Spring 1951

South Dakota Farm and Home Research

Agricultural Experiment Station

SOUTH DAKOTA

FARM and HOME Research

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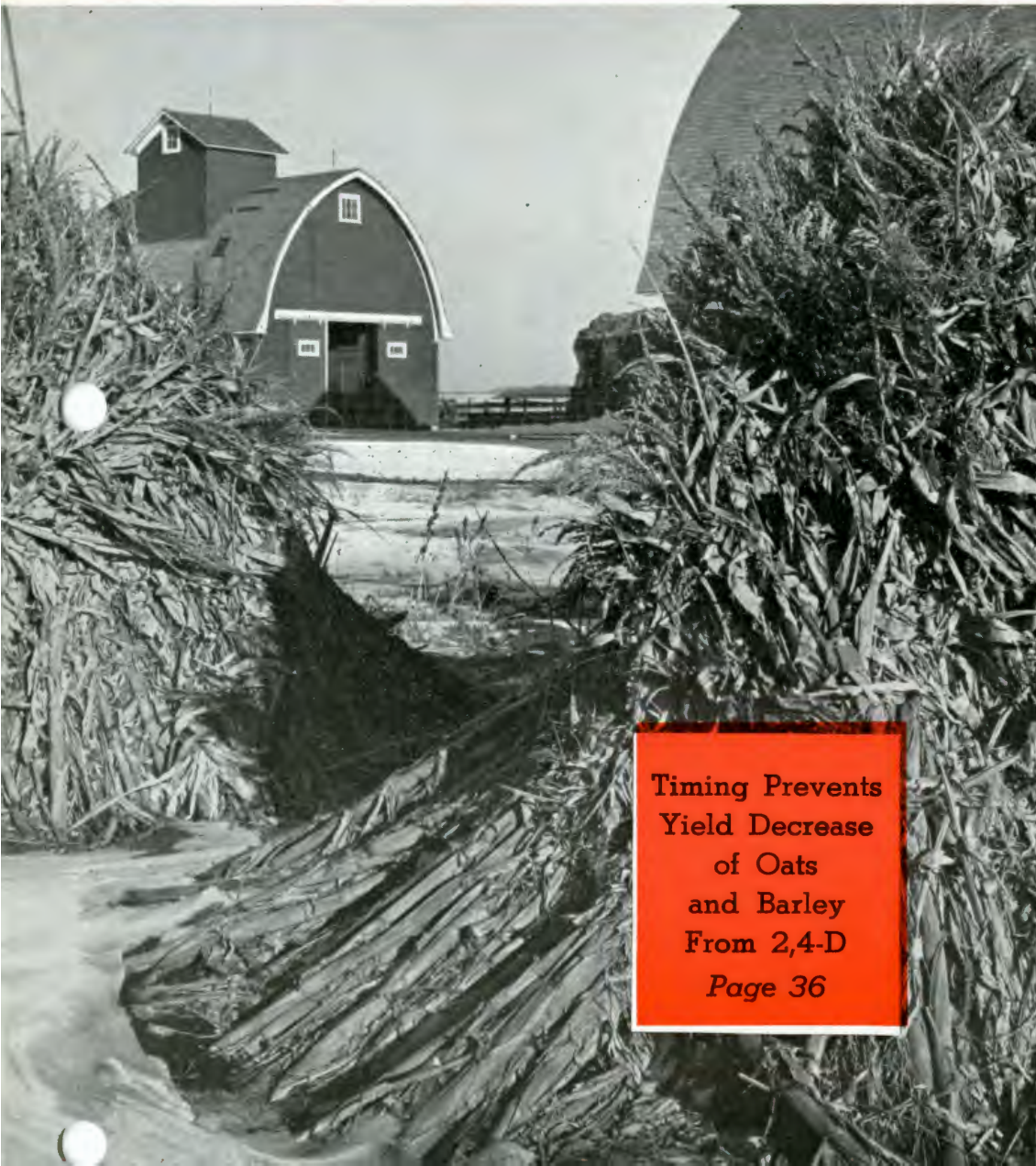

Timing Prevents Yield Decrease of Oats and Barley From 2,4-D

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Dear Folks:

Farmers and ranchers of South Dakota are to be congratulated on their 1951 agricultural production. It has been very favorable throughout the state, in spite of unfavorable weather conditions at harvest time. Right now our feed stocks are being drawn upon rather heavily, because of the increased numbers of livestock and the severe early winter weather.

As the new year approaches, plans are being made for greater production in 1952 to provide the necessary agricultural products for our military forces, our civilians, and to assist other free countries of the world in maintaining their freedoms.

The agricultural research achievements of the Experiment Station for the 1951 crop year are being summarized and progress reports of these results will be made available to the citizens of the state. Workmen are busily engaged in remodeling one of the buildings for an up-to-date laboratory, in which fundamental research can be conducted in animal nutrition. Other crews are at work on the new agricultural hall. In this new building there will be enlarged laboratory space for much of the agricultural research.

Thus, we, who are engaged in research work, as well as farmers and ranchers of the state are looking forward to a very productive 1952, and the Experiment Station staff joins me in wishing everyone of you a Very Happy and Successful New Year.

Sincerely,

L. B. Johnson

Director

SOUTH DAKOTA
FARM and HOME
Research

A REPORT OF PROGRESS

Vol. III WINTER, 1952 No. 2

In This Issue

Our Cover

It seems that we are so busy keeping warm in the wintertime that we rarely take time off to appreciate the beauty of farm scenes such as this. It remains for the photographer to catch the texture of the snow as it swirls around the corn shocks and contrast it with the solid structure of a good red barn. But even photographers are reluctant to leave the home fires to get winter scenes, so your editor finds good winter pictures almost as scarce as hens' teeth.

If any of you amateur photographers have some favorite farm scenes, we would be interested in seeing the prints of all those for which you have negatives. It might be fun to find your picture on the cover of a publication.

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How MARKETING AND PROCESSING METHODS Affect Butter Quality

By Ernest Feder and D. F. Breazeale

Butter manufacturing has remained the major dairy industry in South Dakota. The bulk of butter in the state is produced from cream separated at the farm, and cream sales, though declining in amount, account for approximately 70 percent of the total South Dakota milk production (Figs. 1 and 2).

About 80 percent of the butter produced in the state is shipped to other markets where it is in competition with other butter and other spreads, indicating the importance of quality control for satisfactory marketing.

Information on some of the factors affecting the quality of South Dakota butter has been obtained by several surveys which were part of a North Central Regional Research study or were conducted in cooperation with the State Department of Agriculture and the State Chemist at Vermillion.

A sample of 21 creameries based on size and ownership in South Dakota was selected as part of a regional survey. A federal grader visited each of these plants once in the spring and once in the summer of 1950. He graded all churnings of the butter on hand at the time of his visit, according to the federal standards for U. S. creamery butter. These grades are AA or 93 score, A or 92 score, B or 90 score, C or 89 score and CG (cooking grade). An effort was made to time these trips when a considerable quantity of butter would be available, and a total of 343,646 pounds of butter was represented in these 1950 gradings.

Size of Plant and Season of Year Influence Grades

Results of these gradings show that 81 percent of the butter was B grade and 19 percent C grade, with the larger plants manufacturing a somewhat higher percentage of B grade than the smaller plants (Table 1).

The summer grading resulted in a greater proportion of lower grade butter than the spring grading, in all sizes of creameries. However, the differences were not as great as might well be expected for a normal season, since summer temperatures in South Dakota were unusually low in 1950.

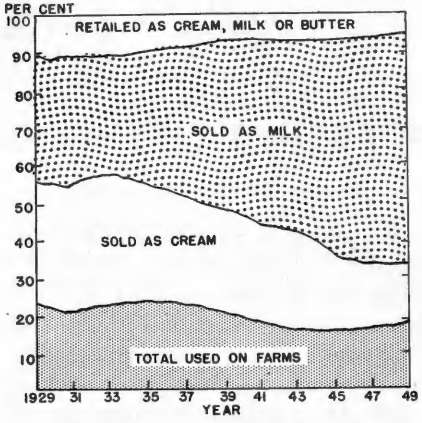


Fig. 1. Milk Utilization in the U. S. (Farm Level. 1929—1949)

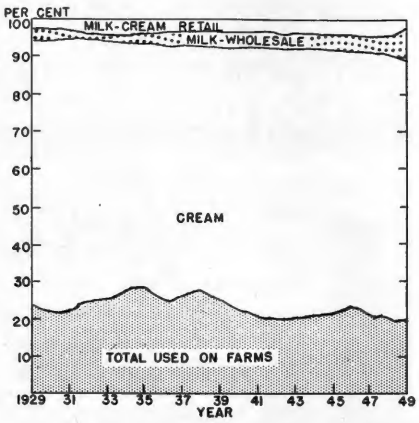


Fig. 2. Milk Utilization in South Dakota (Farm Level. 1929—1950)

Important changes have taken place in the dairy industry during the past few years. From 1940 to 1949, total milk production in the U. S. increased from 110 to 119 billion pounds. There has been a shift from the sale of farm-separated cream to the sale of whole milk. In 1940, 30 percent of the milk produced was sold by farmers in the form of cream while in 1949 only 17 percent was sold in this form. The amount of milk sold to plants and dealers as whole milk increased from 43 to 61 percent. In contrast to the national trend, milk production in South Dakota decreased sharply, but cream sales remained around 70 percent.

Also, cooperative creameries produced a slightly higher proportion of higher grade butter than independently owned plants (including centralizer plants). This is not shown in the table.

Flavor and Aroma Chief Factors in Determining Butter Grades

Butter grades are determined chiefly by the kind and intensity of the predominating flavor and aroma observed by the grader. Other factors considered are defects in body and texture, color and salt, but these were of little significance in the survey. Between 70 and 90 percent of the B grade butter was characterized by "definitely old cream" or "definitely acidy" flavors. The principal flavors in the samples of C grade were "definitely stale" and "definitely metallic."

The occurrence of "metallic" or "utensil" flavors in butter, of which about 10 percent was found in 1950, can probably be attributed to the prolonged contact of the cream with cans having rust spots. The 1950 survey shows that butter with this flavor was manufactured by creameries which obtained their cream supply mainly from cream stations, through door delivery, or direct rail shippers. Plants where no metallic flavored butter was found, obtained their supply mainly through farm truck routes. There did not seem to be any relation between the observed sanitation procedures or the condition of the processing equipment of the plants and the occurrence of these flavors.

The greatest proportion of cream was marketed through cream sta-

tions with truck routes being next in importance. The creameries obtaining their supply of cream by farm truck routes appear to have a somewhat greater control over freshness of cream than plants receiving their supply by other methods (Table 2).

Methods of Collecting Cream Affect Quality of Butter

In 1950, plants collecting more than 50 percent of their cream by farm truck routes produced 94 percent grade B butter (Table 3). The proportion of grade B butter was considerably lower for plants using mainly other methods of collection. This is not conclusive evidence that farm truck routes are always conducive to higher grade butter, since other important factors have not been accounted for, such as, grading of cream, and processing methods at the plants. But control over the age of cream, such as is afforded by regular routes, is one of the important factors in the production of higher quality butter.

In this connection it is interesting to note that the cooperative plants included in the 1950 survey received 55 percent of their cream from truck routes, the remainder through other methods of supply. The independents received 4 percent of their cream by truck routes. Cooperatives received 4 percent and independents 73 percent of their supply through cream stations.

Table 1. South Dakota Butter, by U. S. Grades, and Size of Plant, 1950

Plants Producing	No. of Plants in Sample	No. of Churnings Graded	Total Weight in Graded Churnings	% U. S. "B" Grade	% U. S. "C" Grade
1,000,000 lbs. and over	4*	80	106,461	90	10
500,000 to 999,999 lbs.	5	96	122,157	81	19
Less than 500,000 lbs.	12	116	115,028	74	26
Total	**21***	**292**	**343,646**	**81**	**19**

*One large plant did not cooperate in the summer grading

Table 2. Butterfat Purchases of South Dakota Creameries by Method of Cream Collection, 1950

Plants Producing	No. of Plants in Sample	Total lbs. of Butterfat Purchased	% of Butterfat Received Through			
			Truck Route	Stations	Door Delivery	Direct Rail
1,000,000 lbs. and over	3*	4,011,910	24	64	6	6
500,000 to 999,999 lbs.	5	2,832,260	17	29	39	15
Under 500,000 lbs.	12	2,137,462	37	36	27	----
Total	**20***	**8,981,632**	**25**	**46**	**21**	**8**

*One large plant did not cooperate in the survey

Table 3. Butter Grades, By Major* Cream Receipt-Method, South Dakota, 1950

Major Method of Cream Receipts	No. of Plants in Sample	Total Butter Produced	% U. S. "B" Grade	% U. S. "C" Grade	% of Cream Receipts			
					Truck Routes	Stations	Door Delivery	Rail
By truck route	7	79,706	94	6	94	----	6	----
By stations	8	192,750	78	22	4	76	10	10
By door delivery	5	60,664	73	27	----	5	84	11
Total	**20**	**333,120**	**81**	**19**	----	----	----	----

*Major = receiving 50% or more of the cream by one method

Relationships Between Butter Grades and Chemical Tests Explained

As a food product, butter must comply with state and federal regulations with respect to butterfat content and freedom from adulteration. Butter and cream are considered adulterated under federal laws, if they consist in whole or in part of any filthy, putrid or decomposed substance, or are otherwise unfit for food, or are processed under insanitary conditions. The use of decomposed cream in the manufacturing of butter lowers its grade, and also confronts a plant with the danger of its output being seized by the authorities with resulting fines and loss of butter.

The W.I.A. test (water insoluble acids) is a chemical analysis which the authorities may use to determine the degree of decomposition which the cream has undergone prior to its manufacture into butter. As cream becomes older, decomposition sets in and progresses, depending chiefly upon the temperature at which the cream is held, and the W.I.A. content rises. It is generally considered that samples of butter with a W.I.A. content over 400 are made from cream unfit for human consumption.

Butter Samples Tested

To obtain more information on the characteristics of butter with respect to relationships between fat acidity, pH of the butter, W.I.A. and grades, 368 samples collected by the South Dakota Dairy Inspectors and representing about 200,000 pounds of butter, were analyzed at the Station Dairy department and

Table 4. Summary of Chemical Analyses of Butter Samples

Grades and Periods	No. of samples	Av. pH*	Av. F.A.†	Av. WIA‡	High pH	Low pH	High F.A.	Low F.A.	High WIA	Low WIA
Grade A										
July 1950	3	6.96	0.63	151	7.18	6.61	.76	.57	226	109
May—June 1951	3	6.83	0.69	112	6.92	6.68	.80	.59	179	77
August 1951	------	------	------	------	------	------	------	----	------	------
Total or Average	6	6.89	0.66	131	------	------	------	----	------	------
Grade B										
July 1950	52	6.88	0.86	207	7.75	4.48	1.31	.32	422	79
May—June 1951	122	6.79	0.73	114	7.90	5.05	1.52	.18	375	42
August 1951	84	6.91	0.85	207	8.02	5.40	1.66	.35	423	73
Total or Average	258	6.85	0.79	163	------	------	------	----	------	------
Grade C										
July 1950	37	7.04	0.82	209	8.17	5.37	1.67	.31	416	79
May—June 1951	23	6.75	0.86	141	7.79	5.90	1.53	.32	285	37
August 1951	32	6.60	1.23	310	7.75	5.23	2.24	.74	539	110
Total or Average	92	6.82	0.97	227	------	------	------	----	------	------
Grade CG										
July 1950	5	7.02	0.94	242	7.88	6.47	1.24	.47	295	171
May—June 1951	3	6.23	1.43	262	6.33	6.03	2.29	.77	467	83
August 1951	4	7.00	0.80	251	8.02	6.22	1.13	.32	291	171
Total or Average	12	6.82	1.01	250	------	------	------	----	------	------
Total	368									

*pH of butter serum (active acidity)
†F.A.=Fat acidity (ml. 0.1 N KOH per 10 g. fat)
‡WIA=mg. of water insoluble acids per 100 g. fat)

at the State Chemist's laboratory in a joint venture. To obtain data of most value to the butter industry, a fairly high proportion of lowest grade butter samples was obtained. Table 4 shows the results in condensed form.

(1) There were 11 samples exceeding a W.I.A. test of 400.

(2) A significant relationship exists between the amount of fat acidity and the W.I.A. content within each grade. High fat acidity will normally correspond to a high W.I.A. content. Since the W.I.A. test is an expensive and time consuming test, the comparatively simple fat acidity test will give an indication as to the probable result of the W.I.A. test.

(3) One might assume that the fat acidity and the W.I.A. content of butter would increase as the grade of butter declines. On the whole, it was found that this was so; but there were important exceptions to this rule.[1] The average fat acidity and W.I.A. content in grade C butter was higher than in grade B butter for all samples combined. When the weather was cool and apparently favorable for higher quality butter, such as July 1950 and May and June 1951, the samples showed lower values of fat acidity and W.I.A. than when the weather was warmer (August 1951), and there was little difference between grades B and C, except for August 1951.

It may be tentatively concluded that differences in grades, based mainly on predominating flavors, in many cases do not correspond to appreciable differences in fat acidities or W.I.A. values.

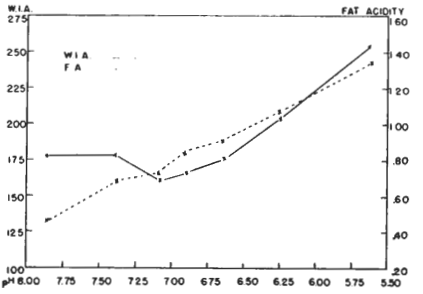


Fig. 3. Trend of average pH values and corresponding average W.I.A. and F.A. values

(4) Does the degree of neutralization, as measured by the pH of the butter, affect its W.I.A. test? Analysis showed that when the pH of the butter was within a range of 6.8 and 7.0, which is usually considered most desirable from the standpoint of good manufacturing, there was no correlation between pH and the W.I.A. test. However as the pH decreased from 6.8, the W.I.A. values increased significantly. This general trend is shown in Fig. 3. These lower pH values indicate that the cream was under-neutralized, and under-neutralization tends to increase the W.I.A. and fat acidity values.

Processors are therefore urged to control cream neutralization very carefully in order that the pH of the butter will be in the range of 6.8 to 7.0 or as close to this as possible. This careful control of neutralization will not only help to minimize the possibility of having excessive W.I.A. values, but also will definitely aid in the manufacture of high quality butter. (Project 201. Leaders: Ernest Feder, Agricultural Economics, D. F. Breazeale, Dairy.)

[1]These remarks refer only to grades B and C since not enough samples could be collected of the other grades.

Reused Wool.

By Lillian Lund, Ethel L. Phelps, and Helen Ward Norton

Blending remanufactured wool with new wool has been a widespread practice for many years. The Wool Products Labeling Act, which became effective in 1941, requires that labels must indicate percentages of new and remanufactured wool present in any wool product. If the consumer does not know what effect such blending may have on the serviceability of the product, it is difficult for him to decide which product will be best suited to his particular needs.

In order to determine the effects upon the serviceability of wool flannels of various combinations of new and reused wool, a cooperative investigation was undertaken by the South Dakota and Minnesota experiment stations. The study also was designed to measure some of the physical changes which might result from dry cleaning and aging as well as from wear.

Wool Fibers Measured

Since the fundamental differences between fabrics are influenced by their fiber content, the two groups of fibers were studied. Length measurements showed that the new wool fiber was approximately one-half inch longer than the reused fiber. Moreover, the new wool contained more than twice as many fibers which were three inches or more in length. The new wool fibers were finer, the average diameter being 23 microns for the new wool and 30 for the reused wool, and showed considerably less variation in diameter measurements than did the reused wool fibers.

One of several experimental skirts worn by college girls in testing the wear-life of a wool flannel fabric containing reused wool.

. . WILL IT WEAR?

During the process of remanufacture, fabrics and yarns are torn apart in order to yield a mass of fiber which can be reused. In this process many fibers are damaged, a common evidence of which is splintered ends. The ends of fibers from both the new and the reused wool were examined under the microscope for damage. On this basis they were classified into groups which varied from fibers showing no damage to those with severely splintered ends. The general tendency was for somewhat greater damage to be observed in the reused wool fibers.

Less Stretch and Strength in Yarn of Reused Wool

In manufacturing the yarn from fiber, every effort was made to produce yarns which were alike. Nevertheless yarn measurements indicated that the additions of reused wool tended to result in yarns of decreasing size. Yarn strength measurements showed that an increase in the amount of reused wool resulted in lower yarn strength. Apparently new wool not only provides more strength, but it also imparts greater elongation to the yarn.

Yarn Woven Into Five Fabrics

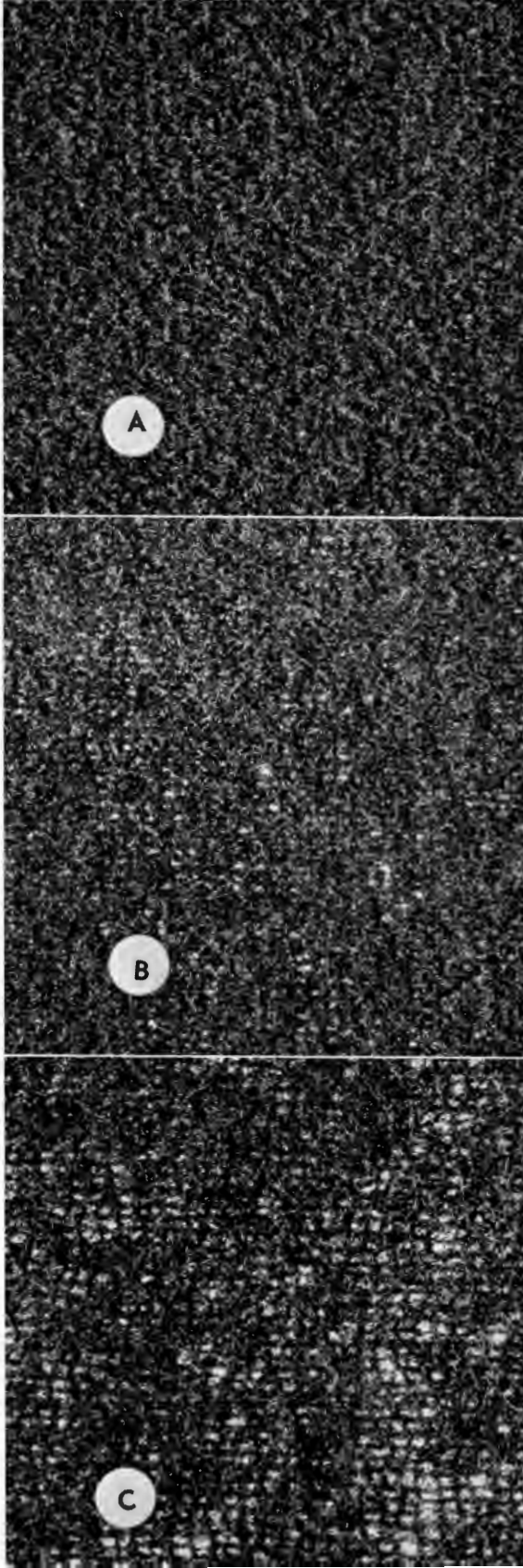
The yarns were woven into flannels with specified fiber content as shown below:

100 percent new wool

75 percent new wool plus 25 percent reused wool

50 percent new wool plus 50 percent reused wool

25 percent new wool plus 75 percent reused wool



A. Flannel made from 100 percent new wool.
B. Flannel made from 50 percent new wool and 50 percent reused wool.
C. Flannel made from 100 percent reused wool.

100 percent reused wool

These experimental fabrics were woven with an even twill weave, weighed 11 to 12 ounces per linear yard in the 54-inch width, and were similar to a commercial flannel of comparable kind and weight.

For convenient identification, each fabric was numbered according to the percentage of its new wool content; that is, the flannel which contained 100 percent new wool was numbered "100" and that containing 0 percent, "0."

The five fabrics were made into plain, four-gore skirts which were worn by students (Fig. 1). Three skirts from each of the first four fabrics were worn 1000 hours; three, 2000 hours; and three, 3000 hours. Fabric No. 0 was not subjected to 3000 hours of wear since yardage was available for only six garments.

Each wearer kept a record of hours of wear, amount of pressing, evidences of wear and damage, and type of activity. After 200 hours of wear each garment was returned to the laboratory for inspection, dry cleaning and repair.

Differences in the Unworn Fabrics

Every effort was made to produce five flannels which would vary only in fiber content. All were dyed navy blue. Nevertheless, it was possible to distinguish between them visually and by feel. The differences between new and reused wool fiber mentioned above were probably responsible for these variations. The all new wool fabric No. 100 produced a soft, smooth fabric, with a close, even weave. With each addition of reused fiber the fabric became harsher to the touch and the weave more irregular. Fabric No. 0 was quite harsh, markedly irregular in weave, and showed thin spots interspersed with thickly matted areas (Fig. 2).

Differences also were shown by laboratory measurements on the new (unworn) fabrics. Weight, strength and elongation tended to decrease as the proportion of reused wool increased (Table 1).

Aging or storage always is involved in a study of wear. However, results from this investigation indicated that only minor changes occurred during storage without wear.

Dry cleaning caused some shrinking and some stretching. In numerous cases these changes were less marked for the fabrics with larger proportions of reused wool.

Table 1. Values for Fabric Properties of Wool Flannels When New and After Wear

Fabric No.	Weight per Square Yard in Ounces	Strength in Pounds Breaking Warp	Strength in Pounds Breaking Filling	Strength in Pounds Bursting	Elongation in Percent Breaking Warp	Elongation in Percent Breaking Filling	Elongation in Percent Bursting
100 New	9.3	32.6	17.6	63.7	28.0	35.0	40.0
Worn 3000 hrs.	9.1	32.4	17.3	59.7	29.7	32.6	22.7
75 New	9.0	23.2	12.2	49.6	24.3	35.7	32.6
Worn 3000 hrs.	8.6	22.6	11.1	42.6	23.4	29.4	20.4
50 New	9.0	20.4	12.3	47.3	23.3	35.7	25.1
Worn 3000 hrs.	8.4	20.8	11.0	39.9	22.8	31.6	19.8
25 New	8.8	17.6	10.9	42.0	23.3	36.3	24.6
Worn 3000 hrs.	8.2	16.5	9.0	31.7	19.7	30.1	17.7
0 New	7.8	14.4	7.5	32.8	19.7	32.3	22.3
Worn 2000 hrs.	6.5	11.0	5.5	18.4	18.1	26.7	12.6

Differences in the Worn Fabrics

Common experience has demonstrated that wear will cause changes in fabric properties. In this connection it must be remembered that manufacturing processes and the uses to which the fabric is subjected cause permanent changes also in the fiber properties. These may detract from the serviceability of the fabric and account for some of the differences observed.

Measurements made on these fabrics have shown that many such changes occurred during the wear life of the flannels. As wear with dry cleaning continued there was a slight shrinking, or pulling together of the yarns. This tendency was not shown in the fabrics containing all reused wool. Here the trend was in the opposite direction since the fabric tended to stretch. Losses in thickness were observed when the percentage of reused wool exceeded 50 percent. All of the fabrics decreased in weight during the wear periods, the losses becoming larger as the amount of new wool was decreased and the amount of reused wool proportionately increased. Such differences in weight could result in a material becoming threadbare and less apt to hold its shape.

Strength losses often are used to portray the effects of wear. When a garment is worn, strain may occur across the shoulders, on the sleeves, or wherever there is pull in one direction. This type of strain can be measured in the laboratory by applying a force to one end of a strip of fabric and increasing the force until the fabric breaks. Such force is measured in pounds and is called the breaking strength of the fabric. Comparing the breaking strength of the unworn fabrics with that of the fabrics which were worn, those materials made of all reused wool lost much more strength than did those containing new wool (Table 1).

Another type of force to which fabrics may be subjected is bursting force such as might occur at the elbows or the knees of a garment. Such strain may be measured by clamping a sample tightly into a machine and forcing a steel ball up against the fabric, continuing to apply pressure until the ball ruptures the cloth. This also is measured in pounds, and is called bursting strength.

Losses in bursting strength of the flannels were greater than losses in breaking strength, varying from four pounds for fabric No. 100 to 20 pounds for fabric No. 0. It is interesting to note that the 4-pound loss in bursting strength occurred after 3000 hours of wear for fabric No. 100, whereas the 20-pound loss occurred after No. 0 had been worn only 2000 hours. Fabric No. 100, which contained all new wool, showed remarkably little change as the result of being worn and dry cleaned for the three wear periods.

All of the skirts were still wearable at the end of the final wear period, but most of them were at a point where they probably would have been discarded for their shabby appearance under normal circumstances. Many of the waist bands had holes in them where they had been fastened; and one skirt of fabric No. 0 needed a new waist band before the end of the second wear period.

Continued on page 35

SOUTH DAKOTA *Barley* HIGH IN PROTEIN

By A. W. HALVERSON

OF THE LARGE ACREAGE of barley grown in South Dakota, a considerable portion reaches industrial outlets (brewing industry), but a much larger proportion is used for feeding purposes by farmers and feeders throughout the state.

There is a tendency for South Dakota barley to be too high in protein to suit brewing requirements. Evidently the environmental factors characteristic of this area sometimes promote excessive protein content in barley varieties which are normally considered to be of moderate protein content. Drouth conditions during the midsummer growing season cause the grain kernels to shrivel and result in abnormally high protein content.

The logical solution to the production of more suitable malting barley for South Dakota appears to be continued development of low-protein, early-maturing, disease-resistant varieties. On the other hand, attention to the continued development of high protein varieties which possess high yield and disease resistant characteristics is also warranted. Using a high protein barley as a livestock feed is practical primarily because protein supplement requirements are reduced to a minimum. The amount of protein supplement (concentrate) required to make a balanced ration is much less when the basic grain is a high protein grain.

A quantitative study of the protein fractions in malting and feeding barley varieties was carried out in a cooperative project between the Experiment Station Chemistry and Agronomy departments.

The fractions studied were salt-soluble protein, alcohol-soluble protein and insoluble protein. The samples analyzed represented Feebar, Odessa and Plains barley (1950 crop) grown on experimental plots in several different areas of the state. Odessa is a malting-type barley of well-established reputation,

Extracting protein from barley

while Plains and Feebar are newly developed varieties that hold promise of being popular feed-type barleys. Plains is considered to have a medium protein content. Feebar is a high protein variety.

Environmental Factors Affect Protein Content

The data already obtained in the current barley protein study are important. The results show a definite relationship between protein composition and total protein content. Changes in the total protein content of barley samples cause regular and comparable changes in the protein fraction percentages of different varieties (6-row type).

Wide variations in the protein content of both low- and high-protein types of barley emphasize that environmental factors may obscure varietal characters such as protein level to a significant extent. The results further indicate that as much as 50 percent of the variation in the protein content of barley samples (Feebar) can be caused by environmental factors which interfere with normal kernel development and thus cause shriveled grain of higher protein content to result. Plains barley was outstanding in that high protein levels were attained in well-developed grain kernels (non-shriveled). A combination of high protein and early maturity characters is no doubt responsible for the ability of the Plains variety to attain good yields of feed-type grain even when grown in drier areas.

Further study of the protein composition of malting and feeding barleys together with evaluation of the effect of environmental factors upon protein composition will greatly help the plant breeder to select varieties for feeding or for malting. An adequate understanding of the differences in nutritive value between low- and high-protein barley will also be of great importance. (Project 195. Leaders: A. W. Halverson, A. L. Moxon, Station Chem.; J. E. Grafius, Agronomy.)

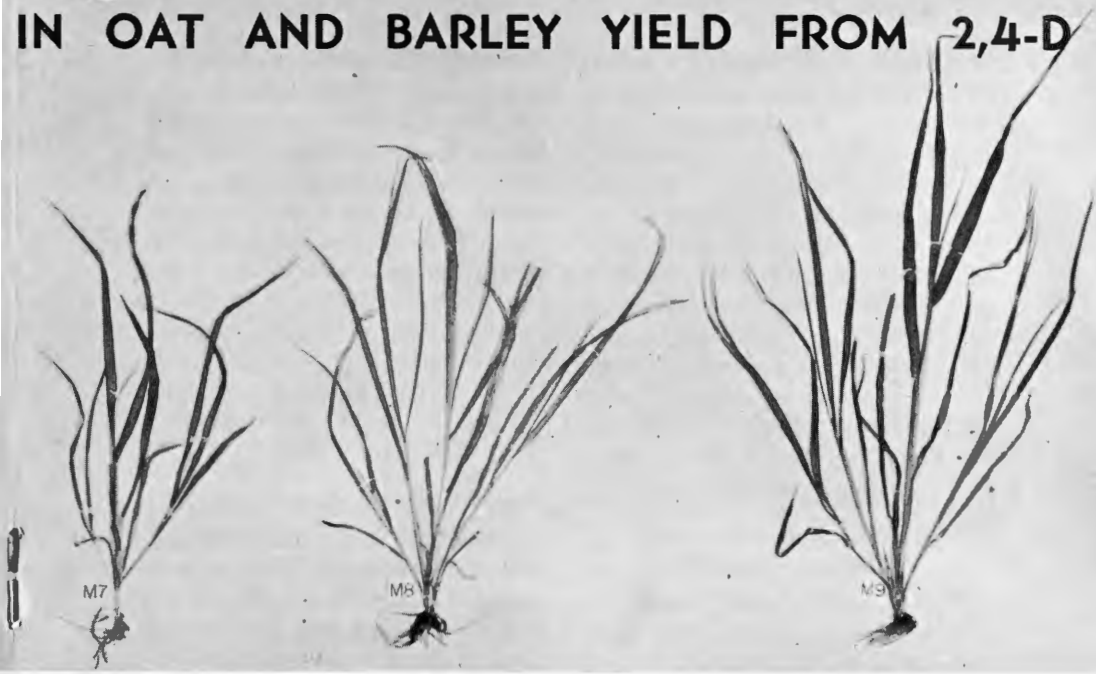
Reused Wool, Will it Wear?

Continued from page 33

It was not possible to keep a record of the number of hours the skirts actually were exposed to sunlight. However, samples of new fabric were exposed to light in a Fade-Ometer to simulate the effect of sunlight. Results indicated that breaking strength values tended to decrease after each period of exposure, and that these decreases were larger for the fabrics with increasing amounts of reused wool.

The serviceability to be expected from reused wool is dependent largely upon the amount of new wool which may be mixed with it. Results of the research conducted at the two stations indicate that, although a fabric made of new wool will be superior in serviceability, the consumer might expect reasonably good service from fabrics containing not more than 50 percent of reused wool. Increasing proportions of the reused fiber will result in a marked decline in serviceability. (Project 140. Leaders: Lillian O. Lund, Home Economics Department, in cooperation with Ethel L. Phelps, Minnesota Ag. Expt. Sta.)

IN OAT AND BARLEY YIELD FROM 2,4-D



8 Leaves 2 Tillers 34 [illegible]./A.	8 Leaves 3 Tillers 40.5 Bu./A.	9 Leaves 3 Tillers 34.0 Bu./A.

Yields Reduced When Treated with Ester of 2,4-D

All farmers who have used 2,4-D realize that there are three general forms of this herbicide – ester, amine, and sodium salt. These three forms do not necessarily have the same effect on crops or weeds. Therefore, all three forms were used in the tests. The 2,4-D was applied when the grain was in four stages of growth (seedling, fully tillered, heading and milk).

Yields of barley and oats were consistently reduced by treatment with the ester at the first three stages of growth (seedling, tillered,

Constricted sheath of barley after being treated at the seedling, or 5-leaf, stage with 2,4-D.

and heading). In barley the reduction in yield was greatest when treated at the seedling and heading stages, but there was a slight reduction when treated at the fully tillered stage. The yield of oats was reduced 15 to 20 percent when treated at the seedling stage and 5 to 10 percent at the fully tillered and heading stages.

The amine and sodium salt forms of 2,4-D reduced barley yields slightly at the critical seedling and heading stages, but did not consistently affect the yield of oats.

Count Leaves to Determine When to Spray

The end of the susceptible seedling period can be determined more accurately by counting the leaves than by the height of the plant. Even though an early variety and a late variety were grown under two distinctly different sets of growing conditions, by the time the fifth leaf was expanded tillers were no longer being formed, and heads were starting to form (inside the plant). At this stage, the two seedling leaves had dried up and almost disappeared on some plants. The plants were 8 inches tall in 1949 and 12 inches tall in 1950. This indicates that the stage of growth can be determined more accurately by counting the number of leaves than by measuring plant height.

Some Varieties More Susceptible

Wisconsin 38 was definitely more susceptible to 2,4-D than the other barley varieties tested. Moore was tested only one year, but in that year it was also more susceptible than the other varieties.

In the oat test plots, Marion, Mindo, Clinton, Andrew and

BARLEY AT FOUR STAGES OF GROWTH

Seedling (5-leaf) Fully tillered

Bonda, in that order, were more susceptible to 2,4-D than the other five. Whenever the yield was reduced, it was found that the number of seeds per head was reduced, but seed weight, number of heads and viability (ability to grow and develop) were not affected.

Effect of 2,4-D Not Transmitted to Progeny

When barley and oats were treated at the seedling (5-leaf) stage with the ester of 2,4-D, the yield was always reduced. Seeds from these treated plots and from untreated plots were planted and yields were taken on the progeny of both. The barley varieties grown in 1948 were tested in 1949, and the barley and oat varieties grown in 1949 were tested in 1950. It was shown that the reduction in yield caused by the application of 2,4-D was not transmitted to the succeeding generation through the seed.

Abnormal heads of barley, caused by treatment with 2,4-D, were threshed and the seed was planted. Since no abnormalities were observed on the progeny of malformed plants, it was concluded that these abnormalities were not transmitted to the next generation through the seed.

How Does 2,4-D Reduce Barley Yields?

An early and a late variety of barley were treated with 2,4-D at nine stages of growth during two years. Plains was used as the early variety each year. Wisconsin 38 was used as the late variety in 1949, but Moore was substituted for it in 1950. The 2,4-D was applied at 3-day intervals beginning at the 4- to 5-leaf stage. Each time 2,4-D was

Three days prior to heading

Milk Stage

applied, the growing point was removed from some plants in order to determine the exact stage of growth that was treated. Yield, seed-weight and number of heads were determined at harvest time and the number of seeds per head was calculated.

In 1950, spaced plants of both varieties were treated each time that the other plots were treated, in order that the yield per plant and the number of tillers could more easily be determined. The first treatment in 1950 was applied when Moore had only four leaves. This treatment caused a large reduction in yield and also caused a a reduction in the number of tillers on spaced plants.

Growing Conditions Affect Response to 2,4-D

The warm, dry conditions of 1949 were conducive to a slow growth rate and the rapid formation of heads. The head was formed in a very short time on any one stem and the heads of all main stems were formed over a short interval. The same was true for tillers. *The application of 2,4-D during the time that heads were being formed caused large reductions in yield and increased the number of abnormal heads.* Under these same conditions there was a period between the time that heads were being formed in the main stem and the time that they were formed in the tillers. *The application of 2,4-D during this period did not materially affect yield or cause any malformed heads.*

The cool growing conditions of 1950 were conducive to rapid growth and slow head formation. Heads were formed more slowly and in fewer stems at any given time. Consequently, no single application of 2,4-D would affect so many growing points and give such large reductions in yield or so many head abnormalities as in the previous season. On the other hand, the overlapping of head formation in main stems and tillers gave a long period (12-16 days) of moderate yield reduction.

Spray Barley in Second and Fourth Periods of Growth

The results of the three experiments show that the growing period of barley can be divided into four developmental periods – each responding in a different way to 2,4-D. The four periods are: (1) a susceptible period beginning when the grain comes up and ending at the 5-leaf stage, (2) a relatively tolerant period between the 5-leaf stage and the early boot stage, (3) a second susceptible period from preheading to late heading and, (4) a resistant period after the grain is in the milk.

During the latter part of the **first** (seedling) period, the application of 2,4-D stopped the formation of tillers. When the number of tillers was decreased, the number of heads was less and consequently the yield was greatly reduced.

In the **second** period (between 5-leaf and early boot stages) the application of 2,4-D affected the formation of the head. The number of seeds per head was reduced, yield was depressed and the number of head abnormalities increased. The severity of this injury was propor-

tional to the number of heads being formed when the 2,4-D was applied.

In a dry year the application of 2,4-D at the time that heads were being formed caused large reductions in yield and many abnormal heads. It did not materially affect yields or cause malformed heads when applied *after* heads were formed in the main culm, but *before* they started to form in the tillers.

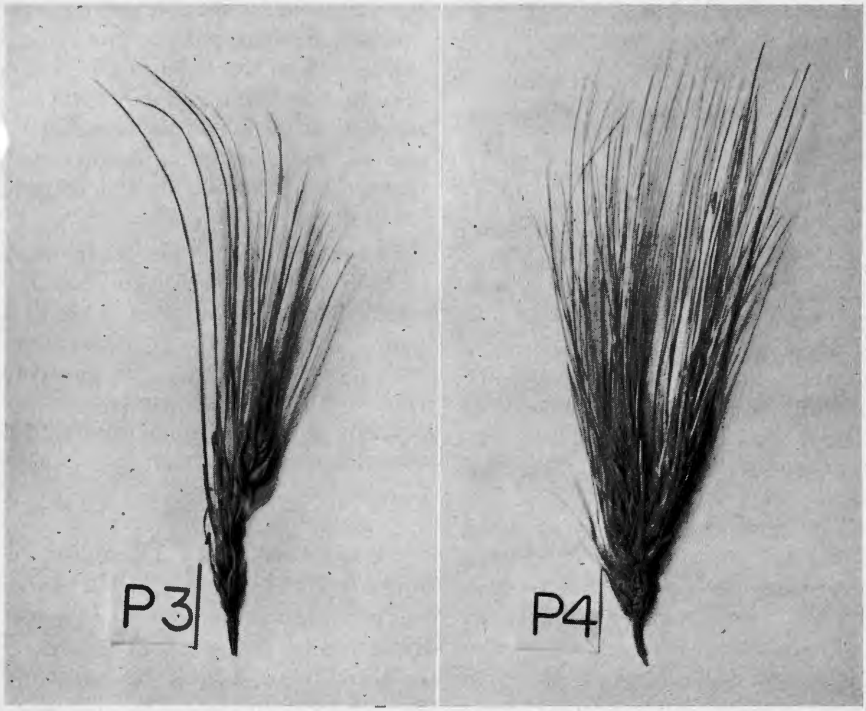
In a wet year the application of 2,4-D caused a small yield reduction and few head malformations over a two-week period. Since 2,4-D would have to be applied during a short interval when many heads were being formed in order to cause a large reduction in yield, this second period is considered to be relatively tolerant. Any reduction in yield is generally offset by advantages gained in control of weeds.

In the **third** (heading) period, 2,4-D consistently caused large yield reductions due to a decrease in the number of seeds and this period is therefore, considered to be susceptible.

The application of 2,4-D during the **fourth** (milk or post-heading) period does not reduce yields and does not cause head abnormalities.

Oats follow the same general pattern, but results for definite stages of growth have not yet been determined. (Project 32. Leader: Lyle A. Derscheid, Agronomy Dept.)

P3 Tweaked spike **P4 Double spike**

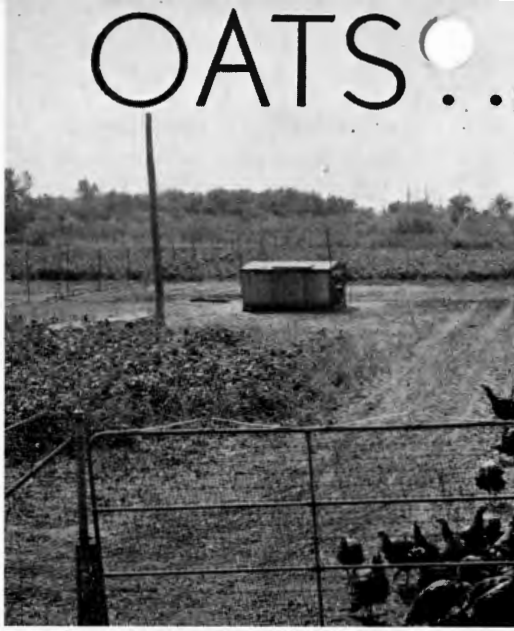


Head abnormalities found on Plains barley when treated with ester form of 2,4-D at time heads were being formed. Yield is decreased in proportion to the number of head abnormalities.

OATS . . .

By C. W. Carlson and
Wm. Kohlmeyer

During the growing season for turkeys, new-crop oats are a relatively plentiful and economical cereal in South Dakota. In view of this, a series of feeding trials was conducted to determine to what extent oats could be used in the turkey growing ration as a replacement for corn. The results suggest that turkeys can consume a great amount of oats, and therefore a great amount of fiber without being retarded in growth. It would also seem that replacing corn in the diet with oats will not hamper the development of the birds.



Typical range used in the growing season

Trials Substitute Oats for Corn

All stock used for the trials was from the same strain, a medium-sized Broad Breasted Bronze, bred at the South Dakota Agricultural Experiment Station for the past several years.

The turkeys were placed on green range at approximately 11 weeks of age and were fed a control diet until the start of each trial. Free access to oyster shells and granite grit was provided. The number of turkeys varied from 60 to 90 birds of mixed sex per pen. Individual weights were taken at intervals of four weeks maximum, and feed consumption records were also kept for each period.

The first three trials, in 1946, 1947, and 1948, were conducted with a free-choice system of feeding mash and a grain mixture. In the experiments of 1946 and 1947 the grain mixture consisted of equal parts oats and corn; the oats level was increased in the mash by replacing the corn. In 1948 the oats level was increased 67½ percent for one pen. For this pen the grain mixture was also altered to one-fourth corn to three-fourths oats. It will be noted in Table 1 that the actual levels of oats consumed did not markedly differ from the calculated levels.

In the last three trials, conducted in 1949, 1950 and 1951, only an all-mash diet was used. In these experiments, the level of oats in the diet was increased from a 10 percent level to an 80 percent level, the 80 percent level meaning that oats completely replaced corn in the diet (Table 1).

Weights and Rate of Growth Not Affected by Level of Oats Used

The results on final body weights are given in Tables 2 and 3. It will be noted that the age at termination for the trials in 1946 and 1947 was 26 weeks, whereas the age at ter-

. FOR GROWING TURKEYS

Rape was used as a forage crop in these trials

mination for the other trials was 28 weeks. The data show that there is no definite trend in final weight differences for either the males or females.

Examination of data available, but not given here, for earlier weight periods shows that the rates of growth were not affected by the levels of oats used in the diets. The turkeys on the lower levels of oats did not grow any faster and reach market size any sooner than the birds on higher level of oats.

Difference Lies in Feed Efficiency

The difference in high and low level of oats in the diet, lies in the feed efficiency. Figures for the entire period for which records were

Table 1. Calculated and Actual Level of Oats in the Turkey Diets*

Calculated Oats Level %	Actual Oats Level Consumed					
	Free-Choice (Mash and Grain†)			All-Mash		
	1946 %	1947 %	1948 %	1949 %	1950 %	1951 %
10	------	------	------	-------	-------	10
40	36.6	39.4	------	-------	----	40
45	43.2	45.0	45.7	45	----	----
50	50.0	50.0	50.0	50	50	----
55	55.5	55.1	54.1	55	----	----
60	------	------	------	-------	60	----
67½	------	------	70.1‡	67½	----	----
70	------	------	------	-------	70	----
80	------	------	------	-------	80	80

*These diets consisted of approximately 80% of corn and/or oats, 10% soybean meal, 5% meat scraps, 2½% dried buttermilk, 2½% alfalfa meal, and ½% salt. In 1950, the soybean meal and alfalfa meal were changed to 7% and 4% respectively, and 1% of steamed bonemeal was added. In 1951, 5% wheat bran and 5% standard wheat middlings were used in place of 10% of the corn, except for the 80% oats diet where the wheat by-products were not used. Niacin was added to this diet at 6 m./lb. The soybean meal in this trial was varied from 5 to 8% in keeping the calculated protein level constant at 16%.

†In this diet only the oats content in the mash was increased; the grain mixture being constant at 50% oats to 50% corn.

‡In this trial the grain mixture was altered to one-fourth corn to three-fourths oats.

Table 2. Average Weights—Males

Oats Level %	26 Weeks 1946 Lbs.	26 Weeks 1947 Lbs.	28 Weeks 1948 Lbs.	28 Weeks 1949 Lbs.	28 Weeks 1950 Lbs.	28 Weeks 1951 Lbs.
10	-----	-----	-----	-----	-----	24.2
40	22.7	20.9	-----	-----	-----	23.8
45	22.9	21.2	24.1	23.2	-----	-----
50	22.8	21.7	24.5	22.4	23.7	-----
55	22.0	21.3	24.3	24.3	-----	-----
60	-----	-----	-----	-----	22.7	-----
67½	-----	-----	25.5	22.8	-----	-----
70	-----	-----	-----	-----	23.1	-----
80	-----	-----	-----	-----	23.4	24.1

Table 3. Average Weights—Females

Oats Level %	26 Weeks 1946 Lbs.	26 Weeks 1947 Lbs.	28 Weeks 1948 Lbs.	28 Weeks 1949 Lbs.	28 Weeks 1950 Lbs.	28 Weeks 1951 Lbs.
10	-----	-----	-----	-----	-----	15.7
40	14.3	13.3	-----	-----	-----	15.3
45	14.4	13.7	14.9	14.3	-----	-----
50	14.0	13.6	14.9	14.6	15.1	-----
55	13.9	13.8	15.0	14.5	-----	-----
60	-----	-----	-----	-----	15.0	-----
67½	-----	-----	15.2	14.5	-----	-----
70	-----	-----	-----	-----	15.0	-----
80	-----	-----	-----	-----	14.0*	15.3

*Birds in this pen were molested by dogs, but previously were growing as rapidly as birds from the other pens.

available are shown in Table 4. The length of time and period involved, shown at the head of the columns, indicate why the figures for 1949 are high and therefore show a poorer efficiency. This is due to the fact that there is a reduced efficiency at the older ages when the growth rate is slowed down. Those for 1946 and 1947 are low, showing a better efficiency in feed conversion.

It will be noted that for the years 1946, 1947 and 1948, in which the free-choice system of feeding was used, there is no definite trend in the efficiency of feed conversion. On all-mash feeding, it appears that better efficiency is obtained on the lower levels of oats feeding. It is difficult to tell from this just at what level feed efficiency was reduced.

Corn Supplies One Third More Calories Than Oats

Examination of feed efficiency as related to calculated available energy allows for a more definite conclusion. The data, as shown in Table 5, indicate that about 850 calories of available energy per pound of diet are required for maximum feed efficiency. There is just a hint that higher energy levels may be somewhat more efficient; however, the irregularity shown by the 859-calorie diet for 1949 is difficult to interpret.

In general, as the oats increased, replacing corn, the calorie value of the diet decreased, since corn supplies about one-third more calories than oats. Slight variation in diets between years makes for considerable variation in calorie content.

Table 4. Eeed Efficiency—Pounds of Feed Per Pound of Gain

Oats Level %	Weeks of Trial* 12–26 1946 Lbs.	12–26 1947 Lbs.	16–28 1948 Lbs.	20–28† 1949 Lbs.	12–28 1950 Lbs.	12–28 1951 Lbs.
10	-----	-----	-----	-----	-----	5.96
40	5.31	5.36	-----	-----	-----	-----
45	5.66	5.42	6.75	8.50	-----	6.44
50	5.39	5.46	7.15	10.36	6.08	-----
55	5.47	5.57	6.61	9.39	-----	-----
60	-----	-----	-----	-----	6.74	-----
67½	-----	-----	6.66	11.15	-----	-----
70	-----	-----	-----	-----	6.79	-----
80	-----	-----	-----	-----	6.73	6.88

*Refers to the age of the turkeys at the beginning and end of the feeding trials.

†These were older birds at the start of the trial, and therefore show a reduced feed efficiency at indicated by the higher figures.

Low Cost of Oats Makes Up for Small Loss in Feed Efficiency

Maximum feed efficiency was achieved when the diet contained 847 calories of available energy per pound, with the oats level at 50 percent and the fiber content at about 8 percent. If this maximum feed efficiency level is compared to the 80 percent oats level in the diet, with a fiber content of 11 percent and the available calories at 720 per pound, a loss of 10 to 15 percent in feed efficiency occurs (Table 5). But this loss is of no great concern to the South Dakota farmer if he can bring his turkeys to market as fast with a high level of comparatively cheap oats as with a high level of costly corn. This will be true as long as new-crop oats remain relatively cheap compared to held-over corn. (Project 52. Leaders C. W. Carlson, Wm. Kohlmeyer, Poultry Department; A. L. Moxon, Station Chemistry Department.)

Table 5. Effect of Available Dietary Energy on Feed Efficiency

Calculated			Lbs. of Feed/Lb. of Gain		
Calories per Lb.*	Oats Level %	Fiber Content %	1949	1950	1951
923	10	5.3	-----	-----	5.96
880	45	6.9	8.50	-----	-----
859	50	7.4	10.36	-----	-----
847	50	8.1	-----	6.08	-----
838	55	7.9	9.39	-----	-----
816	40*	8.2	-----	-----	6.44
806	60	9.1	-----	6.74	-----
786	67½	9.2	11.15	-----	-----
767	70	10.1	-----	6.79	-----
726	80	11.1	-----	6.73	-----
720	80	11.6	-----	-----	6.88

*Available energy content was calculated for the total ration, and the apparent discrepancies are due to the change of supplements between years.

CATTLE GRUB *Control* IN SOUTH DAKOTA

During the first warm days of spring, the heel flies begin egg laying. In attempting to avoid the flies, the cattle run wildly about the pasture or range. The eggs are glued to the hair, preferably on the lower part of the legs and flanks of the host animals. After about a week, the eggs hatch into small larvae which make their way down the hair and burrow through the skin.

By W. L. BERNDT and H. C. SEVERIN

ECONOMIC LOSSES in the United States caused by cattle grubs and heel flies have been estimated at 150 million dollars per year. The average rancher usually does not realize that he is paying his share of this loss. The most apparent loss to a rancher is noted in the spring when the heel flies become active. Cattle attempting to avoid the egg-laying heel flies may stampede through fences. More often they run into brush, or seek shelter in water or in the barns and spend the greater portion of a day in such places instead of grazing.

The packer experiences considerable loss when carcasses come through the plant with the backs and loins covered with a mass of yellowish matter and grubs. This entire mass, plus much of the surrounding flesh, must be trimmed away leaving the backs and loins badly gouged. Since nearly all the trimming is done over the loin, and this is a highly valuable portion of the beef animal, naturally a packer is concerned when too much trimming must be done.

Besides ruining choice cuts of meats, grub holes are made in the back portion of the hide which is the most desirable portion for leather. Any hide with more than five grub holes is classed as "grubby" and brings a lower price from the tanner.

These losses suffered by packers and manufacturers are passed back to the producer in the form of lower prices for his cattle.

Two Kinds of Cattle Grubs

In South Dakota there are two species of heel flies which attack cattle, the common heel fly *(Hypoderma lineatum)* and the northern heel fly *(Hypoderma bovis.)* The habits of these two species differ somewhat. (For a detailed account of life cycles and seasonal histories, see *Farm and Home Research,* Vol. 1, No. 2, pp. 43-45.) During the latter part of December or the fore part of January, the larvae of the common grub usually begin to appear under the skin on the backs of

cattle; in the case of the northern grub, the larvae do not begin to appear until March. Grubs may be found under the skin on the backs of livestock from late in December into early June in South Dakota. Emergence of the flies begins with the first warm days of spring.

Rotenone Kills Grubs

At the present time the only insecticide known to kill cattle grubs effectively and safely is rotenone. In applying rotenone to the backs of cattle, three methods may be employed, power spraying, hand dusting and hand washing.

In power spraying, 7½ pounds of powder containing 5 percent rotenone per 100 gallons of water is used. This material is applied at a pressure of 400 to 600 pounds per square inch in a narrow driving stream rather than as a mist or fog. The spray nozzles should have discs that have at least a 5/64-inch aperture. Nozzles should be operated about 18 inches from the back of the animal, and care should be taken to cover thoroughly an area of about 10 inches on each side of the spine from the shoulders to the base of the tail. Usually 100 gallons of spray is sufficient to treat 100 to 150 head of cattle.

A dry dust containing one part of 5 percent rotenone plus two parts of some inert carrier such as tripoli earth or pyrophyllite may be used to destroy cattle grubs. Many commercial dusts are available on the market all mixed and ready for use. These usually are labeled as containing 1.67 percent rotenone.

The dry dust should be applied by means of a shaker can or jar. (An effective shaker can be made from a quart or pint fruit jar fitted with a lid in which 10 or 12 holes have been punched with a 10-penny nail.) About three ounces of dust should be applied to the back of each animal and rubbed in well with the finger tips with a rotary motion. Some people prefer to use a stiff brush, but, unless the brush is kept clean, it will soon foul with loose hair and become ineffective.

A method fast coming into popularity is the hand washing method. Twelve ounces of 5 percent rotenone is stirred into one gallon of warm water along with one-third of a cup of granulated laundry soap. A pint to a quart of this mixture is poured slowly on the back of the animal and thoroughly scrubbed into the hair coat with a stiff, long-bristled brush. One of the better brushes sells in the hardware stores as a cream can brush. Water may be heated alongside the holding chute with a wood fire, camp stove, or a weed burner. A stove used to heat branding irons makes a very effective heater for water. The hand washing operation avoids the unpleasantness of breathing the dust which is often very irritating to many people.

Number of Treatments

The number of treatments per year that should be given cattle varies somewhat. In general, grubs appear in the backs of cattle from January to June with a separate peak of abundance for each species. The first treatment should be timed to come about one month after the first grubs appear. Subsequent treatments should be made at

monthly intervals until no new grubs make their appearance.

Area Control Important

One of the most important phases of the grub control project was to set up two experimental control areas in South Dakota to determine whether such areas could be freed of cattle grubs through practical control measures; or, if this were not possible, to reduce the population of grubs to such numbers that they would be of minor importance. Accordingly, the Hughes and Meade County grub control areas were established.

The Hughes County area was organized in 1948 and covered about a township. There were 37 cooperators in the area and from 2500 to 3000 cattle were treated at that time. In 1951 the area was expanded to 12 townships with 144 cooperators, and 19,000 head of cattle were treated. In this year, three townships in Hyde County were added to the Hughes County control area. This addition accounted for the principal expansion in 1951.

Herds located in the center of the Hughes County control area, in which the cattle had been treated for four years, showed a 92 percent reduction of grubs as compared with cattle outside of the area.

The Meade County area was also organized in 1948 and covered about 1½ townships. There were 20 cooperators in the area and 1800 to 2000 cattle were treated. The area remained unchanged in 1949 and 1950 with the same number of coopertaors and the same number of cattle being treated. In 1951 this area was expanded to 5½ townships, the cooperators increased to 37, and the cattle treated, to 4000 head.

In the Meade County control area, centrally located herds showed a reduction of 67 percent below untreated herds immediately outside of the area. Herds located on or near the edges of the two areas showed a reduction of grub infestation below untreated herds, but the percent of reduction of grubs here was not as large as it was in the center of the areas.

Spraying and Washing Methods Prove Effective

Spraying and washing are the two more popular and effective methods of treating cattle for grub control in South Dakota. About 75 to 85 percent of the third stage grubs were killed by spraying, 85 to 90 percent by washing, while dusting killed only 68 to 70 percent.

Spraying is popular with the rancher who runs a large herd. Washing is more popular with the small operator, because it has the advantage of low cost investment, but it has a disadvantage in that the operation requires more labor. Dusting is more popular with the dairy operators, but it has the disadvantage of being unpleasant to use and, in addition, it results in the lowest rate of grub kill.

Through experimentation it was learned that grub control programs on an area basis reduce grub populations. It is advisable to obtain close to 100 percent cooperation of all the cattle owners in an area in order to get the maximum control benefits. (Project 163, Cooperative. Leaders: J. A. Lofgren, W. L. Berndt, P. H. Kohler, Entomology-Zoology; I. H. Roberts, USDA-BAI.)

WHY PLANT SHRUBS IN *Windbreaks?*

By PAUL E. COLLINS

TREES ARE THE BACK-BONE of farmstead windbreaks. They furnish the height that is so important in stilling the wind over a greater area. Without height, windbreaks would have little effect in fuel saving for high structures such as the farmhouse, and the livestock protection features of a windbreak would be limited to a narrow zone immediately to the lee of the planted area. And yet, shrubs are generally planted in windbreaks and with good reason.

It is generally agreed that fast growth and maximum height are important for windbreak design. Long life, winter protection and density are equally desirable. To obtain these effects it is obvious that no single species can fulfill all the requirements. Also, a single species windbreak is more susceptible to complete loss by insects, disease, or weather damage. Wherever possible, a good windbreak should include fast-growing trees, trees that attain good height, long-lived trees, evergreens to provide good winter protection, and, *for density and wind resistance below the tree crowns to the ground, shrubs or evergreens like junipers.*

Row Arrangement

How these various species can best be placed row-wise has not been determined. However, from apparent past mistakes and successes, a few guides can be followed. Mixing of species of unlike growth habits in the row usually results in the suppression of the poorer competitor and should be avoided. Likewise, planting a row of slower-growing or shorter-growing trees or shrubs between rows of faster and taller-growing trees has the same effect unless the spacing between rows is very wide. That means that the row arrangement must be largely governed by the growth habits of the trees and shrubs used.

Using the Windbreak as a Snowfence

By planting a row or two of shrubs on the windward side, (which in South Dakota would be to the north and west,) a snow fence is created that effectively lodges the snow immediately to the lee under the other trees. In winters of high winds and heavy snows, some snow drifts beyond the windbreak. In order to guard against trouble in such cases, it is common practice to leave a 100-foot strip between the nearest buildings or service area and the inside row of the windbreak. The accumulation of drifted snow in the windbreak is probably one of the most important factors in maintaining a stand of trees through dry years. This added supply of moisture is very important in the Plains area.

Protect Soil Surface in Windbreak

Foresters strive to obtain a forest condition under the windbreak trees. Essentially this means a thick enough growth to shade out grass and weeds, and the development of a leaf and twig litter on the surface of the soil. In decomposition, the litter returns nutrients and organic matter to the soil, tends to make the soil loose and porous, and acts as a sponge to hold moisture in place where it falls rather than permitting it to run off. A thick growth of shrubs as marginal rows on both sides of the windbreak prevents the wind from sweeping the leaf litter out of the trees.

Other factors are involved such as the spacing and the number of rows, but no windbreak should be without dense, low growth on the outside and inside. Cattle should not be allowed to graze in the windbreak. A good litter floor is never present when sheep, hogs, or even poultry are free to roam under the trees. Everything else being equal, a grazed windbreak will be less effective and in poorer health than a non-grazed windbreak.

Choice of Shrubs

A good choice of shrubs provides cover and food for wildlife. Their interlacing and many branched type of growth provides sanctuary from predators and weather and, in some cases, a ready supply of food. Some shrubs that bear berry-like fruits offer a source of food for the farm folk, too. Many are the compliments that have been paid to the so-called "shelterbelt jelly."

Who has not thrilled at the show of flowers of a plum row in early spring? Or the spectacular display of lilacs in bloom? Here their value lies in beauty and appearance. It dresses up the country and leaves a lasting impression on visitors from other states, not to mention the pride in local achievement.

Because such evergreens as red cedar and Rocky Mountain juniper have a habit of retaining their lower branches as thick foliage down to the ground, they can be used as effective shrub rows. Observation indicates that evergreens may do better when used as north rows, probably because of less snow breakage and protection from hot southerly winds.

If a shrub row is used as an outside row next to a red cedar row, care is needed to choose a low-growing shrub and one that is not too aggressive in spreading by root suckers. In many of the shelterbelts planted 9 to 15 years ago, the wrong shrub was used as evidenced by the damage the red cedars are suffering today from whipping, shading and overtopping.

There are several windbreaks where cedars were used as outside rows in place of shrub rows, and the results are good. Whether cedars or shrubs or both are used, the goal to reach is the same: plant a windbreak that will have a wall of resistance to wind from the ground to the tops of the tallest trees.