FLORAL BIOLOGY AND BREEDING OF CLOVE (*EUGENIA CARYOPHYLLATA* THUNB)

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ABSTRACT

In clove the flowers are bisexual. The male phase starts along with the opening of the flowers. The stamens shed after two days. The female phase starts soon after the male phase. In general inbreeding is common in clove. But controlled cross-breeding is also possible by adopting sophisticated techniques. The maximum receptivity of the stigma is found to be on the 5th day after opening of the flower. The best period for pollination is between the 4th and 6th day after opening. The highest fruit set obtained was 46·66%. A fertilized flower takes about three months for maturity. A suitable hybridisation procedure for clove breeding is described.

INTRODUCTION

THE existing clove plantations in India show great variation in the percentage of high yielding trees. Therefore, it is felt that, there is greater need for upgrading the genetic quality of planting materials to ensure better yields from future plantations. This can be achieved through conventional methods like selection, hybridisation, etc. For the formulation of suitable methods of hybridisation, a knowledge of the floral biology and breeding techniques is necessary, which is lacking in this crop. The present work was, therefore, taken up to provide basic informations on the above aspects.

MATERIALS AND METHODS

The materials used in this study are the progenies of clove plants brought from Kottayam District, Kerala, and planted in the Soil Conservation Research Demonstration and Training Centre at Sipighat, Port Blair, Andamans. Observations on the morphology of the plant including floral biology were made. Cross pollination was conducted by covering one or more flowers in a small muslin cloth bag of the size 10 × 8 cm after emasculation by using small pointed scissors and transferring the desired pollen over the stigmatic surface of the flowers during the receptive period. After 3 to 4 days the bags were removed. The rate of growth of the fruits was recorded periodically. The mature fruits (mother of clove) which fell down on ripening were collected, dehusked and sown immediately.

RESULTS AND DISCUSSION

Floral biology.—The *panicles* in clove are terminal, corymbose, trichotomous, shortly pedunculate or branched from the base, few to many flowered. Flowers are bisexual, fragrant and usually in threes at branchlet ends on stout variable and separable pedicels; the centre flower of the triads are usually on a much shorter pedicel than the others. Bracts and bracteoles narrow, acute, 2 to 3 mm long and quickly caducous. Calyx tube 1 to 1·5 cm long, below lobes green in bud, cylindric angled, base very slightly narrowed, without pseudostalk, flushed pink at anthesis and turning deep reddish-pink after the stamens fall, lobes 4 narrowly ovate acute, fleshy, 3 to 4 mm tall, erect and slightly incurved, green in bud, erect-spreading and pink after anthesis. Petals 4, green, falling in a hemispherical calyptra, about 6 mm diameter but not agglutinated and easily separable, orbicular. The flower buds are elongated with a head-like enlargement at the distal end. The head is formed by the congregation of numerous stamens appearing in 4 grouped masses arising from between the outer edge of the prominent narrow disc-like concave plate and the calyx tube, enclosed by a 'cap' which is clipped together by the four characteristic claw-shaped calyx lobes. On an average, 362 stamens of varying sizes are produced in a single flower; the filaments are whitish, glandular, postulate, inner ones smaller, 2 to 3 mm long and the outer ones longer reaching 5 mm or more; anthers yellow, ovate or ovate-oblong, about 0·5 mm long, connective gland small, pale

brown and inconspicuous; anthers bifid containing somewhat sticky pollen grains. The stamens encircle the pistil situated at the centre of the disc-like plate. The pistil is tower-shaped; style very stout and swollen at the base, very pale green and gland-dotted, 4 to 5 mm long. Ovary 2-celled and multiovulate. On maturity, the filaments elongate and push out the 'cap' and the stamens open out and array themselves on the periphery of the disc-like plate giving the appearance of an open umbrella. The size of an opened flower is about 4 × 15 mm Opened flowers emit a pleasant aroma and secrete honey, which is accumulated around the base of the pistil. Fruit is a berry attaining about 14 × 30 mm in size when fully grown (in about 90 days), oblong, club-shaped; the exocarp is 2 to 3 mm thick and succulent, pinkish-purple-tinged-green, with purplish testa while the endocarp is pale-green, thin and papery. The pericarp (husk) is rounded at both ends, holds the 4 characteristic claw-shaped enlarged narrow fleshy calyx lobes incurved over and hiding the apical excavation at the wider distal end and encompasses the single seed inside. When young, they are greenish with pink tinges and on maturity the colour develops into pinkish and ultimately violescent. The size of the fruits vary within a plant and from plant to plant—the usual sizes being small, medium and large. The fruits are attached to the plant with a thin 2 to 4 delicately jointed pedicel at the narrow proximal end. The fruit becomes dry and shrinks on storage. The pericarp is easily removable by fingers. The seed inside is light green with a longitudinal central groove on one side and an irregular crack on the other side formed by adhering together of the unequal cotyledons, mucilaginous and conical in shape measuring about 8 × 13 mm in size. The cotyledons are side by side, inner fans gland-dotted, excavate, interlocking and irregularly folded and tight fitted each other enclosing the embryo. Sometimes germination starts in fully tree-ripe fruits even before shedding. In such cases, the large hypocotyl which reaches the periphery of the seed at apex or base or midway may be seen pinkish, elongated and protruding out through the folds of the cotyledons.

Majority of flowers start opening at about 3 P.M. The male phase starts with the opening of the flowers. Under normal conditions the stamens shed two to three days after opening. The female phase starts after the male phase, *i.e.*, after three days of opening of the flower. Since opened flowers are fragrant and contain honey, honey-bees are attracted towards the flower. The fertilized flower develops into a mature fruit in about three months. The maximum sizes of fruits (unhusked) recorded in the first, second and third months were 8 × 20 mm, 11 × 25 mm, 14 × 30 mm respectively. The weight of individual fruits (unhusked) vary from 1 to 2 g. The weight of the husked seeds vary from 300 to 700 mg giving an approximate seed to husk ratio of 1 : 3.

The results obtained by cross pollinations of clove plant for evolving new hybrid seeds during February–March 1972 were:

1. The percentages of fruit set recorded on the 4th, 5th, 6th and 7th days after opening of the flower were 23·3, 46·7, 26·7 and 3·3 respectively. Suitable controls were used for the study with flowers emasculated and bagged without pollination. No fruit set was seen in the controls.
2. The receptivity of the stigma started on the 4th day after opening of the flower and continued up to the 7th day, the maximum receptivity being on the 5th day.

From the above, it can be concluded that the best period for pollination is between the 4th and 6th days after opening of the flower. The fact that the maximum fruit set of 46·7 per cent was obtained in pollinations conducted on the 5th day reveals that pollination done on the 5th day after opening of the flower could be most effective in getting maximum seed-set. Therefore, this breeding technique can be adopted for large scale production of hybrid seeds of clove for its genetical upgrading.

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