**3. Maize (Zea mays L.):**

**A) Crop Botany:**

It belongs to family Poaceae.

i) Root: Its root system consists of 3-5 seminal roots, secondary roots that develop from node just under the soil surface and aerial (brace) roots that develop from the nodes above the ground.

ii) Stem or stalk: It is thick and strong which bears leaf at each node.

iii) Leaves: It has narrow leaves. Each leaf consists of a leaf sheath which covers the stem and a broad leaf blade.

iv) Inflorescence: It is of two types i.e. male inflorescence called tassel and female inflorescence called ear. Both types of inflorescence are produced on the same plant. Tassel is produced at the top of plant and is a branched panicle with only male spikelets, each of which contains two florets with three anthers in each.

Ear is developed in the middle of stalk on a short lateral branch called shank. It is a spike whose thick axis (Cob) carries 8-30 rows of paired spikelets. Each spikelet contains two florets, of which usually one in fertile. Each floret has a single ovary, terminated by a long style or silk that is covered with fine sticky hair to which pollen grains adhere. The ear is covered and protected by husks that are modified leaf sheaths. Maize is a cross-pollinated crop.

v) Seed: The grains or kernels are produced that are held very tightly on the cob.

**B) Agro-meteorology:**

i) Climate: It is a summer crop that can be grown in tropical and sub-tropical regions with high temperature and enough sunshine. It is adapted to variable rainfall and can be grown at rainfall of 25 cm up to 500 cm. The optimum rainfall requirement for this crop is 75-125 cm / annum. It can be successfully grown from sea level up to 4000 m altitude.

ii) Soil: The soil having good drainage and water holding capacity is suitable. Medium to heavy loam deep soils with high organic matter content are suitable for this crop. Soil pH should be 7-8 and waterlogged sandy or saline soils are not suitable for it.

**C) Economic Importance:**

It is third most important food crop after wheat and rice. It is major staple food in many countries of the Latin America and Africa. About 2/3rd of total world production is used for livestock feed and for commercial starch and oil production.

Industrial products of maize are starch (it is used in textile industry and production of corn syrup), sugar syrups, glucose, Energile, alcohol, dextrin (it is used in leather industry), jellies and custards, corn flakes etc. Poultry and livestock feed is made from grain. Silage and hay is prepared for milch animals. Its grain contains 3-4% oil that is considered of good quality as it contains linoleic acid. Area of Pakistan under maize crop in 2018-19 was 1.32 million ha, and production was 6.31 million tonnes with average yield 4.79 tonnes / ha.

**D) Production Technology:**

**1) Seed bed preparation:** 1-2 deep ploughings, 3-4 cultivations followed by 2-3 plankings are sufficient to prepare good seed bed.

**2) Sowing time:** There are two growing seasons:

a) Spring maize: End January – 15th March. It matures in June.

b) Autumn maize: 1st week of July – End August. It matures in November.

c) Barani areas: 15th March – 15th April

Two types of maize are grown:

a) Hybrids: FH-810, Yousafwala hybrid, FH-949, FH-1046, YH-1898, Monsanto, ICI and Pioneer hybrids with various names are also popular among growers.

b) Synthetics: Sahiwal-220, Agaiti-2002, Pearl, MMRI-yellow, Malka-2016

**3) Seed rate:** 8-10 kg / acre for ridge sowing

12-15 kg / acre for flat sowing by single row cotton drill

**4) Sowing method:** Two methods are used for maize sowing:

a) Flat sowing: Row to Row distance = 60-75 cm

P to P distance = 9-12 inches

It can be sown by dibbler or single row cotton drill in barani areas. Dibbler maintains P to P distance but single row cotton drill sown crop needs to be thinned for maintaining P to P distance.

b) Ridge sowing: Ridge to Ridge distance = 60-75 cm

Plant to Plant distance = 9-12 inches

After irrigation application in ridges, manual sowing is carried out by *chopa* method or dibbler just above the water line on one side but not on top of ridge. Ridge sowing is usually practiced in the irrigated areas.

In spring sowing, ridges are made in east-west direction and seed is sown on south side of ridge because seed requires sun light from south. East-west ridges increase water use efficiency.

In kharif sowing, ridges are made in north-south direction to facilitate the light penetration into the crop rows.

**5) Fertilizer:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Maize type** | **N** | **P2O5** | **K2O (kg/acre)** |
| Hybrids  | 110 | 46 | 25 |
| Synthetics | 95 | 35 | 25 |
| Barani areas | 34-46 | 23-34 | 12-25 |

Whole of P and K at sowing but N in 3 splits as:

1/3 N at sowing

1/3 N at knee height

1/3 N at earing

 **6) Irrigation:**

Spring crop = 10-12 irrigations

Autumn crop = 8-10 irrigations

Critical stages for irrigation are tasseling, silking, fertilization, milking and dough stages.

**E) Plant protection measures:**

**i) Weeds:** up to 30% reduction in yield occurs due to weeds. All summer season weeds are present in maize especially itsit, tandla, and deela. Weeds must be controlled within 15-45 DAS.

Herbicides:

a) Grassy weeds: Pendimethalin @ 2 L / acre with 1st irrigation

Atrazine + S-metaolachlor @ 800 ml /acre with 1st irrigation

b) Sedges: Halosulfuron methyl @ 20 g / acre as post-emergence spray at 2-3 leaf stage of weeds

c) Broadleaf weeds: Pendimethalin @ 2 L / acre with 1st irrigation

atrazine @ 330 ml / acre at 2-3 leaf weed stage

ii) Insect-pests: Maize stem borer, shoot fly, aphid, whitefly and thrips

Furadan or Padan @ 9 kg /acre. The 2-3 granules of insecticides in uppermost leaf whorl during early growth stages of crop

**7) Harvesting and Threshing:** Cobs are picked up manually or whole plant is cut from the base.

Maize shellers are used to separate grains from cob.

**4. Sugarcane (*Saccharum officinarum* L.):**

**A) Crop Botany:**

It belongs to family Poaceae. It is commonly called kamad or gana. This is the crop that can be propagated vegetatively or through seed.

i) Root: It has fibrous root system that is about 30 cm deep.

ii) Stem or stalk: It is about 2 m tall. It is not hollow but filled with cellular tissue for sugar storage. Its lower and central portion is rich in sucrose whereas upper or top portion is maily glucose. Each bud bears a leaf, at least one dormant bud and a ring of root eyes.

iii) Leaves: Leaves are large and narrow. The maximum number of leaves per tiller is about 10. Leaf sheath encircles the stem and leaf blade is erect. Leaves on lower nodes die off progressively.

iv) Seed: mostly sugarcane does not produce seeds but under certain conditions (low temperature and high humidity), seeds are produced which are very small and less viable. Sugarcane seed is called fuzz. It is mostly propagated through setts (2-3 budded).

**B) Agro-meteorology:**

i) Climate: It is a tropical crop but can be grown in arid and semi-arid areas where irrigation is available. For its better germination and growth, temperature range is 20-33oC.

ii) Soil: Clay loam soil is best. It can tolerate salinity to some extent.

**C) Economic Importance:**

Pakistan is at 5th position regarding area and production in world. It provides employment to nearly 1 million people. The area of Pakistan under this crop is 1.10 million ha that gives 67.2 million tonnes production. Thus average national yield is 60.9 tonnes per ha (609 mds /A).

Its contribution in GDP is 0.7%, value addition 3.2%. The normal sugar recovery is 9.1%. It is mainly grown for sugar extraction. After juice extraction, the crush-cane residue is called *bagasse* which is used as livestock feed and fuel as well as raw material for paper and hard board. Another by-product of sugar industry is *molasses* that is used for the production of ethanol. The remnants of molasses called press mud or filter cake is used as organic manure.

**D) Production Technology:**

**1) Seed bed preparation:** It is a deep rooted crop so land preparation is very important for proper root development. Proper soil tilth is necessary to support germination. Deep ploughing with moldboard plough, sub-soiler or chisel up to depth of 60 cm is necessary in addition to normal seed preparation.

**2) Sowing time:** There are two growing seasons:

a) Spring: Mid February – Mid March

b) September sowing: 1st 3 weeks of September (It gives 25% higher yield than spring crop)

**3) Varieties:**

Early maturing: CP 77-400, HSF-240, HSF-242, CPF-243

Mid Maturing: SPF-213, SPF-234, SPF-246, CPF-247, CPF-248, CPF-249

Late Maturing: COJ-84

HSF-240 and CPF-237 are the best varieties.

**3) Seed rate:**

a) On weight basis: 100-120 maunds per acre

Healthy setts free from pests. Sett length should be 35-40 cm, 2 eyed setts with two node and one internode

b) On setts basis: 30000-40000 setts per acre

Seed treatment by dipping setts in fungicide solution for 3-5 minutes

c) On area basis: Crop standing on area of 12-16 marlas per acre

Setts should be kept from top portion of stem as theses give good germination.

**4) Sowing methods:** Setts are sown in 2 feet deep furrows by placing them end to end with each other.

a) With respect to soil conditions:

1. Dry sowing: It is better for saline and hard soils. Seed bed preparation is carried out in dry soil condition and field is irrigated immediately after sowing.

2. Wet Sowing: Seed bed preparation and sowing is done in proper *wattar* conditions.

 b) With respect to sowing geometries:

1. 60 cm apart single row planting (Conventional method)

2. 90 cm apart double row planting with 30 cm width

3. 120 cm apart triple row planting with 60 cm width

4. Pit plantation of sugarcane.

**5) Fertilizer:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Soil type** | **N** | **P2O5** | **K2O (kg/acre)** |
| Weak | 120 | 69 | 50 |
| Fair | 92 | 46 | 50 |
| Fertile | 69 | 23 | 25 |

Whole of P and K at sowing but N in 3 splits as:

a) For autumn sown crop

1/3 N at sowing

1/3 N at the end of February

1/3 N in mid-April

b) For spring crop

1/3 N at sowing

1/3 N in April

1/3 N in end of May

 **6) Irrigation:**

Spring crop = 16 irrigations

Autumn crop = 20-22 irrigations

Irrigation interval 18-20 days

March-April 10-12 days

May-June 13-15 days

July August 15-22 days

November-December 40-50 days

**E) Plant protection measures:**

**i) Weeds:** up to 10-35% reduction in yield occurs due to weeds. Weed-crop competition period is 90-120 days

Major weeds are deela, itsit, naru grass, khabbal, Lehli, chulai, hazar dani, jangl palak and parthenium

Control:

1. Physical methods: One blind hoeing before germination and 2-4 susequent hoeings are necessary.

Last hoeing is done usually at plant height of 1 m after which earthing-up is carried out.

2. Herbicides:

Atrazine @ 1000 ml /acre as pre-emergence

Pendimethalin @ 1500 ml / acre as pre-emergence

Gesapax combi @ 1000 ml / acre as post-emergence at initial growth stage of weeds

ii) Insect-pests: For top borer, stem borer and Gurdaspur borer, Pyrilla (Carbofuran)

For whitefly, (Imidacloprid) and for termites, bifenthrin and chlorpyrifos

iii) Diseases: Red rot, whipe smut, rust, mosaic, red stripe, *Helminthosporium* leaf spot, Pokkah boeng and brown stripe are serious diseases

Losses of up to 10-70% may occur due to diseases

**7) Harvesting:**

Spring sown in December-February

September sown in October of next year

**Ratoon crop of sugarcane:**

Ratoon crop kept during end of January – 1st week of March is better than one kept during November-December. Cut the sugarcane 1-1.5 inches below the soil surface. Cultivate between the rows. Do not take ratoon crop from lodged crop. Fill the gaps with same variety. Add 25-30% more fertilizer to ratoon crop as compared to fresh crop.