

# New beginnings for an ancient crop

E.J. Weber

The empire of the Incas was once the proud centre of an advanced civilization and highly organized system of agriculture. But the Incas have long since passed into distant history, and today's inhabitants of the High Andes are for the most part poor subsistence farmers, who must work long and hard to provide a bare living for themselves and their families.

The descendants of the Incas did not forget all their traditions, however, and today researchers in a number of Latin American countries are turning their attention to one of the crops first cultivated by those ancient peoples. The crop is called quinoa; it is known to be one of the most nutritious of grains; and the researchers hope it may be the answer to the Andean region's acute shortage of locally-produced food protein.

Suddenly, after centuries of neglect, there is a surge of interest in quinoa. In Peru strong efforts are being made to increase quinoa production as a means of reducing costly wheat imports, and research has been carried out on industrializing quinoa grain processing. In Bolivia the government has gone so far as to pass a law requiring the use of at least five percent of quinoa flour in commercially produced breads, pastas and the like. In Chile quinoa is being used in feeding programs to improve the nutrition of poor children.

All this enthusiasm merits a closer

examination. *Chenopodium quinoa* Willd., to give the plant its full name, is an ancient crop originating in the Andes. Along with the potato it is known to be one of the earliest cultivated crops in the region. It was grown by various indian peoples long before the arrival of the Europeans, and has remained a staple of the peoples of the high Andes despite attempts to introduce European species.

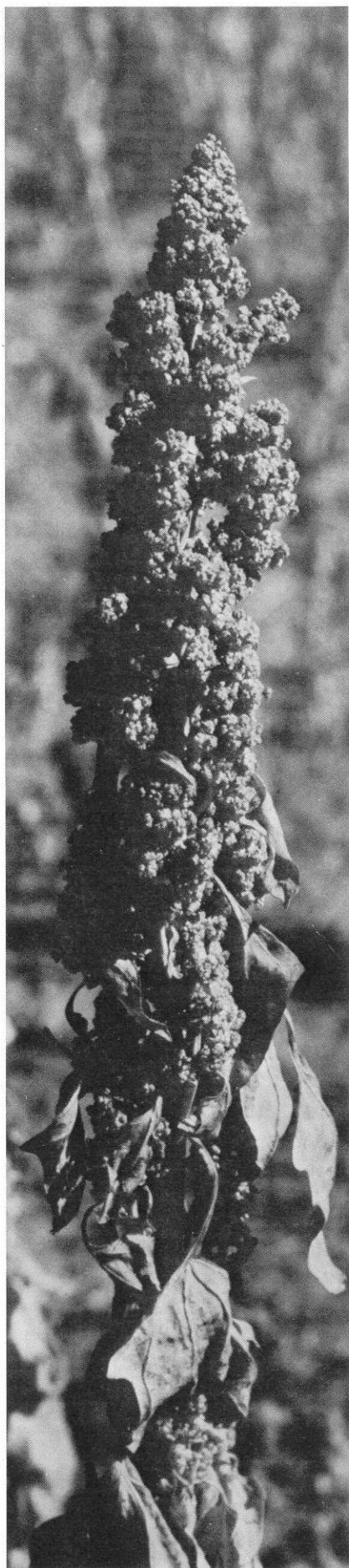
Quinoa is a member of the *Chenopodium* or goose foot family, of which some 60 species are found around the world. Archaeological remains in Europe show that chenopods were also used as grain there, and various forms of the species are still grown today in hilly areas of northwest India. Nowhere, however, did the species become an important crop except in the Andean region — probably because equally good or better cereal grass plants were available.

It is generally accepted that quinoa evolved and was domesticated from wild ancestors by different groups in highland areas of Bolivia, Colombia, and Peru. It is a hardy plant, and provided a nutritious grain to supplement a diet consisting mainly of starchy tubers in regions where there were no adaptable wild grasses from which to create cereal grains.

Unlike potatoes and maize, however, quinoa was ignored by the Spaniards, and this neglect has continued until very recently. In 1965 there were the first stirrings of a renewed interest in the crop

*Some of the many shapes, sizes and colours of quinoa grain are displayed in these samples from the collection at Patacamaya Research Station in Bolivia.*





Quinoa in a farmer's field — ready to harvest.

on the part of a number of researchers in Bolivia and Peru. This led to the development of improved varieties and a better knowledge of the major characteristics of the plant itself, its cultivation and major constraints.

Quinoa is normally sown at altitudes of from 2,500 to 4,000 metres, and most varieties are resistant to frost. It will also yield harvests on poor soils and with an annual rainfall as low as 300 to 400mm. A number of diseases and pests affect the plant, especially mildew and leaf spot, but the most serious economic threat comes from birds, which attack when the crop is about to ripen.

Yields can vary enormously according to growing conditions — they may be as low as 450 kilograms per hectare or as high as 2,000 — but the average on the altiplano is about 800 to 1,000 kg/ha. A record yield of 5,000 kg/ha has been reported under ideal conditions near Lake Titicaca (thought by many to be the original "home" of quinoa) using the new variety *Sajama* developed in Bolivia.

Quinoa is often cultivated in rotation with other crops by highland farmers, some of whom place an almost religious significance on these cropping patterns, and believe quinoa can prevent disease among other crops. It is also used as a medicine for a variety of ailments, and is believed in some areas to improve the skin and to increase milk production in nursing mothers.

Such claims have yet to be proved, but there is certainly no doubt about quinoa's superiority to most other cereal grains in terms of protein content. This superiority is due principally to the quality of its protein, since it has a good balance of the essential body-building amino acids, especially Lysine (six percent). Protein content averages about 14 percent, although some studies have reported as high as 20 percent and others as low as 12 percent. In addition quinoa contains necessary vitamins such as vitamin C and the B complex of thiamine, riboflavin and niacin.

Tests with rats have shown that quinoa can considerably improve the nutritive value of cereal-based diets. Wheat flour mixed with quinoa flour at a ratio of 4:1 improved the nitrogen efficiency for growth by 40 percent, weight gain by 11 percent, and protein efficiency ratio by 72 percent over wheat flour alone.

In poultry feeding trials reported in Bolivia, chicks fed a ration containing cooked quinoa made gains equal to those receiving corn and skim milk. Rations containing uncooked quinoa, however, depressed the growth rate of both chicks and swine.

The reason for this drastic change in growth patterns is the presence of bitter-tasting saponins, glucosides which are found in the seedcoat of quinoa, and which have a toxic and/or growth-depressing effect on animals.

Saponins can be removed from the grain by repeated thorough washing, a

process which is shortened if lime is added to the water. Cooking also helps to remove both the bitter taste and the toxic effects. In Peru machines have been developed for large-scale processing of quinoa in industrial use, such as the preparation of wheat-quinoa flour mixes.

The other alternative is the development of saponin-free varieties, such as the Bolivian variety *Sajama*, which is practically free of saponins, although it still has a slightly bitter taste. Unfortunately it appears that most of the large-grained varieties now in use have a relatively high saponin content.

The utilisation and preparation of quinoa as a food is quite varied. The main uses are in soups and sweets, and a coarse bread called *kispina*. Various drinks are also prepared, hot or fermented. High protein cookies and biscuits can be produced by mixing up to 60 percent quinoa flour with wheat flour. The nutritive value of noodles can also be considerably increased by using up to 40 percent quinoa flour without affecting appearance or other characteristics of the end product. Quinoa flakes have also been tried, but these still retain a slightly bitter taste.

The leaves of the plant can also be eaten in salads or cooked, and in certain regions where vegetables are scarce this is a product of local importance. The leaves and stalks are also fed to ruminants, and the chaff and gleanings from threshing are generally fed to pigs.

Serious research into the improvement of quinoa began in 1965 at the Patacamaya Research Station in Bolivia, with the support of Oxfam and the UN Food and Agricultural Organization. The station now has a collection of some 700 different ecotypes taken mainly from farmers' fields, a further collection in Puno, Peru, contains some 600 entries, and additional collections are being undertaken. Analysis of these collections is enabling researchers to evaluate the genetic diversity of quinoa, and to select cultivars with desirable characteristics for improved varieties.

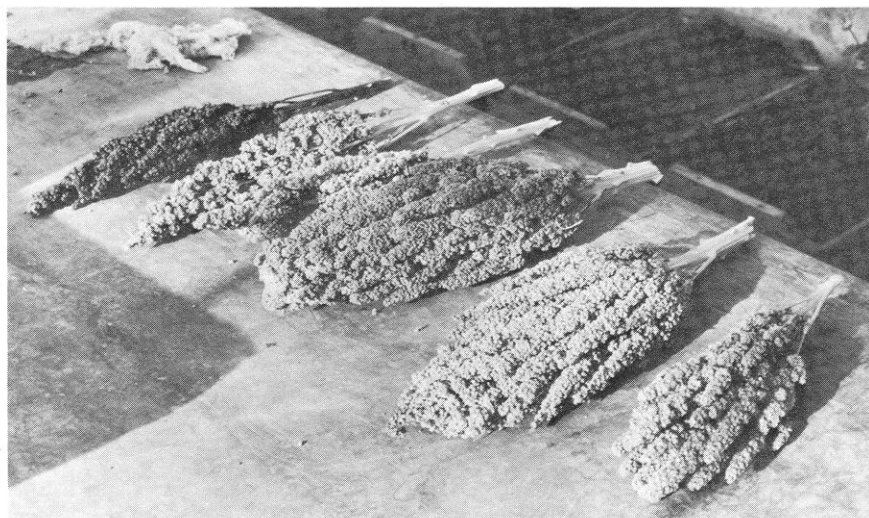
The first international convention on chenopods was held at Puno in 1968, attended by a small group of researchers, mainly from Bolivia and Peru. There was a much larger attendance, and a broader representation, at the second international convention, held in Bolivia in 1975, and a far wider range of topics was discussed.

Quinoa research still has a long way to go, however, and a new impetus was given to the work in 1977 when the IDRC agreed to support an expanded research program based at the Patacamaya Station at the Bolivian Institute of Agricultural Technology. The program has several aims: first to develop new quinoa varieties adapted to different agro-ecological production zones both in Bolivia and in surrounding countries; to develop economic production "packages" for introduction to





*Part of the germ plasm collection at Condoriri, the experimental farm of the University of Oruro on the Bolivian altiplano. This particular crop did not do well.*



*Panicles of six different quinoa ecotypes, showing again the wide variety in seed-coat colour, shape, size, and branching.*

Photos: E.J. Weber

farmers; and to provide training for Bolivian researchers in order to increase the number of scientists familiar with and capable of working intensively with quinoa.

The project is of particular importance in Bolivia, where production is at present insufficient to meet the demands created by the law requiring the addition of five percent of quinoa flour to commercially-produced baked goods. Further research has been underway at the University of Puno in Peru since 1976, supported by the Simon Bolivar Fund, and administered by the Inter-American Institute for the Agricultural Sciences (IICA).

All this is just a start. Much of the current research is still isolated and sporadic, and could benefit from better integration and an interdisciplinary approach. More work is needed in areas such as the development of varieties low in saponins, the removal of saponins

from the grain, and the possible industrial uses of the grain.

In an effort to promote better exchange of current information, a group of researchers is preparing a book on quinoa, to be published by IICA, which will pull together in one document as much of the relevant current knowledge as possible.

A great deal remains to be done, but it now seems certain that the persistence of those early researchers has finally paid off. In the near future, the grain that was once a major foodstuff for a mighty empire may once again become an important economic and nutritional mainstay in the food economy of the Andean region. □

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