J. Ethnobiol. 1 (2): 200-207 December 1981

A "LOST" VIKING CEREAL GRAIN

LISA CARLSON GRIFFIN
State Historical Society of Missouri
Columbia, MO 65211

RALPH M. ROWLETT
Department of Anthropology, University of Missouri-Columbia
Columbia, MO 65211

ABSTRACT.–Lyme grass *(Elymus arenarius)*, a coastal wild grass of the artic and sub-artic of the northern hemisphere, occurs in carbonized form in Viking archaeological sites, especially in Iceland and Greenland. There is also an increase in elymus pollen contemporary with the Viking homesteads at L'Anse-aux-Meadows, Newfoundland. In Iceland, lyme grass grain was the main source of bread flour until the eighteenth century, when imports from Europe of wheat flour replaced it. Folk tradition in Iceland held that lyme grass bread was both more tasty and nutritious than wheat bread. Comparison of some basic nutritional values of lyme grass grain with some other standard foodstuffs, including amaranth, shows that lyme grass has considerable nutritional value for human beings. The most remarkable aspect of the restoration of lyme grass as a foodstuff in the future would be that it would form a cereal crop which can be grown in the artic regions where no other suitable agricultural crop is forthcoming. If the world food shortage becomes more acute in the next few decades, the cultivation of lyme grass would open up millions of acres of food production.

INTRODUCTION

Several peoples of the world have been recorded as having used lyme grass *(Elymus arenarius* L.) as a flour. While this grass (Fig. 1) normally grows in circumpolar contexts, primarily near marine environments, Newberry (1857) cites its collection by Pacific coast "Digger" Indians as far south as northern California. It has also been collected by peoples of the northern Soviet Union (Komarov 1963). The greatest users of lyme grass, however, were the Vikings, especially those Norsemen who came to Iceland, Greenland, and Newfoundland. Different folk names are "strand oats" and "strand wheat" in English, *Strandhvede* (Strand wheat), *Sandhavre* (Sand Oats), *Vild Hvede* (wild wheat), *Melur* and *Sand Melgras* (Sand Meal-grass) in Norwegian and Icelandic. These folk-names (Fernald 1910) reveal a notion of lyme grass bearing an edible grain.

The evidence for lyme grass from mainland North America comes from two sources. The first source is the reference to "self-sown wheat" in the Vinland discovery sagas (Magnusson and Palsson 1965:52). The second source of evidence is from the excavations at L'Anse-aux-Meadows, Newfoundland, where there is a distinct jump in easily recognizable *Elymus* pollen in several zones at the site, although the genus was in Newfoundland thousands of years before the Norse settlements (Henningmoen 1977).

In the pollen at L'Anse-aux-Meadows pond *Elymus* pollen is present at the deep 160-170 cm levels with a $C14$ date of 3,890 ±110 B.P., but it rapidly drops out of the record at two loci. It picks up again later, at the 60-80 cm levels, roughly at the position of the Norse occupation, judging from the date cited, and another date at 2,000 B.P. obtained from the column. A third sample has *Elymus* only at the 60-70 cm zone where the radiocarbon date falls between 1,130 to 1,450 B.P. at a 95% confidence level.

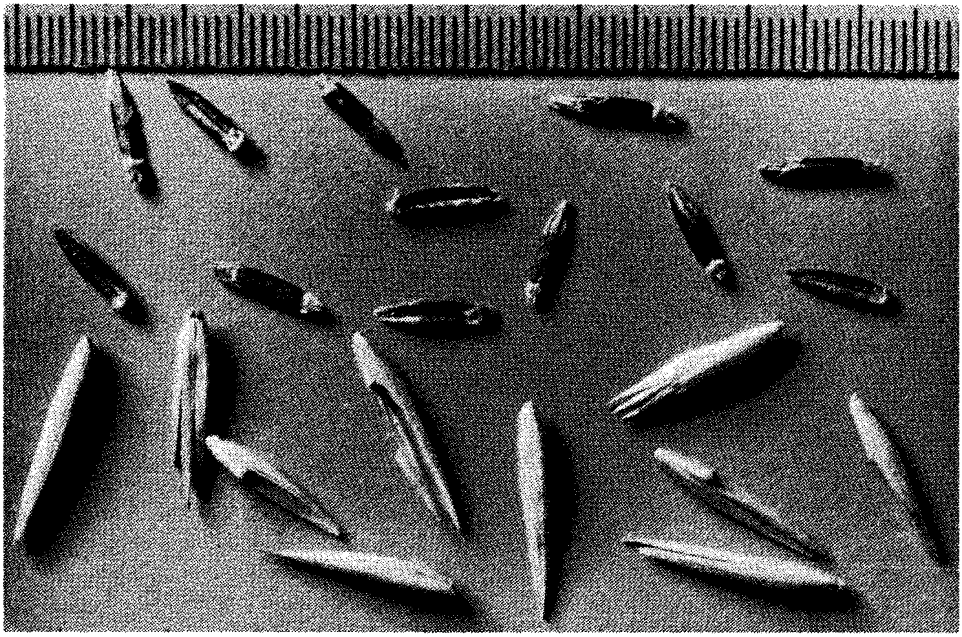

FIG. 1–Glume-covered and bare grains of lyme grass *(Elymus arenarius)*.

Even clearer indications come from the Palsa Bog on terraces immediately behind the Norse houses. *Elymus* is lacking here at the deep 170 cm level with a date of 5,320 ± 60 B.P., but is plentiful at the 40 cm level and up; a sample from the 35 cm level has a date of 460 ± 80 B.P. It appears again at the 65-80 cm level, which should be the zone representing the Norse settlement according to Henningmoen (1977:314-315). Thirty cm east of House F, *Elymus* occurs only at the 50 cm level where there is a corresponding C14 date of 1,280-1,680 B.P. in the levels below.

From the archaeological features themselves, at House A, North wall, *Elymus* first appears at the 40 cm level, where the wall is about 4 cm above the old land surface. It occurs sporadically inside the wall turves, reaching a maximum abundance at the 18 cm level on top of the surviving wall, reducing to a minimum presence at the 13 cm level in the soil overlying the top of the turf wall of the house. This suggests the pollen is concentrated on the ledge of the standing wall. Also occuring outside the houses is the European weed *Rumex*, known only in modern or very recent pollen deposits (Henningsmoen 1977:328-333). Location of pollen in the southern wall of this house is less clear, although the 3 cm deep occurrence of *Elymus* in the diagram is coded "top of the wall" despite the shallow depth. Similarly, the pollen diagram for House F, northern wall, is difficult to equate with a published section, but the sole occurrence of *Elymus* here in the 20-30 cm level of the wall has an unambiguous accompany C14 date of 1,050 to 850 B.P., making it clear that the *Elymus*, like the *Rumex*, associates with the Viking homestead on Newfoundland.

The most intensive use of lyme grass seems to have been in Iceland and Greenland. Historic records imply that at about A.D. 1000 lyme grass was collected from thick wild stands to supplement the crops of wheat and barley which sometimes failed this far north. Apparently, as the climate of the northern hemisphere deteriorated by the late Middle Ages and eventually led to abandment of the Greenland settlements and increased hardship in Iceland, lyme grass replaced the more normal cereals of Western Civilization in cultivation. Archaeological excavations of Norse settlements in Greenland were done mostly before World War II, so the lack of a fine chronology prevents any glimpses of changing incidences of lyme grass use. As late as 1783 the English botanist Sir William Johnson Hooker (quoted in Fernald 1910) spoke of "Fields used to produce the Sea-lyme grass" and noted that devastation by volcanic eruption would have dire consequences for the food supply since very little "corn" (undoubtedly normal wheat grain) was imported into the cities and those isolated regions.

The somewhat vague evidence from the sagas concerning lyme grain in Greenland finds support in the distribution of wild stands of *Elymus* in Greenland. Lyme grass in the narrowest sense (*Elymus arenarius* L. [2n=42] variety *villosus*) grows primarily on the ruins of old Norse and ancient Eskimo settlements. Other lyme grass (*Elymus arenarius mollis* [2n=28]), the Neoarctic variety, is found from Greenland to northwest Asia (Pedersen 1972:76-77; Fredskild 1973) and occurs with less density but more widespread coastal distribution.

It is still uncertain as to whether or not lyme grass was ever domesticated in the Viking homeland. Certainly it is notably lacking in the bizarre gruels which were concocted from cultivated grains, some questionable domestics such as *Chenopodium*, and weeds. These gruels were consumed as last meals by the time-of-Christ bog bodies such as Graubelle, Tollund and Borremose men (Helbaek 1958; Brandt 1950), who clearly antedate the Vikings by nearly a millennium. Olsson (1974:30-32) notes that lyme grass has spread anthropogenously from the coasts all over southern Sweden, exhibiting both a normal littoral as well as xerophytic varieties. He considers the key ecosystem elements in the *Elymus* communities to be human agency and nitrophilia.

Decline in the consumption of lyme grass began with the rise in commercialism in the sixteenth century. After 1800 with the blossoming international trading system and the greatly enhanced food production in Europe and North America, lyme grass grain was slowly replaced by imports of wheat, rye and barley. This process was encouraged by trading regulations from the kingdoms of Norway and Denmark (Nørlund 1936), which successfully exercised sovereignty over Iceland. Lyme grass flour was not abandoned completely, however, until early this century (Sigurbjornsson 1960:52).

At first consideration, it seems only normal for the Icelanders to prefer wheat flour and the like over lyme grass meal for bread and other bakery products. Despite the factors mentioned above, the replacement of lyme grass by imported flour remains something of a mystery. According to some Icelanders, the *melur* flour from lyme grass was more tasty than wheat flour and more nutritious as well. Hooker, the botanist (in Fernald 1910:27-28), shared this opinion concerning the relative taste and the Icelanders had not yet perfected the technique of "drying and preparing the grain."

Is this folkloric insistence on the superior gustatory and nutritional qualities of lyme grass the mere grumbling of some conservative diehards? Hooker's assertions were strongly put and folklore often contains a grain of truth hidden therein. Rather than dismiss these traditions, we have tested the lyme grass grain for some aspects of its nutritional value. Our motives were not merely to vindicate Vikings, who seldom needed help from anyone, but also included the evaluation of lyme grass as a possible agriculture crop for the arctic, a climatic zone which hitherto has been only seldom utilized for food production.

METHODS

With funding at our disposal, we tested the content of lyme grass seeds for iron, seven fatty acids and 17 amino acids (Table 1) at the Experiment Station Chemical Laboratories of the College of Agriculture, University of Missouri-Columbia. A comparison was made between dry, uncooked lyme grass grain and several other prominent foodstuffs including the top four crops (wheat, rice, maize, and potatoes) which produce more tonnage for the world's food then do the next most prominent 26 crops combined (Harlan 1976).

The amino acid assays were made on hulled, twice-ground samples and were saponified and analyzed by liquid chromatography (Benson and Patterson 1971). Heptacecanoic acid (C17:0) comprised the internal standard used to quantify fatty acids. No indigenous heptodecanoic acid had been found in a trial sample. A computer interfaced with the GLC set was used for identification and quantification of the fatty acids. The iron content was assayed by a nitric perchloric acid wet-ash digestion follows by an atomic absorption determination.

TABLE 1.—*Amino Acids, Iron and Fatty Content of Lyme Grass* (Elymus arenarius).

	Sample 1	Sample 2	Sample 3
AMINO ACID (protein per 100 g)			
Aspartic Acid	.94	1.34	1.06
Serine	.87	.81	.88
Glutamic Acid	5.84	4.78	6.62
Proline	2.38	1.70	2.71
Glycine	.87	.88	.94
Alanine	.70	.88	.76
Cystine	.18	.12	.16
Tyrosine	.36	.32	.36
Ammonia	—	—	—
Arginine	.82	1.00	1.01
Threonine	.61	.64	.65
Valine	.73	.84	.94
Methionine	.24	.23	.26
Isoleucine	.55	.61	.71
Leucine	1.21	1.16	1.43
Phenylalanine	.98	.85	1.17
Histidine	.44	.47	.51
Lysine	.51	.75	.59
TOTAL PROTEIN	18.23	17.38	20.76
FATTY ACID (mg per 100 g)			
Palmitic	2.13	1.78	2.04
Palmitoleic	.08	—	.08
Stearic	.13	.09	.14
Oleic	2.83	2.14	2.74
Linoleic	10.10	5.20	10.90
Linolenic	4.85	6.30	4.14
Arachidonic	—	—	—
TOTAL	20.12	15.51	20.04
IRON (mg per 100 g)	5.50	5.40	5.80

DISCUSSION

Comparison of the characteristics of the dry, uncooked lyme grass grain with that of some other foodstuffs (Table 2) shows that among the cereals, its iron content exceeds that of wheat *(Triticum aestivum)* and oats, while its protein content surpassed that of some touted sources such as oats, high-protein corn, Soviet *Triticum-Elymus* hybrids, and amaranth. Wild wheat *(I. monoccum)* does have a higher crude protein rating (22.8%) (Harlan 1967:198; Harlan et al. 1973:318). Red beans have a slightly higher protein value but lyme grass total protein content challenges even salmon. Among the essential amino acids amaranth may have twice as much leucine and lysine as *Elymus,* although *Amaranthus edulis* with a high lysine content which provided protein for Aztecs (Ortiz 1978), has a leucine content somewhat inferior to that of *Elymus* (Downton 1973) even though the absolute content is only slightly higher.

Amaranth's leaves, of course, provide a human and animal foodstuff which though less storable, is even more nutritious. The leaves and glumes of lyme grass would not be suitable for human consumption, but make an excellent hay for livestock. According to data compiled by Sigurbjornsson (1960), sheep, beef cattle, and horses thrive on the

TABLE 2.–*Comparison of Lyme Grass With Other Foodstuffs.*

	Lyme Grass	Amaranth	Soviet Hybrid *Elym.-Trit.*	Soviet Wheat	Wheat	Hybrid Corn High-Protein	Maize	Rice	Potatoes	Oats	Red Beans	Salmon	Beef
AMINO ACID (protein per 100 g)													
Aspartic Acid	1.20					1.38	.60						
Serine	.85					.72	.46						
Glutamic Acid	5.95					2.92	2.33						
Proline	2.26					1.15	.98						
Glycine	.90					.96	.34						
Alanine	.84					.97	.72						
Cystine	.15	.25				.30	.21						
Ammonia	–												
Arginine	.94	1.39				.93	.31						
Threonine	.64	.99				.71	.34						
Valine	.84	1.39				.90	.48						
Methionine	.25	.30				.31	.27						
Isoleucine	.64	1.35				.53	.37						
Leucine	1.27	2.41				1.01	1.35						
Phenylalanine	1.00	1.28				.67	.60						
Histidine	.48	.66				.46	.31						
Lysine	.62	1.26				.68	.20						
Other	–												
TOTAL PROTEIN	18.80	14.5	14.6	14.4	9.3	12.9	8.5		2.1	14.2	22.2	20.2	28.6
FATTY ACIDS (mg per 100 g)	1.866	.5	X	X	4.3	X	2.6	.49	.0	7.4	1.5	12.2	15.4
IRON (mg per 100 g)	5.6	5.9	X	X	2.3	X	1.8	2.9	.6	4.5	2.5	.9	8.2

(Most non-*Elymus* values are taken from Watt et al. 1975 Tables 1, 3. Soviet hybrids and wheat are from Ivanovskaya 1960:89; high-protein maize-corn amino acids are from Misra et al. 1972:1426; Amaranth amino acid means are from Olivera and Carvalho 1975:258.)

cut body of the plant, the food value of which far exceeds that of the straw of wheat and other familiar Eurasiatic cereals. Lyme grass does not endure close grazing by livestock and would not be suitable for a pasture grass, even though it makes excellent fodder as the by-product of grain production.

Lyme grass seems to compare with several other crops as poorest in terms of yield (Table 3). One must bear in mind, however, that high yielding crops such as rice, maize, and wheat have been domesticated for nearly 8000 years, whereas lyme grass has scarcely been selected for productivity during only a few centuries as a cultivar. Lyme grass's yield range actually overlaps with the much tested and promoted amaranth, so it appears to have some potential as to productivity as well as nutritional value. As Sigurbjornsson (1960: 51) points out, the low yield is relatively unimportant, since the crop can be

TABLE 3.—*Yield per hectare of Lyme grass and other crops (world averages).*

Crop	Yield, kg per hectare	Crop	Yield, kg per hectare	Crop	Yield, kg per hectare
Rice	2,300	Wheat	1,560	Amaranth	683-983
Maize-corn	2,400	Oats	1,660	Lyme grass	600-800
Barley	1,910	Soybean	1,740		

(Sources: Amaranth, *Organic Gardening and Farming Research Center* and Downton 1973. Tsitsin and Petrova 1952 quoted in Sigurbjornsson 1960:50; others, U.S. Department of Agriculture, modern world averages.)

grown on land otherwise useless for agriculture. Jack Harlan (personal communications) assures us, moreover, that this yield is identical to that of domesticated cereals, such as rice, maize, and wheat, under conditions of subsistence agriculture with no soil inputs.

In any case, lyme grass has potential as a cultivar in the high artic, north of the Artic circle, in a region hardly utilized for food production and certainly not grain farming. Thus, in any future grain shortage the extension of agriculture into these regions would add immensely to the world land acreage available for food production at a time when some feel (Brink et al. 1977) that there is hardly any more new land for farming. This would include vast areas of the Soviet Union, a region notorious for inadequate grain supplies, as well as millions of acres in North America. In Alaska alone there are an estimated 16 million acres useable for agriculture (Wooding et al. 1974). Figure 2 shows the region of prime potential for lyme grass farming in North America, since stands of wild lyme grass grow there now.

Our conclusion then is that the Icelandic folklore and tradition is correct, that it was a highly nutritious cereal and therefore it must have made a considerable contribution to Norse and Viking diets of the North Atlantic region. Also, the potential of lyme grass to ameliorate the shortage of world food supplies emerged from this study, perhaps the most significant conclusion we can draw. Its ability to thrive in marginal climates and its high nutritional values should bring lyme grass to the attention of both botanists and agricultural economists.

ACKNOWLEDGEMENTS

This research was supported by the University of Missouri Research Council Grant 1851 (1977). Lyme grass (Elymus arenarius) samples were graciously submitted by the following laboratories:

Islandisk Natturugripasafnid (Botaniske) Reykjavik, Island

København Universitets botaniske Museum, Grønlands Botaniske Undersogelse, København, Danmark

Universite de Montreal, Institut Botanique, Herbier Marie-Victorin, Montreal, Quebec, Canada

Newfoundland Forest Research Centre, St. John's, Newfoundland, Canada

Universitet i Oslo, Botanisk Hage, Oslo, Norway

We have been greatly aided by invaluable comments from Alan Leavitt, Charles W. Gehrke, Larry L. Wall, Klaus O. Gerhardt, Richard A. Smith, Paul Rexroad, Clair Kucera, Eythor Einarsson, Normand Cornellier, Alexander W. Roberson, Alex Wilson, Reed C. Rollins, Elmar Marker, C. John Burk, Bent Fredskild, Hanna Stazewska, Deborah Pearsall, Per Stormer, Jack R. Harlan, J.M.J. de Wet, and David Griffin.

LITERATURE CITED

BENSON, J.V., JR. and J.A. PATTERSON. 1971. New Techniques in Amino Acid, Peptide, and Protein Analysis. Ann Arbor Science Publ. Ann Arbor, Michigan.

BRANDT, INGER. 1950. Planterester fra et moselig fra aeldre Jernalder (Borremose). Arboger for Nordisk Oldkyndighed and Historie: 342-349.

BRINK, R.A., J.W. DENSMORE and G.A. HILL. 1977. Soil Deterioration and the Growing World Demand for Food. Science 197:625-630.

DOWNTON, W.J.S. 1973. Amaranthus edulis: A High Lysine Grain Amaranth. World Crops 25:20.

FERNALD, M.L. 1910. Notes on the Plants of Wineland the Good. J. New England Bot. Club 12:7-38.

FREDSKILD, BENT. 1973. Studies on the Vegetational History of Greenland. Meddelser om Grønland 198:No. 4 1-247.

HARLAN, J.R. 1967. A Wild Wheat Harvest in Turkey. Archaeology 20:197-201.

———. 1976. The Plants and Animals that Nourish Man. Sci. Amer. 235:88-97.

HARLAN, J.R., J.M.J. DE WET and E. GLEN PRICE. 1973. Comparative Evolution of Cereals. Evolution 27:311-325.

HELBAEK, HANS. 1958. Grauballemandens sidste Maltid. Kuml: 83-116.

HENNINGSMOEN, KARI E. 1977. Pollen Analytical Investigations in the L'Anse-aux-Meadows Area, Newfoundland. Pp. 289-340, *in* The Discovery of a Norse Settlement in America (Anne S. Ingsted, ed.). Universitetsforlaget, Olso-Bergen-Tromso.

IVANOVSKAYA, E.V. 1960. The Method of Raising Embryos on an Artificial Nutrient Medium and its Application to Wide Hybridization. Pp. 83-187 *in* Wide Hybridization of Plants (N.V. Tsitsin, ed.). Akademya Nauk SSR, Moscow. Translated from Russian 1966. National Science Foundation, Washington, D.C.

KOMAROV, L.V., ed. 1963. Flora of the U.S.S.R., vol. II. Israel Program for Scientific Translation, Ltd., Jerusalem.

MAGNUSSON, MAGNUS and HERMANN PALSSON, translators. 1965. The Vinland Sagas. Peguin Books, Baltimore.

MISRA, PREM S., RAMAMURTHI JAMBUNATHAN, EDWIN T. MERTZ, DAVID V. GLOVER, HELIO BARBOSA and KENNETH S. McWHIRTER. 1972. Endosperm Protein Synthesis in Maize Mutant with Increased Lysine Content. Science 1976: 1425-1427.

NEWBERRY. 1857. Pacific Railroad Report 6:92.

NØRLUND, POL. 1936. Viking Settlers in Greenland. Cambridge University Press, London.

OLIVERA, J. SANTOS and M. FIDALGO DE CARVALHO. 1975. Nutritional Value of Some Edible Leaves Used in Mozambique. Econ. Botany 29:255-261.

OLSSON, HANS. 1974. Studies on South Swedish Sand Vegetation. Acta Phytogeographica Sueica, vol. 60:1-170.

ORTIZ DE MONTELLANO, BERNARD R. 1978. Aztec Cannibalism: An Ecological Necessity? Science, 200:611-617.

PEDERSEN, ANFRED. 1972. Adventitious Plants and Cultivated Plants in Greenland. Meddelelser om Grønland 178: Nr. 7. 1-99.

SIGURBJORNSSON, BJORN. 1960. Studies on the Icelandic Elymus. Ph.D. Cornell University. University Microfilms, Inç. Ann Arbor, Michigan.

TSITSIN, N.V., Ed. 1960. Wide Hybridization in Plants. Akademiya Nauk SSSR. Translated from Russian 1966. National Science Foundation, Washington, D.C.

WATT, BERNICE K., ANNABEL MERRILL, REBECCA K. PERCOT, CATHERINE F. ADAMS, MARTHA L. ORR and DONAL F. MILLER. 1975. Handbook of the Nutritional Contents of Foods. Dover Publications, New York. (Reprint of U.S. Dept. Agric. Handbook No. 8, 1963.)

WOODING, F.J. 1974. Small Grains on Agricultural Land in Remote Areas of Alaska. Agroborealis 7:28-30.