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Production Technology of Saffron (*Crocus sativus* L.) for non-traditional areas

Saffron (*Crocus sativus* L.), the most expensive spice crop of the world, belongs to family Iridaceae. It is a triploid ($2n=3x=24$) plant that fails to produce seeds upon selfing or crossing. Thus, saffron is propagated only vegetatively through corms. Each of these corms sprout to produce plants that bear about 1-5 purple flowers with orange red coloured stigmas. The stigmas constitute the spice. The quality of the spice is dependent on its color (crocin), taste (picrocrocin) and odour (safranal). The spice is acclaimed for its use in food as a flavouring as well as a colouring agent. It is also a component of many medicines.



Saffron flower

In India, saffron is presently grown in Pampore region of Srinagar and Kishtwar district of Jammu and Kashmir. The annual demand for saffron in India is 100 tonnes but its production is less than 6.46 tonnes from 2,825 hectares. Globally, the total annual production of saffron is 300 tonnes per year. Iran is the largest producer of saffron followed by Spain and India.



Field view of saffron under Palampur condition

- CSIR-IHBT has standardized the technology for production of disease free quality corms through tissue culture and also the agro-technology for the introduction of this crop in non-traditional areas of Himachal Pradesh and Uttarakhand.
- Demonstration plots have been laid out at different sites to check the suitability of climate for saffron production. Flowering was recorded in Bharmour and Pangi valley in Chamba district of Himachal Pradesh. Flowering size corms have been produced in some of the sites including regions around Palampur.



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सीएसआईआर—हिमालय जैवसंपदा प्रौद्योगिकी संस्थान
CSIR-Institute of Himalayan Bioresource Technology

पालमपुर, हिमाचल प्रदेश, 176061 (भारत) Palampur, Himachal Pradesh, 176061 (INDIA)

Climate

Saffron thrives well in temperate dry climates at altitudes ranging from 1500-2800 meters above mean sea level. Temperature is the most important environmental factor controlling its growth and flowering. Area covered with snow during winter is particularly suitable for flowering. However, unusually low temperature and high humidity affects flower production, adversely. Optimum temperature for flowering as well as corm development is in the range of 23-27°C. Corms require a temperature of 17°C for flower emergence.

Soil

Sandy loam soil with a pH range of 6.8 to 7.8 is optimum for cultivation of saffron. Mixing sand with well-decomposed farmyard manure for porous texture is generally recommended. Corm becomes susceptible to rotting in/under humid and water logged conditions. Therefore, high dose of calcium carbonate supplementation is desirable for the growth of the crop.

Land preparation

The field is ploughed 3 to 4 times with the depth of 25-30 cm to make the soil fine and porous. For proper cultural practices, 15-20 cm raised beds of 1.2-1.5 m width and 30 cm wide drainage channels between the beds should be made. In sandy to sandy loam soils and dry temperate regions where rainfall is of low intensity, raised beds may not be necessary.



Corms

Spacing and planting depth

Spacing influences both yield and corm production. A spacing of 20 X 10 cm is ideal for the production of large size corms. Plantation of 50 corms/m² at this spacing level and planting depth of 10-12 cm is recommended for commercial size corm production.

Seed/Corm Rate

The seed rate/corm rate/ha depends upon corm size/corm weight, crop duration and spacing. About 40-50 q of saffron corms or about 5 lakh number of corms of average diameter of 2.5 cm (average weight 10 g) are required for plantation in 1 ha area.

Irrigation

Water requirement of saffron is low. Irrigation at an interval of 15 days during end of September to October is most critical for the initiation of proper growth in corms and also for accelerating early bloom.

Propagation

Saffron propagates only vegetatively through corms. During each season, new corms are formed above the old ones, which wither, and eventually rot away. Each corm produces 4-10 daughter corms and cormels.

Plantation time

The plantation time for saffron is from middle of September to October.

Corm size

Corm size has a significant effect on the production of daughter corms and yield of saffron. Flowering size corms should be more than 10 gm or 2.5 cm in diameter. The larger mother corm produces more daughter corms in the annual cycle, which also increases the potential for higher yield in subsequent years.

Nutrient management

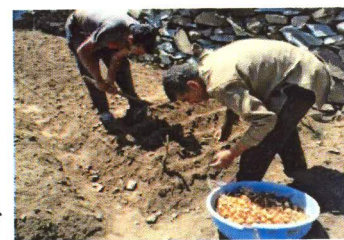
Nutrient management plays an important role in saffron cultivation. Farm yard manure (FYM), as a basal dressing has been recommended @ 15-20 t/ha. A fertilizer dose of 45:60:60 kg NPK/ha is best for higher yield of flowers as well as corms. Full dose of P and K along with 1/3rd N should be applied at the time of plantation. Remaining N should be applied in 2 split doses i.e. half dose at 1 month after planting and remaining half dose in the month of January.

Weed management

Saffron is a slow growing crop that suffers from severe infestation of a large number of weeds. The first hoeing or weeding should be done in the month of October. Three to four hand weedings are sufficient for controlling weeds. Pre-emergence application of pendimethalin @ 1.5 kg/ha or fluchloralin @ 1.0 kg/ha is recommended.

Generating quality planting material (corms) through tissue culture

A tissue culture protocol has been standardized for production of disease free corms of 5.5 to 6.0 g. The method can ensure the availability of quality planting material throughout the year. The method has the capacity to generate about 30,000 disease free corms in one year. The flowering size corms can be produced from these corms in two years.



Planting of corms



Flowering size corms



Corm production through tissue culture



Daughter corm formation under green house conditions of Palampur

Harvesting

The flowers are harvested and immediately brought indoors for the separation of stigmas from the remaining flower parts. Plucking of 1000 flowers needs 45-55 min. Another 100-130 min are required for separating the stigmas for drying.



Harvesting

Crop Productivity

Saffron yield varies from 1.5 to 15 kg/ha based on planting density, plantation age and climatic conditions during the crop season. In India saffron productivity is 1.5-3.0 kg/ha/year.



Flowering

Post harvest technology

Dehydration is a post harvest process necessary for the conversion of stigmas into spice. During the process of dehydration, the stigmas lose 78-80% of their weight. The process is generally carried out at room temperature directly under ventilated conditions. The stigmas are also solar dried for 3 to 5 days until the moisture content is reduced to 8-10%. Lower moisture content of at least below 12% is required for maintaining the quality as well as shelf life of the spice (established by the IS03632).



Stigmas (spice)

Quality

The quality of saffron depends on its color (crocin), taste (picrocrocin) and odour (safranal). Quality saffron has a high crocin absorbance >190 at 440 nm, picrocrocin absorbance of 25-30 at 330 nm and safranal absorbance of 100 at 257 nm wavelength. The best quality spice has a pleasant, dominant floral, sweet spicy note and also a little harsh acid note.

Storage of corms

Corm uprooted in May should be stored at 23-25°C and 65-75% relative humidity for 2 months, and subsequently stored at 17°C for 50 days. Storage of corms at 2°C after flower initiation results in abortion of flowers. Storage at freezing temperature damages the corms.

Techno-economics of saffron production*

Cost of cultivation (Rs./ha/year)	2,75,000
Gross returns (Rs./ha/year)	7,20,000
Net returns (Rs./ha/year)	4,45,000

*On the basis of five years' average

Contact:

Dr. Sanjay Kumar,
Director, CSIR-Institute of Himalayan Bioresource
Technology,
Post Box No.-06, Palampur-176061 (H.P.), India
Telephone: +911894 230411, Fax: +911894 230433
Email: director@ihbt.res.in
Website: <http://www.ihbt.res.in>

Prepared by:

Dr. Rakesh Kumar
Dr. Amita Bhattacharya