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Preliminary observations on Fennel (*Foeniculum vulgare* Gaertn.) with special reference to Floral Biology*

by

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Synopsis: The results of an observational trial conducted at the Botanic Gardens, Coimbatore with 190 types of fennel, *Foeniculum vulgare* Gaertn., on their adaptability and variability in habit, floral biology, pollination, germination, general performance etc., are presented in this paper.

Introduction: Fennel (*Foeniculum vulgare* Gaertn.) the umbelliferous aromatic herb, is commonly cultivated in India mostly as a garden or kitchen crop at altitudes upto 6,000 ft. It is grown as a cold weather crop in North India especially in Uttar Pradesh, Punjab and Rajastan. It was known as a "culinary spice" in the ancient days in India, China and Egypt. The Romans cultivated it for its edible shoots. It has become indispensable in modern French and Italian cooking.

The plant is native of southern Europe and Asia but now diffused over temperate and sub-tropical regions of the world (Kirtikar and Basu 1938). Lindley (1849) has reported that it is a native of Mediterranean and has spread all over the world and often occurs as an escape from cultivation. It is widely accepted as a native of Europe and commonly cultivated throughout India, Ceylon and Malaya (Watt 1890; Chandrasena 1935; Chopra *et al.* 1949; Macmillan 1925 and Nadkarni 1954).

There is some confusion about the Tamil equivalent for fennel. It is very commonly termed as both *Shombu* and *Perunjeeragam* in Tamil. But the real *Shombu* is *Pimpinella anisum* L. The material that is sold as *Shombu* in the market in Madras is *Pimpinella anisum* L. and as *Perunjeeragam* is the real fennel.

Economic Uses: Every part of the plant is aromatic. The fennel fruits contain 0·7 to 6% of volatile oil, anethol and anise camphor, a variable proportion of liquid isomeric with turpentine. The oil is used in Europe in the manufacture of cordials and enters into the composition of fennel water which is employed medicinally. The water is distilled largely in India and sold in the name of 'Arakbadian'. The oil is also used as an adulterant of anise oil. In perfumery the sweet oil is used for scenting soap and in the

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form of essence used as a flavouring for cakes (Stanley Redgrove 1933). The fruits are used for flavouring soups, meat dishes and sauces, bread rolls, pastries and confectionery, for flavouring liqueurs and in the manufacture of pickles. As a medicine the fruits are used as a stimulant, aromatic and carminative in colic. The leaves are used in fish sauce and for garnishing. They posses diuretic properties and reported to improve eye-sight. The root is regarded as a purgative.

Fennel fruits (seeds) are classified for trade purposes according to their places of origin. Well known types in India are: Bombay, Bihar and United Province fennels. Seeds from Lucknow are considered to be the best and are priced higher than those from other areas (*Wealth of India*, 1956)

Object of the Present Investigations: Many varieties with variations in morphology, flowering habit, size, odour and taste of the fruit exist among this species. However very little work has been done on this crop.

Nearly a hundred types of fennel were introduced for the first time at the Agricultural College and Research Institute, Coimbatore from the Division of Botany, Indian Agricultural Research Institute, New-Delhi during 1960. An observational trial was conducted at the Botanic Gardens, Coimbatore, in red soils under irrigated conditions with a view to study their adaptability and the variability in their habit, floral biology, pollination and general performance and the results are discussed below.

Plant Description: A detailed study of the hundred types of fennel showed differences in their characters especially in the floral parts. The plant is a stout aromatic, annual herb (biennial herb with potency for regeneration), the height ranges between 0·61 m. to 1·52 m.; stem hollow, cylindrical with a greyish bloom all over; leaves dull green, stalked, petiole very long and dilated with an amplexicaul base, pinnately decompound, lower leaves are smaller and much less divided.

Inflorescence is a compound umbel and the average number of umbels and umbel rays per plant, worked out from the hundred types, showed 10 to 35 umbels and 15 to 25 umbel rays per plant. In all the types studied, all the flowers were bisexual in the same inflorescence. The flowers are bright yellow and actinomorphic and pentamerous. Bract and bracteoles absent. Calyx gamosepalous, very small; corolla five, yellow, polypetalous; stamens five arranged alternating with the petals.

The pistils of the flowers and stylopodia which are characteristic features of the umbelliferae, offered much variation in their form and structure; the types examined for these characters could be distinctly

classified into three groups. (1) In the first group there were 21 types each having a long pair of styles with a short stylopodium at the base. In this particular group of plants abnormalities in the form of fasciation of style extra branching from the pedicels of umbel rays were observed. (2) In the second group there were 21 types all having normal bisexual flowers; here, all the flowers have each only a pair of short cushiony styles without the stylopodium. (3) In the third group there were 58 types having plants of both normal flowers described under second group above, and flowers having a pair of long styles and stylopodium. These two types of flowers were observed to be present in one and the same plant.

Fruit oblong, ellipsoid or cylindrical, capped by the conspicuous stylopod in certain cases, 6 to 7 cm. long, straight or slightly curved greenish grey, smooth, mericarps flat, five ridged with prominent vittae. Girija Lakshman (1952) from a study of the anatomy of the root, stem, petiole and inflorescence axis has brought out the presence of oil ducts in all these parts.

Germination and Growth: The sowing of the types was done during December under irrigated conditions. The seeds started germination only after 10 to 12 days of sowing. All the hundred types established fairly well under conditions prevailing at Coimbatore. The crop took about 5 to 6½ months to come to harvest from the date of sowing. Depending upon the desirable attributes as vigour, number of compound umbels and umbel rays per plant and the size of fruits, hundred single plants were selected for further studies. Late during the flowering stage the crop suffered severe attack by aphids. Without any exception all the hundred types were affected. None of the types were found resistant to aphid attack. The pest was kept under check by two sprays with the pesticide, Parathion (Folidol).

Anthesis: A detailed account on the anthesis and biology of the flower is lacking as gathered from the literature. It was found that the plant reaches the boot stage within a period of 3 to 3½ months from the date of sowing. The terminal umbels are the first and the axillary ones are the later to develop. This is in confirmation with the observations recorded by Girija Lakshman *(loc cit.)*.

In each compound umbel as well as the single umbel, the flowers at the periphery are the first to open and those in the centre are the last to open. The emergence of the inflorescence from the boot stage to complete emergence takes about 7 to 12 days. From complete emergence to completion of flowering in a single compound umbel it takes about 12 to 15 days. In each flower the stamens are the first to come out. All the five stamens of a flower do not come out simultaneously. They come out one after another and the time taken for complete emergence is 6 to 8 hours and

this again varies with the different types studied. In the case of flowers where the stylopodium is very prominent and the styles are long, the stigmas were exposed even before the flowers open. In such cases the emergence of the stigmas is not centrepetal but it assumes different directions without any regularity.

The exact time of anthesis was studied at intervals of every two hours and it was found that anthesis takes place throughout day and night. But the number of flowers that open during day time is more than those that open during night. Anthesis is not uniform at every hour and the maximum and minimum readings fluctuate with different hours in a day. In a compound umbel all the flowers were found to be bisexual and there were no males and sterile flowers in any of the types studied which were reported to occur in the local type studied by Girija Lakshman. Out of the 12 to 15 days taken by a compound umbel to complete flowering, anthesis was observed to be peak in the last two days of completion of flower opening.

Pollen Grains and Pollination: The pollen collected at the time of anthesis from different umbels of some types selected at random were examined for their development with acetocarmine staining it was observed that about 10 to 20% of the pollen did not take up the stain due to ill development.

An attempt was made in all the hundred types to find out whether fennel is a self-pollinated or cross-pollinated species by covering as many number of individual flowers as possible in each type with pollen proof paper bags early in bud stage and studying the effect of covering on fertilisation by preventing the entry of foreign pollen. Without any exception all the flowers covered set seed. The absence of fruit set in emasculated and bagged flowers ruled out the possibility of seed setting due to apomixis. It was therefore obvious that fennel is a self-pollinated species.

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