Field Corn Production
on the Umatilla Irrigation Project

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There is a real need to increase the production of corn on the Umatilla Project. There are ample supplies of wheat available from the bordering dry land wheat country for the chicken and turkey growers and the winter feeders of livestock. Ample supplies of alfalfa hay also are now being produced under irrigation, but more corn is needed for use by livestock growers. Evidence of this need is the fact that corn is actually being shipped into the area. If corn production is increased, livestock feeding can and will be expanded.

Good corn can be produced in the Umatilla district—in fact yields as high as any in the United States can be produced if growers follow crop recommendations.

Corn has been raised on the Umatilla Project since 1912. The first crop report showed only corn fodder. The average yield was 1.5 tons per acre, with a maximum yield of 12 tons per acre. Shelled corn first appeared on the corn report in 1913. The average yield that year was 19.4 bushels per acre, with a maximum of 85 bushels per acre. In 1914, the crop report showed that the average corn yield had increased to 35 bushels per acre, but some growers in the district had yields that reached 100 bushels per acre.

In 1946, a broad program of research on corn production was started at the Umatilla Branch Experiment Station. Research covered the various problems involved in corn production including the selection of hybrids adapted to the relatively long growing season of the area, methods of applications and kinds of fertilizers necessary to produce good yields, and irrigation requirements.

These experiments have demonstrated that yields up to 200 bushels per acre are possible on the Umatilla Project where summer temperatures often rise above 100° F. and where the monthly mean summer temperatures range from 68° to 77°. The frost-free period varies from 163 to 190 days and the annual precipitation average is 8.65 inches.

The results of the corn production experiments are outlined in this publication.

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Fertilizers for Corn

Nitrogen fertilizers are needed to produce high corn yields. In 1946, hybrid Iowa 939 was grown with applications of ammonium nitrate at rates varying from 40 to 240 pounds of nitrogen per acre. The nitrogen was either applied all at one time when the corn was 6 to 8 inches high or else the applications were split into an initial application and later applications (Table 1). Phosphorus was applied as treble superphosphate and the potash as potassium chloride. The fertilizers were side-dressed about 3 inches deep and 4 to 8 inches from the row. The manure was applied before the corn was planted. Two different amounts of irrigation water were used and three different widths between rows.

Table 1. YIELD OF SHELLED CORN UNDER VARIED MOISTURE AND FERTILIZER EXPERIMENTS[1]
(Umatilla Branch Experiment Station, 1946)

Experiment	Fertilizer treatment per acre					Yield per acre[2]	
	Nitrogen applications	Total nitrogen	Manure	Total P_2O_5	Total K_2O	Heavy irrigation[3]	Light irrigation[4]
	Pounds	*Pounds*	*Tons*	*Pounds*	*Pounds*	*Bushels*	*Bushels*
Experiment 1	60	60	....	200	......	66	61
Experiment 2	120	120	....	200	......	94	62
Experiment 3	60+ 60	120	....	200	......	102	74
Experiment 4	40+ 40+ 40	120	....	200	......	107	83
Experiment 5	120+120	240	....	200	......	113	91
Experiment 6	80+ 80+ 80	240	....	200	......	125	85
Experiment 7	60+120+ 60	240	....	200	......	133	86
Experiment 8	40+ 40+ 40	120[5]	....	200	......	110	89
Experiment 9	60+120+ 60	240	....	......	......	118	86
Experiment 10	40+ 40+ 40	120	....	......	......	104	84
Experiment 11		......	15	......	......	62	51
Experiment 12	60+120+ 60	240	....	200	200	129	71

[1]Yields based on shelled corn with 15.5 per cent moisture.
[2]Yields based on average of three stands with 36-, 30-, and 20-inch spacing.
[3]Heavy irrigation for these experiments was 4.86 irrigation acre feet.
[4]Light irrigation for these experiments was 3.02 irrigation acre feet.
[5]Nitrogen added as ammonium sulphate instead of ammonium nitrate.

The yields in Table 1 clearly show that good corn yields depend on the amount of fertilizer nitrogen used. The response to nitrogen is greater with high moisture than with low moisture. There was no benefit from phosphate, potash, or sulphate applications. There was no benefit from a manure application of 15 tons per acre. There was some advantage in splitting the nitrogen application into two or three applications, as compared with a single early application.

A similar experiment was conducted in 1947 and the yields are shown in Table 2. Yields were in general lower, but an excellent response to nitrogen applications was obtained. Phosphorus or

Table 2. YIELD OF SHELLED CORN WITH VARIOUS NITROGEN AND PHOSPHORUS APPLICATIONS
(Umatilla Branch Experiment Station, 1947)

Experiment	Fertilizer treatment per acre				Yield per acre[1]	
	Nitrogen applications	Total nitrogen	P_2O_5	Manure	Heavy[2] irrigation	Light[3] irrigation
	Pounds	*Pounds*	*Pounds*	*Tons*	*Bushels*	*Bushels*
Experiment 1	40	40	100	......	55	51
Experiment 2	60	60	100	......	67	61
Experiment 3	80	80	100	......	80	80
Experiment 4	120	120	100	......	100	90
Experiment 5	60 + 60	120	100	......	106	101
Experiment 6	80 + 80	160	100	......	118	115
Experiment 7	120 + 120	240	100	......	131	106
Experiment 8	40 + 40	80	100	......	77	83
Experiment 9	120	120	100	15	104	110
Experiment 10	60 + 60	120	......	......	105	89

[1]Yield based on shelled corn with 15.5 per cent moisture.
[2]Heavy irrigation was 4.86 feet.
[3]Light irrigation was 3.02 feet.

manure applications did not improve corn yields. Splitting the nitrogen application was not superior to a single application.

Figure 1 clearly shows the relationship between the corn yields and the fertilizer applied for the two years. In 1947, 40 pounds of nitrogen produced only 55 bushels of corn. Two hundred forty pounds of nitrogen produced 131 bushels—a clear gain of 76 bushels of corn for an additional 200 pounds of nitrogen.

Nitrogen carriers available on the market, such as ammonium nitrate and ammonium sulphate have proved satisfactory. They have shown no significant differences for the production of corn, however, between the various carriers available. If calcium cyanamide is applied late in the season, it is not as good as ammonium sulphate or ammonium nitrate in increasing yields. On the loamy, sandy soil at the Umatilla Project, Ureaform fertilizer, which releases nitrogen slowly, has not been as satisfactory as ammonium nitrate, which is readily available for plant use. Experiments conducted thus far comparing broadcast application of nitrogen fertilizers with side-dressed applications have shown no differences in corn yields between the two methods. These tests were conducted using short, but frequent, irrigations so that nitrogen losses by leaching were minimized.

Spacing of Corn

Corn should be grown in 30 to 36 inch rows with plants about 12 inches apart in the row.

In the 1946 experiment three widths between rows were used in combination with all of the fertility treatments and the two water

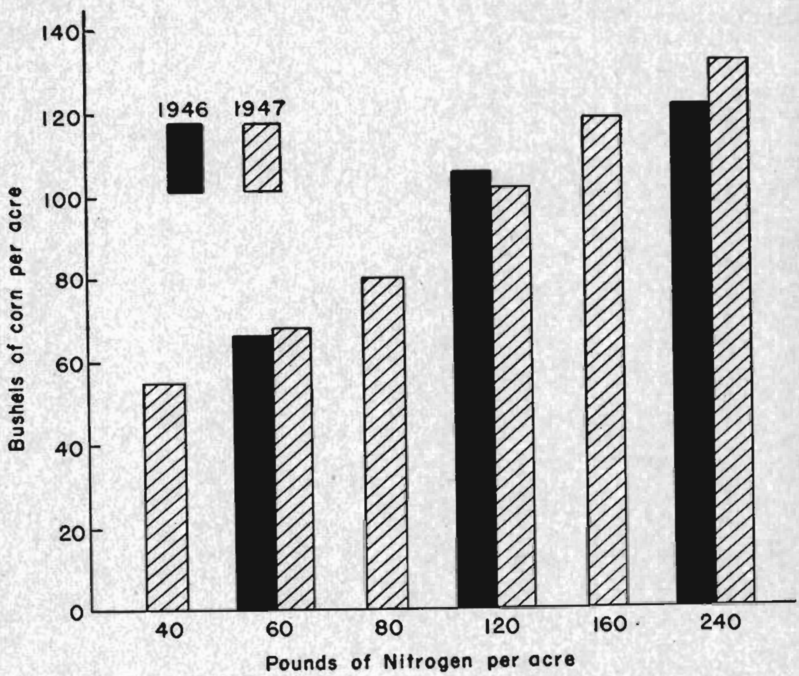

Figure 1. Yield of shelled corn per acre with 15.5 per cent moisture from different rates of nitrogen. Yield data represents average of single and split applications of nitrogen during 1946 and 1947 at Umatilla Field Station, Hermiston, Oregon.

levels. Widths between rows were 36, 30, and 20 inches. These spacings resulted in 14,500; 18,000; and 25,000 plants per acre, respectively. These spacings produced no significant differences in yield.

In 1947 only two spacings were used. One consisted of rows 36 inches apart with plants 12 inches in the row, which gave 14,500 plants per acre. The other was 24-inch rows with plants 8 inches apart in the row, which gave 33,500 plants per acre. The thick stands gave material reductions in yield when little nitrogen fertilizer was used. When heavy applications of nitrogen were used the thick stands produced higher yields than thinner stands, but the difference was not great enough to be significant.

It is generally considered that two pounds of nitrogen are required to produce a bushel of corn. In the large corn growing areas of the Middle West, efficiency of applied nitrogen is usually not this great. It usually requires from three to five pounds of added nitrogen to obtain one bushel increase. However, in the Southeast the efficiency of added nitrogen is somewhat greater. Results have been reported from there indicating that about a bushel of corn can be obtained from two pounds of nitrogen. Therefore, to obtain high yields in bushels per acre it is necessary to supply adequate nitrogen for this production. In the 1947 hybrid trials (Table 8) where various amounts of nitrogen were applied, it was found that nitrogen efficiency on the loamy sandy soil was much better than is ordinarily considered standard in the Corn Belt, because a bushel of corn was produced with approximately one and one-half pounds of nitrogen fertilizer.

When the recommended nitrogen rate is used, the spacing should be about 12 inches in the row and the rows 30 to 36 inches apart.

Irrigation

Proper balance between fertilizer rates and irrigation rates is essential for highest economic returns. Irrigation treatments were used in conjunction with the fertilizer treatments during 1946 and 1947 experimental work. Heavy applications of fertilizer did not increase yields if irrigation water was inadequate. Likewise, large amounts of irrigation water did not increase the yields if only small amounts of fertilizer were used. Table 3 shows some of the relationships between fertilizers and moistures found in 1946 and 1947 experiments.

The distribution of the irrigations is as important as the total amount of water applied. The light irrigation applied to the corn in 1946, 3.02 acre feet, was put on in six irrigations; thus the interval of time between irrigations was too long, making a poor distribution of the water. There was considerable leaf roll and leaf

Table 3. RELATIONSHIP BETWEEN IRRIGATION AMOUNTS AND YIELDS
(Umatilla Branch Experiment Station, 1947)

	Irrigation treatments			Yields per acre[1]	
Year of trials	Number of irrigations	Amount water per irrigation	Total amount irrigation water	60 pounds nitrogen per acre	240 pounds nitrogen per acre
	Total	*Feet*	*Feet*	*Bushels*	*Bushels*
1946	6	.50	3.02	61	84
1946	9	.54	4.86	66	124
1947	11	.33	3.65	61	107
1947	13	.32	4.21	67	131
1947	15	.34	5.07	67	132

[1]Yields are averages of plots with three different spacings.

damage due to this poor distribution. In 1947, 3.65 acre feet were applied in eleven irrigations, which provided a better distribution of the low amout of irrigation water. The low irrigation was adequate that year, and relatively high yields of corn were produced with high amounts of nitrogen. Because of the better distribution of the irrigation water in 1947, no significant difference occurred in the yields of the various fertilizer treatments due to the amounts of irrigation water added.

All soils have a limit to the amount of moisture that can be stored in the root zone. Water added in excess of this amount is lost through surface run-off or percolation to lower depths. Applications of excessive amounts of water result not only in wasteful use of water, but will cause leaching of soluble plant nutrients from the root zone. Excessive amounts may be applied by applying moderate amounts too frequently or by making heavy applications less frequently. The fact that splitting the nitrogen applications proved to be advantageous in 1946 and not in 1947 indicates that the less frequent but heavier irrigations in 1946 caused more leaching of nitrogen than the lighter irrigations applied more frequently in 1947.

It is also important that the water supply in the soil be maintained at a high enough level that the plants have enough water to meet the requirements for normal growth processes. Plants that are allowed to suffer physiological damage from severe wilting will not produce as well as those which have been supplied with adequate water. Severe drought conditions upset the physiological processes of the plant and it takes time for the plant to resume normal growth after water is again made available.

The proper irrigation practice is one which supplies adequate water to the root zone of the plants at frequencies that will prevent the soil moisture from dropping below the wilting coefficient and at sufficiently low amounts per irrigation to prevent excessive run-off or deep percolation.

Because corn is a row crop, it is necessary to practice row irrigation in delivery of the water to the plants. Some work has been done at the Umatilla Irrigation Project, however, with a flat planting and flood irrigation. The results were quite sucessful. Even with row irrigation, flooding can be simulated by making wide flat-bottomed ditches following the cultivation and ridging at the base of the corn only sufficiently to prevent the water from crossing over, and also to cover any weeds at the base of the plant. By this practice, the diversion system of flooding can be used and an efficient irrigation applied to the loamy sandy soil where the land is not too steep. In 1947 an additional irrigation practice was conducted which was very similar to the high moisture level. The quantity of soil moisture was allowed to remain at a low level from planting time to near pollination. The quantity of soil moisture was increased during the pollination period, and thereafter the quantity was reduced until the corn was harvested. It is highly important that the corn have adequate soil moisture during the silking and pollination period. No experimental work has been done at the Umatilla Project on limiting water at the time of pollination to show that poor results will be obtained. It is well known by corn growers in irrigation districts that inadequate water at the time of pollination will prevent kernels from setting on the ears.

When there are no row crop diversion structures on the farm field other than the irrigation lateral for flood irrigation, row crops such as corn have been successfully irrigated by the use of syphon tubes. One of the desirable tubes has been the two-inch metal tube, five feet in length, with control gate attached. These tubes can be placed over the ditch bank to divert water to corn rows. Figure 2 illustrates the use of 1.25-inch plastic tubes, 4 feet long, in operation.

Winter Cover Crops

Hairy vetch is the only winter annual cover crop recommended because of climatic factors and the low supply of nitrogen in these soils. Winter cover crops have been used to determine the effect of

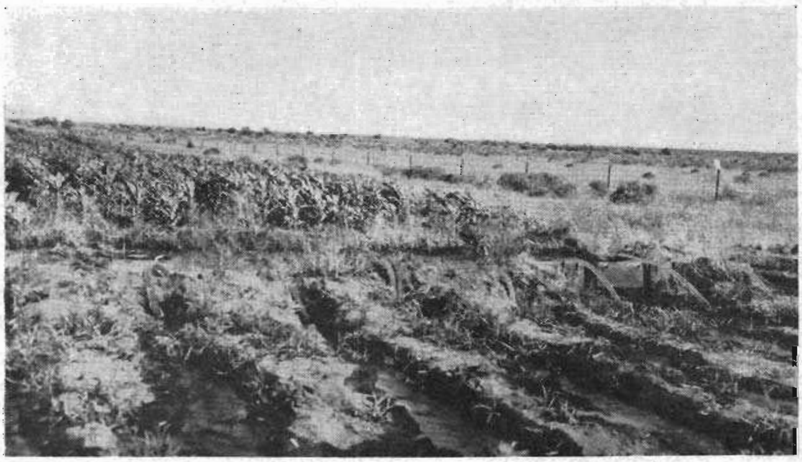

Figure 2. Plastic syphon tubes being used to irrigate corn rows over the ditch bank at the Umatilla Branch Experiment Station, Hermiston, Oregon, in 1946.

Table 4. YIELD AND TOTAL NITROGEN CONTENT OF TOPS OF COVER CROPS IN POUNDS PER ACRE
(Umatilla Branch Experiment Station, 1947)

Cover crop	Yields per acre[1]		Nitrogen content per acre	
	1947	1948	1947	1948
	Pounds	*Pounds*	*Pounds*	*Pounds*
Rye	3,060	2,350	30	18
Winter wheat	1,740	......	28	......
Hairy vetch	3,070	3,560	104	115
Austrian winter peas	1,510	2,180	43	62
Rye and vetch	3,340	......	90	......

[1]Yields based on air-dry weights.

the winter cover crop residues on corn production, and also to observe the value of the winter cover crops in protecting the soil from wind erosion. All of the cover crops tried gave satisfactory protection against wind blowing if planted in September. Hairy vetch fixes enough nitrogen from the air to pay the costs of growing it. Austrian winter peas are not sufficiently winter hardy to be grown in the area.

In 1946, cover crops for green manure were seeded in September. The crops used were rye, winter wheat, Austrian winter peas, hairy vetch, peas and rye, and hairy vetch and rye. These crops were plowed under as green manure in mid-April and corn was planted shortly after the seedbed was prepared. In 1947, cover crops of rye, hairy vetch, and Austrian winter peas were seeded in September and plowed under in late April for corn production. Table 4 shows the 1947 and 1948 yields and nitrogen contents of the air-dry top growth material of the various cover crops that was turned under for the production of corn.

In 1947 results of corn produced following non-legume cover crop combinations are shown in Table 5. The rye and winter wheat were fertilized with nitrogen either in the fall or in late winter; or by having the application divided, part in the fall and part in the late winter. The corn grown following the rye or wheat was fertilized with the amounts of nitrogen indicated in the table, in addition to the amount of nitrogen that was applied to the cover crop itself. Corn grown following cereal cover crop, without additional nitrogen, produced low yields, and even where the nitrogen was applied at the rate of 120 pounds of nitrogen per acre, the yields were low.

Table 6 shows the yield of corn following the legume cover crops hairy vetch and peas. Corn production following the green-manure crop, without additional nitrogen, was much higher than the production of corn following rye, without the addition of nitrogen.

Table 5. YIELDS OF SHELLED CORN FOLLOWING NON-LEGUME COVER CROPS
(Umatilla Branch Experiment Station, 1947)

Experiment	Nitrogen fertilizer per acre				Corn yields per acre	
	Cover crop applications September 1946	Cover crop applications February 1947	Corn crop applications	Total nitrogen per acre	Following rye cover crop	Following wheat cover crop
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Bushels*	*Bushels*
Experiment 1	0	0	0	0	13	15
Experiment 2	0	0	40	40	26	21
Experiment 3	20+	20	40	80	39	29
Experiment 4	20+	20	80	120	28	43
Experiment 5	40	0	0	40	21	22
Experiment 6	40	0	80	120	49	55
Experiment 7	0	40	120	160	33	56

Table 6. YIELDS OF SHELLED CORN FOLLOWING LEGUME COVER CROPS
(Umatilla Branch Experiment Station, 1947)

Experiment	Fertilizer treatment per acre			Corn yield per acre[1]			
	P_2O_5 on cover crop	Sulphur on cover crop	Nitrogen on corn crop	Following vetch cover crop	Following vetch rye cover crop	Following peas cover crop	Following peas rye cover crop
	Pounds	*Pounds*	*Pounds*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Experiment 1	0	0	0	41	20	12	31
Experiment 2	0	0	60	52	36	40	25
Experiment 3	100	0	0	41	34	13	19
Experiment 4	100	0	60	47	63	54	37
Experiment 5	0	100	0	66	62	28	24
Experiment 6	......	100	60	95	92	21	32
Experiment 7	100	100	0	65	59	31	23
Experiment 8	100	100	60	102	84	46	43

[1]Yields based on shelled corn with 15.5 per cent moisture.

Sixty pounds of nitrogen applied to corn following vetch produced a significant increase in corn production. The yield of corn following vetch that was fertilized with sulphur was 25 bushels per acre higher than the corn produced following vetch that did not have sulphur. The yield of corn following vetch fertilized with sulphur was also 14 bushels higher than corn produced with 60 pounds of nitrogen on corn following vetch without sulphur.

Hairy vetch, of all the winter green manure crops tried, is the only one that will produce enough nitrogen to pay for the costs of growing a winter legume. Vetch also gives good protection of the soil against winter blowing. Even hairy vetch, however, will not produce all of the nitrogen required by a following crop of corn. Some supplementary nitrogen is essential.

Cultural Practices

Plowing is recommended on the loamy sand to prepare a seedbed for a crop of corn. Where plowing has been compared with disking in seedbed preparation the plowed land has given the highest production. After the plowing and harrowing, leveling will depend upon the water gradient necessary to get the irrigation water across the field. Where the fall is sufficient to allow the water to run between the corn rows freely, leveling is unnecessary. Planting corn with the lister-planter has been done successfully in the Umatilla irrigation district and has some advantages in combating wind erosion. Both listing and shallow irrigation furrows for planting have been used successfully at the Umatilla Branch Station. When corn is planted on the light sandy soils, it is very often necessary to irrigate the field before planting to assure a supply of moisture for germination and early growth. Pre-planting irrigations can be applied in rows at the approximate location where the corn rows will be. Irrigation of this type does not necessarily demand that the water move out laterally to meet the adjoining irrigation seeded area. For the long-season hybrids the planting date should be near the middle of April. Soil temperatures at that time are often above 60° in the seedbed and the early planting will insure maturity of long-season hybrids and drier corn at harvest time. Planting can be accomplished with the usual type of seeding machinery. It has been found that deeper planting, 3 to 4 inches, will afford some protection from damage by pheasants. Rate of planting varies, but approximately 12 pounds of seed corn per acre is considered a good rate of planting.

Fertilizer may be side-dressed or broadcast at planting time. Where the machinery is available this has been found to save one operation in regard to applying fertilizer. Harrowing prior to the emergence of corn has been found helpful in destroying many weeds where this practice is applicable. Where the fertilizer has not been applied at the time of planting, the first application of fertilizer is side-dressed when the corn is 6 to 12 inches high, depending upon the residual fertility conditions. Broadcasting the fertilizer has been shown to be equal to side-dressing the fertilizer, particularly after the corn is up to the height of 36 inches.

Cultivating to destroy weeds is very important in the culture of corn. Weeds will be a drain on the fertilizer applied to the corn if they are not eradicated. Cultivation and marking out the rows for irrigation water may be accomplished at the same time. Methods of making irrigation furrows have already been discussed under the section of irrigation. The frequency of irrigation will depend upon the soil and weather conditions. Where high moisture has been applied, as many as 15 irrigations have been used. Six irrigations, the lowest number tried in the experiments, has definitely limited production because of lack of water.

Harvesting of the corn is accomplished either by mechanical pickers or hand labor. The corn is ordinarily held in cribs for drying. Many of the cribs in the Umatilla Irrigation District are made of wire netting, and as the rainfall is very low, they are usually open.

Adaptability of Hybrids

Grow recommended hybrids. During 1946 thirteen hybrids and two open-pollinated varieties were tested with and without the addition of commercial fertilizer. The seedbed was prepared by plow and harrow to control early weeds, and the corn was planted in rows 36 inches apart. Following the final thinning of corn there were 75 plants per 90 feet of row, or 12,000 plants per acre.

The fertilization rate on the plots receiving fertilizer was 100 pounds of nitrogen and 50 pounds of phosphorus pentoxide (P_2O_5) per acre. The hybrids and varieties selected covered a maturity range from early, like Thayer Yellow Dent, which is approximately 90-day corn, to U. S. 13, which is approximately 120-day corn. Table 7 shows the average yields of shelled corn (15.5 per cent moisture) for all fertilized and unfertilized plots, the effect of fertilizers on yields, and the average moisture content of fifteen hybrids and varieties of corn in 1946. As the moisture content of field corn at the time of harvest, or first frost, has a definite relationship to the time of maturity, the varieties are grouped according to moisture content at time of harvest.

In 1947, 18 hybrids were tested, using two nitrogen levels and one unfertilized treatment. The cultural practices were similar to those described for the previous year. Plants were thinned to 12 inches apart in the rows, however, leaving about 17,400 plants per acre. The maturity of these varieties ranged from Wisconsin 416, which is very early, to members of the late U. S. 99 class. Table 8 shows the yields of corn in bushels per acre (15.5 per cent moisture) for the different fertilizer treatments for 1947.

These results show that the longer season hybrids of similar maturity to U. S. 13 are well adapted and will produce the highest yields. The data also show that heavy rates of nitrogen fertilization are essential for good results from any hybrid.

Table 7. YIELDS OF SHELLED CORN ON FERTILIZED AND UNFERTILIZED PLOTS AND THE AVERAGE MOISTURE CONTENT AT SHELLING[1]
(Umatilla Branch Experiment Station, 1947)

Variety or hybrid	Corn yields per acre[2]		Moisture content at shelling
	Fertilized[3]	Unfertilized	
	Bushels	*Bushels*	*Per cent*
Idahybrid 680	89	69	21.1
Reids	76	44	20.8
U. S. 13	119	74	20.3
Indiana 882	90	50	19.5
Oregon 695	91	58	19.4
Idahybrid 544	89	63	19.2
Indiana 800 C	95	59	19.1
Illinois 384	100	66	18.5
Ohio W 10	76	53	18.4
Nebraska 362	77	60	18.2
Iowa 939	99	72	17.4
Iowealth 16	99	62	17.1
Oregon 1101	100	70	16.9
Iowealth A Q	70	58	16.1
Thayer	70	55	15.8
Average	89	61	18.8

[1]Differences required for significance between hybrids:
Yield—16 bushels per acre
Moisture content—1.7 per cent
[2]Yields based on shelled corn with 15.5 per cent moisture.
[3]Fertilizer included 100 pounds nitrogen and 50 pounds P_2O_5 per acre.

Corn Production Recommendations

Level the land for row crop irrigation. For corn production, irrigated land does not need to be levelled as accurately as for flood irrigation in borders, but it is necessary to have the land sufficiently level that water will run through the corn rows without forming ponds in the field. On loamy sand and sandy loams the land should be plowed to prepare the seed bed. Where the soil moisture is insufficient to germinate the corn, it is a good practice to irrigate before planting.

Plant corn early, especially when a long-season hybrid is used. Where the corn is planted early, it is a safeguard for maturity before frost, and a corn with low-moisture content can be harvested early. Plant the corn in rows 30 to 36 inches apart where the corn is drilled. Check-rowing of corn can be done successfully to eliminate weeds. Use approximately 12 pounds of seed corn per acre. Use of a few pounds additional corn in planting will insure a good stand with 14,000 to 16,000 plants per acre.

Nitrogen fertilizer can be side-dressed at the time of planting if equipment is available. The fertilizer should be placed approxi-

Table 8. YIELDS OF SHELLED CORN AT THREE LEVELS OF COMMERCIAL NITROGEN AND AVERAGE MOISTURE CONTENT AT HUSKING[1]
(Umatilla Branch Experiment Station, 1947)

Variety or hybrid	Corn yields per acre[2]			Moisture at husking
	148 pounds nitrogen applied per acre	90 pounds nitrogen applied per acre	No nitrogen applied per acre	
	Bushels	*Bushels*	*Bushels*	*Per cent*
Kansas 2234	162	148	57	26.2
U. S. 99	139	100	35	24.9
U. S. 357	155	120	46	24.7
Kansas 1583	150	112	43	22.6
Indiana 8440	143	128	34	20.7
Kentucky 103	160	98	59	20.5
Ohio C 38	127	101	43	18.8
U. S. 13	135	126	41	18.5
Iowa 939	123	112	50	16.6
U. S. 35	158	115	43	16.4
Iowa 306	132	101	48	16.2
Wisconsin 1415A	162	102	37	15.5
Iowa 4297	131	99	46	15.5
Iowa 4316	141	92	44	15.3
Kingscrost KR-2	113	120	43	15.2
Oregon 1101	136	127	47	14.0
Minnesota 404	102	93	32	13.3
Wisconsin 416	82	91	29	9.9
Average	136	110	43	18.0

[1]Differences required for significance between hybrids:
With no fertilizer nitrogen ....15.7 Bu./A.
With 90 pounds of nitrogen per acre ....30.6 Bu./A.
With 148 pounds of nitrogen per acre ....29.8 Bu./A.
[2]Yields based on shelled corn with 15.5 per cent moisture.

mately 4 inches from the row and about 3 inches deep. Fertilizing at the time of planting will save one operation. If the grower desires to be assured of a stand of corn before applying fertilizer, however, it can be side-dressed or broadcast on when the corn is 10 to 12 inches high. Forty to sixty pounds of nitrogen per acre is sufficient for the initial application, depending on the residual fertility in the soil. Additional applications of nitrogen ranging from 80 to 100 pounds per acre should be applied near the time of the final cultivation. Again, the amount to use would depend upon the fertility of the soil.

Irrigation water should be applied at intervals frequent enough to prevent wilting or excessive leaf rolling. Over irrigation may result in the loss of soluble fertilizer and should be guarded against. Weed growth robs the corn of fertilizer and plant food intended for it. Cultivate, harrow, or use weedicides for the control of weeds.

Summary

► Nitrogen is the only commercial fertilizer that has increased production of corn at the Umatilla Branch Experiment Station in comparative trials. Other fertilizers that have been tried include sulphur, phosphorus, and potash.

► Nitrogen applications ranged from 40 pounds to 240 pounds per acre. The bushel return per pound of nitrogen above 120 pounds per acre was considerably less than below 120 pounds per acre.

► Amounts of irrigation water ranged from 3 to 5 acre feet per acre. Low amounts of irrigation water preceding pollenization followed by liberal irrigation during pollenization and then low amounts for the remainder of the season produced as high yields of corn as high amounts of irrigation water (5 acre feet) during the entire season. Corn growers in the irrigation districts recognize the necessity of having adequate moisture at the time of pollenization.

► High levels of nitrogen with insufficient irrigation water reduced the yield of corn materially. The use of syphon tubes for over-the-bank irrigation of individual rows of corn was found convenient and practicable.

► Winter cover crops including hairy vetch, Austrian winter peas, rye, and winter wheat, and combinations of legumes and nonlegumes have been grown in order to determine corn production following these winter cover crops. Hairy vetch is the only winter cover crop that is recommended on the loamy sand soil of the Umatilla irrigation project.

► Hairy vetch fertilized with sulphur produced nitrogen at the rate of approximately 115 pounds per acre in the top growth. Whereas Austrian winter peas produced only about 60 pounds of nitrogen per acre. Sixty pounds of nitrogen per acre added to the corn crop grown on the hairy vetch cover crop produced 100 bushels of corn per acre.

► In preparing the seed bed corn fields should be plowed prior to planting. The seed bed should be irrigated before planting if the soil moisture is low. Nitrogen fertilizer can be side-dressed at time of planting or at a later date with good results, depending upon residual fertility.

► Thirty-two hybrids and varieties of corn were tested at the Umatilla Field Station in 1946 and 1947. The long-season hybrids with nitrogen at the rate of 148 pounds per acre produced around 160 bushels per acre. The short-season hybrid and open pollinated variety under the same conditions produced 82 bushels per acre.