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OUR RUSTED AND BLIGHTED WHEAT, OATS AND BARLEY IN 1890.

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In 1888 we sowed many kinds of oats, wheat, and barley, but all of them were so much injured by rust, that they were scarcely worth harvesting. In 1889 we sowed them again, and a considerable number of them proved productive, and showed no signs of disease; while others suffered severely from rust, although the growing season was much more favorable for such crops than the preceding one. In 1890 we discarded certain varieties which had proved unreliable and procured others that were promising. On the 26th day of last March, the following kinds of oats were sown broadcast on ground which had produced eighty bushels of shelled corn per acre in 1889, viz: Hargett's White Seizure, Carter's Prize Cluster, Station Prize Cluster, Pringle's Progress, Prince Edward's Island, American Beauty, Everett's Scottish Chief, Black Russian, White Russian, Black Prolific, Black Tartarian, Salzer's White Wonder, White Australian, American Banner, Wide Awake, Race Horse, Badger Queen, White Victoria, Henderson's Clydesdale, White Bonanza, Centennial, Currie's Prize Cluster, Welcome, Wilson's Prolific side oats, Baltic Oats, Giant Yellow French, Lackawana, Golden Giant side oats, Everett side oats, and Improved American Oats. The ground was divided into six long plats by lines running from the east end of the field towards the west, and the plats were numbered from the north to the south side as follows: 1, 2, 3, 4, 5, and 6. All of the plats were plowed six inches deep, except plat 3 which was not plowed at all. The plowing of plats, 1, 5 and 6 was done in the fall of 1889, and plats 2 and 4 were plowed on the 25th day of last March. No crops had ever been grown on plats

1, 2, 3, 4, and 5, except the crop of corn to which I referred above; while plat 6 was a part of an old field to which no manure had been applied for five years. Each of the varieties were sown across all of the plats at the rate of two bushels per acre. Then the oats on plat 3 were covered (cultivated in) with an Albion spring tooth cultivator, and all of the plats were well harrowed and rolled. On March 26th, 27th, and 28th spring wheat and barley were sown broad cast on plats adjoining the experimental oat ground, which were treated in every respect like it, except that all of them were plowed last fall. The kinds of wheat were as follows: Campbell's White Chaff, Ladoga, Saxonka, White Russian, Saskatchewan, Wellman Fife, Black Sea, Velvet Chaff Blue Stem, and French Hybrid. The varieties of barley were as follows: California Prolific, Saala, English Malting, Prize Prolific, Imperial, Highland Chief, Black, and Manshury. On April 17th, when many shiftless Iowa farmers were still sowing oats, we seeded three plats as described above, with Salzer's White Bonanza, Salzer's White Wonder and Black Prolific oats. No less than one peck of each of the cereals named above was sown, and on each of a majority of the plats, two bushels were used. From the time that our oats, spring wheat, and barley were sown until the latest of them were ripe, the rain fall at Ames was as follows: April 2.10 inches; May 4.60 inches; June 5.65 inches, and July 1.90 inches. The heaviest rains between seed time and harvest, occurred on the last days of May and early in June. April and May were unusually cold months; but during June and July the average temperature was several degrees above normal, except the fourth and fifth days of the latter month, which were much too cold for corn. On many of the hottest days of June and July, there were high drying winds, from the south and southwest, which were very unfavorable to all kinds of crops. All of the kinds of oats, spring wheat, and barley on our grounds were very promising, from the time that they came up, until about the 20th of June, when some of them began to show rust, which increased from day to day, and appeared to spread from variety to variety, until all of them were effected more or less by it. On July 5th, all of the spring wheats were more or less blighted, except the French Hybrid. On July 12th, there were but few heads of Campbell's White Chaff, Ladoga, Saxonka, Black Sea, White Russian, Saskatchewan, and Wellman Fife wheats, which were not blighted, and they were badly rusted; while the

French Hybrid was healthy and the (Velvet Chaff Blue Stem) was suffering but little from rust and blight.

All of the different kinds of barley were ruined by rust and blight except the Manshury, which produced a good crop, (estimated at forty bushels per acre.) It is a strong healthy six rowed variety, which ripens so early that it generally escapes severe attacks of rust. It was harvested July 3d. The other varieties of spring wheat, oats and barley, were harvested July 12th and 15th; but they were so nearly worthless, that none of them were bound in sheaves or saved for seed, except the French Hybrid and Velvet Chaff Blue Stem wheats, and the Improved American, Everett (side oats), Giant Yellow French, (side oats) and Lackawana. I will try the latter again; because it is early and not so much inclined to rust as many others. The three varieties of oats which were sown on April 17th, did not stool well, and they were rusted so early and badly, that but few of their stalks were able to show seed heads. Each of the varieties of oats produced the weakest straw and were rusted most on plats 2 and 4, which were plowed last spring. They were a little stronger and not quite so much injured by rust on plats 1 and 5, which were plowed last fall, and still better on plat 6 (the old ground) which was plowed last fall; but all of the varieties were strongest and rusted least on plat 3, which was cultivated in without being plowed. On July 12th, I examined oat fields carefully on twenty four farms in Story county, and found all of them more or less rusted; but the best oats were found where the seeding was done very early last spring in unplowed corn stalk fields with two horse cultivators. Last fall I sowed seven varieties of winter wheat broad-cast in a corn field, where no weeds had been allowed to grow. The wheat was covered with a five tooth cultivator and a common hoe. The names of the different kinds of wheat were as follows: Turkish wheat, Golden Cross, Red Fultz, Ontario, New Monarch, Fulcaster and Deitz Longberry. The seeding of the first named variety was done September 4th, and all of the other kinds were sowed ten days later. The Turkish wheat stooled well and covered the ground; while the later seeding of the other kinds prevented their stooling so well. The Turkish and Golden Cross wheats came through the winter in excellent condition; but in many places the other kinds showed signs of injuries on account of a lack of protection. No rust appeared on the winter wheats until about the 28th day of June, when they were so nearly ripe

that it injured them but little. They were harvested on July 3d, when I estimated the yield of the Turkish wheat at twenty four, the Golden Cross at twenty, and the other kinds at from twelve to fifteen bushels per acre. It is well known that certain kinds of oats, barley, and spring and winter wheats are more liable to suffer from attacks of rust and blight than others. For the purpose of determining what varieties are most productive, least liable to suffer from rust, or to be blown down and injured by storms; we have grown a large number of kinds of oats, wheat and barley, where they were exposed to the same and very different surrounding conditions for three years. From such experiments on the college farm, and many others which I have conducted on my own farm during the last twenty five years, I have drawn conclusions which I will give below with the facts on which they are based. From 1850 until 1870, oats and spring wheat were injured but little by fungous diseases or insects, and it was but seldom that they did not produce good crops; but from the latter date until now, they have been unreliable and unprofitable. The average yield of oats in Iowa for the last ten years has been thirty three bushels per acre and the average price has not exceeded twenty cents per bushel, which would give the farmers $6.60 for the product of each acre. But the general rule in all parts of the state has been for renters to give one third of the oats after being threshed for the use of land, which would leave only $4.40 per acre for plowing, seed oats, seeding, harvesting, stacking, and threshing. As spring wheat has not paid any better than oats, it is not remarkable that many farms are mortgaged and that many farmers are complaining of hard times.

Last year was a good year for oats and we recommended the Everett, Salzer's White Bonanza, and Prize Cluster; because they were healthy and very productive. But this year the last two kinds named were not worth harvesting on account of rust. As the summer of 1890 was a remarkably good "test summer" for oats. I would condemn all of the thirty varieties named on the first page of this bulletin, on account of their being very susceptible to severe attacks of rust, except the Everett and Improved American. On our grounds the two kinds which I have just named, were strong, productive, and comparatively free from disease when they were harvested. Last year we recommended the Saskatchewan and Velvet Chaff Blue Stem wheats as very promising; but this year the former was destroyed by rust and blight, and

the latter was severely injured. All of the other kinds of spring wheat were worthless, except the French Hybrid, which resisted the attacks of rust and blight successfully until it was nearly ripe and it produced a fair crop. Until about 1870, the average of the crops of oats and spring wheat in Iowa was good; but rusted oats and spring wheat, has been the rule for the last twenty years on account of unfavorable climatic conditions. Oats is one of our favorite crops and the farmers cling to it, because they expect more favorable seasons in the future. Is it wise to do so? is a question which I will endeavor to answer. That the climate in many parts of Europe and Asia has been modified by man is well authenticated. In many parts of the old world where the forests have been destroyed, large rivers shrink during the summer seasons until they become no larger than creeks, but rise during the spring seasons until they are broad rushing torrents. Large factories in Switzerland, the machinery of which was propelled by water during the entire year, have been rendered useless by the felling of bodies of timber near them, and a consequent shrinkage of the streams. When water on the surfaces of lakes, rivers, the earth, etc. is heated by the sun, it rises in the form of vapor and is carried by the winds until it comes in contact with something which is cold enough to condense it, when it falls to the surface of the earth as rain. The trees of a forest shade the ground and prevent it from becoming heated by the sun. In woods, the leaf mould which is a poor conductor of heat, absorbs water readily and holds it almost as well as the moss which nursery men and florists use when they are packing trees or plants for shipment. Careful experiments have shown that only one fifth as much water is evaporated from a vessel in a forest, as from vessels on bare ground outside of them. During the summer seasons, trees absorb large quantities of water from the cold sub-soil which they exhale through their leaves into the air.

Therefore we can see clearly that by the shading of the soil; by the effects of leaf mould in a forest, and by the exhaling of large quantities of water from the cold sub-soil through the leaves, that the conditions must necessarily be very favorable for the condensation of atmospheric moisture in, over and near forests frequently. I say frequently, because we should not forget that the height to which vapors rise in the atmosphere is dependent entirely upon temperature. Let us compare the conditions of the forests which do cause rains

by condensing the vapors of the atmosphere during the summer seasons with the conditions of our prairies, both before and after they were broken by the plow. Only a few years ago, the greater part of Iowa was covered by wild prairie grasses, but at the present time nearly all of the state is under cultivation. When first broken, the surface soils appeared to be masses of vegetable mould and living and dead grass roots in which could be traced innumerable old root spaces. This loamy vegetable mould on the prairies was from two to four feet deep, and consisted of little clods, varying in size from an eighth to a sixtieth part of an inch in diameter. The very numerous grass roots; tubular root spaces, and interstices between the little clods, rendered the soil so porous that rains and atmospheric air entered it readily. Thirty years ago most of the sloughs were so wet that it was difficult to cross them with teams until after mid-summer. By the middle of June, the prairies were covered with a dense growth of grasses, which shaded them and kept the soils so cool and moist, that the vapors of the atmosphere were condensed in them, and we did not suffer from a want of rains, except once-in-awhile during the autumn seasons. But the conditions of our soils are very different now from the conditions which I have just described. By breaking up the prairies and stirring the soil frequently, we destroyed the innumerable little clods, grass roots, and root spaces, which formed a sufficient number of channels for the free admission of water and air. Instead of being shaded by a thick growth of grass as it was formerly, a very large share of the state consists now of bare hard pastures, which are constantly absorbing the heat of the sun, during the day time, to drive out the limited supplies of moisture which they do contain. When well shaded by deep rooting grasses, soils exhale water slowly, but when they are bare, hard, and hot as our pastures and timothy meadows are frequently during the summer seasons, they evaporate the water which does find its way into them rapidly. When rains do come, it is difficult for them to penetrate such soils, and the result is, that a large part of the water runs off over the surface of the ground to the creeks and is lost. Frequently when we have had good rains after severe drouths, I have found the soil thoroughly wet to the depth of twelve inches in clover and buckwheat fields, when the soils in old pasture fields and timothy meadows were not wet deeper than three inches. Very often the atmosphere is very moist, but we get no rain, because the

moisture does not come in contact with any thing which is cold enough to condense it. At such times large bodies of timber or great tracts of land covered with dense growths of deep rooting grasses, would cause an abundance of rain. It is useless for us to talk about planting forests to increase the rainfall, but if a majority of the farmers of Iowa and the adjoining states, would sow clover on a large scale and plant belts of forest trees to break the force of the winds, we would grow much better crops of wheat, oats, barley, etc., than we have grown during the last twenty years. We should not forget, that wheat, oats, barley, etc., are never injured by rust, where there are no great extremes of summer temperature and no severe spells of drouth.

Clover (if it was sown in sufficient quantities) would not only cause our soils to be much more moist than they are now, but it would increase their fertility, and its roots would improve their mechanical condition. Clover should be sown not only for what it would do for our climate and other crops, but because there is more money in it than in any other crop which can be grown successfully in Iowa, except corn. Why not make clover one of our principal crops, instead of oats, which have failed oftener than they have proved profitable, on account of unfavorable climatic conditions. And why not substitute Manshury barley for oats? It is comparatively free from rust and blight in Iowa. It is very productive, has good strong straw, yields more dollars worth of digestible nutrients per acre in all kinds of seasons than oats, and as a nurse crop for clover, it is much better than oats or sprtng wheat. Although timothy, clover, oats, barley, corn, and rye, are very common crops in Iowa, yet there are but few farmers who have tried to determine the difference between the feeding values of an average acre of oats and an average acre of any of the other crops which I have named. All of them are sufficiently palatable when in good condition; but some of them are not well adapted to our climate, and from equal areas of land some of them will produce much more and much better food for the domestic animals than others. From many carefully conducted feeding experiments in Germany, Dr. Wolff estimated that a fair price for one pound of each of the digestible nutrients of the fodder plants and feed stuffs of that country is as follows: 4⅓ cents per pound for albuminoids, 0.9 cents per pound for carbohydrates, and 4⅓ cents per pound for vegetable fats. From a careful study of the market prices of farm products, and fat cattle and hogs

in the west for the last five years, and from my own experience in feeding animals, I find that Dr. Wolff's prices are too high for this country, and that for Iowa the average prices for a term of years would be about as follows: digestible albuminoids 3.343 cents per pound, carbohydrates 0.6 cents per pound and fats 3.343 cents per pound. I have cut the price of carbohydrates more than the prices of albuminoids and fats, because there is a greater surplus of the carbohydrates in Iowa than in Germany. This greater surplus is found in the hulls of our shriveled oats, in our corn, corn stalks, timothy hay, wild hay, and straw stacks. Many millions of tons of digestible carbohydrates in our corn stalks and straw stacks are wasted every year because they are considered comparatively worthless. In table number two of our station bulletin number nine I gave the number of pounds of digestible albuminoids, carbohydrates and fat in one ton of each of the common grasses, fodder plants, and feed-stuffs which are used in Iowa. By using this table and the prices per pound which I have named above for albuminoids, carbohydrates, and fat, it will not be hard to find the value of a ton, or bushel or the product of an acre of oats, or any of the other feed-stuffs which are named in the table. The reports of the secretary of the Iowa Agricultural Society show that the average yields in Iowa of the crops named below for the seven years preceding 1889, were as follows: oats thirty three bushels; barley twenty three and one-half bushels; rye sixteen bushels, and corn thirty three and one-fourth bushels. The number of bushels in one ton of each of the cereals named above are as follows: oats 62½; barley 41.66; rye 35 5-7 and shelled corn 35 5-7. By using the table to which I referred above, we would find that in each bushel of oats there are albuminoids 2.88 pounds, carbohydrates 13.85 pounds, and fat 1.5 pounds, and in thirty three bushels (the average product per acre in Iowa) we would have albuminoids 95 pounds, carbohydrates 457 pounds, and fat 49.5 pounds. By multiplying the pounds of albuminoids and fat by 3.343 cents (our price per pound) and the pounds of carbohydrates by 0.6 (our price per pound), we would find that the value of an average acre of oats in Iowa is $7.57, or 22.94 cents per bushel. By similar figuring we would find that the values of the products of average acres of other crops would be as follows: barley $7.63 per acre, or 32½ cents per bushel, rye $6.94, or 43⅓ cents per bushel, and corn (shelled) $15.00 per acre, or 45 cents per bushel. At

the prices which we have fixed for the digestible nutrients of grain, hay, etc.; two tons of clover hay, which is about the average product of one acre, would be worth $22.11 or $11.05½ per ton, and an average crop of timothy, (1½ tons) would be worth $12.13 or $8.08 per ton. The different kinds of grain, grass, hay, fodder, etc., are used not only to cause growth and replace the wastes which are taking place constantly in living animals; but also for the production of fat, milk, wool, etc. Therefore, it is easy to see that much discretion should be used in purchasing feed-stuffs and in the growing of crops for different purposes, as a bushel of corn is worth 45 cents for fattening mature hogs or cattle; while it would be worth much less for growing pigs or calves. Again, good timothy hay would be worth $8.08 per ton for fully grown horses or cattle at rest; while good clover hay at $11.05½ per ton, would be much cheaper for the production of milk or muscular growth.

Such facts do not receive the attention which their importance demands. To make money hereafter by farming, brain work will be fully as necessary as manual labor. Men of ordinary ability can pass muster as doctors or preachers without special study or training if they have "cheek;" but the climate and soils of Iowa will not respond favorably to the calls of farmers who do not have higher qualifications

Summary.

From the frequent partial failures of our oat crops on account of rust, and the rapid deterioration of good varieties which we have imported from the best oat countries, we can draw no other conclusion than that Iowa is not a good oat state. The results of our experiments have proved conclusively—1st. That if we shall continue to grow oats, they should be sown as early in the spring as it is possible to cover them with cultivators, harrows or seed drills; that the seed bed should be comparatively hard or compact, (except one or two inches of soil on its surface), and that only such varieties as the Everett or the Improved American should be used for seed.

2d. That no other kind of barley is as valuable as the Manshury; that it shonld be sown very early also, and that it is much more reliable and profitable than any variety of oats.

3d. That all varieties of spring wheat are unreliable in Iowa, and should be discarded on account of their liability to attacks of rust.

We cannot speak positively in regard to winter wheat; but the results of our experiments indicate, that the hardiest varieties may be grown successfully on well drained soils if they are mulched sufficiently to prevent the ground from thawing during the first warm spells in the spring. There is no better mulch than a dense growth of wheat blades, which can be secured generally, by sowing wheat about the first of September in the northern half of the state, and a little later farther south. The Turkish and Golden Corss are the most reliable varieties of winter wheat which we have tested.