GLADIOLUS (*Gladiolus grandiflorus* L.) SCENARIO AND ITS IMPROVEMENT THROUGH INTERVARIETAL HYBRIDIZATION IN BANGLADESH

BY

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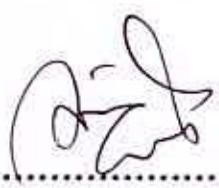

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CERTIFICATE

This is to certify that thesis entitled, "**GLADIOLUS (Gladiolus grandiflorus L.) SCENARIO AND ITS IMPROVEMENT THROUGH INTERVARIETAL HYBRIDIZATION IN BANGLADESH**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in GENETICS AND PLANT BREEDING**, embodies the result of a piece of bona fide research work carried out by **MD. DELUAR HOSSAIN**, Registration 07-02650 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: June, 2009
Dhaka, Bangladesh

.....

Professor Dr. Md. Shahidur Rashid Bhuiyan
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Dedicated
to
My late Parents

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LIST OF ABBREVIATIONS

ABBREVIATIONS	FULL WORD
SAU	Sher-e-Bangla Agricultural University
BARI	Bangladesh Agricultural Research Institute
HRC	Horticulture Research centre
No.	Number
%	Percentage
TSP	Triple Super Phosphate
MP	Murate of Potash
pH	Negative logarithm of hydrogen ion concentration (-log[H^+])
et al.	And others
etc.	etcetera (means and the rest)
SAHDOT	Society And Human Development organization, Tangail
Fig.	Figure
g	Gram
cm	Centimeter
RH	Relative Humidity
viz.	Namely
J.	Journal
GL-21	Gladiolus-21(White colored genotype)
GL-04	Gladiolus-04(Yellow colored genotype)
GL-16	Gladiolus-16(Orange colored genotype)
GL-12	Gladiolus-12(Violet colored genotype)
GL-22	Gladiolus-22(Red colored genotype)
Av.	Average
F_1	First filial generation
AEZ	Agro-ecological zones
EC	Emulsifyable Concentrate
DAS	Days After Sowing

ABBREVIATIONS	FULL WORD
@	At the rate of
ha	Hectare
ml	Milliliter
MT	Moderately Tolerant
S	Susceptible
CV	Cultivar
t	Ton
kg	Kilogram

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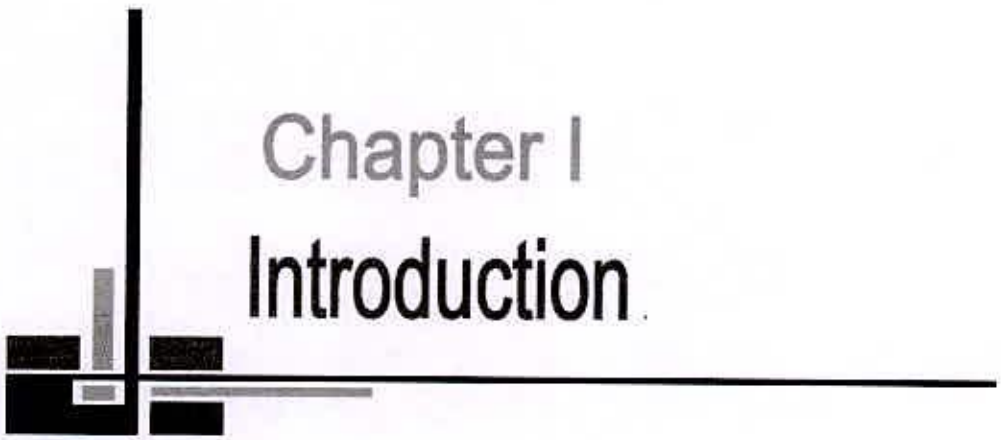
GLADIOLUS (*Gladiolus grandiflorus* L.) SCENARIO AND ITS IMPROVEMENT THROUGH INTERVARIETAL HYBRIDIZATION IN BANGLADESH

BY

MD. DELUAR HOSSAIN

ABSTRACT

The present experiment was carried out during the period from November'2008 to October' 2009 to investigate the morphology, market demand, and production of hybrid seed and % of hybrid seed germination in gladiolus. The experiment included five gladiolus genotypes. The results indicated the existence of wide variability among the genotypes on their morphological characters along with yield and yield attributes. Genotypes varied from 59.63 cm to 92.05 cm and 25.66 cm to 47.30 cm in spike length and rachis length, respectively. Number of flower was the highest in white (14.25) and the lowest in orange (8.40) genotype. Number of cormel and cormel weight of the genotypes significantly differed and ranged from 25.70 to 43.20 and 5.20g to 6.40 g, respectively. The price of gladiolus flower varied from genotype to genotype and the demand and price of gladiolus flower also varied in different month of the year, different days of the week and different special days of the year. Considering crossing parameters, variation were observed for length of capsule (cm), breadth of capsule and thousand seed weight (g). Mean data indicated that all the crosses produced gladiolus true seed i.e. F_1 seed. The number of seeds per capsule ranged from 15.08 to 38.40. The highest number of seed per capsule was produced by the cross Yellow × Red (38.40) while the lowest number of seed per capsule was produced by the cross Violet × Red (15.08).



Chapter I

Introduction

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) belongs to the family Iridaceae and is herbaceous perennial. The name gladiolus has been derived from the Latin word gladius, meaning a sword as it has sword shaped leaves (Lewis, et al., 1872). So, gladiolus (*Gladiolus grandiflorus* L.) popularly known as sword lily, is an ornamental bulbous plant native to South Africa (Sharma and Sharma, 1984). It is now grown as a cut flower very widely in the continent of Europe, particularly in Holland, Italy and Southern France (Butt, 2005). It was introduce into cultivation towards the end of the 16th century (Innes, 1985).

In Bangladesh gladiolus was introduced around 1992 from India (Mollah *et al.*, 2002). It has recently become popular in Bangladesh and its demand in this country is increasing day by day. The following cultivars are widely cultivated in Bangladesh, such as; *Gladiolus auratiacus, Gladiolus byzantinus, Gladiolus cruentus, Gladiolus pripulinus, Gladiolus tristis, Gladiolus trimaculatus, Gladiolus blandas, Gladiolus cardinalis, Gladiolus dracocephalus, Gladiolus psittacinus* and *Gladiolus tristis var. concolon.* Commercial cultivation of gladiolus is gaining popularity due to export potentials and prevalence of favorable growing condition is different parts of the country. In Bangladesh, the agro ecological conditions are very conducive for the survival and culture of gladiolus. This flower is grown round the year but large scale production is done during winter season. Farmers grow it in the field for commercial purpose.

The morphology of Gladiolus differs from genotype to genotype. Morphological variability is the essence of any planned crop improvement programme. It is well established that the greater the genetic diversity the higher the chance of getting better hybrid or recombinant. A plant breeding program can be divided into three stages, viz. building up a gene pool of variable germplasm, selection of individual from the gene pool and utilization of selected individual to evolved superior variety (Kemplhorne, 1957). Selection of better plant type from the collected germplasm can be of immense value to the breeder for improvement of this crop. Further, knowledge of relationship among yield and yield contributing characters is an effective basis for phenotypic selection in plant population (Anuradha and Gowdha, 1994).

It is the most important and popular flower in Bangladesh. It ranks first among the cut- flowers and is known as queen of cut-flowers. It has been rated as the second most important popular flower in the world, especially from the economical point of view (Hamilton, 1976). Gladiolus flowers have for long been important in Bangladesh for three main considerations, namely aesthetic, economic, and social. It is also popular for its attractive spikes having florets of huge forms, dazzling colors, varying sizes and long keeping quality. Gladiolus spikes are most popular in flower arrangement and preparing high class bouquets and it is known as the bulbous flowers (Mukhopadhya, 1995).

In the present times, gladiolus flowers are used at all our social, cultural and religious occasions as cut-flower which are preferred for bouquets and flower

arrangement. It is also used as bedding flower, herbaceous borders or dose quite well in pots (Bose and Yadav, 1989).

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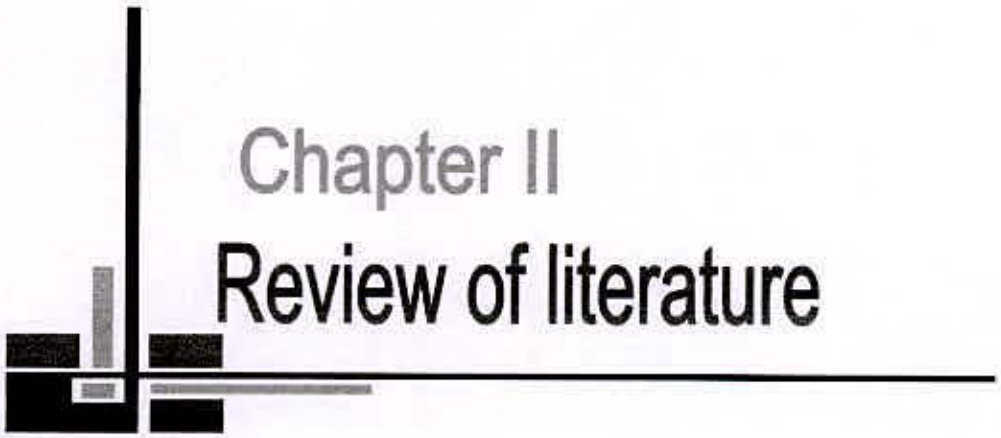
Gladiolus is propagated both sexually by seeds and asexually by corm and cormels. Seed propagation is followed to evolve new cultivars. The plants raised from seeds require four seasons to come to bloom under ordinary conditions and under the best cultural treatments it may be reduced to two seasons (Misra, 1978). In Bangladesh there is a lack of scientific research on the improvement of gladiolus flower. Disease and pest attack is the serious problem in cultivation of gladiolus flower. Limited availability of quality improved hybrid seed hampers the cultivation of gladiolus flower. Superiority of F_1 hybrid over the better parent is a common phenomenon in both self and cross pollinated crops. Commercially F_1 hybrid cultivars become increasingly important for better flower production. Hybrids generally show vigorous growth, uniformity in its growth behaviour, earliness and other desirable traits. Successful exploitation of heterosis through econoic production of hybrid seed in a large scale is depend on various essential prerequisites and information in this regard has not yet been fully explored in gladiolus. Keeping the foregoing status in view, present investigation and research work were undertaken with the following objectives.

- To study morphological differences among the different genotypes of gladiolus
- To know the demand, supply and market price of different genotypes
- To develop new color type through hybridization



Chapter II
Review of literature

REVIEW OF LITERATURE

Gladiolus is one of the most popular cut flower in the world. In different parts of the world many research works have been conducted on various aspect of this important cut flower. A few research works have been carried out on gladiolus in Bangladesh Agro-ecological condition. Therefore, information available in the literature pertaining to variability, market demand, production of hybrid seed and % of seed germination of gladiolus flower have been reviewed briefly and presented below.

2.1 Morphological character

Morphological character varied from genotype to genotype. The extent of genetic and morphological variability existing of genotype of a crop plant is an index of its genetic dynamism. Plant breeding revolves around selection, which can be effectively practiced only in the presence of morphological variability of desired traits. Hence the success of breeding depends entirely upon the morphological variability. Therefore, information available in the literature pertaining to morphological variability of gladiolus flower have been reviewed briefly and presented below.

An appreciable range of variability was noticed for the various characters of hippeastrum studies (Tejaswini *et al.,* 1994). The phenotypic coefficient of variability observed for number of flowers per spike, spike length and vase life indicates the possibility of developing varieties containing long spike with more flowers as well as longevity of individual floret.

Thirty-eight genotypes were evaluated by Rao and Negi (1994). Studies on variability, heritability and genetic advance were conducted on 12 biometric characters in gladiolus. Highly significant differences were observed among the genotypes.

Negi and Raghava (1986) in their study in gladiolus gemrplasm, the estimate of genetic parameters revealed a higher phenotypic coefficient of variation than the corresponding coefficient of variation value for plant height, flower number, corn number, spike length, spike diameter and rachis length.

In a study with gladiolus, Sharma and Sharma (1984) found that the estimate of variances for the characters plant height, spike length, rachis length, flower size and vase life was significant.

Thirty genotypes of gladiolus were evaluated. Highly significant differences were observed among the genotypes. Negi *et al.,* (1984) reported that heritability in the broad sense was medium to high and genetic advance as percentage of mean was high for spike length, rachis length and number of corms per plant in gladiolus.

Lal and Plant (1989) reported that highest direct positive effects on flower yield through number of flowers per plant (0.48) followed by plant height (0.36), self life (0.30) and rachis length (0.19). The results indicate that the importance of number of flowers and rachis length as a selection criteria for improving gladiolus flower yield.

Negi *et al.*, (1981) in their study in gladiolus germplasm, the estimate of genetic parameters revealed a higher phenotypic coefficient of variation than the corresponding genetic coefficient of variation value for plant height, cormel number and weight of cormel.

Selection of parents based on characters such as rachis length, spike length and plant height were useful in a breeding programme of gladiolus described by Singh and Doher (1980).

Negi *et al.*, (1978a) conducted an experiment in gladiolus and concluded that the maximum variability was marked for plant height, corm number and flower yield.

Negi *et al.*, (1978 b) found that the estimate of variance in gladiolus for the characters plant height, flower number, corm number, cormel number and flower yield was significant.

Motil and Basario (1977) observed appreciable variability for plant height, spike length, floret size, floret number and corm number in gladiolus.

According to Misra and Chowdhary (1976) a high value of genotypic and phenotypic coefficient of variation was observed for corm number, cormel number and flower number in gladiolus.

Swarup and Raghava (1972) observed appreciable variability for plant height, spike length, flower number, corm number, flower color and self life in gladiolus.

Robinson *et al.*, (1951) stressed the need to estimate genotypic and phenotypic variances of various characters for choosing individuals based on phenotypic expression with an aim to identify superior genotypes.

Robinson *et al.*, (1951) found high positive correlation between rachis length and flower number (0.929) in gladiolus and followed by plant height and flower yield (0.889). Hence, taller the plant the higher in its yield.

2.2 Market Demand, Supply and Price of Gladiolus

The importance of Gladiolus flowers are been raised throughout the world. Gladiolus flowers have for long been important in Bangladesh. Various kinds of Gladiolus flowers are produced in different parts of the country like Bangladesh. It has a high demand among the consumers due to its attractive colors, and diversified use. Gladiolus flowers have for long been important in Bangladesh for three main considerations, namely aesthetic, economic, and social. In the present times, Gladiolus flowers are used at all our social, cultural and religious occasions as cut-flower which are preferred for bouquets and flower arrangement. It is also used as bedding flower, herbaceous borders or dose quite well in pots (Bose and Yadav, 1989). Therefore, information available in the literature pertaining to Market Demand, Supply and Price of gladiolus flower have been reviewed briefly and presented in the next page.

Studies have established by Momin (2006) that income from gladiolus flower production is six times the returns from rice. Its elegant spikes, richly varied in color and with a long vase life are the reason for its ever increasing demand.

Butt (2005) reported that Gladiolus is now as cut flowers vary widely in the continent of Europe, particularly in Holland, Italy and Southern France.

Mukhopadhyay (1995) said that it is popular for its attractive spikes having florets of huge forms, dazzling colors, varying sizes and long keeping quality. Its spikes are most popular in flower arrangement and preparing high class bouquets.

Bose and Yadav (1989) stated that Gladiolus is a very popular flowering plant and occupying fourth place in the international cut flower trade.

Chadha and Choudhury (1986) reported that Gladiolus has gained popularity in many parts of the world owing to its unsurpassed beauty and economic value.

2.3 Production of Hybrid Seed

Crossing between two genetically different plants is called hybridization. A progeny of a cross between genetically different plants is called hybrid. A hybrid progeny that obtain from a cross between genetically different genotypes of the same species is known as intra-specific hybrid. It is also known as inter-varietal hybrid. In different parts of the world many research works have been conducted on hybrid seed production of gladiolus flower. A few research works have been

carried out on gladiolus in Bangladesh Agro-ecological condition. Therefore, information available in the literature pertaining to production of hybrid seed of gladiolus flower have been reviewed briefly and presented below.

Misra (1975b) observed the varieties Debonair, Golden Goddess, Jo Wagenaar, Katrain Local, and Ratna's Butterfly to be resistant to Fusarium wilt disease under field conditions. Crosses involving these varieties were made in thirteen combinations and a large number of Fusarium disease tolerant hybrids were produced.

To produce beautiful, fragrant gladioli, interspecific hybridization was done involving cultivars of *Gladiolus sp.* as the female parent and *G. callianthus* as the male parent. Six site-specific hybrids along with their seed parent (beauty spot, Melody, Wild rose) and a pollen parent (*G. callianthus*) were calculated by Rao and Jamaican (1994). Improvement was observed in site-specific hybrids in comparison with the species with respect to earliness, plant height, spike length, rachis length, and number of flower per spike. Cormel production per corm, corm size and weight.

Efforts made at the Indian Agricultural Research Institute, New Delhi for breeding new varieties for subtropical conditions through hybridization have results in the development of three new varieties, namely, Agni Rekha, Pusa Suhagin, and Suchitra (Singh and Dohare, 1980; Singh and Dadlani, 1988).

A large number of hybrids were raised at the Indian Institute of Horticultural Research, Hessaraghatta, and Bangalore. These hybrids were evaluated thoroughly for various vegetative and floral characteristics for 2-3 seasons. Performance trials of very promising hybrids along with the standard cultivars were conducted for three years. Based on the performance in the replicated trials, six hybrids were finally selected and released as Meera, Nazrana, Poonam, and Sapna, in 1979(Negi *et al.*,1982) and as Aarti and Apsar in 1980 (Raghava *et al.*, 1981).

Jagadish Chandra *et al.*, (1945c) studied the reaction of different cultivars and hybrids of gladiolus to fusarium wilt disease under artificial condition. Two cultivars, namely, Australian Fair and Mansoer resistered tolerant reaction.

Wilfret (1980) stated that the modern cultivars has been evolved by the use of breeding many species together like page *Gladiolus alatus, G. biflorus,G. blandus, G. byzantinus, G. cardinalis, G. cruentus, G. cuspidatus, G. dracocephalus, G. floribundus, G. melleri,. G. primulinus, G. psittacinus G. purpureoauratus, G. ramosus, G. recurvus, G. saundersii, G. tristris*, etc., however, *G. brenchleyensis, G. childsii, G. colvillei, G. froebelli, G. gandavensis, G. hortulanus, G. hybridus, G. lemoinei, G. nanceianus G. princeps, G. turicensis*, etc., are the hybrid species of garden origin.

Fragrants first originated in the early nineteenth century by Dean William Herbert of England by crossing winter or spring flowering Afrikanders then available, the best known fragrants, arose from a cross between *Gladiolus tristis* and *G. recurvus.*

Afterwards, Morgan also got some success. There are some even 40 South African species themselves fragrant, strongly scented being : *Gladiolus callianthus (Acidanthera bicolor), G. caryophyllaceus, G. engysiphon, G. liliaceus* and *G. tristis ;* night-scented being : *G. hyalinus* (slightly fragrant at evening), *G. liliaceus, G. longicollis* (evening) and *G. tristis ;* and day-scented being : *G. acuminatus, G. alatus, G. arcuatus, G. brevifolius, G. carinatus, G. emiliae, G. equilans, G. exilis* (slightly fragrant), *G. floribundus, G. gracilis, G. guthriei, G. jonquilliodorus, G. lewisiae, G. maculatus, G. marlothii, G. inutabilis, G. odoratus, G. orchidii locus, G. permeabilis, G. pillansii, G. pritzelii, G. quadrangulus, G. recurvus, G. rohertsoniae, G. sculhri, G. seresianus, G. stellatus, G. tenellus, G. uysiae, G. vaginatus, G. virescens, G. viridiflorus* and *G. watermeyeri* (Lewis *et al.,* 1972).

Gladiolus dracocephalus produces strange colors like green, brown and slate. Lemoinei hybrids also produced strange colors and with *G. gandavensis* also, apart from *G. dracocephalus,* produced smokies. First smoky produced from Childsii hybrids after 1871 was Prince of India. Lemoinei strain was produced by M. Lemoine of Nancy. France, by crossing *Gladiohrs purpureoauratus* with *G. gandavensis* strains. He also used *Gladiolus pupilio* with *G. purpureoauratus* which resulted in many of the purples, lavenders and violets (Garrity, 1975).

Wilfret (1980) selected Florida Flame from a cross between WBL 047 and Folies Bergere. The maximum spike length is 160 cm with 14-17 florets. The petals are

light scarlet-red intensifying to darker throat veins. The cultivar is Fusarium tolerant.

Magie (1957-58) reported a new cultivar Florida Pink produced through crossing was vigorous and produced high yield of quality flower. It had considerable resistance to *Fusarium oxysporum*, *Curvularia trifolli* and *Stemphyllum* sp. Resistant to *Botrytis gladiolorum* was as good as that of its pollen parent Spic and Span. Cultivar Mibloom with Pfitzers' Triumph produced Joli and the former with Mammoth White (non-scented) produced Summer Breeze and Honeysuckle, Perfume was evolved by crossing Joli and Summer Breeze. Yellow Rose and Sachet were evolved by crossing the seedlings of Mibloom x Maid of Orleans (non-fragrant) to Perfume and again to the seedlings of Mibloom x Chance and Mibloom X Incense, all highly fragrant.

Cultivar Rosemarie Pfitzer with Picardy produced reasonably fragrant Gwen. Sweetie, a highly fragrant cultivar, was evolved by crossing Rose Gem and This Is It and Ruffles by Friendship and Beautys' Blush. Spice-fragrant cultivars were evolved by crossing faintly fragrant King David and Party Ruffles, Happy Talk by Party Ruffles and Purple Splender. Little Darling, Indian Princess and Summer Fragrance are reasonably fragrant cultivars evolved by crossing Queen of Bremen, Dream of Beauty and an unknown seedling. Lavender and Gold when crossed with a seedling produced Wedgewood ; Statuette with Tigertone produced Foxfire ; Picardy with a seedling produced Wings of Song; Picardy with Mrs. T.E. Langford produced Beacon, which with Incense produced Flashlight ; Doll House when

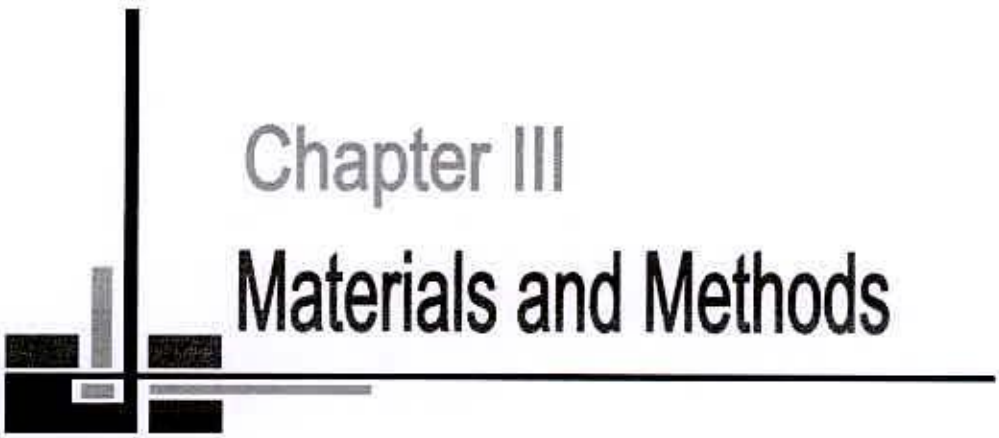
crossed with the seedlings of Picardy x (Wing of Song x Maid of Orleans) ; Crinklette x Wedgewood produced Alouette, which with the seedling of Statuette and Doll House produced Quadrille ; Foxfire with Flashlight produced Danny Boy; and Quadrille when crossed with Danny Boy produced fine Table Talk (Fisher, 1975).

Acacia, one of the best cultivars, was produced by crossing Perfume with Diadem, both fragrant, This Is It by Summer Breeze and New Era, Sweet & Lovely by Paula and Frilled Fragrance, Pink Fragrance by Vista Bonita seedling and Summer Breeze, Sweet Cream by Frilled Fragrance and Perfume, Dark Fragrance and Red Scent by Burma and Cologne, and Lucky Star by Filigree and *Gladiolus callianthus.* Other fragrant cultivars are Progress, Angles Breath, Jimmy Boy, David, Dawn, Gypsy Fire, Carrie Jacob Bond, Lucky Strike, Fragrant Beauty, Sweet Debbie, Sweet Dreams, Cliffie, Fragrant Queen, Bouquet, Royal Fragrance, Golden Fragrance, Incense Smoke, Sweet Rose, Mainliner, Araby, Sweet Lavender, Brenchleyensis, Baron Joseph Hulot, 1910 Rose, Mrs. Dr. Norton, Anna Eberius, Kirkoff's Violet, Aida, Avemaria, Queen of Bremen, Pythia, Mrs. Leon Douglas, Prince of Wales, Lady Eaton, Rosemarie Pfitzer, Arethusia and Camilla. Mrs. Hazel Zeller produced fragrants like Gaytime, Happy Talk, Gypsy Fire and Dawn in 1967 (Fisher, 1975). Gromov of the USSR produced fragrant Ra (Park, 1976). George A. Webster's seedlings S-4, S-69 and S-4; 1 S-69 are highly rose-fragrant.

2.4 Percentage of seed germination.

The F_1 seed collected from different crosses was dried and stored for germination test. Some seeds were sown thinly directon the raised beds in the soil and some in the pot/container on different depth and dates for germination test. Seeds were not germinated under the normal field condition in all cases.

Misra (1978) reported that after sowing, the pot/containers are kept in greenhouse at the temperature between 7 and 13 degree centigrade and seeds germinate in 3 to 5 weeks. Seeds on germination strike a single root down and send up single glass-like blade above the ground. When this root is well established it starts contracting and takes the plant down into the soil. The second leaf may appear after 3weeks. After the seedlings have attained a good growth (in about 2-3 months), these are shifted from greenhouse to a sheltered position at 24 degree centigrade to grow for whole of the season. The seedlings are raised in open need not be shifted and may be grown throughout the cycle. The soil should be kept moist and during summer the seedlings are to be fed with liquid manure to help in developing the corms. The moisture in seed bed could be maintained by using some mulch. The plant raised from seeds required four seasons to come to bloom under ordinary conditions and under best cultural treatments it may reduced to two seasons.



Chapter III

Materials and Methods

MATERIALS AND METHODS

The present experiment was carried out at the Commercial Flower Garden of Society And Human Development Organization, Tangail (SAHDOT) during the period from November'2008 to October'2009 to investigate the morphology, market demand, production of hybrid seed and % of hybrid seed germination in gladiolus genotypes. The experiment included five gladiolus genotypes. Details of the experimental materials and methods followed during the time of the present investigation are described in this chapter.

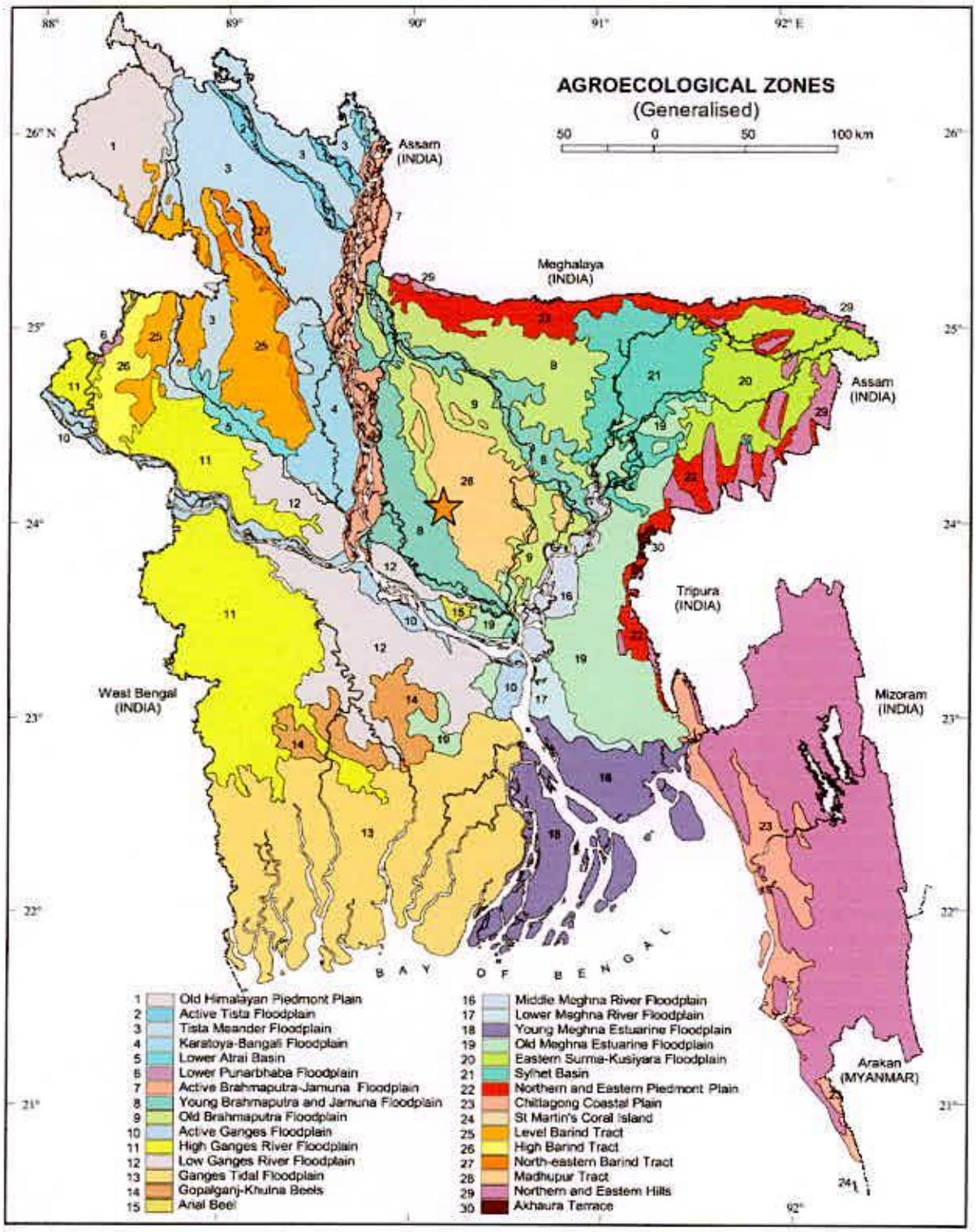
3.1 Experimental site

The present experiment was conducted at the Commercial Flower Garden of Society And Human Development Organization, Tangail (SAHDOT), Village-Shota Gobra, P.O-Gohail Bari, U.P-Bahuria, P.S- Mirzapur, District-Tangail (Figure 1).

3.2 Soil

The experimental sites were situated in the subtropical zone. The soil of the experimental site lies in Agro-ecological region of Madhupur Tract (AEZ no. 28) of Noda soil series. The soil was clay loam in texture. The experimental site was medium high land and the P^H was 5.6 and organic matter content was 1.00 (Appendix 1).

Figure 1. Location of the experimemtal field



★ **The experimental site under study**

3.3 Climate

The geographical situation of the experimental site was under the subtropical climate, characterized by heavy precipitation during the month of May to August and scanty precipitation during the period from October to March. The mean temperature during the research period was 25.68^0c with average naximum and minimum being 29.49^0c and 21.87^0c, respectively. The average relative humidity and rainfall was 85.41% and 194.83mm, respectively (Appendix 2).

3.4 Planting Materials/Genotypes

Five different genotypes were used in this experiment. Most of the genotypes (corms of gladiolus flower) were collected from the farmers field (Table 1).

3.5 Land Preparation

The experimental plot was opened in the first week of November 2008 with a power tiller and was exposed to the sun for a weak. After a week the land was prepared by several ploughing and cross ploughing followed by laddering and harrowing with power tiller and country plough to bring about good tilth. Weeds and other stubbles were removed carefully from the experimental plot and leveled properly. The final land preparation was done on 8^{th} November 2008. Special care was taken to remove the rhizomes of mutha grass.

Table-1. Collected area of different genotypes

Sl. No.	Genotypes	Color of genotypes	Collected area
01	GL-21	White	Gohailbari, Mirzapur,Tangail
02	GL-04	Yellow	Betrashin, Mirzapur,Tangail
03	GL-16	Orange	Gohailbari, Mirzapur,Tangail
04	GL-12	Violet	Gohailbari, Mirzapur,Tangail
05	GL-22	Red	Betrashin, Mirzapur,Tangail

3.6 Manure and Fertilizer Application

The manures and fertilizers were applied with the following doses recommended by gladiolus booklet (Horticulture Research Centre, BARI, Gazipur, 2000) which is presented in the Table 2.

Manure (well decomposed cow dung), MP and TSP were applied as basal dose during the final land preparation and incorporated into the soil, but Urea was applied two installments as top dressing.

Half of the Urea were applied after emerging 4 leaves and the rest half of the Urea will be applied after emerging 6-7 leaves (before flowering) of the plants.

3.7 Seed Sowing/Planting of corms

Medium sized corms were planted at 6 cm depth in furrows on 5th November 2008 following the row to row spacing of 25cm and plant to plant spacing of 15cm.

3.8 Intercultural Operations

Inter cultural operations viz. weeding, irrigation, earthing up, stacking, pesticide and fungicide application was done as and when necessary.

3.8.1 Weeding and mulching

The soil was mulched frequently after irrigation by breaking the crust for better aeration and conservation of soil. Weeding was done in the soil whenever it was necessary to keep the soil free from weeds. The 1st and 2nd weeding were applied after 30 and 60 days of sowing ,respectively.

Table-2. Doses of Manure and fertilizers

Sl. No.	Manure/fertilizers	Doses/ha	System of application
01	Cow dung	10 t	Basal application
02	Urea	200kg	Top dressing
03	TSP	225kg	Basal application
04	MP	190kg	Basal application

3.8.2 Irrigation

The experimental plots were irrigated as when necessary during the crop period. The irrigation was given 10-15 days interval after sowing the corms.

3.8.3 Earthing up

Earthing up was done twice during growing period. The first earthing up was done at 25 days after sowing (DAS). The second earthing up was done after 45 DAS.

3.8.4 Stacking

Stacking was done during flowering stage of plants. For staking bamboo stick was placed and spike was tied with the stick. Each plant was supported by 80cm long bamboo sticks to facillate the plant to keep erect. The plant was fastened loosely with the bamboo stick by jute string to prevent the plant from lodging.

3.8.5 Pesticide/Insecticide Applications

Aphid and larva of many insects were found in the crop during the vegetative and flowering stage of the plant. To control such insects Malathion-57 EC @ 2ml/litre of water was applied. The insecticide was applied in the afternoon.

3.8.6 Fungicide Applications

Ridomil 2g per liter of water was sprayed once the plants as protective measures against fungal disease.

3.9 Demand, supply and market price of gladiolus flower

3.9.1 Demand

Data on demand of selected genotypes were collected from the flower central market (Krishibid Institution market, Khamarbari and Shahbag market, Dhaka) and their mean was calculated.

3.9.2 Supply

Data on supply of selected genotypes were collected from the flower central market (Krishibid Institution market, Khamarbari and Shahbag market, Dhaka) and their mean was calculated.

3.9.3 Market price

Data on market price of selected genotypes were collected from the flower central market (Krishibid Institution market, Khamarbari and Shahbag market, Dhaka) and their mean was calculated.

3.10 Production of hybrid seed

3.10.1 Emasculation

Emasculation was carried out at bud stage when these have started swelling for opening.

3.10.2 Pollination

With the opening of the flowers, the anthers were matured which may be used for pollinating already emasculated females. The stigma became receptive on the third day of the opening of the flowers or anther maturity. So, the pollination was done on the third day of the opening of the flowers in the morning.

3.10.3 Bagging and tagging

After pollination, the flowers were bagged with perforated butter paper bags and tagged with labels mentioning the parents and the date of pollination.

3.10.4 Harvesting

Corms, Cormels and Capsules matured after 3-6 weeks of pollination, which when start dehiscing were collected. Sun-dried, sometimes dewinged and stored in moisture proof envelops until sowing.

3.11 Collection of Data

Data were collected from the selected genotypes in respect of the following parameters.

3.11.1 Average plant height (cm)

Plant height refers to the length of the plant from ground level up to shoot apex of the plant. Height of selected plants of each genotype was measured at an interval of 15 days starting from 30 days after sowing (DAS) till 60 DAS and the mean was calculated. It was measured in cm.

3.11.2 Average number of leaves

All the leaves of selected plants were counted at an interval of 15 days starting from 30 DAS till 60 DAS. Number of leaves per plant was recorded by counting all the leaves from the selected plants of each genotype and the mean was calculated.

3.11.3 Average length of leaves (cm)

The length of leaves of selected genotype was recorded at an interval of 15 days starting from 30 DAS till 60 DAS. The length of leaves from selected genotype was measured by a measuring scale from leaf base to the tip in middle and was expressed in cm.

3.11.4 Width of leaves/Breadth of leaves (cm)

Width of leaves of selected genotype was recorded at an interval of 15 days starting from 30 DAS till 60 DAS. The width of leaves of selected genotype was measured by a measuring scale from one side of the middle and was expressed in cm.

3.11.5 Length of flower stalk (cm)

Length of flower stalk was measured from the base to the tip of the spike and was expressed in cm.

3.11.6 Length of the rachis (cm)

Length of the rachis refers to the length from the axial of first floret up to the tip of the inflorescence. Rachis length was measured by a measuring scale from spike base to the tip and was expressed in cm.

3.11.7 Number of florets per spike

All the florets of the spike were counted from the selected genotype and their mean was calculated.

3.11.8 Weight of a single spike (g)

Ten spikes were cut from selected genotype and the weights of spike were recorded to calculate their mean in gram.

3.11.9 Demand of gladiolus flower

Data on demand of selected genotypes were collected and their mean was calculated.

3.11.10 Supply of gladiolus flower

Data on supply of selected genotypes were collected and their mean was calculated.

3.11.11 Price of gladiolus flower (Tk. /Stick)

Data on market price of selected genotypes were collected and their mean was calculated.

3.11.12 Length of capsule (cm)

Length of capsule was measured by a measuring scale from capsule base to the tip and was expressed in cm.

3.11.13 Breadth of capsule (cm)

Breadth of capsule was measured by a measuring scale and was expressed in cm.

3.11.14 Weight of capsule (g)

Capsules were collected and were weighted in gram.

3.11.15 Number of seeds per capsule

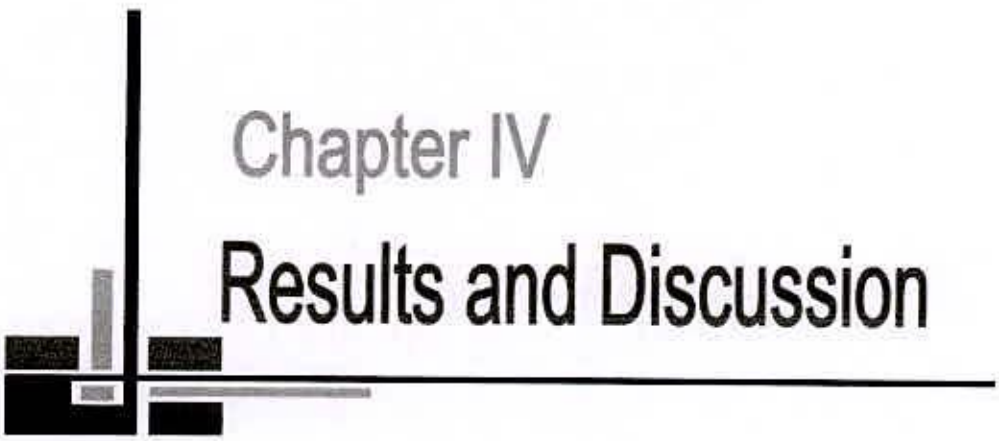
Number of seed was counted from each capsule.

3.11.16 Weight of thousands seeds (g)

Well dried one thousand seeds were taken and were weighted in gram.

3.12 Statistical analysis

The recorded data on different parameters were statistically analyzed. The mean of collected data for the treatments was calculated and Correlation and regression analysis were performed to determine the market behavior of demand and supply and their effect on the market price.



Chapter IV

Results and Discussion

RESULTS AND DISCUSSION

The present study was conducted during the period from November, 2008 to October, 2009 to investigate the morphology, market demand, and production of hybrid seed and % of hybrid seed germination in gladiolus genotypes. The characteristics studied included plants height, leaves, flowers, corm, cormels capsule and seed. The results of present study have been presented and discussed in this chapter under the following headings.

4.1 Morphology of gladiolus genotypes

4.1.1 Plant characteristics

The plant characteristics like height, number of leaves, leaf length, and leaf breadth were recorded and shown in Table 3. The field view of gladiolus genotypes at vegetative stage are shown in Plate 1.

4.1.2 Plant height (cm)

The genotypes varied enormously in plant height (Table 3). The tallest plant (58.65cm) was in Yellow and the shortest in Orange (46.52cm). The variation observed in plant height among the genotype might be due to different in genetically constituents as well as environmental effects.

4.1.3 Leaf length (cm)

Leaf length was affected by genotypes and varied from 33.36cm to 42.25cm (Table 3). The longest leaf (42.25cm) was recorded in Yellow followed by Violet (42.05 cm), White (37.35cm) and Orange (35.50cm), while the shortest one was in Red (33.36cm).

4.1.4 Leaf breadth (cm)

There had variation (1.65cm to 3.05cm) in leaf breadth among the genotypes (Table 3). The genotype Yellow attained the maximum leaf breadth (3.05cm), which was followed by genotypes White (2.90cm), Violet (2.66cm) and Red (2.50cm). Breadth of leaf was found to be minimum in Orange (1.65cm). Bhagur (1989) recorded significant variation in respect of leaf breadth among thirty genotypes of gladiolus. They found leaf breadth varied from 1.3 cm to 4.5cm.

4.1.5 Number of leaves

Significant variation was observed as to the number of leaves among the genotypes (Table 3). The maximum number of leaves (12.25) was obtained from the genotype White which was followed by genotype Red (10.90), Violet (8.70) and Orange (8.65). Genotype Yellow attained the minimum number of leaves (8.50). This variation might be mainly due to genotype variation as well as environmental effects. Plant produces food materials through the process of photosynthesis. With the increasing number of leaves, photosynthesis will generally increase, thus plant can produce more food that influences the growth and development of the plant. So, genotypes that can produce more leaves have more plant growth leading to higher yield.

Table 3. Plant characteristics of different genotypes of gladiolus

Genotypes	Color of genotypes	Plant height(cm)	Length of leaves(cm)	Breadth of leaves(cm)	No. of leaves per plant
GL-21	White	55.20	37.35	2.90	**12.25**
GL-04	Yellow	**58.65**	**42.25**	**3.05**	**8.50**
GL-16	Orange	**46.52**	35.50	**1.65**	8.65
GL-12	Violet	56.97	42.05	2.66	8.70
GL-22	Red	46.65	**33.36**	2.50	10.90

Plate 1. Part of experimental view at vegetative stage

4.2 Flower characteristics

4.2.1 Color of flower

As regards to the color of flower, the observed genotypes showed remarkable variation such as White, Yellow, Orange, Violet, and Red (Table 4). The flower variability of different genotypes of gladiolus are presented in plate 2 and plate 3.

4.2.2 Days to 50% spike initiation

Marked differences were for days to 50% spike initiation among the genotypes under investigation (Table 5). The genotypes Yellow took maximum days (70 days) to 50% spike initiation which was followed by Orange (67 days), Red (65 days) and Violet (62 days). The minimum number of days (60 days) was taken by the White genotype. In a varietal trial, Ashwath and Parthasarathy (1994) reported that the varieties required 40-70 days to 50% spike initiation which was in consonance with majority of the genotypes under investigation. The differences in days to 50% spike initiation might be due to the genetical factors of the genotype concerned.

4.2.3 Spike length (cm)

Significant variation in respect of spike length was found among the genotypes (Table 5). The longest spike (92.05cm) was produced by genotype White which was followed by Yellow, Violet and Red (73.90, 72.50 and 65.65cm, respectively) while the shortest spike (59.63cm) was produced by Orange genotype. Bhagaur (1989) recorded spike length ranged from 61.60 to 137.97cm in varietal evaluation of gladiolus.

Table 4. Flower colors of different genotypes of gladiolus

Sl. No.	Genotypes	Flower color
01	GL-021	White
02	GL-004	Yellow (Deep Yellow)
03	GL-012	Deep Violet, distinct Red cream color present in two petals
04	GL-016	Orange, Reddish pink
05	GL-022	Deep Red, light blue color present in two petals

Plate 2. Part of experimental view at flowering stage

Plate-3a. Yellow (GL-04)

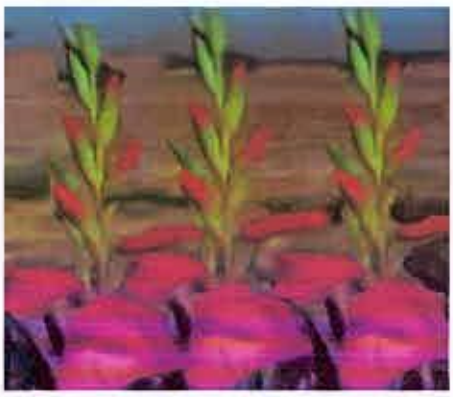


Plate-3b. Orange (GL-16)

Plate-3c.Violet (GL-12)

Plate-3d. White (GL-21)

Plate-3e.Red (GL-22)

Plate-3: Different types of gladiolus genotype

4.2.4 Rachis length (cm)

A great deal of genotypic variation in rachis length was observed (Table 5) and varied from 25.66 cm to 47.30cm. The highest rachis length was observed in White (47.30cm), which was followed by Yellow (34.40cm), Violet (28.32cm) and Red (26.62cm). The lowest rachis length (25.66cm) was observed in genotype Orange. Anuradha and Gowda (1994) reported that rachis length was highest (51.77cm) in genotype Deep Red (GL-06).

4.2.5 Number of flower

Variation regarding number of flower per plant among the genotypes was observed and varied from 8.40 to 14.25 (Table 5). The highest number of flower per plant was produced by White (14.25). The genotype Orange (8.40) produced the lowest number of flower per plant. The number of flowers per plant varied from 5.33 to 20.00 as reported by Negi *et al.*, (1982) from their experiment at the Hariana Agricultural University Farm, Hissar, India. Lal and Plant (1989) recorded 8 flowers per plant in GL-06 to 18 flowers in GL-15 in a gladiolus trail conducted at Maharastra in India.

4.2.6 Weight of single stick (g)

Genotypes had displayed a wide range of variability among them in respect of stick weight. It ranged from in 26.47 g to 53.85 g (Table 5). High stick weight was recorded from genotype White (53.87 g) which was followed by Yellow (45.85g), Red (39.65g) and Violet (37.30g). The lowest stick weight producer genotype was Orange (26.47g).

Table 5. Flower characteristics of different genotypes of Gladiolus

Color genotype	Days to 50% spike initiation	Length of flower (cm)	Breadth of flower (cm)	Wt. of flower (g)	Wt. of single stick (g)	Length of spike (cm)	Length of rachis (cm)	No. of flower/plant
White	**60**	9.42	9.09	7.14	**53.87**	**92.05**	**47.30**	**14.25**
Yellow	**70**	**9.75**	**9.41**	**7.25**	45.85	73.90	34.40	9.80
Orange	67	**8.39**	**6.90**	**4.54**	**26.47**	**59.63**	**25.66**	**8.40**
Violet	62	9.28	9.28	6.20	37.30	72.50	28.32	9.90
Red	65	8.78	8.52	6.51	39.65	65.65	36.62	10.15

4.3 Qualitative traits of gladiolus genotypes

The qualitative traits of five gladiolus genotypes are presented in the Table 6. In all the genotypes, the floret type was open-faced, whereas Orange genotype had funnel shaped floret. One genotype viz Violet had floret with wavy margins while the rest had floret with plain margins. The genotype Orange had thin floret texture while the rest of the genotypes possessed thick floret texture. All the genotypes were rated moderately tolerant except Orange was found susceptible to disease. There was some pest in the field.

4.4 Corm and Cormel characteristics of Gladiolus Flower

4.4.1 Number of corms

Data recorded in respect of corm production of five genotypes of gladiolus are presented (Table 7). The number of corms produced per plant was the highest in Orange genotype (2.55) followed by Red (1.70), Violet (1.40) and Yellow (1.25). The lowest number of corms (1.15) was produced by the White genotype. The variation observed in corm production among the genotypes might be due to difference in genetically constituents as well as environmental effects. Variation (1.0 to 4.0) in corm production among some genotypes of gladiolus was observed at Bangalore in India by Anuradha and Gowda (1994). Corms of different genotypes of gladiolus flower are presented Plate 4.

Table 6. Qualitative traits of different genotypes of Gladiolus

Color of genotype	Floret types	Floret structure	Floret texture	Disease reaction	Disease Incidence	Pest incidence
White	Open faced	Plain	Thick	MT	Fungus	Aphid
Yellow	Open faced	Plain	Thick	MT	Fungus	Lady Bird Beetle
Orange	Funnel shaped	Plain	Thin	S	Fungus	Aphid
Violet	Open faced	Wavy margin	Thick	MT	Fungus	Larva of different insect
Red	Open faced	Plain	Thick	MT	Fungus	Aphid

MT = moderately tolerant
S = Susceptible

4.4.2 Breadth of corm

There had slightly variation (2.74 cm to 3.81 cm) in corm breadth among the genotypes (Table 7). The genotype Yellow attaibed the maximum corm breadth (3.81 cm), which was followed by genotypes Red (3.26 cm), White (3.24 cm) and Violet (3.17 cm). Breadth of corm was found to be minimum in Orange (2.74 cm). Corms of different genotypes of gladiolus flower are presented Plate 4.

4.4.3 Weight of corms (g)

Genotypes had displayed a wide range of variability among them in respect of corm weight (Table 7). It ranged from 18.16g to 36.76g. The highest corm weight (36.76g) was recorded from the genotype Yellow which was followed by White (30.92g), Violet (26.30g) and Red (25.30g). The lowest corm weight per plant was obtained from the Orange genotype (18.16g). Sharma and Sharma (1984) reported that corm weight was the highest in Yellow genotype (67g) and the lowest in genotype GL-25 (18g) which was more or less in consonance with the present investigation. Corms of different genotypes of gladiolus flower are presented Plate 4.

4.4.4 Number of cormel per plant

Number of cormel per plant was significantly affected by genotypes (Table 7). The highest number of cormels per plant was obtained from the genotype White (43.20) which was followed by Violet (28.85), Yellow (27.20) and Orange (25.75). The genotype Red (25.70) produced the lowest number of cormels per plant. Cormels of different genotypes of gladiolus flower are presented Plate 5.

Misra and Saini (1988) recorded 5 to 20 cormel per plant in gladiolus genotypes in a trial conducted at Bangalore, India.

Table-7. Corm and Cormel characteristics of Gladiolus Flower

Color of genotype	No. of corm per plant	Breath of corm (cm)	Wt. of corm (g)	No. of cormel/ plant	Wt. of cormel(g) / plant
White	**1.15**	3.24	30.92	**43.20**	**6.40**
Yellow	1.25	**3.81**	**36.76**	27.20	6.39
Orange	**2.55**	**2.74**	**18.16**	25.75	**5.20**
Violet	1.40	3.17	26.30	28.85	5.75
Red	1.70	3.26	25.30	**25.70**	5.30

4.4.5 Weight Cormels per plant (g)

Genotypes had displayed a range of variability among them in respect of cormel weight per corm (Table 7). It ranged from 5.20g to 6.40 g. The highest cormel weight was recorded in genotype White (6.40g) which was closely followed by Yellow (6.39g), Violet (5.75g) and Red (5.30g). The genotype Orange (5.20g) produced the lowest weight of cormel per corm. Negi *et al.*, (1986) reported that cormel weight in gladiolus genotypes ranged from 5.2g to 17.0g which is more or less similar result with the findings of the present investigation. Cormels of different genotypes of gladiolus flower are presented Plate 5.

Plate 4a. Corm of White genotype

Plate 4b. Cormof Yellow genotype

Plate 4c. Corm of Orange genotype

Plate 4d. Corm of Violet genotype

Plate 4e. Corm of Red genotype

Plate 4f. Sprouted corm of gladiolus

Plate 4. Corm of different genotypes of Gladiolus Flower

Plate 5a. Cormel of White genotype

Plate 5b. Cormel of Yellow genotype

Plate 5c. Cormel of Orange genotype

Plate 5d. Cormel of Violet genotype

Plate 5e. Cormel of Red genotype

Plate 5f. Sprouted cormel of gladiolus

Plate 5. Cormel of different genotypes of Gladiolus Flower

4.5 Demand, supply and price of gladiolus flower

4.5.1 Demand, supply and price of gladiolus in different month of the year

4.5.1a Demand

Marked differences were for demand of gladiolus flower in different month of the year (Table 8). The highest demand of was observed in February (100%), which was closely followed by December (96%), January (95%) and March (95%). The lowest demand was observed in July (70%), which was closely followed by June (72%).

4.5.1b Supply

Significant differences were observed in respect of supply and were varied from 58% to 112% (Table 8).The highest supply was observed in February (112%). In this month the supply was more than the demand of gladiolus flower. The lowest supply (58%) was observed in June and July, which was closely followed by August (60%).

4.5.1c Price (Tk. /Stick)

Marked Differences were observed in respect of flower price in different month of the year and varied from 4.90 Tk. to 11.40 Tk. (Table 8). The highest price of gladiolus flower was observed in August (11.40 Tk.). The lowest price was observed in March (4.90 Tk.).

Table-8: Demand, Supply and price of Gladiolus flower in different month of the Year

Sl. No		01.	02.	03.	04.	05.	Av.
January	Demand	98	98	98	98	98	98
	Supply	90	95	95	100	95	95
	Price	8.00	6.00	7.50	6.50	7.000	7.00
February	Demand	100	100	100	100	100	100
	Supply	120	130	100	110	100	112
	Price	5.50	4.50	4.50	5.00	5.50	5.20
March	Demand	95	95	95	95	95	95
	Supply	120	130	60	90	100	104
	Price	5.50	5.00	4.50	4.50	5.000	4.90
April	Demand	88	88	88	88	88	88
	Supply	80	85	80	80	90	83
	Price	5.50	6.50	7.50	6.50	7.00	6.60
May	Demand	80	80	80	80	80	80
	Supply	70	80	70	70	80	74
	Price	6.00	10.00	7.50	7.50	8.00	7.80
June	Demand	72	72	72	72	72	72
	Supply	60	50	70	50	60	58
	Price	10.00	11.00	11.00	11.00	10.50	10.70
July	Demand	70	70	70	70	70	70
	Supply	60	60	60	50	60	58
	Price	10.00	11.00	10.50	10.50	11.00	10.60
August	Demand	76	76	76	76	76	76
	Supply	70	60	60	50	60	60
	Price	12.00	11.00	11..00	13.00	10.00	11.40
September	Demand	76	76	76	76	76	76
	Supply	60	80	70	70	60	68
	Price	12.00	9.00	9.50	11.00	10.00	10.30
October	Demand	78	78	78	78	78	78
	Supply	60	90	80	60	70	72
	Price	12.00	9.00	10.00	8.00	8.00	9.40
November	Demand	86	86	86	86	86	86
	Supply	90	90	80	70	80	82
	Price	9.00	7.00	7.50	7.50	8.00	7.60
December	Demand	96	96	96	96	96	96
	Supply	90	100	90	100	90	94
	Price	9.00	7.00	6.00	6.00	6.50	6.90

4.6 Correlation matrix of demand, supply and price of five gladiolus genotypes

Actual data on demand and supply of gladiolus flowers were not available in the market. However, information on relative demand and supply in different months in the year 2008- 2009 with demand in relation to the month of February and also the price of five genotypes of gladiolus were collected from five whole sellers and farmers. The demand in February was considered as 100% and average demand, supply and price of five genotypes of gladiolus were determined and are presented in Fig. 2. The result showed that average demand, supply and price were highly fluctuating across the month. Both demand and supply are the highest in the month of February after which the demand decreases gradually, reaches a minimum in July and then starts increasing. While there is a sharp decrease in supply, reaches a minimum in July and then starts increasing at a slower rate compared to demand. It was observed that the supply of flower superseded demand in the month of February and March. On the other hand, price of flower was the lowest in the month of March, increased sharply to a maximum in August and then showed sharp decreasing trend. It was interesting to note that price of flower decreased with the increase of demand and this relationship was highly significant (Table 9) that does not follow the economic norm that price increases with the increase of market demand. Price of flower, on the other hand, showed negative relationship with the supply (Fig. 2 and Table 9), which is consistent with the economic law that price decreases with the increase in market supply.

Results of Fig1 and Table 9 revealed that there is a combined effect of demand and supply on the price of flower in different months. Regression analysis (Fig. 3) revealed that price of flower is a function of the ratio of relative supply to relative demand and the relationship is clearly linear and negative. The relationship between price (y) of flower to the ratio of relative supply to relative demand (x) was obtained as **y = 27.373 -20.494**x (R^2 = 0.88)** that indicates that a 1% increase in the ratio of relative supply to relative demand decreases the price of per stick flower by Tk. 0.20.

Table-9: Correlation matrix of demand, supply and price (average of five genotypes of gladiolus)

	Relative Demand	Relative Supply	Price
Relative Demand	1		
Relative Supply	0.968503	1	
Price	-0.90525	-0.9484	1

Base line demand = 100% (February)

Base line supply = 112% (February) with respect to demand in February.

Price is recorded in actual value (TV/stick)

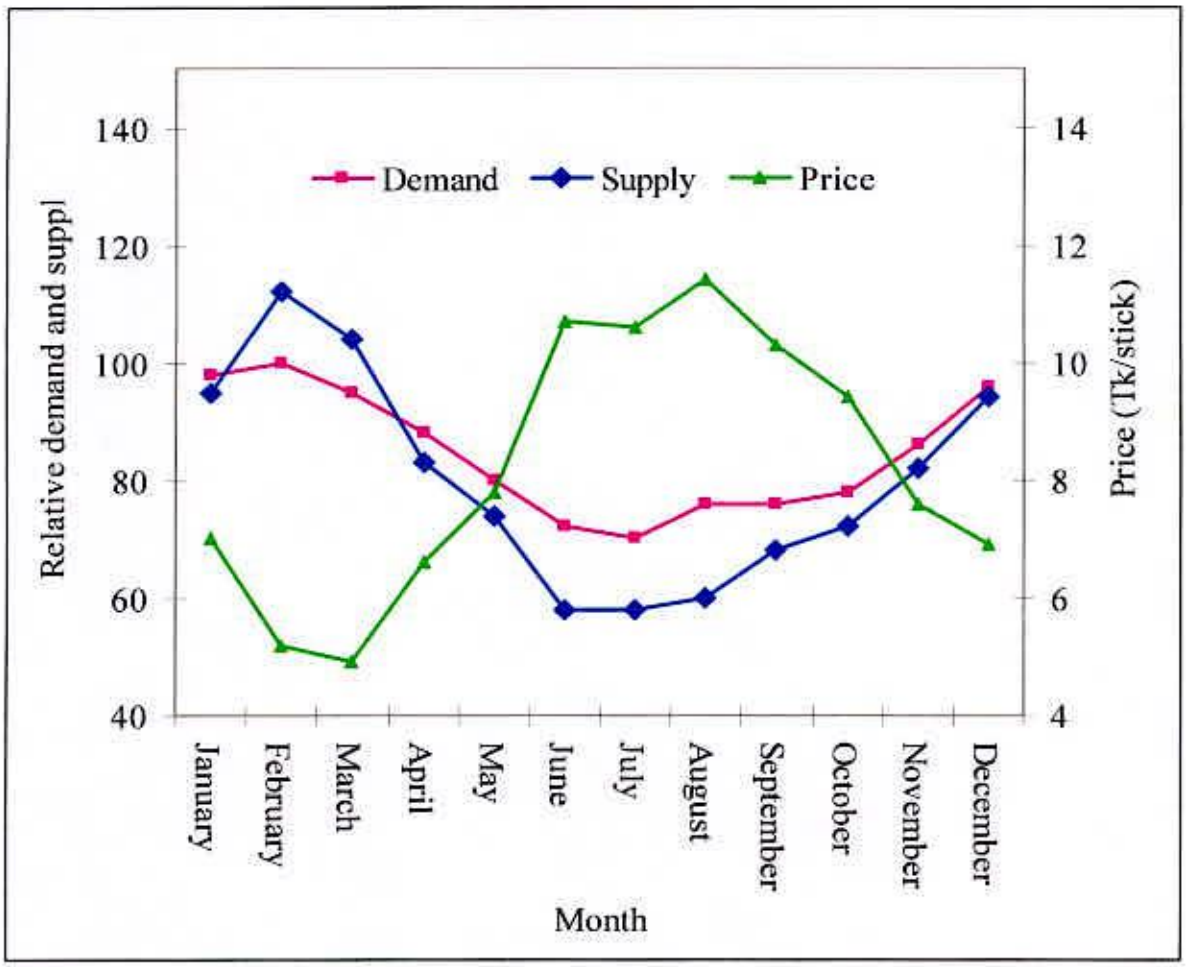


Fig-2: Monthly (2008-2009) Relative demand supply and price of flowers (average of five genotypes of gladiolus) in wholesale market at Dhaka city

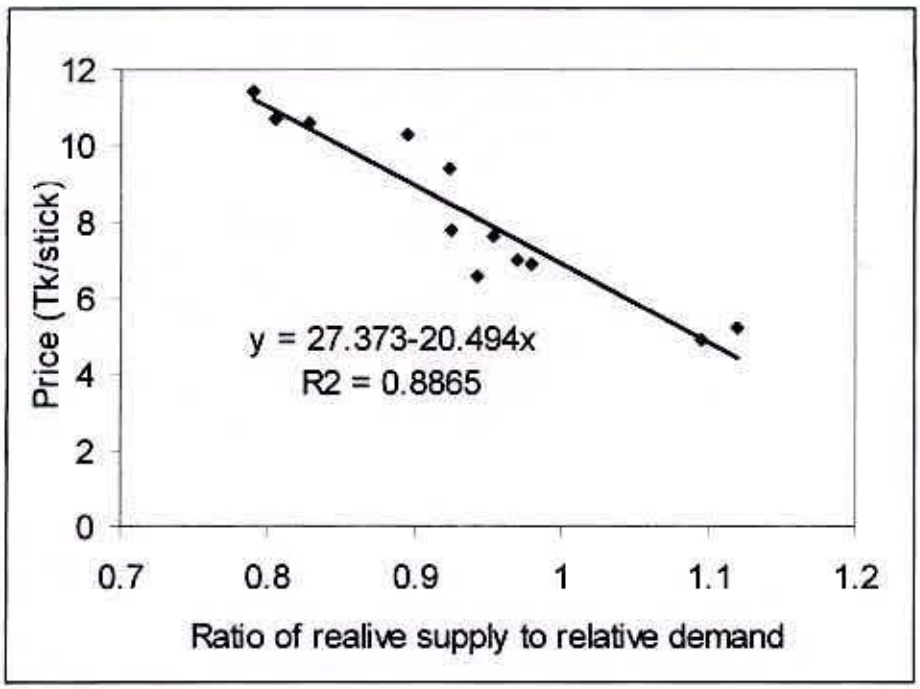


Fig-3: Regression of price of flower (y) on the ratio of relative supply to relative demand (x)

4.7 Price of different type of gladiolus flower in different month of the year

Significant differences were for price of gladiolus in different month of the year (Table 10). Average price of gladiolus flower varied from 5.10 Tk. to 11.40 Tk. on different month of the year. The average highest price was observed in August (11.40 Tk.) and the lowest price was observed in March (5.10 Tk.). On the other hand, significant differences were in respect of price among the genotypes under investigation (Table 8). The average highest price was observed in White (11.95 Tk.) genotype which was closely followed by Violet (10.58 Tk.) and Yellow (10.20 Tk.). The average lowest price was observed in Orange (2.9 Tk.) genotype.

4.8 Price of different types of gladiolus flower in different days of the week

Significant differences were in respect of gladiolus in different days of the week (Table 11). Average price of gladiolus flower varied from 4.9 Tk. to 7.5 Tk. in different days of the week. Average highest price was observed in Thursday (7.5Tk.), which was closely followed by Friday (7.5Tk.). The average lowest price was observed in Saturday (4.9Tk.), which was closely followed by Sunday (4.9Tk.). On the other hand, significant differences were in respect of price among the genotypes in different days of the week under investigation (Table 9). The average highest price was observed in white (8.42Tk.) which was followed by Violet (7.57Tk.) and Yellow (7.42Tk.). The average lowest price was observed in Orange (1.92Tk.) genotype.

Table-10: Price of different type of gladiolus flower in different month of the year

Color	January	February	March	April	May	June	July	August	September	October	November	December	Average
White	10.00	8.00	7.00	10.0	12.0	15.50	15.0	16.00	15.00	14.00	12.00	10.00	11.95
Yellow	8.00	6.00	6.00	8.00	10.0	14.00	14.0	15.00	13.00	12.00	9.00	8.50	10.20
Orange	2.00	2.00	2.00	3.00	3.00	4.00	4.00	4.00	4.00	3.00	2.00	2.00	2.90
Violet	9.00	6.00	6.50	8.00	10.00	14.50	14.50	14.50	13.00	12.00	10.00	9.00	10.58
Red	6.00	4.00	4.00	5.00	5.00	6.50	6.50	7.50	6.50	6.00	5.00	5.00	5.50
Av.	7.00	5.20	**5.10**	6.80	8.00	10.90	10.80	**11.40**	10.30	9.40	7.60	6.90	-

Table-11. Price of different types of gladiolus flower in different days of the week

Colour	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Average
White	**7.00**	**8.00**	**8.00**	**9.00**	**10.00**	**10.00**	**7.00**	**8.42**
Yellow	6.00	7.00	7.00	8.00	9.00	9.00	6.00	7.42
Orange	**1.50**	**1.50**	**2.00**	**2.00**	**2.50**	**2.50**	**1.50**	**1.92**
Violet	6.00	7.00	7.50	8.50	9.00	9.00	6.00	7.57
Red	4.00	5.00	5.00	6.00	7.00	7.00	4.00	5.42
Average	4.90	5.70	5.90	6.70	7.50	7.50	4.90	-

4.9 Price of different types of gladiolus in different special days of the year

Marked differences were for price of gladiolus in different special days of the year (Table 12). The average highest price was observed in Valentine's Day (10.60) which was closely followed by Pahelabaishakh (10.60). The average lowest price was observed in National Independent Day (7.50Tk), which was followed by International Mother Language Day (8.00Tk) and National Victory Day (8.00). On the other hand, significant differences were in respect of price among the genotypes in different special days of the year under investigation (Table). The highest price was observed in White (13.33) which was followed by Violet (11.66) and Yellow (10.50). The average lowest price was observed in Orange (3.00Tk) genotype.

Table-12: Price of different types of gladiolus flower in different special days of the year

Color	Valentine's day (14th Feb.)	International mother language day (21st Feb.)	Independent day(26th March)	Bengali new years day	National Victory day (16th December)	English new year	Average
White	**15.00**	**12.00**	**12.00**	**15.00**	**12.00**	**14.00**	**13.33**
Yellow	12.00	10.00	8.00	12.00	10.00	11.00	10.5
Orange	**4.00**	**2.00**	**2.00**	**4.00**	**2.00**	**4.00**	**3.00**
Violet	14.00	10.00	10.00	14.00	10.00	12.00	11.66
Red	8.00	6.00	5.50	8.00	6.00	8.00	6.91
Ave.	10.60	8.00	7.50	10.60	8.00	9.80	-

4.10 Production of hybrid seed

4.10.1 Days to capsule maturity

Differences regarding the days to capsule maturity were observed among the crosses (Table 13) and varied from 22 days to 36 days. The cross Yellow × White took maximum days (36 days) to capsule maturity which was closely followed by crosses yellow × Orange (35 days), Yellow × Violet (35 days) and Yellow × Red (34 days). The cross white × Orange took 31 days which was closely followed by crosses White × Violet (31 days), White × Yellow (30 days) and White × Red (30 days). The cross Red × Orange took 28 days to capsule maturity which was closely followed by crosses Violet × Orange (27 days), Red × Violet (27 days) and Red × Yellow (27 days), Violet × Yellow (26 days), Violet × Red (26 days) and Violet × White (25 days). The cross Orange × Violet took the minimum days (22 days) which was closely followed by the crosses Orange × Red (22 days), Orange × White (23 days) and Orange × Yellow (23 days).

Misra (1975) reported that the genotype required about four to six weeks of pollination to capsule maturity.

Table 13. Diallel crosses among the selected genotypes of Gladiolus

Crosses	Days to capsule maturity	Length of capsule (cm)	Breath of capsule (cm)	Wt. of capsule (g)	No. of seed/ capsule	1000 seed Wt. (g)
White × Yellow	30	2.67	3.44	0.27	21.76	4.60
White × Orange	31	2.57	3.30	0.26	24.32	4.50
White × Violet	31	2.74	3.42	0.27	35.00	4.61
White × Red	30	2.68	3.44	0.28	25.00	4.50
Yellow × Orange	35	2.35	3.29	0.19	15.23	4.32
Yellow × Violet	35	2.68	3.45	0.25	37.52	4.44
Yellow × Red	34	2.75	3.66	0.26	38.40	4.66
Orange × Violet	22	2.22	2.97	0.18	15.28	3.38
Orange × Red	22	2.18	3.08	0.22	18.80	3.84
Violet × Red	26	2.50	3.33	0.23	15.08	4.08
Yellow × White	36	2.73	3.39	0.24	24.32	4.32
Orange × White	23	2.36	3.07	0.23	16.68	3.92
Violet × White	25	2.38	3.10	0.25	24.76	4.28
Red × White	26	2.56	3.20	0.25	17.28	4.26
Orange × Yellow	23	2.16	3.03	0.22	18.20	3.63
Violet × Yellow	26	2.37	3.23	0.26	19.72	4.24
Red × Yellow	27	2.81	3.39	0.27	19.00	4.48
Violet × Orange	27	2.42	3.05	0.23	20.52	4.04
Red × Orange	28	2.76	3.39	0.27	17.40	4.50
Red × Violet	27	2.52	3.09	0.21	20.68	4.16

4.10.2 Length of capsule (cm)

Crosses had displayed a slight range of differences among them in respect of capsule length (Table 13). The longest capsule (2.81 cm) was produced by cross Red × Yellow which was closely followed by the crosses White × Violet (2.78 cm), Red × Orange (2.76 cm), Yellow × Red (2.75 cm) and Yellow × White (2.73 cm) while the shortest capsule (2.16 cm) was produced by cross Orange × Yellow which was followed by cross Orange × Red (2.18 cm). Capsules of different genotypes of gladiolus flower are presented Plate 6.

4.10.3 Breadth of capsule (cm)

There had slightly varied (2.97 cm to 3.66 cm) in capsule breadth among the crosses (Table 13). The cross yellow × Red attained the maximum capsule breadth (3.66 cm), which was followed by the crosses Yellow × Violet (3.45 cm), White × Yellow (3.44 cm) , White × Red (3.44 cm) and White ×Violet (3.42 cm). Breath of capsule was found to be minimum in cross Orange × Violet (2.97 cm). Capsules of different genotypes of gladiolus flower are presented Plate 6.

4.10.4 Weight of capsule (g)

Crosses had displayed a slight range of differences among then in respect of capsule weight. It ranges from 0.18 g to 0.28 g (Table 13). High capsule weight was recorded from the cross White × Red (0.28 g) which was closely followed by the crosses Red × Orange (0.27 g), Red × Yellow (0.27 g), White × Violet (0.27 g) and White × Yellow (0.27 g). The lowest capsule weight was recorded from the the cross Orange × Violet (0.18 g) which was followed by the crosses Yellow × Orange (0.19 g).

Plate-6a: Bagging after crossing

Plate-6b: Capsule of GL-04

Plate-6c: Capsule of GL-22, GL-16 And GL-12

Plate-6d: Capsule of GL-21

Plate-6e: True seeds of different gladiolus genotype

Plate-6: Capsules and true seeds of different gladiolus genotype

4.10.5 No. of seed per capsule

Differences recording the number of seed per capsule among the crosses were observed and varied from 15.08 to 38.40 (Table 13). The highest number of seed per capsule was produced by the cross Yellow × Red (38.40) which was followed by the cross Yellow × Violet (37.52) and White × Violet (35.00). The cross Violet × Red produce the lowest number of seed per capsule (15.08) which was followed by the cross Orange × Violet (15.28), Orange × White (16.68). Seeds of different genotypes of gladiolus flower are presented Plate 6.

Misra (1976) reported that Gladioli set seed abundantly and about 60 seeds are normally formed in three chambers of each capsule.

4.10.6 Weight of Thousand Seed (g)

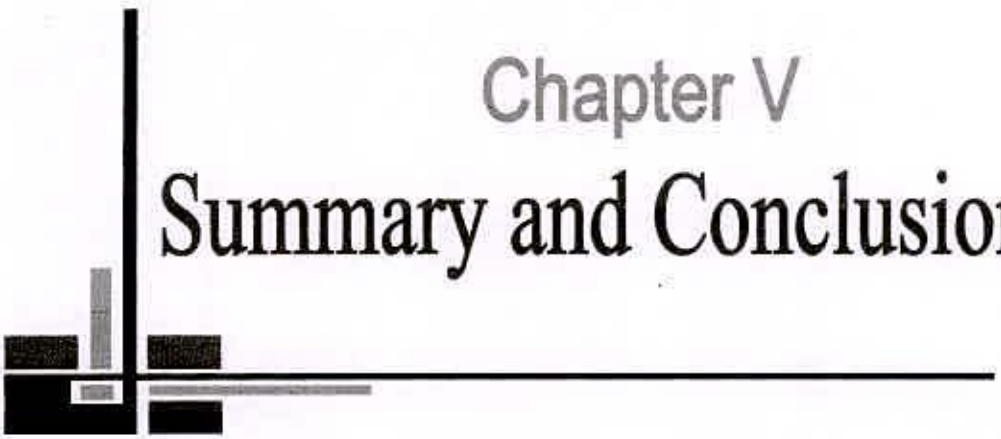
There had difference in weight of thousand seed among the crosses (Table 13). The highest weight of thousand seed was produced by the cross Yellow × Red (4.66 g) and which was followed by the crosses White × Violet (4.61 g) and White × Yellow (4.60 g). The lowest weight of thousand seed was produced by the cross Orange × Yellow (3.58 g) which was followed by crosses Orange × Red (3.63 g) and Orange × Red (3.84 g).

4.11 Germination test of F_1 seed

The F_1 seed collected from different crosses was dried and stored for germination test. Some seeds were sown thinly direct on the raised beds in the soil and some in the pot/container on different depth and dates for germination test. Seeds were not germinated under the normal field condition in all cases.

Misra (1978) reported that after sowing, the containers are kept in greenhouse at the temperature between 7 and 13 degree centigrade and seeds germinate in 3 to 5

weeks. Seeds on germination strike a single root down and send up single glass-like blade above the ground. When this root is well established it starts contracting and takes the plant down into the soil. The second leaf may appear after 3weeks. After the seedlings have attained a good growth (in about 2-3 months), these are shifted from greenhouse to a sheltered position at 24 degree centigrade to grow for whole of the season. The seedlings are raised in open need not be shifted and may be grown throughout the cycle. The soil should be kept moist and during summer the seedlings are to be fed with liquid manure to help in developing the corms. The moisture in seed bed could be maintained by using some mulch.



Chapter V

Summary and Conclusion

SUMMARY AND CONCLUSION

Summary

An experiment was conducted at the Floriculture project of Society And Human Development Organization, Tangail (SAHDOT), Village-Shota Gobra, P.O-Gohail Bari, U.P- Bahuria, Mirzapur, Tangail during the period from November, 2008 to October, 2009 to study the variability, Market demand, Production of hybrid seed and % of seed germination of Gladiolus Flower.

The five parental genotypes used in the study were White (GL-21), Yellow (GL-04), Orange (GL-16), Violet (GL-12) and Red (GL-22) which chosen for their genetic divergence and diverse origin. The characteristics studied were plant height, days to 50% flowering, leaf length, leaf breadth, no. of leaf per plant, length of flower, breath of flower, weight of floret, wt. of single stick, length of spike, length of rachis, no. of flowers per plant, no. of corm per plant, breadth of corm, wt. of corm, no. of cormel per plant, wt. of cormel per plant, days to capsule maturity, length of capsule, breath of capsule, wt. of thousand seed and demand of Gladiolus in different months of the year, different days of the week and different special days of the year. The salient findings of the present study had been summarized below.

All the genotypes varied significantly with each other for all the characters studied. The genotypes Yellow (58.65cm) and Orange (46.52cm) exhibited maximum and minimum plant height, respectively. The height leaf number was obtained by White

(12.25) and lowest in Yellow (8.50). Leaf length ranged from 33.36 cm (Red) to 42.25 cm (Yellow), respectively. The maximum number of flower was found in White (14.25) and the minimum number of flower was found in Orange (8.40). The White genotype took minimum days (60 days) to 50% spike initiation while the maximum days were required for the genotype Yellow (70 days). The highest spike length (92.05cm) was found in genotype White and the lowest in Orange (59.63cm). Regarding rachis length, the genotype white produced the longest rachis (47.30cm) while the shortest rachis (25.66cm) was observed in Orange genotype. The highest weight of single stick was obtained from white (53.87g) and lowest in orange (26.47g) genotype.

A large variation in qualitative trait of Gladiolus genotypes was recorded. As regards to color of flower, the observed genotypes showed remarkable variation such as, White, Yellow, Orange, Violet and Red colors. Genotype Orange had funnel shaped floret as well as thin floret texture. Open faced floret and thick texture were recorded in rest of the genotype. One genotype Violet had floret with wavy margin while rest had florets with plain margins. All the genotypes rated moderately tolerant except Orange which was found susceptible to disease.

The variation of corn and cormel production was remarkable. The highest and lowest number of corm was ranged from 1.15 to 2.55. The genotype Yellow had produce maximum (37.76 g) and Orange produced minimum (18.16 g) corm weight, respectively. Number of cormel ranged from 25.70 to 43.20. The highest number of cormel (43.20) was observed in White and the lowest (25.70) in Red

genotype. As regard to cormel weight, White genotype produced the highest weight (6.40 g) while the Orange genotype produced the lowest weight (5.20 g).

A large difference in market demand and price of Gladiolus genotypes were recorded. The highest and the lowest price of Gladiolus flower was ranged from 2.00 to 15.00 per stick. The White genotype had the highest price (15.00 per stick) while the Orange genotype had the lowest price (2.00 Tk. per stick).

Among the twenty crosses differences regarding the days to capsule maturity were observed and varied from 22 days to 36 days. The cross yellow × white took maximum days (36 days) to capsule maturity while the cross Orange × Violet took the minimum days (22 days). Crosses had displayed a slight of differences among them in respect of capsule length. The crosses Red × Yellow (2.81 cm) and Orange × Yellow (2.16 cm) exhibited maximum and minimum capsule length, respectively. The highest capsule breadth (3.66 cm) was found in the cross Yellow × Red and the lowest (2.97 cm) in the cross Orange × Violet. The weight of capsule ranged from 0.18 g (Orange × Violet) to 0.28 g (White × Red), respectively. Regarding the number of seed per capsule. The cross yellow × Red produced the highest (38.40) number of seed per capsule while the lowest (15.08) was observed in Violet × Red Cross. The highest weight (4.66 g) of thousand seed was obtained from Yellow × Red and the lowest (3.58g) was obtained from Orange × Violet cross.

In respect of seed (F_1) germination, the germination test of F_1 seeds (collected from different crosses) was observed. Seeds were not germinated under the normal field condition in all cases.

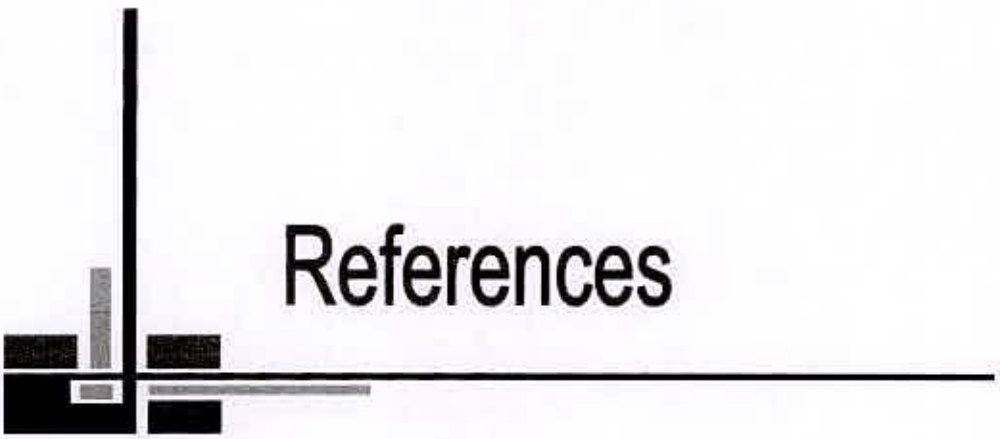
Conclusion:

1. Evaluation of morphological characters indicated a great variation among the gladiolus genotypes in respect of both qualitative and quantitative characters.
2. Demand and price of gladiolus flower varied in different month of the year, different days of the week and different special days
3. With regards to different crosses positive result was observed. All crosses had produced a lot of F_1 seed.
4. With regards to seed germination, seeds were not germinated under the normal field condition in all cases.

Recommendation:

Considering the situation of the present experiment, further studies in the following areas may be suggested.

1. The study on seed germination is needed in different Agro-ecological zones (AEZ) of Bangladesh for regional performance.
2. Intensive research should be applied for the germination of Gladiolus true seed.
3. Tissue culture or other modern techniques may be followed to overcome the dormancy of Gladiolus true seed.



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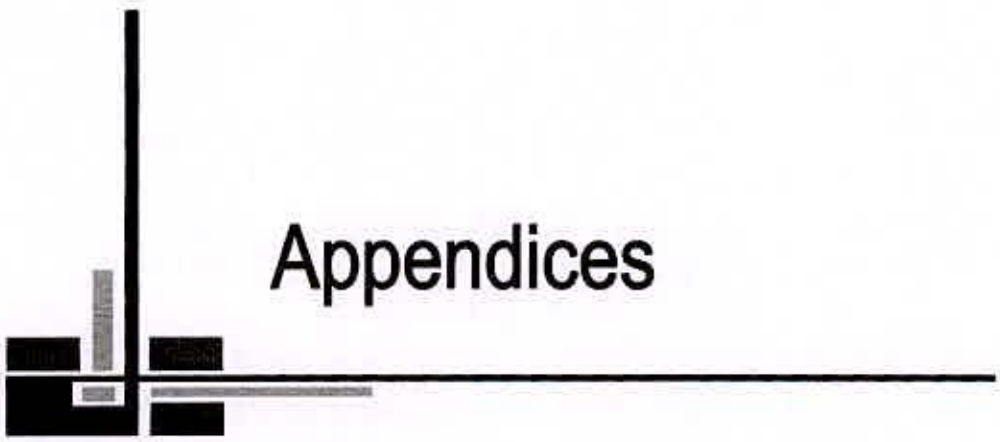

Appendices

Appendix 1. Physical and chenical composition of soil

1. A. Physical composition of soil

Sl. No.	Soil Separates	% of Contents	Soil Textural Class
01	Sands	35.66	Clay Loam
02	Silt	24.50	
03	Clay	35.80	

1. B. Chemical composition of soil

Sl. No.	Elements	% of Elements	Soil Textural Class
01	pH	5.6	Clay Loam
02	Organic matter	1.00	
03	Total N	0.068	
04	Available P(mgP_2O_5/100g soil)	6.00	
05	Exchangeble K(meq/100g soil)	0.075	

Appendix 2. Monthly average temperature, relative humidity and total rainfall of experimental site during the period from November, 2008 to October, 2009

Year	Months	**Air temp.(^{0}c)		*Relative humidity (%)	*Rainfall(mm)
		Max.	Min.		
2008	November	28.32	18.27	80.00	43
2008	December	28.50	15.45	78.50	95
2009	January	20.58	14.30	78.75	00
2009	February	21.71	17.55	72.50	00
2009	March	28.78	19.20	71.00	10
2009	April	32.52	25.15	78.50	75
2009	May	32.75	25.50	81.75	350
2009	June	31.25	24.40	80.00	410
2009	July	30.36	27.75	85.50	420
2009	August	30.09	28.21	85.75	430
2009	September	32.60	24.50	88.75	445
2009	October	31.13	22.26	85.50	60
Average		**29.49**	**21.87**	**85.41**	**194.83**

***Monthly Average**
**** Monthly Total**
Source: Agriculture Office, Upazilla-Mirzapur, District-Tangail