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USAGE, HISTORY, SYSTEMATICS AND MORPHOLOGY OF CORN *(ZEA MAYS L.)*

[1]Khudaykulov Jonibek Bozarovich, [2]Irnazarov Shukhrat Ismatullayevich
[3]Turayeva Yulduz Rustam qizi
[1]Professor, Tashkent state agrarian university
[2]Professor, Karshi Engineering Economic Institute
[3]Master's student, Tashkent state agrarian university
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Abstract. *In this article was given info about usage, history, systematics and morphology of corn (Zea Mays).*

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USAGE. Corn is one of the most common and valuable crops in world agriculture, it takes the second place in the world in gross production and the third in sown areas. Corn is widely used as a food product, as feed for livestock and as a raw material for industrial production, more than 500 types of products are prepared from the crop.

In terms of productivity potential and fodder value, maize far surpasses all other fodder crops. The feeding value of 1 kg of corn grain is 1.34 feed units, 1 kg of biomass in waxy maturity – 0.24 feed unit, 1 kg of straw after harvesting the cobs – 0.37 kg.

According to the FAO, the area under corn throughout the world in 2018 amounted to 184.2 million hectares, gross grain yield over 10,167 thousand tons, with an average global grain yield of 55.2 q/ha. More than 60% of corn grain production falls on the industrial countries of North America and Europe, where the average yield of corn grain is 65.1 quintal per hectare. The production of corn grain in the world is increasing, as can be seen from the data in Table 1.

Table 1

Area, yield and grain production of corn by some leading countries (FAO, 2021)

Country	Sown area, 000 ha	Productivity q/ha	Gross grain production, 000 t
In the world	197,204	58.2	1,148,487
Angola	2,642	106.6	2,818
Argentina	7,232	78.6	56,860
Brazil	17,518	57.7	101,138
Canada	1,451	92.3	13,403
China	41,309	63.1	260,957
Mexico	66,904	40.6	27,228
USA	32,950	105.3	347,047

India	90,271	30.7	277,151
France	15,061	85.2	128,450
Ukraine	49,869	71.9	35,888
Russia	25,062	57.0	14,228
Uzbekistan	43.00	96.9	421

As can be seen from Table 1, in Uzbekistan, the area under maize for grain in 2021 amounted to only 43 thousand hectares, with a yield of 96.9 quintal / ha. Uzbek breeders created and released high-yielding hybrids for the spring sowing period such as Vatan and Uzbekistan 601-ERU with a grain yield of 80–100 quintal per hectare, and for summer sowing hybrids Uzbekistan 306-AMV and Korasuv 350-AMV with a grain yield of 60– 70 quintal/ha.

HISTORY. The center of origin of corn is Central America. Corn pollen grains found during archaeological investigations in Mexico more than 5,000 years ago.

It was brought to Europe by Columbus at the end of the 15th century, then spread to the countries of the Mediterranean, to India, Indochina, etc. Corn started to be cultivated in Central Asia in the end of the 18th and the beginning of the 19th centuries. The presence of trade and religious ties between Muslim countries suggest that corn originally comes into this region through Iran and Afghanistan from Asia Minor, where it was widely cultivated by that time. The local names of makka juhori (Mecca-Zhukhori) or Dzhugara from Mecca undoubtedly indicate a possible way of coming of this crop with caravans of pilgrims who made hajj to Muslim shrines – Mecca and Medina, located in Asia Minor.

SYSTEMATICS. Corn belongs to the class of monocotyledons (Monocotyledonae), order Poales Nakai, family Poaceae Barnh, tribe Andropogoneae Dumort, subtribe Tripsacinae.

According to G.E. Tsvelev (Russian Research Institute of Plant Science), based on a long study of the world diversity of corn variety samples collected from 92 countries of the world, a classification has been proposed, according to which all corn is classified into 7 subspecies:

- everta (Sturt.) Zhuk. (Popcorn);
- indurata (Sturt.) Zhuk. (Flint corn);
- amylaceae (Sturt.) Zhuk. (Flour corn);
- Indentata (Sturt.) Zhuk. (Dent corn);
- saccharata (Koern.) Zhuk. (Sweet corn);
- Ceratina (Kulesh.) Zhuk. (Waxy corn);
- Tunicata (St. Hil.) Zhuk. (Pod corn).

The genus Zea is represented by a single species – Zea mays L. – corn – and only in a cultural form. Plants of these species have a diploid set of chromosomes (2n = 20).

Of these, the following are most common in Uzbekistan:

1. Z. mays, ssp indurata – K. Flint corn. The outer layer of the endosperm is vitreous, horny (the intervals between starch grains are densely filled with proteins), and its central part is much softer, powdery (from rounded starch grains). Breeding varieties for silage: Uzbekistan 100, Kremnistaya and UzROS.

2. Z. mays, ssp indentata – K. Dent corn. The endosperm of the grain is vitreous, horny only on the sides, and the rest is looser, mealy; the grains have a dentlike shape with a dent at the top (the result of a faster drying of the powdery part of the endosperm). Grades: Uzbek dent; hybrids Vatan, Uzbekistan 601-ERU, Uzbekistan 306-AMV, Dneprovsky 70T, etc.

3. Z. mays ssp. amylacea – K. Flour corn. The endosperm of the grain is not dense, mealy, consisting of rounded starch grains with a small amount of proteins in the intervals between them and a very thin outer layer of angular starch grains, as a result of which the outer surface of the grain seems dull (and not shiny as in the previous groups). It is relatively thermophilic. So-called early maturing, “Korean” local maize varieties are widespread in the republic.

4. Z. mays orizoides Golodk. – K. Popcorn. The endosperm of the grain is very dense, horny or siliceous, consists mainly of angular starch grains, the grains are relatively small, bursting when heated. In the republic there are local bursting, rice varieties (badrak).

MORPHOLOGY. Corn is an annual plant that differs from most annual cereals with a thick, full stem, high growth and powerful large leaves. Corn stalk is cylindrical, with thickened nodes, ends with apical inflorescence – panicle with male flowers. The leaves are located along the stem alternately on both sides.

In the leaf axils, with the exception of the 4–5 uppermost ones, second-order shortened shoots are laid, bearing apical female inflorescences – the ears. Second-order shoots in the axils of the widest leaves of many varieties often form elongated stems, the so-called stepchildren, capable of forming a typical panicle or inflorescence with male and female flowers at the apex.

Root system structure. The plant is characterized by a strong, fibrous root system. In maize, there are two groups of roots: embryonic and accessory. The first group includes the main and lateral embryonic hypocotyl (epicotyl) roots. The second group consists of nodal roots – aboveground and underground (aerobic).

During germination, the corn kernels first form one embryonic roots, which quickly penetrates the soil to a depth of 30-40 cm. Plants of most hybrids and varieties form 2 to 7 lateral roots in 2–3 days. Unlike other cereals, the embryonic roots of maize can reach a considerable length.

The first tier of roots is composed of lateral hypocotyl roots, is strongly branching in the soil, and are an embryonic roots. This tier for 2-3 weeks performs the basic functions of supplying the plant with nutrition and water.

The second tier of roots is formed from a coleoptile site due to an increase in the seed embedment depth. These roots, epicotyl, are most strongly developed with a seeding depth of 10–14 cm. The role of these roots in nutrition is negligible.

The third tier – the main or nodal roots are most important for the corn plant, they are formed from the close knots of the stem under the soil surface and grow horizontally at the beginning, then go down to a depth of over 2 meters. The number of these roots reaches 20 - 30 pieces, they are strongly branched. The length of all these roots and root hairs reaches several kilometers. The bulk of the roots is located in the horizon 0 - 30 cm.

Support roots are formed on the second - the third, and in late-maturing forms – on the sixth - seventh above-ground stem nodes, which reach the soil and form lateral roots and hairs. The main function is to protect from lodging and to provide nutrition to the plants.

Corn roots place increased demands on aeration, and therefore they (unlike other cereals) have airy cavities, and the deeper the roots are, the larger they are.

The formation of the root system is greatly influenced by irrigation, contributing to the deepening of the roots in the soil and an increase of 1.5 to 2 times the mass of the roots in the root zone.

The power of the root system is an important factor ensuring the growth and development of above-ground organs and the overall productivity of plants, and all technological methods for their cultivation should be aimed at creating optimal conditions for its growth and development, especially in the early stages of organogenesis.

Stem structure. The stalk of corn is tall, cylindrical, and relatively thick. Depending on the variety, its height varies from 50 cm to 7 m. It has well-defined nodes and interstices – from 8 to 40 cm in different varieties. Approximate underground is 3 - 10, and underground 6 - 30 and more. The shortest internodes are in the lower part of the stem, the longest is that endures the panicle. The number of internodes within the variety varies little, and their length depends on the growing conditions. The growth of internodes begins with the lower nodes and gradually moves to the upper one, which is rapidly growing, leaving the leaf vagina.

Thickness of the stem grows from within. The thickest part is at the base, the thinnest is at the top. Interstices under pressure from the resulting cob have a notch.

The greatest growth of the stem – 15 - 20 cm per day – is observed on warm days before the panicle leaves the vagina of the upper leaf and in the beginning of the flovering. In the bosome of each vagina there is an axillary bud from which the lateral shoot can form, which forms the cob. In most varieties and hybrids of corn, cobs are formed from the upper axillary bud.

From the axillary buds of the lower and underground nodes, elongated shoots can develop – stepchildren, capable of creating their own root system.

Leaf structure. The corn leaf, as well as other cereals, consists of a leaf vagina, tightly covering the lower and middle part of the internode of the stem, a wide and long leaf blade and a small tongue protecting the stem from dust, water and microorganisms.

Where the leaf vagina is attached to the stem, an annular thickening is formed – the leaf node, the growth of which in the case of lodging of the plant helps it to straighten. Ultra-ripened varieties have 8 - 10 leaves, late-ripen tropical ones – 30 - 40 leaves and more. Corn forms 4 groups of leaves:

- embryonic – 5 - 7, which fall to the beginning of flowering;
- the real ones – in their axils they form ear-bearing shoots;
- apical – side shoots are not formed in the axils;
- wrappers – are formed on a shortened shoot, carrying a cob, tightly overlap each other and sharply differ in anatomical structure from true leaves.

The leaves are bare from the bottom, hairy at the top, finely serrated at the edges. Vascular bundles at the edges of the leaves give strength to large leaves of corn and prevent them from breaking in strong winds.

The epidermis of a leaf plate of one plant has 100–200 million stomata, which creates favorable conditions for gas exchange of plants.

The total surface of the leaves varies in the range of 0.3 - 1,2 m2, leaf blades can reach a length of 1 m or more, 10 - 14 cm wide. The leaves of corn have an intense green color, which can vary due to cooling, thickening, nitrogen starvation, radiation intensity and changes in the spectral composition of light, as well as under the influence of pests and diseases.

Inflorescences and flowers structure. Corn is a monoecious dioecious plant capable of forming three types of flowers: male, female and less often bisexual.

Male flowers, which mainly develop male generative organs – stamens, and whose pistil primordia are reduced, are gathered into a panicle, which differs from other grasses in that its

lateral branches are weakly branched. Panicle is painted in green, light green, and blue - purple or red (from the presence of anthocyanin pigment). Spikelets in a panicle are arranged in pairs, one has an elongated spike axis, the other is shortened. Spikelet floret is broad, pointed at the top, haired, with 3-8 longitudinal strings. On the central stem of the panicle, the spikelets are arranged spirally, very tightly around its axis, and on the lateral branches, they are located on the upper side. Depending on the variety or hybrid, the number of spikelets varies on one panicle from 750 to 1400. Spikelets are two-flowered. The flower consists of 2 flower films and 3 stamens. By the time of ripening, the four-nest duster is located on the long staminate filament, which during flowering becomes even longer and brings the anther out, beyond the limits of floral films. Each anther contains 1000 - 2500 pollen grains; mature pollen has a golden yellow color.

Female flowers, in which female generative organs develop and the rudiments of pollen sacks are reduced, are usually formed in the form of a cob, as the apical inflorescence of side shoots developed from axillary buds. Potentially, the plant can form the cobs in the axils of each leaf, except for 2-4 upper ones, but practically they are laid in the axils of the leaves, located from 7 to 15 nodes of the stem.

The largest and most developed is the uppermost ear, the rest – less and lagging behind in development. The cob legs, depending on shortening the internodes of the axillary shoot, have a vertical, horizontal, or drooping direction. The mass of the core of ripe cob is usually 18 - 25% of the mass of the entire cob. Spikelets on the cob, as in a panicle, are arranged in pairs, positioned longitudinally along the fleshy stem of the cob and in each of them a flower is formed, therefore the number of longitudinal rows of flowers, and then the cobs are always even, a multiple of four – 4 - 8 - 12 - 16 - 20 to 32. Self-pollinators or mutants have the number of rows of grains 6 - 10 - 15 - 19 and the rows lose their straightness. The cobs are of different lengths and contain a different number of spikelets in each row – from 20 to 50 and more.

A female flower consists of a well-defined pistil, 3 reduced stamens in the early stages of development, and 2 large non-functioning lodicules. The pestle consists of a rounded ovary, a long column and an even longer stigma ending in two lobes. In the upper flowers, the pistillate columns and stigmas (threads) are the shortest, and in the lower flowers, they are 30–50 cm long. They are a silky thread covered with lobules and hairs. The stigmas of the stigma produce a sticky liquid that helps to catch the airborne pollen and perceive this pollen along its entire length. The color of stigmas is light greenish, sometimes pink or purple, and after fertilization, the stigmas dry out and turn brown.

Corn cob, as a rule, is tightly covered with wrapper, however, if the stem is ahead of the growth in the leaves of the wrapper, it is not covered from above and may be affected by pests and diseases.

Grain structure. Corn kernel casing consists of a multilayer pericarp that develops from the walls of the ovary and a poorly developed seed coat and usually grows with the pericarp.

Depending on the presence of pigments, the shells of the kernels can be colored yellow, orange, red, dark cherry or purple, and in the absence of pigments – they are white. The aleurone layer and endosperm can also be variously colored. If the endosperm is transparent, then its color may depend on the color of the aleurone layer.

The endosperm of the kernels of different botanical groups and varieties differs and is powdery, hornlike, vitreous and waxy in consistency. An embryo with a flap is located laterally at the bottom of the kernel. In the embryo, it is possible to distinguish the primary kidney with 5-7

embryonic leaves, the embryonic root with the root vagina and the epicotyl. At the point of contact between the shield and the embryo there is a layer of suction cylindrical cells.

The mass of various organs in the dry grain is to the whole mass of grain: the embryo – 7,6 - 12,8%, the endosperm - 80,2 - 85,6% and the shells – 6,2 - 7,8%.

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