Technical Bulletin No. T-18 March, 1943

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE

AGRICULTURAL EXPERIMENT STATION

W. L. BLIZZARD, *Director* LOUIS E. HAWKINS, *Vice Director*

EXPERIMENTS WITH IRISH POTATOES: Time of Planting; Seed Sources; Varieties; Irrigation; Fertilizers; Time of Harvest; and Storage of the Spring Crop

By
H. B. CORDNER
Department of Horticulture

Stillwater, Oklahoma

Contents

NOTE: References to the literature will be found in Oklahoma Experiment Station Bulletin B-266.

EXPERIMENTS WITH IRISH POTATOES: Time of Planting; Seed Sources; Varieties; Irrigation; Fertilizers; Time of Harvest; and Storage of the Spring Crop

By H. B. CORDNER
Professor of Horticulture (Vegetable Crops)

The Irish potato is the most widely grown truck crop in Oklahoma. According to the United States Bureau of Agricultural Economics, 2,244,000 bushels were grown in 1942 on an estimated acreage of 33,000 acres. The crop had a value of about $2,939,000.

To supply information needed by both commercial growers and home and farm gardeners, several problems encountered in potato production under Oklahoma conditions have been investigated by the Oklahoma Agricultural Experiment Station. A rather extensive study of fertilizer practices in potato production was completed in 1937 and is published as Oklahoma Station Bulletin B-249. Results secured in studies of fall potato production are published as Oklahoma Station Bulletin B-258. The present publication brings together a group of experiments on other phases of Irish potato production which have been conducted at the Oklahoma Station during the past several years.*

TESTS OF SEED FROM VARIOUS SOURCES

Fall-Grown Oklahoma Seed

A comparison of fall-grown Triumph seed planted as whole tubers with northern seed planted as cut sets was secured in an irrigation test conducted in 1939. Table I presents a brief summary of the results. The lateness in the plants from the fall seed was evident throughout the growing season, and the vines were still green on June 24 when the crop was harvested.

Because the lower yields for the fall Triumph seed apparently were due to slow sprouting in the whole seed tubers, a test was conducted in 1941 comparing whole with cut seed produced in the Oklahoma fall crop of 1940. To hold the size of the seed pieces constant, small tubers approximating one ounce in weight were planted whole in comparison with halves cut from tubers having a weight of about two ounces.

Although there was no significant difference in the final stand of plants for the two kinds of seed, the whole seed was much slower in getting the sprouts up (Table II). No significant trend was established in the number of plants per hill or the percentage of No. 1 tubers produced by the crops from the different seed lots. However, both varieties showed a significant difference in yield in favor of the cut seed.

* Recommendations on potato production resulting from these experiments are published in Experiment Station Bulletin B-266, "Irish Potato Production in Oklahoma." References to the literature will also be found in Bulletin B-266.

Comparison of Oklahoma-Grown and Northern-Grown Seed

1940.—A test conducted in 1940 was designed to furnish information on the value of Oklahoma-grown seed in comparison with certified northern (Minnesota-grown) seed. Two kinds of Oklahoma stock were used: tubers grown in the 1939 spring crop and kept in the cellar and later in cold storage (Fig. 1); and tubers grown in 1939 fall crop and kept in cellar storage. Cut sets of three varieties from each source were planted. Table III summarizes the results of this test.

TABLE I.—Small Whole Tubers from Oklahoma Fall Crop Compared With Cut Minnesota Seed; Triumph Variety; 1939.

	Northern-grown Seed Planted as Cut Sets			Oklahoma Fall-crop Seed Planted as Whole Tubers		
	B*	C*	D*	B	C	D
Sprout Emergence Data						
Days to 50% up	39	37	37	45	43	43
Percentage of stand	97	97	100	100	100	99
Yield Data						
Bushels per acre (Total)**	232	234	176	98	148	72
Percentage of No. 1 tubers	88	88	84	76	85	72

Planted March 17, harvested June 24, 1939.

* "B," "C," and "D" represent different irrigation treatments. "B" irrigated early, on April 23, with overhead Skinner; "C" irrigated with furrows; and "D" unirrigated.

** A difference of 22.4 bushels is required for significance.

TABLE II.—Small Whole Tubers Compared With Cut Sets; Fall-grown Triumph and Warba Varieties; 1941.

	WARBA		TRIUMPH	
	Whole	Cut	Whole	Cut
Sprout Emergence Data				
Percentage up by April 21	28	62	22	73
Plants per hill	1.43	1.28	1.30	1.55
Yield Data				
Total bushels per acre*	192	215	162	183
Bushels per acre No. 1 tubers	166	190	141	161
Percentage of No. 1 tubers	86	88	87	88

Planted March 15, harvested June 29, 1941.
Planted in a 4 x 4 square, single plots 2 rows 75 feet long.
* All differences are significant.

It appears that there were some differences in the quality or value of the Northern seed of the different varieties, with that for the variety Warba being inferior to that of the varieties Triumph and Red Warba. Similarly it appears that the tubers of the Warba varieties had come through storage from the Oklahoma spring crop in better condition than tubers of the Triumph.

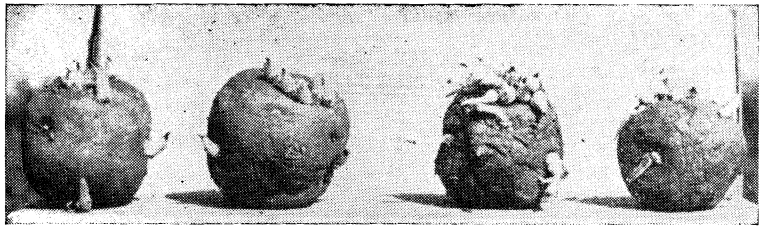

Fig. 1.—Spring-grown tubers representative of those used in the 1940 source-of-seed trial. Such tubers may be shriveled to some extent, and usually exhibit symptoms of multiple sprouting.

1941.—This source-of-seed study was continued in connection with a rotation and fertilizer experiment. Eight kinds of seed were planted, each as a single 100-foot row in each of 18 plots. The northern seed of Warba was purchased from a local seedsman as state inspected but uncertified. Certified irrigated and dry-land seed of Triumph was secured from Nebraska. Fall and spring Oklahoma-grown seed of Warba was planted along with fall-grown Oklahoma seed of the varieties Triumph, Red Warba, and Houma. All were planted as cut sets of uniform size.

Emergence and yield data are presented in Table IV. A favorable moist season made for high production in all varieties and kinds of seed.

The uncertified northern Warba seed appeared to be inferior in many respects. The tubers tended to shrivel and sprout somewhat in common storage prior to planting. Considerable **Fusarium** discoloration was found in cutting the seed, and also was found again in the tubers grown in the crop, some of which were used in planting a 1941 fall crop.

TABLE III.—Oklahoma-grown Seed from the Spring and Fall Crops in Comparison with Northern (Minnesota) Grown Seed, 1940.

	WARBA			TRIUMPH			RED WARBA	
		Oklahoma			Oklahoma			
	Northern	Spring	Fall	Northern	Spring	Fall	Northern	Oklahoma Spring
Sprout Emergence Data								
Days to 50% up	31	36	35	34	37	35	37	36
Plants per hill	2.23	2.29	1.10	2.46	2.58	1.42	2.42	1.78
Percentage emerged	97	90	94	94	98	90	87	87
Yield Data								
Pounds per plot*	188	204	155	212	159	131	194	222
Bushels per acre	151	163	124	170	105	127	155	178
Percentage of No. 1 tubers	76	76	88	79	83	65	66	77

Planted March 20, harvested June 27, 1940.

* Difference between kinds of seed required for significance, 27 lbs.

TABLE IV.—Oklahoma Grown Seed from the Spring and Fall Crops in Comparison with Minnesota and Nebraska Grown Seed, 1941.

	WARBA			TRIUMPH			FALL-GROWN OKLAHOMA	
		Oklahoma						
	Northern	Spring	Fall	Dry-land	Irrigated	Fall (Okla.)	Red Warba	Houma
Sprout Emergence Data								
Percentage up April 23	91	100	50	100	97	67	64	76
Plants per hill	2.78	2.00	1.27	1.65	1.61	1.46	1.26	1.17
Hills per row	95	77	92	91	92	90	89	83
Yield Data								
Total bushels per acre*	234	195	223	249	230	191	235	240
No. 1 tubers (Bu. per acre)	166	142	187	192	183	160	194	201
Percentage of No. 1 tubers	71	73	84	77	80	84	83	84

The northern grown Warba seed was from Minnesota. The irrigated and dry-land Triumph seed was from Nebraska. Planted March 15, harvested June 28, 1941.

TABLE V.—Comparison of Irrigated and Dry-land Seed, and of Three Kinds of Graded, Irrigated Seed; Triumph Variety from Nebraska, 1941.*

	DRY-LAND	IRRIGATED		
	(Blue Tag)	Blue Tag	Red Tag	White Tag
Sprout Emergeence Data				
Percentage up by April 21	95	93	93	94
Plant stand (per cent)	99	94	94	94
* A difference of 19.9 bushels required to be significant.				
Yield Data				
Bushels per acre (Total)	260	232	236	232
Bushels per acre No. 1 tubers	211	200	194	195
Percentage of No. 1 tubers	81	86	82	84

Planted March 12, harvested June 29, 1941. Plots, 2 rows 75 feet long, four for each kind of seed.

Seed secured from the Nebraska Certified Seed Growers at Alliance, Neb. The Blue Tag is certified U. S. No. 1 stock, the Red Tag stock is designated as commercial with the same disease requirements as the Blue Tag but has a lower minimum (80%) of No. 1 tubers. White Tag seed met the same disease requirements in field and bin inspections but failed on grade and thus may be composed of small tubers and may show some scab.

* No statistically significant differences were found in this test although the actual yield for the dry-land seed was highest.

There was a large demand for Warba seed in Oklahoma during the spring of 1941 and it appears that some inferior stock was shipped into the state. This particular lot was entirely unfit for seed purposes.

Nebraska Triumph Seed

In another test made in 1941, certified (Blue Tag) dry-land and irrigated seed as used in the test just discussed were grown in comparison with irrigated Red Tag and White Tag stock which also came from Nebraska. Data are summarized in Table V.

Source-of-seed Tests, 1942

Tests conducted in 1942 included seed from a number of sources: therefore three series or Latin squares were set up. The first was planted to Triumph stock, the second to Warba and Cobbler, and the third to Red Warba seed. All varieties were planted with cut seed (66 sets per plot) on March 17 and received about 600 pounds of 5-10-5 fertilizer placed in bands in the row. The crop was grown without irrigation and suffered to some extent from the drought which occurred in May. Ample rainfall in June helped materially in making a successful crop, and perhaps was most favorable to the lots of seed which were slow to get up and which were less advanced when the dry period arrived in May.

Yield and plant emergence data are given in Table VI.

VARIETY AND IRRIGATION STUDIES

1938

A variety trial conducted in 1938 included named varieties and a few unnamed seedling lines. The latter were furnished by Dr. F. J. Stevenson of the United States Department of Agriculture. The trial included Triumph and Cobbler as standards for comparison with the other varieties. The season was agreeable for potatoes as regards moisture supply and temperatures. Because of an abundant rainfall, no irrigation treatments were applied. The crop was harvested on July 1. The results of the test are summarized in Table VII.

1939

The variety trial with potatoes in 1939 was set up as three series on three adjacent areas. The same arrangement of replicated plots of each variety was used in each area. The first area was irrigated by means of an overhead Skinner line, the second by means of furrows between the rows, and the third area was unirrigated. The crop was fertilized with a 5-10-5 fertilizer at the rate of 600 pounds per acre, and 60 sets were planted in a 65-foot plot with the rows 3 feet apart. Five plots of each variety were planted in each of the series mentioned above.

The rainfall for February, March, and April was limited (total for three months but 2.58 inches) and therefore on March 23 the Skinner block was irrigated. At this time over 50 per cent of the hills were established for all the plots except the Triumph planted as whole seed. In this plot, sprout emergence was just starting. Both the furrow and Skinner series were irrigated on May 7 and at intervals until June 17, with a total of four irrigations applied. The crop was harvested June 24.

As indicated in Table VIII, the Warba variety, as in 1938, was significantly more productive than Triumph. The lower yield of Red Warba probably arose in relation to differences in the condition of the seed, and the difference was not statistically significant. Apparently the early irrigation of the Skinner series, which was made just as the fall seed was be-

TABLE VI.—Yield and Plant Emergence of Seed from Various Sources; Perkins Farm, 1942.

	YIELD (Bushels per acre)		Percentage of No. 1 Tubers	PLANT EMERGENCE	
	Total	No. 1		50 per cent up	Per cent stand
Triumph*					
Nebraska (Blue-Label)	181	127	70	Apr. 13	96
Nebraska (White-Label)	186	123	66	Apr. 14	98
Fall Crop (Perkins farm)	166	118	71	Apr. 18	96
Texline, Texas	172	118	69	Apr. 13	96
Goodwell, Oklahoma	179	116	65	Apr. 11	96
Montana (Certified)	139	93	66	Apr. 12	92
Difference required**	24.0				
Warba and Cobbler					
Fall Warba (Perkins)	194	166	85	Apr. 21	97
Minn. Warba Certified	212	150	71	Apr. 11	98
Minn. Warba Uncertified	172	131	76	Apr. 15	95
Cobbler Goodwell	186	147	79	Apr. 15	98
Difference required**	14.2				
Red Warba					
Minn. Certified—1	199	160	80	Apr. 13	94
Minn. Certified—2	205	156	76	Apr. 13	97
Goodwell, Oklahoma	219	153	70	Apr. 12	99
Fall Crop, (Perkins)	188	149	79	Apr. 22	98
Difference required**	13.5				

Planted March 17, harvested July 7, 1942.

The stock from Texline, Texas, was furnished by Mr. Jack Renfro of the Oklahoma State Department of Agriculture. The Goodwell stocks were grown by Mr. Hugh Thompson of the Panhandle (Oklahoma) A. and M. College and were produced in a late planting under irrigation.

* Nebraska Red-Label Triumph in another trial planting in 1942 was about equal to the Blue-Label seed.

** Difference required to be significant.

TABLE VII.—Potato Variety Trials, 1938.

	BUSHELS PER ACRE		PER CENT BY GRADES		
	Total*	No. 2	No. 1	No. 1	Culls
Warba	223	176	79	17	4
Earlaine	188	109	58	38	4
Triumph	177	140	79	14	7
Houma	175	128	73	20	7
Green Mountain	155	109	70	26	4
Sebago	144	104	72	23	5
Cobbler	140	112	80	16	4
Russet Rural	127	88	69	26	5
Golden	117	53	45	42	13
Chippewa	108	84	78	18	4

Planted March 21, harvested July 1, 1938.

* Difference necessary to be significant, 31.1 bushels.

TABLE VIII.—Potato Variety and Irrigation Trials, 1939.

	IRRIGATED								
	Skinner Line			Furrows			UNIRRIGATED		
	Total yield (Bu./A.)	Yield No. 1 tubers (Bu./A.)	Percentage of No. 1 tubers	Total yield (Bu./A.)	Yield No. 1 tubers (Bu./A.)	Percentage of No. 1 tubers	Total yield (Bu./A.)	Yield No. 1 tubers (Bu./A.)	Percentage of No. 1 tubers
Warba	271	249	92	259	236	91	181	152	84
Red Warba	260	238	91	256	238	93	168	148	88
Bliss Triumph	232	204	88	234	206	88	176	148	84
Late Triumph	173	232	82	168	143	85	108	79	73
Okla. Fall Triumph (whole)	98	75	76	148	126	85	72	52	72
Average	207	199	86	213	190	88	141	116	80
Significant difference (Bu.)	36			24			19		

Planted March 20, harvested June 24, 1939.

TABLE IX.—Potato Irrigation and Variety Trials; Perkins Farm, 1940.

	IRRIGATED								
	Skinner Line			Furrows			UNIRRIGATED		
	Total yield (Bu./A.)	Yield No. 1 tubers (Bu./A.)	Percentage of No. 1 tubers	Total yield (Bu./A.)	Yield No. 1 tubers (Bu./A.)	Percentage of No. 1 tubers	Total yield (Bu./A.)	Yield No. 1 tubers (Bu./A.)	Percentage of No. 1 tubers
Warba	349	325	93	302	281	93	186	153	82
Red Warba	346	322	93	312	287	92	206	155	75
Cobbler	332	312	94	310	291	94	187	148	79
Houma	325	283	87	312	271	87	181	132	73
Triumph	285	268	94	287	273	95	143	124	87
Average	327	303	92	305	278	92	181	142	79
Significant difference (bushels)	25.1			25.5			20.8		

Planted March 16, harvested July 1, 1940.
* Differences in total yield required for significance between varieties are as follows: Skinner series, 25.1 bushels; furrow series, 25.5 bushels, and unirrigated series, 20.8 bushels.

ginning to get its sprouts up, was detrimental to this one planting of the Triumph, although it is probable that it was favorable to the other varieties which were more advanced as regards sprouting.

From the data presented it is very evident that the four irrigations greatly increased the yields of all varieties. As an average, the total yields were increased about 50 per cent by the irrigation treatments, and the quality of the crop as indicated by the percentage of No. 1 tubers was considerably improved.

Carload Lot Test, 1939

In addition to the trial plots grown in 1939, a more extensive planting was made to the Warba (white) and Triumph varieties. Three carloads were shipped to the Chicago market and sold for $1.60 per cwt. for the White Warbas and $1.75 per cwt. for the Triumphs. Considering these prices and the yields as given in Table VIII, a greater income was derived from the crop of Warbas in spite of the lower price.

1940; Perkins Farm

The variety and irrigation trial was repeated in 1940 with results as presented in Table IX. The moisture supply for March was low (0.21 inch), followed by 5.27 inches in April, 1.71 in May and 5.33 inches in June. The June rainfall included about one inch falling on June 10 and the remainder coming after June 23. A deficiency of moisture in May and early June favored the irrigation treatments. The first irrigation was applied May 29 and other irrigations were made on June 6 and June 18 to make a total of three for the season.

When the yields for the several varieties are averaged, it is found that the three irrigations applied to the crop in late May and early June increased the crop yield by over 70 per cent on the basis of the total yield, and when the No. 1 tubers are considered the yield was approximately doubled by irrigating. The yields for the several varieties again indicate that the Warba varieties are most productive. The season was relatively long (crop harvested July 1) and this favored production in the Cobbler and Houma varieties. The yield for Triumph was so low that it is believed that the seed stock was below standard. This seed was purchased locally as certified Minnesota stock.

1940; Rush Springs

A duplicate variety test was conducted in 1940 on the Charles E. Brown farm near Rush Springs, with essentially the same results as secured on the Station Farm, as indicated in Table X.

TABLE X.—Yields for Potato Varieties; Rush Springs, 1940.

	Total yield (Bu./Acre)	MARKETABLE YIELD* (Grades Nos. 1 and 2)	
		(Bu./Acre)	Per cent
Warba	238	228	96
Red Warba	216	209	97
Cobbler	213	207	97
Houma	167	157	94
Bliss Triumph	162	150	96

Planted March 9, harvested June 29, 1940.

A 4-12-4 fertilizer was applied in the row at the rate of 600 pounds per acre at planting time.

Difference required for significance between total yields of varieties, 19 bushels.

Studies With Varying Time and Number of Applications

The rainfall for the 1942 potato season was rather poorly distributed, with an abundance in April (11.26 inches) followed by a dry May. Although the total May rainfall was 1.20 inches, there were no effective rains, the largest being .39 inch on May 11. The May drought was broken June 6, and 10.8 inches were received in June to complete the growing season. The frequent rains in April encouraged rapid vine development in the crop, and as a result the plants were not adapted to endure the dry period which followed.

Four varieties were planted in this trial and a total of three irrigations were applied. By varying the time of irrigating and the number of irrigations, five irrigation treatments were used, and these were arranged in a 5 x 5 Latin square. Each plot was 12 x 64 feet, four rows wide, with a different variety in each row.

The analysis of the yield data indicated that the varieties responded uniformly to the irrigation treatments, and therefore the yields for the four varieties are combined in Table XI which summarizes the results of the irrigation test. The late application (June 1) was followed shortly by rainfall which continued abundantly throughout the remainder of the growing season, and as a result this irrigation was least effective or valuable. It appears that this late application encouraged the development of some tubers which did not have time to mature to the No. 1 size, and thus a larger proportion of the tubers was found in the 2nd and 3rd grades. The lowest percentage of No. 3 tubers (6%) was found when three irrigations were applied.

The extremely variable rainfall for the 1942 season produced some unusual second-growth responses as indicated in Figure 2. Instead of the usual bulging at the eyes as is characteristic in second growth, the tubers apparently sprouted at the apical end with the sprouts developing into small knobs. When the tuber was near the surface of the soil the sprouts developed foliage. All the varieties made this same response but to varying degrees and according to the maturity dates of the varieties. Thus, the Warba varieties (the earliest sorts) were most severely affected, while Triumph, which is slightly later in maturing, was affected less, and the Cobbler, the latest maturing variety, was affected least. This condition in the tubers did not correlate with the irrigation treatments and, therefore, it appears that the second-growth response had been induced before the irrigation treatments were initiated.

Yields by varieties for this test are summarized in Table XII.

EXPERIMENTS ON STORAGE OF SPRING-CROP POTATOES

Although the commercial crop of spring-grown potatoes in Oklahoma is planted largely for marketing at harvest time, a considerable acreage is also grown for home use. Because difficulty is encountered in storing the potatoes from this spring crop during the hot summer months in Oklahoma, tests were conducted by the Oklahoma Station to determine the most satisfactory method of keeping a supply of spring-grown potatoes for home use.

1938

In the first season, No. 1 Triumph tubers harvested June 27 were placed in half bushel baskets and also open-mesh bags (three lots for each sample) and cured 14 days in various locations which provided some differences in temperature and humidity. After this initial curing period, the samples of potatoes were divided into two lots for storage in the cellar or in the refrigerated or cold storage. Throughout the curing and storage periods a reg-

TABLE XI.—Relation of Number of Irrigations and Time of Application to Production and Grades of Potatoes; Perkins Farm, 1942.

	DATE IRRIGATED			BUSHELS ACRE		Per cent	INCREASE FOR IRRIGATION	
	May 19	May 26	June 1	Total	No. 1	No. 1	Bu. No. 1	Per cent
Three irrigations	x	x	x	250	185	74	90	95
Two irrigations	0	x	x	215	151	70	56	59
One irrigation	0	x	0	188	142	70	47	50
One late irrigation	0	0	x	164	107	65	12	13
Not irrigated	0	0	0	140	95	68	---	
Approx. value of irrigation in bushels, No. 1 tubers	34	48	12					

Planted March 16, harvested July 6, 1942.
600 pounds per acre of 5-10-5 fertilizer applied in the row.

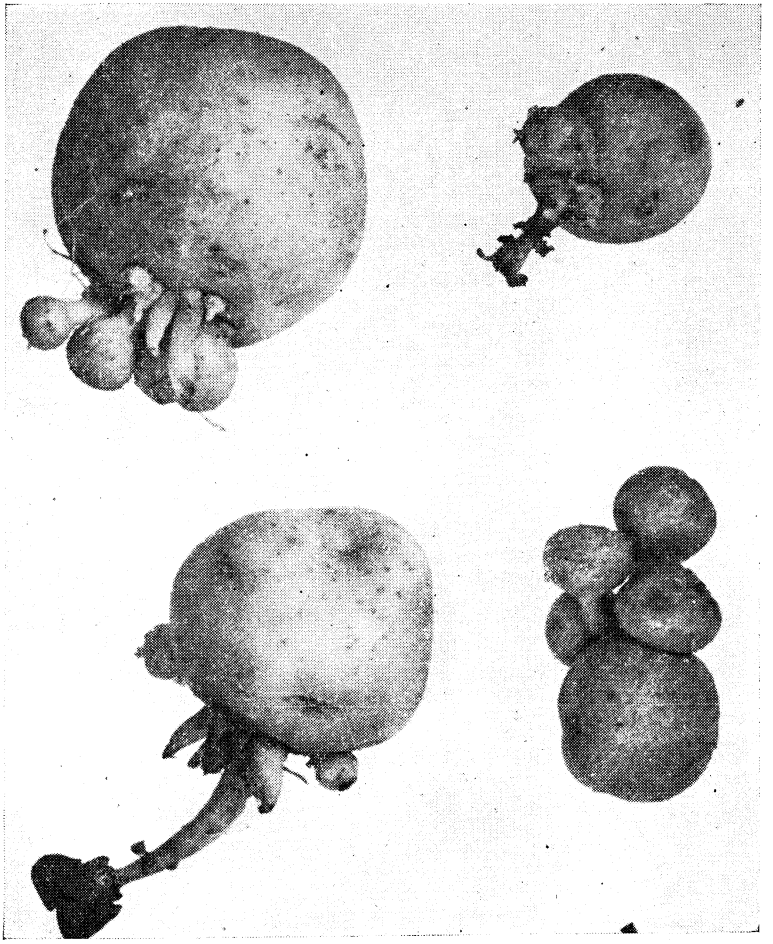

Fig. 2.—The unusual second-growth response shown at the right was noted in 1942. Apparently the growth of the tubers was checked by a dry period in early May, and sprouts were initiated which later developed into small tubers or, when near the surface of the soil, into vegetative shoots. The usual second growth, producing knobby tubers and growth cracks, is shown at the left.

istering hygrothermograph was used to record temperature and humidity, and means were determined from these records. The tubers were weighed at intervals and, when present, decayed tubers were removed. After 120 days (on October 25) the potatoes were removed to room temperature and 17 days later a final record was taken as summarized in Table XIII. Weight loss trends are shown in Figure 3.

TABLE XII.—Production and Grades for Four Varieties of Potatoes Grown in 1942 Irrigation Trials.

	YIELD IN BUSHELS/ACRE		Per cent No. 1
	Total	No. 1	
Red Warba	235	160	68
Warba	205	142	69
Cobbler	176	129	79
Triumph	168	101	60

Planted March 16, harvested July 6, 1942.

All seed stock certified. Red Warba and Warba seed was from Minnesota, Cobbler seed from North Dakota, and Triumph seed was Blue Label from Nebraska (See Table VI).

TABLE XIII.—Shrinkage and Decay for Triumph Tubers Packed in Baskets and Open Mesh Bags in Relation to Various Curing and Storage Treatments; 1938.

(Percentage of original weight.)

STORAGE TREATMENT		SHRINKAGE OR WEIGHT LOSS				LOSS FROM DECAY		
Pre-storage (curing period)	Kind of storage	While curing	While stored	After storage	Total loss	While stored	After storage	Total loss
Stored in Baskets								
Root Cellar	C. S.	2.9	6.7	1.3	10.9	0.1	0.2	0.3
Cabinet I	C. S.							
Shed	C. S.	9.2	5.0	1.4	15.6	1.2	2.2	3.4
Cold Storage	C. S.	4.8	10.3	1.8	16.9			
Root Cellar	R. C.	4.9	14.6	2.0	21.5	17.8	4.2	22.0
Shed	R. C.	9.0	11.2	1.7	21.9	18.0	5.0	23.6
Cold Storage	R. C.	4.9	21.6	1.5	28.0	25.4	5.1	30.5
Cabinet II	R. C.	8.4	18.8	0.7	27.9	45.2	2.9	48.1
Stored in Bags								
Root Cellar	C. S.	5.2	7.5	1.8	14.5	0.5	3.3	3.8
Shed	C. S.	14.6	8.3	1.6	24.5	1.2	2.2	3.4
Cabinet I	C. S.	14.2	13.5	1.6	29.8	2.8	5.8	8.6

Potatoes harvested June 27 and placed in pre-storage for 14 days. Tubers removed from storage to room temperatures on October 25 and final data secured 17 days later. Half bushel baskets with lids were used as containers along with open-mesh onion bags.

Means for temperature and relative humidity at the various locations were as follows:

Location	Relative Humidity	Temperature F.*
Root Cellar	65-85%	70-85
Cold Storage	80-95	45-50
Open Shed	48-70	80-90
Cabinet I	78-84	91
Cabinet II	60-65	91

The preliminary curing treatment in the root cellar before placing the tubers in the refrigerator was helpful, apparently because the rather high humidity and a moderate temperature in the cellar helped to heal over the skinned areas and in this way reduced the normal shrinkage to a minimum. Curing the potatoes at a higher temperature (91° F.) as found in Cabinet I, or with higher temperatures and with a dryer atmosphere as in the open shed, resulted in greater decay during curing and a greater loss of moisture from the tubers. Placing the tubers directly in cold storage at a low temperature prevented the healing of the skinned areas and more shrinkage and shriveling resulted.

Potatoes left in the field and harvested July 14 after passing through a period of hot weather (July 2 to 10) were showing some decay at harvest time and continued to decay in storage except when placed directly in the refrigerated storage. Any attempts to cure these tubers at moderate temperatures were unsuccessful due to the development of decays. The tubers placed at 91° (Cabinets I and II) practically all decayed during the two-week preliminary treatment period. It is interesting to note that a good part of the tubers were preserved by direct storage at about 50° and that there was no tendency for the tubers to decay at room temperatures after 120 days in storage. About 19 percent of the tubers were quite badly shriveled at the end of the storage period and it was apparent that these tubers had been severely damaged by heat prior to harvesting.

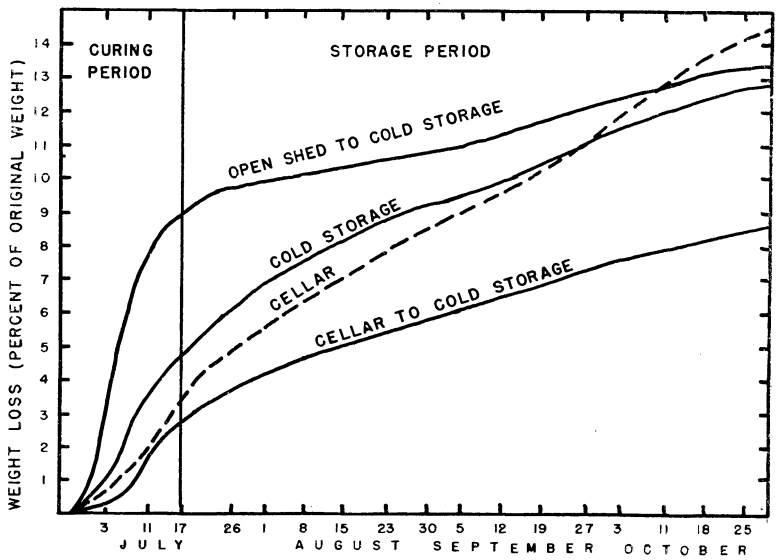

Fig. 3.—Weight losses for several lots of potato tubers in relation to various curing and storage environments. The curing period was terminated July 17, 1938, when some lots were shifted to the storage room.

1939

A similar storage study was conducted in 1939 using No. 1 tubers of the varieties Triumph, Warba and Red Warba. The tubers were harvested June 24 and packed in half bushel baskets. The following day lots were placed in the root cellar, in cold storage, and in a sweet potato house. On July 8, fourteen days later, lots from each location were shifted to the two other locations for permanent storage. The temperature of the cold storage varied but little to produce a mean of 50° F. with a relative humidity of 80 to 90 percent. The door of the sweet potato house was frequently open. As a result, the humidity was lowest at this location (mean 58.0%), and temperatures as high as 90° were recorded at times, while the mean was 84° F. Lower and more constant temperatures were found in the cellar, with a mean of 78° F. and a maximum of 85° which occurred in mid-September. The relative humidity in the cellar was high, with a mean of 78.1 percent.

Weight losses and losses due to decay are shown in Table XIV. The reduction in weight loss due to curing the tubers before placing them in cold storage was greater for the Triumph tubers than for those of the Warba varieties, suggesting that the tubers of the earlier Warba varieties were more mature when harvested on June 24.

Tubers of the Triumph variety also tended to decay more than those of the Warba varieties at the higher temperatures. By September 1 the weight of the sound Triumph tubers in the potato house was reduced to about 50 percent of the original weight, while 78 to 83 percent of the original weight remained for the Warba tubers. The temperatures in the potato house and cellar increased following September 1 and the decay also increased, so that by October 12 a relatively small percentage of the tubers was left in a sound condition at these locations.

Storage Experiments Including Effect of Washing; 1940

These storage tests were continued in 1940 with some modifications, using the Warba variety. An attempt was made to secure some information on the problem of shipping washed potatoes, although it is recognized that the storage facilities available for the work did not make it possible to reproduce entirely the environmental conditions to which the commercial crop tubers are exposed.

The storage cellar and refrigerated storage were used as in the earlier tests, and the pre-storage interval was 14 days.

In preparing the tubers for this study, lots were washed for about four minutes in water with gentle agitation. After washing, part of the tubers were packed in half bushel baskets while still wet and placed in pre-storage. Another part was put out one layer deep on absorbent paper and the surfaces dried thoroughly in a stream of air from an electric fan. After drying, the tubers were packed in baskets and placed with the first lot. A third lot of tubers was packed directly without washing and placed in pre-storage.

Table XV presents shrinkage and decay data.

There was no significant difference in the keeping quality of washed and unwashed tubers.

TIME OF PLANTING EXPERIMENT; 1939

A time of planting study including four varieties and five planting dates was conducted at the Perkins Experiment Station Farm in 1939. March 10 is considered to be the best average planting date for this region, and it was originally planned to make two plantings ahead of this date,

TABLE XIV.—Shrinkage and Decay for Tubers of Three Varieties of Potatoes in Relation to Curing and Storage Treatments; 1939.
(Percent of original weight.)

Pre-storage environment	Storage environment	Wt. loss during curing	MID-STORAGE PERIOD* Loss due to: Loss wt.	Decay	Remaining sound	FINAL STORAGE PERIOD* Loss due to: Loss wt.	Decay	Remaining sound
Triumph Tubers								
Cellar	C. S	4.1	7.2	0	92.8	9.4	0.4	90.2
Sw. P. House	C. S.	5.5	7.1	0	92.9	9.3	0.4	90.3
Cold Storage	C. S.	4.7	9.8	0	90.1	13.7	0	86.3
Sw. P. House	Cellar	5.1	7.7	19.1	74.2	16.4	59.0	24.6
Cold Storage	Cellar	4.9	12.5	15.8	71.7	25.0	61.8	13.2
Cellar	Cellar	4.1	11.7	28.9	59.4	27.1	66.9	6.0
Sw. P. House	S. P. H.	5.0	16.8	32.5	50.7	29.5	54.6	15.9
Cold Storage	S. P. H.	5.0	21.7	25.2	53.1	38.2	59.4	2.4
Cellar	S. P. H.	4.2	18.3	32.6	49.1	35.9	60.3	3.8
Warba Tubers								
Cellar	C. S.	3.7	7.7	0	92.3	10.1	0	89.9
Sw. P. House	C. S.	5.2	7.4	0	92.6	9.5	0.7	89.8
Cold Storage	C. S.	3.7	8.1	0	91.9	11.7	0.6	87.7
Sw. P. House	Cellar	5.4	11.3	8.0	80.7	18.8	62.1	19.1
Cold Storage	Cellar	3.6	9.5	9.3	81.2	16.8	65.9	17.3
Cellar	Cellar	3.8	12.1	12.8	75.1	21.9	62.4	15.7
Sw. P. House	S. P. H.	5.2	13.4	7.6	79.0	23.1	53.8	23.1
Cold Storage	S. P. H.	3.7	13.0	8.9	78.1	18.9	47.7	33.4
Cellar	S. P. H.	3.7	11.9	4.7	83.4	21.2	59.7	19.1
Red Warba Tubers								
Cellar	C. S.	3.3	6.5	0	93.5	9.8	1.4	88.8
Sw. P. House	C. S.	5.4	7.8	0	92.2	10.0	0	90.0
Cold Storage	C. S.	3.7	8.1	0	91.9	12.5	0	87.5
Sw. P. House	Cellar	5.5	11.9	6.8	81.3	22.9	59.6	17.5
Cold Storage	Cellar	3.8	13.1	7.5	79.4	21.0	59.8	19.2
Cellar	Cellar	3.4	10.5	13.8	75.7	18.4	66.6	15.0
Sw. P. House	S. P. H.	5.4	15.8	6.6	77.6	25.5	59.4	15.1
Cold Storage	S. P. H.	3.6	13.5	8.4	78.1	18.6	53.0	28.4
Cellar	S. P. H.	3.3	12.3	7.8	79.9	22.2	66.9	10.9

* Curing period June 25 to July 8. Mid storage September 1; final storage October 12 for sweet potato house and cellar storage and November 16 for cold storage.

Potatoes harvested June 24 and placed in pre-storage June 25; shifted to permanent storage July 8, 1939.

Mean temperatures: cellar 78.0° F.; sweet potato house 84.0° F.; cold storage 50.8° F.

Mean relative humidity: cellar 78.1° F.; sweet potato house 58.0° F.; cold storage 80.9° F.

beginning about March 1, but circumstances prevented this, and the first planting was made on March 6, with repeated plantings at five-day intervals ending March 26. The plantings were made, with an assist-feed planter in single-row plots 65 feet long and averaging 55 sets per plot. Seed of all varieties was prepared by cutting the tubers to sets of an average weight of about 1.3 ounces. Small whole tubers averaging 1.5 ounces, of the variety Triumph, were planted as a fifth variety or treatment. To assist in overcoming soil variations, the varieties were planted in 5 x 5 Latin squares on each planting date, with the squares for each date in consecutive series across the experimental area. The crop was fertilized with a 5-10-5 fertilizer in the row, to the side of the sets, at the rate of 500 pounds per acre.

As the plants emerged, counts were taken at frequent intervals so as to secure information relative to the time and rate of emergence; and a final count ascertained the proportion of the sets that established hills. Weather data was secured at a station on the farm. A soil-air thermograph was set up in the field to register the soil temperature at seed piece depth. This record indicated that the mean soil temperature was at about 38° F. on February 28, at 42° F. by March 4, and reached 51° F. by March 8. Under the circumstances, the sets from even the first plantings germinated favorably; and a good percentage of the sprouts of the first two plantings were up by April 6, when freezing temperatures cut the plants back to the ground surface.

TABLE XV.—Shrinkage and Decay in Triumph Tubers in Relation to Washing and Storage Treatments; 1940.
(Percent)

	Pre-storage treatment (for 14 days)	SEPTEMBER 16			OCTOBER 24		
		Weight loss	Decay	Remaining sound	Weight loss	Decay	Remaining sound
Cold Storage							
Not washed	Cellar	4.3	0	95.6	6.3	0	93.7
Not washed	Cold storage	5.8	0	94.2	8.4	0	91.6
Washed packed wet	Cellar	3.5	0	96.5	5.6	0	94.2
Washed packed wet	Cold storage	4.6	0	95.4	7.0	0	93.0
Washed packed dry	Cold storage	4.3	0	95.7	6.6	0	93.4
Cellar Storage							
Not washed	Cellar	9.8	14.4	75.8	19.5	19.9	60.6
Not washed	Cold storage	6.9	19.4	73.3	16.7	26.0	57.3
Washed packed wet	Cellar	11.2	18.4	70.4	26.1	13.3	60.6
Washed packed wet	Cold storage	6.7	12.7	79.6	13.0	18.1	68.9
Washed packed dry	Cellar	11.0	16.4	72.6	21.0	19.7	59.3

Harvested July 1. Washed and placed in pre-storage July 4 and shifted to final storage July 18, 1940.

Average temperature of cold storage 47.4° F.; relative humidity 85.5° F.

Average temperature of cellar storage 76.6° F.; relative humidity 75.6° F.

Emergence data in Table XVI show that the time required after planting to get the plants up decreased as the planting date was delayed. This is to be expected, since the mean soil temperature increased as the season progressed. However, the first three plantings attained 50 percent up on the same date, April 12. The freeze of April 6 cut the sprouts back for the first two plantings; and this, combined with the lower soil temperatures for the first plantings, delayed the establishment of the plants so that little time was gained in the earlier plantings.

No complete explanation is known for the lower average stands found in the March 11 and 26 plantings. In the case of the Warba variety planted March 11, it appears that some soil factor was operative, since the low average stand (84 percent) was the result of poor emergence on three of the five plots planted.

The crop was given good cultural treatment during the growing season, and all series were harvested on June 18 and 19. Warm weather and high soil temperatures made it appear desirable to take the crop out atthat time, although the vines of the Late Triumph and to some degree those of the Cobbler variety were still green, indicating immaturity. The total yield and the percentage of No. 1 tubers are given in Table XVII.

The marked decline in yield for the last planting, March 26, was accompanied by a similar decline in the percentage of U. S. No. 1 tubers. The proportion of No. 1 tubers for the Warba held up in the same way as did total yield for this last planting (March 26), while marked declines resulted in the case of the Cobbler and Triumph varieties. Apparently the early maturing varieties, especially Warba, were affected least by late planting, while the later maturing varieties were affected most adversely (See Figure 4).

TABLE XVI.—Rate of Emergence and Percentage of Stand of Irish Potatoes in Relation to Planting Dates, 1939.*

	Warba	Triumph		Irish Cobbler	Late Triumph	Average	Date 50% up
		Cut	Whole				
Days to 50% up							
Planted Mar. 6	37	36	36	37	38	36.8	Apr. 12
Planted Mar. 11	31	31	32	33	32	31.8	Apr. 12
Planted Mar. 16	25	28	29	28	27	27.4	Apr. 12
Planted Mar. 21	25	26	26	26	27	26.0	Apr. 16
Planted Mar. 26	21	24	25	25	25	24.0	Apr. 19
Average	27.8	29.0	29.6	29.8	29.8		
Percent stand							
Planted Mar. 6	100	94	97	95	97	96.4	
Planted Mar. 11	84	93	92	90	93	90.3	
Planted Mar. 16	97	92	95	95	97	95.3	
Planted Mar. 21	93	96	94	92	93	93.5	
Planted Mar. 26	90	93	91	91	92	91.4	
Average	92.6	93.6	93.8	92.7	94.2		

* Based on emergence counts taken at 4- to 5-day intervals during the emerging periods.

POTATO FERTILIZER TEST AT RUSH SPRINGS, 1940

A test conducted in a light sandy soil on the Charles E. Brown farm near Rush Springs in 1940 substantiated the results secured in earlier tests (6) relative to the kind and amount of fertilizer for potatoes. The fertilizers were prepared to give the desired analysis by mixing various carriers and were applied at planting time in a band to each side of the sets. Results are shown in Table XVIII. That this soil required fertilization is clearly indicated, since the yield was more than doubled when fertilizer was applied.

Four percent nitrogen in the fertilizer was not quite enough, but the results indicate that an increase to 6 percent would not be economical.

The phosphorus requirement was practically satisfied in the 4-8-4. The difference of 13 bushels between the 4-12-4 prepared for the experiment and the 4-12-4 purchased ready-mixed exceeds the 11.3 bushels required for significance and it is concluded that the experimental fertilizer was superior to the commercial mix. This difference probably arises in relation to the quality of the ingredients used in preparing the fertilizer and the rate at which the nutrients in the fertilizers become available to the crop.

The potash content of the fertilizer is of special interest because of the general belief that potato fertilizers should be high in potassium. The potash requirement of this light sandy soil was definitely taken care of by the 24 pounds of potash in the 600-pound application of 4-8-4. These results agree with numerous other tests conducted with potatoes on Oklahoma soils, and therefore it does not appear economical to always use a 4-8-6 or other high-potash fertilizer for potatoes in this state.

The results for the rate series also agree with previous tests in that 600 pounds of 4-8-4 fertilizer is indicated as the most economical quantity

TABLE XVII.—Total Yield of Tubers as Bushels per Acre and Percentage of Grade No. 1 for Potato Varieties in Relation to Planting Dates.

		Triumph				
	Warba	Cut	Whole	Irish Cobbler	Late Triumph	Average
Total Yield*						
Planted March 6	186	146	168	151	150	160
Planted March 11	156	150	176	140	149	154
Planted March 16	175	153	166	151	165	162
Planted March 21	162	155	174	155	167	163
Planted March 26	179	137	148	131	149	149
Average	172	156	166	146	148	
Percent No. 1 Tubers						
Planted March 6	76	77	72	84	74	77
Planted March 11	78	79	81	82	73	79
Planted March 16	80	78	75	80	81	79
Planted March 21	77	78	79	81	67	76
Planted March 26	79	69	62	73	63	69
Average	78	76	74	80	72	

Planted as 5 x 5 squares on each planting date. Plots single rows 75′ long. Harvested June 18 and 19, 1939.

* A difference of 15.1 bushels is considered significant.

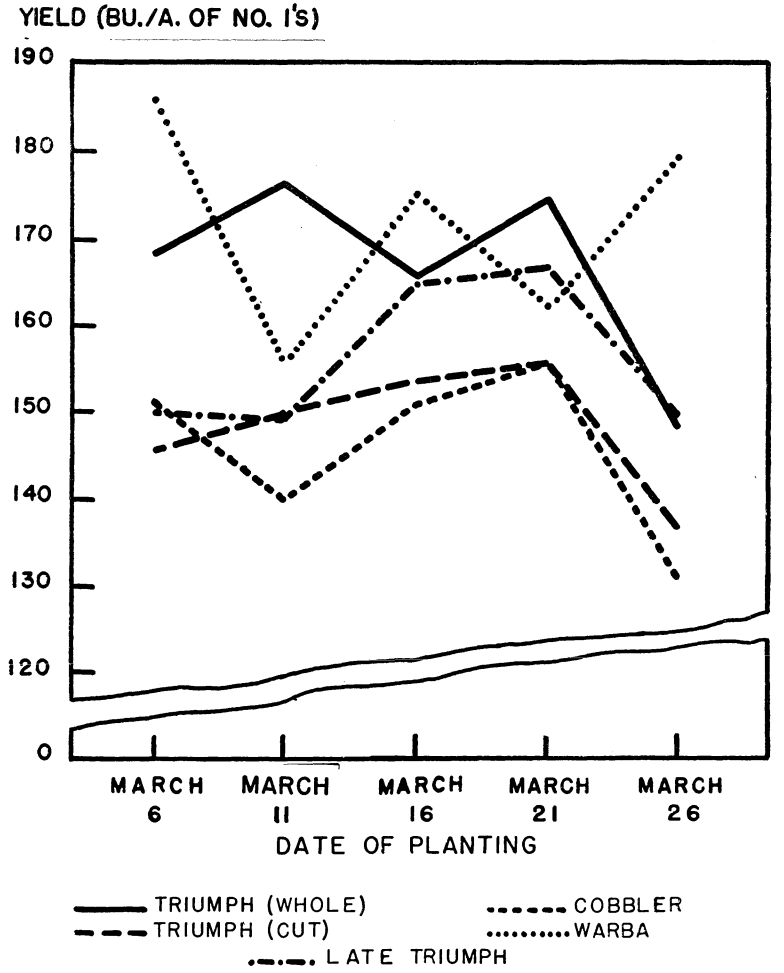

Fig. 4.—Bushels per acre of No. 1 potatoes for varieties and for planting dates. Note sharp decline in production for some of the varieties for the last planting date (March 26).

to apply. The difference of 24 bushels in favor of the 600-pound application over the 400-pound rate was made at a fertilizer cost of about 16 cents a bushel.

TIME OF HARVEST TEST, 1938

In a time-of-harvest test in 1938, the crop was seeded March 11 and, as indicated by the setting of the skins on the tubers, full maturity was attained about July 1. The first harvest was made on June 15 and other harvests were made at intervals of a few days until July 14.

As indicated by the results presented in Table XIX the marketable yield was increased by about 22 percent between June 15 and June 27. This increase was due in part to an increase in the proportion of the tubers making the marketable grade. The last harvest (July 14) was unseasonably late, since the vines were almost entirely dead before this time. Hot weather and high soil temperatures (July 2-10) were quite destructive to these tubers left in the ground. A large number of the tubers had developed rots and were left in the field, accounting for the reduction in total yield. The 18 percent shown as "decayed" were graded out after harvest; and most of the remaining tubers, although they appeared sound at harvest, soon decayed in common storage (See storage tests, p. 00).
soon decayed in common storage (See storage tests, p. 13).

TABLE XVIII.—Yields of Irish Potatoes in Relation to Varied Amounts of Nitrogen, Phosphorus, and Potassium in the Fertilizer, and to Varied Amounts of 4-8-4 Fertilizer; Rush Springs, 1940.

	TOTAL YIELD		Difference in Yield*
	Lbs./Plot	Bu./Acre	
Nitrogen series			
No fertilizer	176	95	
2-8-4, 600 lbs.	354	191	96
4-8-4, 600 lbs.	404	217	26
6-8-4, 600 lbs.	414	223	6
Phosphorus series			
No fertilizer	182	98	
4-8-4, 600 lbs.	404	217	119
4-12-4, 600 lbs.	414	223	6
4-12-4 (commercial mix)	390	210	—13
Potash series			
No fertilizer	182	98	
4-8-0, 600 lbs.	369	199	101
4-8-4, 600 lbs.	404	217	18
4-8-6, 600 lbs.	405	218	1
4-8-8, 600 lbs.	399	215	—3
Rate series			
No fertilizer	170	92	
400 lbs. 4-8-4	358	193	101
600 lbs. 4-8-4	404	217	24
800 lbs. 4-8-4	410	221	4

Sodium nitrate, ammonium sulphate, and dried blood each supplied one-third of the nitrogen Phosphorus was supplied by 20% superphosphate. Potassium was supplied equally by sulphate and muriate of potash.

* Difference between consecutive treatments; e. g., 191—95=96. A difference of 11.3 bushels between treatments is required to be of significance.

TABLE XIX.—Yield of Irish Potatoes in Relation to Date of Harvest; Bliss Triumph, 1938.

	TOTAL YIELD		YIELD NO. 1 TUBERS		Percent Decayed*
	lbs./plot	bu./acre	bu./acre	percent	
Date Harvested					
June 15	380	125	113	91	
June 20	401	132	126	96	
June 27	429	141	138	98	
July 2	432	142	138	97	
July 14	285	94	76	81	18

Planted March 11, 1938, and harvested as indicated.

* Because of high soil temperatures during the first week in July some of the tubers near the surface of the soil were injured.

A difference of 55.2 pounds per plot is required to be significant.

SUMMARY

Source-of-seed Tests

1. Oklahoma grown potatoes, from either the spring or fall crops were found to be slightly less productive as an average, than certified seed from the north.

2. The fall-crop seed compared most favorably with the northern seed when planted as cut sets. Small whole tubers were found to sprout slowly in spring plantings, resulting in later maturity and lower production.

3. Seed grown in a late planting in the Panhandle sections of Oklahoma were found to be comparable to the fall-crop seed produced on the Experiment Station Farm at Perkins, Oklahoma.

4. Oklahoma spring-grown tubers require a period of refrigerated storage to hold them over for spring planting and are therefore less desirable than fall-grown seed. The long storage period of spring-grown tubers results in loss of vigor and multiple sprouting is increased.

5. In a test for one season the difference in production between dryland and irrigated Nebraska Triumph seed was statistically insignificant.

6. The three grades of Nebraska Triumph seed—blue, red, and white tag—were found to be equally productive in tests for two seasons.

7. The importance of buying certified potato seed potatoes was demonstrated in two instances, where tubers that were uncertified but authorized for sale as seed stock were planted in comparison with certified stock.

Variety and Irrigation Studies

1. The early maturing Warba and Red Warba varieties are adapted to the short spring season found in Oklahoma. In trials conducted over a period of 5 years these varieties were quite consistently more productive than Triumph and the Irish Cobbler.

2. The Warba varieties are quite similar in all respects except tuber color. Either is satisfactory for home planting while the red strain is favored for commercial planting.

3. The Houma variety is a little late in maturing for best production in Oklahoma, but because of its smooth high quality tubers, it might be used to replace a part of the Cobbler acreage.

4. Production in potatoes was greatly enhanced by applying two to four irrigations during May and early June. The period is critical in regard to the moisture supply because the potato tubers are developing and because moisture deficiencies are most likely to develop at the time.

5. In 1942 with an extremely dry May period followed by heavy rainfall in June, the greatest net returns were secured for an irrigation applied May 26, followed by the application on May 19, with least benefit derived from the irrigation applied June 1.

Storage of Spring-Crop Potatoes

1. The results of this study indicate that it is difficult to store potatoes harvested in the spring-crop in common storage because of high summer temperatures. At temperatures of 80° F. and above, considerable loss from decay resulted.

2. In refrigerated storage at 50° F. the tubers kept in very good condition.

3. Immature tubers, with the skins or periderms damaged by harvesting and handling, stored best at 50° F. following a curing period of two weeks in the cellar at a moderate temperature and high humidity. This curing treatment seemingly allowed for the renewal of the periderms, and as a result there was less loss of weight during the interval in cold storage.

4. When stored without refrigeration, potatoes were found to keep best in an underground storage cellar.

5. Early maturity in the Warba varieties appeared to be favorable to the keeping quality of these varieties in comparison with Triumph.

6. Heat damage to the tubers in the field before harvesting greatly lowered the keeping quality. Tubers damaged by heat were preserved by direct storage at about 50° F. Damaged tubers shriveled but did not decay in refrigerated storage and held up later when removed to room temperature.

7. Washed potatoes packed either wet or dry in half bushel baskets kept as well as uuwashed ones.

Time of Planting and Time of Harvest Tests

1. The potato season in Oklahoma is definitely terminated by high temperatures in late June and early July. Attempts to extend the season by extra-early planting are usually futile because of low soil temperatures and in some cases by late frosts.

2. Plantings made before the soil is sufficiently warm to induce sprouting of the seed is made at the risk of a poor stand of plants. Soil temperatures are favorable to very early planting in some seasons, but such plantings encounter freezing weather in April which sets these plantings back to the extent that they are not any earlier than later and more seasonable plantings.

3. Soil temperatures in 1939 favored early planting at the Perkins Experiment Farm, but with the sprouts in early plantings frozen back in April, the average yields for plantings made March 6, 11, 16, and 21 were practically identical, with reduced yields resulting for a March 26 planting.

4. Production in the Warba variety appeared to be affected least adversely when the planting date was delayed until March 26.

Potato Fertilizer Tests

1. Potato fertilizer tests conducted in a light sandy soil in the Rush Springs area in 1940 confirmed the results previously published in Bul. 249:

a. That 600 pounds of 4-8-4 per acre is about the right amount of fertilizer for potatoes.

b. That the 1:2:1 ratio as found in a 4-8-4 fertilizer provides a good balance of the three nutrients, nitrogen, phosphorus and potassium.

c. That in this light sandy soil 24 pounds of potash (K_2O) per acre as found in the 600 pound application of 4-8-4 was sufficient for the crop and production was not increased by using more potash in the fertilizer.

Time of Harvest Tests

1. Triumph potatoes planted March 11, 1938 attained full maturity about July 1. Harvesting on June 15 resulted in a loss of about 14 percent in total production and a loss of 22 percent in No. 1 tubers. Harvesting on June 20 reduced these losses to 8 and 11 percent respectively.

2. It appears that the potato tubers made considerable growth this last 15 day period and that potato growers must receive higher prices for early harvests to compensate for the loss in production in the crop.

3. The potato harvest cannot be delayed too long. It must be regulated according to seasonal temperatures if heat damage is to be avoided.