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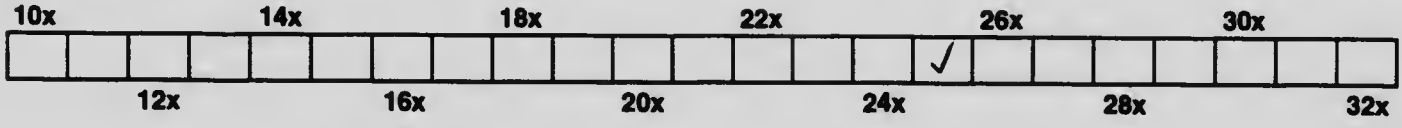

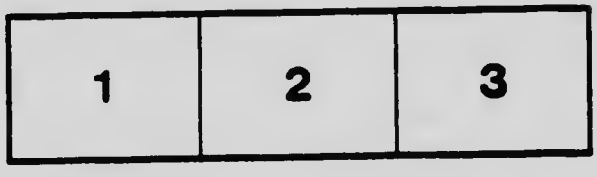

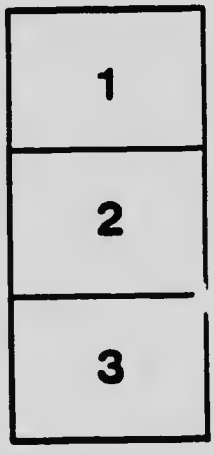

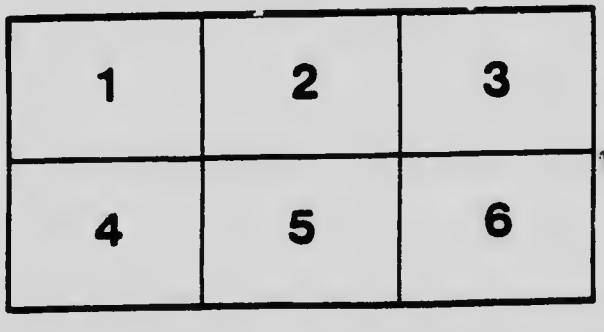

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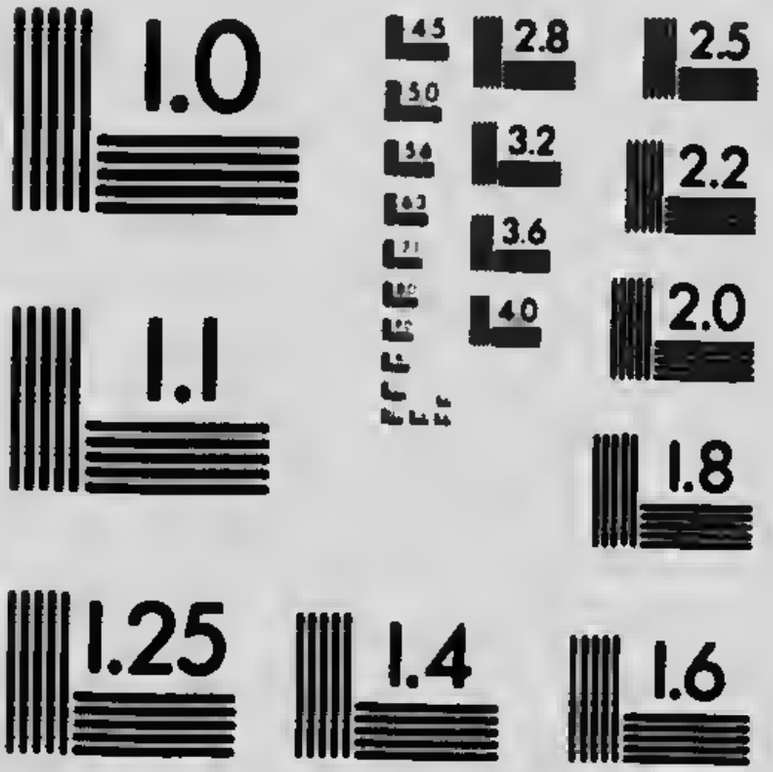

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DOMINION OF CANADA
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DOMINION EXPERIMENTAL FARMS

WILD RICE

By
FAITH FYLES, B.A.
ASSISTANT BOTANIST

Bulletin No. 42
Second Series

Published by direction of HON. S. F. TOLMIE, Minister of Agriculture, Ottawa, Ont.

OTTAWA
J. DE LABROQUERIE TACHÉ,
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1920

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By
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Assistant Botanist

BULLETIN NO. 12
Second Series

Published by direction of Hon. S. F. Tolmie, Minister of Agriculture
Ottawa

OTTAWA
J. DE LABROQUERIE TACHÉ
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1920

77754—1

OTTAWA, December 1, 1919.

The Honourable
The Minister of Agriculture,
Ottawa.

SIR,—I have the honour to submit herewith for your approval the manuscript of Bulletin 42 of the second series, prepared and illustrated by Miss F. Fyles, Assistant Botanist.

As a food for man, wild rice has a distinct value. Our main object, however, in the publication of this bulletin, is to stimulate its growth in those localities where it is found to thrive in order to attract and furnish food for our wild fowl, which, under modern conditions, either tend to disappear or to forsake their former haunts in favour of more unsettled regions.

I have the honour to be, sir,
Your obedient servant,
E. S. ARCHIBALD,
Director, Dominion Experimental Farms.

FRONTISPIECE.—Indians preparing rice for food.

1. A Mississagua squaw parching wild rice by stirring over a slow fire. Near Harwood, Rice Lake, Ontario.

2. "Dancing" wild rice to separate the grain from the hulls. Near Harwood.

3. Winnowing wild rice. Near Harwood, Rice Lake, Ontario.
—*Adapted from photographic postcards.*

77754—2½

WILD RICE.

COMMON NAMES.

Wild rice (*Zizania aquatica* L.) is known under a variety of popular names derived from the English, French and Indian languages. The most familiar are: American rice, Canadian rice, Indian rice, field rice, black rice, squaw rice, water rice, water oats, mad oats, marsh oats, espéce de seigle de marais, fals avoines, fausse avoine, folle avoine, riz du Canada, menoma, menomen, tuscarora.

HABITAT AND DISTRIBUTION.

In Canada wild rice is native in the provinces of Quebec, Ontario, and Manitoba. It is found in abundance in the various quiet, mud-bottomed bays and shallows of the lakes and streams emptying into lake Winnipeg, lake of the Woods, lake Superior, Georgian bay, lake Huron, lake St. Clair, lake Erie, lake Ontario, bay of Quinte: also along the river Trent and its various tributaries, in Rice lake, lake Scugog, lake Simcoe; in the

Photo—F. Fyles.

Wild rice in the Rideau river at Smith's Falls, Ont.

river St. Lawrence at Montreal, in the Rideau and Ottawa rivers in the neighbourhood of Ottawa; above and below the city of Quebec, at New Liverpool, Sillery point, Beauport flats, island of Orleans, Levis and as far down the river (St. Lawrence) as L'Islet. It may possibly extend for some distance below L'Islet, but it was not found at Rivière-du-Loup, owing to the salinity of the water. Wild rice will grow in slightly brackish water, but where the water is distinctly salty to the taste, it is not to be found.

Drawn by F. Fyles.

Wild rice in bloom. *a*—Staminate portion of the flowering stalk, *b* The pistillate, reduced. *c* The ripened head of grain, reduced. *d* The pistillate flower with stigmas protruding, enlarged. *e* Staminate flower, enlarged.

Wild rice was introduced into Nova Scotia without any great success, due to the fact, no doubt, that it was not sown in sufficient quantities to allow for the depredations of wild animals.

It has been reported from New Brunswick.

Mr. A. Robertson, of the Hatchery, Harrison Hot Springs, B.C., has succeeded in growing it in British Columbia from seed sent by us.

DESCRIPTION.

Wild rice is an attractive annual aquatic plant, belonging to the large family of grasses. In the autumn it sheds its seeds into the water, where they remain in the mud during the winter and germinate early in the spring. The first leaves to appear on the surface are the long, narrow, floating leaves which die down when the main stem appears above the surface of the water. The main stem is hollow, from two to ten feet high, with green, vigorous leaves, continuing up to the base of the flowering top. The flowers are of two kinds, the pistillate or seed-producing flowers above, and the staminate, or those which bear the pollen, immediately below. The pistillate flowers are erect and closely appressed to the main axis, while the branches of the staminate are spreading to allow the pollen to be scattered by the wind. Cross-fertilization is provided for by nature, as the pistillate portion of the panicle reaches perfection before the staminate of the same stalk has yet unfolded from the sheath. The pistillate flowers consist of ovary, style and stigmas, with two glumes, or protecting coats, the outer and larger terminating in a long awn. These glumes are open at the base when the stigmas emerge to receive the pollen, but they close and their edges become tightly enfolded as the embryo develops. The two glumes of the staminate flowers open wide to display the six yellow stamens, hanging lightly from slender thread-like stalks.

The plants used for the illustration were grown from seed collected at Hymers, Ont. Those growing about Ottawa differ chiefly in size and colour, showing little or no purple in the glumes which colour is typical of many of the western Ontario plants. The plants at Quebec and its neighbourhood have a very different general appearance due, no doubt, to the effect of the tide. They are much shorter, some mature plants being only 6 to 10 inches high, the highest about three feet. The panicle is more spreading and the seeds are small with little or no awn.

HISTORY.

The period at which wild rice was first used as a food is unknown; but it is certain that for nearly two hundred years it has proved a valuable means of sustenance to the Indian and to the white man, both hunter and settler.

In 1766, Carver wrote in respect to its use by the whites: "In future periods it will be of great service to the infant colonies as it will afford them a present support, until in the course of cultivation other supplies may be produced."

Later, in 1775, Henry in his "Travels" says that without a large quantity of wild rice (obtained at lake of the Woods) the voyage beyond the Saskatchewan river could not have been prosecuted to its completion.

In 1828, Flint wrote as follows: "It is astonishing, amidst all our eager and multiplied agricultural researches, that so little attention has been bestowed upon this interesting and valuable grain. It has scarcely been

known, except by the Canadian hunters and savages, that such a grain the resource of a vast extent of country, existed. It surely ought to be ascertained if the drowned lands of the Atlantic country will grow it. It is a mistake that it is found only in the northern regions of the valley."

Since Timothy Flint wrote his famous "Geography and History," much has been done by the Departments of Agriculture of Canada and of the United States to spread the knowledge of wild rice and its uses. It seems remarkable in the light of our present information, that modern methods and machinery have not been applied to improve the Indian's primitive mode of preparing wild rice for food.

GERMINATION

Many attempts have been made to establish new wild rice beds with little or no success. These failures have been due chiefly to two main causes, i.e., lack of germinable seeds and lack of a suitable bed. As the shallow, mud-bottomed bays and inlets of the waters bordering the Experimental Farm, Ottawa, had previously been proved to be most satisfactory for growing wild rice, attention was given to the germination and storage of the seed.

On August 19, 21, and 22, 1911, wild rice growing at Billings bridge, Ottawa, was studied in the field. It was found that many green coloured seeds fell or were shaken into the water as well as the fully ripened brown ones. This suggested the possibility of keeping seeds dry for a considerable time without loss of vitality. Some of the seeds gathered were kept dry for three days and sown in three inches of mud in quart glass jars which were filled with water. The bottles were then packed in a stout wooden box and the whole covered with wire netting and hung in the boat house, the top of the box being on a level with the water. These seeds were tested May 8, 1912, with the result that the dry seeds were found to have germinated nearly, if not quite, as freely as those which were sown on the day of gathering. It was found, however, that the seeds gathered in a green state and kept dry did not give the same high percentage of germination as those more fully matured.

In 1912 and 1913, similar tests were made over a longer period of time. Seeds gathered at Ottawa and kept dry for two weeks germinated 72 per cent. Seeds gathered at Hymers, Ont., and shipped in Sphagnum moss, being eight days in the damp moss and sown the next day, gave 96 per cent. Some of the same seed taken out of the moss and kept dry for eight days, gave 66 per cent. Seeds shipped dry from Hymers gave 100 per cent, being kept dry twelve days from time of gathering. Some of the same seeds kept dry for two weeks gave 74 per cent, and for three weeks, 66 per cent. Some seeds from Wellington, Ont., which were unfortunately exposed to the sun for five hours after gathering, gave 60 per cent after being kept dry for two weeks, and only 6 per cent after three weeks. This low percentage was partly due to the effect of the sun and partly to the inferior quality of the seed.

Three lots of seed gathered from the beds at the Central Experimental Farm, August 12, 1913, and kept dry for two days before sowing, gave 100 per cent germination each. These seeds were gathered very carefully. The plants were shaken gently so that only the fully matured seeds fell off.

The chief object in making these germination tests, from the practical point of view, was to ascertain whether seeds shipped dry on a journey of two or three weeks would be worth sowing when they reached their destination.

Photo—F. Fyles.

Seeds germinating in the spring, having been stored outside in a barrel of earth and water during the winter.

With this object in view, dry seeds were sent to England and tested at Kew Gardens. Twenty-five days had elapsed from the time they were gathered at Ottawa to the time they were sown at Kew Gardens. They germinated 42 per cent.

The wild rice germination experiments were not carried on again until the autumn of 1917. Then we found some difficulty in obtaining seed. None could be had from Hymers, as our former gatherers had gone

to the front, and that finally obtained from Kars, Ont., was of an inferior quality due to the rainy season. The seed was small, undeveloped, and ripened slowly, so that of the seed gathered, little was in first-class condition. The experiments of 1912 and 1913 had proved that wild rice seed could be stored dry for two or three weeks and still give a fair average percentage of germination. It was hoped to find now the average time for complete loss of vitality of those seeds preserved dry. The seed on hand was not conducive to a fair test, but twenty-four tests were made. It was found that seeds kept dry for four weeks gave 45 per cent, for six weeks 14 per cent and for seven weeks 1 per cent. It was concluded that for all practical purposes, wild rice seed should not be kept dry for longer than two or three weeks before sowing, or storing in water.

SUMMARY OF GERMINATION TESTS.

(1) Wild rice may be kept dry for two or three weeks under ordinary conditions and retain a germination percentage of at least 50.

(2) Seed packed dry gives better results for a journey of two or three weeks than that packed moist.

(3) Seeds to be kept dry for transportation and sowing should not be exposed to the sun after gathering.

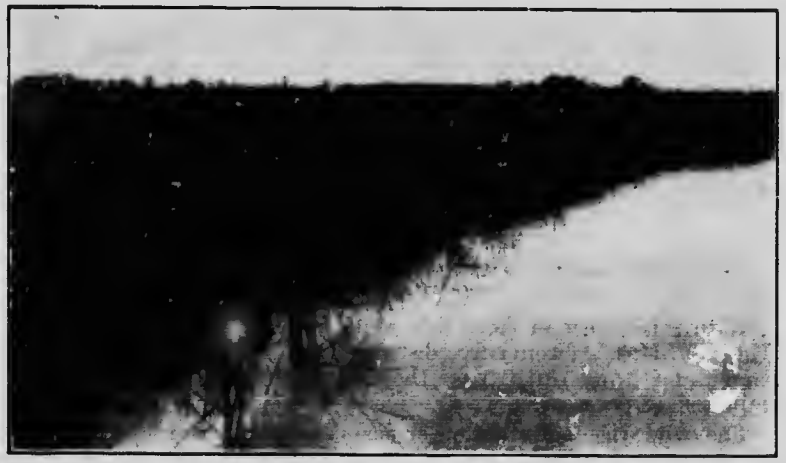
(4) Wild rice to be transported for seed should be gathered on a dry day in a dry vessel and kept in a cool dry place. It should be stirred or turned over two or three times the first one or two hours and then shipped as soon as possible. Each day after gathering means a certain loss of vitality.

(5) Fully mature seeds, kept dry, retain their vitality for a longer period than immature seeds.

(6) Seed gathered at Rice lake, Ont., and westward, being of a larger variety than the eastern, appears to give a higher germination percentage than the latter, when kept dry for two or three weeks.

CULTIVATION.

As mentioned above, wild rice grows naturally in a mud-bottomed bed in shallow waters which are not stagnant nor yet too swiftly flowing.



Photo—F. Fyles

Suitable bed for wild rice along a shallow, mud-bottomed stream.

In the cultivation of this wild plant, these conditions must be borne in mind and carried out as closely as possible. Where these conditions prevail naturally on the margin of lake or stream, the seed may be sown, but if new to the locality, the plants will be as much a novelty to all wild animals as they are to the sower and must be guarded the bed is firmly established. A bed in a stream or pond on cultivated land near dwellings is not so liable to be attacked and may be readily supervised. But where the bed is desired as an attraction for wild fowl, seed must be sown in larger quantities to allow for their depredations.

Having secured a suitable bed, the next step is to obtain germinable seed. It is useless to sow seed which has lost its vitality. The sowing of seed which has been kept dry for several months is the chief cause of so many failures in the cultivation of wild rice. Seed which is freshly gathered and sown shortly after in the late summer or early autumn usually gives the best results. Fresh and well ripened seed, that is seed which has accumulated a sufficient supply of food for the seedling to live upon during the early stages of growth, will sink at once by its own weight. Its sharply-pointed end reaches the mud first at right angles and soon becomes buried out of sight of marauding water-fowl. This is a good test for fresh and properly ripened seed. Unripe seed, dry seed, and seed whose glumes are only partially filled with stored material will float on the surface for some time before sinking and often lie exposed on the surface of the mud where they serve as a decoy for the good seed beneath. Thus failure will again be the result. Seed which has been kept dry for the purpose of transportation should be soaked in a large vessel of water before sowing. It should be left there till all the good seed has sunk. The poor seed and refuse may then be removed and a more evenly planted bed will thus be secured.

The seeds should be scattered on water which is from one to three feet deep. Notice should be taken of the place where the first sink and the next handful sown accordingly. Should they drift too far, the young seedlings are likely to be smothered by the depth of water. Reeds and rushes on the margin, provided they are in sufficient water, are a support to the young plants and protect them against the wind, but they are a great disadvantage if the rice is sown for grain or seed. In that case the rice should be sown beyond the other tall aquatic plants and thickly enough for self-support against winds. A sparsely-sown bed, and also a bed in very shallow water, produces plants which branch from the base and thus the time of maturity is continued on into unpropitious weather. Wild rice needs the hot sun of July and August for good seed development. A well sown bed should produce an even, good stand of ripened heads about the end of August or first week in September. Seed which has been stored during the winter, should be sown as early as possible in the spring, that is as soon as the ice is out and the spring freshets are over. Seed sown in swollen waters is likely to be stranded with the return of normal conditions. Under favourable conditions, the bed needs little attention after sowing and will resow itself if allowed to do so.

Swamp land bordering on stream or lake may be put into trenches for growing seed. The trenches should be dug in the autumn after the weeds have been mown off. They may be made two feet wide, two feet deep, two feet apart, and as long as desired. There is usually sufficient seepage to prevent stagnation but if necessary, an outlet and an inlet trench may be dug from the first and last trench having the trenches connected at alternate ends. The soil should be overturned between the trenches to make a solid path for gathering the seed. If the land is very wet it may be

found better to put the sod from each of two adjacent trenches on the same path. The trenches will soon fill with water and the seed may be sown at once. Trenches were used at the Central Experimental Farm for experimental purposes for the past two years and were found successful. The plants, which were allowed to resow themselves the first year, produced a good stand for next year. The advantages of the trenches are chiefly that they may be supervised more readily, they are less open to the attacks of wild animals and the seed may be gathered without the use of a boat. There is one obvious disadvantage, that a certain amount of the seed is no doubt lost on the paths. This may be prevented by stretching cheesecloth on poles at a slightly obtuse angle to the water level on each side of the trenches. The cheesecloth need only be used during the short period of the ripening of the seed. It might prove advisable to catch all the seed in this way every two or three years in order thoroughly to cleanse the trench and resow with fresh seed. So far this has not been necessary.

HARVESTING THE SEED.

The harvesting of wild rice has been done by the Indians, chiefly by the old men and women in birch-bark canoes or small boats. The man sits in the bow to paddle, or, sometimes, to propel the canoe along with a forked stick which is less injurious to the plants. The woman at the back, with two short sticks, bends the stalks over and knocks the seeds off into the botton of the canoe. With this method it is mostly the fully-ripened seeds which fall into the canoe. Those still adhering to the stalks are left for a later gathering. Thus the harvesting is often extended over a period of from ten to fourteen days or longer.

In some districts too much of the crop is gathered when the grain is still in the milk stage, for parching. This practice necessitates more vigorous handling of the plants to separate the seeds from the stalks, although they drop with the lightest touch when fully ripe. The result is that a greater number of green seeds fall into the water and the crop of the following year is light owing to the fact that seeds in the milk stage have not the same vitality as those more mature. In this way many large beds have gradually disappeared.

Another method of harvesting the seed is that of tying the heads in bunches. This is done while the grain is still in the milk stage. Indian women go out with large balls of twine made of strips from the inner bark of the basswood. They tie several heads together, beginning at the bottom of the lowest head and winding upwards. The top is bent over and fastened in a loop. This method secures for the family the right of gathering the rice tied in their own peculiar manner and also it protects the seed from the attacks of wild fowl.

At the present time in Manitoba, men are using a new invention for gathering in the rice from the sloughs. Mr. Wm. McLaren, of Point du Bois, has perfected a type of schooner which sails over the shallow water with "wings" raised on each side to the right height for knocking the seed off into the boat. The "wings" are raised or lowered readily and do not break the plants which remain growing for a later gathering. Mr. McLaren is also working upon a machine to take the hulls off the grain. The method adopted by the Indians for hulling the seed is as follows: After harvesting, the seed is spread out to dry off in the sun. After drying sufficiently, the seed is parched, ready for hulling. The process of parching, as practised by the Indians, is very primitive. Not more than about half a bushel of

the seed is put into the parching kettle at a time. The kettle is then hung over an open fire. The seed must be stirred constantly to keep it from burning, and so ensure an even all round parching. The heat swells the starch grains and thus the tightly-closed hulls are forced apart. After

Photo—Wm. McLaren.

Wild rice growing at Point du Bois, Man.

parching the seed is left to cool and then placed in a hole in the ground where it is beaten with heavy sticks. Later it is fanned or tossed about in the wind to separate the chaff from the grain. The green seed is parched without drying.

STORAGE

There are many objections to autumnal sowing of wild rice, although, under certain conditions, there is much to be said in its favour. One of the chief objections is that, in the autumn, the water being lower, the seeds are sown too far out and in the spring seedlings are smothered before they reach the surface; or, as in the case with some of our beds at the farm, when the water was unsually high, the seeds did not germinate at all till the following season when the water was two or three feet lower. After trying many methods of storage we found that adopted by nature was the best. As soon as the ripened seed was gathered it was scattered between layers of mud or garden soil in wooden boxes and sunk in barrels of water. These barrels were left outside in the shade and fresh water was added in dry weather until the frosts came and the snow buried them. In storing large quantities of seed it was found more convenient to put the seed at once into the barrels with a six-inch layer of earth at the top and bottom, leaving a space of at least six inches at the top to be filled with water. The water was not allowed to dry off the top, fresh water being added daily, when the rain failed to keep the barrel full. The barrels should be kept in the shade uncovered. Freezing does no harm. Seed may also be stored without appreciable loss of vitality in a cold storage plant. The same precautions should be taken against heat and fermentation after harvesting, and the seed shipped without delay. Should the time of transportation be of any length, arrangements should be made for a reduced temperature. In any

case after gathering, the seed should be submerged in a large vessel of water in order to remove all empty hulls and broken bits of stalk which float. At the storage plant the seed should be placed in vessels of fresh water and kept in the "chill room" at a temperature of 32° to 34° F.

ENEMIES OF WILD RICE

Wild rice is a prey not only to various species of wild fowl, birds and muskrats, but also to a caterpillar and a fungous disease.

The caterpillar (unidentified) is about an inch long when fully grown, pale green when young, becoming tinged with brownish as the season advances, so similar in tone to that of the seeds that as it feeds it is scarcely noticeable. It makes a small round hole through the base of the glume

Photo—F. Fyles.

Caterpillars feeding on the seeds of wild rice.

in a line with the embryo and eats out the heart of the seed. Although nearly two-thirds of the seed remains untouched, all vitality is destroyed.

Several attempts have been made to rear these caterpillars to the adult moth, but as they hibernate all efforts so far have failed.

The fungous disease of wild rice is a species of ergot (proposed name, *Spermoedia Zizaniae*) (1). It is to be seen among the ripening grain in the late summer and early autumn in the form of a hard purplish mass protruding from the otherwise empty glumes. It first attacks the plant early

Photo—A. E. Kellet.

Ergot of wild rice in the "honeydew" stage.

in the season shortly after pollination, and feeds upon the developing embryo which soon yields its place to the usurping ergot. In its early stage it is recognized by a glistening sticky substance oozing from the glumes, called

(1) Fyles, F., Phytopath, Vol. V., No. 3, P. 186.192.

"honeydew". This honeydew, containing myriads of minute reproductive bodies, attracts insects which feed upon it and in their progress carry it to other plants, thus spreading the disease. The stalks containing honeydew, as well as any fully developed ergots, should be cut off and burned at once.

As ergot is a very injurious fungous disease of grains and grasses, this particular species was given considerable attention. Careful infection experiments were carried on in order to see if, in establishing new beds of wild rice, neighbouring fields of grain would be in danger of infection by

Photo—F. Fyles.

Ergot grains in perfection of prowth. The largest heads are ready to shed their numerous spores.

this disease. Barley, rye and oats, as well as other hosts of the common ergot of rye (*Spermoedia clavus* (Dc) Fries) were inoculated with the spores of this species of ergot with negative results. It was concluded, therefore, that this was a new species of ergot and had no effect upon the hosts of ergot of rye. (1)

(1) Fyles, F., Phytopath, Vol, V, No. 3, P. 186, 192.

Before sowing, seed of wild rice should be put into a large receptacle containing water. If there are any ergot grains among the seed, they will rise to the surface and may easily be removed and burned, Do not leave ergot in the way of children and animals. Ergot may also be removed from grain before hulling, by sifting, as the ergot grains are three or four times the diameter of the healthy seed

Photo—F. Fyles.

Ergot grains beginning to germinate after having been cut from the ice at Hymers, Ont.

NUTRIENT VALUE.

Wild rice has always been a food highly valued by the Indians of North America. Combined with maple sugar and wild fruits, or with bison, deer, partridge and other game, it formed a diet as rich as any served in the more civilized world. It is also commonly used to thicken soups. Neill, writing of the Dakota Indians in the early eighteenth century, says: "Wild rice is a good and very healthful food, very light and nourishing; it is excellent with game broth." The Mississagua Indians of Rice lake, Ont., parch the grain and use it without further preparation on their hunting and fishing

expeditions, but more frequently it is made into soups or stews. Diddle says: "The Indian women used to make a favourite dish with wild rice, corn and fish boiled together, called 'Tassimanonny'. I remember it to this day as an object of early love." Mrs. Traill writes of the Indians about the bay of Quinte, Ontario, as follows: "That night . . . . . cooked some of the parched rice, Indian fashion, with venison, and they enjoyed the novelty very much. It made an excellent substitute for bread, of which they had been so long deprived".

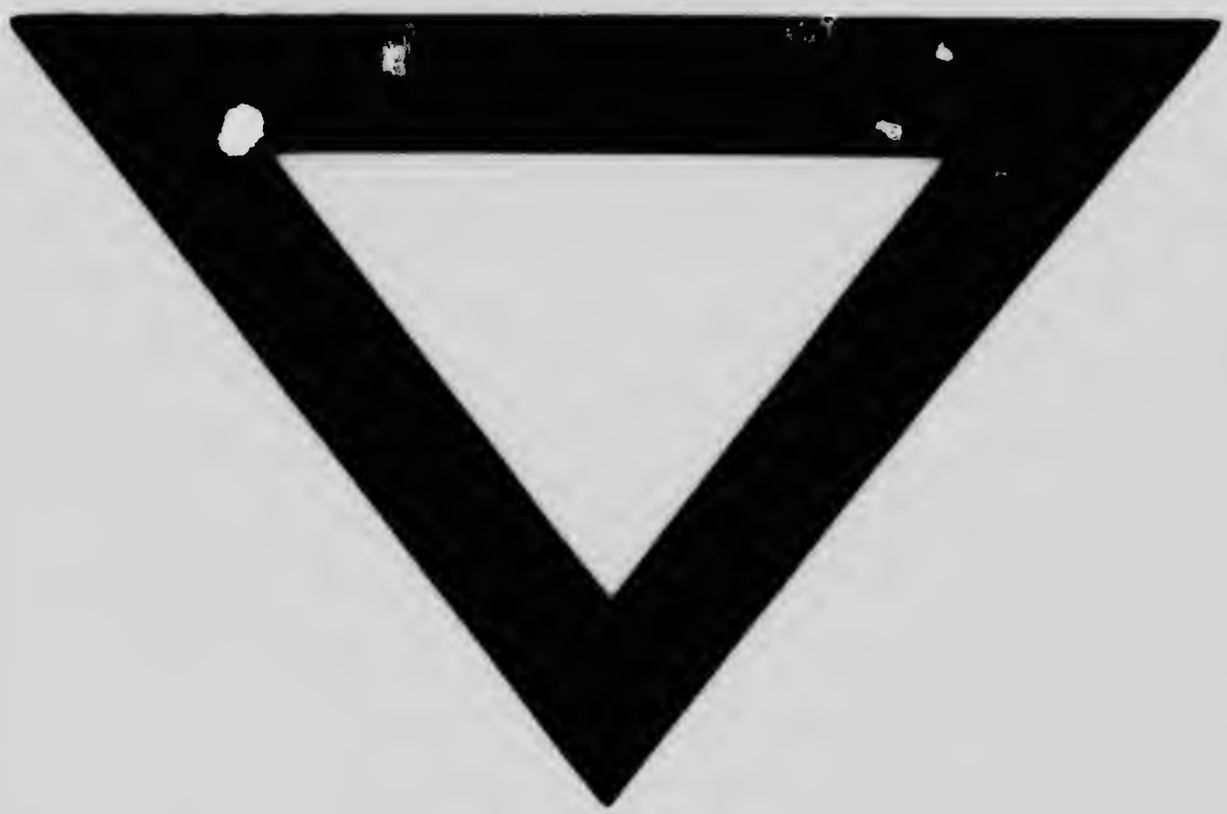
In pioneer days wild rice was a common food of the hunters, traders and settlers. In more recent times, however, it became of interest chiefly to sportsmen, owners of hunting preserves and caretakers of natural parks as a means of attracting birds and water fowl. At the present time it is served in some of the best hotels as a great delicacy with game in season, or as a novel Canadian breakfast food. In 1862, Mr. Ed. Peters, and in 1899, Prof. F. W. Woll, made chemical analyses of the grain, which showed that it was more nutritious than other native foods to which the Indians had access. The analysis given below, comparing wild rice with our common cereals, was made by Dr. C. F. Langworthy, of the Department of Agriculture, U.S., in 1903:—

COMPARISON OF WILD RICE AND OTHER GRAINS.

—	Water.	Protein.	Fat.	Carbo-hydrates.	Ash.	Fuel value per pound.
Wild Rice—	p.c.	p.c.	p.c.	p.c.	p.c.	Calories.
Whole grain	9·5	12·9	1	75·2	1·4	1,625
Ground	13·0	10·9	·8	74·0	1·3	1,740
Parched whole grain	11·2	14·6	·7	72·3	1·2	1,620
Parched and ground	9·5	11·5	·8	76·9	1·3	1,800
Rice, polished	12·3	8	·3	79·0	·4	1,630
Barley, pearled	11·5	8·5	1·1	77·8	1·1	1,650
Wheat, cracked and crushed	10·1	11·1	1·7	75·5	1·6	1,685
Oats, rolled	7·7	16·7	7·3	66·2	2·1	1,850
Corn meal, unbolted	11·6	8·4	4·7	74·0	1·3	1,730
Hominy	11·8	8·3	·6	79·0	·3	1,650
Kafir corn	16·8	6·6	3·8	70·6	2·2	1,595
Buckwheat flour	13·6	6·4	1·2	77·9	·9	1,620

As will be seen, wild rice resembles common cereal grains quite closely in composition. As is the case with wheat, rye, barley, and other grains, the greater portion of the nutritive material consists of carbohydrates, although the amount of protein is proportionately large. Wild rice contains little fat, in this respect resembling rice, barley and wheat, more closely than corn and oats. Judged by its composition and fuel value, it compares very favourably with the common cereal grains. Too much importance should not be placed on the variation in constituents as shown by figures like the above, since it must be remembered that a given constituent in any of the grains may vary to rather wide limits. For instance the protein in common white rice varies from about 6 to 11 per cent. So few analyses of wild rice are available that but little can be said regarding the range in the proportional amount of the different constituents.

Before being cooked, wild rice should be washed thoroughly two or three times. Slightly warm water containing a little soda may be used for the first washing. The parched wild rice requires half an hour's boiling, and the whole or black wild rice somewhat longer.



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