

FOOD CROP PRODUCTION

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Summary

Food crops are usually classified into four groups, “cereal or grain crops”, “tuber and root crops”, “legumes for seeds” and “others”. The food crops provide human beings with most of the energy required to sustain their lives, so appropriate species were domesticated at an early stage of human history; they have a long history of cultivation. Food crops domesticated in different places on Earth, spread from there to various regions in the world through different routes. They became established as important crops in various regions by adaptation to the environmental and social conditions of each established region. In this chapter evolutionary processes will be overviewed with the botanical and agronomic traits for major food crops—rice (*Oryza sativa*), wheat (*Triticum aestivum*) and maize (*Zea mays*) as cereal crops, potatoes (*Solanum tuberosum*) as a tuber crop, and soybean (*Glycine max*) as a leguminous crop for seed.

1. Introduction - Importance and Production of Food Crops

The food crops listed in Tables 1 and 2 provide the staple food for human beings. They were all domesticated a long time ago and have a long history of interaction with human beings. Food crops are mostly grown on a field scale and provide the staple food for human beings (see Table 1). Generally they are grown with relatively low subsidiary energy input to avoid excessive production cost, since they provide the most fundamental nutrition for human beings and they are required in large quantity. Three leading crops, rice, wheat, and maize, supply more than 50% of all the calories consumed by the entire human population. The cultivation area and production of major food crops are shown in Table 1.

Wheat is the leading crop in terms of area harvested each year, at 227 million ha, followed by rice, at 150 million ha. Direct consumption by humans accounts for 85% of

total production of rice, compared with 60% for wheat and 25% for maize. Of the eight food crops regarded as staple in the broadest sense, seven are grain crops. A large proportion of man's essential nutrients are contained in grain. In addition to its high nutritive value, low water content, ease of transport and processing and good storage qualities have made these crops the leading group among food crops. The production of 'tuber crops' is comparatively high relative to the cultivated area, which is much less than that of grain crops. The use of 'legumes for seed' for direct consumption for food is the lowest among the three major groups of food crops. Nowadays most of them are used as feed for livestock, although a significant amount is still used directly for human consumption in the Far East.

	Production x 10⁶	Cultivated area x 10⁶	Yield kg/ha	Food ton x 10⁶
Cereals, total	2096.4	705.6	2971	
Wheat	609.6	227	2686	363*
Rice, paddy	57.3	149.8	3827	372**
Maize	585.8	140.1	4182	147***
Barley	156.6	66.3	2363	
Tubers and roots, total	639.9	49.4	12956	
Potatoes	295.4	18.3	16130	158+
Sweet potatoes	138.4	9.2	14983	69+
Legumes for seed				
Soybeans	147.0	67.6	2174	
Beans, dry	19.0	28.2	672	
Peas, dry	12.6	6.5	1949	

* 65% milling rate

** 70% milling rate, 15% for feed

*** 75% for feed

+ 50% for feed

Table 1. Production, cultivated area and yield of major food crops

Source: FAO, 1997

Production of these crops is highly variable due to environmental conditions, while demand is fairly constant because most of them are a staple food. Their marketing is under public control in many countries in order to avoid harmful price fluctuations resulting from adverse weather.

2. Classification of Food Crops

Generally classification of crops is given according to agronomic use rather than to botanical features. In this chapter the conventional classification is used, although classification of food crops goes back a very long time and utilization of crops is changing with living standards, etc. For example, maize was formerly mainly used as a staple food for human beings but it is now mainly used as feed for livestock.

Food crops are often classified into four groups, i.e. "cereal or grain crops", "legumes

for seeds”, “tuber and root crops”, and “others” (see Table 2). The first two groups are each composed of a single family, Gramineae and Leguminosae respectively. In this text, buckwheat which belongs to Polygonaceae is put in the group of “others” although previously it was often included in grain crops. “Tuber and root crops” is composed of several families. Generally this group gives the highest yield followed by “cereal or grain crops” although the dry matter content is lower. The harvested organs in “tuber and root crops” are vegetative structures produced underground, which assures a longer filling period and less senescence of leaves. In the cereals and legumes it is the seeds, i.e. reproductive organs, which are harvested.

	English name	Scientific name	Family
Cereal or grain crops	Wheat	<i>Triticum</i> sp.	Graminae
	Rice	<i>Oryza sativa</i> and <i>Oryza glaberrima</i>	Graminae
	Maize	<i>Zea mays</i>	Graminae
	Barley	<i>Hordeum vulgare</i>	Graminae
	Sorghum	<i>Sorghum bicolor</i>	Graminae
	Oats	<i>Avena</i> spp.	Graminae
	Millets	<i>Eleusine coracana</i> , <i>Pennisetum americanum</i> ,	Graminae
Legumes for seeds	Beans	<i>Phaseolus</i> spp.	Leguminosae
	Soybean	<i>Glycine max</i>	Leguminosae
	Peas	<i>Pisum sativum</i>	Leguminosae
Tuber and root crops	Potato	<i>Solanum tuberosum</i>	Solonaceae
	Sweet potato	<i>Ipomea batatas</i>	Convolvulaceae
	Cassava	<i>Manihot esculenta</i>	Euphorbiaceae
	Edible aroids	<i>Alocasia</i> , <i>Colocasia</i> , <i>Cyrtosperma</i> , <i>Xanthosoma</i>	Aracea
	Yams	<i>Dioscorea</i> spp.	Dioscoreaceae
Others	Buckwheat	<i>Fagopyrum</i>	Polygoneaceae
	Coconut	<i>Cocos</i>	Palmae
	Banana	<i>Musa</i>	Musaceae
	Quinoa	<i>Chenopodium</i>	Chenopodiaceae
	Grain amaranthus	<i>Amaranthus</i>	Amaranthaceae

Table 2. Classification of food crops

The major composition of the material harvested in cereals is carbohydrates, with approximately 10% protein. The seeds of “legumes for seeds” contain higher amounts of proteins and lipids than the cereals. These differential features in chemical composition and growth of the organs for harvest are reflected in the yield between the groups. The yield of “legumes for seed” and “others” is the lowest, mainly due to the higher content of proteins and fats which need higher energy for biosynthesis, and the lower photosynthetic activity. Numerous cultivars which differ in major agronomic traits exist in each group of food crops.

3. Origin and Spread of Cultivated Forms of Food Crops

Ever since man’s first successful attempts to grow his own food, some 10 000 years ago, the history of crop cultivation and that of human civilization have been closely

interwoven. Domestication of food crops enabled man to produce food in large quantities. This, in turn, led to community settlement, population increase and rapid cultural evolution.

The first domestication of many food crops happened more than 10 000 years ago, and then spread to other areas along with the spread of culture. Food crops were dispersed from their place of origin to various regions of the world, through various routes. The diffusion of food crops in cultivation accelerated in the two or three centuries following the voyages of Vasco da Gama and Columbus. It was not until the middle of the nineteenth century that new cultivation of great utilitarian value was achieved. Through this long process, most of the food crops have been modified to become very different from the original wild species. The major producing area of some food crops is now far from their place of origin, as seen in potatoes which originated in South America and which is now the major food crop of Europe. It is not easy to trace back these evolutionary processes. Although the processes have been studied for many food crops, it remains controversial. The following section gives examples of the evolutionary process for a few major food crops.

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