FLORAL BIOLOGY OF SNAKE GOURD
(*Trichosanthes cucumerina* L.)

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DEDICATED TO MY TEACHERS

THESIS ABSTRACT

FLORAL BIOLOGY OF SNAKE GOURD (*Trichosanthes cucumerina* L.)

BY

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Floral biology and yield performance of different snake gourd (*Tricosanthes cucumerina* L.) genotypes were investigated to develop high quality and yielding variety (ies). There were differences between the snake gourd genotypes in respect of floral biology and yield potentiality. Size of the female flowers were larger than the male flowers. At 13th to 18th node in acropetal order, male flowers appeared within 32 to 35 days and at 23th to 35th node, whereas female flowers appeared within 35 to 45 days. Thirty six to thirty eight days needed to open the male flower and 39 to 49 days required for the female flower after transplanting. Starting of the anthesis occurred within 7 to 8 pm in male flowers and required 19 to 33 minutes for full blooming. The anthesis of the female flower started from 7 pm to 8 pm and completed their full blooming within a range of 80 to 124 minutes. Time

of anther dehiscence started from 4 to 5 pm *i.e.* about 3 hours before anthesis and completed at 7 to 8 pm. The fresh pollen viability was around 99% and the range of the pollen grain diameter was 30 to 25 µm. No pollen grain was germinated before 5 hours at field condition. The stigma became receptive about 15 hours before anthesis and it remained receptive up to 27 hours after anthesis. No pollen tube was found in the style before 10 hours. Genotypes SG 04 was more cross compatible than self compatible. The range of the length, diameter and weight of the individual fruit were 21 to 41 cm, 38 to 51 mm and 132 to 247 g, respectively. Edible fruit maturity attained at 6 to 9 days and ripening of fruits at 30 to 43 days. Fruits per plant and fruit weight ranged from 32 - 41 and 4 - 9 kg, respectively.

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Winter , 1999 **The Author**

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Snake gourd (*Trichosanthes cucumerina* L.) is one of the common summer vegetable. Area covered by it was 2675.40 hectares and annual production was 10,830 metric tones in 1996-97 (BBS, 1998). It is an annual monoecious climbing type herbaceous crop belongs to the family cucurbitaceae having chromosome number, 2n=22 (Jeffrey, 1980; Chakravarty, 1982) under order cucurbitales, sub-class polypetalae and class dicotyledon (Hooker, 1867). There is a number of summer vegetables under cucurbitaceae grown over a wide range of soil and climatic condition (Tindall, 1988). Biochemically the cucurbits are characterized by bitter principles, called cucurbitacins. A systematic research for these substances in the family indicates that great majority of species contain bitter principles in some portion of the plant at some stage of development. Chemically cucurbitacins are tetracyclic triterpenes having extensive oxidation level (Seshadri, 1986). The center of origin is not precisely known but most of the authors agree India or Indo-Malayan region as the original home (Seshadri, 1986 and Roy *et al.*, 1991). Snake gourd can be grown in any time of the year except acute winter. All types of soil having well drained system are suitable

for its cultivation, but a well drained sandy loam soil rich in organic matter is the most suitable texture for its successful production. It prefers long warm dry weather with abundant sunshine although it can be grown in shady place (Kamaluddin, 1966). But Venkataram (1965) reported that short photoperiod encouraged the female phase (Shanmugavelu, 1989).

Snake gourd fruit is a good source of vitamins and minerals. About 98% portion of fruit is edible. Per 100g of edible portion of snake gourd contains 26mg calcium, 20mg phosphorus, 0.3mg iron, 96 μg carotene, 0.04mg thiamine, 0.06mg riboflavin, 0.3mg niacin (Gopalan *et al.*, 1982). The red pulp of the ripe fruit might be very rich in carotene (vitamin A) which is cooked as vegetable in many place of our country (Rashid, 1993).

Yield of snake gourd is very poor in Bangladesh (4.05 tons/ha) (BBS, 1998). There is no recognized variety of snake gourd in Bangladesh but there is a good range of variability in size, shape and colour of fruits available in Bangladesh (Rashid, 1993). Snake gourds are attacked by a number of disease and pest. Due to lack of basic information on floral biology;

combination breeding, transgressive breeding and resistance breeding might not be initiated in snake gourd. There is a scope to develop high yielding disease resistant variety through those breeding processes. As it grows in entire Bangladesh, vertical yield can tremendously be increased by using improved variety.

Flower biology is the study of the science of flowers, which includes anthesis, dehiscence of anthers, pollen fertility and stigma receptivity (Kalloo,1988). Study on floral biology and cross compatibility among different fruit types of snake gourd was given less attention earlier in Bangladesh. Information of such studies are the prerequisite for effective hybridization program to develop high yielding disease resistance varieties of this crop. Considering the scope of varietal improvement, the investigation was undertaken with the following objectives--

1. To study the floral biology such as time of anthesis, time of anther dehiscence, duration of stigma receptivity, pollen viability and pollen tube growth behaviour.
2. To determine the effective hybridization time.

CHAPTER II

REVIEW OF LITERATURE

Snake gourd is an important summer vegetable. A few works have been done for the improvement of this crop in Bangladesh and abroad. Literature related to floral biology, cross compatibility and yield potential of snake gourd is limited. However, presently available literature related to floral morphology and its biology, fruit morphotypes, yield and yield contributing characters in snake gourd have been presented below.

Days to appearance of floral bud and first flower anthesis

Akand (1993) noted in ridge gourd that first staminate flower opened within 42 to 46 days and the first pistillate flower opened within 48 to 52 days while for hybrids it ranged from 40 to 45 days and 43 to 51 days for staminate and pistillate flower anthesis, respectively.

Significant variation was present for days to first flowering among the genotypes of ridge gourd [Rahman *et al.* (1990)]. They mentioned that days to staminate and pistillate flowering ranged from 35 to 37 days and 37 to 43 days, respectively.

They also mentioned that days to staminate flowering was earlier than days to pistillate flowering in the genotypes of ridge gourd studied [Rahman *et al.* (1990 and 1991)].

Rashid (1993) mentioned that the flowering in ash gourd starts between 45 to 50 days after sowing.

Flowering in cucurbits normally starts in about 40 to 45 days after sowing depending on the weather conditions reported by Seshadri (1986).

Staminate and Pistillate flower opening node

Krishna *et al.* (1989) reported that in ridge gourd, the number of node at which first staminate and pistillate flowers opened was an average of 7 to 16.

CHAPTER I

INTRODUCTION

Vegetables are rich and cheaper source of vitamins and minerals. It grows in Bangladesh in 0.195 million hectares of land which is only about 1% of the cultivated area (BBS, 1998). Winter vegetables were grown in 60.12% of the area while 39.88% area were covered by summer vegetables in 1996-97 (BBS, 1998). So, the distribution of the land for vegetable cultivation is not even throughout the year. The annual production of vegetable is 1.29 million metric tons in 1996-97 (BBS, 1998). Per capita consumption of vegetable in Bangladesh is about 50g/day which is the lowest among the countries of South and South East Asia (Rekhi, 1997). But the daily requirement is 300g per capita (BARI, 1991). There is a big gap between the need and supply of vegetable in Bangladesh. Hence, improvement of vegetable crops should be done to meet up the increasing demand.

In sponge gourd, the node number of first pistillate flowers opened ranged from 8 to 20, noted by Arora *et al.* (1983).

Hamid *et al.* (1989) mentioned that the first staminate flower appeared within the node order of 10 to 13 (1st year) and 9 to 15 (2nd year) in same ash gourd genotypes but for the remaining test lines of the study the node order was 22 to 28 in the 1st year and 23 to 31 in the 2nd year.

Rashid (1993) reported that the number of node at which first staminate and pistillate flowers opened ranged from 20 to 30.

Prasad *et al.* (1990) founded in pointed gourd that the first flower appeared at 5th to 18th node based on varieties.

Floral morphology of different snake gourd genotypes

Rice *et al.* (1992) reported in snake gourd that the unisexual flowers were axillary, white and up to five cm in diameter, staminate flowers were

borne on long raceme but pistillate flowers were singly. The flowers had frilled edges and the inner surface of the petals and the ovary were hairy.

Rashid (1976) reported that the flower of pointed gourd is white in colour, 1.5 to 2.0 inches in diameter, each comprised of five sepals and five petals. Staminate flower comprises of three stamens.

Prasad *et al.* (1990) reported in pointed gourd that the ovary breadth varied from 0.4 to 0.7 cm.

Bhandari (1979) noted that ridge gourds are monoecious plants with staminate and pistillate flowers. Staminate flowers are solitary. The flowers are yellow or white in colour and short or long pedicellate. Calyx comprises of five, united sepals. Corolla consists of five petals. Stamens are three in number. Ovary is inferior, stigma are three in number.

Rashid (1993) reported in ash gourd that the flowers are monoecious with staminate and pistillate types. Corolla is composed of five free petals

and the calyx consist of five sepals. There are three anthers in staminate flowers. Three stigmas are present on style.

Rashid (1993) noted that sponge gourd are monoecious with staminate and pistillate flowers in the same plant. The flowers were larger, short or long pedicellate. Calyx comprised of five sepals in both staminate and pistillate flowers. Corolla consisted of five separate petals.

Rashid (1993) reported that the calyx of the ridge gourd comprises of five sepals. Stamens are three in number.

Time of anthesis and anther dehiscence

Alam (1997) reported in pointed gourd that anthesis of both staminate and pistillate flowers began at 6:00 to 7:00 pm but completed in staminate flower within 8.30 to 9.30 pm and in pistillate flower within 9: 00 to 10: 00 pm.

Bhandari (1979) reported on floral biology in ridge gourd that anthesis starts from 4 pm and continues till 8 pm.

Seshadri (1986) reported in pointed gourd that anthesis takes place during night.

Alam (1997) reported in pointed gourd that the anthers were found to start dehiscence at 4:30 pm to 5:30 pm, one to two hours before anthesis and the release of pollen grains continued for the next seven to eight hours.

Begum (1998) noted in sponge gourd that the anthers of staminate flowers of both Japanese and local genotypes started to dehiscence five hours before anthesis and completed at the time of anthesis.

Pollen viability and Duration of stigma receptivity

Randhawa *et al.* (1982) reported in ash gourd that the pollen grains were round with three germpores.

Begum (1998) observed in sponge gourd that the pollen viability percentage of different genotypes was around 99.00.

Rahman (1996) reported in ash gourd that 91.5 to 97% pollen viability was found after 12 hours of anthesis.

Bhandari (1979) reported in ridge gourd that stigma became receptive two to three hours before anthesis and it continued 36 hours after anthesis.

Yield contributing characters

Shanmugavelu (1989) noted in snake gourd that the variety Co. 1 produces 160 to 180 cm long fruit with white stripes, weighing 500 to 750 g. Variety Co. 2 bears short fruit (30 cm length), light greenish white. The fruits of MDU 1 are green with white stripes and medium in length (70 cm). The mean fruit weight of PKM 1 is 500 to 800 g with a mean length of 155 to 170 cm.

Katyal (1977) reported in snake gourd that the fruits are 60 to 90 cm long. The yield varies from 15, 000 to 25,000 kg per hectare.

Shanmugavelu (1989) reported in snake gourd that variety Co. 1 gives a yield of 18 tons per hectare with a crop duration of 135 days. Variety Co. 2 yields 35 tons per hectare, with a crop duration ranging from 105 to 120 days. MDU 1 yields 32 tons per hectare with a crop duration of 143 days. PKM 1 gives a mean yield of 24 tons per hectare.

CHAPTER III

MATERIALS AND METHODS

This experiment was carried out at the experimental farm of the Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur located at 24^0 $0'$ North latitude and 90^0 $25'$ East longitude during January to June, 1999.

Plant materials used

Six different fruit genotypes of snake gourd were used to study the different aspects of floral biology (Table 1).

Table 1. Fruit characteristics of six genotypes of snake gourd (SG)

Genotype	Fruit characteristics
SG 01	Deep green , Short fruit
SG 02	Deep green , Intermediate fruit
SG 03	Pale green , Short fruit
SG 04	Pale green , Intermediate fruit
SG 05	White , Short fruit
SG 06	White , Intermediate fruit

The seeds were supplied by the Department of Genetics and Plant Breeding, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur.

Raising of seedlings

Seeds of all six fruit genotypes were first allowed to soak water for 48 hours. The soaked seeds were then transferred in polyvinyl pot containing a mixture of soil and well decomposed cowdung (1 : 1) on 3rd February, 1999.

Land preparation

The experimental plot was well drained high land. Land preparation was done by three to four ploughing and cross ploughing followed by laddering to have a good tilth. Final land preparation was done one week before the pit preparation.

The raised beds with a width of two meter were prepared. One meter wide drain between two adjacent beds and 0.5m wide drain surrounding the

entire experimental field were made. On the raised bed, pit were prepared. The pits were left open for one week prior to transplanting.

Manuring and fertilization

Manure and fertilizers at the following rates were applied in the experimental field as per recommendation of BARI(1991).

Manure or Fertilizer	**Kg per ha**
Cowdung	5000
Urea	125
TSP	80
MP	60
Gypsum	80
Zinc oxide	8

Total of cowdung, half of TSP and MP were applied in the field. Remaining TSP and MP and whole of gypsum and Zinc oxide and half of

urea were applied in the pit. Remaining Urea was applied as side dressing after 40-50 days of seed sowing.

Layout and Planting pattern

Sixty pits were prepared for transplantation of ten seedlings of each of six different genotypes of snake gourd. One seedling was transplanted in each pit.

Transplanting

The seedlings were transplanted in the pits of experimental field (after 10 to 15 days of seed sowing in polyvinyl pots) on 18th February 1999. A spacing of 2.0m between plants on each bed was maintained. The plants were watered immediately after transplanting. The soil around the base of each seedlings was pulverized after the establishment of seedlings.

After care

Bamboo sticks support was given to the growing plants and allowed them to creep on a rope nets. Weeding was done to break the soil crust and to

keep the plots free from weeds. Irrigation was given to the plants in pits as and when necessary.

Plant protection measures

Proper control measures were taken against red pumpkin beetle and fruit fly at harvesting stage. Adult red pumpkin beetle was controlled through hand picking at seedling stage. Diptarex 50 EC at the rate of 1.5 ml/l water was sprayed at 15 days interval at the time of green fruit emergence. Trap made by 10-15 drops of diptarex 50 EC per 100g crushed sweet gourd was placed in earthen pots in 1m height from the ground with bamboo sticks at eight meter interval (BARI , 1991).

Data collection

The following observations were recorded in this study:

Days to appearance of staminate and pistillate flowers bud: Number of days required for appearance of flower bud after transplanting was recorded.

First staminate and pistillate flowering node number: The number of node where first staminate and pistillate flower bloomed was recorded. The cotyledonary leaves were considered as node zero.

Days to first flowering: The number of days required for first flowering after transplanting was recorded.

Floral morphology : Observations on floral morphology were recorded from ten randomly selected open flowers from both staminate and pistillate types of each genotype.

Time of anthesis : Anthesis time of the day in staminate and pistillate flowers and their duration of blooming in each genotypes was recorded.

Time of anther dehiscence : The starting time of the day for anther dehiscence and duration of full dehiscence in each genotype was recorded.

Stigma receptivity and pollen viability : Stigma receptivity was determined by pollinating 10 flowers. For determining the duration of receptivity of stigma, ten flowers were pollinated 24, 15, 5 hours before of anthesis, at anthesis and 2, 14, 24, 27, 33 hours after anthesis in both way. The effect of such pollination on fruit set was noted.

For determination of viability of pollen grains, staminate flowers were bagged before 12 hours of opening. The fresh pollen grains and 5, 7, 14, 19, 20, 24 hours aged pollen grains were applied to the stigma before 24, 15, 5 hours of anthesis, at anthesis and 2, 14, 24, 27, 33 hours after anthesis. Selected pistillate flowers for artificial pollination were bagged in order to avoid foreign pollen before 12 hours of anthesis. Ten flowers were used in each case. The effect of such pollination on fruit set was noted.

Pollen viability and pollen diameter measurement : Flowers at or just before dehiscence of their anthers were collected from the field. Mature pollen grains were taken on a slide in a drop of aceto- carmine solution (1% v/v) and was covered with a cover slip. Then the slide was observed under a

light microscope. Round and deeply stained pollen grains were considered as viable and shriveled, non -stained or poorly stained pollen grains were recorded as non viable (Latif, 1998). The percentage of viable pollen was determined from ten randomly focused fields of a microscope. The diameter of 10 pollen grains of each of six different genotypes of snake gourd were measured with the help of micrometer using a compound microscope.

Duration of pollen viability and pollen germination : Pollen grains of 5, 12 and 24 hours aged were collected from the field and examined with aceto carmine (1%) under microscope (Latif, 1998). At the same time number of germinated pollen grain were also estimated. Data were recorded from 10 focused field.

Fixation and preservation of pistil for pollen germination, stigma receptivity and pollen tube growth behaviour

Flowers were collected after 8, 10, 12 and 20 hours of pollination. Only the ovary with the style and the stigma were placed in acetic- alcohol (1 part acetic acid : 3 part ethanol v/v) after removal of petals and sepals and the samples were kept at room temperature. After 24 hours, the samples were

removed from the fixative and adhered fixative with the samples was removed by placing them on a tissue paper. Then they were preserved in 70% ethanol at 4^0C in a refrigerator until the samples were observed under microscope(Latif, 1998).

Slide preparation : To prepare the samples for florescent microscopy study, preserved pistils were washed gently with distilled water for two to three times and then heated in 1N NaOH at 60°C for 40 minutes. Then again rinsed with water gently to remove the NaOH and was put in 0.1% aniline blue solution (a fluorescent die) for 15 minutes (Kho and Baer, 1968). One pistil was taken on each slide, covered with cover slip and then slightly tapped.

Observation : The slides were placed under a fluorescent microscope to observe number of total pollen grains adhered on the stigma, germinated pollen, number of penetrated pollen tube in the style and pollen tube growth behaviour. Mean of at least 10 samples were considered.

Study of cross compatibility

Number of cross made: At least 10 pistillate flowers from one genotype was selected for each selected pistillate flower stage for crossing program. Selfing and crossing was done at the same time. The pistillate flower was bagged two to four days before anthesis.

Number of fruit set: Number of fruit sets per plant allowing artificial pollination were calculated. The success and failure of fruit setting were observed by counting the initial flower number and finally developed fruits. The seed number is also counted on each fruit.

Fruit characteristics : The following fruit parameters were recorded :

a. **Fruit length (cm)** - Length of the edible fruits were measured from the top to the bottom just after harvesting.

b. **Fruit diameter (cm)** - Diameter of edible fruits were measured across the middle part of the fruit.

c. **Edible fruit weight (g)** - Edible fruits were weighed just after harvesting.

Number of seeds per fruit : At least 10 ripe fruits of each genotypes were randomly selected and the number of seeds per fruit were counted.

Number of fruit set per plant: Number of fruits set per plant allowing natural pollination were calculated.

Edible maturity and ripening: Ten flowers of each genotype were selected to determine the number of days taken to reach edible fruit size or maturity and its ripening after anthesis.

Yield per plant (kg): Weight of the total number of edible fruits of each individual plant were taken in kg.

CHAPTER IV

RESULTS AND DISCUSSION

Days to appearance of floral bud

The minimum and maximum days required for the appearance of staminate flower was 32.40 and 34.50 in SG 01 and SG 04 respectively and for pistillate flower, it ranged from 35.30 and 44.70 days, after transplanting, in SG 03 and SG 04, respectively. staminate flower bud appeared about 2 to 10 days earlier than the pistillate flower bud in all six genotypes (Table 2).

Rahman *et al.* (1990) noted significant variation for days to first flowering among the genotypes of ridge gourd. They mentioned that days to staminate and pistillate flowering ranged from 35 to 37 days and 37 to 43 days, respectively. Rahman *et al.* (1990, 1991) also mentioned that days to staminate flowering was earlier than days to pistillate flowering in the genotypes of ridge gourd studied. Rashid (1993) mentioned that the

flowering ash gourd starts between 45 to 50 days after sowing. Seshadri (1986) mentioned that flowering in cucurbits normally starts in about 40 to 45 days after sowing depending on the weather conditions.

Staminate and pistillate flower opening node

The earliness of flowering is determined by the node at which first flower appeared. Staminate and pistillate flower appeared in same node in all the six genotypes, but one of them was rudimentary. In this study, the first staminate flower was observed at 13.80^{th} (SG 02) to 17.30^{th} (SG 06) node number and the first pistillate flower at 23.20^{th} (SG 02) to 34.30^{th} (SG 01) node number (Table 3). The staminate flower appeared on the lower node than pistillate flower in all six genotypes.

Krishna *et al.* (1989) reported that in ridge gourd, the number of node at which first staminate and pistillate flowers opened was an average of 7 to 16. Arora *et al.* (1983) observed that the node number of first pistillate flowers opened ranged from 8 to 20 in sponge gourd. Hamid *et al.* (1989) reported that the first staminate flower appeared within the node order of 10

to 13 (1st year) and 9 to 15 (2nd year) in same ash gourd genotypes but for the remaining test lines of the study the node order was 22 to 28 in the 1st year and 23 to 31 in the 2nd year. Rashid (1993) reported that the number of node at which first staminate and pistillate flowers opened ranged from 20 to 30. In pointed gourd, Prasad and Singh (1990) reported that depending on varieties, the first flower appeared at 5th to 18th node.

Days to flower anthesis

Days to opening of first flower did not show considerable variation in staminate and pistillate plants (Table 4). In the present study, among the six genotypes first staminate flower opened in SG 01 (35.60 days) and last was in SG 04 (37.70 days). The anthesis of the pistillate flower was occurred later than the staminate flower. The lowest time required for pistillate flower anthesis was 39.60 days (SG 03) and highest time required was 48.40 days (SG 06).

Akand (1993) noted in ridge gourd that first staminate flower opened within 42 to 46 days and the first pistillate flower opened within 48 to 52

Table 2. Days to appearance of staminate and pistillate flower buds in different snake gourd genotypes

Genotype	Days to appearance of staminate flower		Days to appearance of pistillate flower	
	Range	Mean± SE	Range	Mean± SE
SG 01	29-35	32.40±0.67	39-47	41.30±0.86
SG 02	33-36	34.30±.0.37	36-41	38.70±0.56
SG 03	32-36	33.80±0.42	34-38	35.30±0.45
SG 04	33-36	34.50±0.34	36-40	38.30±0.44
SG 05	31-37	34.00±0.47	42-47	43.60±0.58
SG 06	31-38	34.20±0.43	41-48	44.70±0.73

Table 3. First staminate and pistillate flowering node number in different snake gourd genotypes

Genotype	First staminate flowering node number		First pistillate flowering node number	
	Range	Mean±SE	Range	Mean±SE
SG 01	14-19	16.00±0.49	31-36	34.30±0.52
SG 02	12-16	13.80±0.41	20-25	23.20±0.44
SG 03	13-16	14.40±0.37	22-25	23.50±0.34
SG 04	15-19	17.10±0.41	23-27	25.00±0.37
SG 05	14-19	16.90±0.43	26-31	28.00±0.49
SG 06	15-19	17.30±0.40	27-30	28.80±0.39

days while for hybrids it ranged from 40 to 45 days and 43 to 51 days for staminate and pistillate flower anthesis, respectively.

Floral morphology of different snake gourd genotypes

The morphology of different staminate and pistillate flowers of snake gourd have been presented in Table 5. As staminate and pistillate flowers remained separate in same plant indicated snake gourd as a monoecious plant. The inflorescence of staminate flowers were raceme and pistillate ones were solitary. A range of 9 - 23 flowers was produced in each staminate inflorescence. Staminate and pistillate flowers emerged from the same leaf axil.

The flowers were white in colour and short and long pedicellate. Calyx and corolla comprised of five sepals and five petals respectively. White long hairs were present inside of the each petal. Stamens were three in number and anthers are united. Ovary was hypogynous, stigma three in number and united. Peduncle of female flower was longer than male flower except for SG 02 and SG 04. The length of the peduncle of the staminate flowers varied from 10.39(SG 05) to 13.94 mm (SG 02) and for pistillate flower 8.64mm

(SG 04) to 21.51 mm (SG 01). The petals and the sepals of the pistillate flowers were longer than the staminate flowers in length and width. The length of the stamen, style with stigma and ovary was 15.97 mm (SG 06) to 19.52 mm (SG 05), 14.47 mm (SG 06) to 21.11 mm (SG 05) and 20.95 mm(SG 02) to 30.58 mm (SG 06), respectively. The width and weight of the ovary was 4.01mm(SG 03) to 4.82 mm (SG 06) and 0.23 g (SG 03) to 0.33 g (SG 06), respectively.

Rice *et al.* (1992) reported in snake gourd that the unisexual flowers were axillary, white and up to five cm in diameter, staminate flowers were borne on long raceme but pistillate flowers were singly. The flowers had frilled edges and the inner surface of the petals and the ovary were hairy. Rashid (1976) reported that the flower of pointed gourd is white in colour, 1.5 to 2.0 inches in diameter, each comprised of five sepals and five petals. Staminate flower comprises of three stamens. Prasad and Singh (1990) reported that the ovary breadth varied from 0.4 to 0.7 cm in pointed gourd. Bhandari (1979) noted that ridge gourds are monoecious with staminate and pistillate flowers. Staminate flowers are solitary. The flowers are yellow or

Table 4. Days to anthesis in different snake gourd genotypes

Genotype	Number of days to staminate flower anthesis	Number of days to pistillate flower anthesis
	Mean ± SE	Mean ± SE
SG 01	35.60 ±0.72	45.00 ±0.88
SG 02	37.60 ±0.22	42.80 ±0.61
SG 03	36.90 ±0.43	39.60 ±0.45
SG 04	37.70 ±0.36	42.40 ±0.52
SG 05	37.20 ±0.47	47.50 ±0.52
SG 06	37.20 ±0.63	48.40 ±0.79

Table 5. Floral morphology of different snake gourd genotypes

Genotype	Sex type	Length (mm)						width (mm)		Ovary	
		Peduncle	Ovary	Style with stigma	Filament with anther	Petal	Calyx	Petal	Calyx	Diameter (mm)	Weight (g)
SG 01	Staminate	13.71±0.42			18.84±0.49	14.65±0.38	17.71±0.36	3.43±0.06	2.52±0.04		
	Pistillate	21.51±0.35	30.48±0.32	15.53±0.65		15.52±0.28	19.37±0.49	3.71±0.05	3.10±0.09	4.79±0.03	0.31±0.004
SG 02	Staminate	13.94±0.47			16.81±0.42	14.66±0.30	15.99±0.29	3.40±0.05	2.47±0.04		
	Pistillate	13.48±0.36	20.95±0.28	15.34±0.53		15.47±0.32	18.66±0.56	3.48±0.08	3.06±0.07	4.63±0.04	0.27±0.003
SG 03	Staminate	12.02±0.35			16.94±0.39	11.96±0.29	16.77±0.72	3.18±0.06	2.12±0.04		
	Pistillate	18.94±0.86	23.86±0.40	17.29±0.62		13.97±0.33	18.97±0.52	3.26±0.08	3.50±0.06	4.01±0.04	0.23±0.004
SG 04	Staminate	13.81±0.33			17.97±0.35	14.21±0.44	16.14±0.43	3.16±0.06	2.49±0.05		
	Pistillate	8.64±0.16	29.37±0.28	16.41±0.41		15.08±0.34	20.49±0.52	3.23±0.06	3.54±0.05	4.8±0.04	0.30±0.006
SG 05	Staminate	10.39±0.41			19.52±0.42	13.82±0.38	15.97±0.34	3.39±0.10	2.60±0.09		
	Pistillate	12.41±0.25	29.36±0.33	21.11±0.50		14.98±0.31	20.57±0.49	3.58±0.06	3.21±0.06	4.74±0.04	0.30±0.006
SG 06	Staminate	11.57±0.61			15.97±0.69	12.92±0.31	17.25±0.63	3.23±0.07	2.08±0.04		
	Pistillate	13.01±0.31	30.58±0.29	14.47±0.83		14.00±0.31	21.58±0.45	3.56±0.06	3.10±0.07	4.82±0.04	0.33±0.003

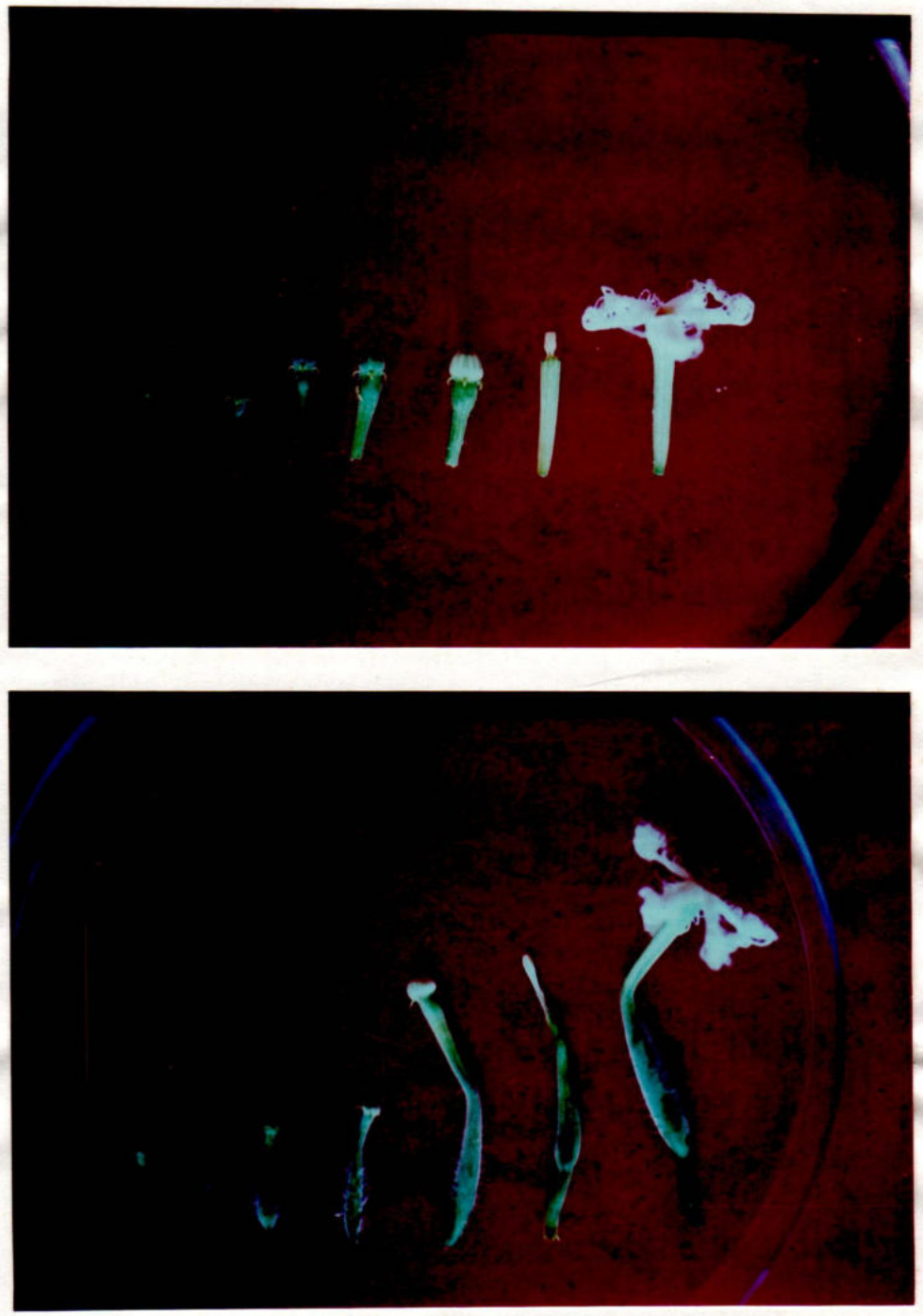

Plate 1 . Flower morphology of snake gourd

a. Top - Staminate flower
b. Bottom - Pistillate flower

white in colour and short or long pedicellate. Calyx comprises of five, united sepals. Corolla consists of five petals. Stamens are three in number. Ovary is inferior, stigmas are three in number. Rashid (1993) reported in ash gourd that the flowers are monoecious with staminate and pistillate types. Corolla is composed of five free petals and the calyx consist of five sepals. There are three anthers in staminate flowers. Three stigmas are present on style. Rashid (1993) noted that sponge gourd is monoecious with staminate and pistillate flowers in the same plant. The flowers were larger, short or long pedicellate. Calyx comprised of five sepal in both staminate and pistillate flowers. Corolla consisted of five separate petals. Rashid (1993) reported that the calyx of the ridge gourd comprises of five sepals. Stamens are three in number.

Time of anthesis

The anthesis period of snake gourd genotypes has been summarized in Table 6. The anthesis of the pistillate flowers took place earlier than the staminate flowers. Anthesis period of different snake gourd genotypes did not differ very much from one genotype to another. The earliest starting of

anthesis of staminate flowers were observed in the genotype SG 05. Within 7 pm to 8 pm, anthesis of staminate flowers of all snake gourd genotypes started and required 19 to 33 minutes for full blooming.

The anthesis of pistillate flowers started from 7 pm to 8 pm and completed their full blooming within the range 1 hours to 2 hours. Among all the genotypes of snake gourd, earliest starting of anthesis of the pistillate flowers was observed in SG 03.

Alam (1997) reported in pointed gourd that anthesis of both staminate and pistillate flowers began at 6 : 00 to 7 : 00 pm but completed in staminate within 8 : 30 to 9 : 30 pm and in pistillate within 9: 00 to 10: 00 pm. Bhandari (1979) reported that the anthesis starts from 4 pm and continues till 8 pm in ridge gourd. Seshadri (1986) reported in pointed gourd that anthesis takes place during night.

Table 6. Anthesis time in different snake gourd genotypes

Genotype	Staminate flower bud		Pistillate flower bud	
	Starting time of anthesis (pm)	Full blooming time (pm)	Starting time of anthesis (pm)	Full blooming time (pm)
SG 01	7.15±0.04	7.37±0.04	7.35±0.06	8.55±0.04
SG 02	7.17±0.04	7.39±0.04	7.38±0.06	9.10±0.05
SG 03	7.21±0.04	7.47±0.05	7.32±0.05	9.02±0.074
SG 04	7.25±0.05	7.44±0.06	7.35±0.06	9.15±0.04
SG 05	7.12±0.04	7.35±0.05	7.39±0.06	9.23±0.05
SG 06	7.20±0.07	7.53±0.07	7.35±0.07	9.09±0.04

Time of anther dehiscence

Anther dehiscence in snake gourd genotypes started before anthesis and completed near about full blooming of flower. The anthers started to dehiscence at 4 pm to 5 pm i.e. about 3 hours before anthesis and completed at 7 pm to 8 pm. The first dehiscence occurred in SG 01 (4 : 15 pm) (Table 7).

Alam (1997) reported in pointed gourd that the anthers were found to start dehiscence at 4 pm to 6 pm, 1 to 2 hours before anthesis and the release of pollen grains continued for the next 7 to 8 hours. Begum (1998) noted in sponge gourd that the anthers of staminate flowers of both Japanese and local genotypes started to dehisce five hours before anthesis and completed at the time of anthesis.

Pollen viability and pollen diameter

Results of viability and diameter of pollens are presented in Table 8. The pollen grains of snake gourd were spherical with three germpores. The

pollen viability percentage of different genotypes was around 99.00 and the highest pollen viability was observed in the genotypes SG 06 (99.11%).

Randhawa *et al.* (1982) reported in ash gourd that the pollen grains were round with 3 germpores. Begum (1998) observed in sponge gourd that the pollen viability percentage of different genotypes was around 99.00.

The largest and smallest diameter of pollen grains were measured in the genotype SG 02 (30.41 μm) and SG 04 (24.80 μm), respectively.

Pollen viability and germination

For the determination of the percentage of pollen viability and germination of different snake gourd genotypes, flowers were bagged 12 hours before anthesis. The results of the pollen viability of the flowers bagged for 5 hours, 12 hours and 24 hours after anthesis in the field and percentage of germinated pollen *in vivo* under similar condition are presented in Table 9. Positive correlation existed between the reduction of the pollen viability of the bagged flowers for different periods after anthesis with increased bagging

Table 7. Starting and completion time of anther dehiscence for staminate flower in different snake gourd genotypes

Genotype	Starting time	Completion time
	Mean ±SE	Mean ±SE
SG 01	4.15±0.07	7.26±0.06
SG 02	4.42±0.06	7.38±0.06
SG 03	4.26±0.10	7.42±0.06
SG 04	4.17±0.04	7.35±0.06
SG 05	4.46±0.07	7.37±0.06
SG 06	4.25±0.07	7.42±0.05

Table 8. Pollen viability and pollen size of different snake gourd genotypes

Genotype	Pollen viability (%)	Pollen diameter (μm)
SG 01	98.97±0.78	30.36±0.46
SG 02	99.01±0.67	30.41±0.41
SG 03	99.07±0.62	26.84±0.61
SG 04	98.86±0.75	24.80±0.51
SG 05	98.29±0.89	27.55±0.51
SG 06	99.11±0.60	27.86±0.61

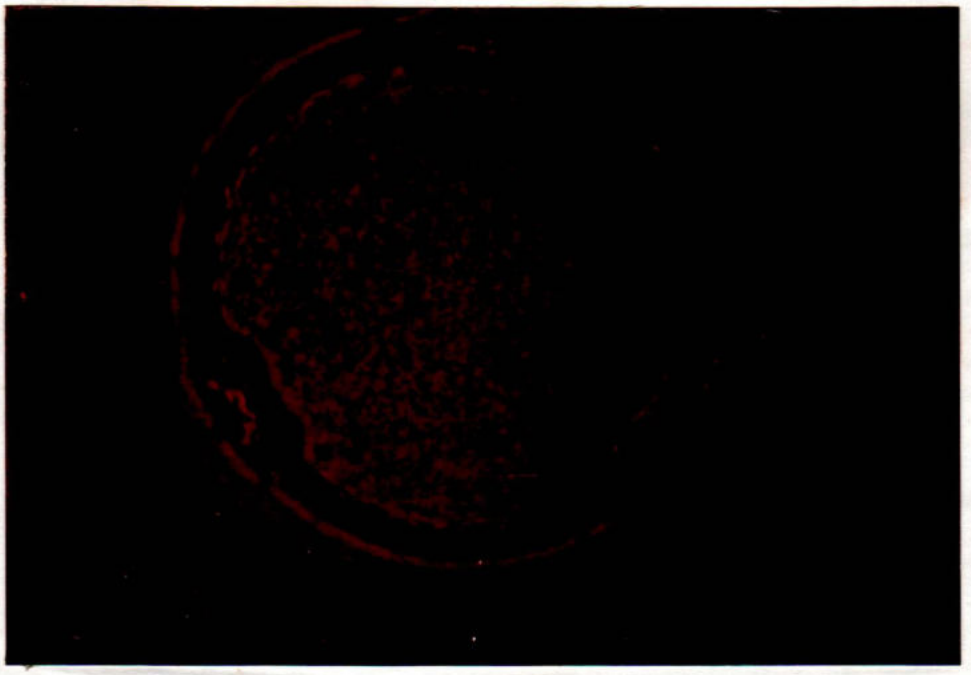

Plate 2. Pollen of snake gourd with three germ pores

time while the percentage of pollen germination *in vivo* was increased with time. After five hours, highest pollen viability percentage was found in SG 04 (97.86%) but after 12 and 24 hours, the highest pollen viability percentage were in SG 03 (94.09%) and SG 01 (82.63%), respectively.

In this study, a certain percentage of pollen grains were found germinated *in vivo*. In the field condition, no pollen was germinated before five hours. After 12 hours of anthesis, the highest percentage (1.60%) of pollen germination *in vivo* was recorded in SG 01. The germination rate was increased to 10.98% in SG 01 after 24 hours of anthesis.

Rahman (1996) reported in ash gourd that 91.5 to 97% pollen viability was found after 12 hours of anthesis.

Duration of stigma receptivity and pollen viability

Fruit setting was taken an index to ensure the duration of stigma receptivity and pollen viability. Pollination with 5h aged pollen just after anthesis produced 100% fruit set indicates highest intensity of receptivity of

Table 9. Pollen viability and *in vivo* pollen germination of different snake gourd genotypes after different time of anthesis

Genotype	Percent pollen viability after			Percent pollen germination after		
	5 hours	12 hours	24 hours	5 hours	12 hours	24 hours
SG 01	97.42±1.10	94.02±1.10	82.63±1.04	0	1.60±0.83	10.98±1.26
SG 02	97.58±1.62	91.82±1.54	76.74±0.93	0	1.19±0.80	10.16±1.31
SG 03	97.35±1.12	94.09±1.28	82.56±1.88	0	1.37±0.70	10.32±1.34
SG 04	97.86±0.89	92.67±1.43	79.06±1.49	0	1.12±0.76	10.07±1.23
SG 05	96.40±1.00	93.34±1.50	80.65±1.43	0	1.08±0.72	9.42±1.10
SG 06	96.19±0.89	94.03±1.35	80.43±1.22	0	1.21±0.81	10.65±1.98

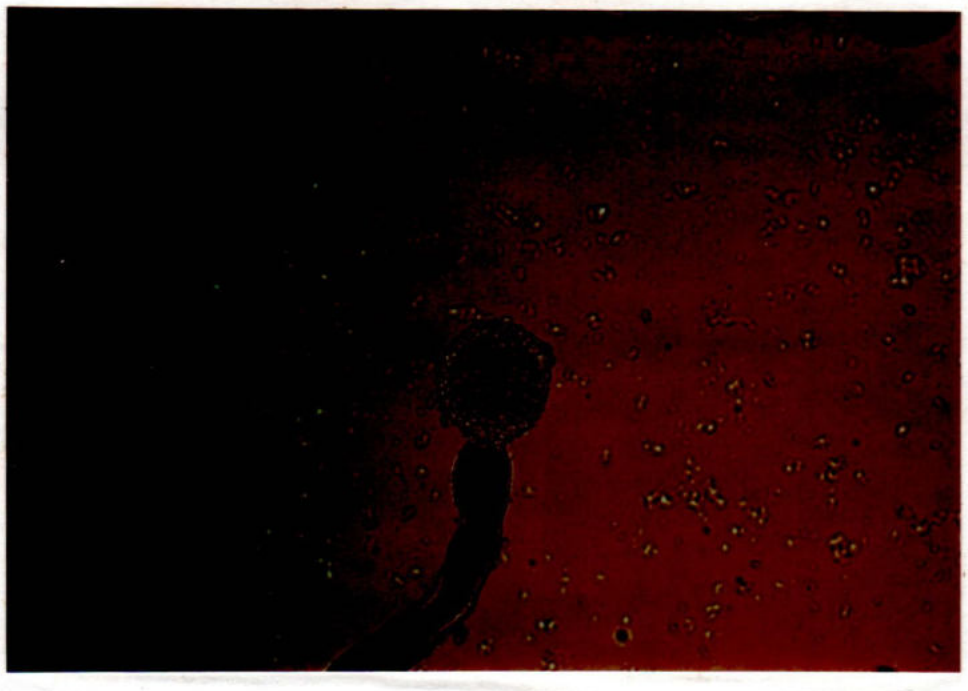

Plate 3. *In vivo* pollen germination of snake gourd

stigma (Table 10). Pollinating stigma before 15h of anthesis with 14 hours aged pollen resulted in 20% fruit set in SG 04 but pollination before 24 hours of anthesis with 5 hours aged pollen failed to set fruit indicating that stigma became receptive about 15hours before anthesis.

Twenty four hours aged pollen used to pollinated pistillate flower at before five hours of anthesis, produced 40% fruit setting and fresh pollen produced no fruit setting with same aged pistillate flower indicated that stigma was receptive before five hours of anthesis but pollen did not able to fertilize caused no fruit setting.

At the time of anthesis, pollination was done with five hours aged pollen produced 100% fruit setting but after 24 hours of anthesis, pollination was done with same aged pollen produced 45% fruit setting. Such reduction of fruit setting indicated the lower trend of stigma receptivity with progressing of time after anthesis.

Pollination of pistils after 27 hours of anthesis with 20 hours old pollen, appeared viable under microscope, resulted in 10% fruit setting but pollination after 33 hours of anthesis with 14 hours old pollen, younger than the 20 hours old pollen, resulted no fruit setting indicated that the stigma remained receptive that the stigma remained receptive 27 hours after anthesis. Time of pollination had no fruitful effect on fruit set in snake gourd.

When pollination was done with 24 hours aged pollen before 5 hours of anthesis, 40% fruits were set indicated that the pollen was viable upto 24 hours. It was also viable under microscope about 79.06%. Bhandari (1979) reported in ridge gourd that stigma became receptive two to three hours before anthesis and it continued 36 hours after anthesis.

Pollen germination, their penetration through the style and pollen tube growth behaviour

The number of adhered pollen, germinated pollen and penetrated pollen tubes have been presented in Table 11. Self and crossing were done with different aged pollen and the pollinated stigmas were collected at different intervals to observe the above mentioned characteristics. No pollen grain was

Table 10. Influence of pistil, pollen and time of pollination on fruit set in different snake gourd genotypes

Genotype	Stage of pistillate flower	Pollen source	Age of pollen	Time of pollination	Fruit set (%)
SG 04	24h before anthesis	Self / Cross	5h	9.15pm	0
	15h before anthesis	Self / Cross	14h	6.15am	20
	5h before anthesis	Self / Cross	Fresh	4.15pm	0
	5h before anthesis	Self / Cross	24h	4.15pm	40
	At anthesis	Self / Cross	5h	9.15pm	100
	2h after anthesis	Self / Cross	7h	11.15pm	100
	14h after anthesis	Self / Cross	19h	11.15pm	55
	24h after anthesis	Self / Cross	5h	9.15pm	45
	27h after anthesis	Self / Cross	20h	12.15am	10
	33h after anthesis	Self / Cross	14h	6.15am	0

found germinated on stigma, when pollinated pistils were collected after 8 hours of pollination and no pollen tube was found in the style, when pollinated pistils were collected after 10 hours of pollination. The pollinated pistils collected after 12 hours of pollination, showed 151.00 pollen grains adhered and 48.30 pollen tubes penetrated into the style. The 24 hours old pistils pollinated with 5 hours old pollen showed lower number of adhered pollen grains on stigma, pollen germination on stigma and pollen tube in style (135.6, 64 and 25.5, respectively). It represents that stigma receptivity reduces with the time and declined the ability of fruit set (out of 20 pollinated pistils 9 fruits set).

Higher number of adhered pollen grains were observed on the stigma while collecting the pistil pollinated before five hours of anthesis with 24 hours old pollen than the stigma pollinated before 15 hours of anthesis with 14 hours old pollen, both pistils were collected after 20 hours. Higher number of adhered pollen on the stigma may be one of the factor for higher number of fruit setting.

Table 11. Mean number of pollen grains adhered per stigma, number of germinated pollen and penetrated pollen tubes in the style of snake gourd

Genotype	Stage of pistillate flower	Pollen source	Age of pollen at pollination	Pollen tube growth behaviour				Fruit set	
				Age of collected pistillate flower	Number of pollen grain adhered/ stigma	Number of germinated pollen	Number of penetrated pollen tube in the style	Number of pistil, pollinated for fruit set	Number of fruit set
SG 04	At anthesis	Self / Cross	5h	8	185.7±7.08	0	0	20	20
		Self / Cross	5h	10	211.2±9.09	106.2±9.51	0	20	20
		Self / Cross	5h	12	151.00±11.72	83.50±6.75	48.30±5.60	20	20
		Self / Cross	5h	20	177.10±23.62	101.90±10.45	61.10±6.14	20	20
	5h before anthesis	Self / Cross	24h	20	120.10±11.60	77.80±8.83	41.70±5.25	20	8
	15h before anthesis	Self / Cross	14h	20	87.50±14.40	56.11±10.29	31.20±9.23	20	4
	24h after anthesis	Self / Cross	5h	20	135.6±5.46	64.00±2.20	25.5±1.28	20	9

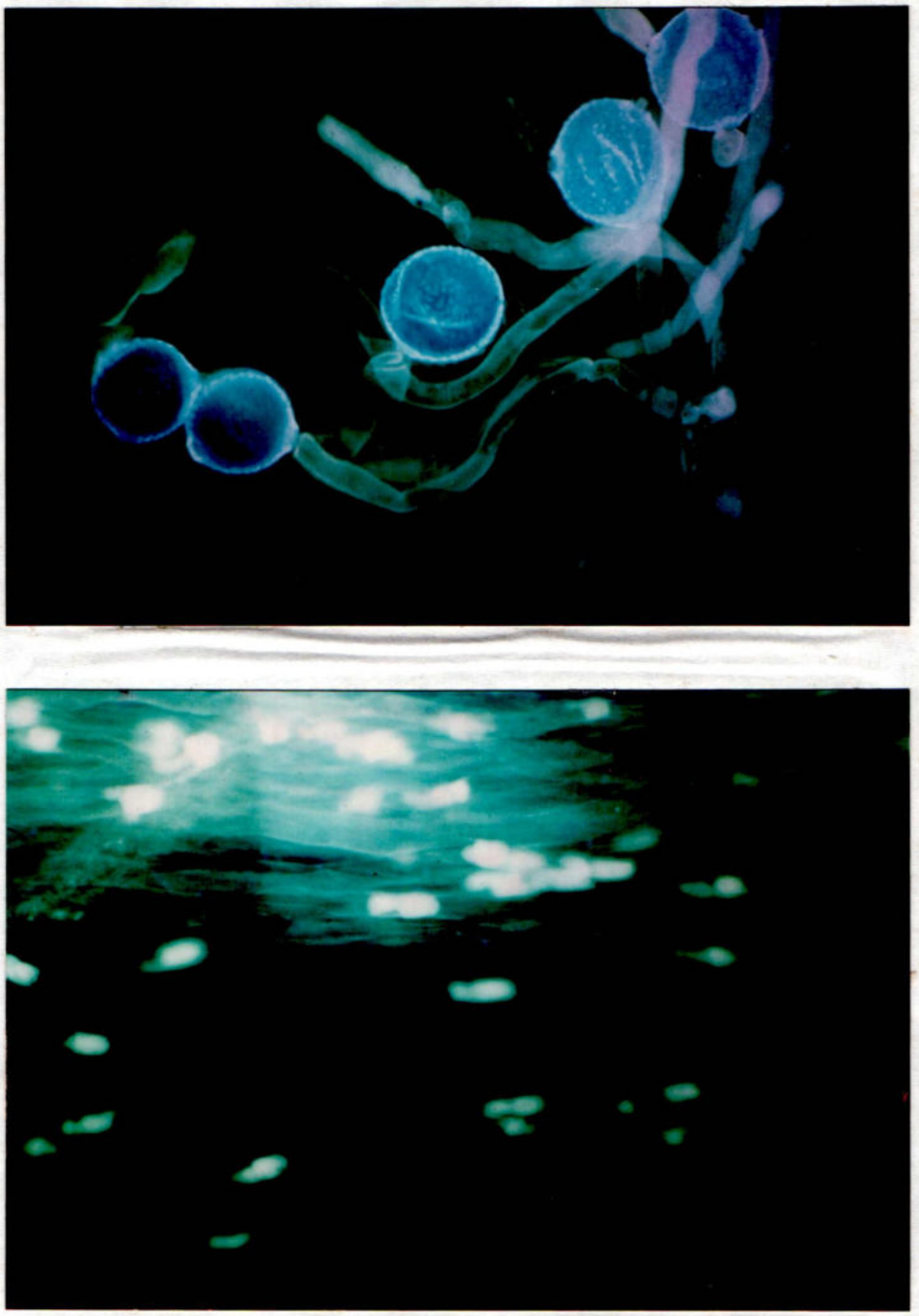

Plate 4. Pollen tube growth behaviour in the pistils of snake gourd

a . Top - Germinated pollen grains
b . Bottom - Penetrated pollen tube in the style

Cross compatibility

Fruit setting and seed development were taken as index to assess cross compatibility. Table 12 represents the fruit and seed setting ability of a particular genotype. At the time of anthesis, both in self and cross pollination, 100% fruits were set but before 5 hours of anthesis, more fruit was set in cross pollination than self pollination. Seeds setting per fruit was also higher in cross pollination. When pollination was done after 14 hours and 24 hours of anthesis, higher number fruits and seeds were set due to cross pollination than self pollination. Such results showed that the genotype SG 04 was more cross compatible than self compatible.

Fruit characteristics

Results of fruit length, diameter and weight of different snake gourd genotypes have been shown in Table 13.The highest length , diameter and weight were observed in SG 06, SG 02 and SG 02, respectively. The length of the fruit varied from 21.35 cm to 41.05 cm and diameter ranged from 37.98 mm to 50.33 mm. There was a big gap between the highest individual fruit weight (246.92 g) and the lowest individual fruit weight (132.47 g).The

Table 12. Fruit and seed setting in one genotype of snake gourd after cross and self pollination

Pistillate flower	Pollen source	Mode of pollination	Time of pollination	Number of fruit set	Fruit set (%)	Seeds per Fruit Mean ±SE
SG 04	SG 02/ SG 04	Self	15h before anthesis	1 (10)	10	25.90±1.16
		Cross	15h before anthesis	3(10)	30	44.10±1.03
		Self	5h before anthesis	3(10)	30	49.30±1.14
		Cross	5h before anthesis	5(10)	50	58.40±1.02
		Self	At anthesis	10(10)	100	70.10±1.20
		Cross	At anthesis	10(10)	100	72.20±1.06
		Self	2h after anthesis	10(10)	100	71.10±1.00
		Cross	2h after anthesis	10(10)	100	72.80±1.04
		Self	14h after anthesis	5(10)	50	55.30±1.37
		Cross	14h after anthesis	6(10)	60	57.90±1.12
		Self	24h after anthesis	4(10)	40	38.90±1.22
		Cross	24h after anthesis	5(10)	50	51.50±1.15
		Self	27h after anthesis	0(10)	0	
		Cross	27h after anthesis	2(10)	20	34.60±1.65

highest number of seeds per fruit was observed in the genotypes SG 02 (60.40) and lowest in SG 05 (32.60). The range of the 100 seed weight was 17.45 g to 30.73 g.

Shanmugavelu (1989) noted in snake gourd that the variety Co. 1 produced 160 to 180 cm long fruit with white stripes, weighing 500 to 750 g. Variety Co. 2 produced short fruit (30 cm length), having light greenish white colour. The fruits of MDU 1 were green with white stripes and medium in length (70 cm). The mean fruit weight of PKM 1 was 500 to 800 g with a mean length of 155 cm to 170 cm.

Yield contributing characters

Yield contributing characters of different snake gourd have been presented in Table 14. The range of days taken to edible fruit maturity after anthesis was 6.6 (SG 01) to 8.6 (SG 06). The minimum and maximum days required to fruit ripening was 30.40 (SG 05) and 42.30 (SG 02) respectively. The number of fruits per plant varied in different snake gourd genotypes. The highest number of fruit was observed in SG 03 (40.80) and the lowest was in

SG 01 (32.00). A wide range of yield ability was observed and the highest was for SG 06 (8.86 kg) while lowest was for SG 01 (4.42 kg).

Katyal (1977) reported in snake gourd that the fruits are 60 to 90 cm long. The yield varies from 15, 000 to 25,000 kg per hectare. Wide range of yielding ability in snake gourd was also reported by Shanmugavelu (1989), confirming the present findings.

Table 13. Length , diameter and weight of single fruit at edible stage for different snake gourd genotypes

Genotype	Length (cm)	Diameter (mm)	Weight (g)	No. of seeds per fruit	100 seed weight (g)
SG 01	21.35	39.34	137.10	46.70	30.43
SG 02	38.40	50.33	246.92	60.40	27.69
SG 03	24.35	37.98	132.47	43.20	17.45
SG 04	38.05	40.37	210.50	55.30	24.17
SG 05	25.05	41.95	144.95	32.60	30.73
SG 06	41.05	42.60	231.42	34.70	22.84

Table 14. Yield and yield contributing characters of different snake gourd genotypes

Genotype	Number of fruit set per plant	Days to edible fruit maturity after anthesis	Days to fruit ripening	Yield per plant (kg)
SG 01	32.00	6.6±0.22	41.40±0.79	4.42
SG 02	34.40	8.4±0.16	42.30±0.70	8.52
SG 03	40.80	7.4±0.16	40.20±0.55	5.41
SG 04	38.70	8.3±0.15	40.90±0.72	8.22
SG 05	32.80	8.4±0.16	30.40±0.52	4.75
SG 06	38.30	8.6±0.16	32.50±0.48	8.86

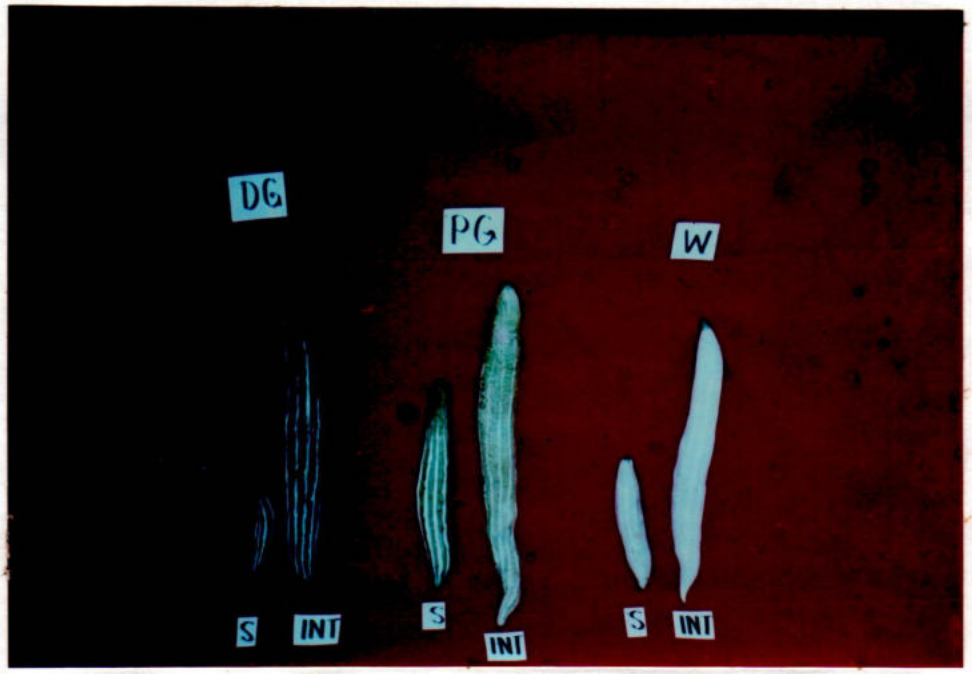

Plate 5. Fruit size and shape of different snake gourds

CHAPTER V

SUMMARY

An investigation was carried out at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh with six snake gourd genotypes to study their floral biology with a view to collect information to be needed for the development of improved varieties.

Study revealed that the staminate flowers appeared in raceme inflorescence but pistillate flowers in solitary. Both types of flowers emerged from the same leaf axil but one of them was rudimentary. The flowers were white coloured with short and long pedicellate. Calyx and corolla were five partite, stamen and stigma were three in number and united. In general, peduncle of pistillate flower was longer than the staminate flower. The petals and sepals of the pistillate flower were larger than the staminate flower in

length and width. Staminate flowers appeared earlier than the pistillate flowers.

The range for days to appearance of staminate flower was 32 to 35 days and for pistillate flower, 35 to 45 days. The first staminate flower appeared at node number 14^{th} to 17^{th} and for pistillate flower it was 23^{th} to 35^{th}. Days to opening of first flower showed no considerable variation in staminate and pistillate flower. The anthesis of the pistillate flower required more days than the staminate flower; 35 to 38 days needed to open the staminate flower and 39 to 49 days for the pistillate flower. The anthesis of the pistillate flowers took place earlier than the staminate flowers. Anthesis period of the different genotypes did not differ very much from one genotypes to another. Anthesis of all staminate flowers of all snake gourd genotypes occurred within 7 to 8 pm and it took 19 to 33 minutes for full blooming. The anthesis of pistillate flowers started from 7 pm to 8 pm and completed their full blooming within the range 80 to 124 minutes. The staminate and pistillate sex ratio was 143.79: 1.

Anther dehiscence in all snake gourd genotypes started before anthesis and completed near about at full blooming of flower. The anthers started to dehiscence at 4:15 to 4 : 46 pm *ie* about three hours before anthesis and completed at 7 to 8 pm. The pollen grains of snake gourd were spherical with three germpores. The viability percentage of fresh pollen of different genotypes were around 99.00. The range of the pollen grain diameter was 24.80 to 30.41 µm. After anthesis, the viability of pollen reduced while the pollen germination was increased with time. The percentage of pollen viability after 5, 12 and 24 hours of anthesis were more than 96, 91 and 76. *In vivo*, no pollen was germinated before 5 hours, more than 1.08% pollen was germinated after 12 hours of anthesis and it was more than 9.42% after 24 hours of anthesis.

The stigma became receptive about 15 hours before anthesis. The highest intensity of receptivity of stigma was at anthesis period. After anthesis, the stigma remained receptive up to 27 hours. Cent percent fruit was set when pollination was done at the time of anthesis.

Just after 8 hours of pollination, no pollen grain was found germinated on the stigma and just after 10 hours, no pollen tube was found in the style. When pollination was done with five hours aged pollen, more pollen grains adhered on the stigma, germinated pollen and penetrated pollen tube in the style was found at the time of anthesis than 24 hours after anthesis.

Pollinating before 5 and 15 hours of anthesis and after 14 and 24 hours of anthesis with same aged pollen, higher number of fruit and seeds were set due to cross pollination than self pollination. This showed that the genotype SG 04 was more cross compatible than self compatible.

The length and diameter of the fruit varied from 21 to 41 cm and 38 to 51 mm respectively. Wide range of variations were observed among the individual fruit weight. The highest was (246.92 g) and lowest was 132.47 g. A range of 6 to 9 days required for edible fruit maturity. The minimum days required to fruit ripening were 30.40 and the maximum were 42.30. The number of fruit per plant varied with different snake gourd genotypes. The highest number of fruit was observed in SG 03 (40.80) and lowest was in SG 01 (32.00). The mean fruit yield per plant ranged from 4.42kg (SG 01) to 8.86kg (SG 06).

CHAPTER VI

CONCLUSION AND RECOMMENDATION

The investigation revealed some new information which lead to draw a worth conclusion and recommendation for substantial improvement of snake gourd.

Anthesis of pistillate flower of all genotypes took place between 9 to 10 pm and dehiscence of anther took place about 3 hours before anthesis *ie* 4 pm to 5 pm.

At anthesis, pollen viability was more than 98%. More than 9% pollen was germinated *in vivo* after 24 hours of anthesis.

Stigma became receptive 15 hours before anthesis and receptivity continued upto 27 hours after anthesis. Therefore, crossing may be effective within this period. Pollination may be effective at any time of the day.

Pollen germination on the stigma took place within 10 hours after pollination. For maintaining the genetic purity, pistillate flowers should be bagged before 24 hours of anthesis to 33 hours after anthesis.

As the genotype SG 04 Showed more cross compatible than self compatible, so, there is a wide scope to develop hybrid variety.

CHAPTER VII

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Appendix I. Nutrient values of snake gourd edible fruit (*Trichosanthes cucumerina* L.)

Constituent	Per 100 g edible portion
Water (%)	95.00
Protein (g)	0.50
Carbohydrate (g)	3.40
Energy (k - ca)	18.00
Carotene (IU)	160.00
Vitamin B_1 (mg)	0.04
Vitamin B_2 (mg)	0.06
Niacin (mg)	0.30
Vitamin C (mg)	5.00
Calcium (mg)	36.00
Iron (mg)	0.60

Source : Rashid, M. M. 1993. Sabjibijnan

Appendix II . Weather data of the experimental Station , Bangabandhu Sheikh Mujibur Rahman Agricultural university, during January 1999 to June 19999

Year	Month	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
		Max.	Min.	Max.	Min.	
1999	January	27.9	10.3	69.0	56.0	00
	February	34.0	10.6	72.2	54.9	00
	March	37.0	14.5	77.9	48.9	00
	April	38.5	21.4	77.8	69.8	0.0327
	May	37.8	21.0	79.9	67.0	12.23
	June	35.4	24.4	78.0	68.0	20.85

Plate 5. Fruit size and shape of different snake gourds

Plate 2. Pollen of snake gourd with three germ pores

Plate 1 . Flower morphology of snake gourd

a. Top - Staminate flower
b. Bottom - Pistillate flower

Plate 4. Pollen tube growth behaviour in the pistils of snake gourd

a . Top - Germinated pollen grains

b . Bottom - Penetrated pollen tube in the style