PROBLEMS, PROSPECTS & BREEDING STRATEGIES FOR IMPORTANT FRUIT & SEED SPICES

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Abstract : India is the land of Spices and has a major contribution in total seed spices production in the world. There is a huge demand for Indian Spices all throughout the globe which makes it a highly potential export. Seed spices in India are predominantly grown in Rajasthan and Gujarat followed by Bihar, West Bengal, Uttar Pradesh, Madhya Pradesh, Orissa, Punjab, Karnataka and Tamil Nadu. Since the seed spices industry has a flourishing scope, it is important to achieve greater yield by implementing new technologies and introducing modern cultural practices, enhancing the acquaintance of most up-to-date techniques to the farmers and putting more land area under these seed spices crops. The review deals with the prospects, Spice breeding strategies and problems related to it.

Introduction

India is known as the 'Land of Spices'. It is blessed with varied agro-climatic and agro-ecological approaches that enable us to grow a large number of spices. The important spices among them, which occupy a sizeable area and are traded nationally or internationally are Black pepper, Cardamom, Ginger, Turmeric, Chillies, Cloves and some seed spices. Seed spices are mainly cultivated in the states of Rajastan and Gujarat. Among these, coriander, cumin, fennel and fenugreek are cultivated on sizeable acreage compared to other spices and considered to be major seed spices. It is a source of livelihood and employment for large number of people in the country, both for rural population, who grow them, and the urban populations, who process and trade them.

The term 'spices' applies to such natural plant or vegetable products or mixture of these, as they are used in whole or ground form for imparting flavour, aroma and pungency to food. It is commonly used to season food dishes.

Uses of Spices

1. The principal use of spices is to season the insipid foods to impart flavor, aroma and taste
2. They are used as preservatives and fumigants
3. Use in pharmacy and indigenous medicines
4. Used in perfumery, soaps, cosmetics and tooth paste

Properties

1. Spices are well known as appetizers.
2. They add a tang (taste) and flavour to otherwise insipid foods.
3. Some of them also possess anti-oxidant properties.
4. Clove and mustard have preservative qualities
5. Some have strong anti-microbial and anitbiotic activities.
6. Several of them possess medicinal properties.

Classification of spices

They are classified according to their taxonomy, economic importance, plant part, longevity and type of plant.

<table>
<tr><td>Taxonomic classification (family wise)
• Piperaceae - pepper.
• Zingiberaceae – Ginger, Cardamom and Turmeric
• Apiaceae – Coriander, Fennel and Cumin.
• Myrtaceae – Clove and Nutmeg
• Fabaceae – Fenugreek
• Lauraceae – Cinnamom</td><td>According to the type of the plant
• Tree spices – Clove, Nutmeg, Cinnamom and Cassia
• Bush spices – Cardamom
• Herbaceous spices – Coriander, Fenugreek, fennel and Cumin.
• Climber spices – Pepper and Vanilla.</td></tr>
<tr><td>According to the longevity of spice plants
• Annual spice – Coriander, Mints and Methi
• Biennial spices – Onion and Garlic
• Perennial spices – Clove, Nutmeg and Pepper etc</td><td>Economic importance
A. Major spice: Pepper, Cardamom, Turmeric, Ginger, Clove and Nutmeg.
B. Minor spice: Coriander, Fenugreek, Cumin and Fennel</td></tr>
<tr><td colspan="2">Plant part useful as spice:
<table>
<tr><td>Root spice – Angelica and Horse radish</td><td>Rhizome spice – Turmeric and Ginger.</td></tr>
<tr><td>Bulbous spices – Onion and Garlic</td><td>Bark spice – Cinnamom and Cassia</td></tr>
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Leafy spices – Mints, Coriander and Methi	Aril spices – Mace.
Seedy spices – Coriander, Celery and Methi	Fruit spice – i) Capsules – Cardamom and Chillies. ii) Berries – Pepper and Allspice.

Constraints

- ✓ The seed spices are mostly grown by marginal to sub-marginal farmers under poor crop management conditions.
- ✓ Occurrence of abiotic stresses *viz.* salinity, drought and frost are the major hurdles for successful production.
- ✓ Inherent nature of slow seed germination and initial growth.
- ✓ High incidence of diseases e.g. wilt, blight and powdery mildew in cumin, wilt and stem gall in coriander, blight and gummosis in fennel and powdery mildew and downy mildew in fenugreek.
- ✓ The available germplasm of different seed spices crops have limited variability.
- ✓ There is shortage of quality seed material of seed spices varieties.
- ✓ Absence of high degree of resistance to major pests (Aphid) and diseases (wilt, Powdery mildew and blight)
- ✓ Non-availability of sufficient number of genotypes tolerant to drought with high productivity

Prospects

Keeping in view the scope and opportunities in seed spices trade at domestic and international level, the major emphasis will be on the following areas:

- ✓ Conservation of valuable gene pools i.e. Cryo-preservation.
- ✓ Strengthen the linkages among different national and international activities engaged with the seed spices research.
- ✓ Improving quality of seed spices
- ✓ Molecular characterization

Coriander

Coriander (*Coriandrum sativum*) (2n=22) is an annual spice and aromatic herb that belongs to the family Apiaceae. It is an important spice crop among spices with pleasant aroma, it is used in culinary and medicine. All parts of the plant are edible, but the fresh leaves and dried seeds are most commonly used in cooking. The essential oil extracted from seed is included among the twenty major essential oils in the world market and its commercial value depends on its physical properties, chemical composition and aroma. The essential oil content of the dried seeds varies from 0.03% to 2.7%.

Fenugreek

Fenugreek (*Trigonella foenum-graecum*) (2n=16). It is widely distributed throughout the world and which belongs to the family Fabacecae. Fenugreek is an annual herb and largely cultivated in India. Fenugreek seed is commonly used in cooking. Fenugreek has strong flavour and aroma. The plants leaves and seeds are widely consumed in Indo-Pak subcontinent as well as in other countries as a spice in food preparations, and as an ingredient in traditional medicine. A wide range of uses were found for fenugreek in ancient times. Medicinally it was used for the treatment of wounds, abscesses, arthritis, bronchitis, ulcer and digestive problems. Fenugreek was, and remains, a food and a spice commonly eaten in many parts of the world

The seeds of fenugreek are good source of diosgenin, because of its shorter growing cycle, lower production cost, consistent yield and quality. There are some cultivar which having highest level of diosgenin. So, For improvement of crop with higher yield of diosgenin in filial generations, estimation of parental diosgenin content among different genotypes is prerequisite.

Cumin

Cumin *(Cuminum cyminum*) (2n=14) belongs to the family Apiaceae, is a herbaceous, dicotyledonous annual plant with hermaphrodite flowers. It has several pharmaceutical and medicinal applications and also used as spice. Because of its low water requirements, farmers are interested in cultivation of cumin in drought affected areas, where most of the other crop plants cannot be grown economically. However, production of cumin is limited due to several biotic stresses, of which wilt diseases are the most serious. The economic product of this plant is seed which has pharmaceutical applications and also used as spice for thousands of years.

Package of practices:

Particulars	**Coriander**	**Fenugreek**	**Cumin**
Climatic requirement	Tropical crop,	Rabi crop. It is tolerant to frost.	Tropical crop, High humidity causes fungal diseases.
Soil requirement	Loamy soil (irrigated), Black soils (rainfed). Not tolerant to alkaline and saline soils.	Any type of soil, but loamy soils are best suited.	Any type of soil, but well drained sandy loam and medium soils are suitable.
Sowing	October – November	2nd fortnight of Oct to 1st fortnight of Nov	1st week of Nov to 1st week of Dec
Seed rate	12–15 kg/ha	10-15 kg/ha	12 -15 kg / ha
Spacing	30x10	30x10	Rows drilled at 30cm
Fertilizer schedule	10-20 MT F.Y.M./ha 60:30:20 NPK/ha	10-15 MT F.Y.M./ha 40 kg Nitrogen and 20 kg Phosphorous/ha	15-20 MT F.Y.M./ha 30:15 Nitrogen & Phosphorus/ha
Weed control	2-3 weeding required	2-3 weeding required	2-3 weeding required

	Pre-emergent Herbicides Pendamithalin @ 1.0kg/ha		
Irrigation	4–5 irrigations	4-6 irrigation	4-6 irrigations
Harvesting	110 to 140 DAS When 50% seeds turn yellow,	120-150 DAS. At the time of ripening/maturity, leaves and pods become yellowish and leaves start falling.	110-115 DAS Leaves and pods become yellowish and leaves start falling

Plant Protection:

a) Pest	
Aphid (Coriander, fenugreek & Cumin)	Aphid is a major pest of cumin crop; it sucks the sap of tender parts and reduces the yield. Spraying of 0.03% solution of Dimethoate or 0.025% solution of Methyl demetone or 0.04% solution of Monocrotophos is recommended to control the aphid.
Cutworm (**Coriander**)	Cuts the plants from ground level and make them to fall down. Infestation of this pest starts seedling stage resulting in heavy loss of crop establishment/crop density. Drenching of Chlorpyriphos before last ploughing is also recommended.
Leaf eating Catterpillar (Cumin)	This pest causes damage to the foliage of plants reducing yield of the crop. It can be controlled by spraying of 0.02% solution of Phosphamidon in the early stage of crop.
b)Diseases	
Wilt disease (**Coriander**)	It affects root system of the plants. To prevent infection deep ploughing during summer, fallow crop rotation. Sowing should be done after seed treatment with Bavistin @ 1.5 gm per kg seed or Thiram 1.5 gm/Kg seed.
Powdery Mildew **(Coriander, fenugreek & Cumin)**	Cloudy weather is favorable for this disease. White powdery growth appears on the leaves and buds during its primary stage. Seed formation may not take place in affected plants due to this disease. To control dusting of Sulphur dust @ 20-25 Kg/ha and also spraying of wettable sulphur or Kerathane is preferable.
Blight (**Coriander**)	Dark brown spots appears on the stem and leaves of infected plants. Spraying of 0.2% solution of Mancozeb should be used to control this disease.
Stem gall **(Coriander)**	Galls appear on the leaves and stems of the plants affected by this disease. Seed shape change due to effect of the disease. Increasing level of humidity, intensifies the effect of this disease on crop. To control the disease, sowing may be done only after treating the seeds with 1.5 g Thiram and 1.5 g Bavistin (1:1)/Kg. Seeds. Spray 0.1% solution of Bavistin when the symptoms start appearing.
Fusarium wilt (Cumin)	Infected plants show peculiar symptoms of dropping of tips and leaves, leading to mortality of the entire plant. Attack of wilt is severe in younger plants. Crop rotation and use of Neem cake are helpful in checking spread. Seeds collected from disease free plots should only be used for sowing.
Alternaria Blight (Cumin)	The blight affected plants show very minute brownish necrotic spots, which later turn to blackish. Mostly diseased plants fail to produce seeds or shrivelled light seeds produced. For the control of this disease seed treatment and spraying of 0.2% solution of Dithane-M-45 4 times at 10 days interval commencing from 40 days after sowing is recommended. Add 1 ml soap solution / liter water for better efficiency of fungicide. The crop should be kept free from weeds. Crops requiring more irrigation and mustard should not be grown in the vicinity of this crop.
Downy Mildew (Fenugreek)	Occurs during February and March. Yellow patches on the upper surface of leaves appear in the infected plants and white cottony mycelium on the lower surface of leaves. This disease can be controlled by spraying of 0.2% solution of Difoltan or any other copper fungicide

Breeding strategies

Enhancing germplasm collection, evaluation and conservation

A time-bound well-set programme of collection of indigenous germplasm of all the seed spices must be immediately started. The indigenous germplasm exists in the form of traditional varieties, which are expected to possess valuable genes for resistance to biotic and abiotic stresses. Adoption of improved varieties may result in irretrievable loss of valuable genes, if their immediate collection and conservation is not ensured.

Germplasm collection and the amount of variability assembled for economically important characters related to crop improvement programme. Indigenous and exotic strains being maintained and studied for variation in all the morpho-physiological characters, yield per plant as well as for resistance for diseases and pest and also the effect of environmental interaction on germplasm must be evaluated over different environments to identify promising material for further utilization.

Population improvement

Population improvement is the process of pyramiding of the positive genes for desirable characters in a variable population through selection or recurrent selection. The appropriate strategy in umbelliferous (cross-pollinated) spices would be to have a short and a long term improvement programme. The short-term programme would aim to improve the elite population through recurrent selection based on the performance of individual plant progenies or even mass-selection.

In self-pollinated spices like fenugreek, pure line selection in the variable material has been quite successful in developing good varieties. Some of these are Rajendra Kranti (Bihar), Pusa early branching (IARI, New Delhi) and Co-1 (TG-2336) (Tamil Nadu).

Long-term programme strategies must be simultaneously started for improvement and to exploit the variability existing within as well as between elite lines in cross-pollinated spices. It involved creation of a wide genetic base pool through inter-mating of selected elite lines/varieties in a poly-cross nursery, followed by recurrent selection based on progeny performance which may be continued till a desirable level of performance and uniformity is achieved. This method is capable of exploiting both additive as well as non-additive effects as high heterozygosity is maintained in the improved varieties.

Mutation and biotechnological approach

Mutations, induced with gamma rays, are useful in creating desirable variability in fenugreek and coriander. Noteworthy achievements made through mutations in fenugreek are UM-305 which is resistant to powdery mildew and determinate in growth habit with high yield potential. UM 301, UM 302, UM 303 and 304 which are resistant to powdery mildew and possess higher yield potential. In coriander, useful mutation lines namely, 10 Kr-15. 5 Kr-14. 20 Kr-5 and 5 Kr-68 have been derived.

Heterosis breeding

Though recurrent selection can be successfully employed in both intra- as well as inter-population improvement, the best approach to exploit both the additive and non-additive gene effects would be the "heterosis breeding." Search for cytoplasmic-genetic type of male sterility should be taken up to make the heterosis breeding a reality.

Breeding for disease resistance

The seed spices are affected by diseases which reduce the yield levels, which is already low. Some of the diseases like cumin wilt, root rot in fenugreek and gummosis in fennel have so far evaded effective control measures. Breeding programmes for resistance to these diseases need to be immediately initiated. Identification of pathogen and/or its races causing the diseases, developing techniques to create uniform and artificial disease epiphytotics.. Use of tissue culture as an aid to accelerate the resistance screening programme, are some of the aspects, on which research work needs to be initiated to make the resistance breeding effective. Resistance breeding is also directly related to quality of the produce as it obviates the necessity of application of pesticides which often leaves undesirable residue.

Improvement of quality

Quality of the produce needs special emphasis in seed spices as these are exported to foreign markets where the quality standards are very stringent. Volatile oil content, shape, size and luster of grains and their cleanliness constitute the important quality factor. Appropriate weightage has to be given to these quality attributes in the breeding programmes.

Conclusion

Genetic variability which assembled so far has been inadequate for many important characters. There is a need to use the available genetic diversity among the population for development of high yielding cultivar. Here some biotechnological application can be employed for enhancing the variability. Resistance to diseases and improvement in quality has special significance in seed spices which is important factor in reduction of yield. Breeding approaches may be applied to be refined and the best use of existing variability. Mutation breeding has become an effective tool for crop important and efficient means of supplementing germplasm for cultivar improvement in breeding programme.

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