborator:	Brent Adler
Planting Date:	April 29, 2019
Harvest Date:	November 2, 2019
Fertilizer:	N at 240, P at 74, K at 60, S at 30, and Zn at 1.25 lb/ac
Herbicide:	Durango at 1 qt/ac, Resicore at 2 qt/ac, and atrazine at 1 qt/ac on May 18; Durango at 1 qt/ac, Parallel at 20 oz/ac, Status at 2 oz/ac on June 25
Insecticide:	Prevathon at 17 oz/ac on Aug. 1
Soil Type:	Julesburg loamy sand
Trial Coordinates:	40.358, -102.1066

Table 9. 2019 Irrigated Corn Hybrid Performance Trial Results at Yuma

by Jerry Johnson, Sally Jones-Diamond, and Ed Azfeld

Brand	Hybrid	Insect and Herbicide Technology Traits[a]	Yield[b]	2-Year Avg. Yield	Relative Maturity[c]	Moisture	Test Weight	Plant Height	Population	Bacterial Leaf Streak
			bu/ac	bu/ac		percent	lb/bu	in	plants/ac	score (1-5)[d]
Dyna-Gro Seed	D51VC67	VT2PRIB, RR2	**247.1**	-	110	16.6	60.5	109	28,459	3.3
Dyna-Gro Seed	D52VC15	VT2PRIB, RR2	225.6	-	112	15.5	61.6	110	33,396	2.6
Augusta Seed	A4559	AV3010, RR2, LL	222.6	-	109	16.0	58.5	111	31,799	3.4
Dyna-Gro Seed	D54VC14	VT2Pro, RR2	217.2	247.3	114	16.8	62.8	110	32,234	2.6
Dekalb	DKC54-64RIB	STXRIB, RR2, LL	213.5	-	104	15.1	61.6	110	32,380	1.8
NK Seed	NK0624	AV3220, RR2, LL	211.8	-	106	15.9	60.5	106	33,396	2.0
LG Seeds	LG66C32VT2RIB	VT2PRIB, RR2	210.8	258.0	116	17.2	62.2	109	32,525	2.8
NK Seed	NK1205	AV3120, RR2, LL	203.1	-	112	14.3	60.7	107	34,122	3.3
Dyna-Gro Seed	D52SS91	STX, RR2, LL	200.2	241.7	112	16.4	61.9	104	33,541	2.4
Dyna-Gro Seed	D48VC76	VT2PRIB, RR2	199.5	227.3	108	15.1	61.3	108	33,686	3.3
NK Seed	NK1082	AV3330, RR2, LL	198.7	-	110	14.1	60.6	106	32,670	2.3
Dyna-Gro Seed	D54SS74	STX, RR2, LL	197.5	-	114	15.9	61.3	109	33,106	2.3
Augusta Seed	A3058	AV3120, RR2	194.9	-	108	12.9	59.8	106	32,380	2.4
Dyna-Gro Seed	D53VC33	VT2Pro, RR2	189.5	-	113	15.6	61.1	117	32,815	2.4
Augusta Seed	A4658	AV3220, RR2, LL	189.4	-	108	14.2	58.2	107	34,122	2.0
Pioneer	P0805AM	AM, RR2, LL	189.3	-	108	15.8	62.6	120	29,911	3.3
Dyna-Gro Seed	D52SS63	STX, RR2, LL	189.0	239.1	112	16.4	60.4	117	33,251	2.9
Dyna-Gro Seed	D52VC50	VT2PRIB, RR2	184.5	-	112	14.4	60.9	109	34,122	1.9
NK Seed	NK0472	AV3110, RR2, LL	184.2	-	104	15.1	62.2	112	32,234	1.8
Dyna-Gro Seed	D49SS70	STXRIB, RR2, LL	183.4	232.9	109	15.4	62.5	107	34,122	2.3
Dyna-Gro Seed	D53TC19	TC, RR2	180.6	-	113	13.9	61.8	107	32,525	3.5
Augusta Seed	A2856	AV3220, RR2	174.6	-	106	14.5	60.2	111	33,832	2.4
NK Seed	NK0821	AV3120, RR2, LL	173.4	213.4	108	12.9	59.4	105	36,010	1.8
Augusta Seed	A4959	AV3110, RR2, LL	167.1	-	109	17.3	61.7	112	32,380	2.0
NK Seed	NK1364	AV3111, RR2, LL	161.5	-	113	13.6	58.2	117	25,120	3.5
LG Seeds	LG62C35VT2Pro	VT2Pro, RR2	153.8	-	112	14.0	60.7	110	32,234	3.3
Pioneer	P1370AMXT	AMXT, RR2, LL	152.3	-	113	16.8	59.8	121	32,815	2.9
LG Seeds	LG5643VT2RIB	VT2PRIB, RR2	151.9	219.3	114	15.5	62.2	111	32,089	1.5
Augusta Seed	A4760	VT2Pro, RR2	147.4	-	110	13.5	59.9	121	31,218	2.5
Dyna-Gro Seed	D50VC51	VT2PRIB, RR2	133.7	-	110	15.9	61.8	98	32,670	1.4
Dekalb	DKC60-87RIB	STXRIB, RR2, LL	129.4	210.8	110	15.1	61.9	115	33,251	2.5
Dyna-Gro Seed	D50VC30	VT2PRIB, RR2	125.5	186.5	110	15.5	61.8	119	33,686	2.1
Average			**184.5**	**227.6**	**110**	**15.2**	**60.9**	**111**	**32,566**	**2.5**
[e]LSD (P<0.30)			20.4							

[a]Technology trait designations: AM=Optimum AcreMax; AMXT=Optimum AcreMax Xtreme; AV3010=Agrisure Viptera 3010; AV3110=Agrisure Viptera 3110; AV3111=Agrisure Viptera 3111; AV3120=Agrisure Viptera 3120 EZ Refuge; AV3220=Agrisure Viptera 3220 EZ Refuge; AV3330=Agrisure Viptera 3330 EZ Refuge; LL=LibertyLink; RR2=Roundup Ready 2; STX=Genuity SmartStax; STXRIB=Genuity SmartStax Refuge in the Bag Complete; STX=Genuity SmartStax; TC= Genuity Trecepta Technology; VT2PRIB=Genuity VecTran Double Protection Refuge in the Bag Complete; VT2Pro=Genuity VecTran Double Protection.

[b]Yields corrected to 15.5% moisture. Hybrid yields in bold are in the top LSD group.

[c]Relative maturity is provided by the respective companies and is the approximate time from planting to harvest maturity.

[d]Bacterial Leaf Streak (*Xanthamonas vasicola* pv. *vasculorum*) Score: 1 equals little disease present (1-20% of leaf area affected) and 5 equals severe disease presence (81-100% of leaf area affected). Most BLS lesions appeared to originate from hail damage.

[e]If the difference between two hybrid yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Site Information

Collaborator: Joe Newton
Planting Date: May 2, 2019
Harvest Date: November 7, 2019
Fertilizer: N at 270, P at 90, S at 27, and Zn at 0.5 lb/ac
Herbicide: Durango at 28 oz/ac, Resicore at 2.25 qt/ac, atrazine at 1 lb/ac
Insecticide: Bifenthrin at 2 oz/ac
Soil Type: Haxtun loamy sand
Trial Coordinates: 40.0967, -102.5378

Table 10. 2019 Dryland Grain Sorghum Hybrid Performance Trial Results at Akron

by Jerry Johnson, Sally Jones-Diamond, and Ed Asfeld

Brand	Hybrid	Grain Yield[a]	Yield	Test Weight	Plant Population	Harvest Population[b]	Tillering[c]	Plant Height	50% Bloom	Lodging	Maturity Group[d]	Grain Color
		bu/ac	% of test avg.	lb/bu	plants/ac	heads/ac	heads/plant	in	days after planting	percent		
Dekalb	DKS29-28	**80.1**	146%	57.6	35,719	65,630	0.8	41	79	0	E	Bronze
Golden Acres	2620C	**79.6**	145%	57.1	31,218	72,019	1.3	52	82	29	ME	Cream
Dyna-Gro Seed	M60GB88	**77.3**	141%	57.4	33,396	60,403	0.8	49	81	8	ME	Bronze
Dekalb	DKS28-05	**76.4**	139%	57.6	31,508	71,438	1.3	50	78	19	E	Bronze
Dyna-Gro Seed	GX17912	**76.3**	139%	58.5	31,508	66,792	1.1	53	82	15	ME	Cream
Dyna-Gro Seed	GX18919	**76.2**	139%	57.6	31,799	58,370	0.8	47	77	58	E	Cream
Sorghum Partners	SP 31A15	**75.7**	138%	56.6	28,750	45,012	0.6	47	82	3	ME	Bronze
Dyna-Gro Seed	M54GR24	74.3	135%	59.2	33,251	72,600	1.2	44	76	15	E	Red
Dyna-Gro Seed	M59GB57	73.7	134%	58.1	29,766	57,209	0.9	44	76	8	E	Bronze
Golden Acres	2950B	71.0	129%	56.5	29,476	71,148	1.4	40	80	5	ME	Bronze
Golden Acres	2730B	69.7	127%	56.5	29,766	56,047	0.9	52	83	39	ME	Bronze
Sorghum Partners	SP 43M80	69.7	127%	58.5	32,234	49,658	0.5	51	82	5	ME	Bronze
Dyna-Gro Seed	M57GC29	68.8	126%	56.7	30,637	82,183	1.7	38	80	1	ME	Cream
Sorghum Partners	SP 25C10	67.8	124%	58.3	31,073	69,115	1.2	43	73	8	VE	Cream
Pioneer	87P06	66.8	122%	58.0	33,832	71,438	1.1	47	80	1	ME	Bronze
Dyna-Gro Seed	M59GB94	63.8	116%	56.8	29,330	54,305	0.9	54	85	46	M	Bronze
Dyna-Gro Seed	M57GB19	60.3	110%	57.8	33,251	55,466	0.7	51	83	25	ME	Bronze
Sorghum Partners	SP 33S40	59.7	109%	59.4	25,555	43,270	0.7	50	78	5	E	Cream
Dyna-Gro Seed	M62GB77	59.4	108%	56.8	30,347	47,916	0.6	53	86	1	M	Bronze
Gayland Ward Seed	19015	59.0	108%	57.4	29,911	49,949	0.7	50	87	0	M	Bronze
Gayland Ward Seed	18100	49.9	91%	56.2	26,281	56,918	1.2	48	88	0	M	Bronze
Gayland Ward Seed	18273	48.3	88%	52.6	29,621	56,338	0.9	51	92	30	M	Bronze
Gayland Ward Seed	18357	45.9	84%	55.6	20,183	49,658	1.5	49	88	1	M	Bronze
Gayland Ward Seed	18274	38.6	70%	52.0	25,846	49,949	0.9	48	90	1	M	Bronze
Gayland Ward Seed	18044	38.4	70%	49.0	28,169	40,946	0.5	53	92	0	M	Bronze
Gayland Ward Seed	18275	37.1	68%	52.1	25,700	44,431	0.7	48	91	0	M	Bronze
Dekalb	DKS33-07	33.1	60%	49.6	34,412	69,406	1.0	45	92	0	M	Bronze
Dyna-Gro Seed	M69GB38	29.3	53%	50.8	24,248	63,888	1.6	56	95	0	M	Bronze
Gayland Ward Seed	19014	27.9	51%	55.1	24,539	44,722	0.8	57	91	0	M	Bronze
Gayland Ward Seed	18057	26.2	48%	52.2	23,813	46,754	1.0	50	93	0	M	Bronze
Dyna-Gro Seed	M60GB31	24.5	45%	49.1	28,459	39,785	0.4	45	93	1	M	Bronze
Alta Seeds	ADV XG390IG	3.7	7%	46.3	23,958	39,494	0.6	47	106	0	L	Red
Alta Seeds	ADV XG009IG	1.0	2%	49.3	31,073	42,689	0.4	41	104	0	L	Red
Average		**54.8**		**55.2**	**29,352**	**56,514**	**0.9**	**48**	**85**	**10**		
[e]LSD (P<0.30)		5.4										

[a]Yields adjusted to 14% moisture and hybrids ranked by yield. Hybrid yields in bold are in the top LSD group.

[b]Total number of grain-producing heads/panicles taken at harvest, including tiller and main plant heads.

[c]Average number of productive (grain containing) tiller heads per plant. Does not include main plant head.

[d]Maturity group: VE=very early; E=early; ME=medium-early; M=medium; ML=medium-late; L=Late. Groupings are based on trial observations in addition to company provided data.

[e]If the difference between two varieties yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Site Information

Collaborator:	USDA-ARS Central Great Plains Research Center
Planting Date:	June 3, 2019
Harvest Date:	October 26, 2019
Fertilizer:	Pre-plant: N at 45 lb/ac; Starter: 4.6 lb/ac of N and 10 lb/ac of Sulfur
Herbicide:	Pre-plant: Lumax EZ at 1.75 qt/ac, glyphosate at 1 qt/ac, and 2,4-D LV6 at 1 pt/ac applied May 24. Post-Emerge: Brawl at 1.33 pt/ac, Sterling Blue at 0.5 pt/ac, atrazine at 1 pt/ac applied June 24. Glyphosate at 0.5 qt/ac, Sterling Blue at 0.5 pt/ac with hooded sprayer between
Soil Type:	Rago silt loam
Trial Comments:	Planted into moisture and heavy wheat stripper-header stubble, which caused slow seedling emergence. Trial received 0.5" rain within a week of planting. Consistent rain received throughout July and August, totaling about 3.4" in July and 2.3" in August. About 0.36" of rain received in September through harvest in October. Killing freeze occurred on Oct. 9th. Dispite herbicide program, there was a heavy infestation of pigweed on about 2% of the trial, and heavily infested plots were not used for data. Rest of the trial had light weed pressure. Some lodging noted at harvest. The two hybrids from Alta at the bottom of the table are new herbicide resistant hybrids that are not adapted to the Colorado growing environment.

Table 11. 2019 Dryland Grain Sorghum Hybrid Performance Trial Results at Seibert

by Jerry Johnson, Sally Jones-Diamond, and Ed Asfeld

Brand	Hybrid	Grain Yield[a]	Yield	Test Weight	Plant Population	Harvest Population[b]	Tillering[c]	Plant Height	50% Bloom	y Group[d]	Grain Color
		bu/ac	% of test avg.	lb/bu	plants/ac	heads/ac	heads/plant	in	days after planting		
Golden Acres	2840B	**86.0**	119%	62.4	35,719	54,595	0.5	41	78	ME	Bronze
Dyna-Gro Seed	M60GB31	80.9	112%	60.0	33,396	43,560	0.3	42	80	ME	Bronze
Dyna-Gro Seed	M59GB94	80.6	111%	60.2	38,115	56,628	0.5	36	75	ME	Bronze
Dyna-Gro Seed	M62GB77	78.5	108%	60.9	39,930	49,949	0.3	38	82	M	Bronze
Dyna-Gro Seed	M69GB38	78.5	108%	60.7	32,452	42,979	0.3	41	79	ME	Bronze
Dyna-Gro Seed	GX18919	77.4	107%	60.1	38,333	60,403	0.6	42	78	ME	Cream
Dyna-Gro Seed	GX17912	77.2	107%	60.8	37,353	54,014	0.4	39	78	ME	Cream
Golden Acres	2620C	76.8	106%	60.6	34,630	54,595	0.6	36	74	E	Cream
Dekalb	DKS33-07	76.0	105%	59.2	38,877	54,305	0.4	40	83	M	Bronze
Pioneer	87P06	75.7	104%	60.3	45,738	-	-	34	74	E	Bronze
Dekalb	DKS29-28	74.5	103%	60.5	42,362	51,691	0.2	29	72	E	Bronze
Dyna-Gro Seed	M57GB19	73.2	101%	60.7	41,818	51,691	0.2	34	74	E	Bronze
Golden Acres	2730B	72.9	101%	60.8	40,656	48,206	0.2	41	74	E	Bronze
Sorghum Partners	SP 25C10	71.5	99%	60.4	40,946	62,726	0.5	33	74	E	Cream
Sorghum Partners	SP 33S40	70.5	97%	61.3	36,590	46,754	0.3	35	74	E	Cream
Dyna-Gro Seed	M59GB57	70.0	97%	60.1	34,195	56,338	0.6	33	72	E	Bronze
Sorghum Partners	SP 43M80	69.9	96%	61.3	40,511	47,626	0.2	35	79	ME	Bronze
Dyna-Gro Seed	M60GB88	69.9	96%	59.6	39,749	46,464	0.2	29	78	ME	Bronze
Dekalb	DKS28-05	67.5	93%	61.0	37,607	56,338	0.5	32	71	E	Bronze
Dyna-Gro Seed	M57GC29	66.5	92%	60.5	42,253	49,658	0.2	30	74	E	Cream
Sorghum Partners	SP 31A15	66.2	91%	59.8	32,343	45,012	0.4	30	73	E	Bronze
Dyna-Gro Seed	M54GR24	64.9	90%	61.3	43,850	69,406	0.6	33	71	E	Red
Alta Seeds	ADV XG390IG	63.3	87%	59.5	34,739	37,462	0.1	40	86	ML	Red
Gayland Ward Seed	18057	62.8	87%	60.7	28,024	33,106	0.2	47	71	E	Bronze
Alta Seeds	ADV XG009IG	61.2	84%	59.9	35,138	42,689	0.2	38	89	ML	Red
Average		**72.5**		**60.5**	**37,813**	**50,675**	**0.4**	**36**	**76**		
[e]LSD (P<0.30)		4.6									

[a]Yields adjusted to 14% moisture and hybrids ranked by yield. Hybrid yields in bold are in the top LSD group.

[b]Total number of grain-producing heads/panicles taken at harvest, including tiller and main plant heads.

[c]Average number of productive (grain containing) tiller heads per plant. Does not include main plant head.

[d]Maturity group: E=early; ME=medium-early; M=medium; ML=medium-late. Groupings are based on trial observations in addition to company provided

[e]If the difference between two varieties yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Site Information

Collaborator:	Tim Stahlecker
Planting Date:	May 28, 2019
Harvest Date:	October 25, 2019
Fertilizer:	N at 50, P at 20, and Zn at 0.5 lb/ac
Herbicide:	Pre-Emerge: Cornerstone 5 Plus at 32 oz/ac, Charger Max at 16 oz/ac, and Atrazine 4 L at 16 oz/ac; Post-emerge: Huskie at 16 oz/ac, Atrazine at 16 oz/ac, and Dicamba at 6 oz/ac.
Soil Type:	Ascalon sandy loam
Trial Comments:	Planted into moisture, cool weather after planting caused slow seedling emergence. Trial received 0.7" rain within a week of planting. Consistent rain received throughout June, totaling about 3.1". July rainfall totaled 1" and there was 3.9" in August. September and October were dry with 0.32" of rain received in September through harvest in October. Killing freeze occurred on Oct. 10th. No lodging noted at harvest.

Table 12. 2019 Irrigated Oil Sunflower Hybrid Performance Trial at Burlington

by Jerry Johnson, Sally Jones-Diamond, and Ed Asfeld

Brand	Hybrid	Oil Type[a]	Technology Traits[b]	Yield[c]	2-Year Avg. Yield	Moisture	Test Weight	Plant Height	Population	Oil Content[c]
				lb/ac	lb/ac	percent	lb/bu	in	plants/ac	percent
Nuseed	N4H521 CL	HO	Clearfield, DM	**3104**	3285	5.6	31.6	70	15,899	39.3
Dyna-Gro	H49NS14CL	NS	Clearfield, DM	**3076**	3148	5.8	33.1	74	14,084	39.8
Nuseed	4170 CL Plus	Traditional	Clearfield Plus	**2971**	-	6.1	32.1	80	15,609	39.8
Croplan by Winfield United	CP450E	HO	ExpressSun, DM	**2930**	-	5.0	33.5	72	14,447	38.6
Croplan by Winfield United	CP545CL	NS	Clearfield, DM	**2872**	3099	5.5	32.9	70	16,045	39.5
Dyna-Gro	H49HO19CL	HO	Clearfield, DM	2671	2985	5.5	33.0	69	16,698	40.2
Nuseed	Hornet	HO	Clearfield, DM	2667	2803	5.5	33.2	74	14,520	38.8
Nuseed	N4H407 CL	HO	Clearfield	2623	-	5.6	32.1	70	15,682	39.8
Croplan by Winfield United	CP455E	HO	ExpressSun, DM	2587	2618	5.4	32.8	74	14,956	39.1
Dyna-Gro	H48HO15CL	HO	Clearfield, DM	2542	2969	5.6	31.9	72	14,302	40.4
Croplan by Winfield United	CP432E	NS	ExpressSun, DM	2495	2533	4.9	32.8	66	16,480	38.6
Croplan by Winfield United	CPX59619CLP	NS	Clearfield Plus	2466	-	5.2	31.8	70	14,956	39.4
Croplan by Winfield United	CL4909E	NS	ExpressSun	2395	-	5.1	33.4	70	16,480	40.2
S&W Seed Co	NSW20440	HO	Clearfield	2339	-	5.6	32.1	70	15,246	39.7
Nuseed	N4H422 CL	HO	Clearfield	2243	-	5.5	32.8	75	14,883	39.1
Croplan by Winfield United	CP3845	HO	N/A	2123	2505	5.0	33.1	68	16,262	41.0
Nuseed	N4H470 CL Plus	HO	Clearfield Plus, DM	2078	2211	5.8	33.4	63	15,682	39.8
Croplan by Winfield United	CP432E ProSize	NS	ExpressSun, DM	2076	-	5.0	32.7	64	14,447	38.5
Nuseed	N4HM354	NS	Clearfield, DM	1863	-	5.0	33.7	72	15,536	40.1
S&W Seed Co	NSW20110	HO	Clearfield	1736	-	5.1	32.9	68	14,883	40.2
Dyna-Gro	H45NS16CL	NS	Clearfield, DM	1734	2063	5.1	32.2	68	15,028	40.5
Nuseed	N4H302 E	HO	ExpressSun	1620	1832	5.3	31.9	64	15,173	39.0
Nuseed	4140 CL	Traditional	Clearfield	1469	-	7.0	32.4	78	17,714	38.9
Average				**2377**	**2671**	**5.4**	**32.7**	**70**	**15,435**	**39.6**
[d]LSD (P<0.30)				289						
[d]LSD (P<0.05)				552						
Coefficient of Variation (%)				17.2						

[a]Oil type designations: HO=High oleic; NS=NuSun/Mid-oleic.

[b]Technology trait designations: Clearfield and Clearfield Plus=tolerant to Beyond herbicide; DM=downy mildew resistance; ExpressSun=tolerant to Express herbicide; N/A=no technology traits.

[c]Yield and oil content were corrected to 10% moisture at harvest. Hybrids in the top yield group (P<0.30) are bolded.

[d]If the difference between two hybrid yields equals or exceeds the LSD value, there is a 70% chance (P<0.30) or 95% chance (P<0.05) the difference is significant.

Site Information

Collaborator:	Gerhard Heintges
Planting Date:	June 10, 2019
Harvest Date:	October 17, 2019
Irrigation:	Center-pivot
Soil Type:	Norka-Colby silt loam

Table 13. 2019 Irrigated Confection Sunflower Hybrid Performance Trial at Burlington

by Jerry Johnson, Sally Jones-Diamond, and Ed Asfeld

Brand	Hybrid	Technology Traits[a]	Yield[b]	2-Year Avg. Yield	Moisture	Test Weight	Plant Height	Population	Seed Retained Over Screen Over 24/64	Over 22/64	Over 20/64	Over 16/64
			lb/ac	lb/ac	percent	lb/bu	in	plants/ac	percent			
Nuseed	X4334	Clearfield	**3188**	-	8.4	20.7	74	12,560	46.3	71.1	88.6	98.6
Valia Genetics	Valia 41	N/A	2842	2769	7.0	21.3	72	9,511	23.8	45.5	72.3	95.8
Nuseed	NSKM65810	Clearfield	2478	-	8.5	19.9	69	10,091	30.5	55.5	78.2	97.9
Nuseed	Jaguar II	Clearfield	2350	-	8.3	21.2	70	11,035	33.1	55.8	79.3	97.2
Red River Commodities	RRC 2414	N/A	2278	3100	7.6	22.2	76	10,963	29.9	49.0	75.1	96.3
Red River Commodities	RRC 2319	N/A	2263	2580	7.8	21.8	72	11,689	21.8	46.0	75.3	96.7
Nuseed	LD5009	N/A	2228	2758	7.9	21.4	66	9,946	27.5	45.5	67.1	96.8
Nuseed	NSKM53777	Clearfield	2102	-	7.5	21.1	66	9,801	27.2	49.3	76.5	97.3
Nuseed	N6L602 CL	Clearfield	1949	-	9.0	20.3	65	11,253	30.9	49.9	72.7	96.9
Red River Commodities	RRC 2310	N/A	1807	2508	9.2	21.1	74	11,035	32.0	55.3	78.0	96.5
Valia Genetics	H9811 EXP	N/A	1546	2086	7.4	21.7	66	10,091	26.2	46.6	71.4	96.8
Valia Genetics	H9814 EXP	N/A	1508	-	7.6	20.3	64	11,979	44.1	60.9	78.7	97.0
Average			**2211**	**2634**	**8.0**	**21.1**	**70**	**10,830**	**31.1**	**52.5**	**76.1**	**97.0**
[c]LSD (P<0.30)			269									
[c]LSD (P<0.05)			517									
Coefficient of Variation (%)			21.3									

[a]Technology trait designations: Clearfield=tolerant to Beyond herbicide; N/A=no technology traits.

[b]Yield and oil content were corrected to 10% moisture at harvest. Hybrid(s) in the top yield group (P<0.30) are bolded.

[c]If the difference between two hybrid yields equals or exceeds the LSD value, there is a 70% chance (P<0.30) or 95% chance (P<0.05) the difference is significant.

Site Information

Collaborator:	Gerhard Heintges
Planting Date:	June 10, 2019
Harvest Date:	October 17, 2019
Irrigation:	Center-pivot
Soil Type:	Norka-Colby silt loam

Pest Alert (Pest Survey) in Northeastern Colorado

Assefa Gebre-Amlak

Extension Specialist, Colorado State University Extension

Introduction: Pest alert program monitors field crop pests in alfalfa, corn, dry beans, sunflowers and winter wheat with objectives of providing timely pest management information to citizens of Colorado. Monitoring of alfalfa, dry beans, winter wheat pests is based on field scouts and reports from co-operators, extension offices and producers whereas corn insects (European corn borer and western bean cutworm moths) and sunflower insects (sunflower moths and banded moths) were monitored with insect pheromone (lures) that are commercially available.

The monitoring sites included Akron, Burlington, Eckley, Haxtun, Wauneta and Yuma, however, in 2018, only Akron (Washington County), Burlington, Eckley (Yuma County) and Prospect Valley (Weld County) sites were used. Historic data of other sites from earlier years were included in the current report. Most of the monitoring sites have ten or more years of data and average was used to show the trend and seasonal abundance of the pest in each site.

European corn borer: as can be seen in Figures 1-6, European corn borer moth emergence and flight period was similar in all locations presented in the report. It generally has two generations per year (see two distinct peaks during the growing season) with exception of slight variations in some years and locations.

The first generation moths emerged around the early part of June and peaked between the 2nd and 3rd week of the same month (figures 1-6). Inspection and monitoring for 1st generation should be conducted between the second and last week of June as mean peak population of this generation occurs during this period. Chemical treatment for 1st generation is based on leaf infestation and presence of live larvae; is justified if 25 percent of plants show leaf typical leaf infestations.

Pheromone trap data show that the 2nd generation European corn borer moth emerged during the 1st week of August and peaked between 2nd and 3rd weeks of the same month (figures 1-6). Second generation moth populations were markedly lower than the 1st generation in all pheromone locations. In general, historic pheromone trap data showed that Burlington, Eckely and Haxtun sites had the largest numbers of European corn borer moth in Colorado.

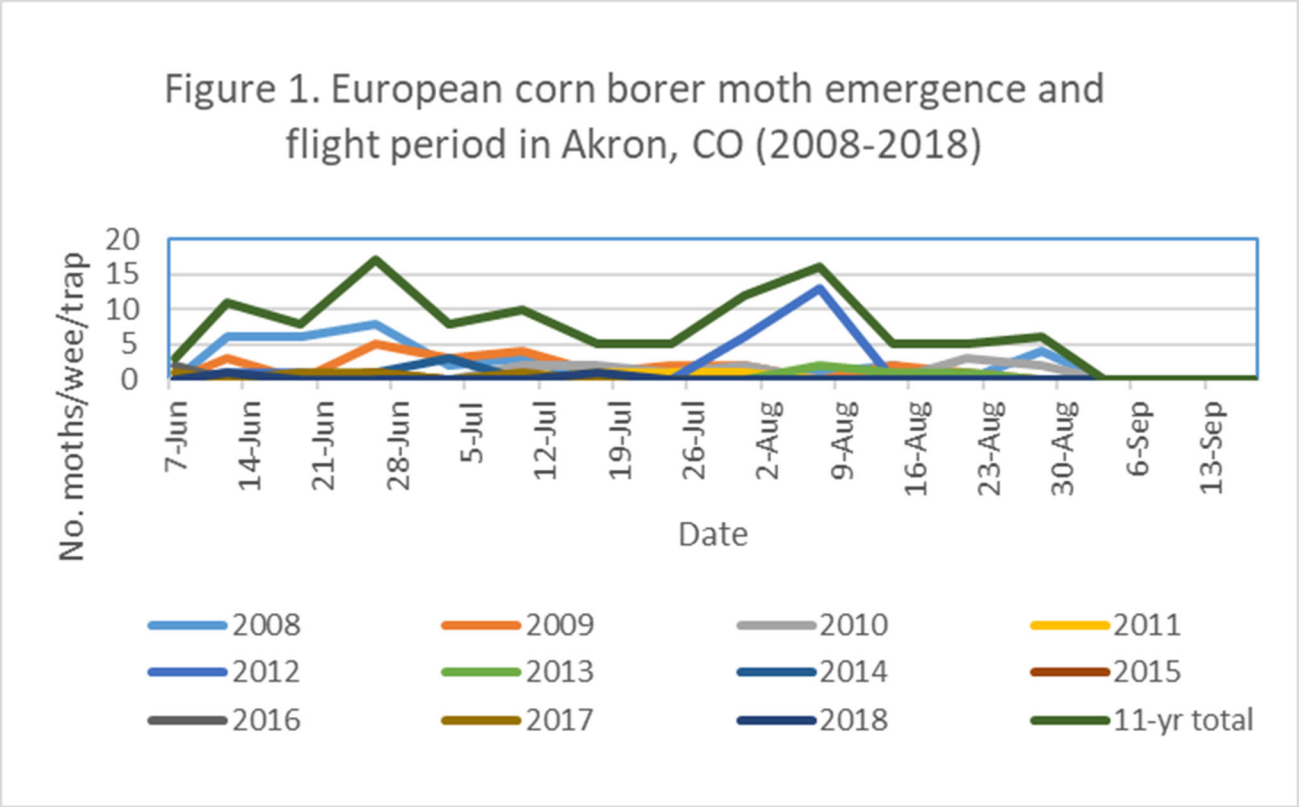
Long term monitoring of European corn borer in northeastern Colorado showed that the pest was more abundant in areas along the Highway 385 including Burlington, Eckley, Haxtun and Wauneta than Akron or Yuma. However, the same data show a decline in number of the European corn borer moth since 2010 in northeastern Colorado (figure 1-6). This decline probably has to do with increased use of Bt corn in the area.

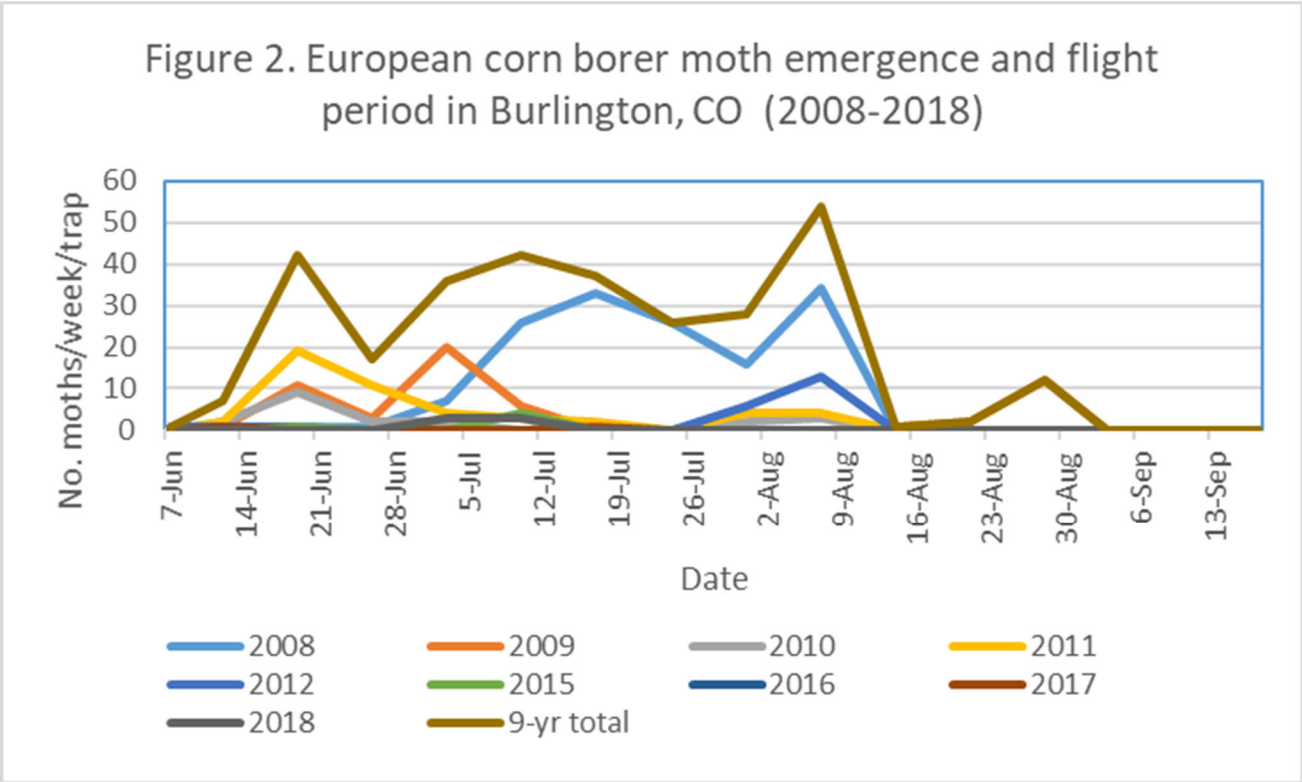
Western bean cutworm: western bean cutworm moth emerged around the end of June and peak population of the insect was observed around the 3rd week of July and 2nd week of August in Colorado. As can be seen from the monitoring data, western bean cutworm populations in Akron, Haxtun and Eckley were twice the size of other sites including Burlington, Wauneta and Yuma (figures 7-12)

Sunflower Insects: sunflower moths and banded moths were observed between early July and the end of August and population peaks around the 2nd week of August (Figures 13-18). In 2015, both Akron and Burlington had the largest numbers of sunflower moth and followed by two years of lower populations of the moth. In Julesburg, however, it was in 2014 that larger numbers of sunflower head moths were captured in pheromone traps in the area.

Despite the fact that there are more banded sunflower moth populations than sunflower moths in all monitoring sites, it is less important according to Colorado State university field study. The key sunflower head-infesting insects are sunflower moth and sunflower red seed weevils.

European corn borer moth seasonal abundance and flight period in Colorado





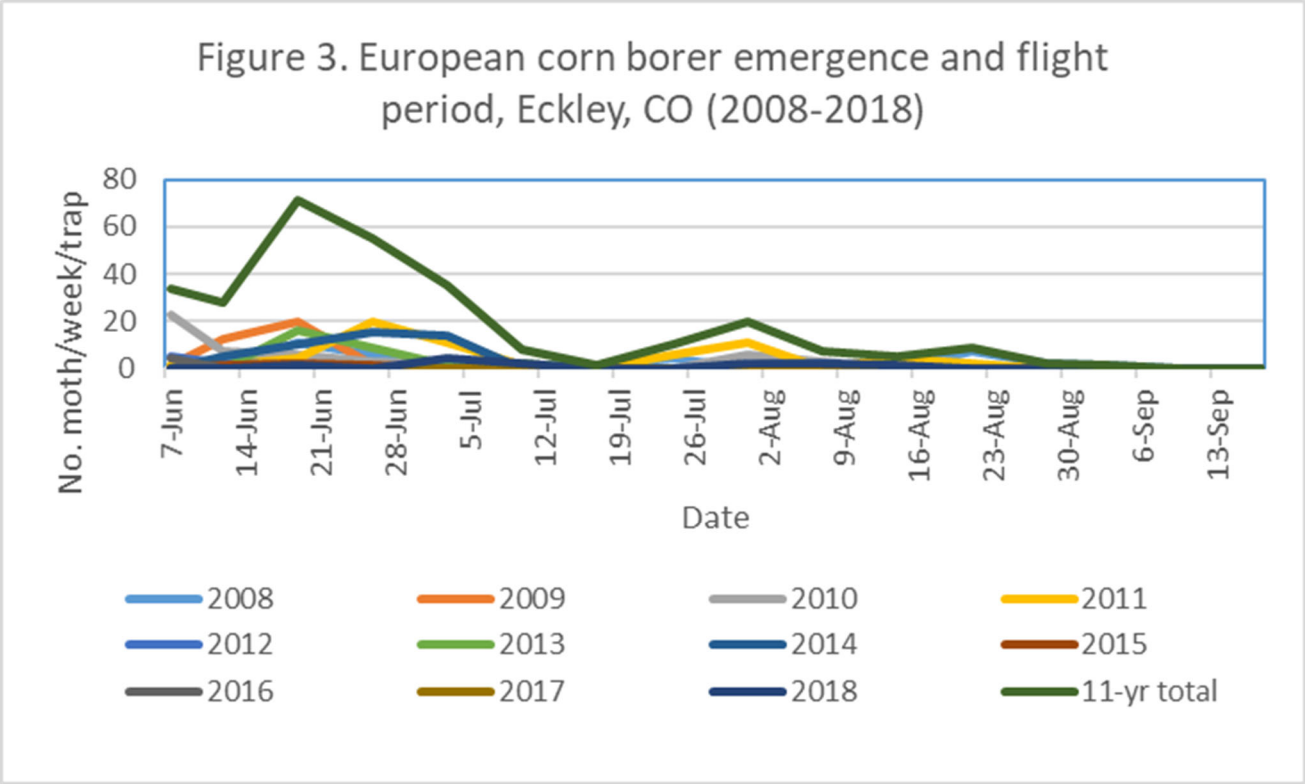


Figure 3. European corn borer emergence and flight period, Eckley, CO (2008-2018)
No. moth/week/trap
80
60
40
20
0
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
30-Aug
6-Sep
13-Sep
Date
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
11-yr total

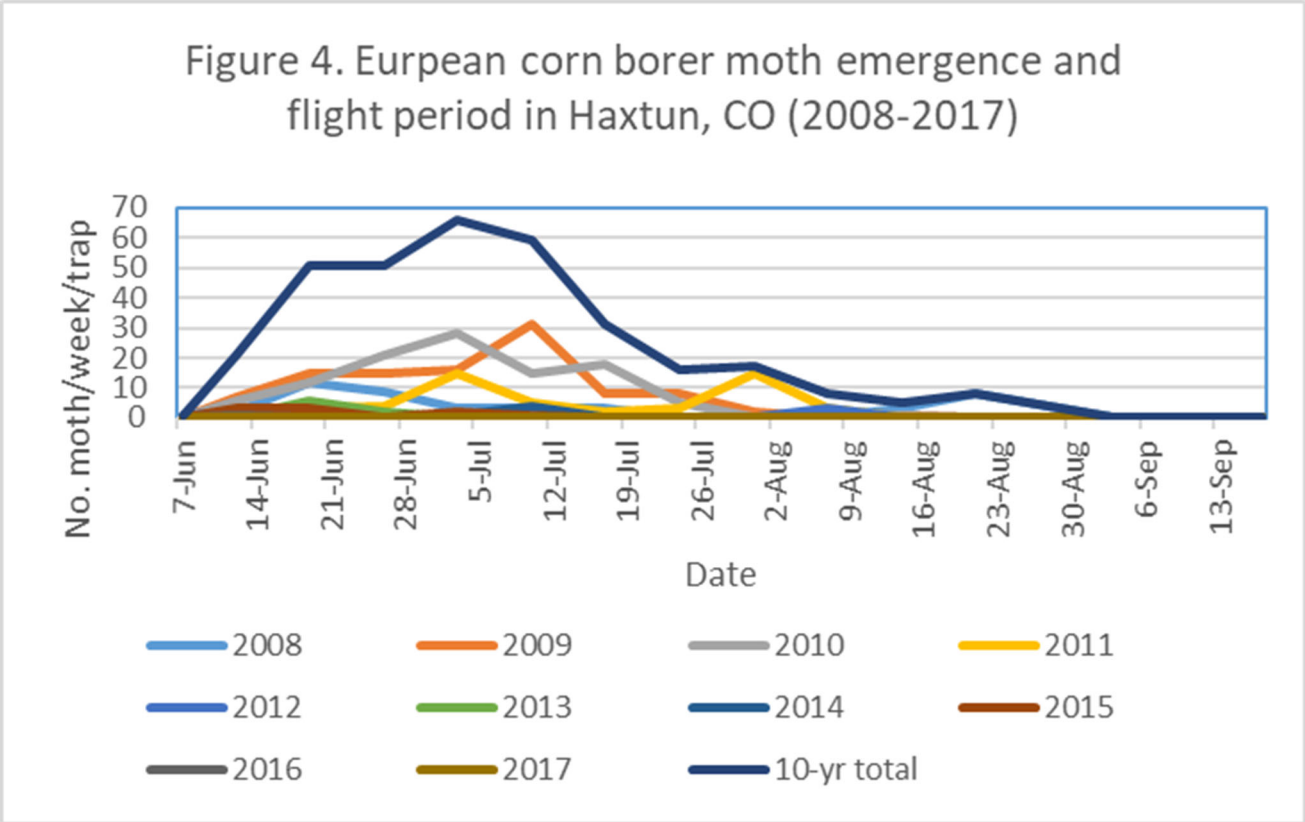


Figure 4. Eurpean corn borer moth emergence and flight period in Haxtun, CO (2008-2017)
No. moth/week/trap
70
60
50
40
30
20
10
0
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
30-Aug
6-Sep
13-Sep
Date
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
10-yr total

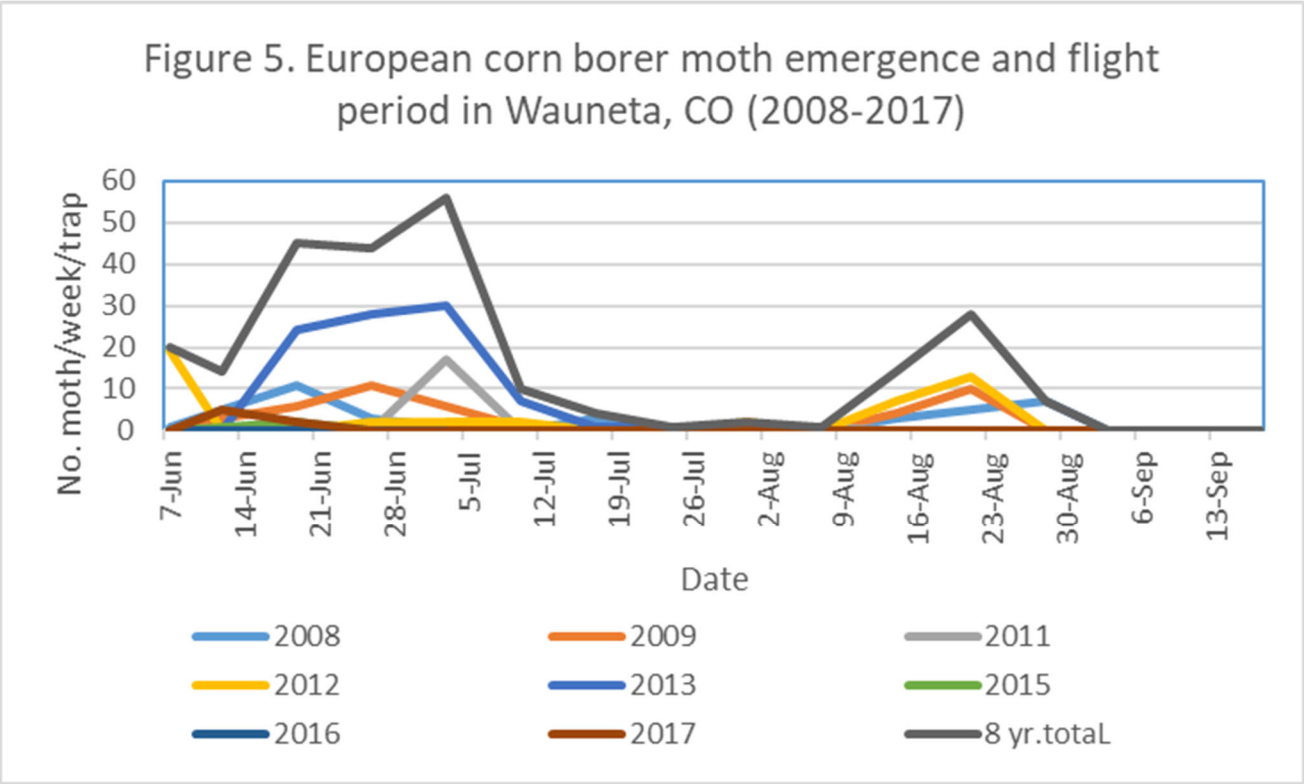


Figure 5. European corn borer moth emergence and flight period in Wauneta, CO (2008-2017)
No. moth/week/trap
60
50
40
30
20
10
0
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
30-Aug
6-Sep
13-Sep
Date
2008
2009
2011
2012
2013
2015
2016
2017
8 yr.totaL

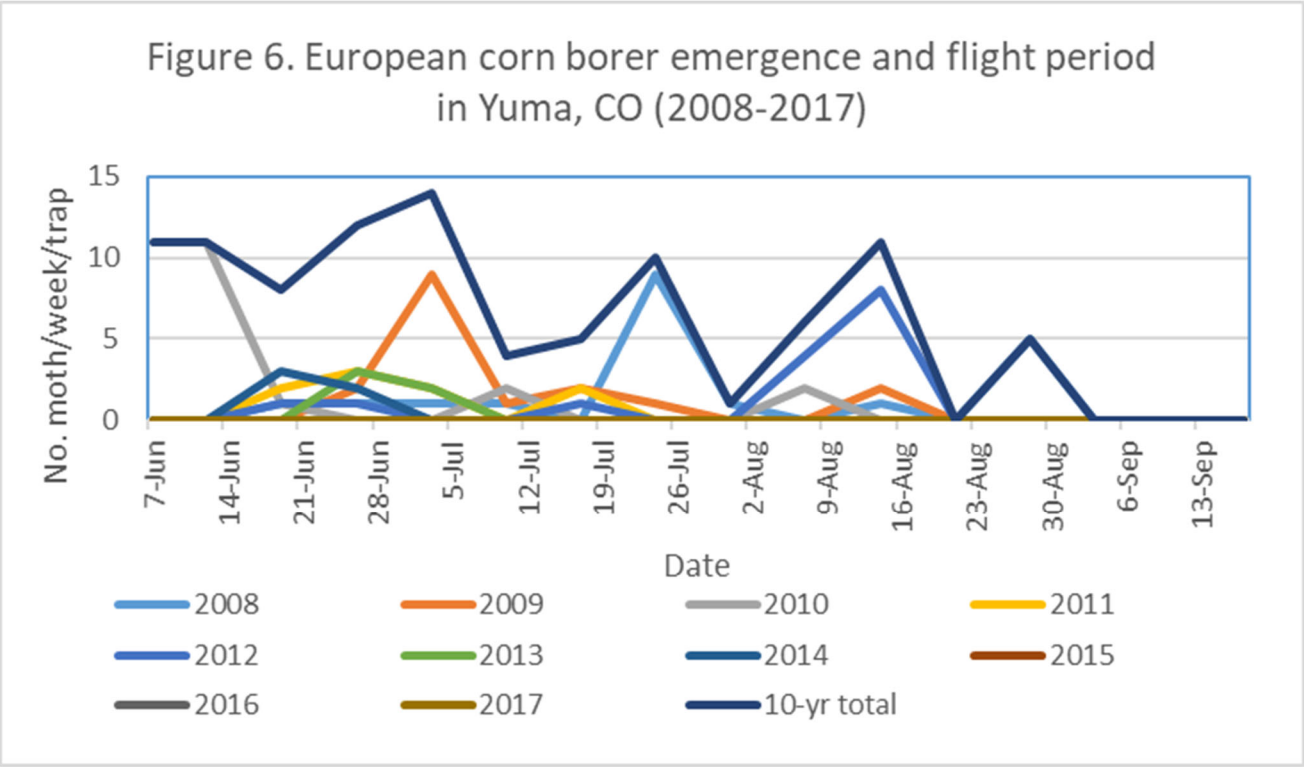
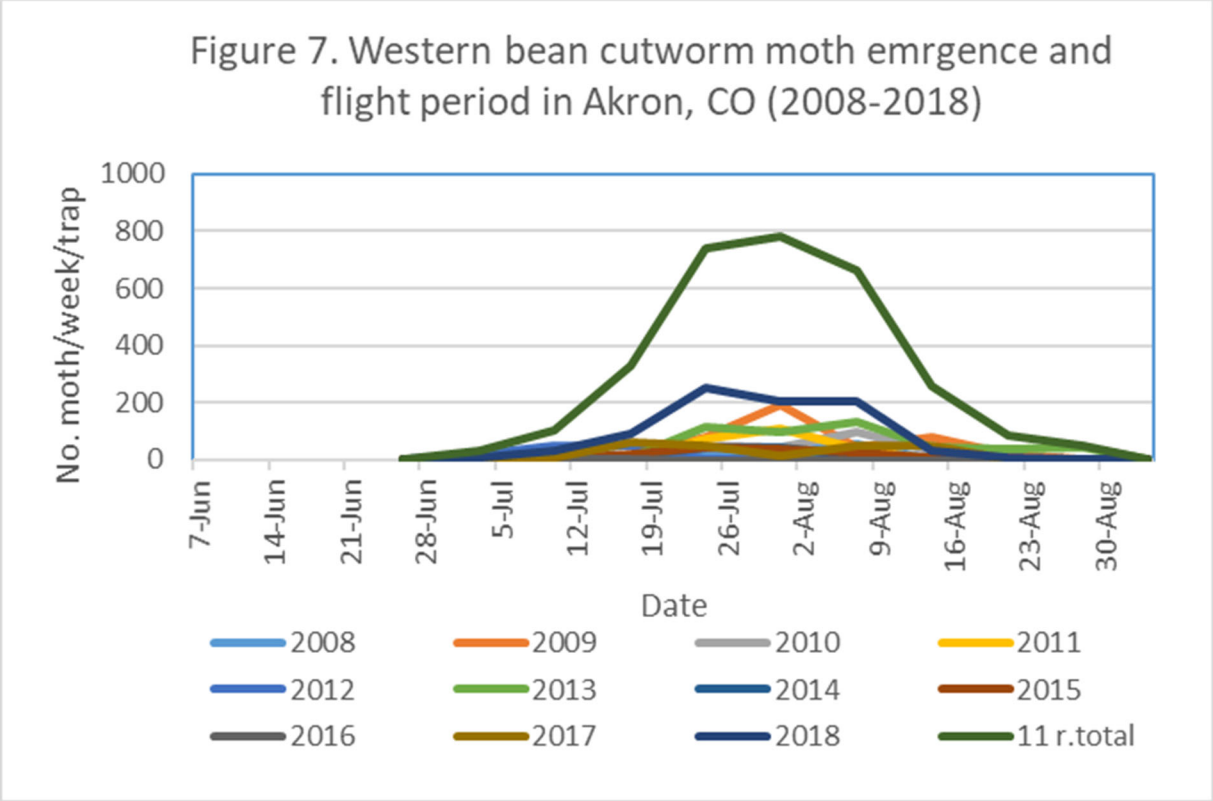
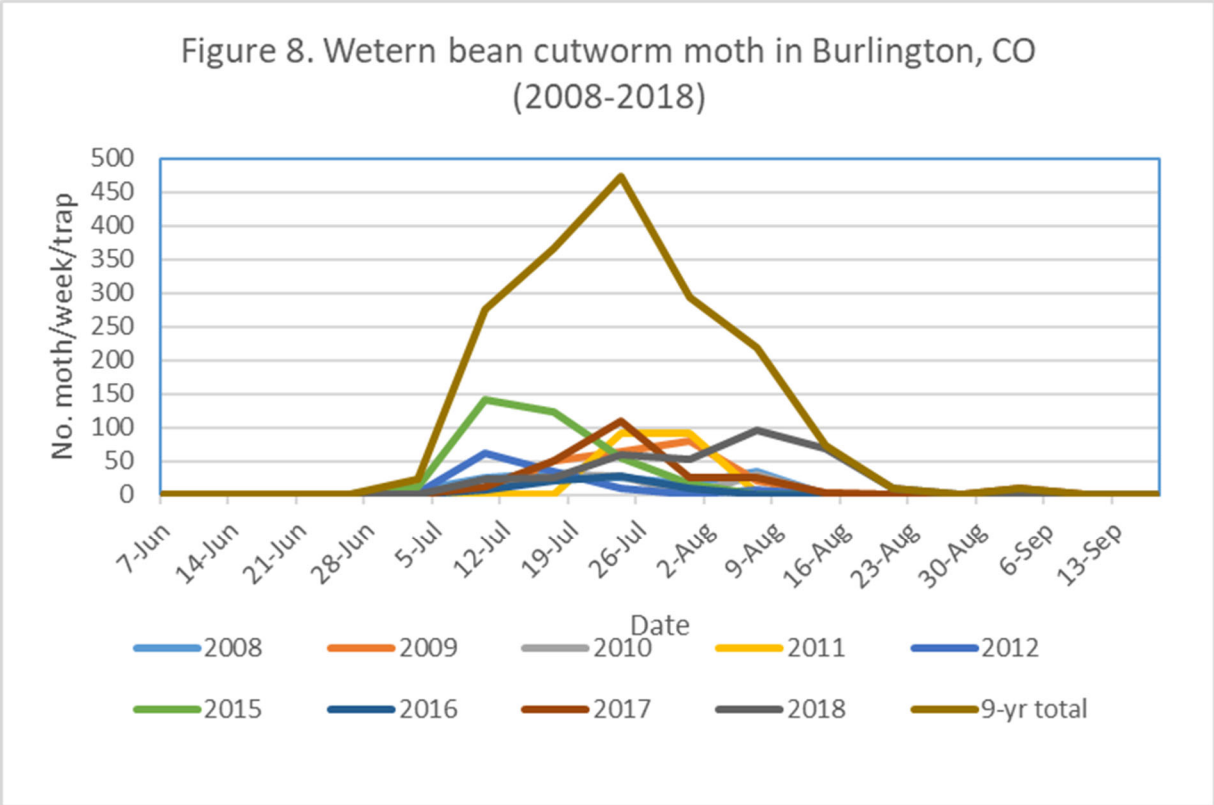


Figure 6. European corn borer emergence and flight period in Yuma, CO (2008-2017)
No. moth/week/trap
15
10
5
0
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
30-Aug
6-Sep
13-Sep
Date
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
10-yr total

Western cutworm moth seasonal abundance and flight period in Colorado





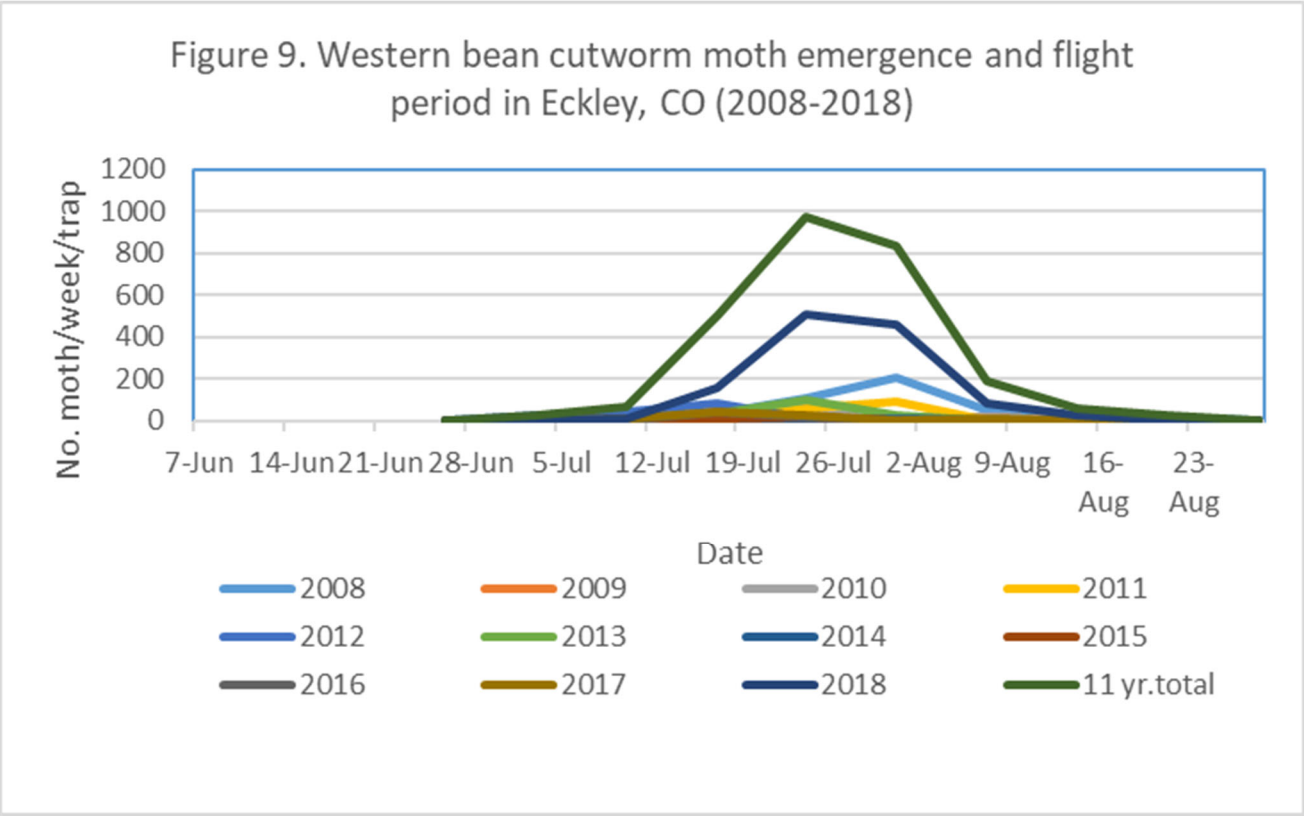


Figure 9. Western bean cutworm moth emergence and flight period in Eckley, CO (2008-2018)
No. moth/week/trap
1200
1000
800
600
400
200
0
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
Date
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
11 yr.total

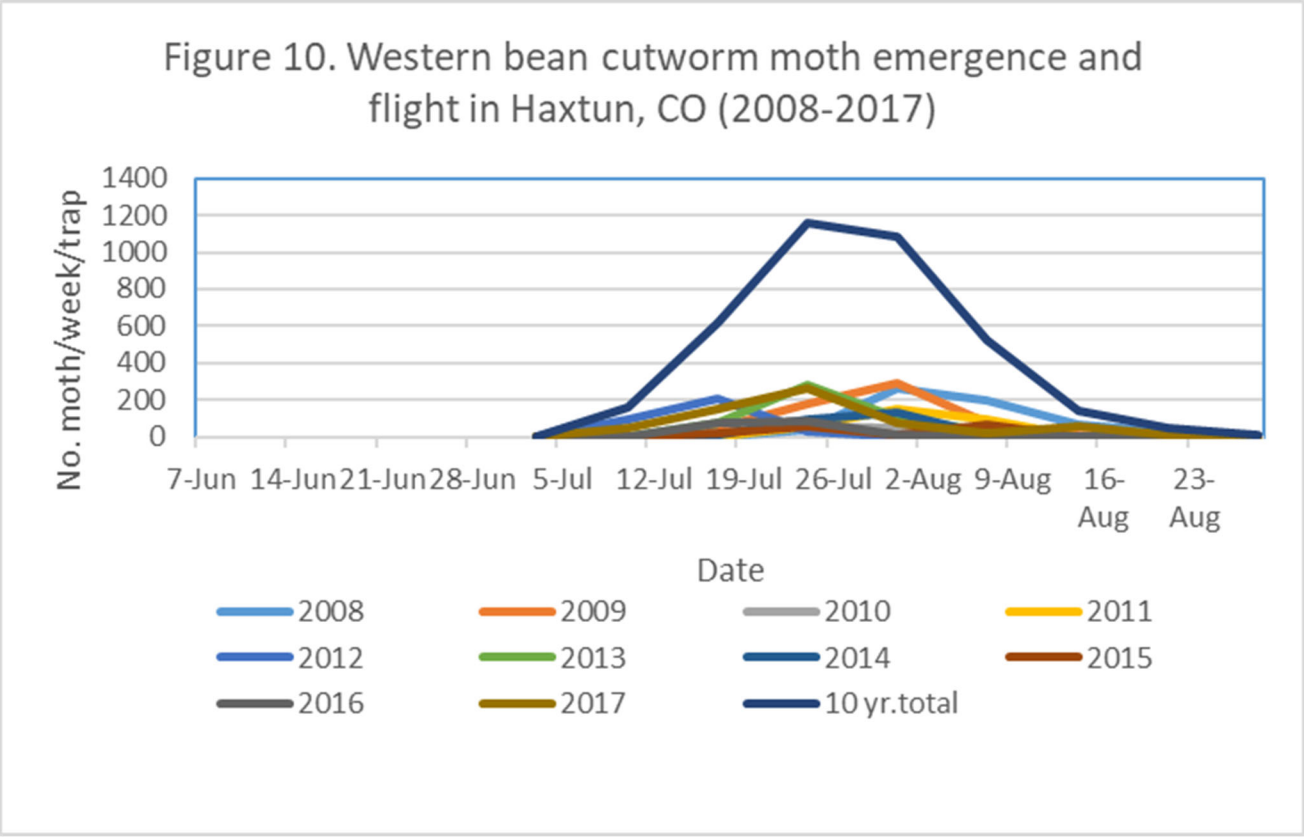


Figure 10. Western bean cutworm moth emergence and flight in Haxtun, CO (2008-2017)
No. moth/week/trap
1400
1200
1000
800
600
400
200
0
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
Date
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
10 yr.total

Figure 11. Western bean cutworm moth emrgence and flight period in Wauneta, CO (2008-2017)

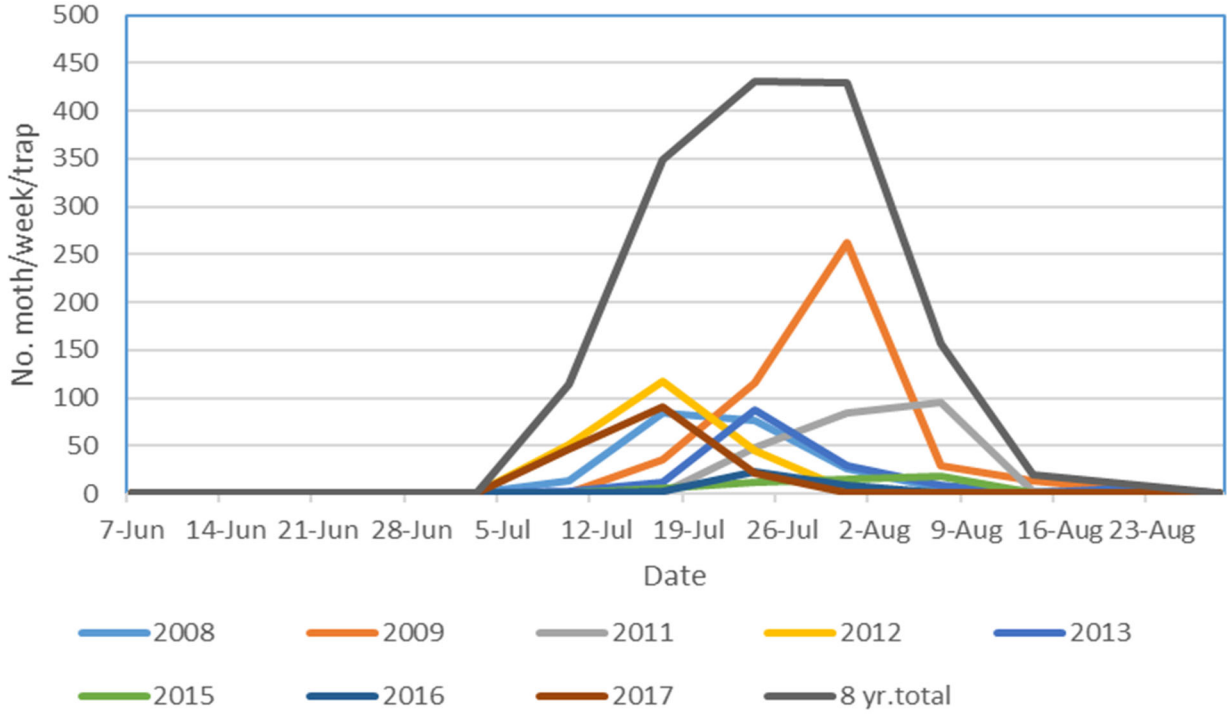
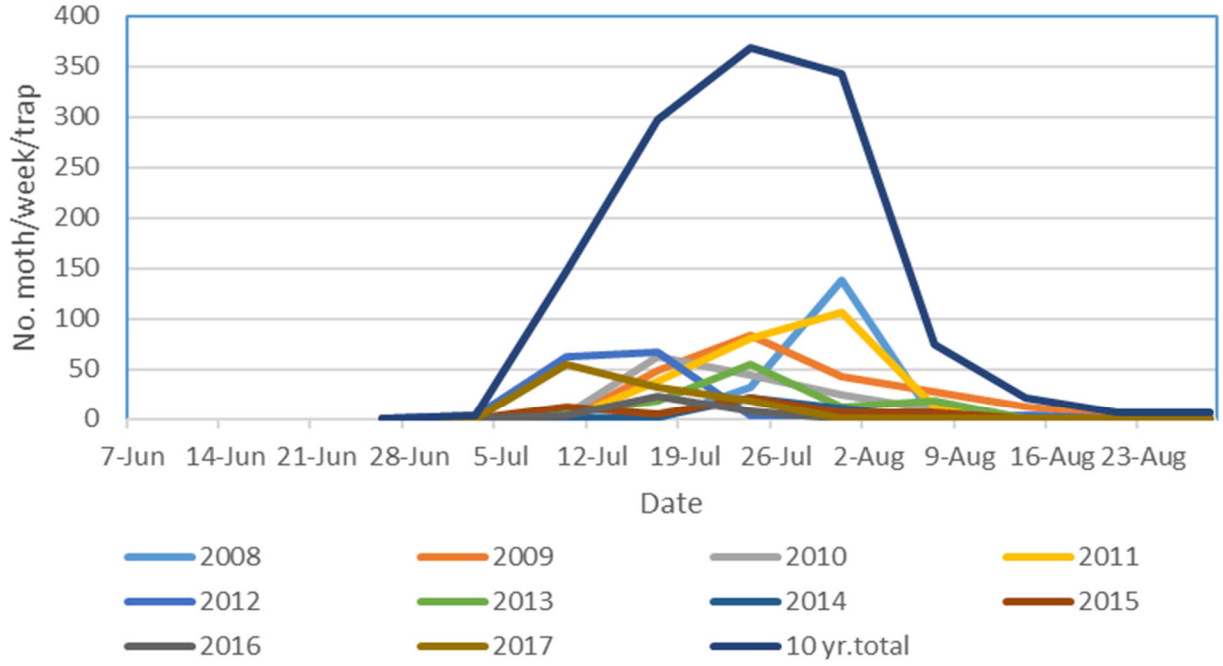
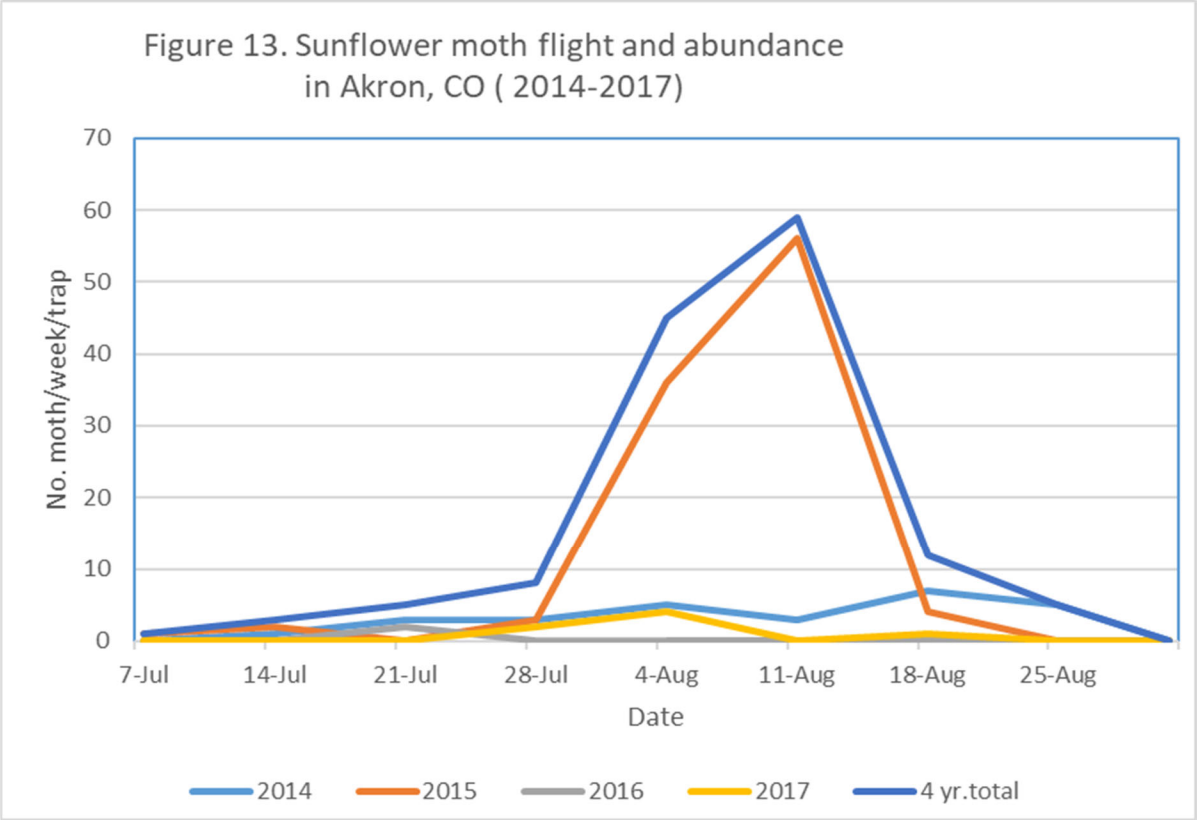
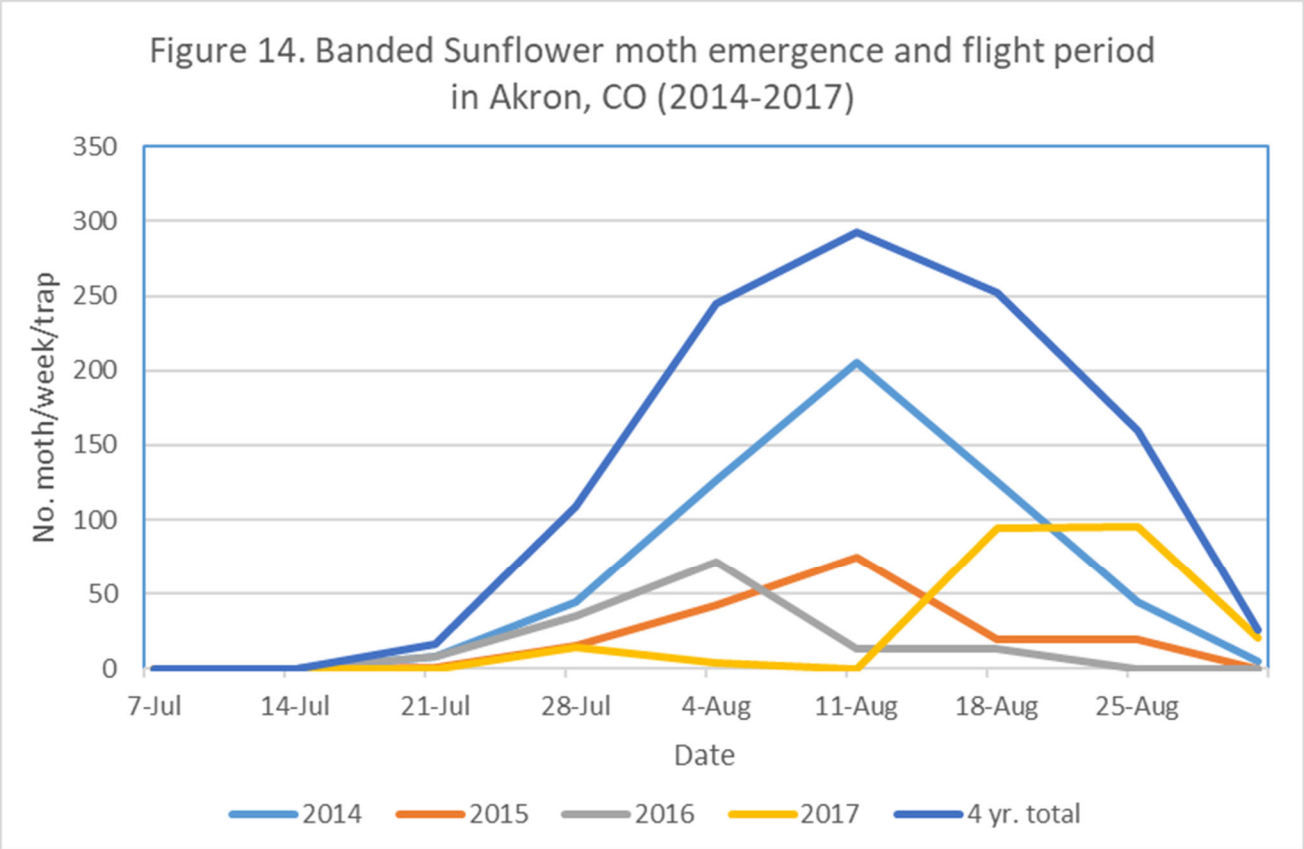


Figure 12. Western bean cutworm emrgence and flight period in Yuma, CO (2008-2017)



Sunflower moth and banded moth seasonal abundance flight periods





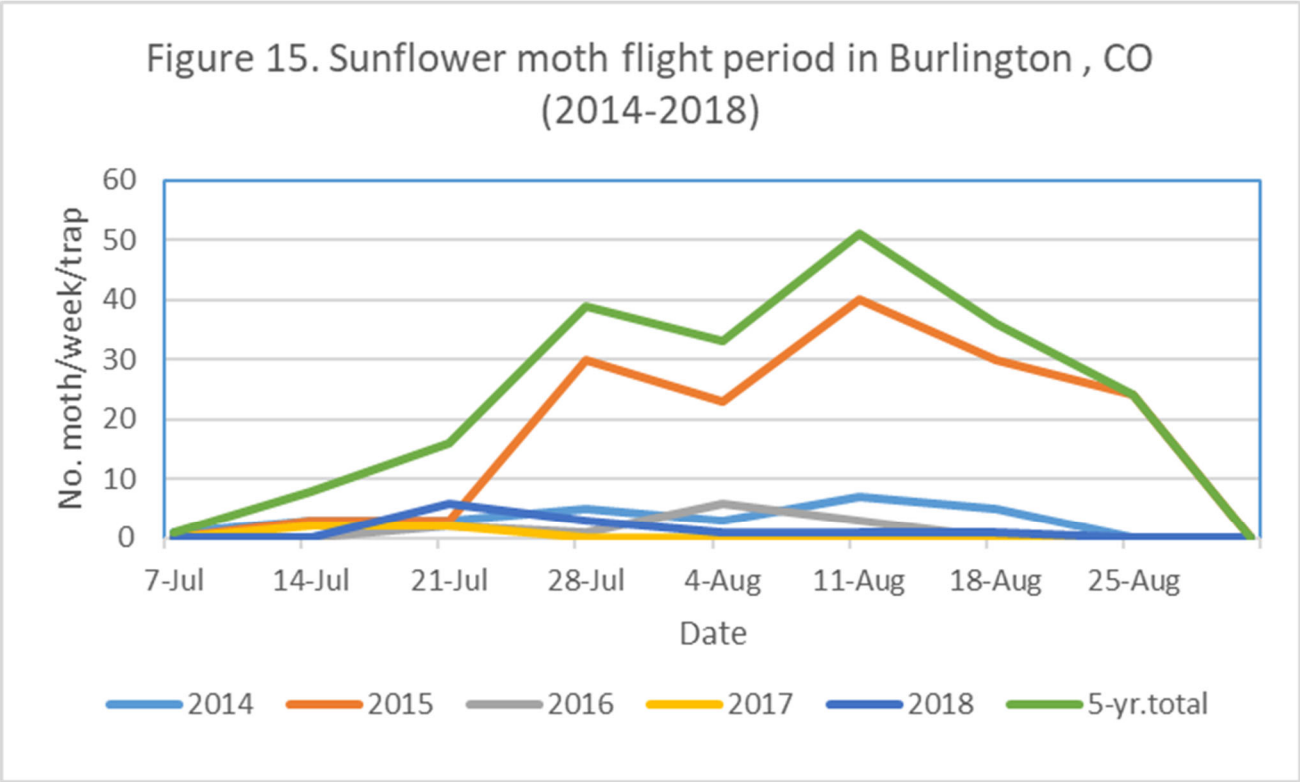


Figure 15. Sunflower moth flight period in Burlington , CO (2014-2018)
No. moth/week/trap
60
50
40
30
20
10
0
7-Jul
14-Jul
21-Jul
28-Jul
4-Aug
11-Aug
18-Aug
25-Aug
Date
2014
2015
2016
2017
2018
5-yr.total

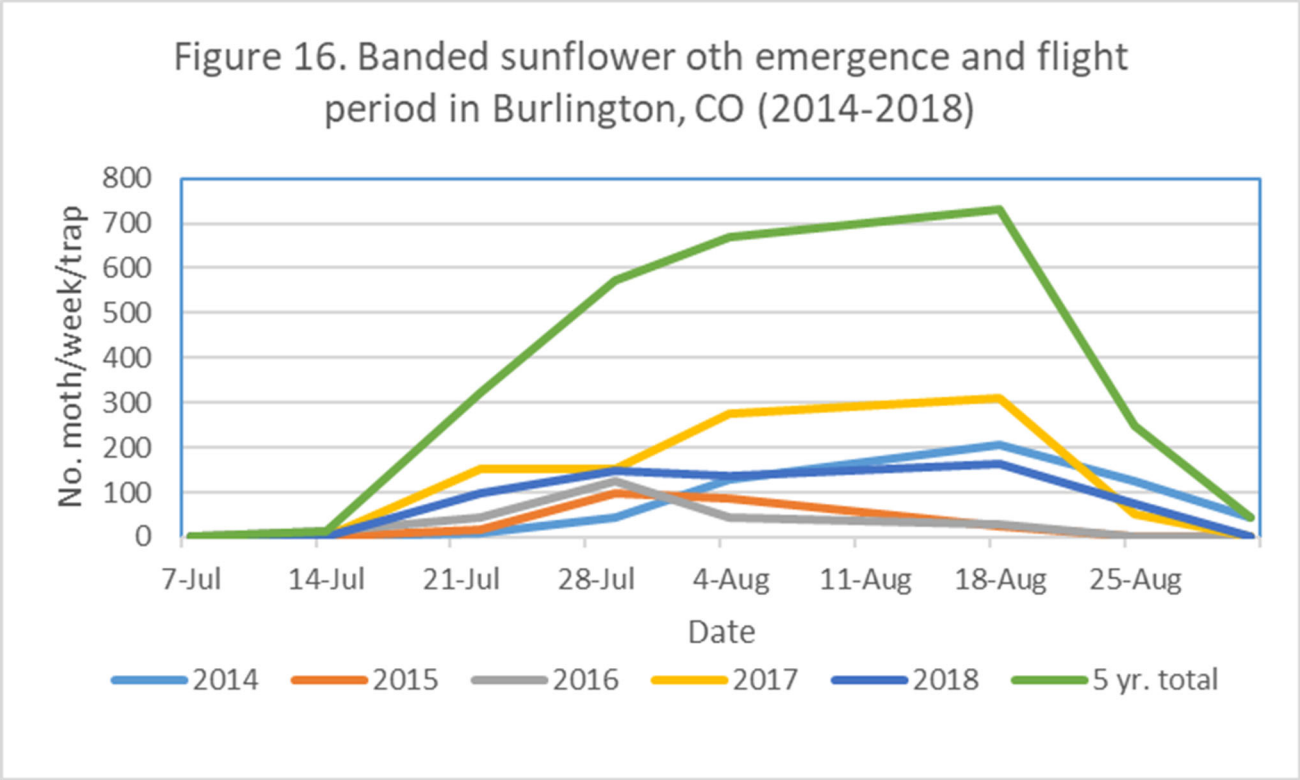


Figure 16. Banded sunflower oth emergence and flight period in Burlington, CO (2014-2018)
No. moth/week/trap
800
700
600
500
400
300
200
100
0
7-Jul
14-Jul
21-Jul
28-Jul
4-Aug
11-Aug
18-Aug
25-Aug
Date
2014
2015
2016
2017
2018
5 yr. total

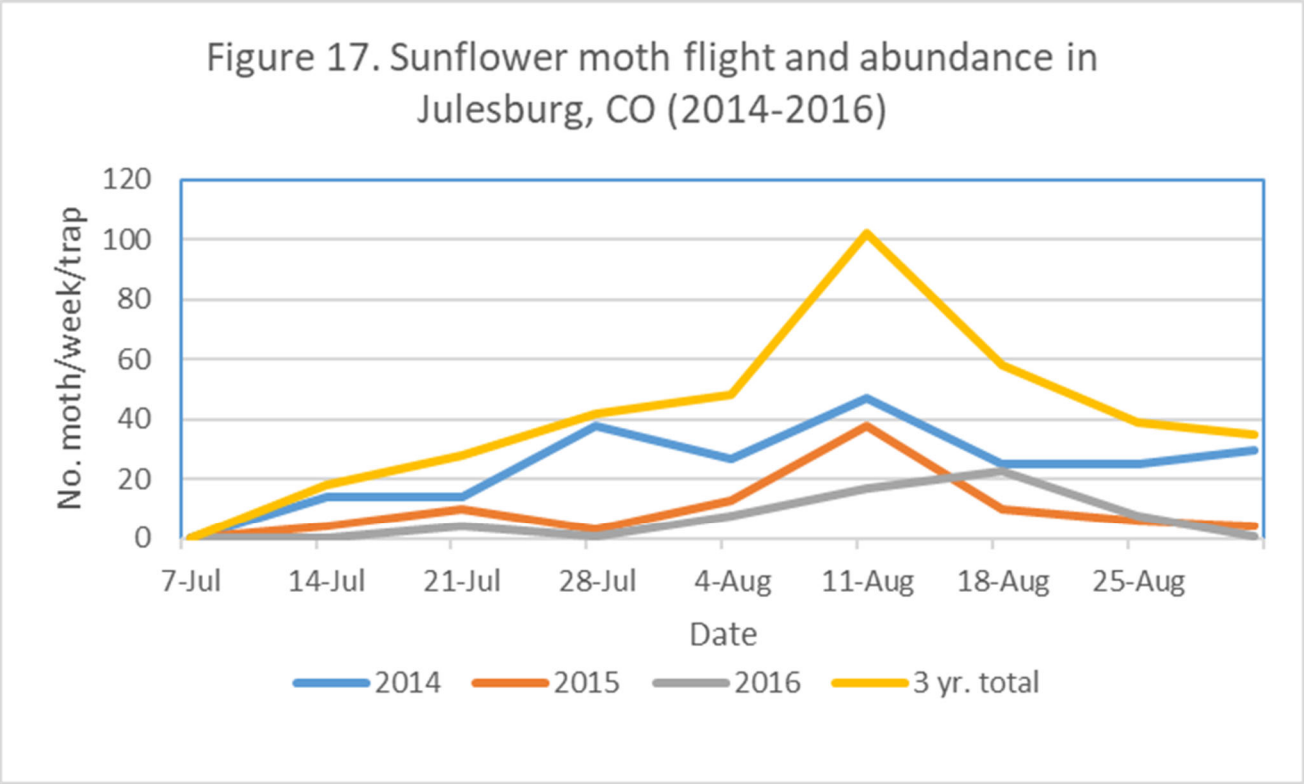


Figure 17. Sunflower moth flight and abundance in Julesburg, CO (2014-2016)
No. moth/week/trap
120
100
80
60
40
20
0
7-Jul
14-Jul
21-Jul
28-Jul
4-Aug
11-Aug
18-Aug
25-Aug
Date
2014
2015
2016
3 yr. total

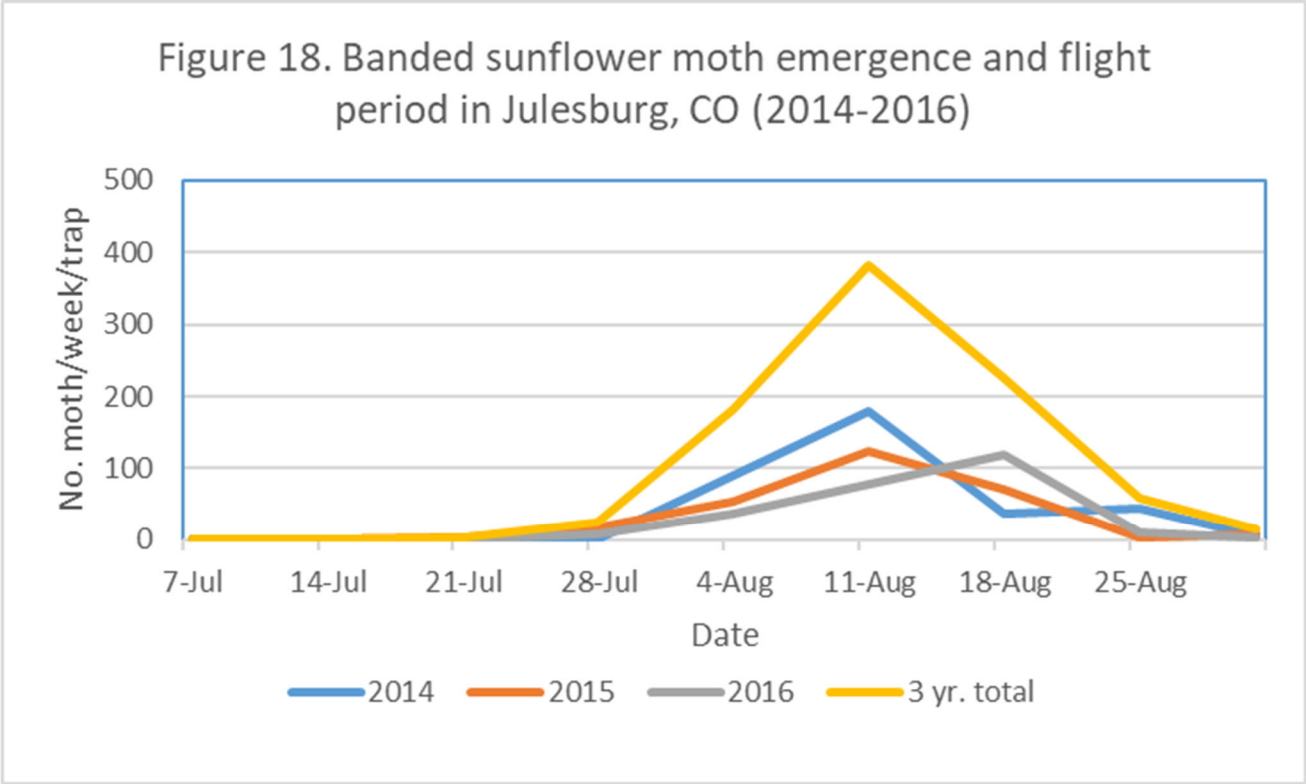


Figure 18. Banded sunflower moth emergence and flight period in Julesburg, CO (2014-2016)
No. moth/week/trap
500
400
300
200
100
0
7-Jul
14-Jul
21-Jul
28-Jul
4-Aug
11-Aug
18-Aug
25-Aug
Date
2014
2015
2016
3 yr. total

Emerging Remote Sensing Products, Rangeland Production Monitoring Service (RPMS) for Managing Rangelands

Annie Overlin, Regional Rangeland Specialist

Who doesn't love looking at aerial images of their ranch? You can see your house, that hopefully permitted new addition, the cows in the pasture. Nowadays using aerial imagery is synonymous with using electric fence to cross fence. It's a tool that just makes management easier. While staring at images of your ranch online is no substitute for walking around in your pasture, once you train your eye to interpret how specific colors and textures correspond to what is actually on the ground, it's a lot easier to gain a holistic understanding of the whole operation. I would imagine most of us who need to know how much production is in a pasture have a decent understanding of the difference between 500 lbs per acre and 2000 lbs/acre. When it comes to managing cows on range, having an accurate number of forageable production is essential to good grazing management. This number informs stocking rate, when to move cows, how long they can stay, and how much feed if any needs to be purchased. Embarrassingly, there have been many times, particularly when working in 1000+ acre pastures, that I've measured a pasture based on what I thought was representative, walked a different route back to the truck and realized my measurement was not representative. So, what I've learned is to have the aerial imagery on hand and measure within different "color/texture signatures" or polygons. A good example of this on the plains is a stand of switch grass/ prairie sand reed has a mottled brown signature whereas sod-bound blue grama has a light tan color and the difference in production is about 1500 lbs/ acre.

What if I were to assign production values without having to measure? Over the last several years, emerging remote sensing developers across the globe have been racing to do just that. Instead of training our eyes to interpret imagery, they're training the computer to interpret imagery. None of the developers have quite cracked the nut of accurately measuring annual production by species using remote sensing but they are getting closer. One such tool developed by the Rocky Mountain Research Station, the Rangeland Production Monitoring Service (RPMS) is a publicly available dataset that quantifies annual production on about 662 million acres of U.S. rangelands from 1984 to present and will be annually updated. This novel product directly links Normalized Difference Vegetation Index (NDVI) to annual production. NDVI can come from a variety of satellite or airborne sensors or "cameras" and is useful for detecting live green plant canopies by measuring the difference between near-infrared and red (visible) light (chlorophyll in plants strongly absorbs visible light for use in photosynthesis while the cell structure of the leaves strongly reflects near -infrared light). While NDVI reflects plant cover, it does quantify plant production. RPMS takes the index a step further by using production values from a data set encompassing millions of acres over 50+ years to calibrate the index to produce annual production. When this method was tested on the Great Plains, validation metrics included an accuracy of 89% between predicted and observed annual production. That is pretty accurate! However, though this product shows promising accuracy in predicting total annual production, it does have limitations: Accuracy above 3000 lbs/acre is not sufficient due to the limitations of NDVI. This is great news for the plains of Colorado because the vast majority of our rangelands are under 3000 lbs/acre. This product only provides total production, not forageable production. So, if you have 2000 lbs/ production per acre and half of it is cheatgrass and half is western wheat, it won't tell you the difference.

How we can use it: Back to my switchgrass/prairie reed and sodbound blue grama pasture. RPMS developer, Matt Reeves graciously worked with me to quickly extract information from this pasture and really where the rubber met the road was when it started pumping out production values on my polygons. Not only were its values within 50 lbs of my field measurements for

2018, it gave values of the previous 34 years. What caught my eye was that sod-bound blue grama polygon (500 lbs/acre) was 850 lbs/acre dur

ing the drought in 2002 and 1870 lbs/acre in 2003. This tool can really help inform how variable and vulnerable specific areas over the whole ranch can be over time. So, the next time I am out in a pasture, I'll use this monitoring service first to help me understand not only the production potential of the site, but how specific areas have changed. Forage insurance- this could be a great tool to help manage risk from forage loss due to drought. The use of actual production can aid in the selection of various aspects of forage insurance such as when production normally occurs and for how much production to insure. For example, a producer would not want to purchase insurance for 2,500 lbs/acre of production if normal production is about 1,250 lbs/acre.

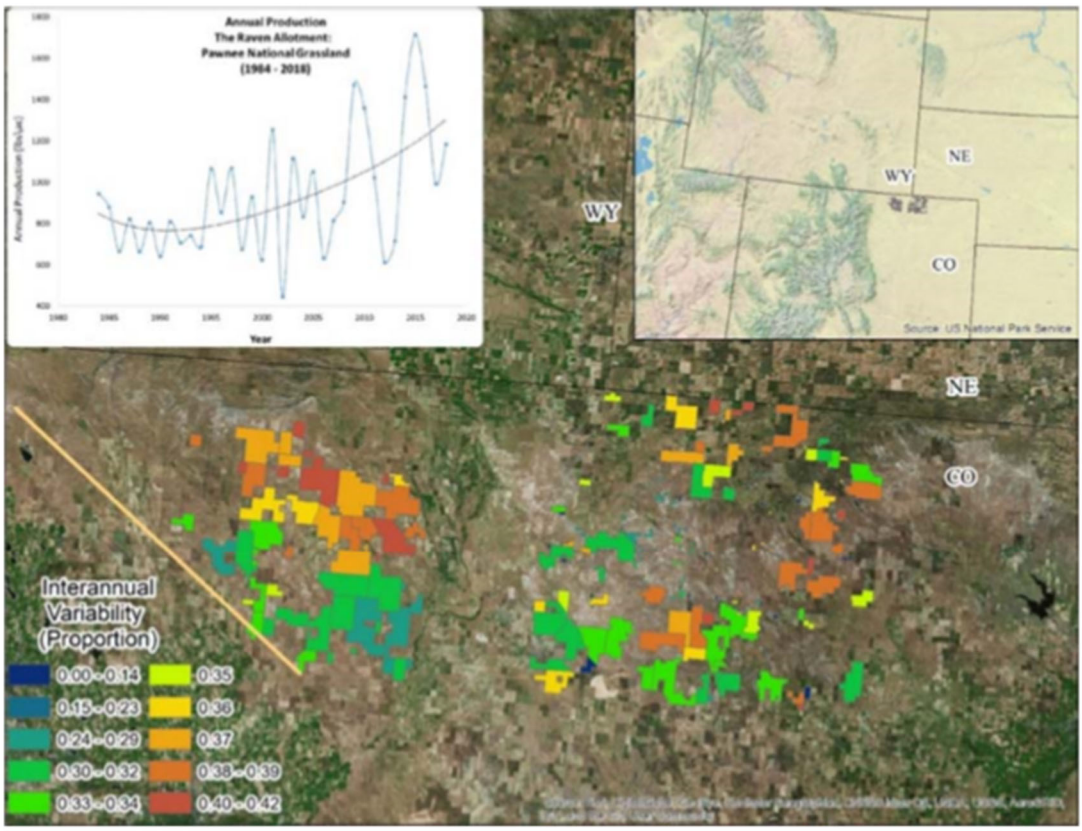


Figure 1. The aerial image left shows inter-annual variability in vegetation production (as a percent of the 34 year mean). The upper left shows how much the production one particular allotment changes over time. Note the extreme variability since about 2002 in the production estimates across the selected grazing allotment.

Corn Stalk Grazing

Travis Taylor, CSU Livestock Extension Agent

Historically, the Golden Plains Area counties impact Colorado's beef industry by providing corn stalk residue as a fall and winter feed source for dry pregnant cows. This opportunity has provided corn growers a second source of income from their crop, while providing cow/calf producers a less expensive forage and the opportunity to rest native winter range. Despite improved harvesting technology and equipment, grazing will reduce field volunteer corn stands that result as kernels pass through a combine, or ear lost to environmental weather conditions. With the opportunities that grazing corn residue brings, other key items should be considered before making any agreements.

Stocking fields correctly can have a dramatic economic effect for producers as leases are generally calculated on a per head basis. Research from the University of Nebraska-Lincoln (UNL) has concluded that there will be about 16 pounds of leaf and husk per bushel of corn yield left as residue. Therefore, in a field that yields 160 bushels/acre there would be 2560 pounds of quality residue. In a "take half, leave half" grazing practice, this equates to 1280 pounds, or enough residue per acre to feed a 1200 pound dry pregnant cow 48 days. The UNL Beef Team developed a simple excel spreadsheet to help producers determine field grazing capacity based on corn yield. Called the "Corn Stalk Grazing Calculator", it is available free online at https://beef.unl.edu/learning/cornstalkgrazingcalc.shtml. Still, unforeseen weather events such as wind, rain, and snow can have drastic effects on forage available. For example leaf material is light and can be moved around by winds, and husks are easily tromped into muddy fields. Cattle can graze though as much as 4 to 6 inches of snow, but should that snow melt and turn to ice, cattle will be unable to uncover residue. It is prudent to have an emergency plan or reserve feed supply in case severe weather shortens the grazing period.

A bred 1200 pound cow needs to be gaining one pound per day during her last trimester. She should consume two percent of her body weight in dry matter. Corn residue averages around 85 percent dry matter, so the example cow eats approximately 26.5 pounds of residue daily. This is enough feed to meet her energy requirement, as average corn stalk residue provides between 52 and 55 percent Total Digestible Nutrients (TDN). However, cattle selectively graze fields in an order searching out the excess grain, leaves, husks, cobs and finally stalks that make up corn residue. This means that although available energy starts as high as 70 percent TDN, it will decrease to less than 45 percent as cows are reduced to eating cobs and stalks. This problem is compounded as cows graze later into the winter because as residue energy levels fall, the cow's energy demands increase due to fetal development. During the same time as residue nutritional value drops and the cow needs increase, fetal growth is also compressing and limiting rumen space so cows consume less of a diminished quality forage. If possible, cross fencing fields or strip grazing may allow for the best utilization of forage and give managers the ability to provide more consistent energy levels, thus maintaining cow body condition score.

Protein supplementation is need for pregnant cows grazing corn residue, especially during their last trimester. Corn fields will not provide enough protein to meet their daily 1.75 pounds Crude Protein (CP) requirement. Average corn residue is only 5 to 5.5 percent CP, leaving cows 0.3 to 0.5 pounds short of their daily needs. This is even more crucial as the excess corn and leaf material are gleaned from the field. Secondly, as excess corn is removed, residue grazing will not meet the phosphorous requirements of a late gestation cow developing a fetus. While residue should meet calcium requirement, phosphorus availability is below required levels. Phosphorous supplementation should be at levels that provide the de-

sired 2:1 calcium to phosphorus ratio needed for fetal development. Free choice salt should be provided and can be combined in lose form with sodium bicarbonate to help buffer rumen acid levels as cows "hunt out" grain during initial grazing. Before turning out cattle, it is wise to check fields for any "dumped" corn piles, as piles would be easy opportunities for cows to overload on grain.

Finally, ensuring cattle have access to adequate water may be the most important factor to grazing stock fields. As always, restricted water intake equals reduced feed intake and decreased nutrient absorption particularly with a dry forage like corn residue. Research from the National Research Council suggest that it takes 8 to 12 gallon per day for a 1200 pound dry cow during the winter. That same cow may only intake 8 gallons on a 40 degree day, but may need 12 gallons if it is 70 degrees. It would be a safe assumption that water availability at one gallon per 100 pounds of body weight should be provided during winter grazing for dry cows. With this in mind, a 10 foot diameter 2 foot high standard round tank will hold approximately 1170 gallons and would water up to 100 head even on the hotter winter days in the Golden Plains Area.

Corn stalk residue grazing can be economically beneficial when it works into a producer's budget. Information on grazing lease rates, help with leases or other beef decision tools including determining your cow carrying costs can be found at the CSU Agriculture Business Management team website http://www.wr.colostate.edu/ABM/resources.shtml.

Cattle and All Those Ears

Travis Taylor, CSU Livestock Extension Agent

The high plains winds caused havoc with this current corn harvest. Corn loss in some fields is being reported between 20 to 60 bushel, and up to 80 per acre in extreme cases. Although not ideal, this does provide grazing opportunities for cattle producers willing to manage fields with extreme amounts of corn available. It is important to remember that management is the key. Cattle are able to acclimate to high corn diets, but engorging on corn will cause lactic acidosis as the rumen microbial population is changed to rapidly. It can be fatal or cause lasting negative production effects.

Producers need to manage cattle properly to ensure a positive and productive outcome. A University of Nebraska article, "Down Corn: Problem or Opportunity for Cattle Producers," (https://beef.unl.edu/down-corn-problem-or-opportunity-cattle-producers) outlines the steps necessary to prepare cattle to enter fields with high amounts of corn. Basically, cattle can be acclimated to graze such fields by adding corn to their diets and gradually increasing to a predetermined daily consumption over ten days to two weeks. This may be the safest and best option.

Another preventive measure may be the use of biologics. One such product called Lactipro advance® from MS Biotec claims beef producers could cut roughage-to-grain transition time by up to 50 percent. These products can change the rumen environment to allow for quicker utilization of high energy grains. Prior to using these products it is recommended to consult with your nutritionist and veterinarian.

If management of the cows is not an option, managing the fields may be. Cross fencing fields or pivot fencing options (see the previously mentioned Nebraska article) can limit each cows daily corn consumption. Likewise, increased cows per acre or limiting available acres available is wise to control intake in a field. If possible, time grazing may work in the right situations. This allows a set time access to fields and utilizes electric fencing to remove and confine cattle to already grazed areas for the remainder of the day. In either case it is the management of the situation or quite possibly a combination of different strategies that will allow producers to make the most of this opportunity.

How Much Hay Do I Need?

Travis Taylor, CSU Livestock Extension Agent

There are many factors that determine the amount of feed needed to winter your mature beef cow herd. Several estimates are required, but more precise information increases a producer's ability to make critical financial decisions. Understanding the average cow size in your herd is important. The best time to get an actual average cow weight would be after weaning and early in the second trimester. Just as importantly, producers should have an accurate inventory of available standing or baled forage when estimating winter feed needs. Better decisions can be made with actual forage quality tests, or more educated forage quality estimates.

Higher-quality forages have larger concentrations of important nutrients, and cattle can consumer them in greater quantity, as rumen fermentation is increased, allowing for quicker passage and utilization. Additionally, after calving, cows will be able to consume a higher percent of their body weight, which increases the needed total ranch winter feed availability. Remember that no two balers are exactly the same, so as producers it is important to have an understanding of your winter forage supply available and its quality. Glenn Selk, Emeritus Extension animal scientist from Oklahoma State University, listed the following general beef cow guidelines relating to forage consumption in the November 12 Cow-Calf Corner broadcast. "Low-quality forages (below 6% crude protein) will be consumed at about 1.5 percent of body weight (on a dry matter basis) per day. Higher-quality grass hays (above 8% crude protein) may be consumed at 2 percent of body weight. Excellent quality forages like good alfalfa, silages or green pasture may be consumed at the rate of 2.5 percent dry mater of body weight per day."

To illustrate, imagine you have 1,200 pound pregnant spring calving cows in good condition (BCS 5-6), and a sorghum hay supply that tested 8 percent crude protein and 90 percent dry matter. Cows should consume 24 pounds of dry matter per day (1200 lbs. x 2% = 24 lbs.). Adjusting for dry matter content of the forage (24 lbs. DM/ 90% forage DM) the cows should voluntarily consume 26.66 pounds per head each day. In a 100 cow herd fed 120 days, or January through April, the producer would estimate feeding 160 tons of hay. If the same cow herd had an average mature cow weight of 1,300 pounds the estimated feed inventory needed would be 173.33 tons. The percent increase or decrease in total feed required is the same as the percent change in mature cow weight, or an increase of 8.33 percent in this example.

Another component to be estimated is Hay wastage. Different feeding methods can improve hay waste which generally ranges from 10 to 20 percent, but can be even higher. At 15 percent in the above example, that would be an additional 24 tons or an entire semi load wasted. Assuming an $85.00 per ton hay value that is $20.40 per cow and increases the break- even price for 500 pound calves by $5 per hundred weight. Waste estimates are influenced by factors like wind, mud, snow, feeding area, forage type and feeding equipment. Extended periods of cold and wet weather equates to cows needing increased energy and additional feed. By using more precise estimates relating to forage available and mature cow size, producers can better calculate an operations winter feed needs. More accurate estimates mean better management decisions and translate into a more profitable operation.

Beef Quality Assurance and Transport Certification

Travis Taylor, CSU Livestock Extension Agent

The national Beef Quality Assurance (BQA) certification is not new to cattlemen, in fact it has been in existence since 1987. The first National Beef Quality Audit was conducted in 1991 with the most recent completed in 2016. "The nationally coordinated and state implemented BQA program focuses on all segments of the beef industry, including focused training for transporters as well as self-assessments for cow/calf, stocker and feeder operations," says Colorado BQA coordinator Libby Bigler. "Now more than ever, consumers show concern for issues pertaining to animal welfare and environmental sustainability, and the BQA program is committed to addressing such topics in order for the cattle industry to continue meeting ever-changing consumer expectations." Those expectations have surfaced most recently appearing as requirements by major beef processors like Tyson and Cargill asking suppliers in feed yards and livestock transporters to be BQA certified. Cargill now requires 90 percent of their cattle to be sourced from BQA certified feeders, and hauled by individuals with a Beef Transport Quality Assurance (BTQA) certification. Likewise, Tyson requires 100 percent of cattle sourced from BQA yards, and by January 1, 2020 all cattle delivered to plants to be hauled by individuals with BTQA certification.

Although such certifications results in additional requirements, it may currently be financially beneficial in cattle marketing. A recent Colorado State University study titled "Effect of Mentioning BQA in Lot Descriptions of Beef Calves and Feeder Cattle Sold Through Video-based Auctions on Sale Price," discovered a $16.80 per head premium result for cattle that listed BQA in the lot description. The study data was collected in partnership with Western Video Market, and based on sale prices of 8,815 lots of both steers and heifers sold in nine western states between 2010 and 2017. It is important to remember that data represents sales prior to the previously mentioned requirements by beef processors. Just as importantly, the National BQA Program has been developed by cattlemen for cattlemen and is primarily funded by the Beef Checkoff. A science based BQA program that is developed by actual beef industry producers, and one that is recognized by both processors and consumers, has immeasurable benefit. Such a program clearly speaks to the dedication United States beef producers have toward their transparency in delivering a safe and exceptional quality product to consumers.

Since BQA inception, many producers have been certified, while others have adopted BQA practices by picking them up from neighbors or local veterinarians. However, the Colorado State University study emphasized how important it is to be able to transfer BQA. certification information from seller to buyer when a transaction is made. Being able to provide buyers with a certification number is quickly becoming integral for producers, feeders, and truckers who deliver cattle to processors. Certifications can be obtained by attending an in-person training or online. The certifications are valid for three years before recertification is required. Training material is updated yearly, but major revision occur every five years after information is received from the most current National Beef Quality Audit. The recertification process helps producers reinforce their existing best management practices while keeping up to date on new practices and procedures. To get your BQA certification as a producer or transporter go online to www.cobqa.org or contact your local Colorado State University Extension Office.

Controlling Flies

Travis Taylor, CSU Livestock Extension Agent

Driving the roads right now, we see cattle herds bunched in pasture corners, standing in ponds, or worse stamping out large areas of grass. It is fly season, and those pests have been causing weight loss, cattle discomfort and rancher aggravation for years. Horn flies have been shown to feed on animals up to 30 times each day and Face files can travel up to 2 miles and effect both gain and animal health. Unfortunately, there is not a "one size fits all" product that will eliminate flies, so a producer's best option is to implement a control strategy. Producers should contemplate if feeding a substance that breaks the insect lifecycle or a

larvicide like insect growth regulator (IGR) works with their operation goals. Cows need to be fed such products, usually in a mineral or protein supplement starting 30 days before flies typically emerge, until 30 days after a killing frost. Another measure that is being successfully utilized is fly tags. With new technological improvements fly tags are now better able to release a uniform insecticide concentration and are an effective tool in controlling flies. It is recommended to rotate between pyrethroid and organophospate based tags, reducing chances for building flies' chemical resistance. Follow label directions on the number of tags per cow, and refrain from using the same chemical tag type more than two years in a row. For best results when using tags, wait until you have around 200 flies per cow to tag as applying too early decreases their efficacy. Keep in mind that tags should be removed in three to five months to help with resistance issues.

Other control measures such as pour-ons, sprays and dust bags are proven beneficial. A pour-on can be used at the same time you fly-tag cows. Most pour-on dewormers will also have efficacy against horn files and will have the added benefit of controlling internal parasites. If deemed necessary to re-pour cattle later in the season, switch to a product only labeled for flies and/or lice as using the same deworming product multiple times throughout a given year can contribute to internal parasites building resistance. Spraying or fogging cattle in certain situations can be beneficial, but the equipment and chemical clean-up necessary makes it less economically feasible for a majority of producers. Cattle rubs or dust bags, when placed correctly can provide for cost effective control of flies. The tradeoff is the time and management required to keep equipment charged with insecticide and in proper working order.

Utilizing only one of the fly control methods will most likely not give you the results you desire. Using a multifaceted approach, rotating insecticides and consulting with your beef extension specialist, veterinarian and animal health consultant to talk strategy can help increase herd health and protect your bottom line.

Crop Enterprise Cost Estimates for 2019 in Northeastern Colorado

Brent Young—Regional Agriculture and Business Management Specialist

Introduction

Estimated production costs and returns for the major crops grown in Northeastern Colorado are included in this section for 2016. It would only be fair to call the following cost of production estimates, or budgets, "typical" and hopefully representative of the area. These budgets are not averages, but rather represent typical costs as reported by producers in Northeastern Colorado and from data provided by the USDA-NASS Colorado field office. These budgets represent no one single individual, as all producers are different with unique management techniques, machinery complements, chemical applications, market timing and uncontrollable fortune with frost, hail, rain and insects. No attempt was made to conform these results to ideal production recommendations. Our goal is simply to report typical production costs from actual production. These cost of production estimates conformed to the traditional economic method of accounting for all variable and fixed costs of production. Starting in 2006, the Mississippi State Budget generator became the software of choice to develop the enterprise budgets. Expected returns on land are capitalized using a capitalization rate based on the "real" rate of interest, which is the rate of interest paid minus the inflation rate. Net receipts need to be large enough to give the operator a four percent return on the land investment. If receipts are large enough to cover these items, the operator then has a positive return to management and risk. From a business management standpoint, farmers must earn positive receipts in order to provide for family living expenses, pay debt, earn positive returns on their investments and make new investments when feasible.

Variability in Input Use and Conditions

Caution is urged when using these 'typical' production cost and return estimates. This is especially true for agricultural lenders, appraisers, insurance adjusters, landlords and government agencies. Even among this survey group, which was pre-screened to be typical of the area, there were great differences. These differences were seldom due to good or bad management, but rather due to a variety of weather and pest conditions, soils, and irrigation management. Table 1 lists typical fertilizer rates for the crops specified in this publication. Again, these rates are not meant to be recommendations for fertilizer requirements, but rather are typical rates reported by producers participating in the survey process. Also, the survey instrument does not inquire as to the usage of soil testing by producers for plant nutrients. As a result, no correlation can be made between the typical fertilizer rate reported and actual plant nutrient requirements. In addition to crop yield and input rates, the survey instrument sent to producers asked for cultural practices, machinery compliments and machinery values. Machine cost variability from one producer to the next was often impacted by management choices. An operator that chooses to purchase newer machinery may feel they realize enough from increased dependability and lower repair costs that the extra investment is warranted. The typical machine complement in use is 7 to 15 years of age. When replacement machines are purchased they are not always new. As stated previously, positive returns to "management and risk" would have to be used to initiate replacement machinery purchases if that is a management priority.

Price Received

As always, a key management perspective for producers will be to pay close attention to production costs, marketing plans and price information. This is especially important in the current environment of rising commodity prices as production costs, and land rents have begun to rise again as well, putting pressure on profits in future years if commodity prices fall be-

low their current levels. All local commodity prices were above FSA established loan rates for the 2016 marketing year. Table 2 presents a summary of the county loan rates for the Golden Plains Area.

Estimated Production Costs and Returns for Irrigated Crops

Tables 3 through 9 describe enterprise production costs and returns for irrigated crops in Northeastern Colorado. These enterprises include alfalfa, dry edible beans, corn, sugar beets, oil sunflowers, soybeans and winter wheat. All irrigated budgets are produced under center pivot irrigation. The alfalfa enterprise is assumed to be in production 5 years. Alfalfa establishment costs are amortized over a 5-year time period as a result. Crop rotations for dry bean production typically assumed production once every three or four years. Crop rotations that include sugar beets typically assumed production of these crops once every four years. Corn was the crop typically used to fill out the rotations. Tables 9, 10, and 11 describe irrigated corn, sugar beet, and winter wheat enterprises for the South Platte River valley. These enterprises also assume center pivot irrigation and sugar beet production once every four years.

Estimated Production Costs and Returns for Dryland Crops

Many dryland producers are adopting a two crop in three-year system such as wheat-corn-fallow, wheatsunflower-fallow, or wheat-millet-fallow. As a result there are two dryland winter wheat budgets defined in this report. Table 12, the conventional wheatfallow budget, charges all fallow costs against the wheat crop, employing traditional tillage operations for weed control in the fallow period. Tables 13 through 16 describe reduced-till intensive cropping system enterprises for winter wheat, corn, millet, and oil-type sunflowers. In these reduced-till intensive cropping system budgets, fallow expenses from wheat harvest to summer crop planting (9 months) are charged to the summer crop enterprise. Fallow expenses from summer crop harvest to wheat planting (11 months) are charged to the wheat enterprise. Fallow operations include a combination of herbicide use and tillage operations for weed control in the reduced-till budgets. The breakeven analysis feature at the bottom of each budget allows us to see the per acre bottom line effect of positive or negative changes in price and/or yield while holding all inputs constant. By matching various different scenarios in this way, we can get a feeling for the relative production and marketing risks of each crop enterprise. In Table 5 - Irrigated Corn, price received was $3.70/bushel while quantity harvested was 260 bushel/acre. For the 2015 crop year, this combination results in $303.96 net receipts per acre before factor payments (Row 3, Column 3). The result of a 25% reduction in yield holding price constant at $3.70/bushel is $63.46 per acre returns over direct costs, a net loss of $240.50 per acre, (Row 1, Column 3). It should be noted that the 25% (+/-) ranges shown in these tables are meant for illustration purposes only and do not represent the worst or best case scenarios for any crop enterprise.

Table 1. Typical Fertilizer Application Rates for Irrigated and Dryland Crops.

	Nitrogen (N)[1]	Phosphate (P)[1]	Potassium (K)[1]
	Lbs/Acre	Lbs/Acre	Lbs/Acre
Irrigated Crops			
Corn	218	45	15
Sugar Beets	160	35	0
Pinto Beans	52	65	16
Winter Wheat	60	12	0
Potatoes	280	148	150
Alfalfa	65	60	73
Corn, South Platte Valley	175	30	50
Sugar Beets, South Platte Valley	120	35	60
Dryland Crops			
Winter Wheat	40	12	0
Corn	60	32	24
Oil Sunflowers	50	10	0
Millet	25	0	0

[1] These values are typical rates reported by producers participating in the survey process and are not meant to be recommendations for fertilizer requirements.

Table 2. National Loan Rates for Wheat, Corn, Sunflowers and Soybeans (2019 Crop Year)

Crop	Unit	Average	Kit Carson	Phillips	Sedgwick	Washington	Yuma
Wheat	**$/Bu**	3.09	2.80	2.79	3.14	3.39	3.34
Corn	**$/Bu**	2.26	2.28	2.21	2.21	2.34	2.26
Sunflower	**$/Cwt**	10.84	10.96	10.81	10.74	10.81	10.89
Soybeans	**$/Bu**	5.87	5.93	5.84	5.84	5.84	5.93

Northeastern Colorado - Irrigated Alfalfa 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER TON	
Alfalfa (Round Bales)	tons	$230.00	6	$1,380	$230.00	Your Farm
Your Farm	tons			$0.00	$0.00	$0.00
Gross Receipts				**$1,380**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER TON	YOUR FARM
OPERATING PREHARVEST						
Seed						
Establishment Allocation (5 yrs)	dollars	33.35	1.00	33.35	5.56	
Crop Protection						
Fertilizer	dollars	65.28	1	65.28	10.88	
Herbicide	acre	23.18	1	23.18	3.86	
Custom Application	dollars	7.00	1	7.00	1.17	
Insecticide	dollars	16.62	1	16.62	2.77	
Irrigation						
Irrigation Energy	dollars	69.64	1	69.64	11.61	
Irrigation Repairs	acre	11.70	1	11.70	1.95	
Sprinkler Lease	dollars	67.20	1	67.20	11.20	
Custom Aerial Spray	dollars	7.50	1	7.50	1.25	
Interest (6 months @ 6.25%)	dollars	9.42	1	9.42	1.57	
Total Pre-Harvest Expenses				$310.89	$51.82	$0.00
HARVEST COSTS						
Fuel	dollars	2.67	1	2.67	0.45	
Repair & Maintenance	dollars	9.21	1	9.21	1.54	
Labor	dollars	4.93	1	4.93	0.82	
Baling[1]	dollars	96.00	1	96.00	16.00	
Hauling/Stacking[2]	dollars	28.00	1	28.00	4.67	
Total Harvest Costs				$140.81	$23.47	$0.00
Total Operating Costs				**$451.70**	**$75.28**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	1.68	
Machinery Ownership Costs	dollars	54.37	1	16.43	2.74	
Real Estate Taxes	dollars	16.99	1	16.99	2.83	
Total Property & Ownership Costs				$43.52	$7.25	$0.00
TOTAL DIRECT COSTS				**$495.22**	**$82.54**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$884.78**	**$147.46**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	30.67	
RETURN TO MANAGEMENT & RISK				**$700.78**	**$116.80**	**$0.00**

1 Baling= $12/Bale (Round Baler)
2 Hauling/Stacking= $3.50/Bale
3 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/ton)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$172.50	$207.00	$230.00	$253.00	$287.50
-25%	4.50	$281.03	$436.28	$539.78	$643.28	$798.53
-10%	5.40	$436.28	$622.58	$746.78	$870.98	$1,057.28
TONS	6.00	$539.78	$746.78	$884.78	$1,022.78	$1,229.78
10%	6.60	$643.28	$870.98	$1,022.78	$1,174.58	$1,402.28
25%	7.50	$798.53	$1,057.28	$1,229.78	$1,402.28	$1,661.03

Northeastern Colorado - Irrigated Corn 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER BU	
Corn	bu	$3.85	201	$774	$3.85	Your Farm
Your Farm	bu			$0	$0.00	$0
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$774**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER BU	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	acre	118.60	1.00	118.60	0.59	
Fertilizer						
N + P	dollars	103.17	1	103.17	0.51	
Custom Application	acre	7.00	1	7.00	0.03	
Herbicide						
Chemicals	dollars	24.18	1	24.18	0.12	
Insecticide & Fungicide						
Chemicals	dollars	19.22	1	19.22	0.10	
Irrigation						
Sprinkler Ownership	dollars	67.20	1	67.20	0.33	
Sprinkler Energy	acre	60.45	1	60.45	0.30	
Irrigation Repairs	dollars	69.38	1	69.38	0.35	
Labor	hours	9.58	1	9.58	0.05	
Crop Consultant	acre	12.00	1	12.00	0.06	
Crop Insurance	dollars	44.94	1	44.94	0.22	
Fuel	dollars	12.69	1	12.69	0.06	
Repairs & Maintenance	dollars	8.11	1	8.11	0.04	
Interest (6 months @ 6.25%)[2]	dollars	17.39	1	17.39	0.09	
Total Pre-Harvest Expenses				$573.91	$2.86	$0.00
HARVEST COSTS						
Fuel	dollars	4.14	1	4.14	0.02	
Repair & Maintenance	dollars	5.43	1	5.43	0.03	
Labor	dollars	1.88	1	1.88	0.01	
Hauling[1]	bu	40.20	1	40.20	0.20	
Total Harvest Costs				$51.65	$0.26	$0.00
Total Operating Costs				**$625.56**	**$3.11**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.05	
Machinery Ownership Costs	dollars	54.37	1	54.37	0.27	
Real Estate Taxes	dollars	15.88	1	15.88	0.08	
Total Property & Ownership Costs				$80.35	$0.40	$0.00
TOTAL DIRECT COSTS				**$705.91**	**$3.51**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$67.94**	**$0.34**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	0.92	
RETURN TO MANAGEMENT & RISK				**($116.06)**	**($0.58)**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.20/Bushel

2 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/bushel)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$2.89	$3.47	$3.85	$4.24	$4.81
-25%	150.75	($270.62)	($183.56)	($125.52)	($67.48)	$19.57
-10%	180.90	($183.56)	($79.09)	($9.45)	$60.20	$164.67
BUSHELS PER ACRE	201.00	($125.52)	($9.45)	$67.94	$145.32	$261.40
10%	221.10	($67.48)	$60.20	$145.32	$230.45	$358.13
25%	251.25	$19.57	$164.67	$261.40	$358.13	$503.23

Northeastern Colorado - Irrigated Oil Sunflowers 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER CWT	
Sunflowers	CWT	$17.60	35	$616.00	$17.60	Your Farm
Your Farm	CWT			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$616.00**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER CWT	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	37.52	1.00	37.52	1.07	
Crop Protection						
Fertilizer	dollars	27.21	1	27.21	0.78	
Herbicide	dollars	45.73	1	45.73	1.31	
Custom Application	dollars	7.00	2	14.00	0.40	
Insecticide	dollars	15.49	1	15.49	0.44	
Irrigation						
Irrigation Energy	dollars	40.01	1	40.01	1.14	
Irrigation Repairs	dollars	11.74	1	11.74	0.34	
Sprinkler Lease	dollars	67.20	1	67.20	1.92	
Crop Insurance	dollars	37.37	1	37.37	1.07	
Custom Aerial Application	dollars	7.50	1	7.50	0.21	
Crop Consultant	dollars	12.00	1	12.00	0.34	
Fuel	dollars	2.74	1	2.74	0.08	
Repair & Maintenance	dollars	1.96	1	1.96	0.06	
Labor	dollars	5.51	1	5.51	0.16	
Interest (6 months @ 6.25%)[2]	dollars	9.97	1	9.97	0.28	
Total Pre-Harvest Expenses				$335.95	$9.60	$0.00
HARVEST COSTS						
Fuel	dollars	4.46	1	4.46	0.13	
Repair & Maintenance	dollars	4.81	1	4.81	0.14	
Labor	dollars	1.24	1	1.24	0.04	
Hauling[1]	dollars	8.75	1	8.75	0.25	
Total Harvest Costs				$19.26	$0.55	$0.00
Total Operating Costs				**$355.21**	**$10.15**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.29	
Machinery Ownership Costs	dollars	18.52	1	18.52	0.53	
Real Estate Taxes	dollars	11.68	1	11.68	0.33	
Total Property & Ownership Costs				$40.30	$1.15	$0.00
TOTAL DIRECT COSTS				**$395.51**	**$11.30**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$220.49**	**$6.30**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	5.26	
RETURN TO MANAGEMENT & RISK				**$36.49**	**$1.04**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.25/Cwt
2 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/cwt)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$13.20	$15.84	$17.60	$19.36	$22.00
-25%	26.25	($49.01)	$20.29	$66.49	$112.69	$181.99
-10%	31.50	$20.29	$103.45	$158.89	$214.33	$297.49
CWT	35.00	$66.49	$158.89	$220.49	$282.09	$374.49
10%	38.50	$112.69	$214.33	$282.09	$349.85	$451.49
25%	43.75	$181.99	$297.49	$374.49	$451.49	$566.99

Northeastern Coloado - Irrigated Pinto Beans 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER CWT	
Pinto Beans	cwt	$33.20	35	$1,162	$33.20	Your Farm
Your Farm	cwt			$0.00	$0.00	$0.00
Gross Receipts				**$1,162**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER CWT	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	acre	48.82	1.00	48.82	1.39	
Fertilizer						
N + P	dollars	100.93	1	100.93	2.88	
Custom Aerial Spray	acre	7.50	1	7.50	0.21	
Herbicide						
Chemicals	dollars	31.68	1	31.68	0.91	
Custom Application	acre	7.00	1	7.00	0.20	
Insecticide & Fungicide						
Chemicals	dollars	29.09	1	29.09	0.83	
Irrigation						
Sprinkler Ownership	dollars	70.00	1	70.00	2.00	
Sprinkler Energy	acre	49.07	1	49.07	1.40	
Irrigation Repairs	dollars	12.37	1	12.37	0.35	
Labor	hours	4.16	1	4.16	0.12	
Crop Consultant	acre	12.00	1	12.00	0.34	
Crop Insurance	dollars	29.46	1	29.46	0.84	
Fuel	dollars	7.74	1	7.74	0.22	
Repairs & Maintenance	dollars	5.73	1	5.73	0.16	
Interest (6 months @ 6.25%)	dollars	12.99	1	12.99	0.37	
Total Pre-Harvest Expenses				$428.54	$12.24	$0.00
HARVEST COSTS						
Fuel	dollars	15.52	1	15.52	0.44	
Repair & Maintenance	dollars	9.08	1	9.08	0.26	
Labor	dollars	6.91	1	6.91	0.20	
Hauling	bu	8.05	1	8.05	0.23	
Total Harvest Costs				$39.56	$1.13	$0.00
Total Operating Costs				**$468.10**	**$13.37**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.29	
Machinery Ownership Costs	dollars	61.86	1	61.86	1.77	
Real Estate Taxes	dollars	15.88	1	15.88	0.45	
Total Property & Ownership Costs				$87.84	$2.51	$0.00
TOTAL DIRECT COSTS				**$555.94**	**$15.88**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$606.06**	**$17.32**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	5.26	
RETURN TO MANAGEMENT & RISK				**$422.06**	**$12.06**	**$0.00**

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/cwt)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$24.90	$29.88	$33.20	$36.52	$41.50
-25%	26.25	$97.69	$228.41	$315.56	$402.71	$533.44
-10%	31.50	$228.41	$385.28	$489.86	$594.44	$751.31
CWT PER ACRE	35.00	$315.56	$489.86	$606.06	$722.26	$896.56
10%	38.50	$402.71	$594.44	$722.26	$850.08	$1,041.81
25%	43.75	$533.44	$751.31	$896.56	$1,041.81	$1,259.69

Northeastern Colorado - Irrigated Soybeans 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER BU	
Soybeans	bu	$8.07	55	$443.85	$8.07	Your Farm
Your Farm	bu			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$443.85**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER BU	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	52.70	1.00	52.70	0.96	
Crop Protection						
Fertilizer	dollars	9.51	1	9.51	0.17	
Herbicide	dollars	30.22	1	30.22	0.55	
Irrigation						
Irrigation Energy	dollars	52.44	1	52.44	0.95	
Irrigation Repairs	dollars	12.01	1	12.01	0.22	
Sprinkler Lease	dollars	70.00	1	70.00	1.27	
Custom Application	dollars	7.00	2	14.00	0.25	
Crop Insurance	dollars	49.49	1	49.49	0.90	
Crop Consultant	dollars	12.00	1	12.00	0.22	
Fuel	dollars	6.43	1	6.43	0.12	
Repair & Maintenance	dollars	4.81	1	4.81	0.09	
Labor	dollars	3.49	1	3.49	0.06	
Interest (6 months @ 6.25%)[2]	dollars	9.69	1	9.69	0.18	
Total Pre-Harvest Expenses				$326.79	$5.94	$0.00
HARVEST COSTS						
Fuel	dollars	3.77	1	3.77	0.07	
Repair & Maintenance	dollars	3.18	1	3.18	0.06	
Labor	dollars	1.96	1	1.96	0.04	
Hauling[1]	dollars	11.00	1	11.00	0.20	
Total Harvest Costs				$19.91	$0.36	$0.00
Total Operating Costs				**$346.70**	**$6.30**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.18	
Machinery Ownership Costs	dollars	32.47	1	32.47	0.59	
Real Estate Taxes	dollars	5.97	1	5.97	0.11	
Total Property & Ownership Costs				$48.54	$0.88	$0.00
TOTAL DIRECT COSTS				**$395.24**	**$7.19**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$48.61**	**$0.88**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	3.35	
RETURN TO MANAGEMENT & RISK				**($135.39)**	**($2.46)**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.20/Bushel

2 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/bushel)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$6.05	$7.26	$8.07	$8.88	$10.09
-25%	41.25	($145.58)	($95.64)	($62.35)	($29.06)	$20.87
-10%	49.50	($95.64)	($35.72)	$4.22	$44.17	$104.09
BUSHELS PER ACRE	55.00	($62.35)	$4.22	$48.61	$92.99	$159.57
10%	60.50	($29.06)	$44.17	$92.99	$141.82	$215.05
25%	68.75	$20.87	$104.09	$159.57	$215.05	$298.28

Northeastern Coloado - Irrigated Sugar Beets 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER TON	Your Farm
Sugar Beets	ton	$17.50	29	$508	$17.50	
WHIP + Payment	ton	$20.41	29	$592	$20.41	
Your Farm	ton			$0.00	$0.00	$0.00
Gross Receipts				**$1,099**	**$37.91**	**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER TON	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	acre	174.82	1.00	174.82	6.03	
Fertilizer						
N + P	dollars	99.08	1	99.08	3.42	
Custom Application	acre	7.00	1	7.00	0.24	
Herbicide						
Chemicals	dollars	59.56	1	59.56	2.05	
Custom Application	acre	7.00	1	7.00	0.24	
Insecticide & Fungicide						
Chemicals	dollars	27.07	1	27.07	0.93	
Irrigation						
Sprinkler Ownership	dollars	70.00	1	70.00	2.41	
Sprinkler Energy	acre	46.50	1	46.50	1.60	
Irrigation Repairs	dollars	12.42	1	12.42	0.43	
Labor	hours	10.99	1	10.99	0.38	
Crop Consultant	acre	12.00	1	12.00	0.41	
Crop Insurance	dollars	3.30	1	3.30	0.11	
Fuel	dollars	14.82	1	14.82	0.51	
Repairs & Maintenance	dollars	13.11	1	13.11	0.45	
Retained Revenue	dollars	2.50	29	72.50	2.50	
Interest (6 months @ 6.25%)	dollars	17.43	1	17.43	0.60	
Total Pre-Harvest Expenses				$647.60	$22.33	$0.00
HARVEST COSTS						
Fuel	dollars	19.61	1	19.61	0.68	
Repair & Maintenance	dollars	94.89	1	94.89	3.27	
Labor	dollars	10.11	1	10.11	0.35	
Hauling	bu	137.00	1	137.00	4.72	
Total Harvest Costs				$261.61	$9.02	$0.00
Total Operating Costs				**$909.21**	**$31.35**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	30.30	1	30.30	1.04	
Machinery Ownership Costs	dollars	136.20	1	136.20	4.70	
Payment on Coop Shares	dollars	28.50	1	28.50	0.98	
Real Estate Taxes	dollars	15.88	1	15.88	0.55	
Total Property & Ownership Costs				$210.88	$7.27	$0.00
TOTAL DIRECT COSTS				**$1,120.09**	**$38.62**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**($20.70)**	**($0.71)**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	6.34	
RETURN TO MANAGEMENT & RISK				**($204.70)**	**($7.06)**	**$0.00**

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/ton)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$13.13	$15.75	$17.50	$19.25	$21.88
-25%	21.75	($834.62)	($777.52)	($739.46)	($701.40)	($644.31)
-10%	26.10	($777.52)	($709.01)	($663.34)	($617.66)	($549.15)
TONS PER ACRE	29.00	($739.46)	($663.34)	($612.59)	($561.84)	($485.71)
10%	31.90	($701.40)	($617.66)	($561.84)	($506.01)	($422.27)
25%	36.25	($644.31)	($549.15)	($485.71)	($422.27)	($327.12)

Northeastern Colorado - Irrigated Silage Corn 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER TON	
Corn	bu	$30.80	25	$770	$30.80	Your Farm
Your Farm	bu			$0	$0.00	$0
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$770**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER TON	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	acre	118.60	1.00	118.60	4.74	
Fertilizer						
N + P	dollars	103.17	1	103.17	4.13	
Custom Application	acre	7.00	1	7.00	0.28	
Herbicide						
Chemicals	dollars	24.18	1	24.18	0.97	
Insecticide & Fungicide						
Chemicals	dollars	19.22	1	19.22	0.77	
Irrigation						
Sprinkler Ownership	dollars	67.20	1	67.20	2.69	
Sprinkler Energy	acre	60.45	1	60.45	2.42	
Irrigation Repairs	dollars	69.38	1	69.38	2.78	
Labor	hours	9.58	1	9.58	0.38	
Crop Consultant	acre	12.00	1	12.00	0.48	
Crop Insurance	dollars	44.94	1	44.94	1.80	
Fuel	dollars	12.69	1	12.69	0.51	
Repairs & Maintenance	dollars	8.11	1	8.11	0.32	
Interest (6 months @ 6.25%)1	dollars	17.39	1	17.39	0.70	
Total Pre-Harvest Expenses				$573.91	$22.96	$0.00
HARVEST COSTS						
Custom Chopping & Hauling	acre	1.90	1	47.50	1.90	
Total Harvest Costs				$47.50	$1.90	$0.00
Total Operating Costs				**$621.41**	**$24.86**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.40	
Machinery Ownership Costs	dollars	54.37	1	54.37	2.17	
Real Estate Taxes	dollars	15.88	1	15.88	0.64	
Total Property & Ownership Costs				$80.35	$3.21	$0.00
TOTAL DIRECT COSTS				**$701.76**	**$28.07**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$68.24**	**$2.73**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	7.36	
RETURN TO MANAGEMENT & RISK				**($115.76)**	**($4.63)**	**$0.00**

1 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/ton)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$23.10	$27.72	$30.80	$33.88	$38.50
-25%	18.75	($268.64)	($182.01)	($124.26)	($66.51)	$20.11
-10%	22.50	($182.01)	($78.06)	($8.76)	$60.54	$164.49
TONS PER ACRE	25.00	($124.26)	($8.76)	$68.24	$145.24	$260.74
10%	27.50	($66.51)	$60.54	$145.24	$229.94	$356.99
25%	31.25	$20.11	$164.49	$260.74	$356.99	$501.36

South Platte Valley - Irrigated Winter Wheat 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER BU	
Hard Red Winter Wheat	bu	$4.18	95	$397.10	$4.18	Your Farm
Your Farm	bu			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$397.10**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER BU	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	21.00	1.00	21.00	0.22	
Crop Protection						
Fertilizer	dollars	47.49	1	47.49	0.50	
Herbicide (Applied)	dollars	23.04	1	23.04	0.24	
Irrigation						
Irrigation Energy	dollars	28.29	1	28.29	0.30	
Irrigation Repairs	dollars	12.01	1	12.01	0.13	
Sprinkler Lease	dollars	70.00	1	70.00	0.74	
Crop Insurance	dollars	53.53	1	53.53	0.56	
Fuel	dollars	6.02	1	6.02	0.06	
Repair & Maintenance	dollars	5.45	1	5.45	0.06	
Labor	dollars	2.82	1	2.82	0.03	
Interest (6 months @ 6.25%)[2]	dollars	8.43	1	8.43	0.09	
Total Pre-Harvest Expenses				$278.08	$2.93	$0.00
HARVEST COSTS						
Fuel	dollars	3.41	1	3.41	0.04	
Repair & Maintenance	dollars	3.74	1	3.74	0.04	
Labor	dollars	1.91	1	1.91	0.02	
Hauling[1]	dollars	19.00	1	19.00	0.20	
Total Harvest Costs				$28.06	$0.30	$0.00
Total Operating Costs				**$306.14**	**$3.22**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.11	
Machinery Ownership Costs	dollars	34.53	1	34.53	0.36	
Real Estate Taxes	dollars	11.51	1	11.51	0.12	
Total Property & Ownership Costs				$56.14	$0.59	$0.00
TOTAL DIRECT COSTS				**$362.28**	**$3.81**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$34.82**	**$0.37**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	1.94	
RETURN TO MANAGEMENT & RISK				**($149.18)**	**($1.57)**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.20/Bushel

2 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/bushel)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$3.14	$3.76	$4.18	$4.60	$5.23
-25%	71.25	($138.91)	($94.23)	($64.45)	($34.67)	$10.00
-10%	85.50	($94.23)	($40.63)	($4.89)	$30.85	$84.46
BUSHELS PER ACRE	95.00	($64.45)	($4.89)	$34.82	$74.53	$134.10
10%	104.50	($34.67)	$30.85	$74.53	$118.21	$183.74
25%	118.75	$10.00	$84.46	$134.10	$183.74	$258.19

South Platte Valley - Irrigated Sugar Beets 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER TON	Your Farm
Sugar Beets	ton	$17.50	29	$508	$17.50	
Whip+ Payment	ton	$20.41	29	$592	$20.41	
Your Farm	ton			$0	$0.00	$0.00
Gross Receipts				**$1,099**	**$37.91**	**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER TON	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	acre	174.79	1.00	174.79	6.03	
Fertilizer						
N + P	dollars	99.08	1	99.08	3.42	
Custom Aerial Spray	acre	7.50	2	15.00	0.52	
Herbicide						
Chemicals	dollars	59.56	1	59.56	2.05	
Insecticide & Fungicide						
Chemicals	dollars	27.07	1	27.07	0.93	
Irrigation						
Sprinkler Ownership	dollars	70.00	1	70.00	2.41	
Sprinkler Energy	acre	46.50	1	46.50	1.60	
Irrigation Repairs	dollars	11.83	1	11.83	0.41	
Labor	hours	10.99	1	10.99	0.38	
Crop Consultant	acre	12.00	1	12.00	0.41	
Crop Insurance	dollars	30.30	1	30.30	1.04	
Fuel	dollars	14.82	1	14.82	0.51	
Repairs & Maintenance	dollars	13.11	1	13.11	0.45	
Retained Revenue	dollars	2.50	29	72.50	2.50	
Interest (6 months @ 6.25%)	dollars	18.13	1	18.13	0.63	
Total Pre-Harvest Expenses				$675.68	$23.30	$0.00
HARVEST COSTS						
Fuel	dollars	19.61	1	19.61	0.68	
Repair & Maintenance	dollars	94.89	1	94.89	3.27	
Labor	dollars	10.11	1	10.11	0.35	
Hauling	bu	137.00	1	137.00	4.72	
Total Harvest Costs				$261.61	$9.02	$0.00
Total Operating Costs				**$937.29**	**$32.32**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	30.30	1	30.30	1.04	
Machinery Ownership Costs	dollars	126.93	1	126.93	4.38	
Payment on Coop Shares	dollars	28.50	1	28.50	0.98	
Real Estate Taxes	dollars	13.65	1	13.65	0.47	
Total Property & Ownership Costs				$199.38	$6.88	$0.00
TOTAL DIRECT COSTS				**$1,136.67**	**$39.20**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**($37.28)**	**($1.29)**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	6.34	
RETURN TO MANAGEMENT & RISK				**($221.28)**	**($7.63)**	**$0.00**

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/ton)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$13.13	$15.75	$17.50	$19.25	$21.88
-25%	21.75	($851.20)	($794.10)	($756.04)	($717.98)	($660.89)
-10%	26.10	($794.10)	($725.59)	($679.92)	($634.24)	($565.73)
TONS PER ACRE	29.00	($756.04)	($679.92)	($629.17)	($578.42)	($502.29)
10%	31.90	($717.98)	($634.24)	($578.42)	($522.59)	($438.85)
25%	36.25	($660.89)	($565.73)	($502.29)	($438.85)	($343.70)

South Platte Valley - Irrigated Corn 2019

Estimated Production Costs & Returns

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER BU	
Corn	bu	$3.85	201	$774	$3.85	Your Farm
Your Farm	bu			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$774**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER BU	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	acre	118.60	1.00	118.60	0.59	
Fertilizer						
N + P	dollars	104.29	1	104.29	0.52	
Custom Application	acre	7.00	1	7.00	0.03	
Herbicide						
Chemicals	dollars	25.71	1	25.71	0.13	
Insecticide & Fungicide						
Chemicals	dollars	21.19	1	21.19	0.11	
Irrigation						
Sprinkler Ownership	dollars	70.00	1	70.00	0.35	
Sprinkler Energy	acre	56.35	1	56.35	0.28	
Irrigation Repairs	dollars	12.01	1	12.01	0.06	
Labor	hours	6.85	1	6.85	0.03	
Crop Consultant	acre	12.00	1	12.00	0.06	
Crop Insurance	dollars	48.02	1	48.02	0.24	
Fuel	dollars	11.22	1	11.22	0.06	
Repairs & Maintenance	dollars	10.20	1	10.20	0.05	
Interest (6 months @ 6.25%)	dollars	15.73	1	15.73	0.08	
Total Pre-Harvest Expenses				$519.17	$2.58	$0.00
HARVEST COSTS						
Fuel	dollars	4.57	1	4.57	0.02	
Repair & Maintenance	dollars	5.8	1	5.80	0.03	
Labor	dollars	1.88	1	1.88	0.01	
Hauling	bu	40.20	1	40.20	0.20	
Total Harvest Costs				$52.45	$0.26	$0.00
Total Operating Costs				**$571.62**	**$2.84**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.05	
Machinery Ownership Costs	dollars	56.59	1	56.59	0.28	
Real Estate Taxes	dollars	13.64	1	13.64	0.07	
Total Property & Ownership Costs				$80.33	$0.40	$0.00
TOTAL DIRECT COSTS				**$651.95**	**$3.24**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$121.90**	**$0.61**	**$0.00**
FACTOR PAYMENTS						
Land ($4,600 @ 4%)				184.00	0.92	
RETURN TO MANAGEMENT & RISK				**($62.10)**	**($0.31)**	**$0.00**

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/bushel)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$2.89	$3.47	$3.85	$4.24	$4.81
-25%	150.75	($216.66)	($129.60)	($71.57)	($13.53)	$73.53
-10%	180.90	($129.60)	($25.13)	$44.51	$114.16	$218.63
BUSHELS PER ACRE	201.00	($71.57)	$44.51	$121.90	$199.28	$315.36
10%	221.10	($13.53)	$114.16	$199.28	$284.41	$412.09
25%	251.25	$73.53	$218.63	$315.36	$412.09	$557.19

Northeastern Colorado - Dryland Winter Wheat Conventional Till- Fallow Rotation

Estimated Production Costs & Returns 2019

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER BU	
Hard Red Winter Wheat	bu	$4.18	45	$188.10	$4.18	Your Farm
Your Farm	bu			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Total Receipts				**$188.10**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER BU	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	8.37	1.00	8.37	0.19	
Crop Protection						
Fertilizer	dollars	26.75	1	26.75	0.59	
Fungicide	dollars	15.70	1	15.70	0.35	
Herbicide	dollars	9.19	1	9.19	0.20	
Custom Application	dollars	7.00	1	7.00	0.16	
Crop Insurance	dollars	31.68	1	31.68	0.70	
Fuel	dollars	7.59	1	7.59	0.17	
Repair & Maintenance	dollars	9.83	1	9.83	0.22	
Labor	dollars	2.87	1	2.87	0.06	
Interest (6 months @ 6.25%)[2]	dollars	3.72	1	3.72	0.08	
Total Pre-Harvest Expenses				$122.70	$2.73	$0.00
HARVEST COSTS						
Fuel	dollars	4.71	1	4.71	0.10	
Repair & Maintenance	dollars	3.46	1	3.46	0.08	
Labor	dollars	1.94	1	1.94	0.04	
Hauling[1]	dollars	9.00	1	9.00	0.20	
Total Harvest Costs				$19.11	$0.42	$0.00
Total Operating Costs				**$141.81**	**$3.15**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.22	
Machinery Ownership Costs	dollars	47.90	1	47.90	1.06	
Real Estate Taxes	dollars	2.46	1	2.46	0.05	
Total Property & Ownership Costs				$60.46	$1.34	$0.00
TOTAL DIRECT COSTS				**$202.27**	**$4.49**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**($14.17)**	**($0.31)**	**$0.00**
FACTOR PAYMENTS						
Land ($1,250 @ 4%)[3]				10.00	0.22	
RETURN TO MANAGEMENT & RISK				**($24.17)**	**($0.54)**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.20/Bushel
2 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%
3 Includes allocation of fallow acres in the rotation

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/bushel)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$3.14	$3.76	$4.18	$4.60	$5.23
-25%	33.75	($96.46)	($75.30)	($61.19)	($47.09)	($25.92)
-10%	40.50	($75.30)	($49.91)	($32.98)	($16.05)	$9.34
BUSHELS PER ACRE	45.00	($61.19)	($32.98)	($14.17)	$4.64	$32.86
10%	49.50	($47.09)	($16.05)	$4.64	$25.33	$56.37
25%	56.25	($25.92)	$9.34	$32.86	$56.37	$91.64

Northeastern Colorado - Dryland Winter Wheat Reduced-Till in Two-Crop in Three Year Rotation

Estimated Production Costs & Returns 2019

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER BU	
Hard Red Winter Wheat	bu	$4.18	45	$188.10	$4.18	Your Farm
Your Farm	bu			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$188.10**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER BU	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	8.37	1.00	8.37	0.19	
Crop Protection						
Fertilizer	dollars	26.75	1	26.75	0.59	
Herbicide	dollars	31.02	1	31.02	0.69	
Custom Application	dollars	7.00	1	7.00	0.16	
Crop Insurance	dollars	32.32	1	32.32	0.72	
Fuel	dollars	6.99	1	6.99	0.16	
Repair & Maintenance	dollars	7.38	1	7.38	0.16	
Labor	dollars	2.70	1	2.70	0.06	
Interest (6 months @ 6.25%)[2]	dollars	3.83	1	3.83	0.09	
Total Pre-Harvest Expenses				$126.36	$2.81	$0.00
HARVEST COSTS						
Fuel	dollars	4.32	1	4.32	0.10	
Repair & Maintenance	dollars	3.46	1	3.46	0.08	
Labor	dollars	1.89	1	1.89	0.04	
Hauling[1]	dollars	9.00	1	9.00	0.20	
Total Harvest Costs				$18.67	$0.41	$0.00
Total Operating Costs				**$145.03**	**$3.22**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.22	
Machinery Ownership Costs	dollars	36.99	1	36.99	0.82	
Real Estate Taxes	dollars	2.46	1	2.46	0.05	
Total Property & Ownership Costs				$49.55	$1.10	$0.00
TOTAL DIRECT COSTS				**$194.58**	**$4.32**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**($6.48)**	**($0.14)**	**$0.00**
FACTOR PAYMENTS						
Land ($1,250 @ 4%)[3]				10.00	0.22	
RETURN TO MANAGEMENT & RISK				**($16.48)**	**($0.37)**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.20/Bushel

2 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

3 Includes allocation of fallow acres in the rotation

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/bushel)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$3.14	$3.76	$4.18	$4.60	$5.23
-25%	33.75	($88.77)	($67.61)	($53.50)	($39.40)	($18.24)
-10%	40.50	($67.61)	($42.22)	($25.29)	($8.36)	$17.03
BUSHELS PER ACRE	45.00	($53.50)	($25.29)	($6.48)	$12.33	$40.55
10%	49.50	($39.40)	($8.36)	$12.33	$33.02	$64.06
25%	56.25	($18.24)	$17.03	$40.55	$64.06	$99.33

Northeastern Colorado - Dryland Corn Reduced-Till in a Two-Crop in Three-Year Rotation

Estimated Production Costs & Returns 2019

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER BU	
Corn	bu	$3.85	79	$304.15	$3.85	Your Farm
Your Farm	bu			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$304.15**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER BU	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	54.04	1.00	54.04	0.68	
Crop Protection						
Fertilizer	dollars	40.35	1	40.35	0.51	
Herbicide	dollars	35.25	1	35.25	0.45	
Custom Application	dollars	7.00	1	7.00	0.09	
Crop Insurance	dollars	25.25	1	25.25	0.32	
Fuel	dollars	3.24	1	3.24	0.04	
Repairs & Maintenance	dollars	2.98	1	2.98	0.04	
Labor	dollars	2.30	1	2.05	0.03	
Interest (6 months @ 6.25%)[2]	dollars	6.17	1	6.17	0.08	
Total Pre-Harvest Expenses				$176.33	$2.23	$0.00
HARVEST COSTS						
Fuel	dollars	4.18	1	4.18	0.05	
Repair & Maintenance	dollars	5.56	1	5.56	0.07	
Labor	dollars	1.70	1	1.70	0.02	
Hauling[1]	bu	15.80	1	15.80	0.20	
Total Harvest Costs				$27.24	$0.34	$0.00
Total Operating Costs				**$203.57**	**$2.58**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.13	
Machinery Ownership Costs	dollars	33.08	1	33.08	0.42	
Real Estate Taxes	dollars	2.53	1	2.53	0.03	
Total Property & Ownership Costs				$45.71	$0.58	$0.00
TOTAL DIRECT COSTS				**$249.28**	**$3.16**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$54.87**	**$0.69**	**$0.00**
FACTOR PAYMENTS						
Land ($1,250 @ 4%)[3]				10.00	0.13	
RETURN TO MANAGEMENT & RISK				**$44.87**	**$0.57**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.20/Bushel

2 Interest on Opererating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

3 Includes allocation of fallow acres in the rotation

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/bushel)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$2.89	$3.47	$3.85	$4.24	$4.81
-25%	59.25	($78.20)	($43.98)	($21.17)	$1.64	$35.86
-10%	71.10	($43.98)	($2.92)	$24.46	$51.83	$92.89
BUSHELS PER ACRE	79.00	($21.17)	$24.46	$54.87	$85.29	$130.91
10%	86.90	$1.64	$51.83	$85.29	$118.74	$168.93
25%	98.75	$35.86	$92.89	$130.91	$168.93	$225.95

Northeastern Colorado - Dryland Oil Sunflowers Reduced-Till in Two-Crop in Three-Year Rotation

Estimated Production Costs & Returns 2019

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER CWT	
Sunflowers	cwt	$17.84	22	$392.48	$17.84	Your Farm
Your Farm	cwt			$0.00	$0.00	$0.00
Farm Bill payments were not included due to great varaiability between counties covered by this budget						
Gross Receipts				**$392.48**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER CWT	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	24.29	1.00	24.29	1.10	
Crop Protection						
Fertilizer	dollars	26.96	1	26.96	1.23	
Herbicide	dollars	40.39	1	40.39	1.84	
Custom Application	dollars	7.00	2	7.00	0.32	
Insecticide	dollars	10.26	1	10.26	0.47	
Crop Insurance	dollars	42.42	1	42.42	1.93	
Custom Aerial Application	dollars	7.50	1	7.50	0.34	
Fuel	dollars	2.02	1	2.19	0.10	
Repair & Maintenance	dollars	2.20	1	2.20	0.10	
Labor	dollars	1.52	1	1.52	0.07	
Interest (6 months @ 6.25%)[2]	dollars	5.14	1	5.15	0.23	0.00
Total Pre-Harvest Expenses				$169.88	$7.72	$0.00
HARVEST COSTS						
Fuel	dollars	4.52	1	5.35	0.24	
Repair & Maintenance	dollars	5.31	1	5.14	0.23	
Labor	dollars	1.84	1	1.84	0.08	
Hauling[1]	dollars	5.50	1	5.50	0.25	
Total Harvest Costs				$17.83	$0.81	$0.00
Total Operating Costs				**$187.71**	**$8.53**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.46	
Machinery Ownership Costs	dollars	23.17	1	23.17	1.05	
Real Estate Taxes	dollars	2.81	1	2.81	0.13	
Total Property & Ownership Costs				$36.08	$1.64	$0.00
TOTAL DIRECT COSTS				**$223.79**	**$10.17**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**$168.69**	**$7.67**	**$0.00**
FACTOR PAYMENTS						
Land ($1,250 @ 4%)[3]				10.00	0.45	
RETURN TO MANAGEMENT & RISK				**$158.69**	**$7.21**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.25/Cwt
2 Interest on Operating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%
3 Includes allocation of fallow acres in the rotation

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/cwt)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$13.38	$16.06	$17.84	$19.62	$22.30
-25%	16.50	($3.02)	$41.14	$70.57	$100.01	$144.16
-10%	19.80	$41.14	$94.12	$129.44	$164.77	$217.75
CWT	22.00	$70.57	$129.44	$168.69	$207.94	$266.81
10%	24.20	$100.01	$164.77	$207.94	$251.11	$315.87
25%	27.50	$144.16	$217.75	$266.81	$315.87	$389.46

Northeastern Colorado - Dryland Proso Millet Reduced-Till in a Two-Crop in Three-Year Rotation

Estimated Production Costs & Returns 2019

GROSS RECIPTS FROM PRODUCTION

GROSS RECIPTS	UNIT	PRICE	YIELD	PER ACRE	PER CWT	
Proso Millet	cwt	$9.24	14	$129.36	$9.24	Your Farm
Your Farm	cwt			$0.00	$0.00	$0.00
Gross Receipts				**$129.36**		**$0**

DIRECT COSTS

	UNIT	COST PER UNIT	QUANTITY	PER ACRE	PER CWT	YOUR FARM
OPERATING PREHARVEST						
Seed						
Seed	dollars	3.62	1.00	3.62	0.26	
Crop Protection						
Fertilizer	dollars	15.68	1	15.68	1.12	
Herbicide	dollars	11.63	1	11.63	0.83	
Custom Application	dollars	7.00	1	7.00	0.50	
Crop Insurance	dollars	11.11	1	11.11	0.79	
Fuel	dollars	5.13	1	5.13	0.37	
Repairs & Maintenance	dollars	5.22	1	5.22	0.37	
Labor	dollars	2.91	1	2.91	0.21	
Interest (6 months @ 6.25%)[2]	dollars	1.95	1	1.95	0.14	
Total Pre-Harvest Expenses				$64.25	$4.59	$0.00
HARVEST COSTS						
Fuel	dollars	8.58	1	8.58	0.61	
Repair & Maintenance	dollars	8.38	1	8.38	0.60	
Labor	dollars	4.82	1	4.82	0.34	
Hauling[1]	bu	5.60	1	5.60	0.40	
Total Harvest Costs				$27.38	$1.96	$0.00
Total Operating Costs				**$91.63**	**$6.54**	**$0.00**
PROPERTY & OWNERSHIP COSTS						
General Farm Overhead	dollars	10.10	1	10.10	0.72	
Machinery Ownership Costs	dollars	44.97	1	44.97	3.21	
Real Estate Taxes	dollars	2.46	1	2.46	0.18	
Total Property & Ownership Costs				$57.53	$4.11	$0.00
TOTAL DIRECT COSTS				**$149.16**	**$10.65**	**$0.00**
NET RECEIPTS BEFORE FACTOR PAYMENTS				**($19.80)**	**($1.41)**	**$0.00**
FACTOR PAYMENTS						
Land ($1,250 @ 4%)[3]				10.00	0.71	
RETURN TO MANAGEMENT & RISK				**($29.80)**	**($2.13)**	**$0.00**

1 Hauling Machinery & Labor Charges= $0.40/CWT

2 Interest on Opererating Capital is calculated on 1/2 of pre-harvest operating costs at 6.25%

3 Includes allocation of fallow acres in the rotation

BREAKEVEN ANALYSIS - PER ACRE RETURNS OVER TOTAL DIRECT COSTS ($/ACRE)

		ALTERNATIVE PRICES ($/cwt)				
		-25%	-10%		10%	25%
ALTERNATIVE YIELDS		$6.93	$8.32	$9.24	$10.16	$11.55
-25%	10.50	($76.39)	($61.84)	($52.14)	($42.43)	($27.88)
-10%	12.60	($61.84)	($44.38)	($32.73)	($21.09)	($3.63)
CWT	14.00	($52.14)	($32.73)	($19.80)	($6.86)	$12.54
10%	15.40	($42.43)	($21.09)	($6.86)	$7.37	$28.71
25%	17.50	($27.88)	($3.63)	$12.54	$28.71	$52.97

Livestock Enterprise Budget Principles

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Introduction| An enterprise is defined as a single crop or livestock commodity being produced. Most farms or ranches consist of a combination of several enterprises. An enterprise budget is a listing of all estimated income and expenses associated with a specific enterprise to help evaluate its profitability. An enterprise budget can be developed for each current or future enterprise in a farm plan. Each is developed on the basis of a common unit such as one acre or one head of livestock. This permits comparison of the profit for alternative and competing enterprises.

Developing an Enterprise Budget| Enterprise budgets can be organized and presented in several different formats, however, they typically contain three sections: 1) Income, 2) Variable or operating costs and 3) Fixed costs. The following are four basic steps in developing an enterprise budget.

- The first step is to estimate variable costs. In the case of livestock such expenses would include feed, veterinary, repairs, fuel, labor, etc.
- The second step is to develop an assessment of fixed costs. Fixed costs include, but are not limited to, machinery, breeding stock replacement and land debt payments, lease payments and overhead charges like insurance, taxes and interest.
- The third step in the process is to estimate the total production and realistic expected commodity price.
- The last step is to determine net returns (profits) for the given enterprise. Net returns represent that income which is left for the farm or ranch manager and his family to live on, pay debts, invest or save.

The primary weakness of the budget is that it presents income and cost data for only one situation. The use of computerized budgets will allow you to ask many "what if" questions, thus allowing greater flexibility of the enterprise budget as a management decision tool. Finally, the enterprise budget ignores the impact of one enterprise on other enterprises. For example, a dairy enterprise may compete for a limited labor supply, particularly when it causes delays in planting or harvesting of grain crops.

Livestock Enterprise Budgets| Livestock budgets follow the same general format as crop budgets but are often more difficult to complete because there is a problem of accounting for multiple outputs such as calves, culls cows and cull bulls for a beef cow enterprise or lambs, wool, cull ewes and cull rams for a sheep enterprise. A second problem is proper accounting for the cost of raising or purchasing replacement animals to maintain a breeding herd. Thirdly is the problem of determining a proper charge for farm raised feed, pasture or crop residues used in the livestock enterprise.

Break-Even Factors for the Cow/Calf Operator| While the producer has little or no control over market prices, he does have at least some control over the price needed to break even. Three important factors of break-even prices for the cow/calf producer are: 1) Annual cow costs, 2) Percent calf crop and 3) Weaning weights. Break-even selling prices for weaned calves are presented in Table 1. Factors affecting annual cow costs are expenses for feed, pasture or range leases, vet and medicine, marketing, utilities, labor, fuel, machinery and facility repairs, interest, depreciation, property taxes, etc.

Percent of calf crop is the number of calves weaned per 100 cows exposed the previous breeding season. The two major factors affecting this are: 1) Failure to conceive at breeding and 2) Death loss at or near birth. Calving difficulties play an important role in both areas through actual losses at birth and by delaying the subsequent rebreeding. Weaning weight is significantly influenced by the age of the calf at weaning. Calves born in the first three weeks of calving season average

70 pounds heavier than those born in the last three weeks. Once a cow starts calving late, she tends to always calve late unless she is left open for a year. Obviously, there are numerous factors affecting percent calf crop and weaning weights. However, three pieces of information, kept on an annual basis for each cow, can provide a basis for evaluating the current status of the herd and suggest areas for improvement. These three pieces of information are: 1) calving date, 2) calving ease, and 3) actual weaning weights.

Summary: Enterprise budgets are a tool Colorado producers can use to assist them in making management decisions involving production, financial requirements and marketing strategies. Although enterprise budgets have been used primarily for production planning, like identifying the most profitable enterprise to produce, they also provide valuable information about dollar needs and the timing of those needs. Marketing decisions must be continually evaluated, and should impact the quantity of various products that a farmer/rancher decides to produce. With increased costs of inputs, including money, producers must concern themselves with financial and marketing management decisions. Enterprise budgets are a tool to help evaluate some of these important management decisions.

Tables 1 through 11 contain enterprise budgets (Cost - Return Budgets) for various classes of livestock. The Cost-Return Budgets have been taken from the Kansas State University AgManager.info web site (www.agmanager.info). Glynn Tonsor and Robin Reid are the authors of the cost-return budgets. Glynn and Robin are located in the Department of Agricultural Economics, K-State Research and Extension, Kansas State University, Manhattan, KS.

KSU Beef Cow-Calf Budget — 2020 Production Year — (as of Dec. 2nd, 2019)

Production Efficiency Information

Weaning Percentage	91.0%
Cow Replacement Percentage	16.0%

Revenue	Price	Unit		Qty	Unit				Total per Year per Cow
Weaned Calf Sale	$ 163.90	*per cwt*	x	550	*lbs*	x	0.91	=	$ 820.29
Cull Cows	$ 54.50	*per cwt*	x	1250	*lbs*	x	0.16	=	$ 109.00
Other Income									
Gross Income									**$ 929.29**
Variable Costs									
Pasture	$ 20.00	*per acre*	x	9.5	*total acres*			=	$ 190.00
Crop Residue	$ 15.00	*per acre*	x	2.0	*total acres*			=	$ 30.00
Harvested Forage	$ 70.00	*per ton*	x	2.25	*total tons*			=	$ 157.50
Grain/Protein Supplements	$ 152.39	*per ton*	x	833.0	*total lbs*			=	$ 63.47
Mineral	$ 850.00	*per ton*	x	100.0	*total lbs*			=	$ 42.50
Other Feed	$ -	*per unit*	x	0.0	*units*			=	$ -
Labor	$ 20.00	*per hour*	x	8.0	*total hours*			=	$ 160.00
Vet Medicine/Drugs									$ 35.00
Replacement Females	$ 856.85	*per head*	x	0.16	*hd*			=	$ 137.10
Annual Bull Charge or A.I.									$ 43.00
Other Livestock Breeding/Marketing									$ 23.50
Utilities									$ 15.00
Gas, Fuel, Oil									$ 22.00
Machinery, Facility/Equip. Repairs									$ 45.00
Cash Interest Paid									$ 32.00
Other variable costs									$ 15.00
Total Variable Costs									**$ 1,011.07**
Fixed Costs									
Depreciation									$ 54.00
Taxes									$ 12.00
Farm/Livestock Insurance									$ 15.00
Opportunity Cost of Investment									$ 135.00
Other fixed costs									$ -
Total Fixed Costs									**$ 216.00**
Total Costs									**$ 1,227.07**
Income Over Variable Costs									$ (81.78)
Income Over Total Costs									**$ (297.78)**

Kansas State University, Department of Agricultural Economics - *www.agmanager.info*
Publication: AM-FMG-CowCalf Version- 12.2.2019

KSU Beef Backgrounding Budget — 2020 Production Year — (as of Dec. 2nd, 2019)

Production Efficiency Information

Death Loss	2.0%			CWT Produced
Days in Backgrounding Lot	150.0	Average Daily Gain	1.25	1.875

Gross Return	Price	Unit		Qty	Unit		Total per Year
Feeder Animal Sale	$ 144.62	*per cwt*	x	738	*lbs*	=	$ 1,066.59
Purchase price	$ 172.00	*per cwt*	x	550	*lbs*	=	$ (946.00)
Death Loss							$ (18.92)
Other							
Total Gross Return							**$ 101.67**

Variable Costs							
Pasture	$ 20.00	*per acre*	x	0.0	*total acres*	=	$ -
Crop Residue	$ 15.00	*per acre*	x	0.0	*total acres*	=	$ -
Harvested Forage	$ 105.00	*per ton*	x	0.53	*total tons*	=	$ 55.13
Grain/Protein Supplements	$ 143.57	*per ton*	x	2100	*total lbs*	=	$ 150.75
Mineral	$ 600.00	*per ton*	x	45.0	*total lbs*	=	$ 13.50
Other Feed	$ -	*per unit*	x	0.0	*units*	=	$ -
Labor	$ 20.00	*per hour*	x	1.5	*hours*	=	$ 30.00
Vet Medicine/Drugs							$ 13.00
Marketing costs							$ 9.00
Utilities,Gas, Fuel, Oil							$ 4.00
Machinery, Facility/Equip. Repairs							$ 7.00
Cash Interest Paid							$ 9.00
Other variable costs							$ 2.00
Total Variable Costs							**$ 293.38**

Fixed Costs	
Depreciation	$ 6.00
Taxes	$ 1.00
Farm/Livestock Insurance	$ 1.50
Opportunity Cost of Investment	$ 22.00
Other fixed costs	$ -
Total Fixed Costs	**$ 30.50**
Total Costs	**$ 323.88**
Income Over Variable Costs	$ (191.71)
Income Over Total Costs	**$ (222.21)**

Kansas State University, Department of Agricultural Economics - *www.agmanager.info*
Publication: AM-FMG-Backgrounding **Version- 12.2.2019**

KSU Beef Stocker Budget — 2020 Production Year — (as of Dec. 2nd, 2019)

Production Efficiency Information

Death Loss	1.0%			CWT Produced
Days on Grass	120.0	Average Daily Gain	1.25	1.500

Gross Return	Price	Unit		Qty	Unit		Total per Year
Feeder Sale	$ 146.14	*per cwt*	x	888	*lbs*	=	$ 1,297.01
Purchase price	$ 150.54	*per cwt*	x	738	*lbs*	=	$ (1,110.25)
Death Loss							$ (11.10)
Other							
Total Gross Return							**$ 175.66**
Variable Costs							
Pasture	$ 20.00	*per acre*	x	2.5	*total acres*	=	$ 50.00
Crop Residue	$ 15.00	*per acre*	x	0.0	*total acres*	=	$ -
Harvested Forage	$ -	*per ton*	x	0	*total tons*	=	$ -
Grain/Protein Supplements	$ -	*per ton*	x	0	*total lbs*	=	$ -
Mineral	$ 600.00	*per ton*	x	12.0	*total lbs*	=	$ 3.60
Other Feed	$ -	*per unit*	x	0.0	*units*	=	$ -
Labor	$ 20.00	*per hour*	x	0.8	*hours*	=	$ 16.00
Vet Medicine/Drugs							$ 6.00
Marketing costs							$ 9.00
Utilities,Gas, Fuel, Oil							$ 5.00
Machinery, Facility/Equip. Repairs							$ 7.00
Cash Interest Paid							$ 6.00
Other variable costs							$ 2.00
Total Variable Costs							**$ 104.60**
Fixed Costs							
Depreciation							$ 5.00
Taxes							$ 1.00
Farm/Livestock Insurance							$ 1.00
Opportunity Cost of Investment							$ 15.00
Other fixed costs							$ -
Total Fixed Costs							**$ 22.00**
Total Costs							**$ 126.60**
Income Over Variable Costs							$ 71.06
Income Over Total Costs							**$ 49.06**

Kansas State University, Department of Agricultural Economics - *www.agmanager.info*
Publication: AM-FMG-Stocker **Version- 12.2.2019**

KSU Beef Finishing Budget — 2020 Production Year — (as of Dec. 2nd, 2019)

Production Efficiency Information

Death Loss	1.5%			CWT Produced
Days on Feed	150.0	Average Daily Gain	3.7	5.550

Gross Return		Price	Unit		Qty	Unit			Total per Year
Fed Animal Sale	$	102.99	*per cwt*	x	1443	*lbs*	=	$	1,485.61
Purchase price	$	146.14	*per cwt*	x	888	*lbs*	=	$	(1,297.01)
Death Loss								$	(19.46)
Other									
Total Gross Return								**$**	**169.15**

Variable Costs									
Harvested Forage	$	105.00	*per ton*	x	0.23	*total tons*	=	$	23.63
Grain/Protein Supplements	$	137.34	*per ton*	x	3300.0	*total lbs*	=	$	226.61
Mineral	$	600.00	*per ton*	x	75.0	*total lbs*	=	$	22.50
Other Feed	$	-	*per unit*	x	0.0	*units*	=	$	-
Labor	$	20.00	*per hour*	x	1.5	*hours*	=	$	30.00
Vet Medicine/Drugs								$	20.00
Marketing costs								$	10.00
Utilities,Gas, Fuel, Oil								$	9.00
Machinery, Facility/Equip. Repairs								$	10.00
Cash Interest Paid								$	17.00
Other variable costs								$	8.00
Total Variable Costs								**$**	**376.73**

Fixed Costs		
Depreciation	$	15.00
Taxes	$	2.00
Farm/Livestock Insurance	$	3.50
Opportunity Cost of Investment	$	36.00
Other fixed costs	$	-
Total Fixed Costs	**$**	**56.50**
Total Costs	**$**	**433.23**
Income Over Variable Costs	$	(207.59)
Income Over Total Costs	**$**	**(264.09)**

Kansas State University, Department of Agricultural Economics - *www.agmanager.info*
Publication: AM-FMG-Finishing **Version- 12.2.2019**

KSU Dairy Cow Budget-Purchased Replacements — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Milk Produced Per Cow (lbs)	23,500				
Replacement Heifer Purchases	37.0%	Cull Cows Sales	30.0%	Calves Sold	92%

Returns	Price	Unit		Qty	Unit				Total per Cow/Year	Total per CWT Milk/Year
Milk Sales	$ 18.00	*per cwt*	x	23500	*lbs*			=	$ 4,230.00	$ 18.00
Milk Premiums	$ -	*per cwt*	x	23500	*lbs*			=	$ -	$ -
Calves Sold	$ 75.00	*per head*	x	0.92	*hd*			=	$ 69.00	$ 0.29
Cull Cows Sold	$ 38.00	*per cwt*	x	1350	*lbs*	x	0.30	=	$ 153.90	$ 0.65
Manure Credit									$ 120.00	$ 0.51
Other Income									$ 80.00	$ 0.34
Total Gross Return									**$ 4,652.90**	**$ 19.80**
Variable Costs										
Feed Cost	$ 6.04	*per head/day*	x	365	*days*				$ 2,204.93	$ 9.38
Replacement Heifers	$ 1,300.00	*per head*	x	0.37	*hd*			=	$ 481.00	$ 2.05
Cow Breeding Fees									$ 44.50	$ 0.19
Daily Labor	$ 15.00	*per hour*	x	35.0	*hours*			=	$ 525.00	$ 2.23
Management Labor	$ 25.00	*per hour*	x	8.0	*hours*			=	$ 200.00	$ 0.85
Milk Marketing & Hauling									$ 105.00	$ 0.45
Veterinary									$ 130.00	$ 0.55
Fuel & Oil									$ 70.00	$ 0.30
Utilities									$ 65.00	$ 0.28
Machinery, Facility/Equip. Repairs									$ 137.00	$ 0.58
Bedding									$ 85.00	$ 0.36
Custom Hire									$ 75.00	$ 0.32
Cash Interest Paid									$ 95.00	$ 0.40
Other variable costs									$ 280.00	$ 1.19
Total Variable Costs									**$ 4,497.43**	**$ 19.14**
Fixed Costs										
Depreciation									$ 185.00	$ 0.79
Farm/Livestock Insurance									$ 54.00	$ 0.23
Opportunity Cost of Investment									$ 260.00	$ 1.11
Other fixed costs									$ 115.00	$ 0.49
Total Fixed Costs									**$ 614.00**	**$ 2.61**
Total Costs									**$ 5,111.43**	**$ 21.75**
Income Over Variable Costs									$ 155.47	$ 0.66
Income Over Total Costs									**$ (458.53)**	**$ (1.95)**

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Publication: AM-FMG-Dairy Cows-Purchased **Version- 12.2.2019**

KSU Dairy Cow Budget- Raised Replacements — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Milk Produced Per Cow (lbs)	23,500	Cull Cows Sales	30.0%	Calves Sold at Birth	46%
Cull Replacements Sold	5.0%	Cull Yearlings Sold	2.0%	Repl. Heifer Death Loss	7.0%
Replacement Heifer Turnover	36.0%				

Returns	Price	Unit		Qty	Unit				Total per Cow/Year	Total per CWT Milk/Year
Milk Sales	$ 18.00	*per cwt*	x	23500	*lbs*			=	$ 4,230.00	$ 18.00
Milk Premiums	$ -	*per cwt*	x	23500	*lbs*			=	$ -	$ -
Calves Sold	$ 75.00	*per head*	x	0.46	*hd*			=	$ 34.50	$ 0.15
Cull Cows Sold	$ 38.00	*per cwt*	x	1350	*lbs*	x	0.30	=	$ 153.90	$ 0.65
Cull Replacements Sold	$ 107.88	*per cwt*	x	1250	*lbs*	x	0.05	=	$ 67.43	$ 0.29
Cull Yearlings Sold	$ 115.00	*per cwt*	x	725	*lbs*	x	0.02	=	$ 16.68	$ 0.07
Manure Credit									$ 132.60	$ 0.56
Other Income									$ 86.00	$ 0.37
Total Gross Return									**$ 4,721.10**	**$ 20.09**
Variable Costs										
Heifer Feed Cost	$ 852.00	*total cost*				x	0.43		$ 366.36	$ 1.56
Cow Feed Cost	$ 6.04	*per head/day*	x	365	*days*				$ 2,204.93	$ 9.38
Breeding Fees									$ 62.00	$ 0.26
Daily Labor	$ 15.00	*per hour*	x	42.0	*hours*			=	$ 630.00	$ 2.68
Management Labor	$ 25.00	*per hour*	x	9.5	*hours*			=	$ 237.50	$ 1.01
Milk Marketing & Hauling									$ 105.00	$ 0.45
Veterinary									$ 160.00	$ 0.68
Fuel & Oil									$ 85.00	$ 0.36
Utilities									$ 83.00	$ 0.35
Machinery, Facility/Equip. Repairs									$ 160.00	$ 0.68
Bedding									$ 120.00	$ 0.51
Custom Hire									$ 77.00	$ 0.33
Cash Interest Paid									$ 102.00	$ 0.43
Other variable costs									$ 303.00	$ 1.29
Total Variable Costs									**$ 4,695.79**	**$ 19.98**
Fixed Costs										
Depreciation									$ 192.00	$ 0.82
Farm/Livestock Insurance									$ 65.00	$ 0.28
Opportunity Cost of Investment									$ 268.00	$ 1.14
Other fixed costs									$ 134.00	$ 0.57
Total Fixed Costs									**$ 659.00**	**$ 2.80**
Total Costs									**$ 5,354.79**	**$ 22.79**
Income Over Variable Costs									$ 25.31	$ 0.11
Income Over Total Costs									**$ (633.69)**	**$ (2.70)**

Kansas State University, Department of Agricultural Economics - *www.agmanager.info*
Publication: AM-FMG-Dairy Cows-Raised **Version- 12.2.2019**

KSU Dairy Replacement Heifer Budget — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Cull Replacements Sold	5.0%	Death Loss	7.0%
Cull Yearlings Sold	2.0%		

Returns	Price	Unit		Qty	Unit		%		Total per Heifer
Springer Heifer Sales	$ 1,300.00	*per head*	x			x	0.86	=	$ 1,118.00
Cull Replacements Sold	$ 107.88	*per cwt*	x	1250	*lbs*	x	0.05	=	$ 67.43
Cull Yearlings Sold	$ 115.00	*per cwt*	x	725	*lbs*	x	0.02	=	$ 16.68
Manure Credit									$ 35.00
Other Income									
Purchase of Heifer Calf	$ 75.00	*per head*							$ (75.00)
Total Gross Return									**$ 1,162.10**
Variable Costs									
Feed Costs									$ 852.00
Daily Labor	$ 15.00	*per hour*	x	15.0	*hours*				$ 225.00
Management Labor	$ 25.00	*per hour*	x	3.0	*hours*				$ 75.00
Breeding Fees									$ 25.00
Veterinary									$ 48.00
Fuel & Oil									$ 26.00
Utilities									$ 25.50
Machinery, Facility/Equip. Repairs									$ 49.00
Bedding									$ 41.00
Custom Hire									$ 10.00
Cash Interest Paid									$ 33.00
Other Variable Costs									$ 44.00
Total Variable Costs									**$ 1,453.50**
Fixed Costs									
Depreciation									$ 74.00
Insurance									$ 18.00
Opportunity Cost of Investment									$ 84.00
Other fixed costs									$ 43.00
Total Fixed Costs									**$ 219.00**
Total Costs									**$ 1,672.50**
Income Over Variable Costs									$ (291.40)
Income Over Total Costs									**$ (510.40)**

Kansas State University, Department of Agricultural Economics - *www.agmanager.info*
Publication: AM-FMG-Dairy Heifers **Version- 12.2.2019**

KSU Farrow-to-Finish Swine Budget — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Weaned Pigs/Mated Sow/Year	23.90		
Litters/Mated Sow/Year	2.30		
Wean-Finish Mortality (%)	7.99	Nursery Feed to Gain	1.54
Market Hogs Sold/Mated Sow/Year	21.99	Grow/Finish Feed to Gain	2.54
Sow Replacement Rate	50%	Weaned Pig Weight	14.00
Sow Mortality (%)	8%	Nursery Exit Weight	52.00

Revenue	Price	Unit		Qty	Unit				Total per Year per Sow	Total per Year per Pig Sold
Market Hogs	$ 33.18	*per cwt*	x	277	*lbs*	x	21.99	=	$ 2,021.11	$ 91.91
Cull Sows	$ 43.42	*per cwt*	x	400	*lbs*	x	0.42	=	$ 72.95	$ 3.32
Manure Credit									$ 131.94	$ 6.00
Other revenue									$ -	$ -
Gross Income									**$ 2,225.99**	**$ 101.23**
Variable Costs										
Sow Feed	$ 0.09	*per lb*	x	125.0	*lbs*			=	$ 26.06	$ 11.33
Nursery Feed	$ 0.14	*per lb*	x	58.5	*lbs*			=	$ 194.95	$ 8.16
Grow-Finish Feed	$ 0.09	*per lb*	x	571.5	*lbs*			=	$ 1,068.88	$ 48.61
Feed Processing	$ 17.00	*per ton*	x	0.4	*ton*			=	$ 141.13	$ 6.42
Labor	$ 15.00	*per hour*	x	6.0	*hours*			=	$ 207.00	$ 9.41
Vet Medicine/Drugs									$ 187.00	$ 8.50
Replacement Females	$ 166.25	*per head*	x	0.50	*hd*			=	$ 83.12	$ 3.78
Semen Cost & Genetic Fee									$ 29.90	$ 1.36
Marketing, Bedding, and Misc									$ 62.13	$ 2.83
Utilities, Gas, Fuel, Oil									$ 116.95	$ 5.32
Machinery, Facility/Equip. Repairs									$ 87.11	$ 3.96
Other variable costs									$ -	$ -
Total Variable Costs									**$ 2,204.24**	**$ 109.67**
Fixed Costs										
Machinery, Facilities, General Overhead									$ 907.00	$ 41.25
Taxes and Insurance									$ 38.38	$ 1.75
Legal, Accounting, etc.									$ 32.99	$ 1.50
Other fixed costs									$ -	$ -
Total Fixed Costs									**$ 978.36**	**$ 44.49**
Total Costs									**$ 3,182.60**	**$ 154.16**
Income Over Variable Costs									$ 21.75	$ (8.45)
Income Over Total Costs									**$ (956.61)**	**$ (52.94)**

Kansas State University, Department of Agricultural Economics - *www.agmanager.info*
Publication: AM-FMG-FarFin **Version- 12.2.2019**

KSU Farrow-to-Wean Swine Budget **Current Prices** **(as of Dec. 2nd, 2019)**

Production Efficiency Information

Weaned Pigs/Mated Sow/Year	23.90
Litters/Mated Sow/Year	2.30
Weaning Weight (lbs)	14.00
Sow Replacement Rate	50%
Sow Mortality (%)	8%

Revenue	Price	Unit		Qty	Unit				Total per Year per Sow	Total per Year per Pig Sold
Weaned Pig	$ 33.86	*per hd*	x	1	*hd*			=	$ 809.25	$ 33.86
Cull Sows	$ 43.42	*per cwt*	x	400	*lbs*	x	0.42	=	$ 72.95	$ 3.05
Manure Credit									$ 11.95	$ 0.50
Other revenue									$ -	$ -
Gross Income									**$ 894.15**	**$ 37.41**
Variable Costs										
Sow Feed	$ 0.09	*per lb*	x	125.0	*lbs*			=	$ 270.81	$ 11.33
Feed Processing	$ 17.00	*per ton*	x	0.1	*ton*			=	$ 25.39	$ 1.06
Labor	$ 15.00	*per hour*	x	6.9	*hours*			=	$ 103.50	$ 4.33
Vet Medicine/Drugs									$ 60.03	$ 2.51
Replacement Females	$ 166.25	*per head*	x	0.50	*hd*			=	$ 83.12	$ 3.48
Semen Cost & Genetic Fee									$ 29.90	$ 1.25
Marketing, Bedding, and Misc									$ 3.42	$ 0.14
Utilities, Gas, Fuel, Oil									$ 18.59	$ 0.78
Machinery, Facility/Equip. Repairs									$ 11.27	$ 0.47
Other variable costs									$ -	$ -
Total Variable Costs									**$ 606.05**	**$ 25.36**
Fixed Costs										
Machinery, Facilities, General Overhead									$ 178.37	$ 7.46
Taxes and Insurance									$ 6.08	$ 0.25
Legal, Accounting, etc.									$ 11.95	$ 0.50
Other fixed costs									$ -	$ -
Total Fixed Costs									**$ 196.40**	**$ 8.22**
Total Costs									**$ 802.45**	**$ 33.58**
Income Over Variable Costs									$ 288.10	$ 12.05
Income Over Total Costs									**$ 91.70**	**$ 3.84**

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KSU Wean-to-Finish Swine Budget — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Wean-Finish Mortality (%)	7.99
Wean-Finish Feed to Gain	2.54
Placement Weight (lbs)	14.00

Revenue	Price	Unit		Qty	Unit				Total per Year per Pig Sold
Market Hogs	$ 33.18	*per cwt*	x	277	*lbs*	x	0.92	=	$ 84.57
Less cost of Weaned Pigs	$ 33.86	*per hd*	x	1	*hd*			=	$ (33.86)
Manure Credit									$ 5.50
Other revenue									$ -
Gross Income									**$ 56.21**
Variable Costs									
Nursery Feed	$ 0.14	*per lb*	x	57.4	*lbs*			=	$ 8.00
Grow-Finish Feed	$ 0.09	*per lb*	x	610.6	*lbs*			=	$ 51.94
Feed Processing	$ 17.00	*per ton*	x	0.3	*ton*			=	$ 5.68
Labor	$ 15.00	*per hour*	x	0.7	*hours*			=	$ 10.50
Vet Medicine/Drugs									$ 6.02
Marketing, Bedding, and Misc									$ 0.75
Utilities, Gas, Fuel, Oil									$ 3.84
Machinery, Facility/Equip. Repairs									$ 2.40
Other variable costs									$ -
Total Variable Costs									**$ 89.11**
Fixed Costs									
Machinery, Facilities, General Overhead									$ 25.43
Taxes and Insurance									$ 2.14
Legal, Accounting, etc.									$ 1.00
Other fixed costs									$ -
Total Fixed Costs									**$ 28.57**
Total Costs									**$ 117.68**
Income Over Variable Costs									$ (32.90)
Income Over Total Costs									**$ (61.47)**

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KSU Nursery Swine Budget — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Nursery Mortality (%)	4.77
Feed to Gain Conversion	1.54
Entry Weight (lbs)	14.00
Exit Weight (lbs)	52.00

Revenue	Price	Unit		Qty	Unit				Total per Year per Pig Sold
Feeder Pigs	$ 48.61	*per hd*	x	52.00	*lbs*	x	0.95	=	$ 46.29
Less cost of Weaned Pigs	$ 33.86	*per hd*	x	1	*hd*			=	$ (33.86)
Manure Credit									$ 0.50
Other revenue									$ -
Gross Income									**$ 12.93**
Variable Costs									
Nursery Feed	$ 0.14	*per lb*	x	57.3	*lbs*			=	$ 7.98
Feed Processing	$ 17.00	*per ton*	x	0.03	*ton*			=	$ 0.49
Labor	$ 15.00	*per hour*	x	0.2	*hours*			=	$ 3.00
Vet Medicine/Drugs									$ 1.76
Marketing, Bedding, and Misc									$ 0.18
Utilities, Gas, Fuel, Oil									$ 0.75
Machinery, Facility/Equip. Repairs									$ 0.49
Other variable costs									$ -
Total Variable Costs									**$ 14.66**
Fixed Costs									
Machinery, Facilities, General Overhead									$ 5.80
Taxes and Insurance									$ 0.33
Legal, Accounting, etc.									$ 0.50
Other fixed costs									$ -
Total Fixed Costs									**$ 6.63**
Total Costs									**$ 21.29**
Income Over Variable Costs									$ (1.73)
Income Over Total Costs									**$ (8.36)**

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KSU Finishing Swine Budget — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Finisher Mortality (%)	5.19
Feed to Gain Conversion	2.71
Entry Weight (lbs)	52.00
Exit Weight (lbs)	272.80

Revenue	Price	Unit		Qty	Unit				Total per Year per Pig Sold
Market Hogs	$ 33.18	*per cwt*	x	273	*lbs*	x	0.95	=	$ 85.82
Less cost of Feeder Pigs	$ 48.61	*per hd*						=	$ (48.61)
Manure Credit									$ 5.00
Other revenue									$ -
Gross Income									**$ 42.21**
Variable Costs									
Grow-Finish Feed	$ 0.09	*per lb*	x	598.4	*lbs*			=	$ 50.89
Feed Processing	$ 17.00	*per ton*	x	0.30	*ton*			=	$ 5.09
Labor	$ 15.00	*per hour*	x	0.2	*hours*			=	$ 3.00
Vet Medicine/Drugs									$ 4.13
Marketing, Bedding, and Misc									$ 0.55
Utilities, Gas, Fuel, Oil									$ 3.11
Machinery, Facility/Equip. Repairs									$ 1.88
Other variable costs									$ -
Total Variable Costs									**$ 68.65**
Fixed Costs									
Machinery, Facilities, General Overhead									$ 19.39
Taxes and Insurance									$ 1.77
Legal, Accounting, etc.									$ 1.00
Other fixed costs									$ -
Total Fixed Costs									**$ 22.15**
Total Costs									**$ 90.80**
Income Over Variable Costs									$ (26.44)
Income Over Total Costs									**$ (48.59)**

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KSU Once-a-Year Lambing Budget — Current Prices (as of Dec. 2nd, 2019)

Production Efficiency Information

Lamb Crop Percentage	180.0%
Ewe Replacement Percentage	15.0%

Revenue	Price	Unit		Lbs.	Unit				Total per Year per Ewe
Slaughter Lambs	$ 138.05	*per cwt*	x	130	*lbs.*	x	1.65	=	$ 296.12
Cull Ewes	$ 43.62	*per cwt*	x	150	*lbs.*	x	0.15	=	$ 9.81
Other Income									$ -
Gross Income									**$ 305.93**
Variable Costs									
Pasture	$ 20.00	*per acre*	x	1.0	*total acres*			=	$ 20.00
Harvested Forage	$ 72.10	*per ton*	x	1187.0	*total lbs*			=	$ 42.79
Grain/Protein Supplements	$ 129.88	*per ton*	X	672.0	*total lbs*			=	$ 43.64
Mineral	$ 0.50	*per pound*	X	19.0	*total lbs*			=	$ 9.50
Other Feed	$ -	*per unit*	X	0.0	*units*			=	$ -
Labor	$ 20.00	*per hour*	x	4.2	*total hours*			=	$ 84.00
Replacement Ewe	$ -	*per head*	x	0.15	*hd*				$ -
Ram Charge									$ 2.43
Vet Medicine/Drugs									$ 6.00
Other Livestock Breeding/Marketing									$ 4.00
Shearing									$ 5.00
Utilities,Gas, Fuel, Oil									$ 6.50
Machinery, Facility/Equip. Repairs									$ 6.00
Other Variable Costs									$ -
Cash Interest Paid									$ 8.50
Total Variable Costs									**$ 238.36**
Fixed Costs									
Depreciation - Buildings/Equipment									$ 15.00
Depreciation - Livestock									$ 1.00
Taxes/Insurance - Farm & Livestock									$ 5.00
Interest - Buildings/Equipment & Livestock									$ 17.00
Other Fixed Costs									$ -
Total Fixed Costs									**$ 38.00**
Total Costs									**$ 276.36**
Income Over Variable Costs									$ 67.57
Income Over Total Costs									**$ 29.57**

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Livestock Terms, Tables, and Figures

Travis Taylor, Area Livestock Agent

Livestock management decisions determine the success of an operation. The following section contains important information and tools to aid livestock producers in their decision-making and management practices.

Livestock Nutrition Terms

Proper livestock nutrition requires an understanding of the composition of animal feeds. This section contains key terms and definitions for understanding feed nutrient analysis results.

DM % - Dry Matter

Moisture levels vary greatly between livestock feeds. The material remaining in a feed after the water is removed is called the DM. The DM content of a feed affects feed intake. The following feed analysis values are on a DM basis.

CP % - Crude Protein

CP is an estimation of the protein content in a feed by measuring the amount of nitrogen. On average, proteins contain 16% nitrogen; therefore, by multiplying the nitrogen content by (6.25 or 100/16) gives an estimation of the protein content.

DIP % - Degradable Intake Protein

DIP is the fraction of the feed crude protein that is degraded in the rumen. It provides a nitrogen source for rumen microbes from both protein and nonprotein nitrogen.

UIP % - Undegraded Intake Protein

UIP, also known as "by-pass" protein, is the fraction of the feed crude protein that passes out of the rumen undigested. It contributes to the metabolizable protein value.

MP % - Metabolizable Protein

MP is protein that is available to the animal including microbial crude protein and UIP.

NDF % - Neutral Detergent Fiber

NDF is the percentage of fiber in a feed (cellulose and lignin) including hemicellulose. There is a high correlation between NDF and feed intake.

ADF % - Acid Detergent Fiber

ADF is the percentage of fiber in a feed (cellulose and lignin) not including hemicellulose. There is a high correlation between ADF and digestibility.

TDN % - Total Digestible Nutrients

TDN is the preferred value for expressing the energy content of feeds despite some fundamental flaws with its use. TDN is generally calculated using the ADF value. One of the issues with TDN is it tends to overestimate the livestock performance consuming roughages.

NE – Net Energy

The NE system divides the energy use into three categories based on the production stage of the animal. The three categories are NE for maintenance (NEm), NE for growth (NEg) and NE for lactation (NEl). The efficiency in which animals use the feed energy will change depending on bodily function. For example, energy is used more efficiently to meet maintenance requirements than for muscle/tissue growth. The accuracy of the NE system relies on the ability to predict animal intake.

RFV – Relative Feed Value

RFV is a value used solely for identifying the quality of hay. It is the combination of estimated feed intake and digestibility calculated from NDF and ADF values correspondingly.

RFQ - Relative Forage Quality

RFQ is similar to RFV in that it is used to identify the quality of hay, incorporating feed intake and digestibility. Where RFQ differs from RFV is that a

simulated rumen digestion test is performed, making it more accurate than RFV. Neither RFV nor RFQ are useful in balancing rations for livestock.

Comparing Prices of Livestock Feeds

Feeding livestock makes up the majority of the costs associated with livestock production. The ability to compare and price one feed to another gives livestock producers the ability to choose least cost feeding solutions and save money. This table allows the user to compare the price of feeds on a nutrient or feed analysis basis.

To use the feed price calculator, enter information that you know about the feed in the feed analysis table.

Feed Costs, Pounds per unit, and Dry Matter must be entered to perform calculations. Crude protein, TDN, and Net Energy values are optional, but are valuable in balancing rations for livestock. For descriptions of these values, see the terms and definitions on the previous page.

Next, use the Feed Price Comparison table to calculate prices per nutrient/analysis value. Use the numbers in the calculations column to complete the Feed Price Comparisin Table 1. The price of the feeds in the Feed Price Comparison section can then be compared horizontally between feed #1 and #2.

Table 1. Comparing Prices of Livestock Feeds

Feed Analysis Information	Feed #1	Feed #2	Example	Calculation #	
Feed Name			Ex. Alfalfa	1	
Feed Cost per unit ($)			240	2	
Pounds per unit (pounds, ex: 2000 lbs)			2000	3	
Dry Matter (%)			91	4	**Use decimal form*
Crude Protein (%)			20	5	*of percent's in*
TDN (%)			58	6	*calculations*
Net Energry for maintenance (Mcal/lb)			0.56	7	*Ex: 91% /100 = .91*
Net Energy for gain (Mcal/lb)			0.31	8	

Feed Price Comparison	Feed #1	Feed #2	Example	Calculations	
Price per pound of DM ($/lb)			0.132	2/(3*4)	**Use calculation #'s*
Price per pound of CP ($/lb)			0.659	2/(3*4*5)	*from above to*
Price per pound of TDN ($/lb)			0.227	2/(3*4*6)	*perform the*
Price per pound of NEm ($/lb)			0.235	2/(3*4*7)	*calculations.*
Price per pound of NEg ($/lb)			0.425	2/(3*4*8)	

**Use the "Calculations" column on the right to find feed prices for specific nutrients.*

Animal Unit Equivalents for Grazing

Grazing management is crucial for rangeland health in the Golden Plains Area. Using a stocking rate too high can lead to overgrazing and damage the ecology of the rangeland. Effective grazing strategies identify forage availability and the animal units the pasture can support. The following table allows livestock producers, who know their pasture's forage availability and the appropriate stocking rate, to determine the appropriate number of grazing animals by species. Animal intake may fluctuate between animals and on a day-to-day basis. The data in Table 2 are averages, and the assumption is that 1 animal unit (AU) will consume 26 pounds per day of air dried forage.

Table 2. Animal Unit Equivalents for Various Livestock and Wildlife Species

Animal Class	AU Equivalent
Cattle	
Cow (1,000 lb non- lactating)	1
Pregnant heifer (≥ 18 months)	1
Bull (> 24 months)	1.5
Bull (< 24 months)	1.2
Cow and calf	1.3
Yearling (> 18 months)	0.9
Yearling (< 18 months)	0.8
Calf (< 12 months)	0.6
Sheep and goat	
Non-lactating ewe or doe	0.2
Ewe or doe with young	0.3
Weaned lamb or kid	0.15
Horse	
Draft	1.5
Saddle	1.25
Others	
Deer (red)	0.34
Deer (fallow)	0.17
Bison (mature)	1
Elk (mature)	0.65
An animal unit is considered to be equal to a mature 1,000 lb cow that is not lactating and is being fed at a maintenance level diet with an intake of 26 pounds per day.	

Estimated Livestock Water Requirements

Livestock use water for temperature regulation, digestion, growth, and many other bodily functions, making it very important for producers to know how much their livestock will drink. The ambient temperature, water temperature, diet, growth, lactation and the animal's activity all play a part in how much the animal will drink. Table 3 contains average water consumption for various livestock species at various temperatures. Actual water consumption may vary.

Table 3. Estimated livestock water requirements (gallons per head per day)

	Temperature in °F					
Weight in lbs	**40**	**50**	**60**	**70**	**80**	**90**
Growing Beef Calves[a]						
400	**4.0**	**4.3**	**5.0**	**5.8**	**6.7**	**9.5**
600	**5.3**	**5.8**	**6.6**	**7.8**	**8.9**	**12.7**
800	**6.3**	**6.8**	**7.9**	**9.2**	**10.6**	**15.0**
Finishing Beef Cattle[a]						
600	**6.0**	**6.5**	**7.4**	**8.7**	**10.0**	**14.3**
800	**7.3**	**7.9**	**9.1**	**10.7**	**12.3**	**17.4**
1,000	**8.7**	**9.4**	**10.8**	**12.6**	**14.5**	**20.6**
Wintering Pregnant Beef Cows[a]						
900	6.7	7.2	8.3	9.7	---	---
1,310	6.0	6.5	7.4	8.7	---	---
Lactating Beef Cows[a]						
900 and up	**11.4**	**12.6**	**14.5**	**16.9**	**17.9**	**16.2**
Mature Beef Bulls[a]						
1,400	**8.0**	**8.6**	**9.9**	**11.7**	**13.4**	**19.0**
1,600 and up	**8.7**	**9.4**	**10.8**	**12.6**	**14.5**	**20.6**
Lactating Dairy Cows[b]						
75 lbs/d milk	**17.1**	**18.8**	**20.6**	**22.3**	**24.1**	**25.9**
Horses and Mules						
---	**8.0**	**8.8**	**9.6**	**10.4**	**11.2**	**12.0**
Sheep						
---	1.5	1.9	2.3	2.7	3.1	3.5
Goat						
---	1.5	1.9	2.3	2.7	3.1	3.5
Swine						
per 100 lbs	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
Turkey						
per 100 lb	**10.0**	**11.0**	**12.0**	**13.0**	**14.0**	**15.0**
Chicken						
per 100 lb	**6.0**	**6.6**	**7.2**	**7.8**	**8.4**	**9.0**

[a] Meehan, M.A., G. Stokka, and M. Mostrom. *Livestock Water Requirements.* 2015. NDSU Extension Service.

[b] Calculation from Murphy, M. R., C. L. Davis and G. C. McCoy. 1983. Factors affecting water consumption by Holstein cows in early lactation. *J. Dairy Sci.* 66: 35. Variables include typical temperature fluctuations, dry matter intake, milk production, and salt intake.

Table 4. Body Condition Score Description (Adapted from Herd and Sprott, 1986)

	BCS	Description
Thin	1	Bone structures are sharp to the touch. Little evidence of fat deposits or muscling.
	2	Little evidence of fat deposition but some muscling in hindquarters. Spinous process are sharp to the touch and easily seen with space between them.
	3	Slight fat cover over loin, back and foreribs. Backbone highly visible and spinous processes are identifiable by touch. Spaces between processes are less pronounced.
Borderline	4	Foreribs not noticeable. 12th and 13th rib still noticeable. Transverse processes identifiable only by palpation (slight pressure), feel rounded rather than sharp. Full but straightness of muscling in hindquarters.
Ideal	5	12th and 13th ribs not visible unless animal has been shrunk. The transverse spinous processes can only be felt with firm pressure to feel rounded—not noticeable to the eye. Spaces between the processes not visible and only distinguishable with firm pressure. Areas on each side of the tail head are fairly well filled but not mounded.
	6	Ribs fully covered, not noticeable to the eye. Hindquarters plump and full. Noticeable sponginess to covering of foreribs and on each side of the tail head. Palpation of the transverse process requires firm pressure.
	7	Ends of the spinous processes can only be felt with very firm pressure. Spaces between processes can barely be distinguished at all. Abundant fat cover on either side of tail head with some patchiness evident.
Fat	8	Animal taking on a smooth, blocky appearance; bone structure disappearing from sight. Fat cover thick and spongy with patchiness likely.
	9	Bone structure not seen or easily felt. Tail head buried in fat. Animal's mobility may actually be impaired by excess amount of fat.

Figure 1. Body Condition Score Palpation Guide (over the loin)

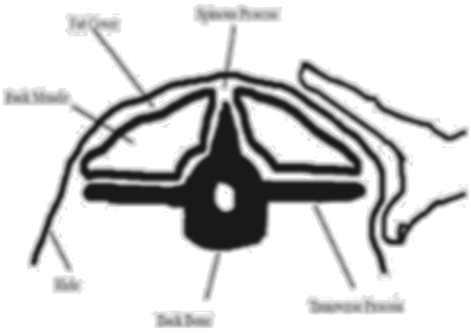

Figure 2. Cross Section of Body Condition Scores for Beef Cattle

Table 5. Cattle Temperature Humidity Index Chart (Adapted from Herd and Sprott, 1986)

	Relative Humidity (%)											
Temperature (°F)	30	35	40	45	50	55	60	65	70	75	80	85
100	84	85	86	87	88	90	91	92	93	94	95	97
98	83	84	85	86	87	88	89	90	91	93	94	95
96	81	82	83	85	86	87	88	89	90	91	92	93
94	80	81	82	83	84	85	86	87	88	89	90	91
92	79	80	81	82	83	84	85	85	86	87	88	89
90	78	79	79	80	81	82	83	84	85	86	86	87
88	76	77	78	79	80	81	81	82	83	84	85	86
86	75	76	77	78	78	79	80	81	81	82	83	84
84	74	75	75	76	77	78	78	79	80	80	81	82
82	73	73	74	75	75	76	77	77	78	79	79	80
80	72	72	73	73	74	75	75	76	76	77	78	78
78	70	71	71	72	73	73	74	74	75	78	76	76
76	69	70	70	71	71	72	72	73	73	74	72	75
	Temperature Humidity Index (THI)											

Normal <75	Alert 75-78	Danger 79-83	Emergency >84

Table 6. Livestock Gestation Calendar

Date of Service	Date Animal is Due to Give Birth				
	Cow	Mare	Ewe	Doe	Sow
1-Apr-14	9-Jan-15	7-Mar-15	26-Aug-14	29-Aug-14	25-Jul-14
15-Apr-14	23-Jan-15	21-Mar-15	9-Sep-14	12-Sep-14	8-Aug-14
1-May-14	8-Feb-15	6-Apr-15	25-Sep-14	28-Sep-14	24-Aug-14
15-May-14	22-Feb-15	20-Apr-15	9-Oct-14	12-Oct-14	7-Sep-14
1-Jun-14	11-Mar-15	7-May-15	26-Oct-14	29-Oct-14	24-Sep-14
15-Jun-14	25-Mar-15	21-May-15	9-Nov-14	12-Nov-14	8-Oct-14
1-Jul-14	10-Apr-15	6-Jun-15	25-Nov-14	28-Nov-14	24-Oct-14
15-Jul-14	24-Apr-15	20-Jun-15	9-Dec-14	12-Dec-14	7-Nov-14
1-Aug-14	11-May-15	7-Jul-15	26-Dec-14	29-Dec-14	24-Nov-14
15-Aug-14	25-May-15	21-Jul-15	9-Jan-15	12-Jan-15	8-Dec-14
1-Sep-14	11-Jun-15	7-Aug-15	26-Jan-15	29-Jan-15	25-Dec-14
15-Sep-14	25-Jun-15	21-Aug-15	9-Feb-15	12-Feb-15	8-Jan-15
1-Oct-14	11-Jul-15	6-Sep-15	25-Feb-15	28-Feb-15	24-Jan-15
15-Oct-14	25-Jul-15	20-Sep-15	11-Mar-15	14-Mar-15	7-Feb-15
1-Nov-14	11-Aug-15	7-Oct-15	28-Mar-15	31-Mar-15	24-Feb-15
15-Nov-14	25-Aug-15	21-Oct-15	11-Apr-15	14-Apr-15	10-Mar-15
1-Dec-14	10-Sep-15	6-Nov-15	27-Apr-15	30-Apr-15	26-Mar-15
15-Dec-14	24-Sep-15	20-Nov-15	11-May-15	14-May-15	9-Apr-15
1-Jan-15	11-Oct-15	7-Dec-15	28-May-15	31-May-15	26-Apr-15
15-Jan-15	25-Oct-15	21-Dec-15	11-Jun-15	14-Jun-15	10-May-15
1-Feb-15	11-Nov-15	7-Jan-16	28-Jun-15	1-Jul-15	27-May-15
15-Feb-15	25-Nov-15	21-Jan-16	12-Jul-15	15-Jul-15	10-Jun-15
1-Mar-15	9-Dec-15	4-Feb-16	26-Jul-15	29-Jul-15	24-Jun-15
15-Mar-15	23-Dec-15	18-Feb-16	9-Aug-15	12-Aug-15	8-Jul-15
1-Apr-15	9-Jan-16	6-Mar-16	26-Aug-15	29-Aug-15	25-Jul-15
15-Apr-15	23-Jan-16	20-Mar-16	9-Sep-15	12-Sep-15	8-Aug-15
1-May-15	8-Feb-16	5-Apr-16	25-Sep-15	28-Sep-15	24-Aug-15
15-May-15	22-Feb-16	19-Apr-16	9-Oct-15	12-Oct-15	7-Sep-15
1-Jun-15	10-Mar-16	6-May-16	26-Oct-15	29-Oct-15	24-Sep-15
15-Jun-15	24-Mar-16	20-May-16	9-Nov-15	12-Nov-15	8-Oct-15
1-Jul-15	9-Apr-16	5-Jun-16	25-Nov-15	28-Nov-15	24-Oct-15
15-Jul-15	23-Apr-16	19-Jun-16	9-Dec-15	12-Dec-15	7-Nov-15
1-Aug-15	10-May-16	6-Jul-16	26-Dec-15	29-Dec-15	24-Nov-15
15-Aug-15	24-May-16	20-Jul-16	9-Jan-16	12-Jan-16	8-Dec-15
1-Sep-15	10-Jun-16	6-Aug-16	26-Jan-16	29-Jan-16	25-Dec-15
15-Sep-15	24-Jun-16	20-Aug-16	9-Feb-16	12-Feb-16	8-Jan-16
1-Oct-15	10-Jul-16	5-Sep-16	25-Feb-16	28-Feb-16	24-Jan-16
15-Oct-15	24-Jul-16	19-Sep-16	10-Mar-16	13-Mar-16	7-Feb-16