

Cross – Artificial Pollination on *Hibiscus Rosa-Sinensis* L.

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Abstract: The study was focused on pollination of *Hibiscus rosa-sinensis* L. The study area is situated at Therkkumedu, Salem district. The study initiated from May 2016 to February 2017. Flowering initiation, fruit set, fruit initiation and maturation of fruits, seed production and germination was observed from September 2016 to February 2017. Natural pollination of *Hibiscus rosa-sinensis* L. resulted 0% fruit set, because there are no any pollinators or insect visitors. In controlled pollination treatments one type of pollination were examined. That is cross pollination, resulted better results and moreover it confirms the pollination take place by hand pollination. This method is give 100% result *Hibiscus rosa-sinensis* L. Naturally the pollination and fruit set is very rare in *Hibiscus rosa-sinensis* L. Artificial cross-pollination was followed in two different character of *Hibiscus rosa-sinensis* L. mother plants. Both are Red colour with contrast flower character. The result positive in one type of mother plant, result negative in another type of mother plant. Because the flower character is entirely different.

Keywords: *Hibiscus rosa-sinensis* L., Pollination, Cross-Artificial pollination, Pollen, Ovule, Fruits, Seed dormancy and Seed germination.

1. Introduction

Pollination is the result of pollen being transferred from the anther (male part) to the stigma (female part) of another flower. 5 types of pollination is commonly occurring in plants. They are Self-pollination, Cross-pollination, Artificial pollination, Hand pollination and Bud pollination. In this study focused on artificial pollination and cross pollination.

In plants such as hemp and willow, where the flowers are unisexual, cross-pollination becomes obligatory. Pollen is transferred from one plant to another, the process is called *cross-pollination*. Landing of pollen on stigma is no guarantee for seed-set. Failure of fertilization after self-pollination in self-sterile plants may also be due to the inability of the pollen to germinate on its own stigma. All those plants which pollen from a flower is incapable of bringing about fertilization in the same flower are said to be self-sterile or self-incompatible (Bhojwani S.S, Bhatnagar S.P. 2004). The family *Malvaceae* is in the major group Angiosperms (Flowering plants). The family *malvaceae* otherwise known as Mallow or cotton family. This family consists of about 243 genera and at least 4,225 species of herbs, shrubs, and trees. The members of this family are cosmopolitan in their distribution. They are specially found in tropical regions of the world. Several species of this family have been reported from our country *H. rosasinensis* is a large ornamental shrub with beautiful red flowers. A number of species are economically important, including cotton (various *Gossypium* species), cacao (*Theobromacacao*), linden (*Tilia* species), durian (*Durio* species), *Hibiscus*, and okra (*Abelmoschus esculentus*). (Paul E. Berry). Habit- herbs, shrubs or trees. Root Tap and branched. The stem is erect, herbaceous or woody, branched, cylindrical, solid usually with stellate hairs with mucilage sacs occur. The leaves are alternate, hairy, palmate and lobed or divided. The calyx is composed of five sepals, gamosepalous, sepals are united to each other. Five petals, polypetalous but the petals are inferior

and coloured Mucilage sacs are also found. The inflorescence is of cymose type, very rarely racemose, solitary, axillary, terminal, or compound cyme. The flowers are usually pedicellate, bracteolate, actinomorphic regular, hermaphrodite, complete, hypogynous and pentamerous, large and composed of five separate petals. The stamens and style form a long tube protruding from the centre of the flower, and the stigma at the end of the tube is divided. Stamens are found arranged on a stamina tube. The stamens are monadelphous. The filaments are short and the anthers are monothecous, i.e., one-celled and dorsifixed. The anthers dehiscence transversely.

The stamens are derived from profuse branching of five antipetalous stamens. The outer whorl has been lost, but however, represented in *Hibiscus* by five staminodes. Gynoecium consists of 5 to indefinite carpels (polycarpellary), syncarpous. The ovary is superior ovules. The placentation is axile. The styles are united but the stigmas are free. The styles pass through the stamina tube. The number of stigmas is as much as the number of carpels. The fruit is loculicidal capsule or schizocarp. It splits into a large number of mericarps. The number of mericarps is equal to the number of carpels. The seeds are usually buried in a hairy covering formed from the testa. The reniform or ovoid in shape. The embryo possesses large much folded cotyledons. The endosperm is scanty. Pollination Entomophilous (Sambamurthy et al., 2005).

2. Materials and Methods

Study Area

The study area is Therkkumedu village, located in sangakiritaluk, salem district was selected.

Description of *Hibiscus Rosa-Sinensis* L.

Habit: Ornamental perennial shrub. **Root:** Tap, branched. **Stem:** Erect, woody, branched, cylindrical, glabrous and solid. **Leaf:** Simple, alternate, petiolate, stipulate, ovate, serrate, glabrous, apex acuminate, multicostate reticulate

venation. **Inflorescence:** Cymose, solitary axillary. **Flower:** Pedicellate, hermaphrodite, large, showy, pentamerous, actinomorphic, complete, hypogynous. **Epicalyx:** 5-7 bracteoles constitute epicalyx below calyx. **Calyx:** Five sepals, gamosepalous, green, inferior, valvate aestivation. **Corolla:** Five petals, polypetalous, slightly united below, adnate to the stamina tube, inferior twisted aestivation. **Androecium:** Stamens indefinite, monadelphous, stamens from a stamina tube round the style, epipetalous, anthers monotheous, reniform, basifixed. **Gynoecium:** Five carpels (pentacarpellay), syncarpous ovary superior, pentalocular, axile placentation, style long and passes through the stamina tube ending in five distinct rounded stigmas. **Fruit:** Capsule, Dry dehiscent fruits, the fruit wall shrink and splits up exposing the seed they ripen. **Seed:** Seeds contain hard seed coat with black in colour.

Pollination

Pollination is commonly defined as the process of pollen transfer from anther to the stigma. There are many types like Self-pollination, Cross -pollination, Artificial pollination, Hand pollination.

Cross Pollination

Pollen is transferred from one plant to another, the process is called *cross-pollination*. Landing of pollen on stigma is no guarantee for seed-set. Failure of fertilization after self-pollination in self-sterile plants may also be due to the inability of the pollen to germinate on its own stigma. All those plants which pollen from a flower is incapable of bringing about fertilization in the same flower are said to be self-sterile or self-incompatible (Bhojwani S.S, Bhatmagar S.P. 2004). Reasons for cross pollination in a *Hibiscus rosa-sinensis* L. flower, if both the sex organs mature at the same time, the pollination is prevented by the arrangement of the sex organs at different heights. (G.N. Kulkarni., 2002).

Hand Pollination

Pollination were recorded by using mature flowers were noted for the timing of fruit formation and fruit dehiscence. Flowers were observed carefully during the life of single flowers in both selected plant. Inflorescence is selected at random from normal flower character of *Hibiscus rosa-sinensis* L. (Red) plants. At the same way another red colour mother plant was selected with contrast flower character. These were followed daily. After dehiscence of anther, the pollen grains are just transfer from white flower to stigma of red flower (mother plant) by the hand. After transfer of pollen grains, flowers were watch daily and observed carefully in both plant. Pollen load was observed by number of pollen grains deposited on the stigma after pollination. To determine the number of pollen grains on the stigma receptive stigmas were randomly chosen and removed from the flowers that had just undergone pollination efficiency was observed in both plants. *Hibiscus rosa-sinensis* L. stigmas receive an approximately 20-25 pollen grains in 24 hour. (Alexander 1987) Some pollen grains are deposited on the sticky surface of each stigma and each compatible pollen grain sends a tube through the style to the ovule to complete fertilization. Within three days of fertilization, petals drop and the pistil begins to elongate to form a pod as the seeds develop inside.

Methods of breaking dormancy

- 1) Use of solvents like hot water or cool water, organic solvent ect.
- 2) Impaction of the seed.
- 3) Scarification
- 4) Acid scarification
- 5) Extreme cold temperature (-5 to -10)
- 6) Heat treatment
- 7) Light treatment
- 8) Application of growth regulators such as Gibberellic acid, Ethylene, Cytokinin etc.

Hibiscus rosa-sinensis L. seed dormancy was broken by cold and hot water treatment, scarification, acid scarification, extreme cold temperature, use of chemicals.

Cold and hot water treatment: *Hibiscus rosa-sinensis* L. seeds was soaked in cold or hot water for few hours. After few hours remove the seed coat carefully. Then showed the seeds in the field. Within 5-10 days the seeds will be germinate into a new *Hibiscus rosa-sinensis* L. plant.

Scarification: 2-5 *Hibiscus rosa-sinensis* L. seeds was put in Pestle and add small amount of sand soil and graind lightly with the help of mortar. Then showed the seed. After one week seed will be germinated. Because, water is penetrate in to the embryo through the scratches. **Acid scarification:** Acid scarification has the same effect as rupturing the pericarp. The treatment is found effective in removing the dormancy in *Hibiscus rosa-sinensis* L.. concentrated sulphuric acid scarification for three minutes gave highest germination in *Hibiscus rosa-sinensis* L. seeds. **Extreme cold temperature:** The dormant seeds are subjected to 5-10°C for 5-30 days. *Hibiscus rosa-sinensis* L., pre -chilling was found best for breaking dormancy. **Use of chemical:** Acetone can be used for breaking the dormancy in *Hibiscus rosa-sinensis* L. seeds.

3. Result and Discussion

Pollination

The transfer of pollen from the anther to the stigma is known as *pollination*. Pollination of the selected plants *Hibiscus rosa-sinensis* L. (Red colour) was studied from May 2016-February 2017. Pollination is the process by which pollen is transferred to the female reproductive organs of a plant, thereby enabling fertilization to take place. Like all living organisms, seed plants have a single major goal: to pass their genetic information on to the next generation. The reproductive unit is the seed, and pollination is an essential step in the production of seeds in *Hibiscus rosa-sinensis* L. (Plant Reproduction: 837-850). Pollination to be successful, a pollen grain produced by the anther, the male part of a red flower of *Hibiscus rosa-sinensis* L., must be transferred to a stigma of another flower in a same plant. In *Hibiscus rosa-sinensis* L., after the pollen grain has landed on the stigma, it creates a pollen tube which grows down the style until it reaches the ovary. Sperm cells from the pollen grain then move along the pollen tube, enter the egg cell through the micropyle and fertilise it, resulting in the production of a seed. A successful pollen grain (gametophyte) containing the male gametes is transported to the stigma, where it germinates and its pollen tube grows down the style to the ovary. Its two gametes travel down the tube to where the gametophyte(s)

containing the female gametes are held within the carpel. One nucleus fuses with the polar bodies to produce the endosperm tissues, and the other with the ovule to produce the embryo Hence the term: "double fertilization".(Fritsch, Felix Eugene; Salisbury, Edward James 1920).Natural pollination of *Hibiscus rosa-sinensis* L. resulted 0% fruit set, because there is no any pollinators or insect visitors. In controlled pollination treatments one type of pollination were examined. That is cross pollination Xenogamy, resulted better results and moreover it confirms the pollination take place by hand pollination.

Fruits & Seeds:

Fruiting commences from May(2016)continues up to end of February It is technically, a schizocarp and carcerulus, disc shaped with persistent calyx which turn brown on ripening. Fruits mature in 20-25 days. The fruit is divided into 5 sections the mericarps each containing a black seed. The seeds are kidney shaped, flattened, and notched on one side. The mericarps are released from the cup like structure formed by calyx. They disperse in air due to the movement of plant with air currents but do not travel much distance from the plant. The mericarps release seeds after decaying. (AlpnaJohri& R. K. Raghuvanshi.,2014).

Breaking Dormancy

- 1) Use of solvents like hot water or cool water, organic solvent ect.

- 2) Impaction of the seed.
- 3) Scarification
- 4) Acid scarification
- 5) Extreme cold temperature(5 to 10)
- 6) Heat treatment
- 7) Light treatment
- 8) Application of chemical and growth regulators such as Gibberellic acid, Ethylene, Cytokinin etc.

In *Hibiscus rosa-sinensis* L. seed dormancy was broken by first cold water, sulphuric acid, Acetone, hot water, soil scarification, extreme cold temperature.

Seed Germination

Seed germination is the resumption of the embryo that results in the rupture of the seed coat and the emergence of the young plant. When a viable seed absorbs water under favourable environment, respiration, protein synthesis and other metabolic activities begin, and lead to embryo emergence after some time; such a seed is called germinated. In *Hibiscus rosa-sinensis* L. hypogeal germination is taking place. Because the cotyledons or comparable storage organs do not emerge above the soils surface; only the plumule emerges above the ground. This is because in this type of germination the epicotyls, and not the hypocotyls, undergoes rapid elongation.

Plate-1: Habit



Non-fruit forming plant

Fruit forming plant

Inflorescence



Non-fruit forming plant

Fruit forming plant

Plate-2



Cross pollination

Stigmatic pollen



Pollinated flowers are covered



Corolla closure



Corolla fall down

Plate-3



Month of October 2016

Month of November 2016

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Month of December 2016



Month of January 2017



Month of February 2017

Plate 4



Fruit dehiscence



Seeds



Seed Germination in cup



Field Seed Germination

Plate 5: Seed dormancy broken test



Cold water test



Soil scarification test



Cold temperature test



Hot water test



Chemical test (Acetone) Acid scarification (Sulphuric acid)

Plate 6: Seed dormancy broken test results



Acid scarification (Sulphuric acid)

Cold water



Chemical (Acetone)

Hot water



Cold temperature

Soil scarification

4. Summary and Conclusion

The study was focused on pollination of *Hibiscus rosa-sinensis* L. The study area is situated at Therkkumedu, Salem district. The study initiated from May 2016 to February 2017. The flowering period of *Hibiscus rosa-sinensis* L. ranges from January to December. The time of flower anthesis seems to be temperature and light dependent. The flowers are protandrous and anther dehiscence takes place just prior to flower opening but this protandrous condition is not so pronounced. Though the upper anthers mature first and till the maturation of all anthers stigmas also become mature. The flower life time is one day.

Flowering initiation, fruit set, fruit initiation and maturation of fruits, seed production and germination was observed from September 2016 to February 2017. Flowers life span approximately one day, after which the corolla string together with style and stamens. The flower of *Hibiscus rosa-sinensis* L. were receptive for one day. The flower opening starts between 6.30 am to 7.30 am., however the anther dehiscence at the time of anthesis. Natural pollination of *Hibiscus rosa-sinensis* L. resulted 0% fruit set, because there is no any pollinators or insect visitors. In controlled pollination treatments one type of pollination were examined. That is cross pollination, resulted better results and moreover it confirms the pollination take place by hand pollination. This method is give 100% result *Hibiscus rosa-sinensis* L. In same species of *Hibiscus rosa-sinensis* L. cross pollination is failed. When cross pollination fails, the stigma bend down ward. Structure of pollen (male reproductive part) and Structure of ovule (female reproductive part) was observed. Pollination to be successful, a pollen grain produced by the anther, the male part of a red flower of *Hibiscus rosa-sinensis* L. , must be transferred to a stigma of red colour *Hibiscus rosa-sinensis* L. the female part of the flower. In *Hibiscus rosa-sinensis* L. after the pollen grain has landed on the stigma, it creates a pollen tube which grows down the style until it reaches the ovary. Sperm cells from the pollen grain then move along the pollen tube, enter the egg cell through the micropyle and fertilise it, resulting in the production of a seed. In artificial cross-pollination experiments successfully 100% of fruit set and seed set was observed. Fruit formation, fruit dehiscence and seed dispersal was observed. And also observed seed dormancy. Gave methods of breaking dormancy and observe seed germination in both cup and field. Naturally the pollination and fruit set is very rare in *Hibiscus rosa-sinensis* L.

Artificial cross-pollination was followed in two different character of *Hibiscus rosa-sinensis* L. mother plants. Both are Red colour with contrast flower character. The result positive in one type of mother plant, result negative in another type of mother plant. Because the flower character is entirely different. So the positive pollination is based on the flower character and Environmental impacts like Loss of pollinators, also has been noticed in recent years. Possible explanations for pollinator decline include habitat destruction, pesticide, parasitism/diseases, climate change and others, and many researchers believe it is the synergistic effects of these factors which are ultimately

detrimental to pollinator populations. Pollination studies on *Hibiscus rosa-sinensis* L. is a new report. So the pollination is 50 % possible in *Hibiscus rosa-sinensis* L.

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