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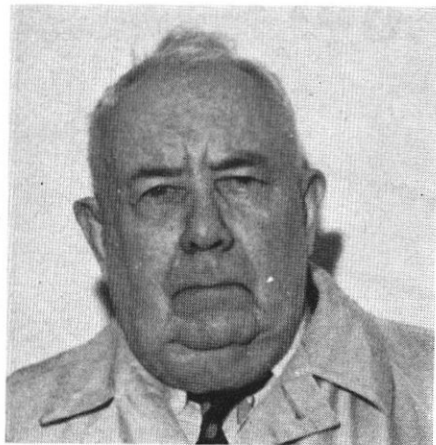
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# The golden sedges of Iceland



Mr Ingvason, an Icelandic agronomist, has studied the development of pasture and grass crops in various parts of the world. He has used irrigation as a means of improving pasture in the Rockies in the USA and pioneered patna rice growing in California in reclaimed saline soils. He considers there is insufficient exploitation of sedges as fodder in his native land, and describes the potential for the Gulstör there.

THIS UNIQUE and extraordinary forage species (*Carex lyngbyei*), known in the vernacular as 'Gulstör', occurs wild as the dominant or sole vegetation in many riverines, flood plains, estuary meadows and level stretches along the littorals in Iceland, which are subject at times to tidal inundation, or periodic flooding from lakes and glacial rivers. Frequently, during the winter season, high tides will build a barrier of sand and gravel in the river estuaries and the drainage channels of the meadows, resulting in complete inundation of the valleys or plains till spring, when the dam breaks or is opened by excavation.

### Similar to rice

The cultivation of this superb forage is in principle similar to the culture of rice, under seasonal inundation. River water is diverted on to the meadows during spring and impounded in basins



'Gulstör'—Iceland's golden sedge (*Carex lyngbyei*). Several meadows are over 1000 years old

(25-35cm deep), or kept continuously flowing through if the supply is ample. In estuaries of glacial rivers, where the saline tidal water blends with the flow of the sediment-laden river, and is utilised for irrigation, the silt and clay is deposited in the basins and the salines serve as fertilizer for the sedge. The sedge is rhizomatous and makes a dense, resilient, tough sward. Growth is lush and rank and may attain a height of

1m. The meadows billowing under the breeze in days of brilliant sunshine look very much like rice plantations. As the season advances vivid green changes to greenish-amber. The meadows are drained in June and harvest takes place in July-August.

Edaphically, Gulstör has rather exacting requirements. The best meadows are found in alluvial plains of silt and fine sandy loam, derived from basalts and palagonite. Coastal soils of silt and clay, somewhat saline and impregnated with shell sand (lime), often yield the heaviest crops of hay.

Hummocky moorland and fens which are brought under irrigation often change over spontaneously into fine sedge meadows and become level within a period of five years. The seed seems to be carried on to the land by the water and germinates and grows in the ooze. Plants proliferate by their rhizomes and form a solid sward.

Coverage by an ice layer in winter tends to suppress hummocks and leaves the ground surface level. The sward is preserved by the water and ice in perfect condition year after year.

### Harvested since ninth century

Sedge meadows in several of the large valleys have been extant and in operation since the island was settled in the ninth century and never failed to yield a harvest as long as water for irrigation was available and properly applied. In bad years, when polar ice is landlocked along the northern and eastern coasts, ordinary grass meadows often fail to yield a harvest, but the sedge water-meadows still produce a fair crop of hay and silage.

Strange as it might seem, since the introduction of tractors, tillage machinery and chemical fertilizers three decades ago, the State has concentrated upon reclamation of moorland and paid subsidies to farmers who lay such land down to meadows. Unfortunately, reclamation work is often makeshift and done in great haste. Foreign grass-seed is sown, and fertilization with ammonium nitrate is heavy. The result is short-lived sward and mediocre quality hay, which causes sickness and often death of livestock. The tendency is to neglect the old sedge meadows and use them only in season.

### Other parts of the world, too

I was raised in a district in Northern Iceland where sedge meadows were good and plentiful. I have also had varied



Sedge meadows in this valley below Kristnes Hospital in the vicinity of Akureyri used for pasture and hay. The irrigation system is obsolete, and fertilizer application insufficient, but the author believes these and other meadows could be made to flourish

experience with irrigated meadows of sedge and semi-aquatic grasses in the mountains and coastal regions of the North American continent. In some of these remote mountain valleys and coastal districts one finds splendid herds of beef and dairy cattle which graze in wet pastures and are fed in winter almost entirely on hay from the water-meadows of sedges and aquatic grasses.

The Pacific littoral, including the Bering coasts of Alaska, British Columbian mountains, Oregon and North California have swampy areas of *Carex cryptoncarpa*, a subspecies of Gulstör, which provides excellent pasturage for cattle and game animals. Flood plains of the Alaskan rivers in the interior also have luxuriant growth of this sedge. The coastal region of Labrador has some wild meadows of the species.

In the littorals of eastern Siberia it is also found in abundance, and has a high rating as forage. In Iceland, experience has shown that well-cured hay of Gulstör is actually equal to upland meadow hay (*Tada*) for feeding the cattle and sheep and keeps the animals healthy and vigorous.

A comparative analysis of our premier pasture grass, Bluegrass and Gulstör, is shown in Table 1.

The forage lends itself very well to making silage, without addition of

**Table 1**  
Comparative analysis of pasture grass and golden sedges

|                      | Bluegrass<br>( <i>Poa pratensis</i> )<br>(%) | Gulstör<br>( <i>Clynbyei</i> )<br>(%) |
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molasses or chemical preservatives. Average yield of silage per hectare would be 8-12 tons. Records from one meadow in the western littoral show a yield as high as 5 tons of hay per hectare. The land there is replete with lime, and manure may have been applied.

#### Cultivation

Sedge meadows respond very well as a rule to sedimentation (warping). Silt, clay, disintegrated peat and humous earth improve the sward and augment yields of forage.

Hydraulic sluicing of such materials into the swampy meadows would be quite remunerative and effect a lasting improvement.

Low-lying meadows in valley bottoms

and along estuaries should have open ditches for drainage and pumpage prior to hay harvest.

Track-type tractors are preferable to wheel tractors in harvest operations.

Some farmers use sleds instead of wagons to haul fresh forage out of the meadows. The stubble is slick and smooth enough for this.

A hoist and nets are used for transfer of the forage on to trucks.

In curing of sedge hay it is as well to let the stacks heat up a little and settle down well. Thus, the hay becomes very palatable and appetising to the animals.

#### Improving the Gulstör

In the course of the last six summers I have studied the condition of old sedge meadows, their restitution, and reclamation of new land for water-meadows.

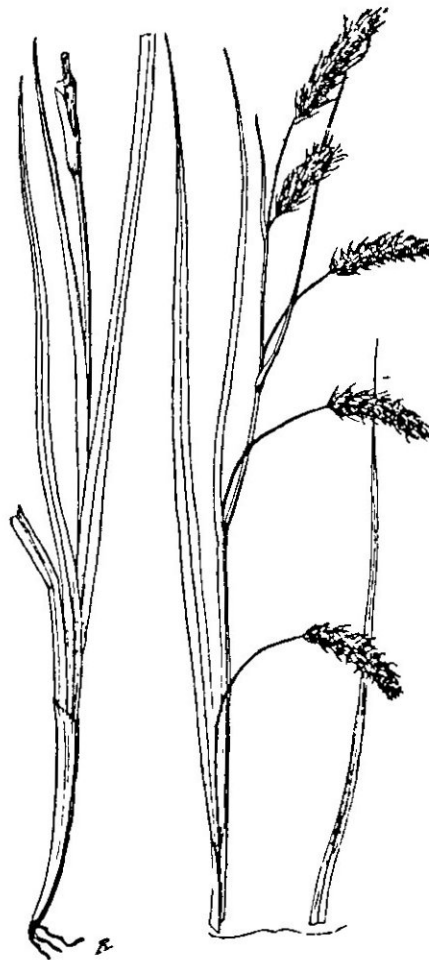
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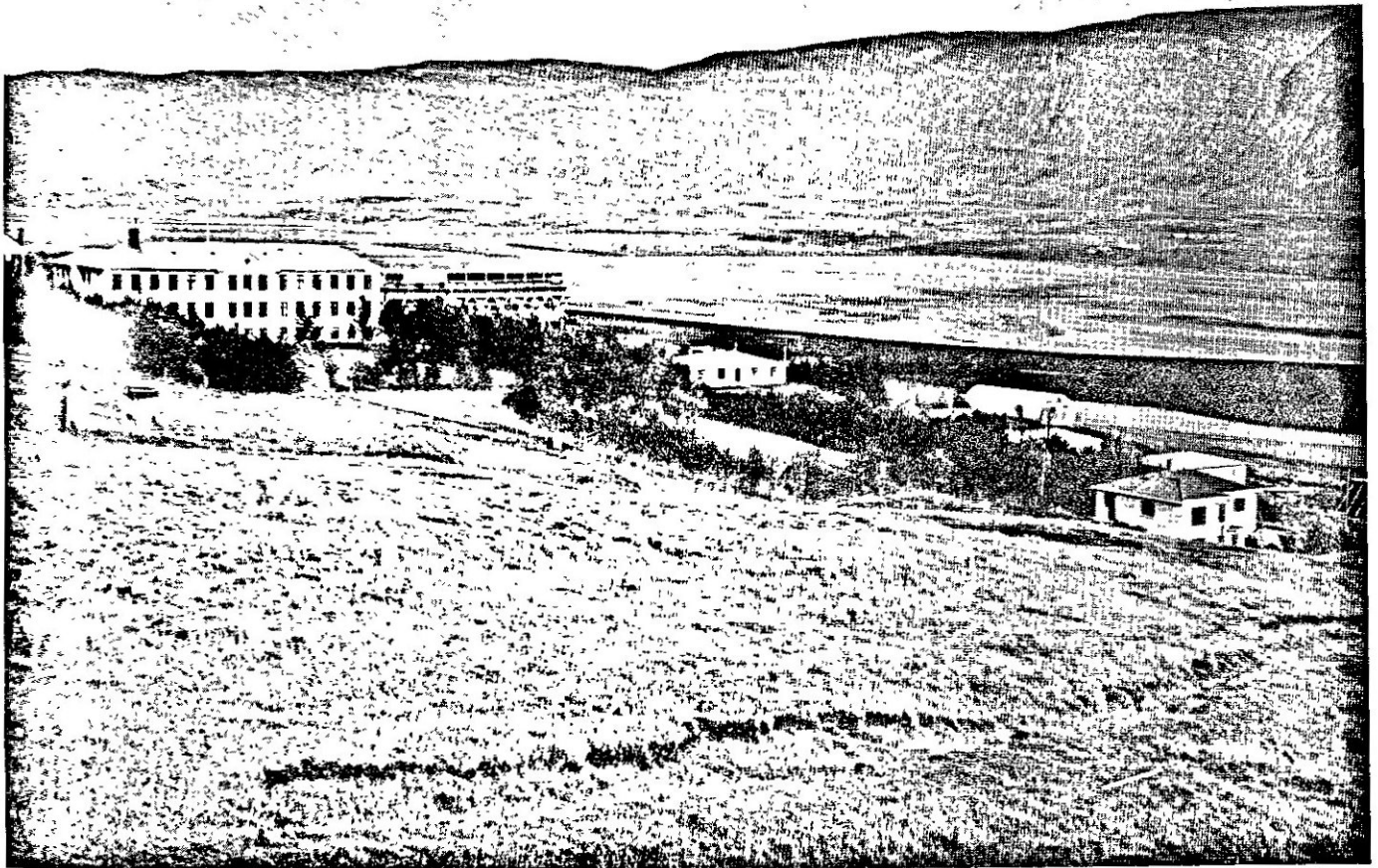
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thinly in the new basins. Then roll the field with a cultipacker; irrigate frequently afterwards and a profuse growth will ensue. At the present time I am studying the germination of sedge seed and also having tests made abroad both in laboratory and field.

Systematic field experiments should be made in several inland valley areas with lime, crude potash salts, nitrate of soda, nitrolime, phosphorite (Gafsa) and compost.

Indications are strong that the yield potential is very high with judicious fertilization, provided irrigation is in good order.

Mineral fertilizers should be applied after harvest, but compost and saltpetre, subsequent to drainage of the basins in May-June.

The optimal soil reaction for Gulstör is considered to be within a range of 5.5-6.8 pH.

The total cost of reclaiming alluvial land for sedge meadows is generally less per hectare than conversion of wet moors and fens into non-irrigated meadows, which require heavy fertilization annually and are seldom durable with the grasses sown.

### Highly regarded in Russia

In the Soviet Union several sedges are highly regarded as forage for livestock and game animals. Dr D. V. Ter-Avanesyan of the Institute of Plan Industry, Leningrad, has informed me that in the alpine zone of Caucasus *Carex nigra* constitutes very good forage in season. In the arctic regions of Siberia two of the Icelandic species, *C. halleri* and *C. rariflora*, occur widely and constitute good pasturage.

Also quite widespread are *Carex stans*, *C. discolor* and *C. substansacea*, which provides good grazing for reindeer and cattle.

Finland has about one-fourth of its total area as fens, wet moors and lakes. Reclamation of such land constitutes a great problem.

Recently a Finnish plant explorer visited Iceland and made an investigation of Gulstör meadows. He collected seed and exported sward for trial planting in Finland.

Analytical work on Icelandic sedges which was done in Sweden about 60 years ago showed a crude protein content average of 10.2%, carbohydrates 45.5% and fibre 20.7%.

### Other carices used in animal husbandry

The flora of Iceland counts 40 species of carices and several hybrids.

Carices constitute, along with rushes, 'Brok' (*Eriophorum angustifolium*) and a few native grasses, the vegetation of fens and wet moorland. Scrubland, heath and sands also have a mixed vegetation of carices and certain upland grasses. Pasture for livestock is based mainly upon such forage at all seasons of the year.

Certain sedges retain their green base leaves under snow cover during the winter. Sheep and horses will scratch the snow away to reach such forage.

Gulstör has a stout, solid, erect triangular stem, leaf-sheath ranked and enclosing the culm. Leaves are long, relatively wide, tapered, slightly ridged with recurved margins. Colour is vivid green during spring, gradually turning to amber yellow, and finally to ochre yellow as the season advances. Spiklets are brown; one or two staminate spiklets near the top. Pistillate ones, two or three, are axillary with long pedioles. Acenes are oval oblong, having three curved, convergent, faint veins on each side of the nutlet; chestnut brown when well mature. Bracts are pointed, subtending the nutlets on the spikes.

Gulstör is a prolific seeder, but seeds are often immature at the end of the season.

After frost in the autumn, seeds desiccate, scatter in the sward and eventually become buried in the mud. Evidently ripe seed goes through prolonged dormancy and is capable of sprouting when conditions for growth are appropriate. Renewal growth is mainly from rhizomes, keeping the field free of weeds.

### Blue sedge

Blue sedge (*C. rostrata*) is a superb, large and vigorous aquatic species of riparian lands and forming fringe growth around lakes and ponds. (Description: Perennial rhizomatous; succulent, solid triangular culms; leaves long, wide, slightly ridged with upturned margins; staminate spikes two or three, near the top, slender and light coloured; below, two or three pistillate ones, robust, round, nearly upright; yellow in colour; acene sessile, in axils, black with a green streak; nutlet has two tiny protuberances at the apex; prolific seeder; very frost resistant.) It is excellent forage for cattle, which will wade deep into water to reach it. This species is widespread in Siberia as an aquatic forage and is rated very highly.

### Myrastör

Myrastör (*C. nigra*). Erect perennial, up to 50cm high. Slender culms, leafy. Has very extensive range in wet moorlands and alluvial plains. Rates as good forage in the spring and early part of summer. Pistillate spikes, two, sessile in leaf axils, black with a green streak. Staminate spikes, one or two near top.

### Hrofnastör

Hrofnastör (*C. saxatilis*). Erect rhizomatous; up to 50cm tall. Slender culms and leafy. Pistillate spikes, one to three; glossy black. Staminate one at the top. Grows in swamps, together with 'Brok' (*E. angustifolium*). Both of these rate as very good pasturage, even in winter.

Gulstör hybridises readily with *C. nigra*. The hybrid is called Bleikstinnungur. It is vigorous and rates as a fine forage.

A hybrid of Gulstör and *C. rigida* is quite common. It thrives well in poor soil. It is considered fair quality forage in season.

There is a great scope for selection of superior phenotypes of Gulstör and propagation of these in a systematic way.

# PLANT BREEDING

## HAPLOIDS WILL SPEED ALFALFA IMPROVEMENT

A University of Wisconsin, USA, agronomist, E. T. Bingham, has discovered a technique to produce haploids of cultivated alfalfa. Haploid alfalfa plants have one-half the number of chromosomes of normal alfalfa and greatly shorten the time required in breeding and genetic research.

Haploids have been produced in a number of vegetables and cultivated crops, including potatoes, but haploid alfalfa has always eluded the forage crop breeder.

Bingham's production of several alfalfa haploids is a significant breakthrough in breeding work in alfalfa.

'The alfalfa haploid with its 16 chromosomes rather than the normal 32 is a living egg or gamete of alfalfa', says Bingham. This means that the whole alfalfa plant has only as many characteristics as one parent would normally have. With only half as many chromosomes to express various characteristics, the progeny of haploid alfalfa will have only half as many characteristics to complicate each other.

### Characteristics discovered rapidly

In breeding work using haploids, desirable or undesirable characteristics will therefore express themselves more often. Desirable plants can be selected for further breeding and undesirable ones can be eliminated.

Bingham says there is a tremendous advantage in the chance of finding desirable characteristics in haploid plants. In tetraploid alfalfa, the normal type, the chance of a trait expression is only one in 36. In haploid alfalfa the chance of this trait showing up is one in four.

Only three alfalfa haploids have been found in previous research, and the main problem has always been the lack of a technique to isolate them. Bingham's technique has made it possible to detect the haploids much more easily, and his first experiment produced eight of these which can be used in further breeding work.

### Using a marker

He developed a technique of crossing widely different types of plants and used a marker in the breeding stock to show when an unusual plant is produced. This marker causes red seedlings which can be identified from the green haploids.

Normal tetraploid plants vary in their capacity to produce haploids. One alfalfa plant produced one haploid in every 1,500 flowers pollinated, and another tetraploid produced only one haploid in every 10,000 flowers pollinated.

The eight haploids produced by Bingham are thrifty and normal in shape