II.3 Maize

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1 Introduction

Maize (Zea mays L. ssp. mays) is one of the three most cultivated crops in the world, along with wheat and rice. Modern maize is quite different from its proposed ancestor, the teosintes (Zea mays L. ssp. parviglumis or mexicana), grown by the pre-Columbian and Mesoamerican civilizations. Centuries of selection and genetic improvement of domesticated maize have influenced its evolution into the hundreds of landraces now grown worldwide. Genetic improvement of maize has been sustained by an increase in the variety of uses of this crop (Johnson 2000). In addition to genetic improvement through breeding, recent developments in plant genetic transformation have introduced new possibilities for trait improvement in maize.

1.1 Old and New Uses of Maize

Maize does not exist in the wild. It was created through the domestication of teosinte by the Mesoamerican civilizations for which it was the major staple food. Today, maize is the most important food and feed crop worldwide. In the past 20 years, it has also been increasingly used in industrial processing; and in 2004, close to one-third of United States maize production was for food, feed or industrial use (Fig. 1).

New industrial uses of maize include plastic, sweeteners and ethanol. Zein, a major protein component of the maize kernel, is a good example of this diversification of use. Its thermoplastic and film-forming properties are used by industry to produce paper and paperboard adhesive, additives in oil cloth and linoleum, moisture and oxygen barriers and varnish substitutes (Johnson 2000). In the United States, maize seed is currently refined to produce six major outputs: high fructose corn syrup (HFCS), fuel alcohol, beverage alcohol, glucose and dextrose, starch and food (Fig. 2). In the past 25 years, production of sweeteners (HFCS), and in particular fuel alcohol, has increased dramatically. Production of ethanol from maize is a rapidly developing area of industrial crop utilization, due in part to the search for alternative energy sources. Although any starch-containing grain is theoretically suitable for ethanol production,
maize represents 95% of the current starting material for this process. For sweeteners, maize competes with sugar beet and sugar cane, the two major sweetener-producing crops in the world.

All continents (except Antarctica) produce maize, which ranks second to wheat in metric tonnes (t) of crop production world-wide. The United States produces and consumes more maize than any other country, with an annual