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HYBRID SEED PRODUCTION OF SUNFLOWER

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INTRODUCTION

Sunflower (Helianthus annuus L.) is an important oilseed crop in India and belongs to the family Asteraceae (Compositae). It has a chromosome number of 2n = 34. Sunflower oil is widely preferred because of its nutritional quality and health benefits, especially for maintaining heart health. Besides edible oil, sunflower also provides protein-rich feed obtained from the seed cake after oil extraction. Good quality sunflower seed contains about 46–52% oil and 20–25% protein, making it an economically valuable crop.

Botanical Description

The genus Helianthus includes nearly 70 species of annual, biennial, and perennial flowering plants. Cultivated sunflower is an annual herbaceous plant that grows to a height of about 1–4.6 m. The stem is rough and hairy, while leaves are broad and arranged spirally on the stem. Leaves are simple, alternate, and attached by strong petioles. They are lanceolate in shape, about 5–25 cm long, rough on both surfaces, and have irregular toothed margins. The sunflower inflorescence is a typical capitulum of the Compositae family. Sunflower is a protandrous crop, where male and female reproductive parts mature at different times. Usually, there is an interval of 18–24 hours between pollen release and stigma receptivity, which results in cross-pollination. Flowers are yellow in colour. The head diameter ranges from 10–15 cm and contains 40–80 ray florets with brown or black disc florets. One sunflower head may produce 350–2000 seeds. Seeds are generally less than 1.5 cm long, pointed at one end and rounded at the other. Seed colour varies from white to black or black with white stripes.

Requirements for Hybrid Seed Production

Production of high-quality sunflower hybrid seed mainly depends on maintaining genetic purity of parental lines. Hybrid seed production involves two major steps:

1. Maintenance of parental lines (A, B, and R lines)
2. Commercial hybrid seed production by crossing A and R lines

Breeder Seed Production of A and B Lines

Hybrid seed production in sunflower is based on the Cytoplasmic Male Sterility (CMS) system, which helps in efficient hybrid development. A line (CMS line) is a male sterile line, while the B line (Maintainer line) is a fertile line used to maintain sterility in Aline.

Maintenance and multiplication of these lines are essential for preserving genetic purity and stability. The A line possesses cytoplasmic male sterility and cannot produce viable pollen grains. Therefore, it cannot be maintained through self-pollination. It is maintained by crossing with the B line, which has identical nuclear genes but fertile cytoplasm. During breeder seed production, A and B lines are planted in a fixed row ratio under proper isolation conditions. Pollination of A line plants occurs through pollen from B line plants. Seeds obtained from A line plants constitute breeder seed of the CMS line.

The B line is genetically similar to the A line except for fertile cytoplasm. It is self-fertile and maintains sterility in the A line. B line plants are grown under isolated conditions and allowed to self-pollinate. Rouging of off-type plants is carried out regularly to maintain purity. Seeds harvested from true-to-type plants are used as breeder seed of the maintainer line. Proper isolation, field inspection, and removal of undesirable plants are necessary to maintain genetic purity and uniformity.

Planting Methods

Different planting methods are followed in sunflower seed production.

1. Row Method

This method is commonly used for breeder and foundation seed production. The A and B lines are planted in a 3:1 ratio with a recommended spacing of 60 × 30 cm (row × plant spacing).

2. Block Method

In this method, A and B (or R) lines are planted in adjacent blocks in a proportion of 75:25. Pollen from B or R line plants is collected and used for pollinating A line plants.

Agronomic Practices

For successful sunflower hybrid seed production, fertile and well-drained soil should be selected. Continuous cultivation of sunflower in the same field should be avoided, and a crop rotation gap of 3–4 seasons is recommended. During the rabi season, the suitable sowing period is October to November. For successful sunflower hybrid seed production, proper crop geometry and nutrient management are essential for obtaining good seed yield and maintaining seed quality. A spacing of 60 cm between rows and 30 cm between plants is generally recommended to maintain an optimum plant population. The seed requirement varies among parental lines, where approximately 3.75 kg seed ha^{-1} is required for the A line and 1.25 kg seed ha^{-1} for the B or R line. For balanced crop nutrition, fertilizers should be applied at the rate of 60 kg nitrogen, 45 kg phosphorus, and 45 kg potassium per hectare. In addition, the application of sulphur at 20 kg ha^{-1} improves crop growth and performance. Foliar spraying of borax at 0.2 % during the ray floret opening stage enhances pollination efficiency and promotes better seed setting.

Isolation and Pollination

Isolation is essential for maintaining genetic purity in sunflower seed production. Sunflower is mainly a cross-pollinated crop. If seed production fields are located near other sunflower fields, foreign pollen contamination may occur, reducing seed purity. Therefore, adequate isolation distance should be maintained, particularly in breeder and foundation seed production plots. Pollination in sunflower mainly occurs through insects such as honey bees and other pollinators. The sunflower head contains many small florets arranged on the capitulum. During hybrid seed production, pollinating insects transfer pollen from male parent plants to receptive stigmas of female parent plants, resulting in fertilization and seed development.

Rouging

Rouging is an important operation for maintaining seed purity. All off-type plants should be removed from both male and female parental lines before flowering. Off-type plants appearing during crop growth should also be removed regularly from the field.

Harvesting and Post-Harvest Processing

Before harvesting hybrid seed crops, B and R parental lines should be removed. Harvesting is recommended when the backside of the sunflower heads turns yellow. The capitulum should be cut and dried before threshing. After threshing, seeds should be cleaned and graded using a 7 mm sieve. Seeds should be dried to about 9–10% moisture content and stored in moisture-proof containers to maintain seed quality.

Bird Damage

Birds may cause serious damage in sunflower seed production fields, especially when nearby crops are absent during the grain filling stage. Therefore, regular bird monitoring is necessary. Bird damage is generally lower when sunflower is grown along with seasonal crops. Bird scarers may be installed during seed setting stage if bird infestation becomes severe.

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