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Saffron is the spice derived from the flowers of the saffron plant scientifically known as *Crocus sativus* L. and its cultivation spreads across the western Mediterranean region (Spain) to India (Kashmir). Saffron predominantly contains chemical constituents such as crocin, picrocrocin and safranal which are responsible for colour, flavour and aroma, respectively. Low yield of this spice is attributed partly to the primitive non-scientific agronomic practices and partly to the genetically uniform planting material both of which call for immediate refinement. In order to ensure the future of the saffron crop especially under Cold Ard Regions of Ladakh, it is indispensable to improve cultivation techniques, planting material and quality evaluation methodology.

Soil and Climate

Saffron grows best in friable, loose, low-density and well-drained clay, calcareous soils having high organic content. Alkaline soil is supposed to be desirable for giving better stand of the crop. Temperature is the most important environmental factor controlling growth and flowering in *Crocus* species. Optimum temperature for flower initiation and development of the corms falls in the range of 23–27°C with 23°C being marginally better for formation of maximum number of flowers. Day temperature range of 12-18^{0}C and night temperature of 4-5^{0}C is ideal for its cultivation. Flower emergence requires the transfer of the corms from the conditions of flower formation to a markedly lower temperature, i.e., 17-18°C. Cloud cover overnight encourages maximum production of flowers in the following morning. Rainfall or irrigation during August to September is helpful in boosting early flowering for higher production. Weather conditions especially from November- February has greater effect on corm yield as well as the flower ontogenesis in the subsequent season.

Land preparation

Scientific preparation of land is necessary to create friable and loose texture for saffron cultivation. The field is ploughed 4–5 times to a depth of

30 – 35 cm to bring the soil into fine tilth. This is followed by a planking and leveling as needed. The field should be cleared off from all the weed growth, penetrating roots and stubble stones. For ease in weeding, hoeing and irrigation, raised beds of convenient size preferably of 1.0 – 1.25 m width and 20–25 cm height with desired length preferably 4.0 m should be made. Paths may be made 25- 30 cm wide in between the beds, which also act as drainage channels during rainy season.

Planting time

Strong emphasis should be laid on timely planting of corms. Delay in planting of corms results in poor establishment of crop and subsequent low flower yield during 1st year of planting. It is desirable to complete planting operation from 15th to 30th of July. Placement and position of the corms at proper depth ensures better flower and corm yields. Hand sowing of corms is a good practice as sowing at proper depth of 15 cm not only ensures good flowering in the first year itself but also favours contractile root formation that favours better daughter corm formation.

Corm rate and plant geometry

Under high density with a target plant population of 12 lac corms/ha, 86.4 quintals of mixed grade corms are required. The proportion of corms weighing above 8 g to the tune of 57.6 quintal (7.20 lac corms) and proportion of corms weighing 4-8 g to the extent of 28.8 quintals (4.80 lac corms) are required. 15x10 cm^2 ditches (24 ditches/m^2) all around one hectare of land are dug in rows with inter ditch to ditch distance of 25 cm and intra ditch to ditch distance of 15 cm. In each ditch 5 corms are planted with 3 bigger corms (>8 g) and 2 smaller corms (4-8 g) in alternate position with centre of ditch occupied by bigger corm.

Corm treatment

To protect the saffron from major corm and soil borne diseases, dip the corms before sowing for 5-10 minutes in fungicidal solution prepared by dissolving (0.1%) Carbendazime 50 WP and Mancozeb (0.3%) in 100 liters of water. The saffron corms are taken out and spread on a clean cloth and then allowed to dry in shade for another 10 to 15 minutes to drain off excess moisture before sowing.

Nutrient management

Saffron is highly responsive to nutrients applied either through organic or inorganic sources. Application of nutrients depends mainly on soil nutrient status/balance and cropping system. To maintain soil health under high density plantation and to ensure excellent crop growth, requirement in terms of manures and fertilizers is more than normal density plantation. Following schedule is to be followed:

Inorganic fertilizers=N: P_2O_5: K_2O 120: 90:80 kg/ha

i) Nitrogen in the form of Urea @ 186 kg/ha
ii) Phosphorous in the form of DAP @ 195 kg/ha
iii) Potassium in the form of MOP @ 133 kg/ha

Manures

i) Well decomposed FYM @ 15 tons/ha (7.5 quintals /kanal)
ii) Vermicompost @ 10 quintal/ha (50 kg/kanal)

In fresh planting all inorganic fertilizers and manures should be applied during land preparation as a single supplement except for Nitrogen that should be applied in three equal split doses. After disc plough well rotten Farm Yard Manure should be applied and mixed thoroughly. Before final ploughing with cultivator chemical fertilizers and organic manures in the form of 1/3rd urea and full dose of DAP, MOP and vermicompost should be applied and mixed well with the soil. Remaining Nitrogen should be applied as band placement in December and February when moisture is available.

Weeding and hoeing

Weeds compete with saffron for nutrients during crop growth and causes flower and corm yield losses to the tune of 30%. Therefore, timely intercultural practices are needed for achieving higher yield. Hand weeding needs to be practices during recapitulation stage from December to April. To facilitate soil aeration during dormancy 1st hoeing should be practiced in the second fortnight of June. 2nd hoeing should be practiced in August and soil should be developed to a fine tilth to ensure emergence of sprouts. Metribuzin being a selective herbicide in saffron checks the emergence of most prevalent saffron associated weeds. Application of metribuzin in December followed by metribuzin in February @ 560 g/ha diluted in 300-350 litres of water is recommended for control of winter and spring weeds in saffron.

Irrigation

Saffron is sensitive to water particularly during active stags of crop growth viz., August to November. Irrigation schedule based on 5 irrigations (700m^3 = 70mm) @ 140m^3/ irrigation starting from 1st September to 10th October

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and 10th November to 30th November should be given. Water requirement is in addition to 131 mm (1310 m^3) available to saffron through rains during August to November, confirming total water requirement of 201 mm (2010 m^3) for saffron.

Disease and rodent management

Saffron usually suffers from corm rot and leaf blight diseases. In case of disease symptom appearance, apply following plant protection measures

i. Corm rot of saffron caused by *Fusarium* spp. can be managed by drenching Carbendezium 12% + Mencozeb 63% WP @ 50 grams per 100 liters of water.
ii. Leaf blight caused by *Stemphyllum* sp. can be managed by applying foliar spray of Zineb 68% + Hexaconazole 4% 72 WP @ 50 grams in 100 liters of water.

Rodent management is a very complicated problem in saffron. Two rodents viz., Blyth's Vole (*Pitymys leucurus*) and Indian crested porcupine (*Hystrix indica*) are the major problem in saffron. *Pitymys leucurus* can be managed by adopting following measures:

i. Removal of dropped debris and grasses from field to discourage rodents from availability of food and shelter.
ii. Reduce the size of bunds or boundaries around the fields up to 30 cm to force the rodents to leave the burrows which will discourage the rodents to burrows and inhibit in the bunds (November-April).
iii. Fumigation with smoke: Use of burrow fumigator is very effective against rodents in field. In this method recharge fuel (Cow dung + Maize straw + Local herbs) are burnt to produce smoke in the burrows.
iv. Chemical control by using Rodent bait schedule

Indian crested porcupine, *Hystrix indica* is the other rodent which causes heavy damage to saffron crop. It is managed by the following practices:

i. Placement of light lamps in and around the field.
ii. Fencing is a preventive measure with 45-60 cm metallic sheet can be placed around the field.
iii. Application of 5 lt of herbolive in 45 lt water along the border bunds of the field at 7-8 days interval can control the damage caused by porcupine.

Harvesting and yield

Saffron flowers are picked exactly when they are ready to bloom and the saffron strand or stigma appear bright red in colour. The harvesting must begin shortly after dawn and completed quickly. If left exposed to the sun, saffron quickly loses its colour and flavour and withers under the sun light. Picking of unopened flowers is advised as it would not only give best quality product but will also give ample time for separation of stigmas due to more shelf life. Separation has to be done within 10-12 hours and if it is not separated within the given time after flower picking, respiration of flowers turns stigma in to chaff like substance thus reducing recovery of pistil.

Stigma yield of saffron is 4.5-5.0 kg/ha and corm yield is 160-180 quintals/ha over 3 years of planting cycle under normal density plantation.

Saffron drying

Post harvesting handling of saffron, particularly the drying process is critical for the quality of saffron as indicated by the levels of secondary metabolites. Drying of saffron at temperature of 60°C in hot air, solar, electrical or vacuum dryers is recommended. Drying temperature varies because stigmas from unopened flowers have more moisture compared to stigmas from opened flowers. A lower moisture content, at least 10-12% value established by International ISO 3632-2-2010 maintains the quality of products for a longer time.

Corm harvesting and storage

After 3 years of planting cycle lift the corms of saffron, store them under appropriate conditions to avoid sprouting. Corms lifted in June can be stored in boxes covered with soil at 19–23°C and 65–75% relative humidity for 40-45 days.

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