

EXPERIMENT STATION
OF THE
KANSAS STATE AGRICULTURAL COLLEGE,
MANHATTAN.

Bulletin No. 78—April, 1898.

CHEMICAL DEPARTMENT.

J. T. WILLARD, M. S., Chemist.

SUGAR BEETS.*

Realizing the importance of intensive and diversified agriculture, this department began answering the question "Can rich sugar beets be grown in Kansas?" some eight years ago, and continued it for several years. The beets produced were not of a high order of excellence, due in part doubtless to improper culture. With the revival of interest in the subject last year we again took up the work, this time in connection with the U. S. Department of Agriculture. The station received 200 pounds of seed from the Department. We applied for a larger amount but this was adjudged to be our proper quota.

This seed was distributed to 393 farmers of the state. Late in the fall, to give ample time for maturing, directions for sampling and forwarding were sent out. These were not all sent at once, the northern parts of the state being called upon first, and from week to week the notices were sent to other sections southward. The first sections were asked to send by freight samples of ten beets each. Later, we received penalty tags for sending samples through the mails, and then asked for six beets in three packages, which, according to the provisions of law,

*In the interest of justice, it is proper to say that the investigation described in this bulletin was begun last spring when Prof. G.H. Failyer was chemist of the experiment station and the present writer was assistant chemist. The work of that season was done under that organization; the work since has been entirely in the hands of the writer.

might not in any case weigh over four pounds. The faith of the people in the efficiency and care of our postal service received ample confirmation in this work. From half a dozen to half a bushel of loose beets mixed with wads of string and newspaper were received daily. Not infrequently, too, well-packed samples would be received with no name attached. In several cases the sender was identified by the address tag on his newspaper wrappings, confirmed of course by other data. In a number of instances, however, it was entirely impossible to discover the name of the sender. I desire to state here that while errors occur with every one, and the writer is not beyond this human weakness, it has been his intention to ask for samples from all who had seed; to spare no pains to identify packages that came without names; and, if the name could be found, to ask for more beets in case the first sample had broken out of the wrapper; to analyze all beets that could be identified, and to answer promptly all letters of inquiry. If the reader knows anything apparently inconsistent with the above expressed intention, he is requested to inquire before condemning. I realize fully the debt of obligation the state is under to its citizens who have co-operated with us and desire to thank them for this service. I hope that they and many others will unite to make the test this season much more useful than that of last year.

Of the 393 persons receiving seed 156 sent beets with name attached or capable of ascertainment: 104 reported that they had no beets to send, and the remaining 133 were never heard from or their beets could not be identified.

The season was in many localities very unfavorable to the growth of crops of any kind. One of the points upon which reports were requested was "Obstacles to success." One hundred and twelve reported drouth as interfering with success. This factor may work both ways however. While preventing large growth it may have led to the production of a denser, richer juice in the beet. The insect pests of the beet were found to be by no means insignificant.

In respect to the seed it is proper to say that, as it was all alike, those who asserted that the seed "was worthless," or used other expressions of like effect, must have been mistaken, since many reported the germination as "splendid," "perfect," "ninety-nine per cent," etc. In many cases, doubtless, poor germination is to be traced to other of the obstacles mentioned, such as, drouth, or heavy rains immediately after planting.

The following statement summarizes obstacles reported:

| Obstacles to Success with Sugar Beets. | Reported by those sending Beets. | Reported by those not sending Beets. |
|--|----------------------------------|--------------------------------------|
| Poor germination of seed..... | 35 | 34 |
| Drouth..... | 42 | 70 |
| Hail..... | 3 | 6 |
| Heavy rains..... | 7 | 17 |
| Worms..... | 8 | 9 |
| Gophers and Moles..... | 1 | 3 |
| Rabbits..... | 6 | 2 |
| Chickens..... | 3 | 2 |
| Potato Bugs..... | 7 | 13 |
| Grasshoppers..... | 15 | 5 |
| Late planting..... | 0 | 5 |
| Neglect..... | 2 | 14 |

The beets were in almost all cases analyzed on the day of arrival. In the tables which follow certain terms are used which require some explanation to the unprofessional reader. In respect to the form, it may be said that a sugar beet should be long and tapering and grown entirely below ground with the exception of the crown or "neck" from which the leaf-stalks grow; the classification as good, fair, or poor, is based on this standard. The gross weight includes the part that has grown above ground. The net weight is the weight of those parts only which have grown below ground. The part grown above ground is not suitable for sugar manufacture and is removed, being available only for feeding. The nearer the net weight approaches to the gross weight the better the beet. The specific gravity of the juice is its weight compared with water at 1,000; the greater the specific gravity the greater amount of sugar or other substances in solution. The total solids include everything dissolved in the water of the juice, and the coefficient of purity is the number representing the percentage of sugar in the total solids. The higher the number, the better the beet, since the solids not sugar are not only undesirable in themselves but they interfere with successful extraction of the sugar.

TABLE SHOWING ANALYSES OF SUGAR BEETS.

| Serial number | Name of grower. | Postoffice. | County. | Date of planting. | Kind of Soil. | Date of analysis. | Number of beets. | Form of beets. | Average weight in pounds. | | Specific gravity of juice. | Total solids in juice. | Cane sugar in juice. | Purity of juice. |
|---------------|----------------------|------------------|----------------|-------------------|------------------------|-------------------|------------------|----------------|---------------------------|-------|----------------------------|------------------------|----------------------|------------------|
| | | | | | | | | | Gross. | Net. | | | | |
| 140 | Wm Launders..... | Humboldt..... | Allen..... | June 15 | Sandy loam..... | Dec 7 | 10 | Fair..... | 1.22 | .88 | 1.080 | 14.70 | 10.04 | 72 |
| 20 | Richard Gerety | Monrovia..... | Atechison..... | May 10 | Black " | Nov 3 | 7 | Fair and good | 1.22 | .80 | 1.064 | 15.62 | 11.91 | 76 |
| 133 | Herbert Stebbins.. | Atchison..... | " | " | " | 23 | 10 | Fair..... | 1.74 | 1.21 | 1.066 | 16.08 | 13.31 | 83 |
| 157 | Wm Barnett..... | Medicine Lodge.. | Barber.. | Apr 15 | Black..... | Dec 20 | 7 | Fair* | .76 | .63 | 1.086 | 20.60 | 15.14 | 73 |
| 158 | Jas Benning..... | " | " | " 19 | " loam..... | " 20 | 7 | Fair* | 1.05 | .82 | 1.085 | 20.88 | 14.60 | 72 |
| 69 | Geo Ettridge..... | Roberts..... | Barton..... | May 5 | " | Nov 15 | 4 | Good..... | 2.74 | 2.12 | 1.057 | 13.99 | 10.85 | 74 |
| 98 | W P Spencer..... | Marmaton..... | Bourbon..... | " 1, 20 | Upland..... | " 18 | 8 | Poor* | .34 | .28 | 1.077 | 18.58 | 13.88 | 75 |
| 43 | W P Todd..... | Horton..... | Brown..... | " 25 | Black loam..... | " 8 | 10 | Good..... | 1.97 | 1.84 | 1.057 | 13.99 | 11.20 | 81 |
| 160 | J M Foy..... | Brainerd..... | Butler..... | " 15 | Sandy loam upland..... | Jan 10 | 6 | Fair* | 1.30 | .99 | 1.065 | 15.85 | 13.05 | 82 |
| 140 | H H Grover..... | El Dorado..... | " | Apr. 25 | Upland..... | Nov 20 | 4 | Fair..... | 1.56 | 1.12 | 1.053 | 13.05 | 8.16 | 63 |
| 119 | J T Oldham..... | " | " | June 5 | Black..... | " 22 | 6 | Poor..... | 1.93 | 1.14 | 1.054 | 13.20 | 8.63 | 65 |
| 122 | W H Curry..... | Gordon..... | " | " | " | " 22 | 8 | Good..... | 1.39 | 1.06 | 1.067 | 16.31 | 12.62 | 77 |
| 124 | A S McCully..... | Pontiac..... | " | May 1 | Dark, mellow..... | " 22 | 4 | Fair..... | 1.46 | 1.09 | 1.074 | 17.90 | 14.05 | 78 |
| 56 | Mrs Cora Archer..... | Cottonwood Falls | Chase..... | " 12 | Rich and mellow..... | " 11 | 6 | Fair..... | 1.19 | .88 | 1.062 | 15.16 | 11.61 | 77 |
| 41 | M Mellinger..... | St Francis..... | Cheyenne..... | " 1 | Sandy loam..... | " 8 | 10 | Good..... | 1.33 | 1.06 | 1.063 | 15.39 | 12.14 | 79 |
| 27 | Adam Diller..... | Clay Center..... | Clay..... | " 15 | Light " | " 3 | 17 | Good..... | 1.55 | .99 | 1.056 | 13.76 | 11.15 | 81 |
| 44 | Wm McNeill..... | Idana..... | " | " 15 | Black, sandy..... | " 9 | 10 | Good..... | 2.91 | 2.32 | 1.059 | 14.46 | 11.31 | 78 |
| 93 | Warner Richards.... | Morganville..... | " | " | Black, sandy loam..... | " 18 | 10 | Fair..... | 3.63 | 1.98 | 1.061 | 14.93 | 11.19 | 75 |
| 132 | Louis Hanson..... | Concordia..... | Cloud..... | " 26 | Black, sandy..... | " 23 | 10 | Good..... | 1.99 | 1.43 | 1.069 | 16.77 | 13.41 | 80 |
| 28 | Joseph Moreland.... | Rice..... | " | " 18 | " loam..... | " 4 | 11 | Good..... | 1.94 | 1.34 | 1.061 | 14.93 | 11.75 | 79 |
| 31 | John Finley..... | Halls..... | " | June 1 | " | " 4 | 10 | Good..... | 2.09 | 1.60 | 1.060 | 16.08 | 12.91 | 80 |
| 92 | A Munger..... | " | " | Apr. 30 | Very sandy loam..... | " 4 | 10 | Bad and good | .82 | .58 | 1.063 | 15.39 | 13.75 | 90 |
| 33 | Peter Bedor..... | " | " | May 10 | Light, sandy..... | " 4 | 10 | Good..... | 1.29 | .95 | 1.063 | 14.23 | 11.18 | 78 |
| 54 | L K Richardson..... | Clyde..... | " | " 5 | Upland; some sand | Nov 11 | 10 | Good..... | 1.57 | .96 | 1.054 | 13.29 | 11.17 | 84 |
| 55 | S J Swanson..... | " | " | " 5 | " mixed..... | " 11 | 10 | Fair..... | 1.68 | 1.057 | 1.057 | 13.99 | 10.43 | 75 |

*Wilted.

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| Serial number | Name of grower. | Postoffice. | County. | Date of planting | Kind of soil. | Date of analysis. | Number of beets. | Form of beets. | Average weight in pounds | | Total solids in juice | Cane sugar in juice | Purity of juice. |
|---------------|-----------------|---------------|------------|------------------|--------------------------|-------------------|------------------|----------------|--------------------------|------|-----------------------|---------------------|------------------|
| | | | | | | | | | Gross. | Net. | | | |
| 70 | Robt Hanson | Concordia | Cloud | May 25 | Rich loam. | Nov 16 | 12 | Good. | 1.71 | 1.85 | 13.99 | 10.36 | 74 |
| 71 | J O Hemphill | Mercedith | " | " | Black, sandy | " | 17 | Good. | 1.30 | 1.15 | 13.52 | 9.93 | 73 |
| 72 | F G Richmond | Half's Summit | Coffey | " | loam | " | 11 | Good. | 1.54 | 1.28 | 10.04 | 15.18 | 78 |
| 73 | J K Acklin | Pittsburg | " | 3 | Light " | " | 12 | Good. | 1.10 | .89 | 1.070 | 17.00 | 82 |
| 74 | Thos E Evans | McCune. | " | " | Light, gray | " | 29 | Fair* | 2.38 | 1.78 | 1.032 | | |
| 75 | J F Rumold | Dillon | Dickinson | Apr. 27 | Black, sandy loam | " | 17 | Good. | 1.23 | 1.01 | 1.000 | 16.77 | 14.62 |
| 76 | J F Shump | Hedington | " | " | Black gumbo. | " | 3 | Poor. | 1.30 | 1.07 | 1.000 | 10.77 | 12.13 |
| 77 | E W Plummer | Ablone | " | " | Rich garden. | " | 23 | Fair. | 1.20 | .79 | 1.063 | 15.30 | 11.83 |
| 78 | G D Gould | Solomon | " | " | " | " | 6 | Fair. | 2.35 | 1.38 | 1.031 | 14.93 | 11.69 |
| 79 | J J Gray | Severance | Doniphan. | May 10 | Dark; mellow subsoil | " | 5 | Good. | 2.07 | 1.50 | 1.067 | 16.31 | 10.67 |
| 80 | H C Allen | Grover | Douglas | " | " | " | 15 | Good. | 2.17 | 1.07 | 1.070 | 17.00 | 12.01 |
| 81 | E P Watson | Lawrence. | " | " | " | " | 10 | Good. | 1.13 | .85 | 1.022 | 15.16 | 12.05 |
| 82 | J L Cross | Lewis | Edwards | Apr. 17 | Heavy, sandy | " | 22 | Fair. | 1.09 | .76 | 1.064 | 15.02 | 11.12 |
| 83 | John Dame. | Howard. | Elk | May 12 | Limestone. | " | 20 | Fair. | 1.28 | 1.03 | 1.072 | 17.45 | 14.79 |
| 84 | Mrs M S Gilman | Molino | " | " | " | " | 2 | Good. | 1.74 | 1.55 | 1.067 | 16.81 | 13.35 |
| 85 | Jas F Crofoot | Wilson. | Ellsworth. | Apr. 24 | Black | " | 10 | Good. | 1.49 | 1.08 | 1.058 | 14.23 | 10.77 |
| 86 | Wm Ford | Garden City | Finney | May 15 | Sandy loam. | " | 6 | Good. | 1.54 | 1.10 | 1.070 | 19.04 | 14.14 |
| 87 | H E Gillette | Ottawa | Franklin | Apr. 25 | Rich, sandy | Dec 8 | 6 | Poor. | 1.81 | .99 | 1.063 | 15.39 | 11.80 |
| 88 | R W Scott | Junotlon City | Geeary | " | Dark, sandy loam | Nov 9 | 6 | Good. | 1.33 | .79 | 1.055 | 13.63 | 9.61 |
| 89 | Jas Baird. | Morland | Graham | May 15 | Dark loam | " | 17 | Good. | 1.48 | 1.10 | 1.065 | 15.85 | 12.03 |
| 90 | J E Milliken | Hill City | " | " | Calcareous loam. | " | 23 | Fair* | 1.51 | 1.19 | 1.070 | 17.00 | 13.14 |
| 91 | " | " | Graham | " | " | " | 10 | Fair. | 1.46 | 1.11 | 1.073 | 17.08 | 13.83 |
| 92 | " | " | Grunt | " | " | " | 22 | Fair. | 1.21 | 1.03 | 1.082 | 18.71 | 15.47 |
| 93 | T W Marshall | Ulysses | Harvey | Apr. 1 | Sandy loam; clay subsoil | " | 6 | Fair and good | 1.21 | 1.03 | 1.082 | 18.71 | 15.47 |
| 94 | H W Prouty | Hesson | " | " | " | " | 24 | Fair | .41 | .28 | 1.076 | 18.30 | lost |
| 95 | Jas W Milne | Putnam. | " | May 1 | Prairie bottom. | " | 6 | Fair. | 1.14 | .80 | 1.067 | 16.81 | 12.83 |
| 96 | John Downie | Denison | Jackson | " | " | " | 14 | Bad. | 1.58 | 1.24 | 1.068 | 15.89 | 11.17 |
| 97 | M M Maxwell | Valley Falls | Jefferson | " | Mixed clay and loam | " | 17 | Fair. | 1.40 | .94 | 1.064 | 15.62 | 11.82 |
| 98 | J E Stefa | Randall | Jewell | " | Prairie loam | " | 3 | Good. | 1.77 | 1.23 | 1.037 | 13.00 | 10.80 |

*Wilted.

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|----------------|-----------------|-------------|-------------|-------------------|----------------------------------|-------------------|------------------|----------------|---------------------------|------|------------------------|----------------------|------------------|
| | | | | | | | | | Gross. | Net. | | | |
| 24 | W W Petrie | Randall | Jewell | May 5 | Prairie; gumbo subsoil | Nov 3 | 10 | Fair and bad. | 1.11 | .87 | 14.23 | 10.97 | 70 |
| 34 | Jas Bingham | Jewell | " | " | Loam | " | 4 | Fair and good | 1.93 | 1.33 | 14.70 | 11.16 | 70 |
| 5 | Otto R Miller | Ioniah | " | Apr. 24 | Limestone; creek-bottom | Oct 28 | 10 | Good and bad. | 1.70 | 1.20 | 14.70 | 11.57 | 70 |
| 156 | C E Pincumb | Hector | Johnson | May 5 | Loose, black | Dec 20 | 6 | Good | 1.75 | 1.36 | 17.46 | 14.08 | 80 |
| 112 | F E Uhl | Gardner | " | " | Black loam | Nov 20 | 8 | Fair | 1.12 | .94 | 16.54 | 14.20 | 86 |
| 147 | C D Lynd | Parsons | Labetto | Apr. 23 | Sandy | " | 3 | Fair | 1.73 | 1.20 | 13.06 | 8.76 | 67 |
| 127 | A C Hildreth | Dighton | Lano | May 10 | Prairie-lime-loam(not irrigated) | " | 10 | Poor* | .12 | .10 | 1.049 | 12.11 | 7.87 |
| 128 | " | " | " | " | " | " | 22 | 16 | .47 | .34 | 1.071 | 17.23 | 12.47 |
| 92 | W H Prather | Boling | Leavenworth | Apr. 27 | Red; sandy | " | 18 | 7 | 1.61 | 1.13 | 1.063 | 15.59 | 10.44 |
| 95 | J O'Brien | Tonganoxie | " | " | Black loam | " | 5 | Good | 1.21 | .88 | 1.047 | 16.31 | 12.81 |
| 97 | A M Doege | " | " | " | Sandy | " | 18 | 6 | .80 | .58 | 1.068 | 16.54 | 13.73 |
| 103 | W A Mintier | " | " | " | Heavy; black | " | 19 | 4 | .54 | .44 | 1.066 | 16.08 | 14.05 |
| 63 | H T Graves | Lincoln | Lincoln | May 18 | Black sandy loam | " | 13 | 5 | 1.11 | .90 | 1.059 | 14.46 | 11.06 |
| 111 | A Roenigk | " | " | " | loam creek-bottom | " | 20 | 7 | 1.52 | 1.14 | 1.047 | 16.31 | 13.99 |
| 72 | John Kinsley | Oakley | Logan | May 15 | Black loam | Nov 16 | 10 | Good | 1.71 | 1.10 | 1.062 | 16.10 | 11.40 |
| 135 | J F Swartzel | Admire | Lyon | Apr. 24 | " | " | 23 | 8 | 1.00 | .78 | 1.077 | 18.58 | 14.93 |
| 48 | W T Walters | Emporia | " | May 25 | " | " | 10 | 6 | 1.00 | 1.26 | 1.060 | 14.70 | 11.68 |
| 50 | S E Richardson | Marion | Marion | " | Second bottom | " | 6 | Poor | 1.38 | .96 | 1.064 | 15.62 | 12.35 |
| 68 | C A Stebbins | Janary | " | Apr. 17 | Upland | " | 11 | 6 | 1.10 | .73 | 1.051 | 13.90 | 7.32 |
| 61 | E A Hodge | Marion | " | May 1 | prairie | " | 12 | 6 | 1.30 | 1.04 | 1.068 | 16.54 | 13.62 |
| 97 | Dan Merlatt | Ramona | " | " | Black loam | " | 15 | 2 | 1.81 | 1.16 | 1.070 | 17.00 | 12.62 |
| 80 | " | " | " | " | " | " | 16 | 4 | 1.85 | 1.20 | 1.058 | 14.23 | 9.46 |
| 81 | M G Bissey | Aulne | " | May 1 | Black loam | " | 17 | 9 | .93 | .67 | 1.064 | 15.62 | 12.02 |
| 36 | Wm Hacker | Blue Rapids | Marshall | " | " | " | 3 | 8 | 2.75 | 2.06 | 1.635 | 14.23 | 11.60 |
| 37 | Sarah Frost | " | " | " | " | " | 15 | " | 1.15 | .77 | 1.065 | 15.85 | 12.32 |
| 53 | Hannah Potter | Vermillion | " | " | Upland | " | 11 | 10 | 2.02 | 1.37 | 1.691 | 14.93 | 11.46 |
| 10 | Jas Wariner | Blue Rapids | " | " | Black loam | Oct 30 | 11 | Good and bad | 2.20 | 1.68 | 1.062 | 15.16 | 11.06 |

*Wilted.

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| Serial number | Name of grower. | Postoffice. | County. | Date of planting. | Kind of soil. | Date of analysis. | Number of beets. | Form of beets. | Average weight in pounds. | | Specific gravity of juice. | Total solids in juice. | Cane sugar in juice. | Purity of juice. |
|---------------|------------------|--------------|--------------|-------------------|------------------------|-------------------|------------------|----------------|---------------------------|------|----------------------------|------------------------|----------------------|------------------|
| | | | | | | | | | Gross. | Net. | | | | |
| 3 | A W Gibson | Blue Rapids | Marshall | Apr. 15 | Upland; rich old | Oct 28 | 10 | Fair and good | 2.39 | 1.81 | 1.069 | 16.77 | 14.16 | 85 |
| 47 | J W Jones | Canton | McPherson | May 20 | Black loam | Nov 9 | 7 | Poor | .63 | .42 | 1.071 | 17.22 | 13.08 | 76 |
| 151 | B F Moore | Cherryvale | Montgomery | Apr. 17 | Dark | Dec 1 | 4 | Good | 1.48 | 1.03 | 1.051 | 12.50 | 8.69 | 69 |
| 123 | A H McConnell | " | " | " | " | Nov 22 | 6 | Good | 1.81 | 1.27 | 1.063 | 16.39 | 11.82 | 77 |
| 169 | J F McConkle | Independence | " | 10 | Sandy | Dec 20 | 11 | Fair | .95 | .59 | 1.072 | 17.46 | 13.05 | 78 |
| 83 | T J Samuels | Wisley | Morris | " | Black; hardpan subsoil | Nov 16 | 6 | Poor* | 1.49 | 1.08 | 1.082 | 19.71 | 14.75 | 75 |
| 89 | H B Harmon | White City | " | May 5 | Black sticky | " 18 | 8 | Fair* | 2.09 | .77 | 1.074 | 17.00 | 13.28 | 74 |
| 23 | I L Worley | Centralia | Neenaha | " 20 | " sandy loam | " 8 | 10 | Good | 1.78 | 1.78 | 1.060 | 14.70 | 11.07 | 75 |
| 42 | S J Baldwin | Seneca | " | June 1 | Rich sandy loam | " 8 | 17 | Poor | .70 | .41 | 1.065 | 18.62 | 10.08 | 75 |
| 4 | J F Ruhlén | Wetmore | " | May 15 | Second bottom | Oct 28 | 11 | Fair | 3.09 | 2.07 | 1.055 | 13.70 | 10.82 | 75 |
| 3 | N J Mosher | Centralia | " | June 2 | Sandy loam | Nov 10 | 4 | Poor | 2.05 | 1.42 | 1.058 | 16.54 | 13.85 | 84 |
| 40 | W T Merryweather | Queenemo | Os ge. | May 2f | Light | Nov 10 | 4 | Fair | 1.22 | .95 | 1.007 | 16.31 | 13.00 | 80 |
| 64 | E S Palmer | Burlingame | " | " | " | Nov 15 | 6 | Poor | 1.49 | 1.10 | 1.007 | 16.31 | 13.00 | 80 |
| 68 | C M Smith | " | " | " 10 | " old | " 15 | 6 | Fair | 1.47 | 1.33 | 1.037 | 13.99 | 9.46 | 68 |
| 113 | T M Ethington | Overbrook | " | Apr. 19 | Upland | " 20 | 6 | Good | .97 | .65 | 1.066 | 16.08 | 12.38 | 77 |
| 124 | G H Rice | Alton | Osborne | May 1 | Black loam and gravel | " 23 | 10 | Good | 1.32 | 1.03 | 1.073 | 17.85 | 12.39 | 79 |
| 142 | Spring Kresky | Minneapolis | Ottawa | " 1 | " | " 26 | 9 | Fair | .94 | .74 | 1.074 | 17.90 | 14.84 | 83 |
| 74 | G W Romlok | " | " | " | " | " 16 | 4 | Good | 3.44 | 2.67 | 1.062 | 16.16 | 11.84 | 76 |
| 66 | J L Steele | Minneapolis | " | Apr. 16 | Black | " 15 | 5 | Fair | 1.76 | 1.25 | 1.067 | 16.31 | 12.41 | 76 |
| 78 | Henry Baird | " | " | May | Clay | " 16 | 9 | Fair | 1.04 | .76 | 1.007 | 16.31 | 12.77 | 78 |
| 110 | B B Gillett | Garfield | Pawnee | " 1 | Black loam | " 20 | 8 | Poor | .33 | .23 | 1.049 | 12.11 | 8.24 | 70 |
| 39 | A D Radliff | Phillipsburg | Phillips | " 1 | Sandy | " 4 | 11 | Fair | 1.14 | 1.07 | 1.068 | 18.54 | 13.39 | 80 |
| 21 | W W Colby | Kirwin | " | " 25 | Black loam | " 8 | 10 | Good | 1.88 | 1.30 | 1.057 | 13.09 | 11.03 | 70 |
| 13 | F B Finet | Onaga | Pottawatomie | " 29 | Upland and bottom | Oct 30 | 10 | Good | 1.46 | 1.09 | 1.062 | 15.16 | 12.49 | 82 |
| 12 | G E Grin | " | " | " 6 | Heavy loam | " 10 | 10 | Good | 1.23 | 1.00 | 1.063 | 15.85 | 12.72 | 89 |
| 8 | John F Nagle | Belvue | " | Apr. 16 | Sandy | " 10 | 10 | Fair | 1.44 | .93 | 1.032 | 12.82 | 11.43 | 89 |
| 169 | J J Ablard | Lawndale | Pratt | May 1 | Black loam | Dec 1 | 8 | Good | .89 | .68 | 1.070 | 17.00 | 12.62 | 74 |
| 126 | W H Hamm | Preston | " | Apr. 2 | Sandy | Nov 22 | 6 | Poor | .50 | .38 | 1.065 | 15.39 | 11.76 | 78 |

*Wilted.

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| Serial number. | Name of grower. | Postoffice. | County. | Date of planting. | Kind of Soil. | Date of analysis. | Number of beets. | Form of beets. | Average weight in pounds. | | Specific gravity of juice. | Total solids in juice. | Cane sugar in juice. | Purity of juice. |
|----------------|-----------------|-------------|----------|-------------------|--------------------------|-------------------|------------------|----------------|---------------------------|------|----------------------------|------------------------|----------------------|------------------|
| | | | | | | | | | Gross. | Net. | | | | |
| 154 | S S Hinerman | Chardon | Rawlins | May 15 | Sandy loam | Dec 8 | 8 | Fair | 1.57 | .98 | 1.053 | 13.05 | 9.57 | 73 |
| 136 | J W Van Alstino | Nickerson | Reno | " | Black loam | Nov 24 | 6 | Fair | 1.19 | .9 | 1.069 | 16.77 | 12.99 | 77 |
| 118 | J W Dix | Lerado | " | Apr. 10 | Sandy loam | " | 22 | Fair | 1.90 | 1.39 | 1.048 | 11.87 | 8.49 | 72 |
| 130 | J W Beauchamp | Plevna | " | " | Sandy black | " | 23 | Fair* | .78 | .53 | 1.073 | 17.08 | 14.08 | 83 |
| 29 | F H Fischer | Warwick | Republ. | May 30 | Black sandy | " | 4 | 0 | 1.81 | 1.34 | 1.060 | 14.70 | 10.75 | 73 |
| 75 | E G Havens | Belleville | " | " | " loam | " | 4 | 0 | 1.69 | 1.10 | 1.057 | 13.99 | 9.70 | 69 |
| 22 | A Comstock | Courland | " | Apr. 10 | Clay | " | 8 | Fair | 1.34 | .75 | 1.037 | 13.99 | 11.03 | 70 |
| 9 | W A Baird | Republ. | " | Apr. 20 | Sandy loam | Oct 30 | 2 | Good | 1.69 | 1.21 | 1.060 | 14.70 | 11.81 | 77 |
| 45 | W E Edgar | Saxman | " | May 6 | Clay loam | Nov 9 | 10 | Fair | 1.15 | .69 | 1.064 | 15.02 | 11.61 | 74 |
| 60 | J G Thompson | Storling | Republ. | " | Sandy | Nov 11 | 11 | Poor | 1.33 | 1.07 | 1.065 | 15.85 | 11.81 | 75 |
| 79 | H Pruetze | Munhattan | " | " | " loam | " | 17 | Fair | 2.53 | 1.79 | 1.050 | 12.35 | 8.20 | 68 |
| 105 | F D Randall | " | " | " | Rich upper bottom | " | 20 | Poor | 1.18 | .82 | 1.053 | 13.05 | 10.04 | 77 |
| 11 | G E Spahr | " | " | Apr. 10 | Sandy | Oct 30 | 11 | " | 1.47 | 1.07 | 1.071 | 17.22 | 13.29 | 78 |
| 40 | C C Smith | Woodston | " | June 15 | Black loam | Nov 8 | 10 | Fair | 1.13 | .87 | 1.068 | 16.08 | 13.49 | 89 |
| 52 | Mary E Wilkin | Bow Creek | " | Apr. 22 | Sandy loam | " | 11 | " | 1.69 | 1.25 | 1.063 | 15.59 | 11.88 | 77 |
| 73 | J P James | McCraon | Rush | May 20 | Black | " | 16 | 4 | 1.01 | .73 | 1.074 | 17.99 | 15.09 | 79 |
| 77 | J W Welch | Russell | " | " | Sandy | " | 16 | 4 | 1.00 | .68 | 1.063 | 15.39 | 11.52 | 79 |
| 76 | " | " | " | " | Clay loam | " | 19 | 8 | .79 | .75 | 1.062 | 15.16 | 9.87 | 65 |
| 100 | J C Ruppenthal | " | " | " | Black loam and limestone | " | 12 | " | 1.11 | .72 | 1.064 | 15.62 | 13.47 | 89 |
| 62 | J E Bailiff | " | " | " | Sandy loam | " | 20 | 6 | .46 | .58 | 1.062 | 21.93 | 18.10 | 82 |
| 155 | Jacob S Wolfe | Salina | Saline | " | Black | Dec 20 | 6 | Fair* | .88 | .58 | 1.057 | 13.99 | 9.93 | 71 |
| 144 | J H Lindsay | Peotone | Sedgwick | Apr. 15 | " | Nov 26 | 6 | Fair | 1.17 | .88 | 1.067 | 16.31 | 12.53 | 77 |
| 120 | S L Pope | Goddard | " | May 1 | New prairie | " | 22 | 8 | 1.38 | 1.06 | 1.067 | 16.31 | 12.59 | 76 |
| 67 | P H Butler | Silver Lake | Shawnee | " | Garden | " | 10 | Fair | 1.96 | 1.16 | 1.059 | 12.35 | 8.42 | 68 |
| 90 | John Frey | Monoken | " | " | Black loam | " | 18 | 10 | .87 | .68 | 1.074 | 17.99 | 15.77 | 88 |
| 96 | W J McColm | Waveland | " | " | " | " | 18 | 11 | 1.54 | 1.40 | 1.060 | 14.70 | 11.57 | 79 |
| 114 | J C Hoffeltz | Hoxie | Sheridan | " | Prairie loam | " | 20 | 10 | 2.00 | 1.57 | 1.061 | 14.93 | 11.61 | 78 |
| 115 | David Shafer | " | " | " | Sandy | " | 20 | 10 | | | | | | |

*Wilted.

Historical Document

Kansas Agricultural Experiment Station

| Serial number. | Name of grower. | Postoffice. | County. | Date of planting. | Kind of Soil. | Date of analysis. | Number of beets. | Form of beets. | Average weight in pounds. | | Specific gravity of juice. | Total solids in juice. | Cane sugar in juice. | Purity of juice. |
|----------------|-----------------|---------------|--------------|-------------------|---------------------------|-------------------|------------------|----------------|---------------------------|------|----------------------------|------------------------|----------------------|------------------|
| | | | | | | | | | Gross. | Net. | | | | |
| 7 | Thos L Keed. | Smith Center. | Smith | May 10 | Sandy loam. | Oct 28 | 10 | Poor | 2.33 | 1.76 | 1.058 | 14.28 | 11.12 | 78 |
| 141 | D. M. Adams. | Rome | Sumner | Apr 23 | Low upland. | Nov 26 | 7 | Fair | 1.53 | 1.11 | 1.073 | 17.08 | 13.38 | 70 |
| 71 | Jos Fields | Alma | Wabauunsee | May 2 | flott m land. | " | 16 | " | 1.82 | 1.63 | 1.061 | 14.93 | 11.84 | 76 |
| 80 | W B Bolton | Paxico | " | Apr 27 | Black | " | 17 | Good | 1.32 | .86 | 1.067 | 16.31 | 12.04 | 70 |
| 65 | L J Hedstrom | Macon | Wallace | May 26 | Prairie upland | " | 6 | " | 1.67 | 1.21 | 1.082 | 15.16 | 11.58 | 70 |
| 39 | J T Johnson | Palmer | Washington | " | Black loam | " | 10 | Poor | 1.71 | 1.11 | 1.039 | 14.46 | 11.00 | 77 |
| 38 | J C Ingman. | Barnes. | " | " | " | " | 10 | Fair | 1.91 | 1.25 | 1.056 | 13.76 | 10.13 | 74 |
| 19 | Chas Wurtz. | Strawberry | " | " | Upland | " | 9 | Bad | 5.23 | 3.23 | 1.050 | 12.35 | 8.48 | 60 |
| 18 | S Doughty. | " | " | May 15 | Sandy | " | 9 | Poor and good | 4.01 | 2.69 | 1.052 | 12.82 | 9.17 | 72 |
| 17 | " | " | " | " | Black loam | " | 9 | Fair | 2.05 | 1.42 | 1.054 | 13.20 | 10.17 | 77 |
| 16 | D A Kramer | Washington | " | " | Prairie gumbo | " | 10 | Fair to good | 1.18 | .84 | 1.061 | 14.93 | 11.60 | 77 |
| 15 | A M Dull | " | " | Apr 26 | Black loam; clay subsoil. | " | 10 | Good | 1.89 | 1.63 | 1.060 | 16.08 | 12.64 | 78 |
| 14 | J Q Adams. | Lynn | " | May 1 | Sandy loam. | Oct 30 | 11 | Fair | 2.45 | 1.66 | 1.035 | 13.52 | 10.37 | 76 |
| 6 | Omer Danitz. | Washington | " | Apr 25 | Heavy upland. | " | 10 | Good | 1.54 | 1.12 | 1.064 | 15.02 | 11.10 | 71 |
| 1 | N A J Martin | Palmet. | " | May 15 | Sandy loam. | " | 10 | Poor | 2.09 | 1.80 | 1.062 | 15.16 | 12.23 | 81 |
| 57 | J H Scott | Leoti. | Wichita | Apr 28 | " | Nov 11 | 6 | Fair | 1.08 | .96 | 1.058 | 14.23 | 11.24 | 70 |
| 102 | Milton Pratt | New Albany | Wilson | May 7 | " | " | 6 | " | .97 | .69 | 1.056 | 13.76 | 12.57 | 62 |
| 100 | W J Burris. | Fredonia. | " | " | Clay | " | 6 | " | 1.66 | 1.31 | 1.073 | 17.08 | 14.33 | 81 |
| 107 | W H Haller. | Roper | " | Apr 20 | Red upland. | " | 11 | Good | .88 | .70 | 1.069 | 16.77 | 14.38 | 83 |
| 121 | J E Taylor. | La Fontaine. | " | June 1 | " | " | 8 | Fair | .98 | .70 | 1.071 | 17.22 | 12.47 | 72 |
| 120 | H G Markle | New Albany | " | May 25 | Sandy loam. | " | 5 | Good | 1.18 | .94 | 1.064 | 15.02 | 11.73 | 76 |
| 148 | J H Bayer | Yates Centre. | Woodson. | June 15 | " upland. | " | 10 | Fair | .53 | .41 | 1.031 | 16.40 | 14.32 | 73 |
| 153 | S D Gratigny. | Loring | Wyandotte | May 15 | Sandy; limestone. | " | 4 | Good* | 1.35 | .89 | 1.078 | 18.81 | 14.11 | 75 |
| 161 | M T Long. | Alva | Woods, Okla. | " | Sandy loam. | Jan 10 | 6 | Poor. | 1.35 | .86 | 1.077 | 18.58 | 10.02 | 54 |

*Wilted.

The averages deduced from the preceding table are as follows:—

- Average gross weight 1.51 pounds.
- Average net weight 1.09 pounds.
- Average specific gravity of juice 1.064.
- Average total solids in the juice 15.52.
- Average percentage of sugar in the juice 11.88.
- Average coefficient of purity of the juice 76.1.

These figures do not mean much to one unacquainted with the question, unless compared with others. The average per cent of sugar found by us in 1891, when 147 samples were analyzed, was 10.54. This year's average is 1.24 per cent greater, and is about as good as the beets first supplied to factories in California. At present, however, the beets of California are much richer. At Chino during the last campaign the average amount of sugar for five months, and in over 50,000 tons of beets, was 14.6 per cent.

It can scarcely be doubted that with better culture the quality of the beets produced in this state might be considerably improved. It has been held that our summer temperature is too high to allow us to expect that very rich beets can be produced here, and it must be confessed that the results obtained so far do not do much toward dispelling this view. A study of the results obtained with beets from the different counties of the state, however, does not show that there is any tendency toward a poorer product in the southern sections. Some of the best beets were produced in southern parts of the state. I am inclined to the view that at present no conclusions can be drawn in respect to climatic influence.

In many instances the seed was planted too late to allow the beets to attain a good size before the summer drouth. The beet requires moisture in moderate amount for its growth, and drier weather for maturation, and sugar elaboration. It would seem then that we should endeavor in this state to start the crop early, so that the roots may be well-grown by midsummer. The beets of California are not infrequently grown without rain or irrigation after seed-planting, sufficient moisture being furnished by subterranean accumulations, and the progressive drying of the soil favoring richness in sugar. It is a matter of considerable doubt whether, with our liability to early drouth before beets will have had time for growth, we can hope to successfully establish the beet-sugar industry in this state. It is our belief that it is quite as important a function of the experiment station to guard

our people from unwise and disastrous ventures, as it is to point the way to successful ones. In our investigation of the state as a producer of beets therefore, truth only will be sought and published, believing that a temporary boom would result in much longer continued reaction. If we cannot produce sugar beets of high quality our farmers and capitalists want to be out of the beet sugar business; if we can, the industry should be encouraged by all legitimate means.

The advantages of sugar beet culture are various. It provides much labor for a given area of land, thus being adapted to the support of a congested population. Sugar contains carbon, hydrogen and oxygen only, elements which are obtained from the carbon dioxide, or carbonic acid gas, of the air, and water. It does not exhaust the soil. Beets contain other things than sugar, however, and are rich in ash. They require correspondingly rich soil, but these mineral substances may be almost wholly returned to the land upon which the beets grew by using the proper foresight. In the manufacture of beet sugar, the sugar is obtained by diffusion; a process in which the thinly sliced beets are treated with successive portions of hot, weak juice, or water, and their sugar extracted. The residue known as "pulp" is used in feeding, and may be preserved in silos for this purpose. The tops and leaves are also excellent for feed. If these by-products be thus utilized, and the manure produced returned to the land upon which the beets were grown, the soil will lose but little of its fertility. This conservation of soil fertility will be most marked if milch cows be the cattle fed, as their products, milk, butter and cheese, especially butter, remove the minimum quantity of ash from the farm. Beet culture, therefore, is well adapted to operate as an important factor in any agriculture that considers the permanent usefulness of the soil.

Beet culture, demanding as it does the most thorough preparation and cultivation of the soil, puts it into a condition of tilth which greatly increases the yield of other crops grown in rotation with the beets. It is asserted that in Germany the farmers now get as much of other crops in three years as formerly in four years, and have the year's crop of beets besides. The advantages of including beets in a regular rotation of crops are thus very great, and rotation of crops is one of the necessary features of intensive agriculture. It will be seen that sugar beets are properly a factor in only the highest type of agriculture. They have no

place in pioneer farming. They yield high returns to careful labor, but they demand it, and a satisfactory outcome need not be expected if they do not get it.

Kansas is in a transition stage. From dependence upon one or two staples, the Kansas farmer is gradually diversifying his crops so as to be less subject to extremes of scarcity with high prices, or abundance with low prices. The advantages of a diversified agriculture need not be enlarged upon here. With the manifest adaptability of sugar beets to this object, where they can be grown successfully, we should be quick to avail ourselves of them if we can; at the same time we should be slow to invest capital unless there exists a reasonable assurance of remunerative business. We need healthy growth of industrial enterprises, but no voting of bonds for expensive experiments. A beet sugar factory costs a great deal of money, and it requires much besides good beets for success. Cheap fuel, a great abundance of good water, cheap limestone and convenient markets are prominent essentials. To these must be added a hearty co-operation between the beet producers and the sugar manufacturers.

It is especially desired that the experiments to be conducted this season be under as favorable circumstances as possible. In addition to many growers of small plats we desire a few, representing the several regions of the state, and cultivating typical soils therein, who will undertake to grow one-half acre or more under definite conditions. It is believed that the crop will amply repay anyone for its production, as the beets are a very superior feed for milch cows.

It seems wise to include in this bulletin the directions for growing sugar beets which will be sent to all having seed from us this year. It is requested that none apply for seed who do not expect to follow directions essentially as subjoined. Applications for seed should be made at once; they will be filed as received, and the seed sent as soon as possible.

DIRECTIONS FOR GROWING SUGAR BEETS.

The following directions are based upon our own experience combined with careful study of the methods in use for producing beets for sugar manufacture in Nebraska, Utah and California. A correct judgment in regard to the adaptability of our state to the production of beets suitable for sugar-making cannot be made unless the beets are grown under proper conditions. It is urgently requested, therefore, that these directions be closely followed.

PREPARATION OF THE SOIL. If soil deeply plowed last fall, and suitable otherwise is available, use that. It is necessary that the soil be readily penetrable by the growing beet to a depth of ten or twelve inches. If the soil has not hitherto been plowed to that depth, plow an inch or two deeper than before and loosen the subsoil in each furrow by a subsoil plow or spade. Two rods square well prepared will be of more service than more improperly prepared. The soil must be in perfect tilth, well pulverized by repeated disking and harrowing, and as free of weed seeds as practicable. Soil that runs together and packs with rain is not suitable. Throughout the growth of the beet the soil must be permeable to the air and this should be in mind in selecting it. The soil must not be handled when too wet or too dry, it should have been under cultivation at least two years, and must have no stable manure applied this spring.

PLANTING. Just previous to planting, the final harrowing of the soil should be given so as to kill all weeds that may have started. It is well to roll the ground then. Plant by hand or with a seed-drill in rows from 16 to 18 inches apart. The seed should not be covered deeper than one inch, and the soil above the seed must be well firmed by the press wheel of the drill or otherwise. Most failures to secure good germination are due to leaving the surface so loose as to dry out. Beet seed must be planted shallow but must have moisture. If planted by hand, the seed may be dropped three or four together at the intervals desired for the beets. This almost insures an even stand. About 20 pounds of seed per acre is required in field planting. The time of planting varies with the latitude and the season, but should be about the same as early corn-planting, so that the plants may be well grown before the summer drouths. If we obtain the seed in time we desire to have it in your hands before the first of April.

THINNING. When the beets have four leaves they must be thinned. If left more than a week longer the roots of the plants left are injured in pulling out the others. The distance apart that the plants should be left depends upon the richness of the soil,—the richer the soil, the closer they may be grown. Six to ten inches will include all cases, and with most of our soils seven or eight inches is about right. It must be borne in mind that the mature beets are to be of about two pounds weight and that very large size is not desirable. Where the beets have been sown uniformly throughout the row, thinning is begun by “bunching”

the plants by means of a narrow-bladed hoe, with which the beets are cut out entirely excepting bunches of three or four at the proper intervals for the mature beets. The bunches are thinned by hand, leaving the strongest plant, and at the same time pulling up any weeds near it.

CULTIVATION. In cultivation, the conditions to be met are perfect freedom from weeds, looseness of soil, and guarding against injury to the leaves or roots of the beets. If the ground becomes crusted by heavy rain before the beets are up, it should be hoed, following the marks left in firming the soil; otherwise a first shallow hoeing should be given as soon as the beets break through. A second hoeing must follow the thinning; this should be to a depth of three inches. Similar hoeings will be necessary later. The space between the rows may be cleaned with a suitable cultivator, but loosening the soil between the plants in the rows will require the hoe.

IRRIGATION. For such as are able to try the growth of beets by irrigation, a few words based upon information kindly furnished by Mr. George Austin, Agricultural Superintendent for the Utah Sugar Company, Lehi, Utah, may not be amiss. Beets should not be watered too freely. Let them suffer a few days before irrigating. The water must be applied by means of little furrows made by a six inch furrower attached to the rear of the cultivator, taking care not to flood the ground. Unless the soil has considerable slope, or is very sandy, watering in alternate rows is sufficient. The second time, the water is run down the rows left without water the first time. Cultivate as soon as practicable after each irrigation, to a depth of five or six inches. Two to four irrigations are given during the season in Utah, the last one three or four weeks before harvesting.

TAKING AND FORWARDING SAMPLES. Directions for this will be sent in due time to all taking part in this test, and the beets are to be left in the ground until such directions are received. Some of the beets will be called for early, others quite late. Inquiries at any time will be gladly received and promptly attended to.

GENERAL. It is recommended that in localities possessing a considerable area of similar soil, and otherwise favorably situated for sugar manufacture, a number of farmers unite in a co-operative experiment. Their samples of beets can be sent us together by freight at a minimum expense, and larger samples thus supplied than is practicable by mail. In other cases we expect to be able

to furnish penalty tags allowing free transmission of the samples by mail. Applications for seed to be used substantially as directed above will be filed as received, and seed sent as soon as possible after we receive it ourselves. Be careful to write name and address very distinctly. Address all applications for seed and communications concerning the experiment, to J. T. WILLARD, Chemist of the Experiment Station, Manhattan, Kansas.

Growers will be asked to report as fully as may be upon the following points which should be in view from the start:—

Kind of soil.

Preparation of soil, in full.

Date of planting.

Distance between rows.

Mode of planting.

Depth planted.

Time required to come up.

Date of thinning.

Distance between plants. On this point one is liable to be deceived unless some actual measurements are made.

Cultivation, in detail.

Yield of a measured area.

Obstacles to success.

General character of the season. An accurate record of the rainfall showing date and amount would be very valuable. A tall two-quart tin fruit-can with the upper rim melted off will answer every purpose as a rain-gauge. This should be firmly set in an open space remote from trees or buildings.

SUMMARY OF BULLETIN.

Beet seed furnished by the U. S. Department of Agriculture was distributed to 393 farmers. Samples of the beets produced were received from 156. Reports were received from 104 who had no beets to send, while 133 were never heard from.

The chief obstacles reported as interfering with success were drouth, poor germination, and insect pests of various kinds, grasshoppers and potato bugs being the worst. As others reported perfect germination, the poor germination could not have been due to poor seed.

The average results obtained were as follows:—Gross weight, 1.51 lb.; net weight, 1.09 lb.; specific gravity of juice, 1.064; total solids in juice, 15.52; percentage of sugar in the juice, 11.88; coefficient of purity, 76.1.

The results obtained are better than those of 1891, when a similar test was made, in which the average percentage of sugar in the juice was 10.54. There seems to be no connection disclosed between latitude and quality of beets. The belief is expressed that with proper culture the average richness of the beets may be materially raised.

The advantages of a successful beet-sugar industry in our midst are fully recognized, but local natural limitations must not be lost sight of. Farmers and others should not be hasty in making large investments of capital until further investigation and careful consideration of the question from an agricultural, business and scientific point of view makes success reasonably certain.

Plans for continuing the experiment in 1898 are outlined and the co-operation of the citizens of Kansas solicited.

NOTICE .

The bulletins of 1898 will include full reports of all completed experiments, and will not be reprinted with the annual report of the Station. They will be paged consecutively, beginning with No. 76, and a complete index will be furnished at the close of the year, to enable all who preserve them to bind in a single volume.

The bulletins and annual reports of this Station will be sent free to residents of Kansas, on application to the Secretary of the Experiment Station, Manhattan, Kansas.

Published by order of the Council.

I. D. GRAHAM. Secretary.