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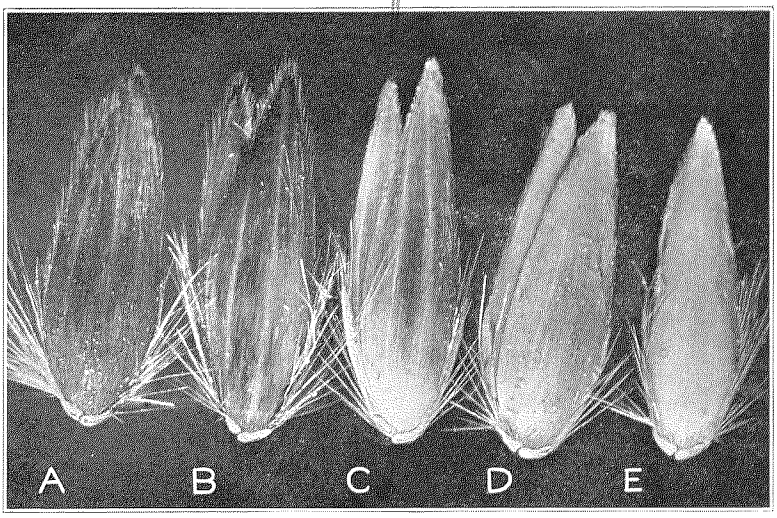
REED CANARY GRASS

A. C. ARNY, M. C. HANSEN, R. E. HODGSON, AND G. H. NESOM



SEEDS OF REED CANARY GRASS (SEE PAGES 17 AND 18)

UNIVERSITY FARM, ST. PAUL

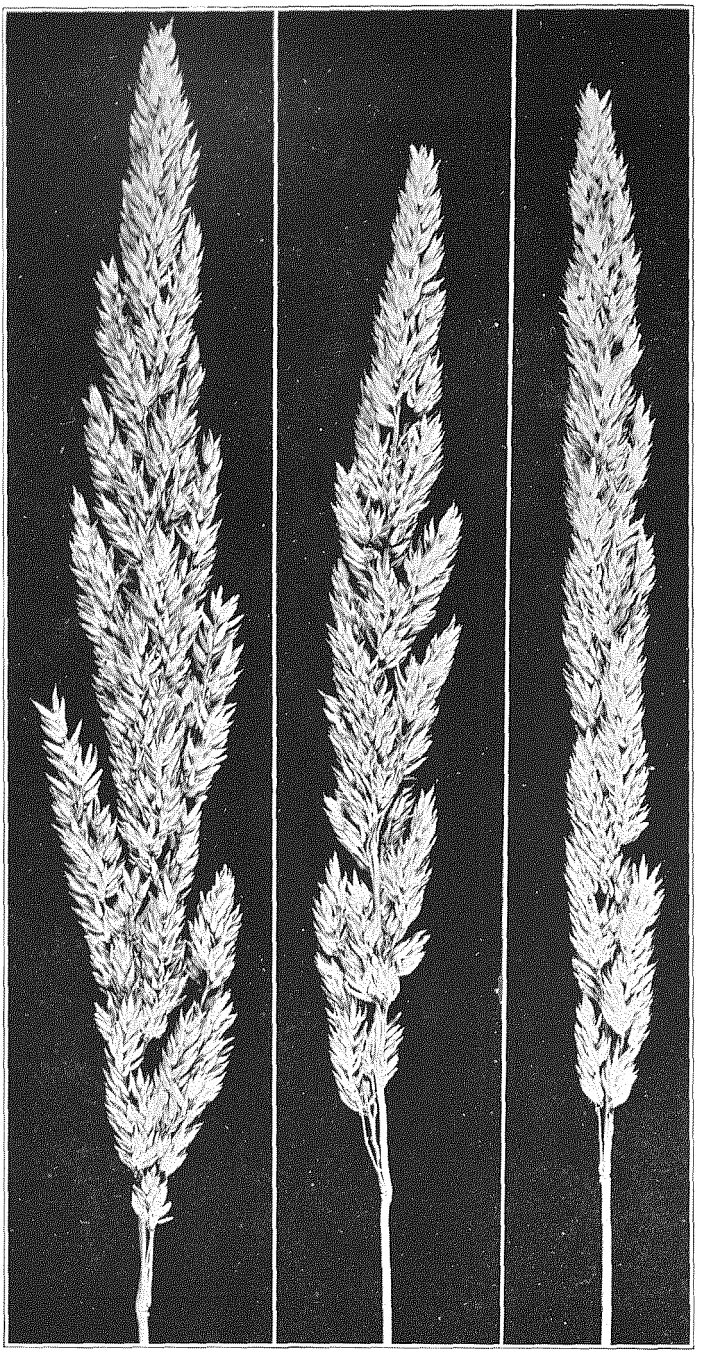


Fig. 1. Dense Mature Panicles of Reed Canary Grass Showing Variation in Shape

Note that the glumes of the spikelets are mostly erect, the glumes have spread and the seeds have fallen out. (Natural size.) At blooming time the branches of the panicles are nearly at right angles to the main stem. After the blooming period is over the branches take the more upright position shown in the figure.

REED CANARY GRASS

A. C. Arny, M. C. Hansen, R. E. Hodgson, and G. H. Nesom[1]

Reed canary grass *(Phalaris arundinacea)* is comparatively new among the tame forage and pasture crops in Minnesota altho it grows wild in practically every part of the state. Farmers, mainly in the south central part of the state, find it fills a definite need for a high-yielding, nutritious hay and pasture crop on numerous comparatively small areas of low-lying, poorly drained lands mostly of a peaty nature, which have been bringing in practically no return. The success of reed canary grass in south central Minnesota on land too wet to produce other crops has led to the purchase of seed by farmers in other parts of the state and questions arise as to its adaptability all over the state.

At the Minnesota Experiment Stations, work on the important phases of the crop has been planned for the next several years. Hence additional information of value to growers should be available.

HISTORY

Reed canary grass grows wild in North America northward from New Jersey, Colorado, and northern California. In Europe and Asia it is native to the temperate regions, particularly those to the north.

As a forage crop on cultivated lands, it was grown in England prior to 1824 and in Germany as early as 1850. In the United States, it has been grown in Oregon as a tame forage crop for forty years but the chief increase in acreage has come within the last ten years. In Coos County, Oregon, it is estimated that 10,000 acres of reed canary grass is grown as a tame forage crop. The acreage is steadily increasing in all the coast counties of Oregon and Washington, and in northern California. The crop is being established on the coast of the New England states. In Minnesota, mainly in Blue Earth, Le Sueur, and Waseca counties, it has been grown as a tame forage crop for at least fifteen years and the combined acreage of the comparatively small isolated fields is considerable.

Ribbon grass, a variety of reed canary grass with striped green and white leaves, is widely grown as an ornamental plant.

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The authors desire to give credit to the following men for supplying material incorporated in this bulletin: Prof. M. S. Grunder, Agronomist, Western Washington Experiment Station, Puyallup; Prof. M. A. Heim, Bureau of Plant Industry, U.S. Dept. of Agr., Washington, D.C.; H. A. Schoth, Assistant Agronomist, Oregon Experiment Station, Corvallis; H. S. Hale, County Agent, Coos County, Coquille, Oregon; Messrs. Farr and Elwood, and J. L. Smith, Coquille, Oregon; Prof. F. S. Wilkins, Iowa Experiment Station, Ames.

ADAPTATION

Where it grows wild in Minnesota, reed canary grass is found practically without exception on low-lying, poorly drained lands on which water usually stands in the spring and at other times during the year. As a tame forage crop, it is satisfactory on productive lands that are peaty or mucky and are too wet for other crops. On such lands, which would otherwise give practically no return, reed canary grass has yielded pasture and hay as valuable as the forage crops harvested from equal areas of adjoining well drained soils.

Because reed canary grass has done well on the peaty and mucky lands near Mankato, it should not be inferred that it is particularly adapted to peat or that it will be equally successful on such lands in other parts of the state. Conditions may appear similar in different areas but trial often proves them unlike. It is well adapted to wet mineral lands, and should be a desirable forage crop on the mineral soils subject to overflow along the banks of the Mississippi and Minnesota rivers.

Even the ribbon grass with striped leaves thrives better where moisture is abundant than on well drained lawns and gardens.

The conditions of soil and moisture under which reed canary grass is found growing wild and under which it has been successful in Minnesota as a tame forage crop indicate definitely that the seed now available at a high price should be sown on low-lying poorly drained lands where returns will be greatest.

Until more information is available on the adaptation of reed canary grass to different parts of the state, as a matter of precaution, only a pound or two of seed, at the most, should be sown by each prospective grower. If the first small area is successful when the best available information regarding seeding and handling the crop is followed, the acreage may be increased from seed produced on the farm. If the crop is not successful, the loss will be small.

After much of the low-lying land either originally adapted to its growth or made so by applying what is needed, is seeded to reed canary grass, consideration can be given to growing it on well drained mineral soils, if trials indicate that it can compete successfully with the hay and pasture crops now grown on this type of soil.

PLANT CHARACTERISTICS

Reed canary grass is a long-lived perennial, particularly when grown under favorable conditions. The plants are cold-resistant both as seedlings and in more mature stages. However, some plants may be killed when a covering of ice forms directly over the crowns. Reed canary

grass will grow up through fresh water, but is usually injured if covered by stagnant water for any length of time.

The rapidly spreading, short, underground stems form a sod, which becomes so thick and tough after a good stand is established that ordinary hay-making machinery may be used without difficulty, where before it was planted animals could walk over the land only with great difficulty. The underground stems and the abundant root system of reed canary grass are shown in Figure 2. It is not difficult to get rid of reed canary grass by fall plowing, even after a thick sod has been formed.

Fig. 2. Plant of Reed Canary Grass Showing Underground Stems

At A, what is left of the stem of the old plant from which the underground stems B and C sprang. At D, two new underground stems are starting.

Growth starts early in the spring and, when moisture is abundant, continues throughout the summer and autumn. In from 8 to 10 weeks, or about the first week in June, the panicles begin to appear and about four weeks later the seed matures.

The plants grow from 5 to 6 feet high or higher, depending on the productivity of the soil. The stems become increasingly coarser after the panicles begin to appear. Because of the strength of the stems, lodging rarely occurs. The leaves are broad, smooth to slightly rough, and light green, with the exception of the ribbon grass, the leaves of which are striped green and white.

The dense spike-like panicles vary in length from 5 to 8 inches and in width from one-half inch to one inch. There is considerable variation in the branching of the panicles. Typical panicles are shown in Figure 1.

The glumes of the spikelets making up the panicles turn straw-color, in some cases tinged purple, and the seed matures while the stems and leaves are still green. The lowest leaves usually turn yellow long before the seed is mature, owing largely to the dense growth and shading by the leaves higher up.

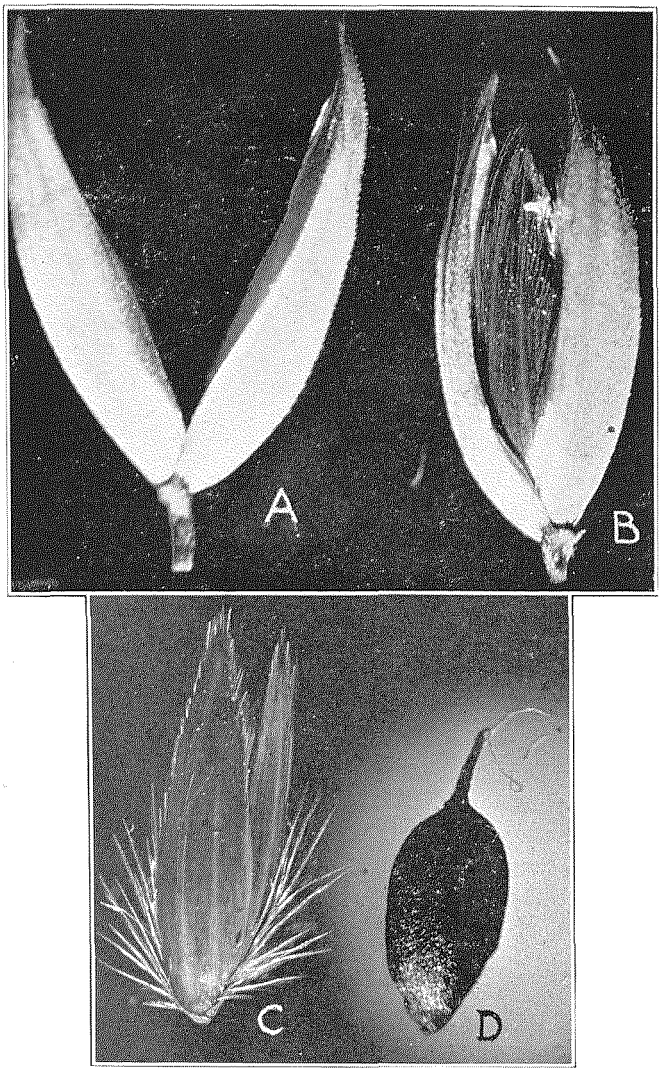

Fig. 3. A. Two Glumes of a Spikelet of Reed Canary Grass
B. A Complete Spikelet
C. Mature Seed
D. Naked Kernel, with Germ at Base at the left

The glumes turn straw-color at maturity. The seed, gray to brown in color and sparsely covered with long hairs, is still within the glumes, which have not opened. The mature seed resembles a gray to brown oat kernel. The two hairy scales, approximately one-third the length of the hulls, are shown, one on each side, in C. All are approximately 16 times natural size.

SEED CHARACTERISTICS

A panicle is made up of a large number of erect spikelets. A spikelet with the seed still in place is shown in Figure 3, B; and the two glumes of the spikelet from which the seed has fallen, at A.

Mature seeds are somewhat similar in appearance to those of oats but are much smaller. A typical seed, 16 times natural size, is shown in Figure 3, C. At maturity the hulls of the seeds are gray to brown, very shiny and slippery, like the seeds of flax. They vary from being sparsel covered with long silky hairs that give the seed a soft, fluffy feel to being almost free from hairs. At the base of each seed, two awl-shaped scales are attached that extend upward about one-third of the length of the seed. These may be covered with long hairs or nearly smooth. They can be easily seen on each side of the seed at C, in Figure 3. Each of these awl-like scales is enlarged somewhat at its base, which is free of hairs, as shown in Figure 4, and has a slightly corrugated surface. These enlarged portions form one part of each of the joints by which the seeds are firmly attached to the parent plant until maturity. These joints separate easily at maturity and the seeds lie loose between the glumes until the spikelets are tipped to one side. Then they fall out easily.

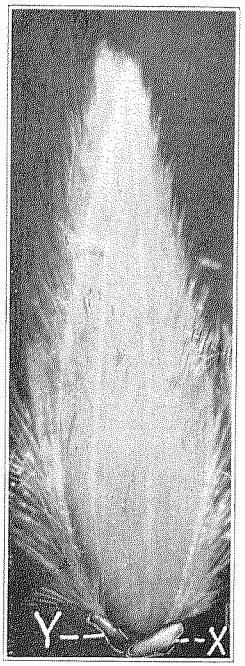

Fig. 4. Side View of a Reed Canary Grass Seed Enlarged 24 Times, Showing the Enlarged Bases of the Two Awl-like Scales at X and Y

The base of the scale at X usually overlaps the end of the base of the scale at Y. These enlarged portions form one part of a joint which holds the seed firmly attached until the approach of maturity. As the parts dry out when the seed is mature, the joint is released and the seed lies free between the glumes.

The seeds are small, 7 or 8 placed end to end measure one inch. Mature reed canary grass seed ranges from 425,000 to 600,000 per pound, and if there is considerable light-colored immature seed, there may be 700,000 or more. The weight per measured bushel of mature seed of the 1928 American crop, thoroly freed from chaff, ranged from 33 to 36 pounds. This varies with the plumpness of the seed.

GROWING THE CROP

Altho comparatively few have grown reed canary grass as a forage crop, available facts should aid all interested in growing it.

Present Sources of Seed

The necessity of gathering the seed by hand in the few days after it is mature and before it shatters excessively has limited the amount available and made the price high. The present price of from $1.00 to $1.75 per pound will undoubtedly be reduced materially when a machine is perfected that will harvest the seed satisfactorily and rapidly. The surplus seed harvested by farmers in Minnesota in 1928 was exhausted as soon as it was cleaned and put on the market. Because of the greater interest in the crop and the ready market for the seed, more will be harvested in 1929 than in 1928.

Another seed supply is that produced in Oregon and Washington Considerable amounts are still available, particularly in Oregon. One successful 18-acre field in Minnesota, increased from a small purchase of western grown seed several years ago, indicates that seed from this source can be used to advantage in Minnesota. However, as a matter of caution, only small amounts of western grown seed should be sown until carefully conducted comparative trials indicate that it is equal to that produced in Minnesota.

A considerable amount of seed is produced in Germany and adjoining countries but none is being imported at present. A German firm handling large amounts of seed guarantees the germination to be 89 to 90 per cent.

All American grown seed should be purchased with the understanding that the germination test is at least 65 to 75 per cent. This is low, but appears to be about the average for 1928 seed.

Securing a Stand

Where low-lying land is well enough drained that a good seedbed can be prepared, that method is best. Less seed per acre is required on a well prepared seedbed because practically every seed has favorable conditions. This is important at the present price of seed.

Plowing the ground in the fall makes it possible to do the seeding earlier in spring. If difficulty in getting on the fields in the early spring is anticipated, the surface may be worked down well in the fall and the seed sown in October. If sown as late as this in the fall the seed will lie in the ground until spring without germinating. It is there ready to germinate as soon as conditions are favorable. The seed germinates readily in water, but when covered with soil underneath water, it does not germinate until the water has disappeared. If water does not stand on the ground too long in spring, the seedbed may be prepared and the seed sown in the spring.

Where large numbers of broad-leaved weeds will grow rapidly, reed canary grass seed should be sown as early in spring as possible so the seedlings may be well established before the weeds begin to grow. The

seedlings of reed canary grass are as hardy as those of timothy and similar grasses, hence there is no danger of loss by freezing after growth has started. Where weedy land makes early seeding impractical, it may be delayed until the last week in June or the first week in July. This gives ample opportunity to disk the land throughout the spring months, in order to kill out the weeds before the seed is sown. When the seed is sown as late as this, the ground is not completely covered with sod the first year, unless more seed is used per acre than is economical at present prices. An average clump developed from a single seed planted early in July, 1928, on moist peaty land and photographed in November is shown in Figure 5.

Another method, on small areas, is to sow the seed in drill rows so that the weeds can be killed by cultivation. This has the further advantage of requiring less seed per acre than the broadcasting method.

Bogs that are too wet to bear up horses and machinery during the open season of the year and are not covered with water in the spring may be burned over and disked and harrowed as soon as the surface 3 to 4 inches is thawed out in spring. The burning should be done when the grass is dry and a brisk wind blowing so the fire will pass over the field quickly. Where there is danger of burning peat land, attention must be given to places where fire starts in it, as soon as the surface has been burned over. Even if the surface soil is wet, this practice levels the field and makes conditions more favorable for the germination of the seed and the establishment of the plants.

Bogs that are covered with water in spring should be burned over in the fall. As soon as the water settles away and before the surface dries, broadcast the seed by hand on the muddy surface. It will settle down in the mud and germinate promptly.

Where old reed canary grass stands are available, sods as small as 3x6 inches or other convenient shape can be dug in spring and planted two feet apart each way. Where there is a good seedbed and other conditions are favorable, the sods planted 2 feet apart each way in spring should completely cover the ground by fall. This method is more certain of results than that of sowing seed on land where no seedbed can be prepared, and 2 feet apart or less is preferable to a greater distance. Burning the land off clean facilitates planting the sods in spring and gives them a better chance to become established.

Rate, Method, and Depth of Seeding

At the present high price of seed, and the difficulty of securing seed of satisfactory germination, it is much more economical to broadcast from 4 to 6 pounds or drill 2 to 3 pounds per acre in 16- to 18-inch rows and let the sod form more slowly through growth of the underground parts than to sow at a higher rate. When germination is le-

Fig. 5. A Clump of Reed Canary Grass 6 Inches in Diameter Developed from a Single Seed Sown on Moist Highly Productive Land July 16, 1928
(Photographed in November.)

Many of the clumps from single seeds were larger than this. The extensive vigorous feeding root system is shown below the main part of the clump.

than 50 per cent, more than these amounts must be sown; and more must be sown on poorly prepared than on well prepared seedbeds.

Four pounds of seed germinating 80 per cent, sown evenly over an acre, means about 40 good seeds per square foot and when the germination is 50 per cent, about 24. On a well prepared seed bed 24 seeds per square foot should give a satisfactory stand. Sowing 4 pounds of timothy and 2 pounds of alsike clover seed with that of the reed canary grass on well drained soils will give more growth the first year but will delay the securing of a full stand of the reed canary grass. On poorly drained land subject to overflow, 4 pounds of redtop seed and 2 of alsike clover may be used with that of the reed canary grass. In time the reed canary grass crowds the others out. When reed canary grass seed becomes lower in price, more seed per acre can be used.

The seeds of reed canary grass and the seedlings are small. Therefore a covering of from less than half an inch to three quarters of an inch is ample. On peat lands, the use of a heavy roller after the seed is sown firms the surface and provides better conditions for germination and growth.

Care After Seeding

If a thick stand of broad-leaved weeds is growing more rapidly than the reed canary grass seedlings, they should be clipped back. Where the reed canary grass is drilled in rows, some cultivation can be given until the plants become well enough established to compete successfully with the weeds. Reed canary grass should not be pastured at all the season it is sown. If a luxurious growth is made on spring seedings, it may be cut high as hay in early September, but should not be cut later. Maximum pasture and hay crops are not produced until after a good sod is established.

If the first crop of the second year is left to mature seed, it helps to establish a good sod. The seed that falls to the ground, even when carefully harvested, germinates and grows the same or the following season.

Reed canary grass needs the same fertilizer as other grasses on the same land. Applications of fertilizers to this crop in south central Minnesota have not increased yields. This should not be taken as indicating that reed canary grass will not respond to fertilizer applications in parts of the state where they are needed for other crops.

USING THE CROP

After a good reed canary grass sod is formed, animals do not sink in fields that were difficult to traverse before and ordinary hay making machinery may be used without difficulty.

Pasture

Reed canary grass starts early in spring, even before water standing on it disappears. Where the water in the soil is adequate, it will produce an abundance of green feed throughout the summer and fall. Its use for pasture lengthens the grazing season. When Kentucky bluegrass pastures on high lands are dry during August, this grass on low lands continues to furnish large amounts of green feed.

Records of the carrying capacity per acre of reed canary grass pasture are not numerous but check fairly well. In Oregon, where the sod is well established on lands where the moisture supply is abundant and other conditions are favorable, pasture for three or four mature dairy cows per acre throughout the grazing season may be expected. In Minnesota, so little use has been made of the crop for pasture that no accurate data are available. The grass is palatable if kept grazed fairly close and has about the same nutrient value as other tame pasture grasses grown under the same conditions. Pasturing close late in the fall should be avoided until the best methods to follow in pasturing this crop are determined.

Hay

The first crop should be cut for hay as soon as the panicles begin to appear, as the hay is higher in nutritive value and finer than when it grows beyond this stage. In south central Minnesota the grass usually reaches this stage of development during the first part of June. Where this practice is followed, two or three crops with some fall pasture are usually secured per season. The crops produced after the first one has been removed do not usually produce panicles. A field of second crop hay is shown in Figure 6. How many cuttings to remove after the first one and when to cut will be determined by the growth made and the weather for drying the crops. Ordinarily it is desirable to have a growth of from 6 to 8 inches on the meadows at the beginning of winter.

As with other forage crops used for hay, the first crop has a tendency to be coarse. Using the crop for pasture up to June, and then letting it grow for hay results in a leafy crop. Where pasture is likely to be short in summer, the first crop is often used for hay or seed and later crops are pastured.

From well established meadows growing under favorable conditions of soil and moisture, from 4 to 6 tons per acre have been cut. Where the soil is very productive and moisture is abundant, yields may be higher. Yields per acre in parts of the state outside of what is known to be the favorable growing section (around Mankato) must be determined by trial. The hay is bulky and yields per acre estimated from the number of loads hauled from the field are likely to be placed too high.

When the panicles have been removed in saving seed, the leaves and stems, which are still green, should be cut immediately for hay. This gives a large yield of comparatively coarse hay. Following this

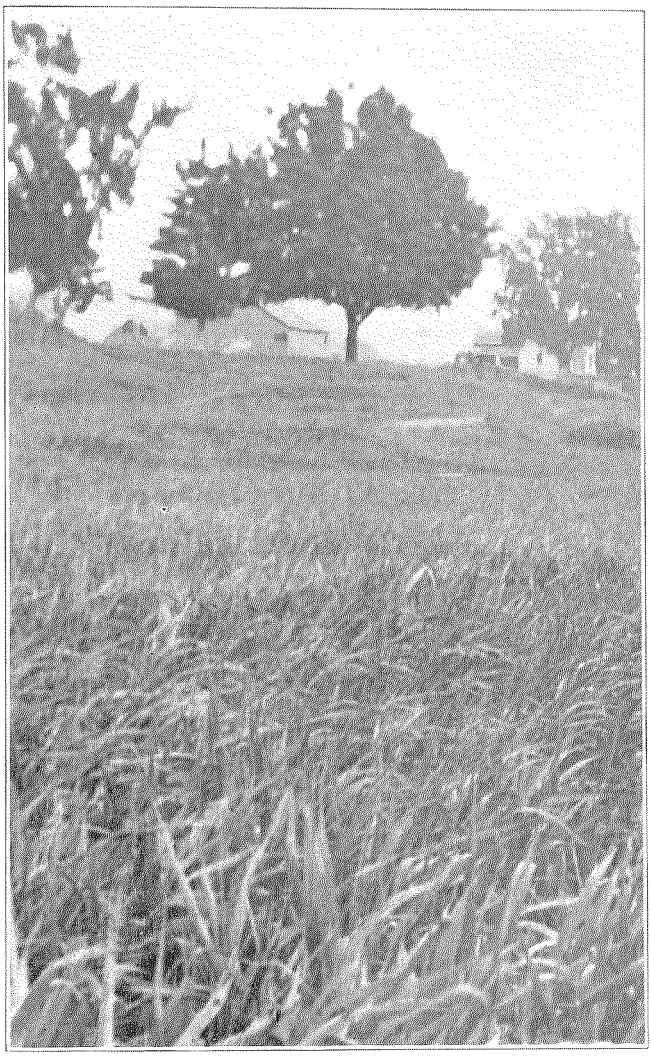

Fig. 6. Second Crop Reed Canary Grass Hay Photographed in August, 1928, on the Farm of L. F. Guentzel, Madison Lake

a second crop and some fall pasture are usually obtained. In Oregon, the crop harvested immediately after the seed has been removed is satisfactory for silage.

Composition of the Hay

Relatively few complete analyses have been made of the fresh grass and the hay. An average of ten analyses of the hay is given by Henry and Morrison in "Feeds and Feeding," but no information is given as to where the samples analyzed were grown or the stage of maturity. This average, together with the average for timothy at the stage from early to full bloom and of redtop and alfalfa in bloom, is given in Table I.

TABLE I

COMPOSITION OF REED CANARY GRASS HAY COMPARED WITH THAT OF OTHER HAYS

Crop	Water	Crude protein	Crude fiber	Starches and sugars	Fat	Ash	No. of samples analyzed
	per cent	per cent	per cent	per cent	per cent	per cent	
Timothy	12.8	6.3	29.5	44.2	2.6	4.6	50
Redtop	8.0	7.2	29.9	44.7	2.1	8.1	15
Reed canary grass	9.6	7.9	29.0	42.9	2.7	7.9	10
Alfalfa	7.5	15.0	30.2	35.5	1.8	10.0	31

The crude protein was slightly higher in reed canary grass hay than in timothy and about half as high as in alfalfa. If the crops from which these samples came were cut at full bloom or just past that stage, as is the custom here with other grasses, the results are not representative of what may be expected from reed canary grass crops cut at the proper stage of development. The protein content of the reed canary grass hay fed in the trial, the results of which are given on pages 14 and 15, was considerably higher than this average. Weber,[2] a German writer, gives the crude protein content of reed canary grass as 10.5 per cent, with the comment that the hay analyzed was somewhat past the most desirable stage of development. He states that reed canary grass cut at the proper stage of development may be expected to approach red clover of average quality in feeding value. In other constituents reed canary grass hay is similar to timothy and redtop except in ash, in which timothy is lower.

In digestible nutrients, there is approximately the same relationship as in the average composition. These data are from "Feeds and Feeding," by Henry and Morrison, and are given in Table II.

TABLE II

DIGESTIBLE NUTRIENTS IN 100 POUNDS OF HAY

Crop	Total dry matter	Crude protein	Carbohydrates	Fat	Total	Nutritive ratio
	lb.	lb.	lb.	lb.	lb.	
Timothy	87.2	3.6	44.7	1.2	51.0	13.2
Redtop	92.0	4.5	46.4	1.1	53.4	10.9
Reed canary grass	90.4	4.5	44.6	1.4	52.3	10.6
Alfalfa	92.5	10.5	38.5	0.7	50.6	3.8

[2] Weber, C. A. "Das Rohrglanzgras durch die Rohrglanzwiesen." Verlag. von Paul Parey, Berlin. 1928.

Additional data are needed on the composition of reed canary grass hay grown in Minnesota under different conditions and cut at definite stages of development.

Any grass crop must be cut for hay at a comparatively early stage of development in order to approach in protein content alfalfa hay cut at the usual time. The expense of cutting grass crops for hay at very immature stages usually makes such a practice unprofitable. The largest yield possible of good hay should be secured. Such hays are high in carbohydrates, sugars, starches, and fats, which provide heat and energy needed by animals. The additional protein needed to balance the ration can be had by feeding leguminous hays as part of the roughage along with the reed canary grass and the usual concentrates.

Grass hay produced on soils above the average in available nitrogen may be higher in protein content than those produced on soils lower than average. Some of the low-lying lands on which reed canary grass has been produced in this state may be higher in available nitrogen than the average well drained mineral soils.

Palatability and Feeding Trials of the Hay

Farmers who have been feeding reed canary grass hay cut before it became too coarse have found it palatable to all classes of livestock.

At the Iowa Experiment Station hay made from reed canary grass cut after the seed had matured was fed to horses in comparison with timothy hay cut at the usual time. The horses ate this relatively coarse reed canary grass hay cut long after the proper stage of development in preference to the timothy.

At the Southeast Experiment Station, at Waseca, good reed canary grass hay was as palatable to cattle, after they became accustomed to it, as good timothy and was superior to wild hay. It was less palatable than alfalfa hay.

The following results were secured from comparative feeding tests of good reed canary grass, timothy, wild hay, and alfalfa hay.

The cows used in the trial always have had an abundance of good alfalfa. No other hay has been fed. Group I consisted of four cows producing an average of 25.2 pounds of milk per day. They were eating from 13 to 14 pounds of alfalfa each, daily.

When well cured second cutting reed canary grass hay was substituted for the alfalfa, they consumed only 5.7 pounds per day. Other feeds were held constant, and the consumption of hay increased steadily, so that after three weeks the cows were eating 11 pounds of the reed canary grass.

Milk production dropped gradually after the change in hay until the average was from 3 to 3½ pounds per day less than when alfalfa was

fed; there was no increase in the first 10 days after the feeding of alfalfa was resumed.

Four other cows, forming Group II, were eating about 12 pounds of alfalfa per day each. When reed canary grass hay was substituted, they ate less than 6 pounds. They, too, ate more as they became accustomed to the change, eating more than 8 pounds per day at the end of a week. When choice early cut timothy was substituted for the hay under trial, each cow ate an additional pound per day.

After a week on timothy, wild slough hay was given, and consumption decreased. When alfalfa was restored to the ration, the amount of hay consumed daily went back to normal.

In milk production the cows of Group II dropped about the same as those of Group I on reed canary grass, more on timothy, and still more on wild hay. No further loss in milk production occurred when alfalfa was again used in the ration. The total reduction was about 4½ pounds per cow per day.

Group III, fed alfalfa throughout the test period, varied only 2 pounds of milk per day in the same period.

This brief trial indicates that the cows did not like a sudden change from alfalfa to reed canary grass. They ate only half as much at first and their production dropped. Gradually they ate more of the grass but not enough to keep up the milk flow maintained on alfalfa. Whether this was due to the change in hay or to a lack of food nutrients is not known. The crude protein content of the second cutting reed canary grass hay used in the trials was 12.7 per cent.

Further feeding tests are planned for next winter.

SEED PRODUCTION

Reed canary grass seed is high in price, partly because no machine has been perfected that will harvest it satisfactorily. Some progress has been made in adapting a machine to do this work and a considerably lower price appears to be reasonably certain within the next few years.

The seeding habits of the plant make it difficult to harvest large amounts of seed by hand. Maturing of the seed in the panicles is progressive. When the first seeds in the panicles of reed canary grass are mature, as indicated by the hulls being fully colored gray or brown like the one at A (see cover page), others range in amounts of color present down to the one at D, where there is only a trace. Still more immature seeds are entirely green and others lack the green color entirely, like the one at E. The germination percentages and other data for seeds with varying amounts of color in their hulls are given on page 17. The first mature seeds drop out and are lost before the most of it is far enough advanced to harvest. To make matters worse, there are only

a few days between the ripening of the first seeds and the time when too many have fallen to make it worth while to continue gathering the panicles. This makes it necessary to watch the crop closely during the latter part of June and the first days of July as the panicles begin to turn color and, when the largest amount of mature seed can be secured, to put all available help to work gathering the panicles.

Where only a small area of reed canary grass is available from which to gather seed, the practice of shaking the panicles each day over a wide pan, beginning on the day that the first gray to brown seeds appear in the panicles and repeating the operation daily until all the seeds have matured, will give more good seed than if the panicles are cut at any one time.

Harvesting the panicles when the first gray to brown seeds appear results in low yields, made up of too large a proportion of seeds light in color and low in weight. Seeds that were straw colored, light green, or had only a slight amount of gray or brown on the hulls, were separated from samples of the 1928 crop and weighed in comparison with seeds from the same samples having the hulls entirely gray or brown. The light colored immature seeds weighed only 68.6 per cent as much as the mature seeds. The average germination of the gray seeds was 86 per cent and that of the seeds only partly gray was 65 per cent.

In another test, in which seeds of two lots of the 1928 crop harvested at the usual time and not cleaned or graded, were separated into groups according to amount of gray or brown on the hulls (see cover page), the average results were as follows:

Color of hulls	Seeds of the various grades of color present	Weight per 1,000 seeds	Weight per 1,000 seeds	Germination in 16 days
	per cent	grams	per cent	per cent
Entirely gray or brown (A, cover page)	48.5	0.865	100.0	91.0
Down to 75 per cent gray or brown (B, cover page)	23.5	0.775	89.8	83.5
Down to 50 per cent gray or brown (C, cover page)	13.2	0.691	79.9	83.0
Down to trace gray or brown (D, cover page)	8.2	0.574	66.4	72.5
Entirely green	4.1	0.452	52.3	51.5
Trace of green (E, cover page)	2.5	0.358	41.4	30.5

From these data it is evident that the more mature the seeds are, as evidenced by the amount of gray or brown color on the hulls and plumpness as indicated by weight per 1,000 seeds, the higher the percentage of germination. In these samples, 93.4 per cent of the seeds had a trace or more of gray or brown on the hulls when harvested. All germinated more than 70 per cent. The data show that the seeds that were entirely green or with only a trace of green in the hulls har-

vested at the same time as the more mature seed may be expected to germinate from 30 to 50 per cent. As long as the price of seed remains high, the seeds with green hulls separated out from the others in preparing the seed for market may be used to advantage for increasing the acreage at home. The indications are that more than twice as much by weight of this seed should be used per acre as of mature seed.

These germination tests show definitely that the low germination of many samples of mature seed tested in 1928 and 1929 is not due to immaturity but to unsatisfactory methods of drying the seed after it was harvested.

In order to lengthen the harvest period the maturity in different parts of the same field or in different fields might be varied by pasturing in spring for a short time or by clipping back the growth early in spring. What the effect of following out these practices would be on the yield of seed is not known.

Some work has been done on the selection of strains that retain the seeds better than others after they are mature. Further developments along this line may be expected.

One method followed in gathering the seed by hand is as follows: A wooden or wire keg or barrel hoop is fastened inside at the top of a wide, tightly woven canvas bag. Canvas straps are attached so the bag can be suspended over the neck at the proper height and the panicles can be dropped in easily as they are cut with a hand sickle. Tight canvas bags are necessary so the slippery seeds will not work through the cloth.

As the panicles are grasped, cut off, and placed in the bag, care should be exercised to keep them strictly upright, so that as many of the mature seeds may be secured as possible. As the bag is filled, the contents are either emptied on a tight canvas or into a wagon box that is tight enough to retain the loose seeds as well as the panicles. The panicles and the loose seed are then spread on a tight floor in a well ventilated place where wind can not blow the seed away, and are turned daily to facilitate drying.

The water content of the panicles and the seed is relatively high at the time they are gathered and care must be exercised to avoid molding and heating, both of which rapidly reduce the germinating power of the seed. It is more necessary to stir the seeds that have fallen out of the panicles and that lie close together on the canvas or floor underneath them than to turn and stir the panicles frequently. There is no reason why the seed of reed canary grass should not germinate from 80 to 90 per cent or more. Many lots of seed of the 1928 crop germinate lower than from 50 to 60 per cent and a considerable number as low as 20 per cent. This unsatisfactory germination is due to a limited extent to immature

seed and largely to improper methods of drying. With the high cost of labor for gathering the seed by hand, more care should be exercised in properly drying the product so as to conserve this value. Satisfactory methods of drying the seed should be worked out while the amounts harvested are still comparatively small. Rapid harvesting of large amounts of seed by machine methods will make the problem of drying much more difficult unless developments in drying are in advance of those of harvesting.

Until better methods of handling the seed are generally followed, all purchases should be made on sample with the understanding that the seed purchased test as high in germination as the sample. Good seed germinates promptly at ordinary room temperature in 9 or 10 days. At lower temperatures the germination is slower.

Yields of from 150 to 200 pounds of seed per acre have been harvested. As a considerable quantity of the seed is always lost before harvesting can begin and while it is in progress, the actual amounts produced per acre were undoubtedly considerably higher than this.