

Western Region



Sustainable Agriculture
Research and Extension

Alternative Crops for Dryland Agriculture in the Intermountain Pacific Northwest

GROWER EXPERIENCES WITH FIELD CORN IN EASTERN WASHINGTON, 1996–2000

By Norm Herdrich, Agricultural Writer

The information for this bulletin was gathered from a seminar on field corn held in Washington State in February 2000. Speakers included John Aeschliman, Tracy Eriksen, Jay Lyman, Roger Willis, and Russ Zenner.

Corn is a crop with a relatively long history in Washington, but mostly under irrigation. Producers grow corn for both grain and silage. In fact, the highest recorded corn yields were grown under irrigation in Benton County, Washington. The second highest yield was recorded in Oregon.

Sweet corn is also produced under irrigation. Grant County has the largest production of sweet corn for processing of any county in the United States. Washington also produces popcorn.

Farmers have tried growing corn as a dryland crop in the past, without a great deal of success. However, with the advent of no-till crop production methods, corn is getting another look as an alternative to wheat. Some of the impetus for trying corn comes from the fact that it is being grown successfully in parts of North Dakota under no-till in areas which are similar climatically to parts of eastern Washington.

Roger Willis, District Sales Manager with Pioneer Hi-Bred in Kennewick, put out plots of dryland corn in 1996 and 2000. He says that the minimum requirements to produce the crop are 15 inches of annual precipitation if no-till production techniques are used.

Willis notes that corn growth depends on air temperature, and it is definitely a warm-season crop. Its growth rate peaks at a temperature of 86°F, and the minimum temperature at which active growth occurs is 50°F.

The measure used to determine the suitability of a corn hybrid for a given area, for the suitability of a potential production site for producing corn is the Growing Degree Unit or GDU. The GDU is the daily high temperature plus the daily low temperature, divided by 2, minus 50. The maximum temperature to use is 86°F, and the lowest temperature to use is 50°F. The growing season for a corn hybrid is stated in GDUs.

Pullman has 1729 GDUs between May 1 and September 20, on average, over 30 years of data. This means that Pioneer's variety 3984, if planted on May 20, would mature on September 20. Walla Walla has 2597 GDUs over the same period. Moisture stress also influences corn maturity.

The seeding depth for corn is 1¹/₂ to 2 inches, and it needs 120 to 160 GDUs for emergence. Willis advises planting according to the calendar date rather than the soil temperature. If the soil temperature is 50 degrees or above, early planted crops yield more than late-planted crops. If the crop can be planted at this depth, the roots should get down into good moisture. If the crop is planted too shallow, less than an inch deep, the main roots of the plant will develop on the surface and the crop will be more prone to moisture stress. If planted more than an inch deep, the root system will develop ³/₄ to 1 inch below the soil surface. For a seeding rate, Willis advises aiming for a stand of about 1,000–1,300 plants per acre/per inch of annual precipitation.

GDUs are also used to figure time of emergence. If the daily high temperature is 92°F and the daily low temperature is 60°F, the daily GDU is 86 plus 60 or 146 divided by 2 or 73. Then, 73 minus 50 equals 23. If the 120 GDU figure is used, 120 divided by 23 equals 5.2 days. If the temperature is cooler, with a daily high of 65°F and a low of 49°F, the daily GDU is 65 plus 50 or 115 divided by 2 or 57.5. If 50 is subtracted from 57.5, the remainder is 7.5 for a daily GDU. When 120 is divided by 7.5, the result is 16 days from planting to emergence.

A starter fertilizer applied 2" below and 2" to the side of the seed at planting time will help get the crop out of the ground. The roots of the corn plant will reach the starter fertilizer by emergence when it is below and to the side of the seed row.

NUTRIENT REQUIREMENTS

Corn is a heavy user of nutrients, and it uses them relatively early in the growth cycle. In Iowa, by silking time, the corn plant will have used 70% of its nitrogen needs, 55% of the phosphorus requirement, and 90% of the potassium needed. Research in Nebraska found that corn hybrids had taken up between 70 and 100% of their potassium requirement by silking time. Willis points out that corn is a heavy user of potassium. The major and minor nutrients needed in adequate levels by the corn plant are nitrogen, phosphorus, potassium,

magnesium, sulfur, boron, zinc, manganese, iron, molybdenum, chloride, copper and calcium.

At a yield level of 1.4 tons per acre, the corn crop will require 65 pounds of N per acre, 29 pounds of P, 65 pounds of K, 8.4 pounds of S, 16.5 pounds of Mg, .05 pound of Zn and .02 pound of B. If the yield is 2.8 tons per acre, the requirements are 130 pounds of N per acre, 58 pounds of P, 130 pounds of K, 16.8 pounds of S, 33 pounds of Mg, .10 pound of Zn, and .04 pound of B. Determine expected yield according to anticipated moisture. Then fertilize for expected yield according to the results of soil testing.

If moisture stress occurs during tasseling or pollination, the result can be kernel abortion in the first ten days after pollination. This will result in light, chaffy grain and small kernels, according to Willis. If the ears don't fill completely to the end, Willis says this is an indication that the stand density was heavy enough. A little bit of cob showing at the end is not a bad thing. It shows the grower was challenging his yield goal. If everything fills to the tip, you've probably given up yield.

CORN PLANT GROWTH STAGES

The corn plant has a number of distinct growth stages. Iowa State University's Report #48, *How a corn plant develops*, is available hard copy from Cooperative Extension Services, Iowa State University of Science and Technology, Ames, Iowa, 50011. The cost is \$2 plus shipping and handling.

WEED CONTROL

Brian Lewis, an agronomist with Pioneer, says there are many weed control options in corn. Post-plant applications of herbicide seem to work better than pre-plant applications in no-till corn production. Some herbicides available for post-application in corn are Accent, Basis, Basis Gold, Atracene, and Clarity. Please refer to herbicide labels for specific recommendations for weed problems on your farm.

MARKETING

Generally, the market for corn is good in Washington. The market classes of corn include flint, popcorn, sweet corn, dent corn and pod

corn. Also, because of the smaller seed size of dryland corn, it is a good product for the birdseed industry. The flint corn does not dent and does well in a marine climate, according to Willis. The vast bulk of U.S. grain corn is yellow dent, and these types of hybrids are the ones we are looking at.

Stan Sessions of Eppich Grain, notes that farmers producing dryland grain have a disadvantage compared with irrigated producers who can take advantage of various pricing options to shoot for maximum yield and hedge their production costs. His firm does contract corn for early orders, but he warns that dryland producers may not get the yield they need to fill a contract if they are too optimistic. For dryland corn producers, Sessions advises farmers to market their crop where they can get the best deal. He warns farmers to make sure they know what is in all the big clauses of a contract as well as the little ones.

In general, the seven Western states are deficient in corn production. Washington is the biggest producer and accounts for 29% of the corn produced in the seven Western states. Sessions says there is a positive basis for corn in Washington compared with the Chicago futures and locally produced corn sells for 25 to 30 cents above the Chicago futures price. The demand can be large. Sessions points out that the Simplot feedlot uses 47 tons of corn per day and imports 47% of what it uses.

The optimum moisture for threshing corn is 18 to 22%. It is considered dry corn, as compared with high-moisture corn, if the moisture content is 21% or below. The corn will need to be dried down to its optimum storage moisture content of 15%.

With good facilities, air-drying can be used for moisture contents up to 22%. When using commercial storage, there can be a drying charge. Hopefully, Sessions says, dryland producers won't have to deal with this, but it can be \$2 to \$3 per ton for moisture content up to 18%. For 24% moisture corn, the drying charge would be \$8 to \$10 per ton, and there would be shrinkage.

Most corn grown in the Pacific Northwest stays in the Pacific Northwest, according to Sessions. He said his firm doesn't contract in tonnage, and the Midwest uses bushels. Corn is traded in Washington and Oregon in 35.7 bushels/ton. The standard test weight for corn is 56 pounds per bushel at 15% moisture. Generally, 50 bushels equals 1.4 tons, he notes. However, he also says dryland corn is not likely to make the test weight of 56 pounds per bushel. Some

growers in the Columbia Basin have trouble making the test weight, he notes.

Corn can be stored for awhile at a moisture content of 15 to 16.5% moisture if the bin has aeration and there are not cracked and broken kernels. For real long-term storage, 12% moisture is best. If aeration is not adequate, condensation can cause quality problems.

GROWER EXPERIENCES

John Aeschliman, who has farms from Dusty to Colfax in Whitman County, tried corn for the first time two years ago. He has been using no-till farming practices since the 1970s, and now uses direct-seed systems for all of his farming. The no-till is for erosion control and Aeschliman says rotations are very important in making it work. He uses both three- and four-year rotations.

He direct-seeded his corn and aimed for a population of 20,000 to 24,000 plants per acre. The first year, in the 15-inch rainfall zone, he averaged 72 to 85 bushels per acre on ground that had previously grown peas that yielded 1,800 pounds per acre. In the 20-inch rainfall zone, he had yields of about 145 bushels per acre. To harvest the crop the first year, Aeschliman tried using a wheat header and says it didn't work very well. The second year, he planted corn in an area that is sub-irrigated. To harvest it, he used a corn header.

Aeschliman put down fertilizer in the fall. He then put on starter fertilizer with the seed in the spring. He uses a 7000 series John Deere Corn Planter seeding on 30-inch row centers, seeded an inch and a half deep.

He follows the corn with a legume crop and says the chemicals for corn do not affect the peas. He also thinks a rotation of corn, peas and winter wheat should work, although there might be a residue problem. An alternative, he says, might be to follow corn with corn. Corn, he notes can be touchy with certain chemicals.

As for weeds, Aeschliman says wild oats can be a problem. He said other potential problem weeds are prickly lettuce, pigweed and lamb's quarter. As for insects, he says grasshoppers can be a problem in the dryer areas next to the river canyons.

Aeschliman says field corn will have to compete with barley economically. Aeschliman says farmers have to consider the economics

when considering corn or any other alternate crop. For him, corn is better than barley.

In 1999, Aeschliman planted corn April 16 and harvested the corn on October 10 when it was field dry. The preceding year, he also planted on April 16 and harvested on September 22. He has been using Pioneer 3970, which is a 77-day corn. He planted 90 acres of corn in 2000. He anticipated a yield of 150 bushels per acre. He notes that height does not seem to have a lot to do with yield.

Jay Lyman, Dayton, is another farmer who has tried corn. He says that anyone growing corn needs a header that matches the planter. He modified a level-land planter to work on hillsides. However, he ended with an uneven seeding depth that had a major effect on yield. In his experience, the corn planter goes through heavy residue with no problem.

Lyman seeded late and says it really hurt the yields. They ranged from 8 to 70 bushels per acre. Rainfall was 15 to 16 inches and the exposure and elevation varied. Corn was planted in five different locations on a total of 350 acres. He tried a population of 16,500 plants per acre, but says he will go back to 20,000. He has also tried 21,000 to 22,000. He said that the key to growing corn is uniformity in everything. This starts with matching row spacing to the combine header.

Lyman says using row cleaners can help deal with problems caused by cold soil. He said using them might allow moving up seeding dates. Also, warming the soil during the first two weeks after seeding is critical, he says.

For Lyman, the market has been good. He says his transportation costs are about \$3. Also, there are some real pluses for corn growers in Columbia County. He sells directly to the feedlot and the requirement is 15% moisture or drier. He will get docked if the moisture is too high. On the other hand, he notes that the feedlot wants his corn. He says corn growers in the Pacific Northwest will never have a problem getting rid of their crop.

Lyman has had no volunteer problems with corn. He says growing corn may help improve fertility levels for other crops as well. He also points out that the phosphorus in the soil has to be in a form that the corn can use.

The potassium has to be in the water-soluble form in order for the corn plants to use it. He says between 3 and 15 pounds per acre may

be needed. He advises working with an amount that is economically feasible, which is about the same as for phosphorus and sulfur. He suggests using the carbonate forms of K and says if it is too low in the soil profile it will not be available to the corn. Lyman says adding calcium can result in the release of potassium if it is bound up in the soil.

He also says the corn plant cannot access fertilizer that is only an inch deep, but it can use fertilizer that is two inches deep. Lyman points out that barley residue tends to have higher potassium than wheat residue.

In his opinion, corn yields of two tons per acre are not out of line in some of the higher rainfall areas after a grower learns how to grow the crop. This would be about 71¹/₂ bushels per acre at a 56-pound test weight, and Lyman says he is not that far away from this level now.

In 2000, Lyman planned to plant Pioneer 3941 and 3970. He says he will not plant anything with a growing season longer than 85 to 90 days. He thinks the 3970 does a little better on the hillsides. The two varieties are about equal on the flats.

Russ Zenner farms east of Genesee, Idaho, in a 22-inch rainfall zone. His cropland is at 2,200 to 2,700-foot elevation. He is using annual cropping and is trying to work into a continuous no-till cropping system. Zenner has grown corn for four years. He uses a 30" row spacing and seeds into the winter wheat residue. He says he can raise a corn crop every year, but the yields and economics of the crop are still questionable for him.

In 1996, he planted one acre of corn. The next three years he hired Tumac Machinery to custom-plant his corn. Zenner has tried both no-till and two-pass systems for the corn. In the two-pass, the fertilizer is put down in the fall. Zenner advises using nothing but a precision planter because the row spacing is critical.

Zenner observes that corn seems to be more sensitive to environmental conditions than other crops. Cool, wet weather at or after seeding can slow the crop, and dry spells and other weather factors can affect it.

Zenner is using corn in a three-year rotation that is winter wheat, corn and chickpeas. He seeded the first week of May in 1997, and got a good stand. He found that it is necessary to set the row cleaners pretty aggressively to get the residue from a 120-bushel winter wheat

crop out of the way. In 1999, environmental factors affected the crop. He planted on May 24 and 25.

He notes that with corn in the rotation, winter wheat yields following the rotation didn't seem to be hurt. He no-tills the chickpeas into the corn residue. He has found that a pulse crop following corn produces higher yields than it does following winter wheat.

Zenner picked up a used grain drier and thinks using a dryer would pay for many farmers because there is a good market for corn at 12 to 14% moisture. Local markets pay a premium for 12% corn. He says a corn header is a definite must to harvest the crop.

For weed control, Zenner says Accent and Banvel are available. He uses Roundup at the one-pint rate and has not used atrazine. He warns that corn does not tolerate weeds.

Zenner may try growing continuous corn, as well as different rotation systems that include corn. So far, he says he has had mixed results for yield and says part of this may be due to different types of soils as well as different elevations.

Zenner has not given up on the crop. Although he admits that there is still a lot to learn about it, he says it seems to have a lot of potential for the higher-rainfall dryland cropping areas. Also, on the plus side, is a good local market.

Tracy Eriksen, who farms near St. John, started growing corn in test plots in 1995. The first time, he used an Ag-Pro no-till drill and seeded Cargill 1077 which is a drillable corn. This has a higher seed cost. The Ag-Pro did not do a good job of handling the seed and seed placement was erratic. Eriksen planned to plant 3^{1/2} acres, but due to inconsistent seed placement by the drill, ended up with 1^{1/2} acres. The plot was seeded June 10 and emerged June 15.

Most of the plants had tasseled by August 8 and the crop looked good. The plants were about five feet tall. In November, the corn was ready to harvest, but Eriksen figured it would be too much bother and left it for the birds. The following January, he notes, a hard winter developed and birds used the cornfield extensively.

In 1996, he tried a Pioneer short-season dryland corn and some Germaine varieties. They were seeded May 7 and 29. In all, he planted two plots, one with three acres and the other 30 acres. Eriksen tried using dry fertilizer this time. However, 1996 was a

very dry year and fertilizer was more than what was needed by the crop because of limited moisture. For weed control, Eriksen used Roundup preplant to clean up weeds.

A freeze in mid-June hurt the crop in the low areas of the small plot. The large field had an irregular stand due to poor seed placement. Weeds that caused problems included prostrate knotweed, Russian thistle, lamb's quarter, and dog fennel.

Eriksen says the ears were about seven inches long at the end of July. They had 12 rows of kernels and about 40 kernels per row. At that point, he says, the crop look pretty good considering there had been no rain since the end of May.

The Pioneer plots were harvested October 10 and yields ranged from 29 to 47 bushels per acre. The large plot was harvestable October 15, but due to fall rains, was finally dried down to 18% moisture and harvested November 15. The Germaine varieties in the plots did not make a crop.

In 1997, Eriksen put out test plots for eight varieties. He then seeded two different fields, one 24 acres and the other, a flat that was 42 acres, to Pioneer 3970. The 24-acre site was on a hill. The crop was seeded by Tumac on May 14 and 15. For this crop, Eriksen rented a corn head for his combine. He started harvesting October 18 and finished October 23. The yield for the field on the flat was 70 bushels per acre and the hill plot produced 35 bushels per acre.

Eriksen attributes the disappointing yields to two factors. First, the phosphorus was placed in the deep band with the nitrogen, which the corn plant didn't reach in time for the phosphorus to be taken up when needed. Also, he seeded too shallow at about an inch deep.

In 1998, Eriksen tried to reduce his fertilizer costs by using aqua-ammonia, but this was not successful. He says the deep bander on the planter he was using put the aqua too close to the seed row, which can damage the corn. He was shooting for a yield of 100 bushels per acre, but didn't make it. The corn did not compete well with weeds, and wild oats were really bad. In 1999, Eriksen grew corn on 35 acres.

After five years of experience growing corn, Eriksen says seeding depth is one of the most critical factors. One and a half to two inches

is advised, and he says a farmer can go as deep as three inches in warm, light soil. Planting at least 1½ inches deep will insure the growing point is well below the surface to protect it from chemicals and frost.

He uses short season varieties, not more than 95 days and prefers 85-day or less varieties. Another variety which caught Eriksen's attention is Cargill's 1077 which is a 75-day dwarf. The plants only grow about three feet tall. This variety can be drilled with a regular grain drill and harvested with a regular grain header. The recommended seeding rate is 32,000 plants per acre on a spacing of 15 by 13 inches. Eriksen notes that although this is listed as a short-season variety, it requires 2,500 GDUs to harvest, and it probably can't be grown in many areas of the Pacific Northwest which receive only about 2,000 GDUs. Yield, in his experience, is not as good as the taller varieties.

In Eriksen's experience, the longer the season, the taller the corn and the better the yield. He suggests plant breeders might want to look at developing a forage-type corn with grain potential to increase grower options. He emphasizes this area needs more short-season types. For Eriksen, Pioneer 3970 is turning out to be the best variety. This is a 79-day variety.

For weed control, Eriksen recommends 12 ounces of Roundup plus a pint of atrazine before planting. At the spike stage, a pint of Banvel plus a half-pint of atrazine can be used. When the plants are four to five inches tall, Buctril can be used along with a half-pound of atrazine. Accent and Basis can be used to control grasses.

He says atrazine will not control wild oats, and Russian thistle can also be a problem. On the other hand, Eriksen points out that atrazine is a cheap chemical and, if used carefully, can help keep down production costs. For fertilizer, Eriksen recommends a pound of nitrogen per bushel of expected grain yield.

Concerning environmental factors, Eriksen says an early frost in the spring will not necessarily be a problem, but an early frost in the fall can hurt badly.

If a farmer also has cattle, Eriksen says the risk of raising corn is very low because the crop can be grazed if necessary. The aftermath can also be grazed.

As for row spacing, he thinks a narrower row —15 to 20 inches— might be better for this region, unless residue is very heavy. If this is the case, a 30-row spacing might work better. Eriksen suggests a rotation of spring wheat, winter wheat, corn and peas. This rotation sequence is Beck's suggestion with the following explanation: two years (half our acres in wheat in deference to our wheat tradition) wheat. Then, seed corn into winter wheat stubble, because planters can be made to plant in extremely heavy residue with wider spacing and available attachments, along with large-sized seed tending to emerge better in heavy residue compared with small-sized seed. Then, seed peas because of their large-sized seed and being a different crop type, to break the disease cycle. Peas will produce a minimum amount of residue, which will make it easier to plant back with wheat. The question exists whether we should be planing winter wheat—spring wheat or spring wheat—winter wheat behind the peas. Some plots of the NWCP are addressing that question. It's not our tradition to plant spring wheat after peas, but the emergence of spring wheat in pea ground is more successful then when seeded behind winter wheat stubble. He notes that corn may have a positive effect on *Rhizoctonia*, and that growers are writing the book on dryland corn production now because there is nothing available from other production areas that is a direct fit.

CORN INTERNET INFORMATION SOURCES

The National Corn Growers Association: <http://www.ncga.com/>
<http://www.ncga.com/03world/main/contents.html>

Iowa State University's Report #48, *How a Corn Plant Develops*.

<http://www.ag.iastate.edu/departments/agronomy/corngrows.html#illustrations>

The Corn Growers Guidebook from Purdue University:
<http://www.agry.purdue.edu/ext/corn/>

Pioneer Hi-Bred International, Inc. home page:
http://www.pioneer.com/index_ie.htm

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