Chapter 1

Introduction

Spices are low volume high value crops which play vital role in our national economy and international market. The association of spices and mankind is prehistoric and multifarious. They are used as food additives, flavouring and colouring agents, curatives, body toners, preservatives, contraceptives, cosmetics, etc. India has been the leading spice producing and exporting country of the world since the recorded history and still considered the “Home of Spices”. It constitutes an important group of agricultural commodities, since antiquity and has been considered virtually indispensable in culinary art.

Seed spices are annual herbs, whose dried seed or fruits are used as spices. They are nature’s gift to humankind and add flavour to our food in addition to having preservative and medicinal value. There are about 20 seed spices grown in India. The most prominent among them are cumin, coriander, fennel, fenugreek, ajwain, dill, nigella, celery, aniseed and caraway. They contain a variable amount of protein, fats, carbohydrates, fibres, minerals and vitamins. However, owing to very small quantity used in the food, their contribution to nutrient requirement is not much significant.

ISBN: 978-93-85822-48-3

Coriander (*Coriandrum sativum* L.) is an important annual spice herb that belongs to the family Umbelliferae/Apiaceae (Hedburg and Hedburg, 2003).It is a diploid cross pollinated crop. The plant, indigenous to Southern Europe and the Mediterranean region, is one of oldest consumed spices in India. Its name has been derived from Greek world “Koris”, meaning bed-bug, because of unpleasant, fetid bug like odour of the green unripened fruits. However, when ripe, the seeds have a distinctive sweet citrus/mint/musty aroma that has been valued over the centuries. It is also cited that the name coriander has been derived from French coriander through Latin “*coriandrum*” in turn from Greek “*κορίαννον*”.

The leaves are variously referred to as coriander leaves, cilantro (in the United States, from the Spanish name for the plant), dhania (in the Indian subcontinent, and increasingly in Britain), and Chinese parsley or Mexican parsley. The leaves have a very different taste from the seeds, similar to parsley but "juicier" and with citrus-like overtones. Some people instead perceive an unpleasant "soapy" taste and/or a rank smell. This perception is believed to be a result of an enzyme that changes the way they taste cilantro, a genetic trait, but has yet to be fully researched.

It is commercially grown in India, Egypt, Morocco, USSR, USA, Hungary, Poland, Rumania, Mexico, Czechoslovakia and Guatemala. Coriander is exported to other countries like Malaysia, Singapore, Australia and Central European countries. By exporting 46,000 tonnes, it fetched Rs 498.12 crore (Spices Board, 2015). India has prime position in cultivation and production of coriander. The production in India during the year 2014-15 is 496240t (Spices Board, 2015). The main coriander growing states in India are Andhra Pradesh, Rajasthan, Madhya Pradesh, Karnataka, Tamil Nadu and Uttar Pradesh. Rajasthan emerges as the largest producer with 63 % of domestic production. In 1993-1994 India exported 13552 t of

ISBN: 978-93-85822-48-3

coriander seeds and imported 73 t of coriander seed oil. During the year 2014-15 by exporting 46,000 tonnes, it fetched Rs 498.12 crore. Like other spices, the productivity of coriander is 1011 kg per hectare.

Coriander grows without human assistance over a wide area of the Near East and southern Europe, which forced Zohary and Hopf to admit that "it is hard to define exactly where this plant is wild and where it only recently established itself." (Daniel Zohary and Maria Hopf, 2000*).* Thought to have been introduced to Britain by the Romans as a meat preserver, coriander seems to have been cultivated in Greece since at least the second millennium BC. One of the Linear B tablets recovered from Pylos refers to the species as being cultivated for the manufacture of perfumes, and it appears that it was used in two forms: as a spice for its seeds and as a herb for the flavour of its leaves (Chadwick *et al.,* 1976). Coriander seed and leaf was very widely used in medieval European cuisine, due to its ability to make spoiled meats palatable by "masking" rotten flavours. Even today, coriander seed is an important ingredient in many sausage products. Coriander was brought to the British colonies in North America in 1670 and was one of the first spices cultivated by early settlers.Coriander seed is a key spice (Hindi name */dhania*) in garam masala and Indian curries, which often employ the ground fruits in generous amounts together with cumin. It also acts as a thickener. Roasted coriander seeds, called *dhania dal*, are also eaten as a snack. It is also the main ingredient of the two south Indian gravies: *sambhar* and *rasam*. Outside of Asia, coriander seed is an important spice for sausages in Germany and South Africa. In Russia and Central Europe coriander seed is an occasional ingredient in rye bread as an alternative to caraway. Apart from the uses just noted, coriander seeds are rarely used in European cuisine today, though they were more important in former centuries. Coriander seeds are also used in brewing certain styles of

ISBN: 978-93-85822-48-3

beer, particularly some Belgian wheat beers. The coriander seeds are typically used in conjunction with orange peel to add a citrus character to these styles of beer. Coriander roots are used in a variety of Asian cuisine. They are commonly used in Thai dishes. Coriander has been used as a folk medicine for the relief of anxiety and insomnia in Iranian folk medicine. Experiments in mice support its use as an anxiolytic.

Coriander essential oil showed a delay in *E. coli* growth, suggesting possible agricultural anti-bacterial applications.Coriander seeds have also been used to prepare a traditional diuretic in India. The diuretic is prepared by boiling equal amounts of coriander seeds and cumin seeds. The extract is then cooled and consumed as a diuretic. The seeds are used as spices in the preparation of curry powder and pickling spice. They are used for flavouring pastry, cookies-cakes, tobacco, bakery product, meat fish, soda, syrups, candy, preserve and liquor (Thamburaj and Singh, 2004). It is used as a spice in culinary (Diederichsen,1996), medicine (Kubo *et al.,* 2004; Delaquis *et al.,* 2002). Coriander is also a good melliferous plant and studies indicated that one hectare of coriander allows honey bees to collect about 500 kg of honey**.** The seed contains significant quantities of carotene, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin C and E (Holland *et al., 1991*); iron, manganese, magnesium and dietary fiber to the diet (Ensminger and Esminger, 1986).

They are also used as a condiment in the preparation of sausages, seasonings and cookies, and as a flavouring for alcoholic beverages (Diederichsen, 1996). The essential oils of the fruits are rich in linalool and possess antibacterial and antioxidant activity. The other primary product, the fresh green herb of coriander, also known as cilantro, has a specific flavour, completely different from that of the fruits. The characteristic smell of the green plant is due to the aldehydic content of the essential oil.

ISBN: 978-93-85822-48-3

Extracts of the green herb have also been found to exhibit antibacterial (Kubo *et al.,* 2004) and antioxidant activity. Coriander is one of the most important of vegetables, spice and medicinal plant. Also, Coriander grains, rich in linalool, have as a medicinal plant (analgesic, carminative, digestive, depurative, anti-rheumatic and antispasmodic agent) and a spice, for flavouring candies, in cooking and perfumery. Coriander leaves is used for preparing chutneys, sauces and for curries and soups. Fresh leaves are pungent and aromatic. The aromatic taste and odour of coriander fruit is due to volatile oil (0.1%) which is pale yellow liquid. The distilled oil contains 65 to 70% of (+) linalool (coriandrol) and pinene. The chief consumption of coriander fruit is as flavouring agent in cooking. The dried fruit is generally used as infusion in sore throat, flatulence, indigestion, vomiting and other intestinal disorder and bilious complaints. The plant is alleged to have antiseptic, antitubercular properties and is an antidote for snake bite and scorpion stings.

With the discovery of new uses for coriander, consumption of its products is expected to increase worldwide. Coriander can be cultivated widely in India in locations where semi-temperate agro-climatic conditions prevail in the winter season spanning the period from October-November to March-April. At present coriander is cropped extensively in parts of western and central India in the states of Gujarat and Rajasthan where it faces little competition from vegetable and food grain crops. The cultivation of the available cultivars of coriander competes with conventional crops such as potato, brassicas, wheat, lentil and other legumes. Although agro-climatic conditions for the cultivation of coriander are favourable in the Indo-Gangetic plains, food grains and vegetables are preferred crops in this area. In the Indo-Gangetic plains the normal time for sowing of prevalent varieties of coriander is mid-October to early November. The coriander

ISBN: 978-93-85822-48-3

crop is usually harvested in late March to April. Of the various vegetable and food grain crops that are grown in winter season in the Indo-Gangetic plains, certain varieties of vegetable potato and oilseed Brassicas are harvested in late November to early December. The coriander could possibly be cultivated in the so-vacated fields in order to be able to rotate coriander with early maturing Brassicas and vegetable potato. It is primarily grown for grain and grain essential oil. Plant height is 60 to 90 cm and growth period is 90 to 120 days in spring grown.

In spite of its wide cultivation in India, the average seed yield of coriander is rather low because of lack of attention given to this crop. In order to exploit the yield potential of coriander, the factors affecting yield and yield component should be thoroughly investigated. These factors include environment and cultural practices which directly affect the yield. The productivity of coriander has increased substantially due to rapid development of varieties. However, fewer attempts have been made to standardize them for various locations. Since several varieties are available for cultivation, it is necessary to identify the potential variety for the prevailing agro-climatic conditions.

In agriculture, path analysis has been used by plant breeders to assist in identifying traits that are useful as selection criteria to improve crop yield (Dewey and Lu, 1959). The availability of genetic variability among population is most important for judicious selection and breeding to desired plant genotypes. Plant breeding according to Dudley and Moll (1969) can be divided into three stages; assembly or creation of a pool of variable germplasm, selection of superior individuals from the pool and the utilization of selected individuals in the process to evolve a superior variety. By reason of the evolutionary history of a cultivar, it is becoming increasingly clear that what could be termed as the total energy of traits with economic significance is not present even in the best cultivars.

ISBN: 978-93-85822-48-3

Correlation studies are meant to detect the inter relationship between various plant characters. Selection is the most effective technique in changing the traits of cultivated plants. In artificial selection, the breeder is mainly concerned with selection of best combination of characters which, contribute towards maximum yield.The success of a breeding program depends upon the extent and magnitude of variability existing in the germplasm. Generally, genotypic coefficient of variability (GCV) and phenotypic coefficient of variability (PCV) are measured to study the variability.

Planning and execution of a breeding program for the improvement of quantitative attributes to a great depend, to a great extent, upon the magnitude of genetic variability and divergence existing in the germplasm. Yield is a complex characteristic controlled by several yield contributing components and it is highly influenced by environmental factors; consequently estimates of their ability are useful. Selection is based upon the association of characteristics. Generally, fruit number and size are the main yield components and have positive associations with yield. However, most of the yield components have negative associations to each other, therefore, consideration of one component adversely affects the other and any procedure to break such association would eventually be desirable. Correlation coefficients become more evident when they are partitioned into their components in path analysis. It is imperative to develop stable and widely adapted varieties, and for this study of genotype X environment interaction is required.

Heritability is the transmissibility of characteristic from parents to offering. Heritability in a broad sense is the ratio of genotype variance to total phenotypic variance in percentage. The working knowledge of heritability, especially narrow sense heritability is essential for a breeder.

ISBN: 978-93-85822-48-3

This helps in the selection of parents which may exhibit superior segregants or progenies. Heritability is estimated either performing analysis of variance or regressing the value of the offspring on the mean value of the parents. An important aspect of heritability estimates is that it applies to a particular environment at a particular time. Heritability has been used as an index of transmissibility of a character from the parent to its offspring (Lush, 1943) and thus an aid to foresee the improvement that can be made in a crop by selection for various characters. Genetic advance has an added advantage in selection, breeding programme.

Association of characteristics among yield, its components, and other economical traits is important for making selection in the breeding program. It suggests the advantage of a scheme of selection for more than one character at a time. The genetic correlation among traits suggested that selection for increased main stem internodes length should result in simultaneous improvement in both yield and seed weight. Correlation studies during different years or environmental are important.Yield and seed appearance are strongly affected by environmental conditions and appear to be poor subjects for phenotypic selection. Maturity, seed size, and growth habits are strongly heritable and thus may be subject of phenotypic selection.

The correlation coefficient becomes more evident when genotypic correlations are partitioned into its components in path analysis in order to determine the relative magnitude of various attributes contributing to correlation. Path coefficient provides an effective means of entangling direct and indirect causes of association and measures the relative importance of each causal factor. Partitioning of total correlation into direct and indirect effect would be worthwhile for an effective selection program. The method of path coefficient was sought by Dewey and Lu, 1959 as a means of analyzing correlation coefficients.

ISBN: 978-93-85822-48-3

Germplasm collection with good variability for the desirable characters is the basic requirement of any crop improvement program. In addition crop improvement is primarily based on extensive evaluation of germplasm. The importance of cultivar/variety identification was recognized long back with the increased number of varieties, which were expected to further increase in future due to ever changing objectives to meet the current and the future demands of the producers and consumers. The basic objective of varietal identification is to confirm the occurrence of traits that helps in identifying a particular variety when grown in different environmental conditions and generations (Flenner and Smith, 1983).

In spite of its wide cultivation in India, the average seed yield of coriander is rather low because lack of attention given to this crop. Therefore, much concentrated efforts are necessary to improve its yield and yield components. Hence, evaluation of the potentialities of the existing genetic resources is essential because promise for further improvement programme depends on the genetic diversity of the crop. The magnitude of heritable and more particularly its genetic components, is clearly the most important aspect of the genetic constitution of the breeding material which has a close bearing on its response to selection. Again selection of one trait invariably affects a number of associated traits which evokes the necessity in findings out the interrelationship of various yield components both among themselves and with yield. In any sound breeding programme, proper choice of parents based on their genetic diversity, is a prerequisite.

Coriander is grown in almost all the districts of West Bengal. Mostly local cultivars/landraces are predominant in the state. Characterization of local genetic resources for identification of important traits for further utilization is important in the present day breeding programme. Keeping

ISBN: 978-93-85822-48-3

this information in view and the lack of consorted work done on them under West Bengal condition, the present investigation has been undertaken with the following objectives –

i) Assemblage, evaluation and characterization of coriander germplasm as par documented descriptors.
ii) Determination of genetic variability parameters for important growth and seed characters influencing yield, their interrelationship and their direct and indirect effect on yield.
iii) Analysis of genetic divergence of collected materials based on some important quantitative traits.

ISBN: 978-93-85822-48-3