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***FARM DEPARTMENT.***

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***SPONTANEOUS COMBUSTION OF ALFALFA.***

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THERE were many instances during the summer of 1901 of alfalfa hay becoming so hot that it took fire by spontaneous combustion and was destroyed. Six examples will give an idea of the conditions under which spontaneous combustion took place.

O. L. Hull, Manhattan, Kan., cut 100 acres of alfalfa, beginning the cutting May 19, when the first bloom appeared. The alfalfa was on river-bottom land and had made a heavy growth. The cut alfalfa was left in the swath about three days, when it was put in windrows with a side-delivery rake. It was left for about three days on an average in the windrows, when it was gathered by a hay-loader and stacked. The alfalfa was so heavy that the tops of the windrows got too dry and the leaves shattered considerably, while the bottoms of the windrows were too green to be in good condition for stacking. The entire first cutting from the 100 acres was put in one stack, and was estimated to be 150 tons. The stack settled more than usual and became very hot, but was not thought to be sufficiently hot to be in danger. July 9 fourteen loads of alfalfa hay from the second cutting from the same field were placed on the stack, to fill out where it had settled. This made 164 tons of hay in the stack. At one A. M. July 10, fifty-two days after the first cutting was made, a neighbor noticed a small fire on the stack that appeared like a locomotive headlight.

An alarm was immediately given, but in a few minutes the entire outside of the stack was in flames, and all of the 164 tons were burned.

Emmet McDonald, Manhattan, Kan., made his first cutting of alfalfa the last week in May. The growth of alfalfa was rank, and it was cut the when the first blooms appeared. Cutting began Friday; the cut alfalfa was raked into windrows Saturday with a side-delivery rake, where it stayed until Tuesday, when stacking began. The hay was taken from the windrows with a hay-loader, and twenty-five to thirty tons put in a stack. The hay was so dry that the leaves shattered off considerably and, at the time of stacking, it was considered that the stems were also well cured. Early in July it was noticed that the hay was quite hot and the stacks were examined frequently. Mr. McDonald reports that the alfalfa took "spells" of being hot. It would be quite hot for about a week, then cooler for a few days, and then hot again. On the morning of July 25 one stack was so hot that it was thought unsafe to leave it longer, as other stacks stood near it, and work was started to tear the stack down and take it away. After a few feet were taken from the top of the stack the hay was found to be dry and charred, and so hot that water hissed when thrown on it. The stems held their shape, but were apparently thoroughly charred. The exposed hay was too hot to handle, and it was well wet down and left to see what would follow. In about three hours a blaze broke out of the side of the stack about four feet from the ground and the stack was consumed. Another stack from the same cutting did not burn, but the interior of the stack was found to be well charred.

J. L. McCormick, Zeandale, Kan., had alfalfa hay on rich bottom land. It made a rank growth, and was cut late in May, when the first blooms appeared. It lay in the swath about one and a half days, when it was put in windrows with a side-delivery rake. After curing in the windrows one to two days the alfalfa was gathered on wagons with a hay-loader, and placed in the stack with a stacker. The stack was built thirty feet wide, thirty feet high, and of a sufficient length to hold 150 tons. Two months and a half after stacking fire broke out. The stack settled badly in the middle, and two or three weeks before fire broke out several loads from the second cutting of alfalfa were placed on the top of the stack, to fill out where settling had taken place. At that time the stack was quite hot and the smell of heating alfalfa was strong, but no danger was anticipated. The hay kept getting hotter and it was decided to take the stack down and save as much hay as possible. One end was taken off safely. After the top of the stack near the middle had been taken off for several feet, the hay was so hot that men could no longer stay on the stack. A few minutes afterward smoke burst out at the ground all along the stack.

Men cut two feet into the side of the stack, and a blaze started. This was kept smothered with water until fifty tons of the hay had been taken away, when the fire could no longer be controlled, and what hay remained was burned.

George Washington, Manhattan, Kan., had a rank growth of alfalfa. It was cut early in June, when half in bloom, and burned in August. The cut alfalfa lay in the swath one to one and a half days, when it was gathered in windrows with a side-delivery rake. It was allowed to remain in the swath until apparently well cured, when it was stacked, 150 tons being put in a stack. The stack settled badly in the middle and smelled hot for quite a while before it burned. Two or three days before the fire broke out a boy went on top the stack where it had settled the most, and taking a pole started to force it down through the center of the stack. The pole went through two or three feet of hay and then dropped down, the entire center of the stack apparently being burned out. Fire broke out all along the top of the stack and no hay was saved.

W. D. Poole, Briggs, Kan., cut alfalfa May 20, when about one-fifth had come in bloom. The alfalfa was on bottom land and had made a rank growth. It was left in the swath half a day, gathered in windrows with a side-delivery rake, left in the windrows two days, loaded on wagons with a hay-loader, and unloaded with a horse fork. Twenty tons were put in the stack. June 25 the second crop was cut, and six tons put on top of the stack. Early in July it was noticed that the stack was heating badly. August 2 the stack became so hot that fire burst out and it was entirely burned. It began to burn about one o'clock in the afternoon.

T. W. Andrews, Rossville, Kan., had alfalfa on river-bottom land where it made a very rank growth. It was cut the latter part of May, just as it was coming into bloom. It was put in windrows with a side-delivery rake, and left in the swath until considered well cured. It was put on wagons with a hay-loader and taken from the wagon to the mow with a horse fork. Two hundred and fifty tons of alfalfa hay were stacked in a hay shed, the sides of the shed being boarded down from the roof for a distance of four feet. In the north end of the shed there was one bent filled with the previous year's cutting of alfalfa. The storing of the new crop was begun next to the old hay. July 24 a load of alfalfa was taken out of the south end of the shed. The men had finished loading but had not yet driven from the shed when smoke burst out along the line where the new alfalfa hay joined the old. In a few minutes a blaze followed and the shed and all the hay it contained were destroyed. For a week or more before the fire

broke out the smell of heating alfalfa was strong. Mr. Andrews is not certain that the fire was caused by spontaneous combustion, but all the facts in the case indicate that it was.

*Conditions for Spontaneous Combustion.*

All cases of spontaneous combustion of alfalfa hay that have come to our notice have occurred with the first cutting. Early spring growth of alfalfa in an ordinary season is rank. The alfalfa is cut either in May or early in June, and at this time of the year the weather is such that it is difficult to thoroughly cure the alfalfa without getting it wet. Usually there is considerable damp weather and little wind after the first cutting is put in the mow or stack, and this hinders further drying. With later cuttings the growth is not so rank and succulent, and the weather is dryer, and there is often wind. This makes curing easy.

At this Station we have not had alfalfa heat sufficiently to take fire, but we have had it become so hot that, as a matter of safety, we took it out of the barn several weeks after putting it in the mow and stacked it outdoors. We have had so much trouble with the first crop heating, that for the past four years we have stacked it outdoors, and put the other cuttings in the barn. We have cured the first cutting as carefully as we knew how, keeping it several days in cocks, putting covers on the cocks at night, and opening the cocks during the daytime; and with all these precautions, if there came a week or more of wet, "muggy" weather in July or August, the alfalfa hay would become hot. If the weather stayed dry no heating took place. The College barn is of stone, and is well ventilated at the roof above the mows. In all cases of spontaneous combustion given in this bulletin the alfalfa was handled as little as possible, and was turned but little. This resulted in the leaves becoming dry, while the stalks contained considerable moisture. Where weather conditions were favorable, this moisture in the stems was sufficient to promote fermentation, and in the cases given the fermentation generated sufficient heat to start a fire. Usually alfalfa will not get hot enough to do this, and the heating causes little damage. It is quite common to find alfalfa hay from the first cutting that is brown or black from heating, and the cattle eat it with relish.

*When to Cut Alfalfa.*

Alfalfa should be cut when not more than one-tenth of the plants have come in bloom. Cut at this early stage, the yield of hay for the season will be much greater than if the alfalfa is cut near maturity, and every pound of hay secured will be worth more for feed.

At the Kansas Experiment Station, a strip through a field of alfalfa

was cut when one-tenth was in bloom, another strip was cut after full bloom had passed. The strip cut early was nearly ready to cut the second time when that cut after full bloom was being harvested the first time. The strip cut early grew vigorously through the season and made three cuttings and a good aftermath. The strip cut after full bloom gave a low yield the first cutting and did not grow sufficiently to yield a good second cutting. Early cuttings invigorate the plant.

The late cutting of the first crop injures the plant more than at any other time, and we have found it profitable to cut alfalfa the first time as soon as one-tenth was in bloom, even though the weather was bad and we knew that the crop would spoil in curing. The increased yield from succeeding cuttings over that cut late much more than makes up for the loss of the first crop.

#### *How to Cure Alfalfa.*

The leaves of alfalfa contain more than three times as much protein as the stems, a ton of alfalfa leaves containing as much protein as 2800 pounds of bran. Protein is the material in feed necessary for the formation of blood, lean meat, and milk. Every effort, then, should be made to cure the alfalfa in such a way as to save all the leaves possible. The method of curing will vary with the condition of the crop, ground, and weather. When alfalfa has made a slow growth, and at the time of cutting the ground and the weather are dry, there is no difficulty in curing. Often, under these conditions, it is safe to rake within a few hours after mowing, and stack a few hours after the alfalfa has been put in the windrows.

When alfalfa has made a rapid growth, and is rank and succulent, and the weather and ground are damp, the problem of curing is a difficult one. It is easy to dry the leaves, but the stems will contain much moisture after the leaves are too dry. Alfalfa hay should become so dry before stacking that when a handful of stems are tightly twisted together no water can be squeezed out. The most practical way to accomplish this, and at the same time save the leaves, is the plan to adopt, and this will vary with different seasons and places.

There is practically no difficulty in curing any but the first crop. When the conditions for curing the first crop are unfavorable, we have usually found the most practicable method to be to cut the alfalfa in the morning, after the dew is off, allow it to barely wilt in the swath, then rake, and before night put in narrow, tall cocks. After the dew is off the next morning and the surface of the ground has become dry, we open these cocks carefully, so as not to shatter off the leaves. If the weather is favorable the hay may be stacked in the afternoon; if not, we recock carefully, and repeat treatment until the hay is properly cured.

Some alfalfa-growers, in stacking the first cutting of alfalfa, put alfalfa and dry straw or prairie hay in alternate layers. This is a satisfactory way if the dry material is available. Others use ten to fifteen pounds of salt or air-slaked lime for each ton of hay, sprinkling the salt or lime so as to cover as much of each load as possible. Experiments made at this Station indicate that considerably less gains are made by cattle when salt is mixed with the feed. A trial of lime on alfalfa, made at this Station, showed little effect. From all the experience we have gained to date, we advise that the best way to prevent spontaneous combustion of alfalfa is to thoroughly cure before stacking. It is not often that all the conditions necessary to produce spontaneous combustion are present, and ordinarily there is no danger, where reasonable care is taken, except with the first cutting, and with this cutting only when the growth is rank.