INFLUENCE OF BIO-INOCULANTS, FYM AND INORGANIC FERTILIZERS IN GLADIOLUS (*Gladiolus grandiflorus* L.) cv. AMERICAN BEAUTY

A

THESIS
SUBMITTED TO THE
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI

IN

PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR
THE AWARD OF THE DEGREE

OF

DOCTOR OF PHILOSOPHY
(HORTICULTURE)

IN

FLORICULTURE AND LANDSCAPING

BY

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OCTOBER – 2009

Registration No. 04 – 0254 – 2006

ABSTRACT

INFLUENCE OF BIO-INOCULANTS, FYM AND INORGANIC FERTILIZERS IN GLADIOLUS (*Gladiolus grandiflorus* L.) CV. AMERICAN BEAUTY

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ABSTRACT

The present experiment entitled "Influence of bio-inoculants, FYM and inorganic fertilizers in gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was carried out during late *Kharif* season of 2007 and 2008 at Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat).

The experiment was laid out in a Randomized Block Design with Factorial concept (FRBD) with three replications and twelve treatment combinations, comprising of two treatments of Bio-inoculants (Inoculation of AZT + PSB and No inoculation), two treatments of FYM (FYM @ 5.0 kg/plot and No FYM) and three treatments of inorganic fertilizers (50 % RDF, 75 % RDF and 100 % RDF).

Among various bio-inoculants treatments, an inoculation of corms in dual culture of AZT + PSB (B_1) enhanced growth, yield and quality parameters as well as soil and plant nutrient content as compared to uninoculation. However incase of FYM, application of FYM @ 5 kg/m^2 significantly increased growth, yield and quality parameters and also soil and plant nutrient contents as compared to no application of FYM. Whereas, incase of inorganic fertilizers, among different levels of inorganic fertilizers an application of 100 % RDF significantly increased growth, yield and quality parameters as well as soil and plant nutrient content which was statistically at par with 75 % RDF in many parameters which ultimately decreased the further application of inorganic fertilizers. As far as CBR concerned, the combined application of $B_1F_1C_2$ (AZT + PSB Inoculation, FYM @ 5 kg/m^2 and 100 % RDF) resulted in the highest net realization of Rs. 10,34,407.11 Rs/ha with 1 : 3.78 CBR which was closely followed by $B_1F_1C_1$ (1: 3.25) that may ultimately reduced excessive application of inorganic fertilizers.

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CERTIFICATE

This is to certify that the thesis entitled "INFLUENCE OF BIO-INOCULANTS, FYM AND INORGANIC FERTILIZERS IN GLADIOLUS (*Gladiolus grandiflorus* L.) cv. AMERICAN BEAUTY" submitted by **Mr. CHAUDHARI SACHIN RATILAL** in partial fulfillment of the requirements for the award of the degree of **DOCTOR OF PHILOSOPHY (HORTICULTURE) in FLORICULTURE AND LANDSCAPING** of the Navsari Agricultural University is a record of bona fide research work carried out by him under my guidance and the thesis has not previously formed the basis for the award of any degree, diploma or other similar title.

Place : Navsari.

(J.R. Desai)

Date : 13th October, 2009

Major Advisor

DECLARATION

This is to declare that the whole of the research work submitted in this thesis for the partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY (HORTICULTURE)** in **FLORICULTURE AND LANDSCAPING** is the result of investigation done by the undersigned under the direct guidance and supervision of **Dr. J. R. Desai,** Associate Professor, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari and that no part of the work has been submitted for any other degree so far.

Place : Navsari

Date : 13th October, 2009

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ACKNOWLEDGMENT

I would like to express my deepest sense of gratitude and reverence to my major guide and chairman of my advisory committee Dr. J. R. Desai, Associate Research Scientist, Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, for his able guidance, critically going through the manuscript and rendering me all the possible help during the entire Ph.D. studies.

I am thankful to my minor advisor: Dr. B.V. Padhiyar, Associate Professor of Pomology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, for providing the valuable help, constant attention and critically going through the manuscript and giving constructive criticisms.

I take proud privilege to record of my grateful thanks to the members of my advisory committee, for their valuable help, constant attention and useful suggestions rendered by: Dr. Alka Singh, Assistant Professor of Floriculture, and Dr. S . J. Patil, Assistant Research Scientist (Hort.), Soil and Water Management Research Unit, Mr. H.N. Chhatrola, Assistant Professor (Statistics).

I also want to pay my cordial thanks to Farm Staff, Maheshbhai, Patel Hiren and other labour staff for providing all facilities and sincere help during the course of my research.

I express my sincere thanks to my colleagues and friends especially Dr. M. B. Tandel, Mr. M. R. Chamar, Mr. N. K. Patel, Tejas Ahir, Parita Shah, Aditi and Anisha for ever ready help to me during the course of my research.

My vocabulary fails to get word to express my respect and sense of gratitude to my Father Ratilal Chaudhari, Mother Rekhaben and beloved wife Shital and daughter Grishma for their everlasting love, constant encouragement, inspiration, prayer, support and guidance. Lastly, I would like to express my enormous indebtedness and deep sense of gratitude to the GOD for providing me spiritual exuberance and infinitum.

Place: Navsari

Date: 13th October, 2009

(S. R. Chaudhari)

CONTENT

LIST OF TABLES

Contd.... **List of Table**

LIST OF FIGURES

Contd... List of Figure

LIST OF PLATES

LIST OF ABBREVIATION AND SYMBOLS

Sr. No.	Abbreviation	Meaning
1.	%	Per cent
2.	°C	Degree Celsius
3.	C.D.	Critical difference
4.	C.V.	Co-efficient of variance
5.	S.Em.	Standard error of mean
6.	cm	Centimeter
7.	cm^2	Square Centimeter
8.	cv.	Cultivar
9.	ha	Hectare
10.	MT	Metric Tones
11.	*et al.*,	And his co-workers
12.	Anon	Anonymous
13.	Rs.	Rupees
14.	CBR	Cost Benefit Ratio
15.	AZT	Azotobacter
16.	PSB	Phosphate Solubilizing Bacteria
17.	AZO	Azospirillum
18.	FYM	Farmyard Manure
19.	RDF	Recommended Dose of fertilizer

INTRODUCTION

I. INTRODUCTION

The God's best gift to humankind is flower. Flowers are delicate, colorful and bright, attracting insects, animals and human beings. Flowers are the soul of the garden and convey the message of nature to man and vice versa. Flowers have been integral part of human life even before humans could find speech and alphabets for the dissemination of their ideas and feelings. Different flowers and their colours have played a very vital role in communication of our feelings and emotions with more impact than the words. During the Victorian reign the flower language was considered most noble than verbal languages.

Man has traditionally used flowers for expressing or exhibiting his innermost feeling to God and deities or presenting it to beloved ones or complementing anyone or versifying any conceivable emotion. Floriculture which is an ancient farm activity with immense potential is now not only generating remunerative self employment among small and marginal farmers, but also earning the much needed foreign exchange as well. Now a day's with the floriculture industry urban Indian has becoming an exceedingly lucrative business. Sending bouquets for birthdays, weddings, anniversaries and other occasions, sending flowers as seasonal or festive are gifts is becoming a common practice, today, flowers are preferred over sweets or chocolates as presents, and the awareness of exotic flowers has percolated to middleclass as well.

Flowers and their different colours also symbolize different human moods viz., red symbolizes energy, blue for peace and tranquility, white for purity and pink for affection etc. Colours play a very important role in our lives. Colour is the quality by which objects we have a different impact to our eyes, independents of their forms. For a floral designer, colour is an ultimate dimension to his creation. The impact of colour is so tremendous in our mind that the name of colour itself is able to draw out attention to the attributes of a thing that is resembled by that colour eg. 'Red as rose', or 'green as grass', or 'black as tar' etc.

Gladiolus (*Gladiolus grandiflorus* L.) "Queen of bulbous flowers" is a leading cut flower of India belonging to family Iridaceae. It is a glamorous bulbous flowering plant standing for its beauty and perfection. It is a prominent bulbous cut flower plant which is also known as 'sword lily' due to its sword shaped leaves or 'corm flag' which is a popular subtropical cut flower grown on almost all over the world. Previously it was known by the name 'Iris'. It has got a prestigious place both in national and international flower trade. Gladiolus is a popular cut flower grown almost all over the world; whereas in India it has recently gained importance as a modern cut flower, although the herbaceous winter flowering plants was introduced in country only during 19th century. It is ideal both for garden and floral decorations. It is excellent for beds, rockeries, pots, herbaceous borders and cut flowers. The

herbaceous plant sprouts from auxiliary buds of an underground structure, the corm which is modified thickened, fleshy stem covered by 4 – 6 dry scales which are basis of old leaves.

There are about 226 species from different parts of Africa and particularly, Cape of Good Hope and Natal is considered to be the centre of diversification of the genus. It is native of Mediterranean region and Tropical South Africa and Asia. The common cultivated species are *Gladiolus primulinus, G. childsii, G. tristis, G. cardinalis, G. colvilli, G. byzantinus, G. psittacinus* and *G. grandavensis*. The existing varieties have arisen from crosses between the species. The species *G. primulinus* have however, contributed the most in evolving an ornamental gladiolus. The presently cultivated gladiolus hybrids (*Gladiolus grandiflorus* L.) have been developed genetically from 20-25 species out of many species found in its native place. There are about 30,000 varieties and about 200 are added and deleted every year because of degeneration. The flowers are variously coloured, pink to reddish or light purple with white, contrasting marketing or white to cream or orange to red. They can be of any colour except true blue, although some of the violet appears to be very near to blue in subdued light.

Floret of American Beauty var. of gladiolus is redish pink in colour with whitish throat and whitish blue anthers, spike 70-75 cm long with 15-16 florets of 9.5-10.5 cm size. Each corm produces 70-80 cormels with 2-3 corms.

Gladiolus stands 4th in the international cut flower trade after rose, carnation and chrysanthemum. It is only flower crop accepted in European countries when grown in open field. Hence as a cut flower, it has great potential for export to European countries during winter months to earn valuable foreign exchange for our country. Ornamental bulbous crops contribute a major share to the global floriculture business with a contribution of 7 per cent of the trade amounting to U.S. $ 931 million. The contribution of bulbous ornamentals in the landscape sector is non-significant but silent.

World trade in cut flowers is around Rs 16,000 crore and India's share is negligible. Rose and carnation are two flowers in demand in the world market followed by chrysanthemum, orchids and gladiolus. Indian commercial flower cultivation is in development. At present there are about 70 export oriented units in operation and floriculture export had gone up to Rs. 24,954.84 lakh during 2003-2004 but in 2004-2005 the value dropped by 15.45% to Rs. 21,099.00 lakh (Gokak, 2006). The area under flower crops in India has increased to 1, 06,477 ha with the production of 5.5 lakh metric tones of loose-flowers and 25,847 lakh number of cut-flower-stems (Anon, 2006). The increasing passage and exotic flowers to foreign nation mostly western countries have given Commerce Ministry the sweet whiff of goldmine.

The scope of floriculture in India has increased tremendously, which is evident from the 22.0% increase in area

from 53,000 ha (1993-94) to 1,60,720 ha (2007-08) and more than 27.0% increase in loose flower production 2,33,000 kg in 1993-94 to 870 M.T. in 2007-08 and 68.0% increased in cut flower production from 555 in 1993-94 to 4342 million nos. in 2007-08.(Anon, 2008).

The South Gujarat has taken a big leap in flower cultivation. A total of 7.5 lakh ha area of Gujarat is under the cultivation of horticulture crops out of which 5,000 ha area is under floricultural crops with production of 30187 MT (Anon, 2006). The area under floriculture has been increasing at 5 to 6 per cent every year because of increased demand and more use of flowers. Six district of South Gujarat having 1318 ha area with a production of 8266 MT, accounts for 27 per cent of total area and production of flower in Gujarat. (Dhaduk and Panj, 2006)

Gladiolus can be cultivated on all types of soil having good structure and drainage. The soil pH range of 6.0-7.0 is ideal for good growth and spike production. It is a winter season crop but can be grown during rainy season in low rainfall areas with mild climate. Its cultivation is found in most of the states either for garden display or for commercial purposes. The main centers of its commercial cultivation being Srinagar (Jammu and Kashmir), Simla (Himachal Pradesh), Chaubattia and Supi (Uttar Pradesh), Kalimpong and Darjeeling (West Bengal), Shilong and Jorhat

(Assam), Pune (Maharashtra), Bangalore (Karnataka) and Ooty (Tamil Nadu).

Nutrients play an important role in determining the growth and yielding ability of crop. The indiscriminate application of chemical fertilizer alters the soil fertility, leading to the pollution of soil and water bodies. The use of organic manures holds prestigious position with the farmers since long back. The organic manures play an important role in crop production. It helps the soil physically. Organic matter promotes formation of soil crumbs that help the easy absorption of rainwater. Chemically, organic manures add an organic compound to the soil while going under decomposition. Biologically, organic manures provide food for the beneficial soil microorganisms.

Biofertilizers are microbial inoculants of selective microorganisms like bacteria, algae, fungi, already existing in nature. They may help in improving soil fertility by the way of accelerating biological nitrogen fixation from atmosphere, solubalization of the insoluble nutrients already present in soil, decomposing plant residues, stimulating plant growth and production. The process consumes less energy and provides cheap nutrients to agriculture without polluting the nature.

Azotobacter is one of the most important non-symbiotic nitrogen fixing micro-organism. A number of experiments conducted have shown a positive response to *Azotobacter* application on a wide

range of crops like cereals, cash crops, flower crops and vegetables. It is observed that, the one ton of *Azotobacter* is equivalent to 40 tonnes of nitrogen. Considering minimum fixation of 20 kg N ha^{-1} from application of *Azotobacter* culture 0.5 kg ha^{-1}, the bioinoculants can save 25 to 35 per cent of the requirement of inorganic nitrogen per hectare (Vyas *et al.*, 1998). The beneficial effect of *Azotobacter* is attributed to its N fixing capacity (15-30 kg ha^{-1}) and ability to produce growth promoting substances like auxins, gibberellins and cytokinins (Azcon and Barea, 1975).

Phosphate Solubilizing Bacteria are useful for all the crops i.e. cereals, cash crops, leguminous crops, horticultural crops, vegetables, flowers etc. The effective strain of Phosphate Solubilized Bacteria increased the level of available P_2O_5 in the soil. With the increase in available P_2O_5 level, overall plant growth can be increased. In certain condition they also exhibit anti-fungal activities and thereby fungal diseases may be controlled indirectly. About 10 to 15% increase of crop yield can be achieved with the use of this culture.

The bacterial culture can be produced cheaply and with ease in India to meet the entire demand. The estimated production of bio-inoculant in India during 1999-2000 is 10038.9 tonnes, which has increased to 532206 tonnes (2003), out of this Gujarat produces 630.8 tonnes and is likely to produce 800 tonnes during 2000-2001.

The production of Azotobacter and PSB have increased to 145953 tonnes and 25,534 tonnes, respectively during 2003 in India.

However, considering the recent concept of eco-technology and increased cost of chemical fertilizers, use of cost effective and eco-friendly bio-fertilizers which was currently attained especially significance in crop production to address the sustainability problem and tremendous success has been achieved in several economic crops. In order to reduce the dose of chemical fertilizers and supplement these with low cost input like bio-fertilizer, therefore present investigation is proposed to under taken under field condition of South Gujarat with below objectives.

i) To study the effect of bio-inoculants on growth, flowering, yield and quality of gladiolus cv. American beauty.

ii) To study the effect of FYM on growth, flowering, yield and quality of gladiolus cv. American beauty.

iii) To study the effect of inorganic fertilizers on growth, flowering, yield and quality of gladiolus cv. American beauty.

iv) To find best combination of bio-inoculants, FYM and inorganic fertilizers on growth, flowering, yield and quality of gladiolus cv. American beauty.

v) To worked out economics of different treatments.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

In order to evaluate the influence of bio-inoculants, FYM and inorganic fertilizers in gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty, an experiment was conducted at Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during the year 2007-08 and 2008-09. In recent years, intensified research has been in progress for ascertaining the usefulness of bio-inoculants and FYM with combination of inorganic fertilizers to improve and modify the existing pattern of cultivation and ultimately the yield and quality of farm produce to meet the growing needs of consumers and farmers both. Review concerning multiple aspects of bio-inoculants, FYM and inorganic fertilizers and their effect on plant and its products is presented in this chapter. The relevant literature available on different aspects in Gladiolus as well as to meet the objectives, supporting works on the other flower crops was collected and reviewed under the following heads:

2.1 Effect of bio-inoculants

2.2 Effect of organics

2.3 Effect of inorganic fertilizers

2.4 Interaction effect

2.5 Effect of bio-inoculants, FYM and inorganic fertilizers on economics of cultivation

2.6 Effect of bio-inoculants, FYM and inorganic fertilizers on nutrient content and uptake

2.1 Effect of Bio-inoculants

Bio-fertilizers which are known for efficient nitrogen fixing, phosphorus solubilizing or cellulose decomposing microorganisms, when applied it enhances the availability of nutrients to plant providing an economically viable and ecological sound means of reducing external input of chemical fertilizers.

Azotobacter is free living nitrogen fixers, however in plant rhizosphere due to availability of various readily utilizable carbon compounds, the bacteria are considered to be advantage for plant growth and yield (Gupta and Pandhar, 1996). Likewise, PSB enhances the availability of phosphorus.

The bio-fertilizer inoculated plant resulted in earlier flowering (112.80 day) as compared to water soluble and commercial straight fertilizers (116.90 and 117.40 day, respectively) by Bhatia and Gupta (2007) in carnation.

Syamal *et al.*, (2006) carried out an experiment on effect of bio-fertilizers on growth and yield in marigold and stated that plants treated with 1.50 kg/ha Azotobacter gave maximum flower yield as compared to other bio-fertilizers.

An investigation was conducted at Division of Floriculture and Landscaping, IARI, New Delhi during the year 2000-02 by (Dubey and Misra, 2006) revealed that the dual inoculation of gladiolus corm with AZT + PSB was found best

among all the bio-fertilizer treatments for early corm sprouting (15.75 days), increased number of leaves/plant (8.39), leaf area (316.13 cm^2), plant height (21.99 cm), induced heading (91.90 days) and dry weight (24.13 g) over control.

Singh (2006) concluded that the significant increased in leaf area index and plant height was recorded with application of Azotobacter in rose.

Singh and Jauhari (2005) stated that the maximum leaf area (1196.18 cm^2) and length of first order lateral shoot (97.15 cm) were observed with inoculation of Azotobacter treatment. While, there was no significant effect on number of leaves/plant, leaf biomass and number of second order lateral shoots per plant in rose.

Srivastava and Govil (2005) studied influence of biofertilizers on growth and flowering in gladiolus Cv. American Beauty and stated that vase life was significantly increased as result of different biofertilizers application over control.

An investigation was conducted at Division of Floriculture and Landscaping, IARI, New Delhi during the year 2000-02 by (Dubey and Misra, 2005) revealed that the combined inoculation of gladiolus corms with AZT + PSB was found best for corm weight (39.14 g), number of corms/plant (2.27), number of cormels/plant (82.03), cormel weight (1.38 g) and increased propagation coefficient (1492.99%).

Yadav *et al.*, (2005) reported that among different bio-fertilizers, the Phosphorus Solubilizing Bacteria (PSB) was found more effective in increasing bulb production and root biomass closely followed by Azotobacter in tuberose cv. Double.

Mathew and Singh (2003) reported that combined application of PSB, Azotobacter and Azospirillum gave maximum plant height and number of branches over control.

Chang (1993) studied effects of VAM on floriculture and vase life of cut flowers and stated that VAM significantly increased vase life of different cut flowers.

2.1 Effect of organics

Jhon *et al.*, (2007) studied on response of organic manure and inorganic fertilizer on growth and bulb production in tulip and found maximum values in terms of plant height (36.15 cm), stem thickness (6.83 mm), wrapper leaf area (133.16 cm^2), bulb number/m^2 (52.75m^2) and their weight (1.14 kg/m^2) were recorded with highest level of 60 t/ha organic manure.

Singh (2006) concluded that the significant increased in leaf area index and plant height was recorded with application of FYM (5 kg/m^2) in rose.

Nagaraju *et al.*, (2003) studied on application of pongamia cake and neem cake and revealed that neem cake significantly increased neck length, length of flower buds, yield and percentage of quality flowers in rose Cv. Landora.

2.3 Effect of inorganic fertilizers

Barad *et al.*, (2008) stated that plant height, number of branches per plant, leaf area, fresh, dry weight of plant, diameter of flowers, number of flowers per plant, weight of flowers per plant, yield of flowers per hectare in gladiolus were significantly increased with higher level (250 kg N/ha) as compared to lower level of nitrogen.

Jhon *et al.* (2007) studied on response of organic manure and inorganic fertilizer on growth and bulb production in tulip and stated that NPK in the ratio of 75 : 30 : 30 kg/ha being at par with 100 : 40 : 40 kg/ha, recorded highest values in terms of plant height (36.25 cm), stem thickness (6.73mm), wrapper leaf area (133.58 cm^2), bulb number (50.50/m^2) and their weight (1.03 kg/m^2) over lower levels of fertilizers.

Patel *et al.*, (2008) studied on graded dose of nitrogen in chrysanthemum and stated that fresh weight, dry weight, stalk length and shelf life of flower in situ were maximum in higher level of N (200 kg/ha)as compared to 100 and 150 kg/ha.

Sharma and Singh (2007) worked on response of N, P and K on vegetative growth, flowering and corm production in gladiolus under mango orchard and stated that significantly maximum number of leaves per plant and number of florets per spike remaining open at a time, corms produced per plant, corm size and weight as well as number of cormels per plant were recorded with higher level of $N_{50}P_{25}K_{25}$ g/m^2 whereas

significantly maximum plant height was obtained by application of $N_{40}P_{20}K_{20}$ g/m^2.

Singh (2006) noted significant increased in leaf area index and plant height with application of higher dose of nitrogen (60 g/ m^2) in rose.

Baboo and Singh (2006) tried five levels of each of nitrogen (0, 150, 200, 250 and 300 kg/ha) and phosphorus (0, 75, 100,125 and 150 kg/ha) on gladiolus and stated that higher level of nitrogen (300 kg/ha) and phosphorus (150 kg/ha) significantly increased number of corms per plant, corm diameter, corm weight, cormels per plant and number of cormels per plant.

Dubey and Misra (2006) studied effect of chemical and bio-fertilizers on gladiolus and stated that full dose of NPK had significant influence on early corm sprouting, number of leaves, leaf area, plant height, total fresh and dry weight.

Field experiments were conducted to study the effect of different levels of nitrogen (50, 100, 150 and 200 kg/ha), phosphorus (50 and 100 kg/ha) and pinching (20 and 40 DAT) in Africa marigold (*Tagetes erecta* Lina.) cv. Pusa Narangi Gainda, during Rabi seasons of 2003-2004 and 2004-2005. The optimum levels of nitrogen and phosphorus were assessed to be 200 kg N/ha and 100 kg P_2O_5/ha for maximum growth and flower production in African marigold under Jabalpur (MadhyaPradesh) conditions (Sharma *et al.*, 2006).

Haokip and Singh (2005) studied on response of nitrogen and phosphorus on growth and flowering parameters in gladiolus and found that application of higher dose of 60 kg P_2O_5/ha resulted in maximum leaf area at 20 day after planting (104.66 cm^2) which showed significant increase over the control (88.12 cm^2).

Khandelwal and Nagda (2005) while working on effect nitrogen and phosphorus on growth, floral characters and essential oils yield in henna (*Lawsonia inermis* Linn.) revealed that crop fertilized with highest level of nutrients i.e. nitrogen at 120 kg/ha along with phosphorus at 60/kg significantly increased plant height, number of branches and inflorescences and weight of flowers as compared to lower level.

Kumar and Mishra (2003) studied on response of gladiolus to nitrogen, phosphorus and potassium fertilization and stated that higher dose of nitrogen (80 g/m^2), P (20 g/m^2) and K (25 g/m^2) resulted into maximum cormels per plant (1.8), corm size (5.3 cm), corm weight (44.8g), cormel weight (5.0 g), cormels per plant (19.3) and propagation coefficient (315.2%).

Kumar and Chattopadhyay (2001) observed that the fertilizer combination of N at 50 g/m^2, P at 10g/m^2 and K at 20 g/m^2 resulted in the highest spike weight, number of florets per spike, floret diameter, number of open florets at a time, size and weight of corms and number of corms in gladiolus.

Pandey *et al.*, (2000) studied effect of different levels of nitrogen and phosphorus on gladiolus under Agra conditions

and stated that combination of N (20 g/m^2) and higher dose of P_2O_5 (40 g/m^2) increased plant height, number of leaves per clump, length of longest leaf, diameter of plant neck, rachis length and number of florets per spike.

Sankar and Bhattacharjee (2000) carried out a field trial to study the influence of nitrogen on rose cv. 'Raja Surendra Singh of Nalagarh". Among four nitrogen doses of 200, 300, 400 and 500 kg/ha/year maximum flowering and vase life were recorded with 400 kg N/ha/year.

Preetihatibarua and Misra (1999) while working on effect of nitrogen sources on vegetative and floral characters of gladiolus cv. Dhanvantari found that higher level of fertilizers increased number of spikes per plant, number of florets per spike and first floret diameter.

Spike length, floret number per spike, number of spikes per clump and bulb production in terms of quality and quantity were increased with increasing level of nitrogen in tuberose (Kumar and Singh, 1998).

Moradinefad and Malakooti (1998) concluded that the rose cv. "Masquerade" plants were grown in pots and given 0, 150, 300 or 450 ppm each of N or K fertilizer. Cut flower yield was highest when 300 ppm N and 450 ppm K were applied.

The study was under taken at Research Farm, Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi by Bhattacharjee and Damke (1994) on

response of "Super Star" rose to nitrogen, phosphorus and potash fertilization. They reported that the increased dose of nitrogen ranged from 25 to 175 g per 1.44 m^2 delayed flower bud initiation, flower bud opening and shortened the longevity of flower in intact plant. While lower level of N (25g./1.44 m^2) induced early flowering and lengthened the life of flowers. Application of nitrogen at 75g per 1.44 m^2 gave maximum beneficial response on flower bud size, diameter of fully open flowers and number of petals per flower. Further, increase in dose did not show any added benefit. Similarly Sable and Kale (1994) reported that nitrogen at 80 g with 30 g potash per plant influenced bud length, diameter and number of petals per flower, are important cut flower attributes of rose potassium alone exerted no influence, but with nitrogen produced favourable effect.

Investigation was carried out on flowering behaviour of rose plants applied with various levels of nitrogen, phosphorus and potassium in the Horticulture Garden, C.S. Azad University of Agriculture and Technology, Kanpur. During the experimentation, the most beneficial results were obtained by the application of 1 g and 40 g N. An application of 1.0 g N per plant showed the earliest flower bud emergence. However, the application of 40 g nitrogen resulted in the maximum floral bud diameter and number of petals per flower and increased duration of flowering. The longevity of flowers was increased in plants treated with 1 g nitrogen compared to others although the

longevity between plants treated with 20 and 40 g nitrogen per plant also enhanced the keeping quality of cut flowers (Prasad *et al.*, 1994).

Gowda and Uma (1992) studied the effect of nutrition and pruning levels on flower production in rose cv. "Super Star". They reported that number of marketable and unmarketable flowers per plant was highest with the individual effects of nitrogen at 16g per plant.

A nutritional trial on rose cv. "Super Star" was conducted by Sindhu and Yamdagni (1992) at Haryana Agricultural University, Hisaar. It was observed that application of nitrogen at 60 g per sq. m was most effective in increasing plant height, stem diameter, plant spread and number of shoots per plant.

An investigation was carried out to study the effect of nitrogen phosphorus and potassium on growth of rose by Anamika and Lavania (1990) at Department of Horticulture, Pantnagar. The plant height and spread were significantly increased by all the fertilizer treatments over control, because the nitrogen is important constituent of protein, which may be increased by addition of N fertilizer causing better growth.

2.4 Interaction effect

Chauhan *et al.*, (2008) worked on effect of bio-fertilizers and chemical nitrogen fertilizer on growth of chrysanthemum and revealed that a combined application of (175

kg N/ha + Azotobacter + Azospirillum) significantly increased plant height, number of branches per plant, plant spread, maximum number of flowers per plant and flower diameter and minimum days for appearance of first flower bud.

Gurav *et al.*, (2008) conducted an experiment on pre-harvest management of rose through organic culture and stated that RDF + organic significantly increased number of flowers per plant per year and flower stem length.

Bhalla *et al.*, (2007) while working on effect of organic manures and bio-fertilizers on growth and flowering in standard carnation stated that when standard carnation grown in sand + soil + vermicompost (1 : 1 : 1) (v/v) + inorganic fertilizers + bio-fertilizers @ 2g/plant (*Azospirillum* and phosphate solubilizing microorganisms) produced maximum plant height (73.20 cm), number of flowers (6.06), length of flower stem (68.70cm), flower size (7.30 cm), earliness in flowering (130.80 day), maximum percentage of A grade flowers (97.33) and vase life (11.00days).

Priyadharshini and Anburani (2007) carried out a study on nutritional studies on flowering and yield parameters in mullai (*Jasminum auriculatum*) and stated that a combine application of FYM @ 25t/ha combined with 100 per cent of the RDF @ 120 : 240 : 240 g/plant as basal along with vermiwash @ 1 : 5 dilution (T_4) improved the flowering and yield characters.

Singh (2007) carried out an investigation on response of integrated nutrient management on growth and flowering attributes in rose and revealed that among different growth parameters, maximum leaf biomass and dry weight of leaves were recorded with 4 kg FYM + remaining required dose of NPK by chemical fertilizer + P.S.B. which was at par with all the treatment except control. However, maximum dry weight of flowers/plant was recorded with 4 kg FYM + remaining required NPK by chemical fertilizer + Azotobacter.

Waheeduzzama *et al.*, (2007) studied on integrated nutrient management practice to improve flower yield in anthurium revealed that the treatment combination of Panchagavya 4% + 5% recommended dose of fertilizers increased plant height, number of leaves per plant, days to first flowering, number of suckers per plant and flower yield per plant.

Singh *et al.*, (2006) observed significant increased in leaf area index and plant height with application of FYM (5kg/m^2), Azotobacter and higher dose of nitrogen (60 g/ m^2) in rose. They further stated that poultry manure 4 kg + NPK 25, 20, 15 g/m^2 + VAM was found to be better for plant growth and yield of flower followed by poultry manure (4kg/m^2) + NPK 25 : 20 : 15 g/m^2 + Azotobacter.

Panchal (2006) conducted a research on effect of bio-fertilizer and nitrogenous fertilizers on growth and flower yield of China aster (*Callistephus chinensis* (L.) Nees) cv. Purnima and reported that the plant treated with 90 kg N/ha + 3 kg Azotobacter

per hectare + 3 kg Azospirillum per hectare registered significantly minimum days for appearance of first flower and 50% flowering and it was also produced significantly maximum flowers per plant and flower diameter as well as weight of individual flower and flower yield per plant as well as per hectare in china aster.

Yadav *et al.*, (2005) reported that the growth parameters viz. plant height, number of leaves per plant, leaf length and area of leaf significantly increased with application of Azotobacter along with the increasing levels of nitrogen in tuberose.

Patil (2005) concluded that the rose plant cv. 'Gladiator' when treated with ¾th dose of N + Azotobacter 2 g/plant (immediately after pruning) + foliar spray of BA 100 mg l^{-1} (15 days after pruning) produced vigorous growth in terms of plant spread, leaves per plant, total leaf area and number of shoots per plant. He further stated that plant height, fresh weight and dry weight of pruned shoots were noted maximum in rose plant receiving full dose of N (75 g) with Azotobacter 2 g/plant and foliar spray of BA 100mg l^{-1}.

Gayithri *et al.*, (2004) conducted a trail on response of bio-fertilizers and their combined application with different level on inorganic fertilizers in statice and revealed that a combined application of 75 % NP + 100 % K + VC + Azotobacter + PSB significantly increased the growth components like plant height,

plant spread, number of leaves and suckers. The flower components like spike emergence, initiation of flower, flower harvesting, spike length, spread and number of branches per spike were favourably influenced by application of 50 % NP + 100 % K + VC + Azotobacter + PSB.

Padmadevi *et al.*, (2004) carried out a study at Coimbatore, Tamil Nadu, India, to investigate the effects of biofertilizers Azospirillum, phosphobacteria and vesicular arbuscular mycorrhizas (VAM), along with inorganic nutrients (30:10:10, 30:5:10, 30:0:10, 15:10:10, 15:5:10 and 15:0:10 NPK, each at 0.2% spray) and growth regulator gibberellic acid (GA_3; at 200 ppm), on floral characters and vase life of anthurium (*A. andraeanum*) Cv. Temptation and stated that the treatment receiving all the three biofertilizers, along with full dose of inorganic nutrients and GA_3, recorded the highest vase life and improved the floral characters.

An application of $3/4^{th}$ of the recommended dose of N and P in combination with full K + VAM + phosphobacteria proved to be the most effective in increasing the plant height, number of leaves, leaf area, number of branches, flower weight, flower diameter, number of flowers and flower yield of china aster (Kumar *et al.*, 2003).

Kumar and Misra (2003) studied the effect of different doses of nitrogen, phosphorus and potassium in gladiolus and reported that interaction between nitrogen and phosphorus was

found significant on growth parameters, flowering characters and yield parameters of gladiolus. But, interaction among N, P and K was found non-significant in this respect.

Barman *et al.*, (2003) observed that the plant height increased significantly with application of NPK @ 200 : 200 : 150 kg/ha) + 5 tonnes of FYM/ha with *Bacillus firmus* (3 kg/ha). However, leaf number and bulb formation/clump did not vary significantly in tuberose. They further stated that application of FYM along with biofertilizer significantly reduced time taken for emergence of spike compared to untreated plants. They also found that application of NPK + FYM + Biofertilizer significantly increased the length of rachis, spike length, number of flowers per spike and flower yield in tuberose.

Singh and Singh (2003) reported that the application of full dose of NPK (@ 50, 40, 30 g/ m^2) supplied by chemical fertilizers significantly increased leaf area index, whereas application of 4 kg FYM + remaining dose of NPK by chemical fertilizers with Azotobacter resulted in maximum plant height in rose cv. Gruss-an-Teplitz.

Kathiersan and Venkatesha (2002) studied the effect of Azospirillum and VAM in combination with N and P on yields of gladiolus cv. "White Property" and found significant increased in days for 50% flowering, spikes/ha, corms/ha, cormels/ha, florets/spike, rachis length and longer vase life over control.

Ram *et al.*, (2002) reported that the treatment of Silver nitrate at 90 ppm enhanced the vase life of gladiolus cut flower

harvested from plots treated with cotton cake, vermicompost and farmyard manure. Further, they noted that the NPK fertilizers were less effective than the organic amendments. Organic amendments applied at the highest rates did not significantly affect the vase life.

Bhaskaran *et al.*, (2002) studied the effect of Azotobacter and Azospirillum bio-fertilizers in marigold (*Tagetes erecta*) under different levels of chemical nitrogen and stated that the both bacterial inoculants responded to all levels of chemical nitrogen with an increased yield over control significantly.

Singh (2001) reported that increasing levels of NPK fertilizers resulted in earlier flowering. Most and heaviest flowers, as well as longest stalks, were produced with the highest fertilizer rate combined with Azospirillium and VAM. Combined treatments were better than single treatments.

Kathiyar *et al.*, (1999) studied on flowering behaviour of rose plants as affected by various levels of N and P in Uttar Pradesh. The most beneficial results were obtained by the application of 60 g N/plant and 60 g P/plant on sodic soils. Application of nitrogen influenced floral parts in roses. It has been noted that high level had delayed opening of flower but increased fresh weight of flower and stem length in rose plant.

Swaminathan *et al.*, (1999) found that the treatment with 120 : 65 : 62.5 kg NPK/ha + Azospirillum + PSB (Phosphate

Solubilizing Bacteria) resulted in the highest yield 3.08 and 2.75 t/ha for the first and second year, respectively in tuberose.

Wange and Patil (1994) revealed that application of 100 kg N/ha alone and inoculating with mixture of Azotobacter + Azospirillum significantly increased the number of flowers per stalk, bulb yield and number of flower stalks in tuberose.

2.5 Effect of bio-inoculants, FYM and inorganic fertilizers on economics of cultivation

Gangadharan and Gopinath (2000) reported that the treatment 10 tone vermicompost/ha resulted in the highest benefit: cost ratio (1.56 : 1), gross (Rs. 1316400) and net (Rs. 801779) income in Gladiolus grandiflorus cv. "White Prosperity".

The study was taken up at Indian Institute of Horticultural Research Station in rose cv. "Happiness" spaced at 30 x 30 cm (18000 plants/acre) by Sujatha *et al.*, (1994). They reported that application of 100 kg N + 200 kg P_2O_5 + 150 kg K_2O per acre was fond to be more economical when benefit : cost was calculated. This reduced cost of cultivation was mainly due to lower input of fertilizers.

Virdia (1990) reported that the nitrogen at 40 g per plant recorded maximum net returns per hectare per annum over control.

2.6 Effect of bio-inoculants, FYM and inorganic fertilizers on available nutrient contests and uptake

Thakor *et al.*, (2008) found that significantly maximum nitrogen content, N uptake and available N_2 were recorded with highest level of nitrogen.

Das *et al.*, (2008) stated that combined applications of biofertilizers PSB+VAM+AZO the amount of available nitrogen (N), phosphorus (P) and potassium (K) contents in soil have been found to increased significantly up to third month and thereafter, the amount of the same decreased with the progress of the plant growth up to sixth month.

An inoculation of Azotobacter significantly increased foliar nitrogen, phosphorus and potassium content in rose (Singh, 2006) as compared to un-inoculated.

An application of FYM @ 5 kg/m^2 significantly increased foliar nitrogen, phosphorus and potassium content in rose as compared to without application (Singh, 2006).

Higher dose of nitrogen (60 g/m^2) significantly increased foliar nitrogen, phosphorus and potassium content in rose (Singh, 2006) as compared to lower doses of nitrogen.

Bhat and Shepherd (2006) studied on leaf nutrient status of rose as influenced by organic and inorganic sources and stated that 4 kg FYM + remaining required dose of NPK by chemical fertilizers + Azotobacter significantly increased leaf N concentration whereas maximum P and K contents was recorded

with 4 kg FYM + remaining required dose of NPK by chemical fertilizers + PSB.

Singh *et al.*, (2005) from the results of an experiment conducted at Imphal, Manipur, observed that the combined application of inorganic and organic fertilizers was better to build up organic C and available N, P and K after crop harvest.

Stephen and Nybe (2003) revealed that an application of 50% N as FYM + 50% NP as inorganic + P solubilizers + AMF + 100% K as inorganic significantly increased available N and K whereas 50% N as FYM + 50% N and P as inorganic + *Azospirillum* + P solubilizers + AMF + 100% K as inorganic increased available P content of soil.

Prakash *et al.*, (2002) in a field experiment carried out at West Bengal reported that the application of organic matter and chemical fertilizer enhanced total N, P and K uptake.

Shalini *et al.*, (2002) in an investigation at Dharwad, Karnataka, reported that the application of 50 percentage N (urea) + 50 percentage N (VC) + Azospirillum resulted in higher availability and uptake of nutrients by knolkhol (Kohlrabi).

Rajni and Srivastava (2001) conducted a pot experiment in a glasshouse at Varanasi, Uttar Pradesh and observed that the combined application of 2/3 N through fertilizer + 1/3 N through Vermicompost revealed the highest N uptake by grain.

Patil and Biradar (2001) conducted a field experiment at Dharwad, Karnataka and revealed that highest N, P and K uptake was recorded with the application of 200 per cent RDF + Vermicompost.

Sreenivas *et al.*, (2000) reported that available nitrogen in soil increased significantly with increase in levels of vermicompost at all the growth stages of ridge gourd. While, N content increased significantly with the increased level of vermicompost @ 10t ha^{-1} + 50 : 25 : 25 kg NPK through chemical fertilizer.

Rajadurai *et al.*, (2000) in a pot experiment on African marigold (*Tagetes erecta*) inoculated with Azospirillum and/or vesicular mycorrhizas (VAM) before sowing and given 30.0, 37.5 or 45.0 mg N, 30 or 45 mg P and 37.5 mg K/kg soil, N, P and K uptakes were highest in marigold inoculated with both Azospirillum and VAM at the highest N and P application rates. Soil nutrient status was highest in soils given N and P at 45.0 mg/kg soil. The soil nutrient status was lowest in treatments without VAM or Azospirillum inoculation.

Nethra *et al.*, (1999) reported that the highest available N in soils (493.31 kg/ha) was observed in the plot receiving 5 t vermicompost/ha + 100% NPK in China aster (*C. chinensis*).

Jadhav *et al.*, (1997) in a pot experiment on rice observed that dry matter production and uptake of most of major nutrients were highest form 75kg N ha^{-1} as urea + 25 kg N as vermicompost.

MATERIALS & METHODS

III MATERIALS AND METHODS

The details of the materials used and experimental methods followed during the course of the present investigation are narrated briefly in this chapter.

3.1 Experimental site

The present investigation entitled "Influence of bio-inoculants, FYM and inorganic fertilizers in gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was carried out at the Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, during late *Kharif* season in the year 2007-08 and 2008-09 (Plate - I). This farm is situated at 20^0-57' North latitude and 72^0-54' East longitude and at an altitude of about twelve meters above the mean sea level. It is situated twelve kilometers away in the East from the great historical place Dandi (Sea shore).

3.2 Climate and weather

The climate of South Gujarat region, where Navsari Agricultural University, Navsari is typically tropical characterized by fairly hot summer, moderately cold winter and humid warm monsoon. The average figures of weather data recorded at the meteorological observatory of the College Farm. located in the Agronomy Farm, during the period of experimentation are given in Appendix-I (a) and (b) .

The climate of the area is characterized by three well defined season viz., monsoon, winter and summer; the monsoon commences from the middle of June and ends by the second

Layout of experimental area

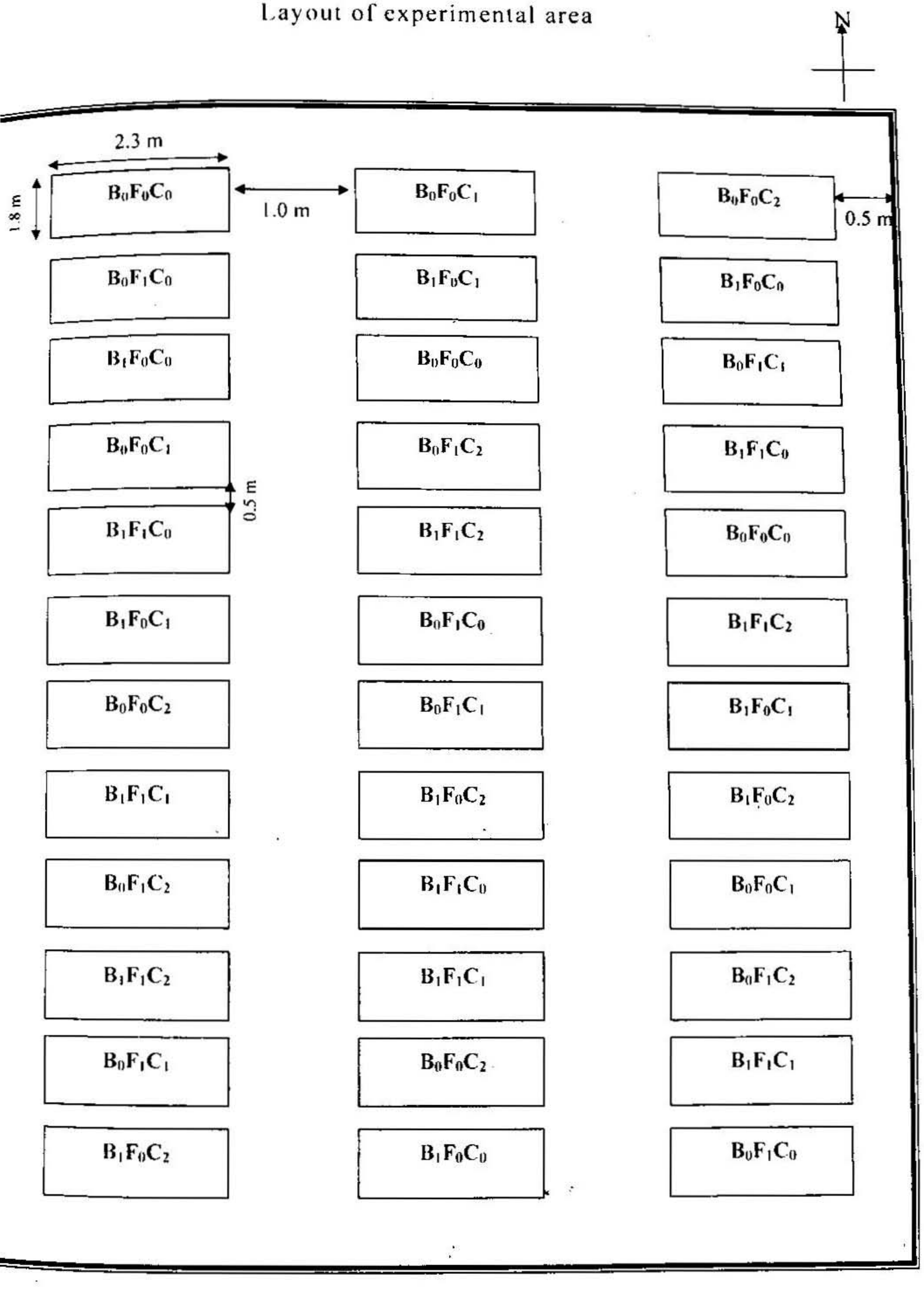


Plate –I : General view of experimental area

fortnight of September. Pre monsoon rains in the last week of May or in the first week of June are not uncommon. Most of the precipitation is received from South West monsoon, concentrated during the month of June, July and August.

Winter season starts from middle of October with mild cold and extends up to the first fortnight of February. December and January are the coldest months of the seasons and the minimum temperature registered during these months of the experimental period were 13.4^{0}C and 9.6^{0}C, respectively. The summer season commenced at the end of February and prolonged upto the second fortnight of May. The temperature reached a maximum of now 34.9°C in the month of May. April and May were the hottest months of summer season. The climate of this area is humid and the mean relative humidity remained above 68.27 per cent throughout the year. The weather condition was favorable for growing winter and summer crops during this study.

3.3 Chemical properties of the experimental soil

The soil type of the Floriculture Research Scheme is placed under Jalalpore series, which includes deep, moderately drained clayey soils classified as "Deep black soil" predomination with montmorillonite clay mineral by its origin. It is medium to high in fertility (Table-3.1). The topography of the experimental plot was fairly level. The soil samples were collected from near the plant at 0-15 cm and 15-30 cm depth and a composite sample was prepared and analyzed for chemical properties of soil as per the methods mentioned in Table-3.2.

Table – 3.1: Soil chemical properties of experimental site

Sr. No.	Parameters	Depth of soil	
		0-15 cm	15-30 cm
1.	pH (1:2.5 soil : water)	7.40	7.85
2.	Electrical conductivity (dsm^{-1})	0.75	0.21
3.	Available Nitrogen ($kg\ ha^{-1}$)	231.0	209.0
4.	Available P_2O_5 ($kg\ ha^{-1}$)	29.75	29.42
5.	Available K_2O ($kg\ ha^{-1}$)	424.0	319.0

Table-3.2 : Method employed for soil and plant analysis

Sr. No.	Particulars	Methods employed
1.	Available N ($kg\ ha^{-1}$)	Alkaline Potassium Permanganate method (Jackson, 1967)
2.	Available P_2O_5 ($kg\ ha^{-1}$)	Olsen's Method (Jackson, 1967)
3.	Available K_2O ($kg\ ha^{-1}$)	Flame photometry method (Jackson, 1967)
4.	Total N (%)	Modified Kjeldahl's method (Jackson, 1967)
5.	Total P (%)	Spectrophotometer (Jackson, 1967)
6.	Total K (%)	Flame Photometry method (Jackson, 1967)

3.4 Experimental details

3.4.1 Location : Floricultural Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari 396 450

3.4.2 Year and season : 2007-08 and 2008-09 Late *Kharif*

3.4.3 Experimental details:

3.4.3.1Design : FRBD (Factorial Randomized Block Design)

3.4.3.2 No. of Treatments : 12

3.4.3.3 No. of Replication : 3

3.4.3.4 Spacing : 30 x 20 cm

3.4.3.5 Total number of plots : 36

3.4.3.6 Gross plot size : 1.8 x 1.2 m^2

3.4.3.7 Net plot size : 1.2 x 0.8 m^2

3.4.3.8 Total number of plants per net plot: 16

3.4.4.9 Treatment details:

I) Bio-fertilizers

a) No inoculation : (B_0)

b) AZT + PSB : (B_1)

II) Farmyard manure

a) No FYM : (F_0)

b) FYM @ 5 kg/m^2 : (F_1)

III) Chemical fertilizer

a) Half dose of recommended NPK : (C_0)

b) ¾ dose of recommended NPK : (C_1)

c) Full dose of recommended NPK : (C_2)

(Recommended dose: 200:200:200 kg NPK/ha)

Full dose of FYM, P and K and half dose of N as a basal dose and remaining half dose of N applied 2 months after planting.

The corms to be inoculated by dipping in slurry of carrier based bio-fertilizers (100 g/l) for half an hour then drying in shade for 30 minutes (Plate – 2 & 3).

3.4.4.10 Treatment combinations

$B_0F_0C_0$: No Inoculation + No FYM + 50 % RDF

$B_0F_0C_1$: No Inoculation + No FYM + 75 % RDF

$B_0F_0C_2$: No Inoculation + No FYM + 100 % RDF

$B_0F_1C_0$: No Inoculation + FYM 5 kg/m^2+ 50 % RDF

$B_0F_1C_1$: No Inoculation + FYM 5 kg/m^2 + 75 % RDF

$B_0F_1C_2$: No Inoculation + FYM 5 kg/m^2+ 100 % RDF

$B_1F_0C_0$: AZT + PSB Inoculation + No FYM+ 50 % RDF

$B_1F_0C_1$: AZT + PSB Inoculation + No FYM+ 75 % RDF

$B_1F_0C_2$: AZT + PSB Inoculation + No FYM+ 100 % RDF

$B_1F_1C_0$: AZT + PSB Inoculation + FYM 5 kg/m^2+ 50 % RDF

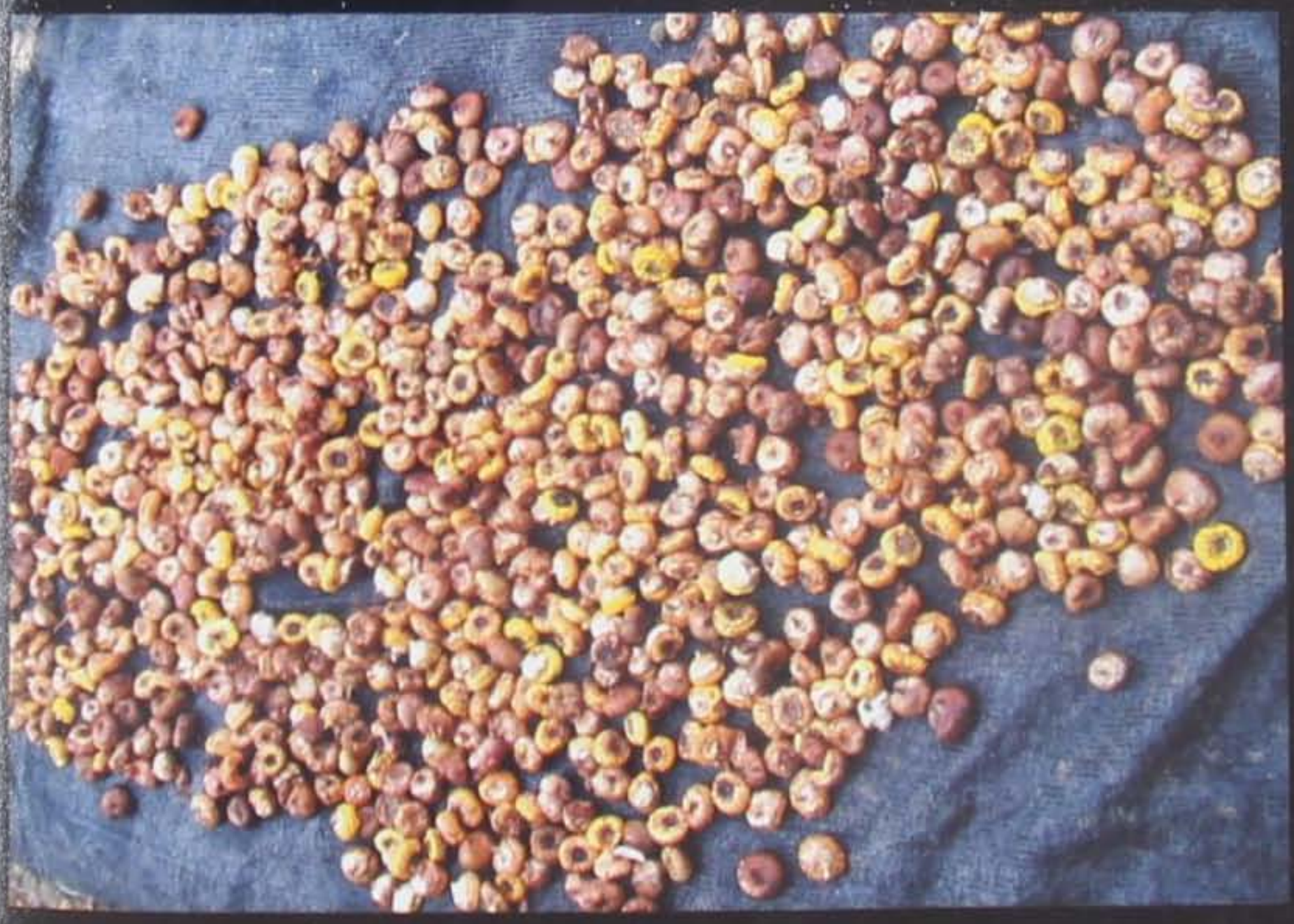
Plate-II : Different Biofertilizer used for inoculation of gladiolus corms

Azotobacter

Phosphate Solubilizing Bacteria

Plate–III : Biofertilizer inoculation of gladiolus corms

Dipping of corms in combined inoculation of AZT+PSB



Drying of corms in shade

$B_1F_1C_1$: AZT + PSB Inoculation + FYM 5 kg/m^2+ 75 % RDF

$B_1F_1C_2$: AZT + PSB Inoculation + FYM 5 kg/m^2+ 100 % RDF

3.5 Source of planting materials

Equal size corms of gladiolus were obtained from the Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari.

3.6 Preparation of experimental plot

The land was brought to a fine tilth by ploughing and then working with cultivator. The pebbles of various sizes, roots of weed plants etc. were removed.

3.7 Planting and cultural operation

Planting of corms was done on 10th October and 19th September, respectively during both the years i.e. 2007-08 and 2008-09. The corms were planted (one per hill) at about 6 cm depth. Gape filling was not needed, as there was uniform sprouting throughout the experimental plot.

The crop was irrigated at 10 to 15 days intervals. Total 4 weedings were carried out. Earthing up was done as and when required to cover the corms to avoid exposure to the sun, to provide the support to the plants and to avoid logging during the growth of gladiolus.

3.8 Cultural operation

3.8.1 Plant protection measures

The incidence of pests and diseases were negligible except for *Fusarium wilt*. It was controlled by drenching and spraying of 0.1 per cent Bavistin.

3.9 Observations to be recorded

3.9.1 Observations on vegetative growth parameters

3.9.1.1 Number of days required for corm sprouting

Number of days required for corm sprouting was recorded after sprouting started and average days for sprouting per treatment were calculated.

3.9.1.2 Height of plant (cm)

The height of selected five plants was measured from ground level upto the top most part of longest leaf of the plant without spike was recorded in centimeter with standard scale meter then average plant height was worked out in each.

3.9.1.3 Number of leaves per plant

The leaves of marked five plants were counted and then average number of leaves per plant was worked out.

3.9.1.4 Leaf area (cm^2)

The leaf area of previously selected five plants was measured in cm^2 with the help of leaf area meter and average was worked out.

3.9.2 Flowering parameters

3.9.2.1 Number of days required for spike initiation

The days required for spike initiation were calculated from the date of planting to the initiation of spikes in the plots and average days required for spike initiation were calculated.

3.9.2.2 Days required for first floret opening

The days required for first floret opening were calculated from the date of planting to the first floret opens on spike in the plots and average days required for first floret opening were calculated.

3.9.2.3 Length of spike (cm)

The length of spike from observational five plants was measured from basal portion of spike attached with four leaves to the growing point of the top most floret of the spike with the help of standard scale and average was estimated.

3.9.2.4 Number of spikes per plant

The spikes intact with four leaves were served from the plant other than the net plot after just opening of first floret. Such marketable spikes as and when harvested from each plant were counted. The value obtained was used for statistical analysis. Yield of spike is also calculated per hectare basis.

3.9.2.5 Number of florets per spike

The numbers of florets produced by each spike were counted. Five plants per replication were selected and average was worked out.

3.9.2.6 Weight of florets per spike (g)

Florets per spike were weighed on electronic balance. Five plants per replication were selected and average was worked out.

3.9.2.7 Floret diameter (cm)

Diameter of floret from observational five plants were measured by separating three florets from basal, middle and upper portion of the spike with the help of standard scale and average was calculated.

3.9.2.8 Number of corms per plant

From the observational five plants, the corms were separated, cleaned and their number per plant counted and the average number of corms were worked out.

3.9.2.9 Weight of corms per plant (g)

Corms per plant were weighed on electronic balance and average was worked out.

3.9.2.10 Size of corms (Diameter in cm)

Diameters of corms were measured with the help of digital vernier caliper and average was worked out.

3.9.2.11 Number of cormels per plant

The cormels attached to the corms of observational five plants were separated and counted and average was worked out.

3.9.2.12 Weight of cormels per plant (g)

Cormels obtained from individual observational plants were weighed on electronic balance and average was worked out.

3.9.3 Quality parameters

3.9.3.1 Longevity (days)

The selected five plants per replication in field were tagged and the time till the senescence of last florets was counted and average was worked out.

3.9.3.2 Vase life in laboratory (days)

The gladiolus spikes were harvested with the help of secateur retaining four leaves on cut stem with first floret open. Spikes were immediately placed in flasks containing 150 ml of distilled water after harvest. The observation was taken daily and weathered florets were removed regularly.

The basal 1-2 cm portion of stalk was cut off with sharp blade to prevent infection and regularize the flow of water. The vase life in days was calculated from the date of harvesting of spike to senescence of the last floret.

3.10 Statistical analysis

The data on various observations were recorded during the course of investigation were statistically analyzed using Factorial Randomized Block Design (FRBD) as suggested by Panse and Sukhatme (1967). The appropriate standard error of mean (S.Em. $\pm$) and the critical difference (C.D.) were calculated at 5 percent level of probability. Data have been depicted by suitable graphs at the appropriate tables.

3.11 Economics

Cost of cultivation, total returns and profits per hectare were calculated for different treatment combinations separately.

The cost benefit ratio (CBR) was worked out from the data on spikes, corms and cormels yield of gladiolus spikes obtained by treatment of bio-inoculants, FYM and inorganic fertilizers. The cost of each treatment of bio-inoculants, FYM and inorganic fertilizers was obtained by considering prevailing market prices. Similarly, each incremental benefit was also determined for bio-inoculants, FYM and inorganic fertilizers considering prevailing market price and thus CBR value was computed by dividing net return by total cost of treatment of bio-inoculants, FYM and inorganic fertilizers and recorded accordingly.

EXPERIMENTAL RESULTS

IV. EXPERIMENTAL RESULTS

The present investigation entitled "Influence of bio-inoculants, FYM and inorganic fertilizers on in gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was taken during the late *Kharif* season of the year 2007-08 and 2008-09. The data collected on various characters were analyzed statistically and the results relating to each character have been interpreted in this chapter under appropriate heads.

4.1 Growth parameters

4.2 Yield parameters

4.3 Quality parameters

4.4 Soil analysis

4.5 Plant analysis

4.1 Growth parameters

4.1.1 Days taken to sprouting

The data pertaining to the number of days taken to sprouting of gladiolus as affected by bio-inoculants, FYM and inorganic fertilizers are presented in Table – 4.1, Plate - IV and graphically depicted in Fig.-1.

4.1.1.1 Effect of bio-inoculants

The significant differences in number of days taken to corm sprouting were found during year 2007-08, 2008-09 and in

pooled analysis (Table – 4.1). The corms inoculated with AZT + PSB recorded earlier sprouting (8.78 days) as compared to un-inoculated (9.78 days) during year 2007-08. Similar results were also obtained in 2008-09 and in pooled analysis also.

4.1.1.2 Effect of FYM

It is evident from the data presented in Table – 4.1 that application of FYM significantly altered the number of days taken to sprouting of gladiolus. The earliest sprouting (8.94 days) was noted in F_1 (FYM 5 Kg/m^2) whereas sprouting was delayed in treatment F_0 (No FYM) during both the years and in pooled also.

4.1.1.3 Effect of in-organic fertilizers

In both the years and in pooled, 100 % RDF had recorded earlier sprouting of corms (8.67, 8.58 and 8.63, respectively) which was statistically at par with treatment C_1 (75 % RDF) in the year 2007-08. While, the delayed sprouting was found in C_0 (50 % RDF) being 9.75, 9.75 and 9.75 days.

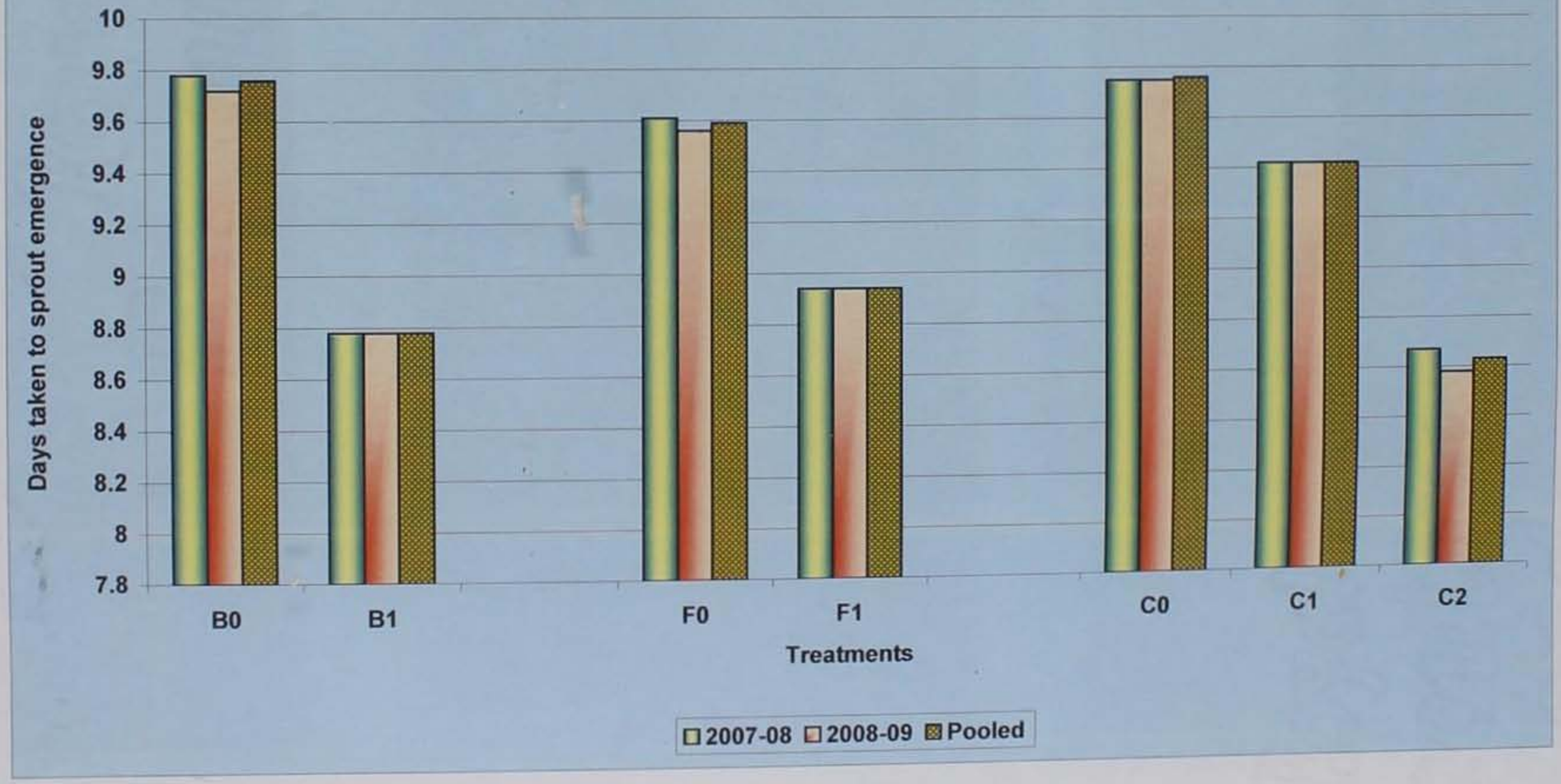
4.1.1.4 Interaction effect

Interaction effect of different bio-inoculants, FYM and inorganic fertilizers and their higher order interaction were found non-significant in respect to number of days taken to sprouting of gladiolus for both years and in pooled analysis.

Table-4.1 : Effect of bio-inoculants, FYM and inorganic fertilizers on days taken to sprouting of gladiolus cv. American Beauty

Treatments		Days taken to sprouting		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	9.78	9.72	9.76
B_1 :	AZT + PSB	8.78	8.78	8.78
	S. Em. ±	0.220	0.208	0.150
	C.D. at 5%	0.64	0.61	0.43
FARM YARD MANURE (F)				
F_0 :	No FYM	9.61	9.56	9.59
F_1 :	FYM 5 kg/m^2	8.94	8.94	8.94
	S. Em. ±	0.220	0.208	0.150
	C.D. at 5%	0.64	0.61	0.43
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	9.75	9.75	9.75
C_1 :	75% RDF	9.42	9.42	9.42
C_2 :	100% RDF	8.67	8.58	8.63
	S. Em. ±	0.269	0.255	0.181
	C.D. at 5%	0.79	0.75	0.52
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	10.05	9.55	9.80

Fig.-1 : Effect of bio-inoculants, FYM and inorganic fertilizers on days taken to sprouting of gladiolus cv. American Beauty



Plate–IV: Sprouting of corms as influenced by bio-inoculants, FYM and inorganic fertilizers

B_1 : AZT + PSB

F_1 : FYM 5 kg/plot

C_0 : 100 % RDF

4.1.2 Plant height (cm)

The data on plant height as influenced by bio-inoculants, FYM and inorganic fertilizers during both the years and in pooled analysis are presented in Table – 4.2, Plate – V and laid out in Fig.-2.

4.1.2.1 Effect of bio-inoculants

From Table – 4.2, it is evident that bio-inoculants had a significant effect on plant height. During both the years and in pooled analysis, higher plant height (61.89, 63.67 and 62.78 cm, respectively) was observed in treatment B_1 (AZT + PSB).

4.1.2.2 Effect of FYM

The application of FYM showed significant effect on plant height during both the years and in pooled analysis (Table – 4.2). During the year 2007-08, significantly higher plant height (60.89 cm) was observed with application of FYM @ 5 kg/m^2. Moreover, the same results were reported for the year 2008-09 and in pooled analysis.

4.1.2.3 Effect of inorganic fertilizers

It is evident from Table-4.2 that, significantly higher plant height (63.92 cm) was recorded in treatment C_2 (100 % RDF) which was followed by C_1 (75 % RDF) i.e. 58.75 cm during the year 2007-08. In the year 2008-09 the treatment C_1 (75 %

Table-4.2 : Effect of bio-inoculants, FYM and inorganic fertilizers on plant height (cm) of gladiolus cv. American Beauty

Treatments		Plant height (cm)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	55.39	55.94	55.67
B_1 :	AZT + PSB	61.89	63.67	62.78
	S. Em. $\pm$	1.346	1.188	0.890
	C.D. at 5%	3.95	3.49	2.54
FARM YARD MANURE (F)				
F_0 :	No FYM	56.39	57.50	56.94
F_1 :	FYM 5 kg/m^2	60.89	62.11	61.50
	S. Em. $\pm$	1.346	1.188	0.888
	C.D. at 5%	3.95	3.49	2.53
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	53.25	54.83	54.04
C_1 :	75% RDF	58.75	60.17	59.46
C_2 :	100% RDF	63.92	64.42	64.17.
	S. Em. $\pm$	1.649	1.456	1.077
	C.D. at 5%	4.84	4.27	3.07
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	9.74	8.43	9.10

Fig.- 2 : Effect of bio-inoculants, FYM and inorganic fertilizers on plant height (cm) of gladiolus cv. American Beauty

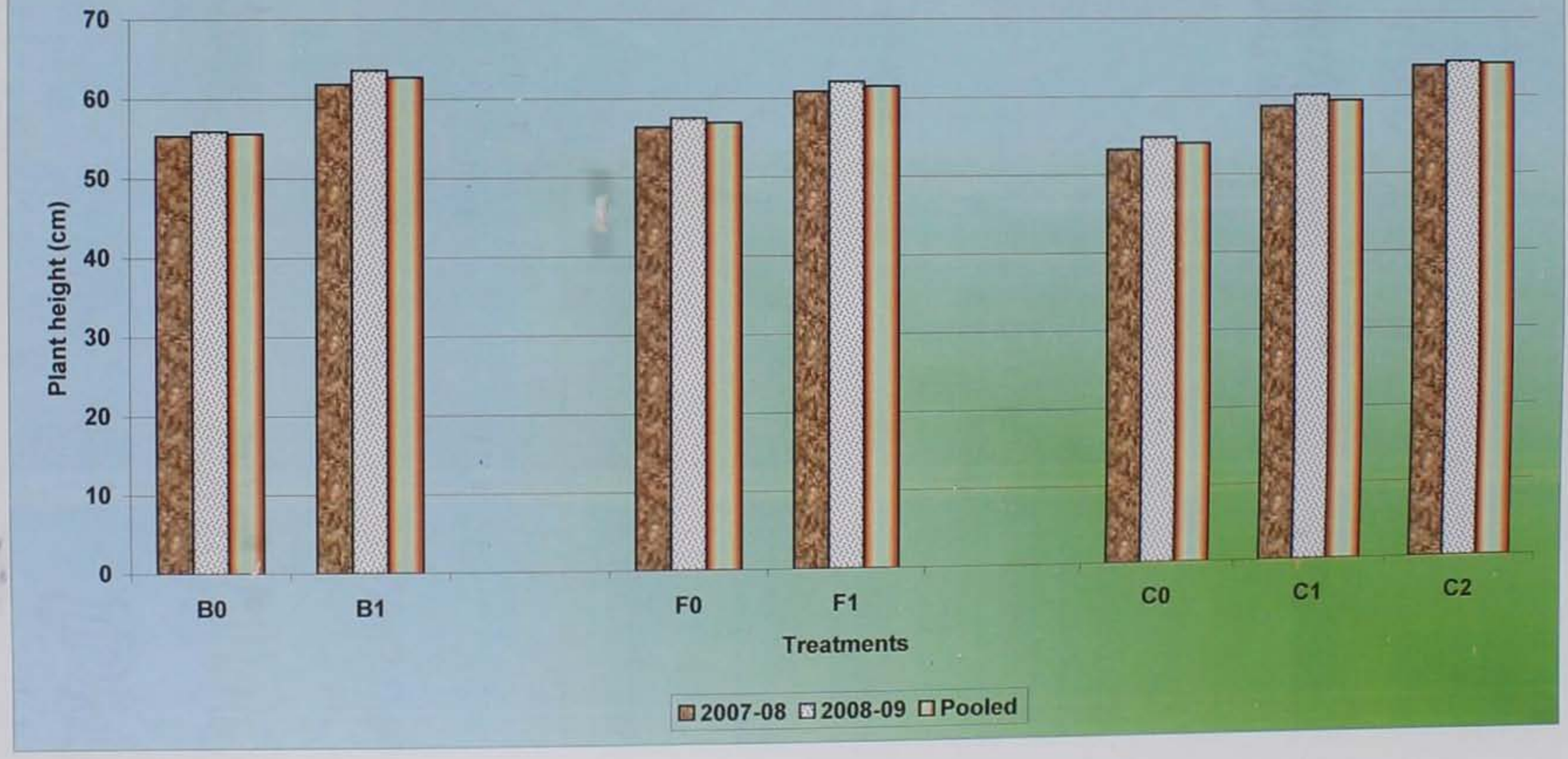


Plate-V : Plant height as influenced by bio-inoculants, FYM and inorganic fertilizers

B_1 : AZT + PSB

F_1 : FYM 5 kg/plotT

C_2 : 100 % RDF

RDF) i.e. 60.17 cm was statistically at par with C_2 (100 % RDF). Similar results were noted in the year 2008-09 and in pooled analysis.

4.1.2.4 Interaction effect

All the interactions of bio-inoculants, FYM and inorganic fertilizers were failed to show any significant effect on plant height during 2007-08, 2008-09 and in pooled analysis.

4.1.3 Number of leaves per plant

It is seen from the data (Table – 4.3 and Fig.- 3) that number of leaves per plant was found to be significant due to individual effects of bio-inoculants, FYM and inorganic fertilizers but their interactions did not reach at the level of significance.

4.1.3.1 Effect of bio-inoculants

In both the years and in pooled, inoculation of gladiolus corms in AZT + PSB (B_1) had recorded maximum number of leaves per plant (8.94, 9.17 and 9.06, respectively) which was followed by B_0 (Uninoculated) being 8.06, 8.28 and 8.17, respectively.

4.1.3.2 *Effect of* FYM

The data pertaining to number of leaves per plant are presented in Table – 4.3 and trace out in Fig.3, indicated that there were significant differences in number of leaves per plant due to application of FYM. Among them, application of FYM @ 5

kg/m^2 (F_1) recorded the higher number of leaves per plant (8.94, 9.17 and 9.06, respectively) in both the years and in pooled analysis.

4.1.3.3 Effect of inorganic fertilizers

It is seen from Table- 4.3 that number of leaves per plant was recorded significantly highest in C_2 (9.08, 9.33 and 9.21, respectively) for the year 2007-08, 2008-09 and in pooled analysis which was statistically at par with C_1 (8.58, 8.83 and 8.71, respectively) for the year 2007-08, 2008-09 and in pooled analysis. Whereas, application of 50 % RDF recorded significantly lowest number of leaves per plant (7.83, 8.00 and 7.92, respectively for the year 2007-08, 2008-09 and in pooled analysis).

4.1.3.4 Interaction effect

All the interactions were found to be non-significant for number of leaves per plant during both the years and in pooled analysis.

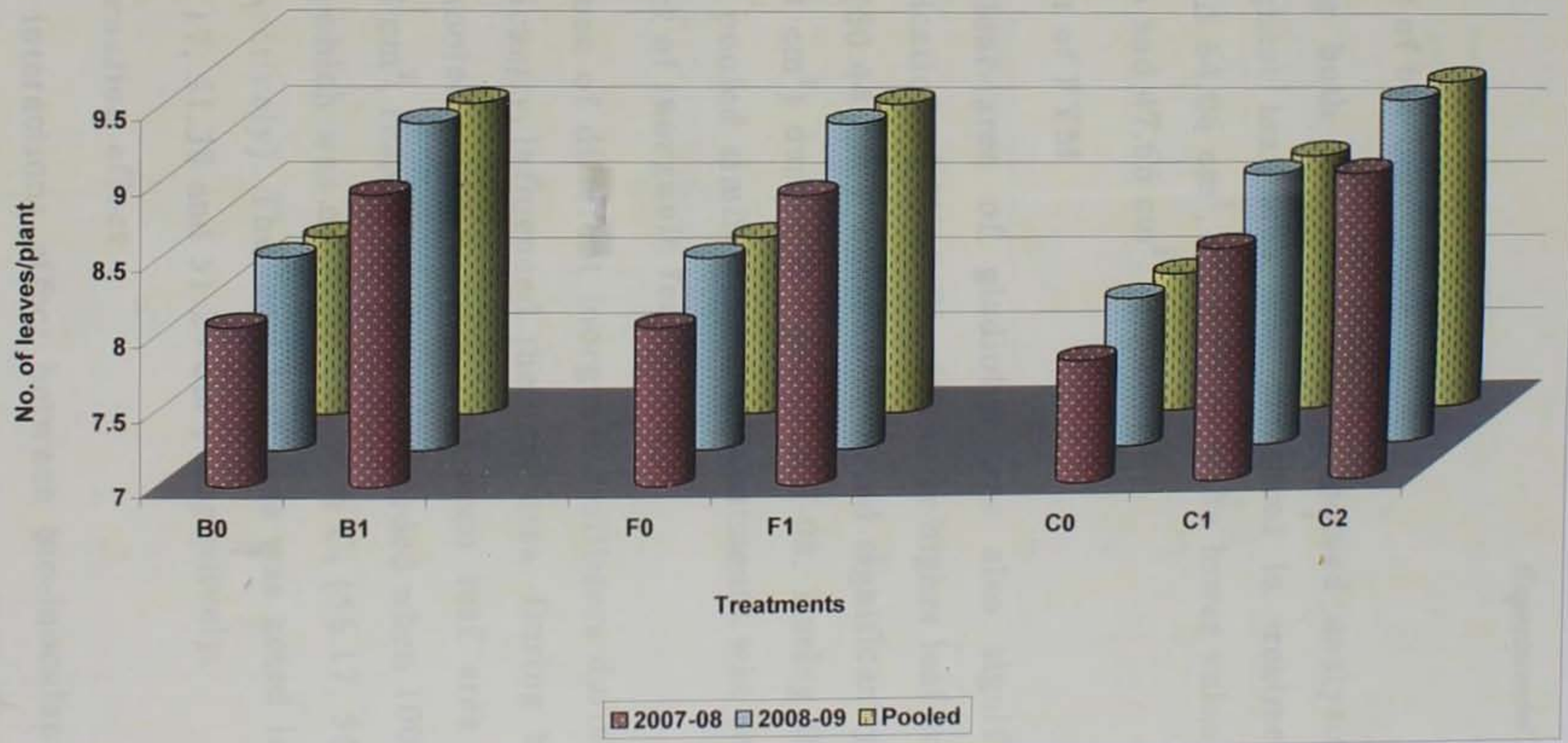
4.1.4 Leaf area (cm^2)

The effect of different bioinoculants, FYM and inorganic fertilizer treatments on leaf area are presented in Table - 4.4 and depicted in Fig. - 4.

Table-4.3 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of leaves per plant of gladiolus cv. American Beauty

Treatments		Number of leaves per plant		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	8.06	8.28	8.17
B_1 :	AZT + PSB	8.94	9.17	9.06
	S. Em. ±	0.212	0.212	0.149
	C.D. at 5%	0.62	0.62	0.424
FARM YARD MANURE (F)				
F_0 :	No FYM	8.06	8.28	8.17
F_1 :	FYM 5 kg/m^2	8.94	9.17	9.06
	S. Em. ±	0.212	0.212	0.149
	C.D. at 5%	0.62	0.62	0.424
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	7.83	8.00	7.92
C_1 :	75% RDF	8.58	8.83	8.71
C_2 :	100% RDF	9.08	9.33	9.21
	S. Em. ±	0.260	0.260	0.180
	C.D. at 5%	0.76	0.76	0.51
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	Sig
	B x F x C	NS	NS	NS
	C.V. %	10.59	10.35	10.47

Fig.-3 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of leaves per plant of gladiolus cv. American Beauty



4.1.4.1 Effect of bio-inoculants

During both the years and in pooled analysis, the significantly highest leaf area was measured in treatment B_1 (63.89, 64.22 and 64.06 cm^2, respectively) the lower value in B_0 was 47.56, 47.76 and 47.66 cm^2, respectively.

4.1.4.2 Effect of FYM

The leaf area of gladiolus was also significantly affected by application of FYM. Significantly higher leaf area was recorded in F_1 (60.44 cm^2) whereas F_0 noted significantly lower leaf area (51.00 cm^2) during the year 2007-08. During the year 2008-09 and in pooled similar trend of treatments was reported.

4.1.4.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers during study had also significantly influenced the leaf area. During both the years and in pooled, significantly maximum leaf area (59.83, 60.12 and 59.98 cm^2, respectively) was recorded when 100 % RDF (C_2) was given which was on same bar with C_1 (56.17, 56.48 and 56.33 cm^2, respectively). The least leaf area was noted in C_0 (50 % RDF) i.e. 51.17, 51.38 and 51.27 cm^2, respectively.

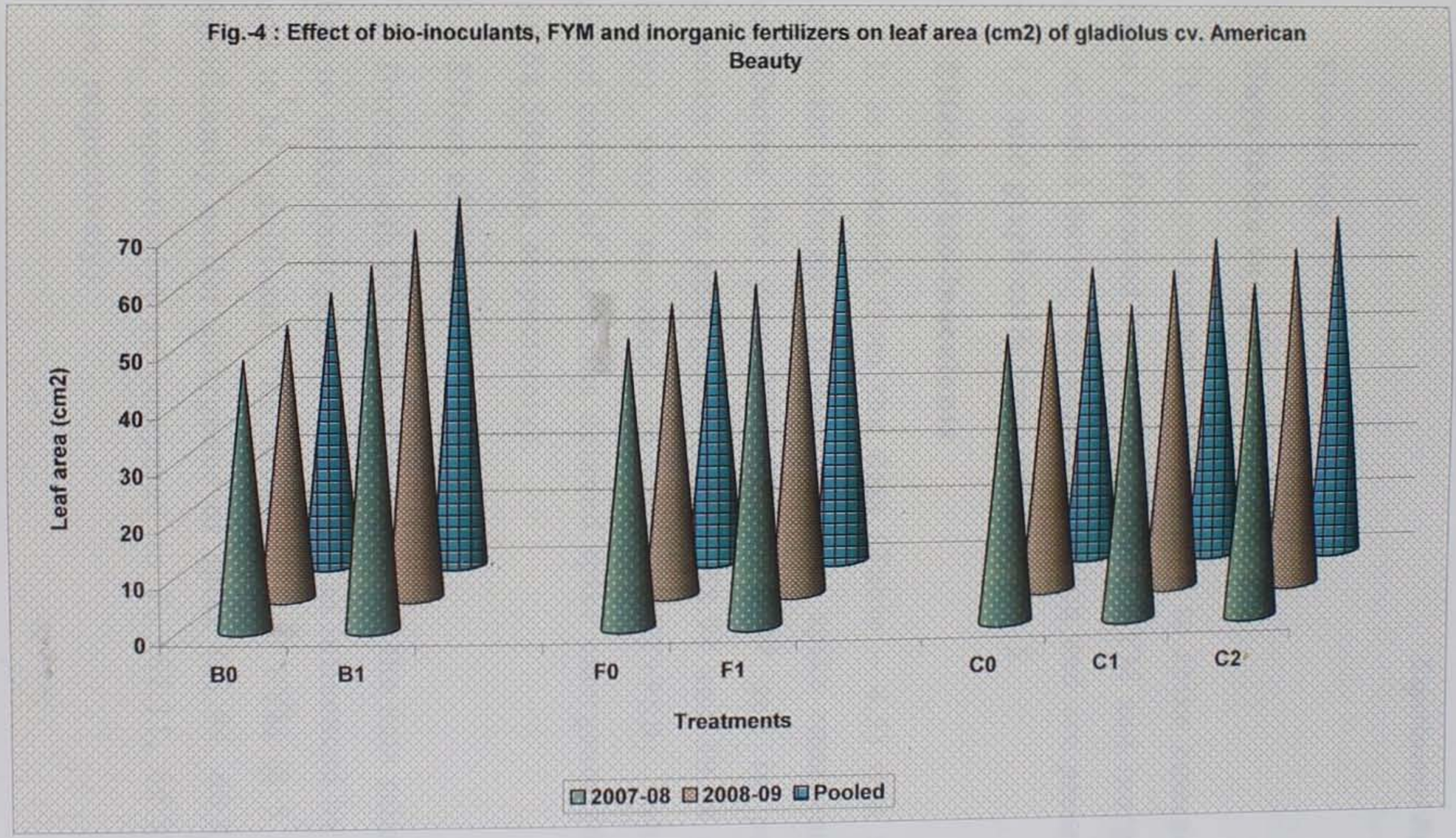
4.1.4.4 Interaction effect

The interactions effect between bio-inoculants, FYM and inorganic fertilizers in respect to leaf area were found to be non-significant during both the years and in pooled analysis also.

Table-4.4 : Effect of bio-inoculants, FYM and inorganic fertilizers on leaf area (cm^2) of gladiolus cv. American Beauty

Treatments		Leaf area (cm^2)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	47.56	47.76	47.66
B_1 :	AZT + PSB	63.89	64.22	64.06
	S. Em. ±	1.574	1.578	1.102
	C.D. at 5%	4.62	4.63	3.14
FARM YARD MANURE (F)				
F_0 :	No FYM	51.00	51.19	51.09
F_1 :	FYM 5 kg/m^2	60.44	60.79	60.62
	S. Em. ±	1.574	1.578	1.102
	C.D. at 5%	4.62	4.63	3.14
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	51.17	51.38	51.27
C_1 :	75% RDF	56.17	56.48	56.33
C_2 :	100% RDF	59.83	60.12	59.98
	S. Em. ±	1.928	1.932	1.335
	C.D. at 5%	5.65	5.67	3.80
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.98	11.95	11.97

Fig.-4 : Effect of bio-inoculants, FYM and inorganic fertilizers on leaf area (cm2) of gladiolus cv. American Beauty



4.2 Flowering Parameters

4.2.1 Days taken to spike emergence

The data pertaining to days taken to spike emergence of gladiolus as influenced by bio-inoculants, FYM and inorganic fertilizers recorded during the experimentation and are presented in Table – 4.5 and graphically trace out in Fig. - 5.

4.2.1.1 Effect of bio-inoculants

It is revealed from the data (Table – 4.5) that there were significant difference in days taken to spike emergence of gladiolus. During the year 2007-08, 2008-09 and in pooled analysis, earlier spike emergence (60.33, 58.94 and 59.64 days, respectively) was recorded in B_1 (AZT+PSB) whereas uninoculated corms of gladiolus delayed spike emergence (68.72, 68.28 and 68.50 days, respectively).

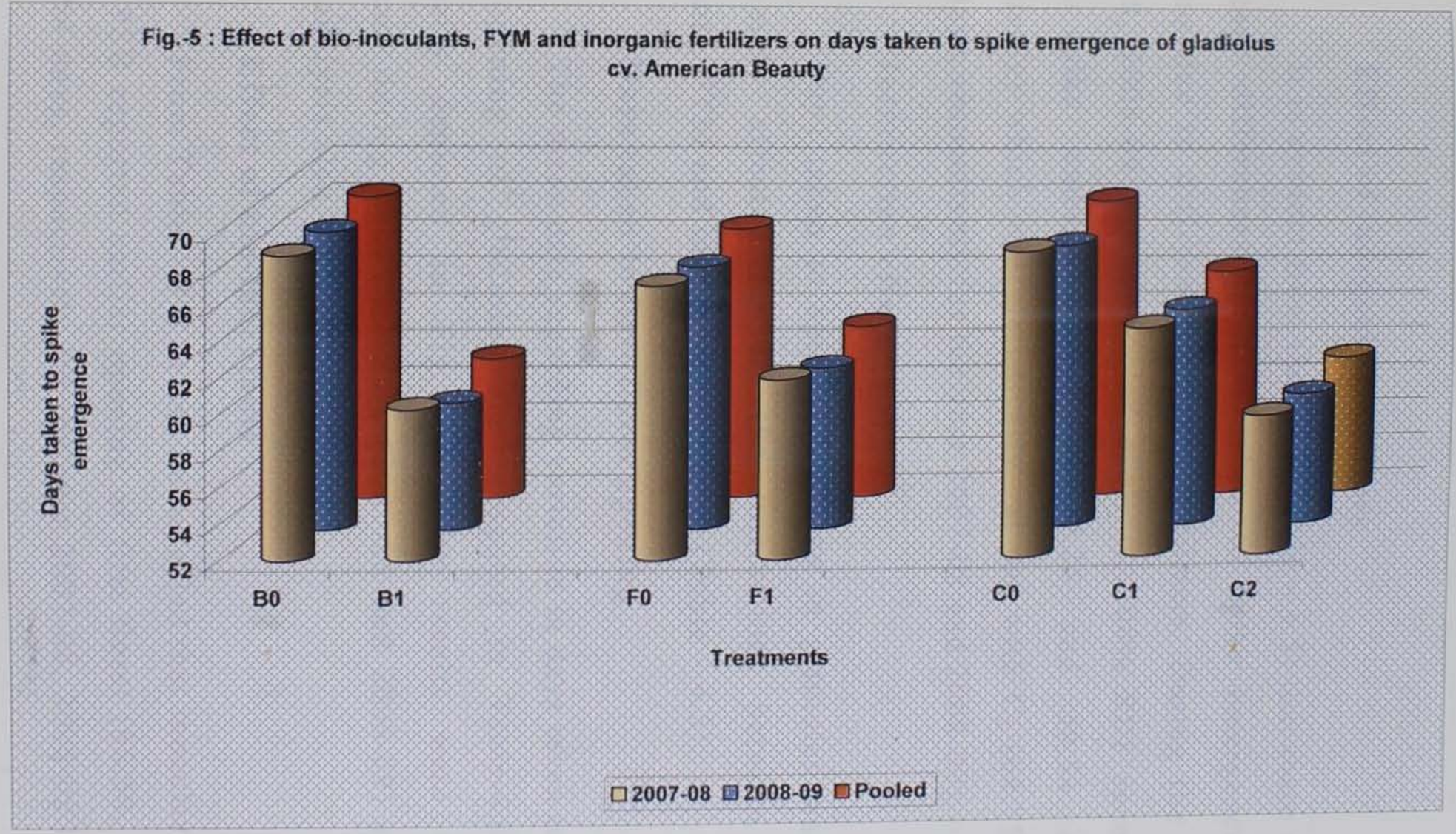
4.2.1.2 Effect of FYM

During both the years and in pooled, the data related to days taken to spike emergence of gladiolus as influenced by FYM was found to be significant. The application of FYM @ 5 kg/m^2 noted significantly earlier emergence of spike (61.94, 60.83 and 61.39 days, respectively) as compared to F_0 (67.11, 66.39 and 66.75 days, respectively).

Table-4.5 : Effect of bio-inoculants, FYM and inorganic fertilizers on days taken to spike emergence of gladiolus cv. American Beauty

Treatments		Days taken to spike emergence		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	68.72	68.28	68.50
B_1 :	AZT + PSB	60.33	58.94	59.64
	S. Em. ±	1.756	1.692	1.206
	C.D. at 5%	5.15	4.96	3.44
FARM YARD MANURE (F)				
F_0 :	No FYM	67.11	66.39	66.75
F_1 :	FYM 5 kg/m^2	61.94	60.83	61.39
	S. Em. ±	1.756	1.692	1.206
	C.D. at 5%	5.15	4.96	3.44
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	69.00	67.58	68.29
C_1 :	75% RDF	64.75	64.00	64.38
C_2 :	100% RDF	59.83	59.25	59.54
	S. Em. ±	2.150	2.072	1.461
	C.D. at 5%	6.31	6.08	4.16
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.54	11.28	11.42

Fig.-5 : Effect of bio-inoculants, FYM and inorganic fertilizers on days taken to spike emergence of gladiolus cv. American Beauty



4.2.1.3 Effect of inorganic fertilizers

It is evident from the data (Table – 4.5) that there were significant differences in days taken to spike emergence of gladiolus due to different inorganic fertilizers. During the year 2007-08, 2008-09 and in pooled analysis, 100% RDF recorded earlier spike emergence (59.83, 59.25 and 59.54 days, respectively) which was statistically at par with C_2 (64.75 and 64.00 days, respectively for the year 2007-08 and 2008-09).

4.2.1.4 Interaction effect

Days taken to spike emergence in gladiolus was not significantly affected by all the interactions between bio-inoculants, FYM and inorganic fertilizers (Table – 4.5).

4.2.2 Days taken to first floret opening

The mean data regarding variation in days taken to first floret opening of gladiolus are presented in Table-4.6 and graphically depicted in Fig. 4.6. The results were found significant during both the years (2007-08 and 2008-09) and in pooled analysis also.

4.2.2.1 Effect of bio-inoculants

From Table – 4.6, it can be revealed that inoculation of AZT + PSB reported earlier opening of first floret (66.50, 65.39 and 65.94 days, respectively for the year 2007-08, 2008-09 and in

pooled) whereas uninoculated noted delayed opening of first floret being 76.06, 74.78 and 75.42 days during year 2007-08 and 2008-09 and in pooled analysis.

4.2.2.2 Effect of FYM

The significant differences in days taken to first floret opening were found during year 2007-08, 2008-09 and in pooled analysis (Table – 4.6). An application of F_1 (FYM 5 kg/m^2) reported earlier opening of first floret (66.67, 65.22 and 65.94 days, respectively for the year 2007-08, 2008-09 and in pooled). While F_0 delayed first floret opening being 75.89, 74.94 and 75.42 days during year 2007-08, 2008-09 and in pooled.

4.2.2.3 Effect of inorganic fertilizer

It is seen from the Table – 4.6 that there were significant differences in days taken to first floret opening during the year 2007-08, 2008-09 and in pooled analysis. The earliest opening first floret was noted in C_2 (65.22, 65.00 and 65.46 days) which was statistically at par with C_1 (69.67, 68.58 and 69.13 days) during both the years and in pooled.

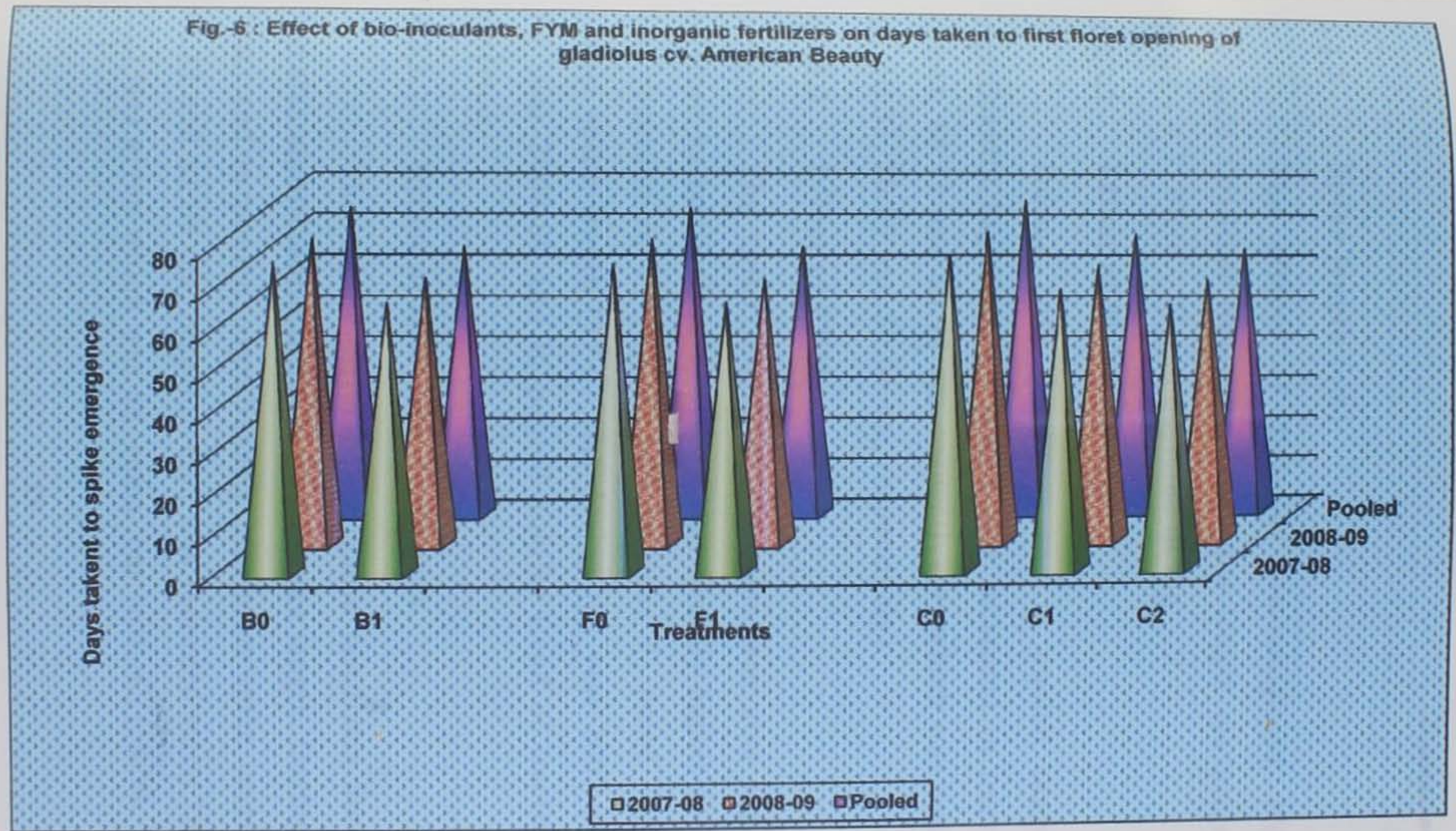
4.2.2.4 Interaction effect

The effect of all interactions between bio-inoculants, FYM and inorganic fertilizers were found to be non-significant (Table – 4.6).

Table-4.6 : **Effect of bio-inoculants, FYM and inorganic fertilizers on days taken to first floret opening of gladiolus cv. American Beauty**

Treatments		Days taken to first floret opening		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	76.06	74.78	75.42
B_1 :	AZT + PSB	66.50	65.39	65.94
	S. Em. ±	1.742	1.685	1.198
	C.D. at 5%	5.11	4.94	3.42
FARM YARD MANURE (F)				
F_0 :	No FYM	75.89	74.94	75.42
F_1 :	FYM 5 kg/m^2	66.67	65.22	65.94
	S. Em. ±	1.742	1.685	1.198
	C.D. at 5%	5.11	4.94	3.42
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	78.25	76.67	77.46
C_1 :	75% RDF	69.67	68.58	69.13
C_2 :	100% RDF	65.92	65.00	65.46
	S. Em. ±	2.133	2.064	1.452
	C.D. at 5%	6.26	6.05	4.14
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	10.37	10.20	10.29

Fig.-6 : Effect of bio-inoculants, FYM and inorganic fertilizers on days taken to first floret opening of gladiolus cv. American Beauty



4.2.3 Spike length (cm)

The effects of different bio-inoculants, FYM and inorganic fertilizer treatments on spike length are presented in Table – 4.7, Plate - VI and depicted in Fig. - 7.

4.2.3.1 Effect of bioinoculants

During both the years and in pooled analysis, the significantly higher spike length was measured in treatment B_1 (65.44, 66.11 and 65.78 cm, respectively) which was followed by B_0 (50.33, 50.89 and 50.61 cm, respectively).

4.2.3.2 Effect of FYM

The spike length of gladiolus was also significantly affected by application of FYM. Significantly higher spike length was recorded in F_1 (60.11 cm) whereas F_0 noted significantly lowest spike length (55.67 cm) during the year 2007-08. During the year 2008-09 and in pooled similar trend of treatments was reported.

4.2.3.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers during study had also significantly influenced the spike length. During both the years and in pooled, significantly maximum spike length (60.75, 61.42 and 61.08 cm, respectively) was recorded when 100 % RDF (C_2) was given which was on same bar with C_1 (58.50, 59.17 and

Table-4.7 : Effect of bio-inoculants, FYM and inorganic fertilizers on length of spike (cm) of gladiolus cv. American Beauty

Treatments		Length of spike (cm)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	50.33	50.89	50.61
B_1 :	AZT + PSB	65.44	66.11	65.78
	S. Em. ±	1.367	1.418	0.974
	C.D. at 5%	4.01	4.16	2.78
FARM YARD MANURE (F)				
F_0 :	No FYM	55.67	56.17	55.92
F_1 :	FYM 5 kg/m^2	60.11	60.83	60.47
	S. Em. ±	1.367	1.418	0.974
	C.D. at 5%	4.01	4.16	2.78
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	54.42	54.92	54.67
C_1 :	75% RDF	58.50	59.17	58.83
C_2 :	100% RDF	60.75	61.42	61.08
	S. Em. ±	1.675	1.736	1.180
	C.D. at 5%	4.91	5.09	3.36
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	10.02	10.28	10.15

Fig.- 7 : Effect of bio-inoculants, FYM and inorganic fertilizers on length of spike (cm) of gladiolus cv. American Beauty

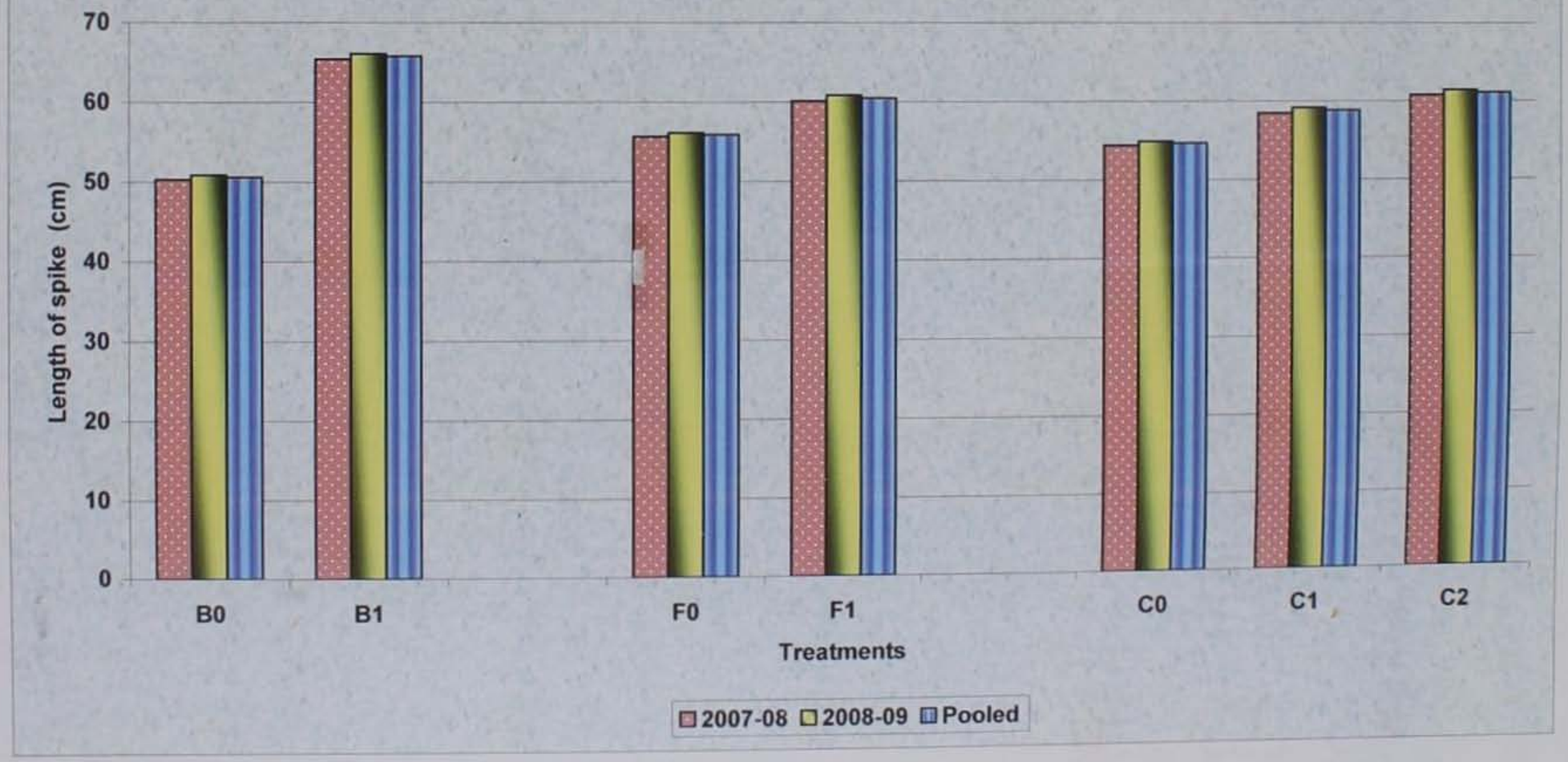
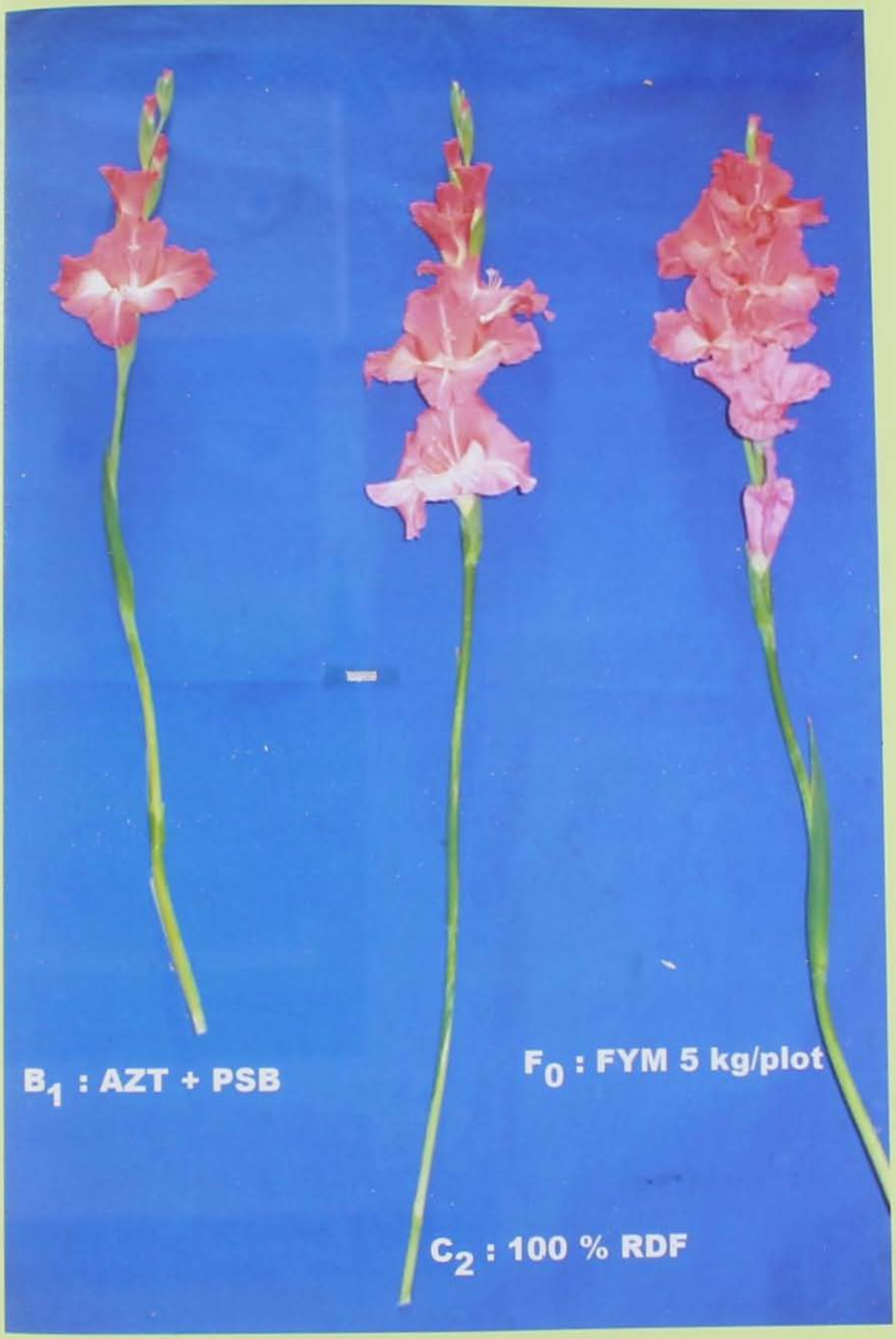


Plate-VI : Spike length as influenced by bio-inoculants, FYM and inorganic fertilizers



58.83 cm, respectively). The least spike length was noted in C_0 (50 % RDF) i.e. 54.42, 54.92 and 54.67 cm, respectively.

4.2.3.4 Interaction effect

The interactions effect between bio-inoculants, FYM and inorganic fertilizers in respect to spike length were found to be non-significant during both the years and in pooled analysis also.

4.2.4 Number of spikes per plant

The data on number of spikes per plant are presented in Table – 4.8, Plate - VII and depicted in Fig. – 8 indicated that there were significant differences in number of spikes per plant of gladiolus due to different bio-inoculants, FYM and inorganic fertilizers treatments.

4.2.4.1 Effect of bioinoculants

It can be seen from Table 4.8 that during both the years and in pooled analysis, the significantly higher number of spikes per plant was noted in inoculation of AZT + PSB treatment B_1 (3.17, 3.28 and 3.22, respectively) which was followed by B_0 (2.56, 2.56 and 2.56, respectively).

4.2.4.2 Effect of FYM

The number of spikes per plant of gladiolus was also altered due to application of FYM. The significantly higher

Table-4.8 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of spikes per plant of gladiolus cv. American Beauty

Treatments		Number of spikes per plant		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	2.56	2.56	2.56
B_1 :	AZT + PSB	3.17	3.28	3.22
	S. Em. ±	0.086	0.094	0.063
	C.D. at 5%	0.25	0.28	0.18
FARM YARD MANURE (F)				
F_0 :	No FYM	2.61	2.67	2.64
F_1 :	FYM 5 kg/m^2	3.11	3.17	3.14
	S. Em. ±	0.086	0.094	0.063
	C.D. at 5%	0.25	0.28	0.18
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	2.50	2.50	2.50
C_1 :	75% RDF	2.92	3.00	2.96
C_2 :	100% RDF	3.17	3.25	3.21
	S. Em. ±	0.106	0.115	0.077
	C.D. at 5%	0.31	0.34	0.22
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	12.79	13.68	13.25

Fig.- 8 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of spike per plant of gladiolus cv. American Beauty

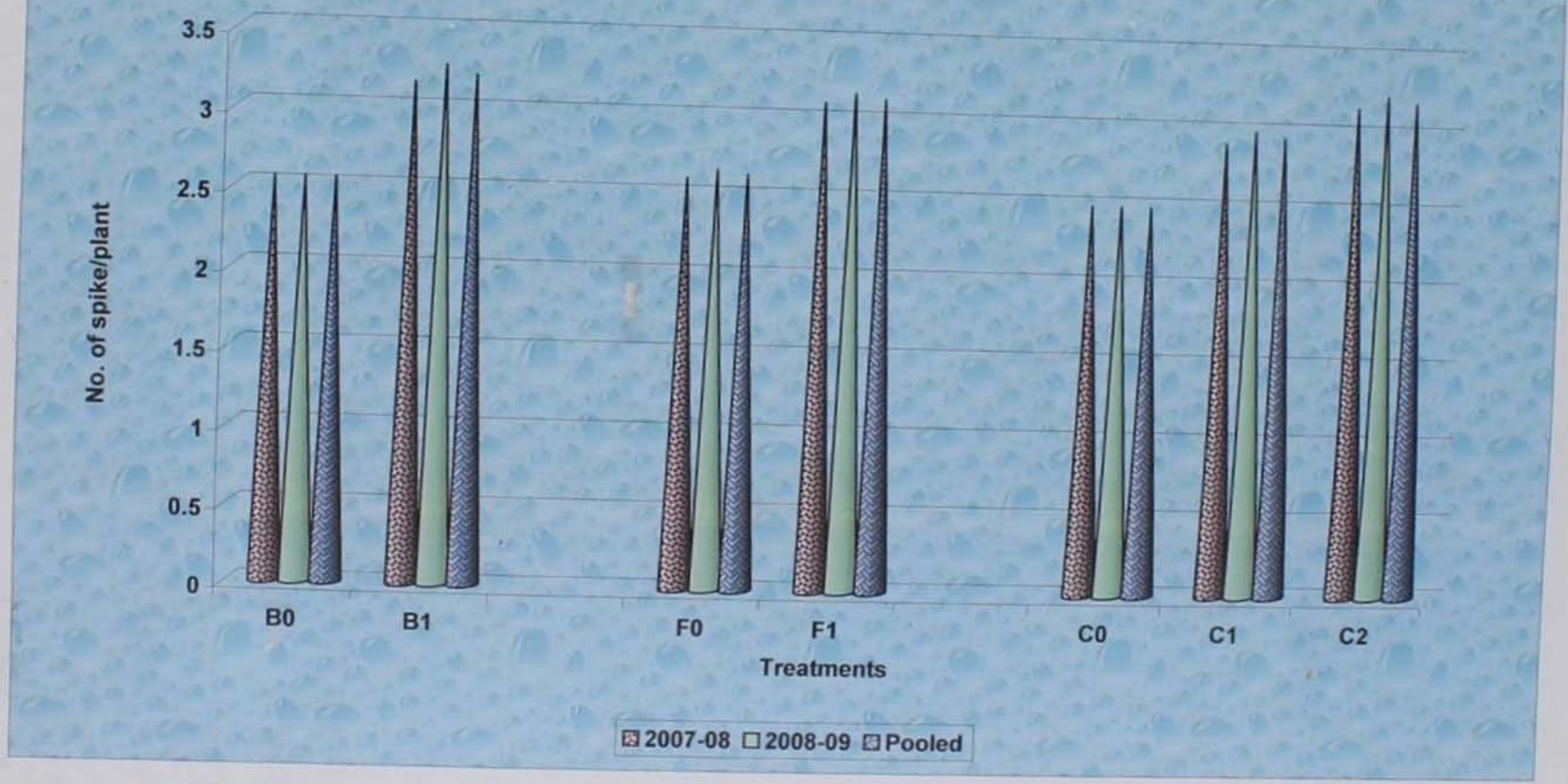


Plate – VII: Number of spikes per plot as influenced by bio-inoculants, FYM and inorganic fertilizers

B_1 : AZT + PSB

F_1 : FYM 5 kg/plot

C_2 : 100 % RDFC2 : 100 % RDF

number of spikes per plant (3.11, 3.17 and 3.14, respectively) during both the years and in pooled was observed in treatment F_1 which was followed by F_0 (2.61, 2.67 and 2.64, respectively).

4.2.4.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers had also significantly influenced the number of spikes per plant in both the years and in pooled. The significantly highest number of spikes per plant was recorded when highest dose of RDF was applied i.e. 3.17, 3.25 and 3.21, but which was statistically at par with C_1 (2.92 and 3.00, respectively for the year 2007-08 and 2008-09). Whereas in pooled analysis, it was followed by C_2.

4.2.4.4 Interaction effect

The interaction between bio-inoculants, FYM and inorganic fertilizers in respect to number of spikes per plant were found to be non-significant during both the years and in pooled analysis also.

4.2.5 Number of florets per spike

The effects of different bio-inoculants, FYM and inorganic fertilizers treatments on number of florets per spike are presented in Table – 4.9 and depicted in Fig. - 9.

4.2.5.1 Effect of bioinoculants

During both the years and in pooled analysis, significantly maximum number of florets per spike was found in treatment B_1 (11.22, 11.44 and 11.33, respectively) whereas B_0 recorded minimum self life (8.44, 8.67 and 8.56, respectively).

4.2.5.2 Effect of FYM

The number of florets per spike of gladiolus was also significantly affected by application of FYM. Maximum number of florets per spike was recorded in F_1 (10.72) whereas F_0 noted significantly minimum number of florets per spike (8.94) during the year 2007-08. During the year 2008-09 and in pooled similar trend of treatments was reported.

4.2.5.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers during study had also significantly influenced the number of florets per spike. During both the years and in pooled, significantly maximum number of florets per spike (10.58, 10.83 and 10.71, respectively) was recorded when 100 % RDF (C_2) was given which was on same bar with C_1 (10.00, 10.17 and 10.00, respectively).

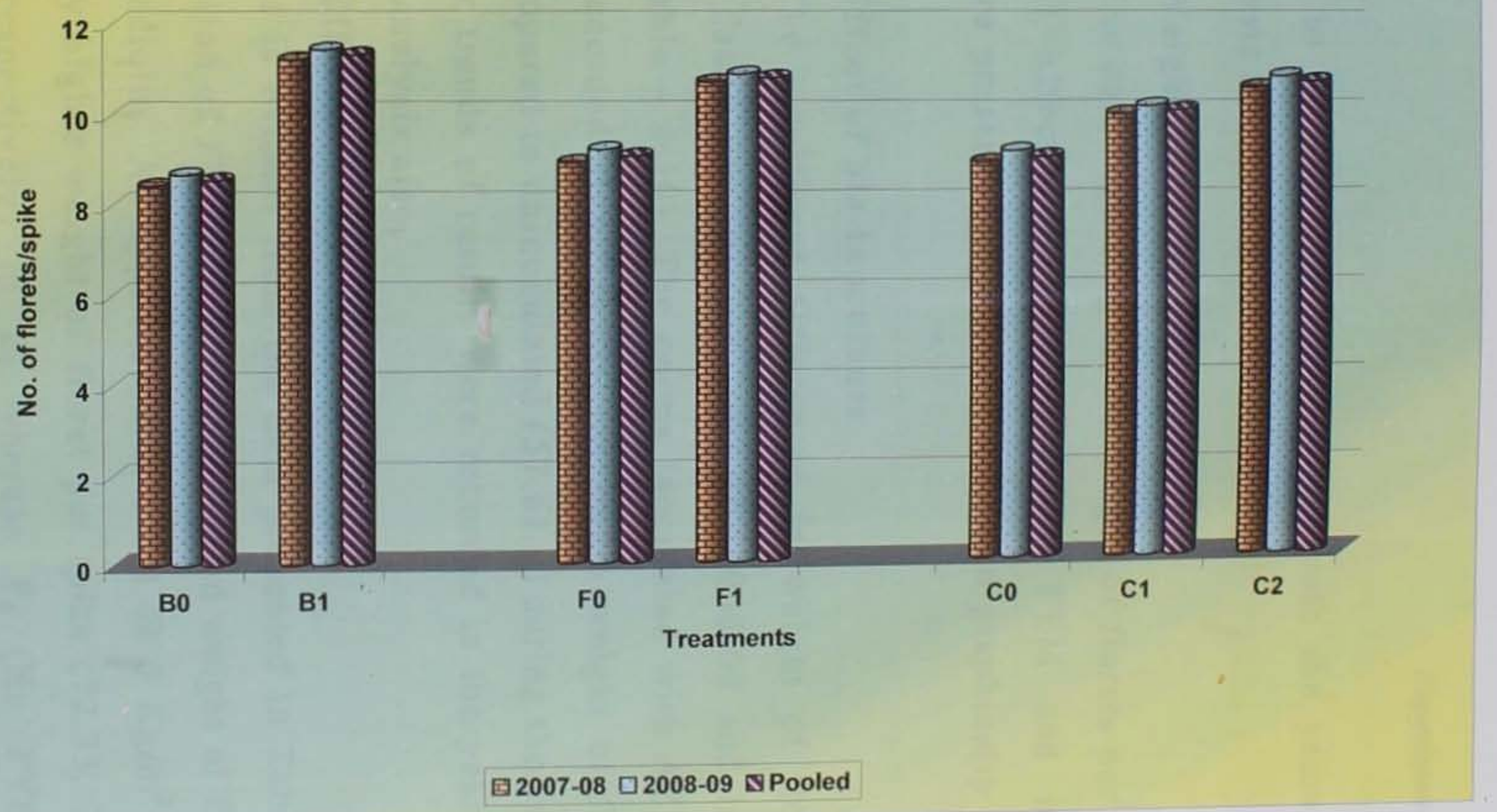
4.2.5.4 Interaction effect

The interactions effect between bio-inoculants, FYM and inorganic fertilizers in respect to number of florets per spike

Table-4.9 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of florets per spike of gladiolus cv. American Beauty

Treatments		Number of florets per spike		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	8.44	8.67	8.56
B_1 :	AZT + PSB	11.22	11.44	11.33
	S. Em. ±	0.267	0.266	0.185
	C.D. at 5%	0.78	0.77	0.53
FARM YARD MANURE (F)				
F_0 :	No FYM	8.94	9.22	9.08
F_1 :	FYM 5 kg/m^2	10.72	10.89	10.81
	S. Em. ±	0.267	0.266	0.185
	C.D. at 5%	0.78	0.77	0.53
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	8.92	9.17	9.04
C_1 :	75% RDF	10.00	10.17	10.08
C_2 :	100% RDF	10.58	10.83	10.71
	S. Em. ±	0.323	0.321	0.224
	C.D. at 5%	0.96	0.94	0.64
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.51	11.07	11.29

Fig.- 9 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of florets per spike of gladiolus cv. American Beauty



were found to be non-significant during both the years and in pooled analysis also (Table - 4.9).

4.2.6 Weight of florets per spike (g)

The data regarding to the weight of florets per spike of gladiolus as affected by bioinoculants, FYM and inorganic fertilizers are presented in Table – 4.10 and graphically depicted in Fig.-10.

4.2.6.1 Effect of bio-inoculants

The significant differences in weight of florets per spike were found during year 2007-08, 2008-09 and in pooled analysis (Table – 4.10). The corms inoculated with AZT + PSB (75.56 g) recorded significantly maximum weight of floret per spike as compared to uninoculated (57.61 g) during the year 2007-08. Similar trends of results were recorded in the year 2008-09 and pooled analysis also.

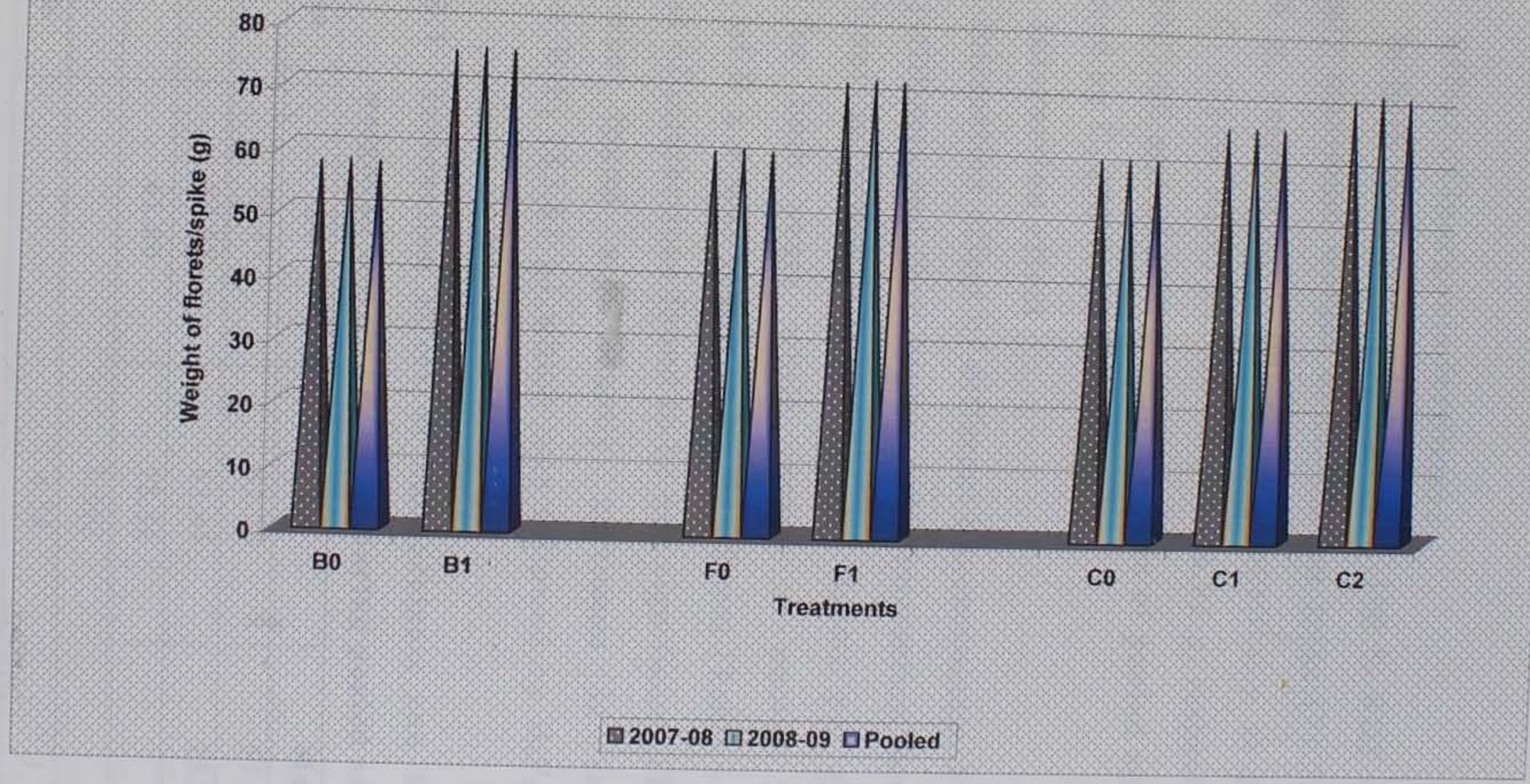
4.2.6.2 Effect of FYM

It is evident from the data presented in Table – 4.10 that application of FYM significantly altered weight of florets per spike of gladiolus. An application of FYM @ 5 Kg/m^2 recorded significantly higher weight of floret per spike (72.33, 72.78 and 72.56 g, respectively) in F_1 whereas F_0 (No FYM) noted significantly lower weight of floret per spike (60.83, 61.17 and 61.00 g, respectively) during both the years and in pooled also.

Table-4.10 : Effect of bio-inoculants, FYM and inorganic fertilizers on weight of florets per spike (g) of gladiolus cv. American Beauty

Treatments		Weight of florets per spike (g)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	57.61	58.00	57.81
B_1 :	AZT + PSB	75.56	75.94	75.75
	S. Em. ±	1.571	1.649	1.126
	C.D. at 5%	4.61	4.84	3.21
FARM YARD MANURE (F)				
F_0 :	No FYM	60.83	61.17	61.00
F_1 :	FYM 5 kg/m^2	72.33	72.78	72.56
	S. Em. ±	1.571	1.649	1.126
	C.D. at 5%	4.61	4.84	3.21
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	61.25	61.25	61.25
C_1 :	75% RDF	66.75	66.92	66.83
C_2 :	100% RDF	71.75	72.75	72.26
	S. Em. ±	1.924	2.020	1.365
	C.D. at 5%	5.64	5.92	3.89
INTERACTION EFFECT				
	B x F	NS	NS	Sig
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	10.01	10.45	10.23

Fig- 10 : Effect of bio-inoculants, FYM and inorganic fertilizers on weight of florets per spike (g) of gladiolus cv. American Beauty



4.2.6.3 Effect of inorganic fertilizers

In both the years and in pooled, 100 % RDF recorded significantly maximum weight of florets per spike (71.75, 72.75 and 72.26 g, respectively) which was statistically at par with treatment C_1 (75 % RDF) i.e. 66.75 and 66.92 g, respectively in the year 2007-08 and 2008-09. While, incase of pooled analysis it was followed by C_1 (75 % RDF).

4.2.6.4 Interaction effect

Interaction effect of different bio-inoculants, FYM and inorganic fertilizers and their higher order interaction were found non-significant in respect to weight of florets per spike of gladiolus for both years while incase of pooled analysis interaction of B x F was found to be significant (Table – 4.10.1) whereas rest of interactions found to be non significant. The floret diameter was found signiticantly maximum in treatment combination B_1F_1 (83.61 g) which was followed by B_1F_0 (67.89 g).

Table – 4.10.1 Interaction effect of bioinoculants and FYM on weight of florets per spike during pooled analysis

Treatments	F0	F1	Mean
B0	54.11	61.50	57.81
B1	67.89	83.61	75.75
Mean	61.00	72.56	
S. Em. ±	1.593		
C.D. at 5 %	4.54		

4.2.7 Floret diameter (cm)

The data on floret diameter as influenced by bio-inoculants, FYM and inorganic fertilizers during both the years and in pooled analysis are presented in Table – 4.11, Plate – VIII and laid out in Fig. - 11.

4.2.7.1 Effect of bio-inoculants

From Table – 4.11, it is evident that bio-inoculants had a significant effect on floret diameter. During both the years and in pooled analysis, significantly higher floret diameter (7.67, 7.73 and 7.70 cm, respectively) was observed in treatment B_1 (AZT + PSB) which was followed by treatment B_0 (Uninoculated).

4.2.7.2 Effect of FYM

The application of FYM showed significant effect on floret diameter during both the years and in pooled analysis (Table – 4.11). During the year 2007-08, significantly higher floret diameter (7.46 cm) was observed with application of FYM @ 5 kg/m^2. Moreover, the same results were reported for the year 2008-09 and in pooled analysis.

4.2.7.3 Effect of inorganic fertilizers

It is evident from Table-4.11 that, significantly higher floret diameter (7.63 cm) was recorded in treatment C_2 (100 % RDF) which was followed by C_1 (75 % RDF) i.e. 7.07 cm during the year 2007-08. In the year 2008-09 the treatment C_1 (7.11 cm)

Table-4.11 : **Effect of bio-inoculants, FYM and inorganic fertilizers on floret diameter (cm) of gladiolus cv. American Beauty**

Treatments		Floret diameter (cm)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	6.48	6.51	6.49
B_1 :	AZT + PSB	7.67	7.73	7.70
	S. Em. ±	0.139	0.160	0.105
	C.D. at 5%	0.41	0.47	0.30
FARM YARD MANURE (F)				
F_0 :	No FYM	6.69	6.72	6.71
F_1 :	FYM 5 kg/m^2	7.46	7.52	7.49
	S. Em. ±	0.139	0.160	0.105
	C.D. at 5%	0.41	0.47	0.30
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	6.53	6.57	6.55
C_1 :	75% RDF	7.07	7.11	7.09
C_2 :	100% RDF	7.63	7.68	7.66
	S. Em. ±	0.170	0.196	0.127
	C.D. at 5%	0.50	0.58	0.36
INTERACTION EFFECT				
	B x F	Sig	Sig	Sig
	B x C	NS	NS	Sig
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	8.34	9.54	8.96

Fig.- 11 : Effect of bio-inoculants, FYM and inorganic fertilizers on floret diameter (cm) of gladiolus cv. American Beauty

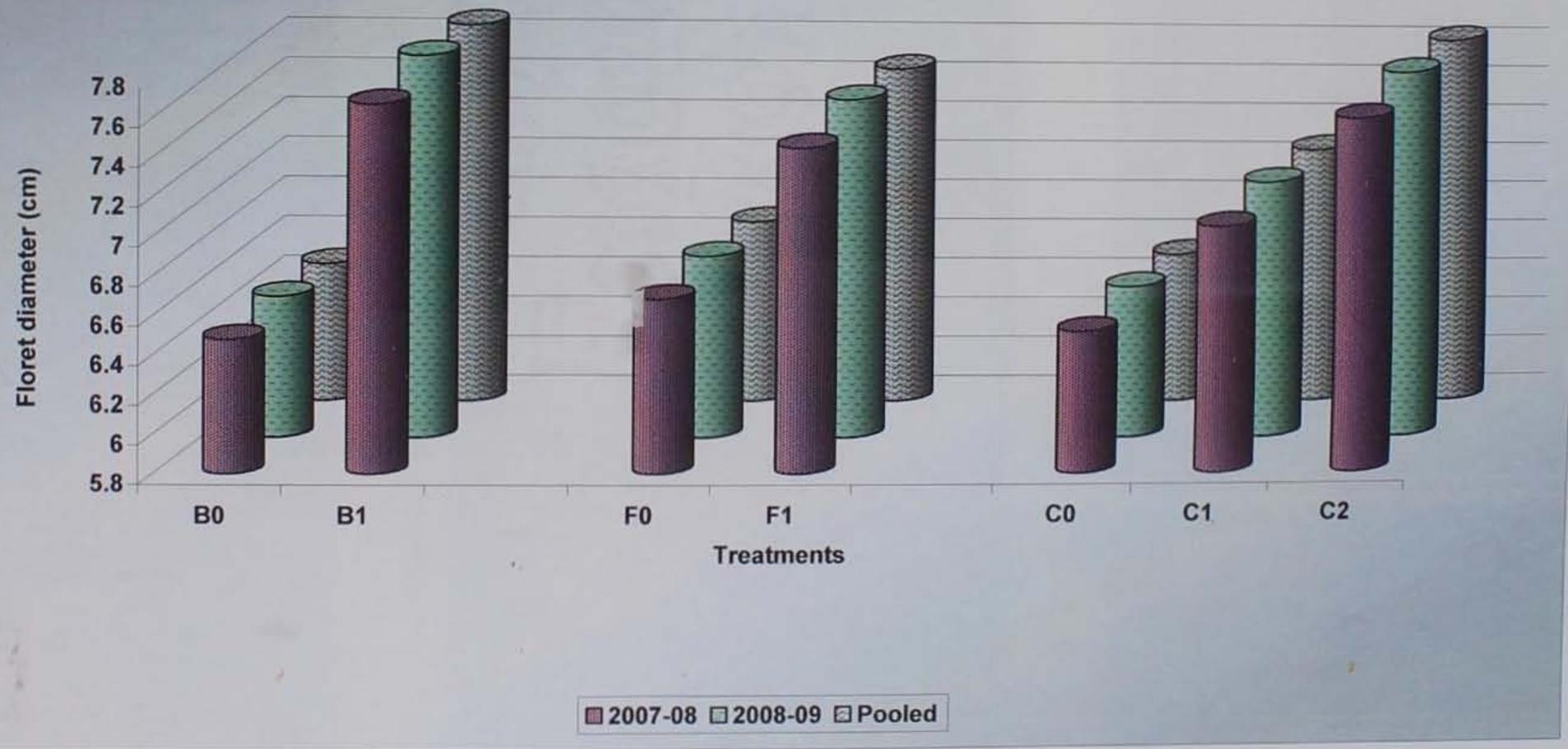
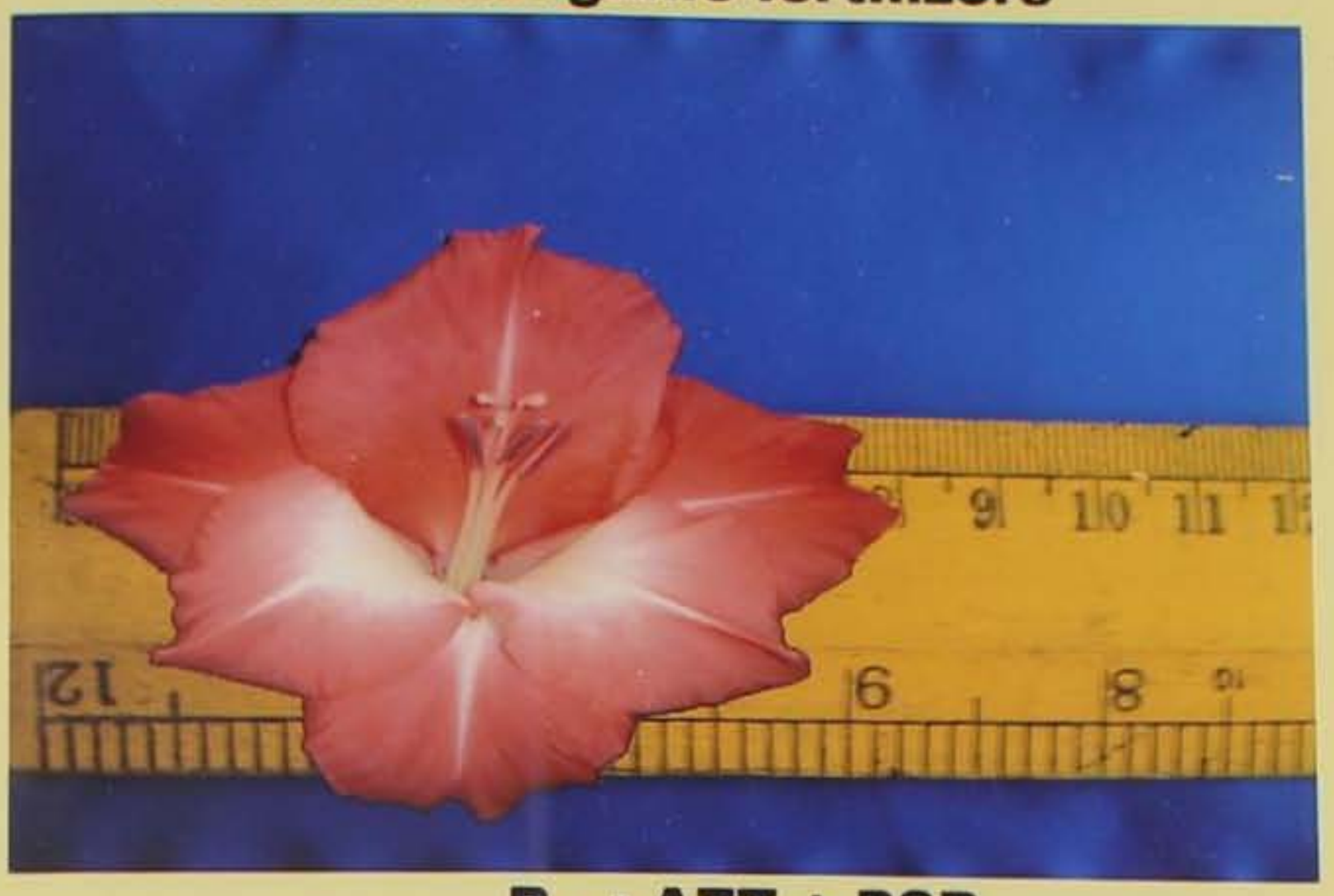


Plate-VIII: Size of floret as influenced by bio-inoculants, FYM and inorganic fertilizers



B_1 : AZT + PSB

F_1 : FYM 5 kg/plot

C_2 : 100 % RDF

was statistically at par with C_2 (7.68 cm). Similar results were noted in pooled analysis as per the year 2007-08.

4.2.7.4 Interaction effect

All the interactions of bio-inoculants, FYM and inorganic fertilizers were failed to show any significant effect on floret diameter during the years 2007-08, 2008-09 and pooled analysis with the exception of B x F and B x C interactions (Table – 4.11.1 and Table – 4.11.2).

The floret diameter was found significantly maximum in treatment combination B_1F_1 (8.33, 8.43 and 8.38 cm, respectively for the year 2007-08, 2008-09 and pooled) which was followed by B_1F_0 (7.00, 7.03 and 7.02 cm, respectively for the year 2007-08, 2008-09 and pooled).

Table – 4.11.1 Interaction effect of bioinoculants and FYM on floret diameter

Treatments	2007-08			2008-09			Pooled		
	F_0	F_1	Mean	F_0	F_1	Mean	F_0	F_1	Mean
B_0	6.39	6.58	**6.49**	6.40	6.61	**6.51**	6.39	6.59	**6.49**
B_1	7.00	8.33	**7.67**	7.03	8.43	**7.73**	7.02	8.38	**7.70**
Mean	**6.70**	**7.46**		**6.72**	**7.52**		**6.71**	**7.49**	
S. Em. ±	0.197			0.226			0.148		
C.D. at 5 %	0.58			0.66			0.42		

The interaction effect between B x C was found to be significant in the pooled analysis. The treatment combination B_1C_2 registered significantly maximum floret diameter (8.56 cm) which was followed by B_1C_1 (7.62 cm).

Table – 4.11.2 Interaction effect of bioinoculants and inorganic fertilizers on floret diameter during pooled analysis

Treatments	C_0	C_1	C_2	Mean
B_0	6.17	6.56	6.76	6.50
B_1	6.92	7.62	8.56	7.70
Mean	6.55	7.09	7.66	
S. Em. ±	0.148			
C.D. at 5 %	0.42			

4.2.8 Size of corm (cm)

The data pertaining to size of corm as affected by bio-inoculants, FYM and inorganic fertilizers and their interactions are presented in Table – 4.12, Plate - IX and depicted in Fig., - 12.

4.2.8.1 Effect of bio-inoculants

In both the years and in pooled, inoculation of gladiolus corms in AZT + PSB (B_1) had recorded maximum size of corm (5.23, 5.28 and 5.26 cm, respectively) which was

followed by B_0 (Uninoculated) i.e. 3.48, 3.52 and 3.50 cm, respectively.

4.2.8.2 Effect of FYM

The data on size of corm are presented in Table – 4.12 and trace out in Fig.- 12, indicated that there were significant differences in size of corm due to application of FYM. Among them, application of FYM @ 5 Kg/m^2 (F_1) recorded the maximum size of corm (4.74, 4.78 and 4.76 cm, respectively) in both the years and pooled also which was followed by B_1 (3.98, 4.01 and 3.99 cm, respectively).

4.2.8.3 Effect of inorganic fertilizers

It is seen from Table- 4.12 that size of corm was recorded significantly higher in C_2 (4.65, 4.70 and 4.68 cm, respectively) for the year 200/-08, 2008-09 and in pooled analysis which was statistically at par with C_1 (4.45, 4.48 and 4.46 cm, respectively) for the year 2007-08, 2008-09 and in pooled analysis whereas application of 50 % RDF (C_0) recorded significantly lower size of corm (3.98, 4.02 and 3.99 cm, respectively for the year 2007-08, 2008-09 and in pooled analysis).

4.2.8.4 Interaction effect

All the interactions were failed to produce any significant effect on size of corm during both the years and in pooled analysis apart from B x F and B x C interactions.

Table-4.12 : **Effect of bio-inoculants, FYM and inorganic fertilizers on size of corm (cm) of gladiolus cv. American Beauty**

Treatments		Size of corm (cm)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	3.49	3.52	3.50
B_1 :	AZT + PSB	5.24	5.28	5.26
	S. Em. ±	0.099	0.108	0.073
	C.D. at 5%	0.29	0.32	0.21
FARM YARD MANURE (F)				
F_0 :	No FYM	3.98	4.01	3.99
F_1 :	FYM 5 kg/m^2	4.74	4.78	4.77
	S. Em. ±	0.099	0.108	0.073
	C.D. at 5%	0.29	0.32	0.21
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	3.98	4.02	4.00
C_1 :	75% RDF	4.45	4.48	4.46
C_2 :	100% RDF	4.65	4.70	4.68
	S. Em. ±	0.121	0.132	0.088
	C.D. at 5%	0.36	0.39	0.25
INTERACTION EFFECT				
	B x F	Sig	Sig	Sig
	B x C	NS	NS	Sig
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	9.64	10.42	10.04

Fig.- 12 : Effect of bio-inoculants, FYM and inorganic fertilizers on size of corm (cm) of gladiolus cv. American Beauty

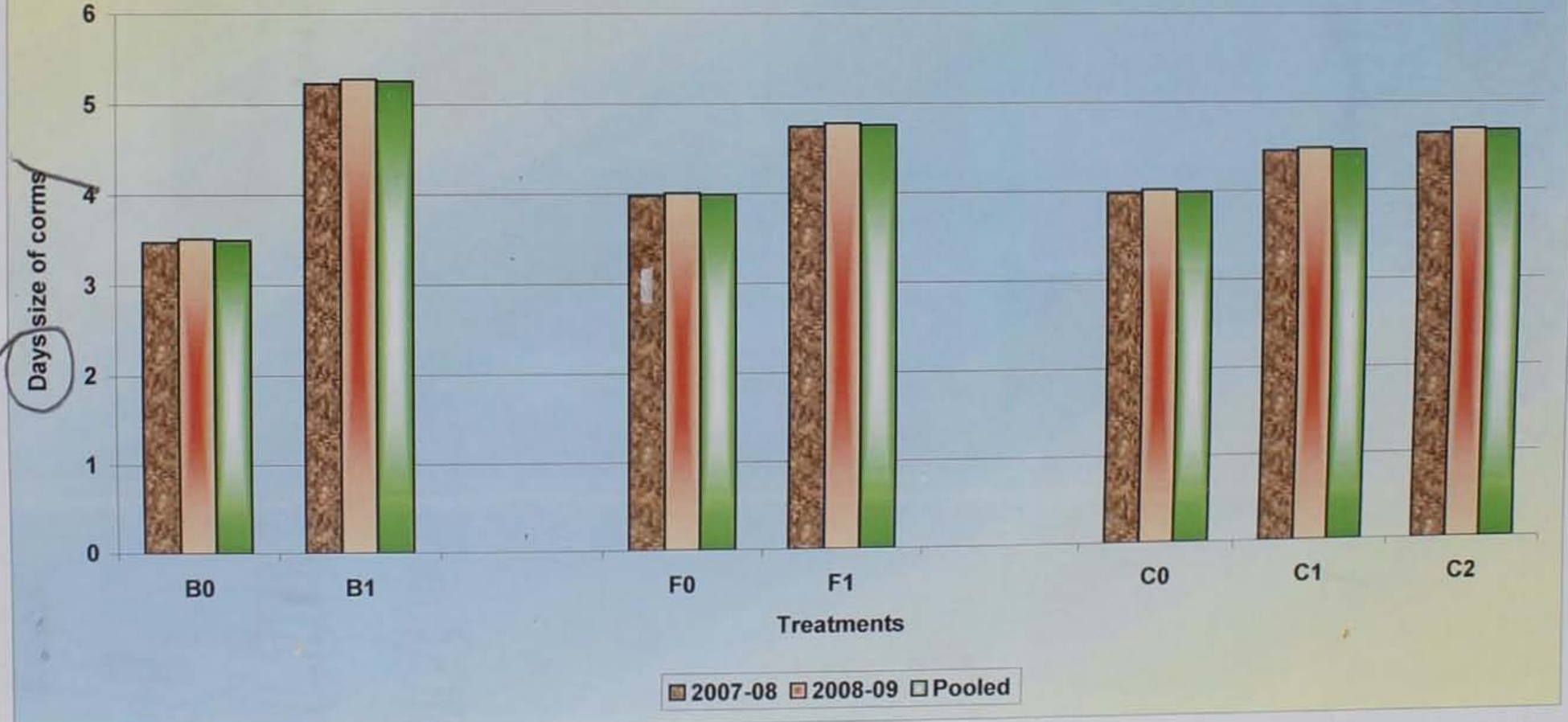


Plate-IX : Corm diameter as influenced by Bio-inoculants, FYM and inorganic fertilizers

B_1 : AZT + PSB

F_1 : FYM 5 kg/plot

C_2 : 100 % RDF

It is evident from Table – 4.12.1 that significantly maximum size of corm was noted in treatment combination B_1F_1 (5.89, 5.94 and 5.92 cm, respectively for 2007-08, 2008-09 and in pooled) which was followed by B_1F_0 (4.58, 4.61 and 4.59 cm, respectively for 2007-08, 2008-09 and in pooled).

The data on interaction effect of B x C was found to be significant during pooled analysis are presented in Table – 4.12.2. The size of corm was recorded significantly maximum in treatment combination B_1C_2 (5.69 cm) which was on same bar with B_1C_1 (5.38 cm). While, treatment combination B_0C_0 recorded significantly lower size of corm (3.30 cm).

Table – 4.12.1 Interaction effect of bioinoculants and FYM on floret diameter

Treatments	2007-08			2008-09			Pooled		
	F_0	F_1	Mean	F_0	F_1	Mean	F_0	F_1	Mean
B_0	3.38	3.59	**3.49**	3.41	3.62	**3.52**	3.39	3.61	**3.50**
B_1	4.58	5.89	**5.24**	4.61	5.94	**5.28**	4.59	5.92	**5.26**
Mean	**3.98**	**4.74**		**4.01**	**4.78**		**3.99**	**4.77**	
S. Em. ±	0.140			0.153			0.088		
C.D. at 5 %	0.41			0.45			0.25		

Table – 4.12.2 **Interaction effect of bioinoculants and inorganic fertilizers on floret diameter during pooled analysis**

Treatments	C_0	C_1	C_2	Mean
B_0	3.30	3.54	3.66	**3.50**
B_1	4.69	5.38	5.69	**5.26**
Mean	**4.00**	**4.46**	**4.68**	
S. Em. ±	0.124			
C.D. at 5 %	0.35			

4.2.9 Number of corms per plant

The data on number of corms per plant as influenced by bio-inoculants, FYM and inorganic fertilizers during both the years and in pooled analysis are presented in Table – 4.13, Plate – X and laid out in Fig.- 13.

4.2.9.1 Effect of bio-inoculants

From Table – 4.13, it is evident that bio-inoculants had a significant effect on number of corms per plant. During both the years and in pooled analysis, higher number of corms per plant (3.24, 3.32 and 3.28, respectively) was observed in treatment B_1 (AZT + PSB) which was followed by treatment B_0 (Uninoculated).

4.2.9.2 Effect of FYM

The application of FYM showed significant effect on number of corms per plant during both the years and in pooled

Table-4.13 : **Effect of bio-inoculants, FYM and inorganic fertilizers on number of corms per plant of gladiolus cv. American Beauty**

Treatments		Number of corms per plant		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	1.94	2.04	1.99
B_1 :	AZT + PSB	3.24	3.32	3.28
	S. Em. ±	0.073	0.059	0.047
	C.D. at 5%	0.22	0.17	0.13
FARM YARD MANURE (F)				
F_0 :	No FYM	2.07	2.17	2.12
F_1 :	FYM 5 kg/m^2	3.11	3.19	3.15
	S. Em. ±	0.073	0.059	0.047
	C.D. at 5%	0.22	0.17	0.13
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	2.31	2.39	2.35
C_1 :	75% RDF	2.53	2.61	2.57
C_2 :	100% RDF	2.95	3.03	2.99
	S. Em. ±	0.090	0.073	0.057
	C.D. at 5%	0.26	0.21	0.16
INTERACTION EFFECT				
	B x F	Sig	Sig	Sig
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	12.00	9.42	10.75

Fig.- 13 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of corms per plant of gladiolus cv. American Beauty

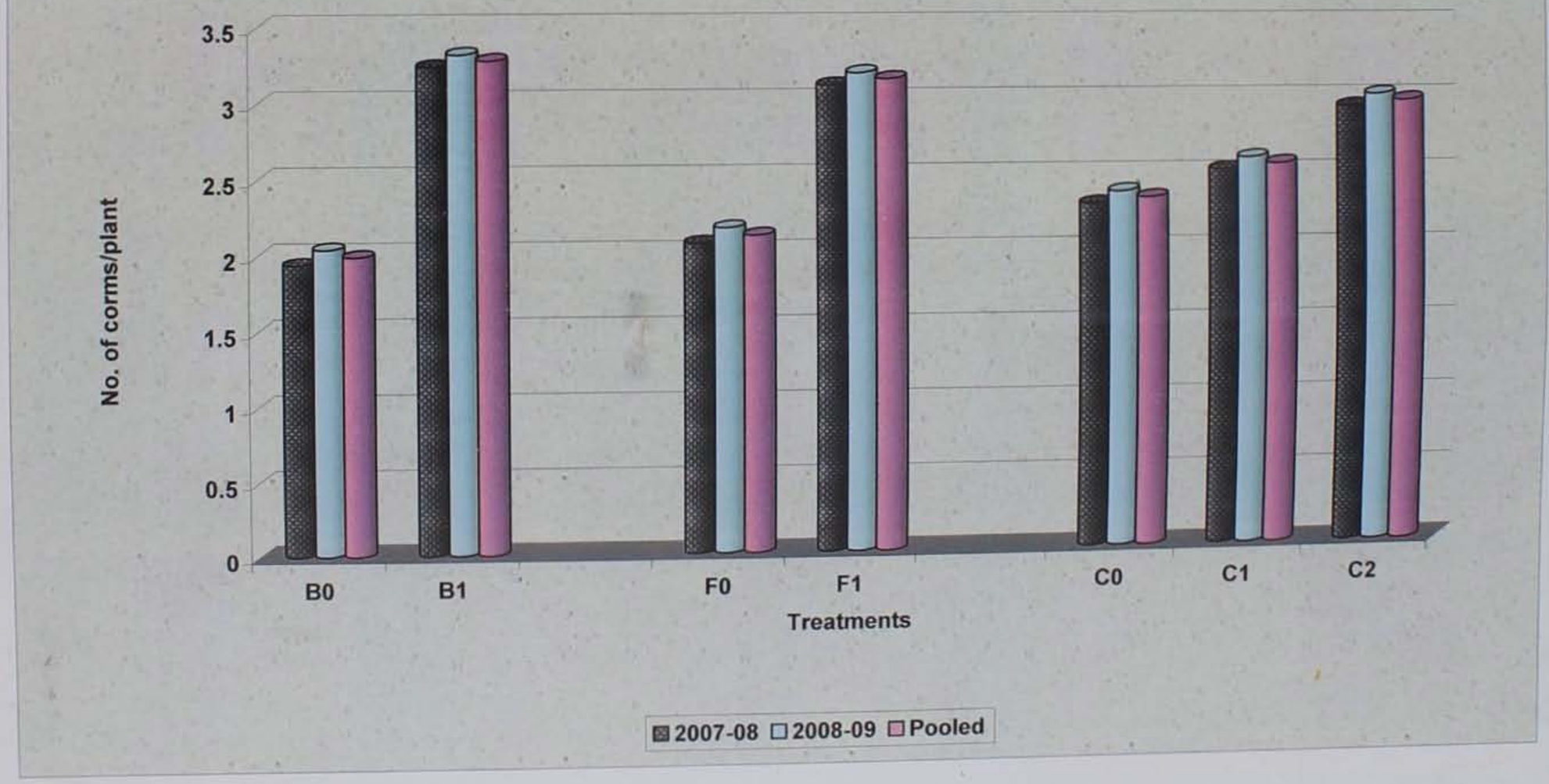


Plate – X : Number of corm and cormels as influenced by bio-inoculants, FYM and inorganic fertilizers

B1 : AZT + PSB

F1 : FYM 5 kg/plot

C2 : 100 % RDF

analysis (Table – 4.13). During the year 2007-08, significantly maximum number of corms per plant (3.11) was observed with application of FYM @ 5 kg/m^2 while F_0 reported significantly minimum number of corms per plant (2.07). Moreover, the same results were reported for the year 2008-09 and in pooled analysis.

4.2.9.3 Effect of inorganic fertilizers

It is evident from Table-4.13 that, significantly maximum number of corms per plant (2.95, 3.03 and 2.99, respectively) was recorded in treatment C_2 (100 % RDF) which was followed by C_1 (75 % RDF) i.e. 2.53, 2.61 and 2.57, respectively during the year 2007-08, 2008-09 and in pooled analysis. Whereas C_0 (50 % RDF) gave lowest number of corms per plant (2.31, 2.39 and 2.35, respectively).

4.2.9.4 Interaction effect

All the interactions of bio-inoculants, FYM and inorganic fertilizers were failed to show any significant effect on plant height during 2007-08, 2008-09 and in pooled analysis (Table – 4.13).

4.2.10 Weight of corms per plant

The data regarding weight of corms per plant of gladiolus as influenced by bio-inoculants, FYM and inorganic

fertilizers recorded during the experimentation and are presented in Table – 4.14 and graphically trace out in Fig. - 14.

4.2.10.1 Effect of bio-inoculants

It is revealed from the data (Table – 4.14) that there were significant differences in weight of corms per plant of gladiolus. During the year 2007-08, 2008-09 and in pooled analysis, significantly higher weight of corms per plant (31.87, 32.00 and 31.94 g, respectively) was recorded in B_1 (AZT+PSB) whereas uninoculated corms of gladiolus recorded lowest weight of corms per plant (28.78, 28.87 and 28.82 g, respectively).

4.2.10.2 Effect of FYM

During both the years and in pooled, the data related to weight of corms per plant of gladiolus as influenced by FYM was found to be significant. The application of FYM @ 5 kg/m^2 registered significantly higher weight of corms per plant (31.78, 31.91 and 31.84 g, respectively) as compared to F_0 (28.87, 28.96 and 28.91 g, respectively).

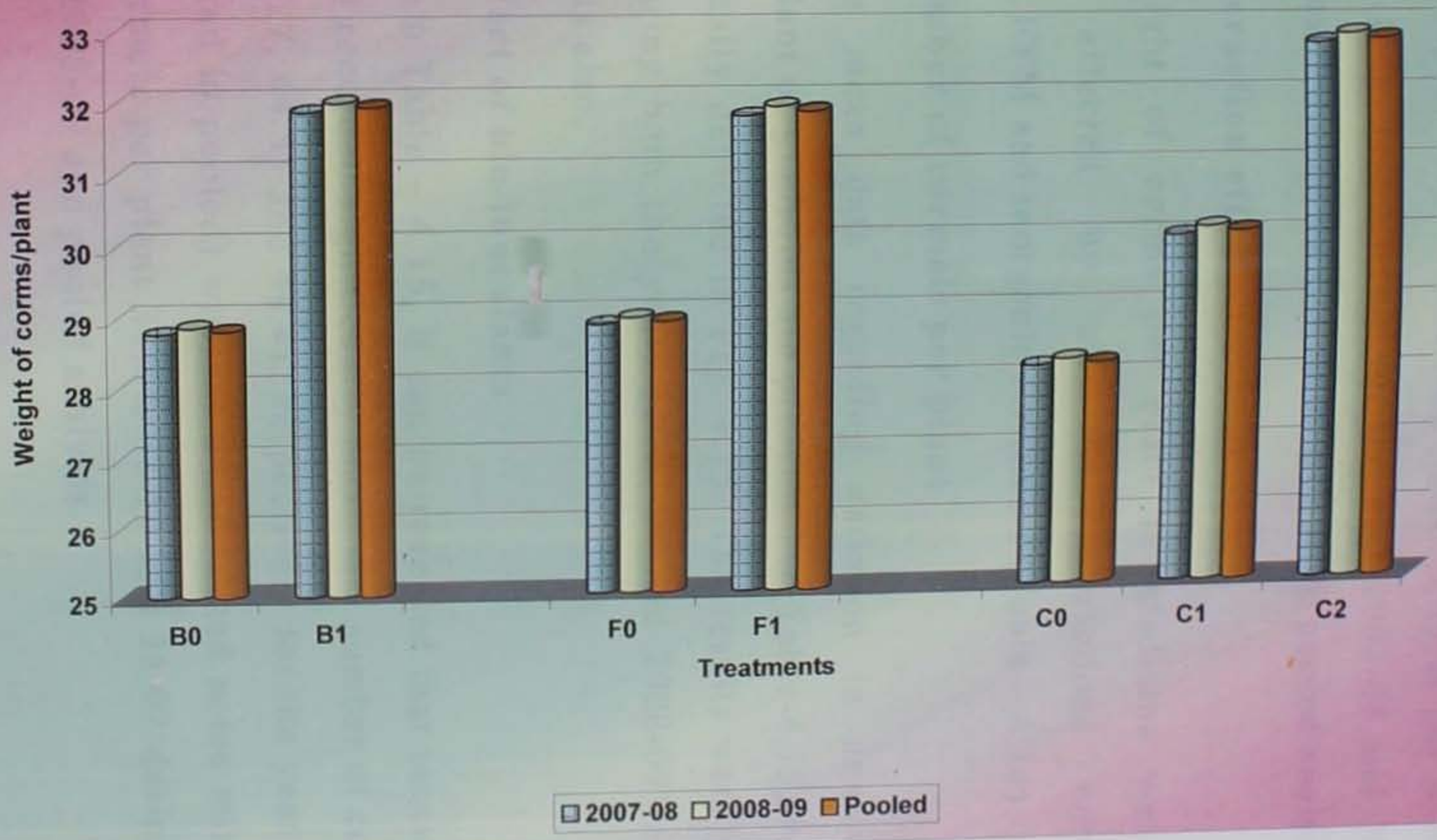
4.2.10.3 Effect of inorganic fertilizers

It is evident from the data (Table – 4.14) that there were significant differences in weight of corms per plant of gladiolus due to different inorganic fertilizers. During the year 2007-08, 2008-09 and in pooled analysis, 100% RDF recorded significantly maximum weight of corms per plant (32.75, 32.88

Table-4.14 : Effect of bio-inoculants, FYM and inorganic fertilizers on weight of corms per plant (g) of gladiolus cv. American Beauty

Treatments		Weight of corms per plant (g)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	28.78	28.87	28.82
B_1 :	AZT + PSB	31.87	32.00	31.94
	S. Em. ±	0.856	0.834	0.591
	C.D. at 5%	2.51	2.45	1.68
FARM YARD MANURE (F)				
F_0 :	No FYM	28.87	28.96	28.91
F_1 :	FYM 5 kg/m^2	31.78	31.91	31.84
	S. Em. ±	0.856	0.834	0.591
	C.D. at 5%	2.51	2.45	1.68
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	28.19	28.28	28.23
C_1 :	75% RDF	30.03	30.15	30.09
C_2 :	100% RDF	32.75	32.88	32.81
	S. Em. ±	1.048	1.021	0.716
	C.D. at 5%	3.07	3.00	2.04
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.97	11.63	11.80

Fig.- 14 : Effect of bio-inoculants, FYM and inorganic fertilizers on weight of corms per plant (g) of gladiolus cv. American Beauty



and 32.81 g, respectively) which was statistically at par with C_2 (30.03 and 30.15 g, respectively for the year 2007-08 and 2008-09) while it was followed by C_2 (30.09 g) during pooled analysis.

4.2.10.4 Interaction effect

Weight of corms per plant in gladiolus was not significantly affected by all the interactions between bioinoculants, FYM and inorganic fertilizers (Table – 4.14).

4.2.11 Number of cormels per plant

The mean data regarding variation in number of cormels per plant of gladiolus are presented in Table-4.15, Plate – X and graphically depicted in Fig. 4.15. The results were found significant during both the years (2007-08 and 2008-09) and in pooled analysis also.

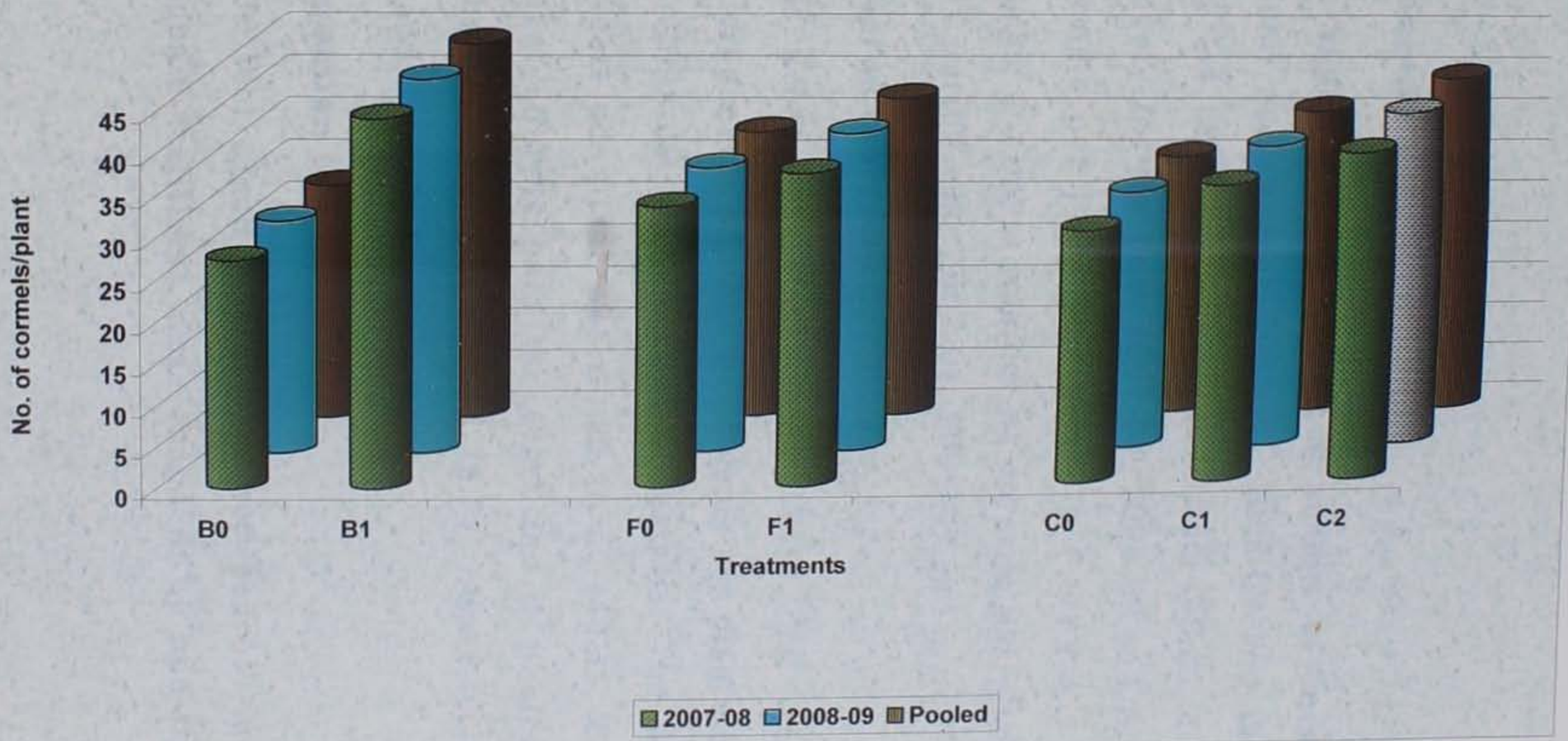
4.2.11.1 Effect of bio-inoculants

From Table – 4.15, it can be revealed that inoculation of AZT + PSB recorded significantly maximum number of cormels per plant (44.27, 44.55 and 44.41, respectively for the year 2007-08, 2008-09 and in pooled) whereas uninoculated noted minimum number of cormels per plant 37.84, 38.19 and 38.02 during year 2007-08 and 2008-09 and pooled analysis.

Table-4.15 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of cormels per plant of gladiolus cv. American Beauty

Treatments		Number of cormels per plant		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	27.42	27.74	27.58
B_1 :	AZT + PSB	44.27	44.55	44.41
	S. Em. ±	1.008	1.018	0.708
	C.D. at 5%	2.96	2.98	2.02
FARM YARD MANURE (F)				
F_0 :	No FYM	33.84	34.10	33.97
F_1 :	FYM 5 kg/m^2	37.84	38.19	38.02
	S. Em. ±	1.008	1.018	0.708
	C.D. at 5%	2.96	2.98	2.02
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	30.92	31.13	31.03
C_1 :	75% RDF	36.36	36.66	36.51
C_2 :	100% RDF	40.25	40.65	40.45
	S. Em. ±	1.235	1.246	0.858
	C.D. at 5%	3.62	3.66	2.44
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.93	11.94	11.94

Fig.- 15 : Effect of bio-inoculants, FYM and inorganic fertilizers on number of cormels per plant of gladiolus cv. American Beauty



4.2.11.2 Effect of FYM

The significant differences in number of cormels per plant were found during year 2007-08, 2008-09 and in pooled analysis (Table – 4.15). Significantly maximum (40.25, 40.65 and 40.45, respectively for the year 2007-08, 2008-09 and in pooled) number of cormels per plant was noted in F_1 (FYM 5 kg/m^2). While F_0 reported minimum number of cormels per plant 36.36, 36.66 and 36.51 during year 2007-08, 2008-09 and in pooled.

4.2.11.3 Effect of inorganic fertilizers

It is seen from the Table – 4.15 that there were significant differences in number of cormels per plant during the year 2007-08, 2008-09 and in pooled analysis. The maximum number of cormels per plant was noted in C_2 (40.25, 40.65 and 40.45, respectively during both the years and in pooled) which was followed by C_1 (36.36, 36.66 and 36.51, respectively during both the years and in pooled).

4.2.11.4 Interaction effect

The effect of all interactions between bio-inoculants, FYM and inorganic fertilizers were found to be non-significant (Table – 4.15).

4.2.12 Weight of cormels per plot (g)

The data pertaining to weight of cormels per plot of gladiolus as influenced by bio-inoculants, FYM and inorganic fertilizers recorded during the experimentation and are presented in Table – 4.16 and graphically trace out in Fig. - 16.

4.2.12.1 Effect of bio-inoculants

It is revealed from the data (Table – 4.16) that there were significant differences in weight of cormels per plot of gladiolus. During the year 2007-08, 2008-09 and in pooled analysis, significantly highest weight of cormels per plot (135.65, 136.16 and 135.90 g, respectively) was recorded in B_1 (AZT+PSB) whereas uninoculated corms of gladiolus noted significantly lowest weight of cormels per plot (94.15, 94.80 and 94.47 g, respectively).

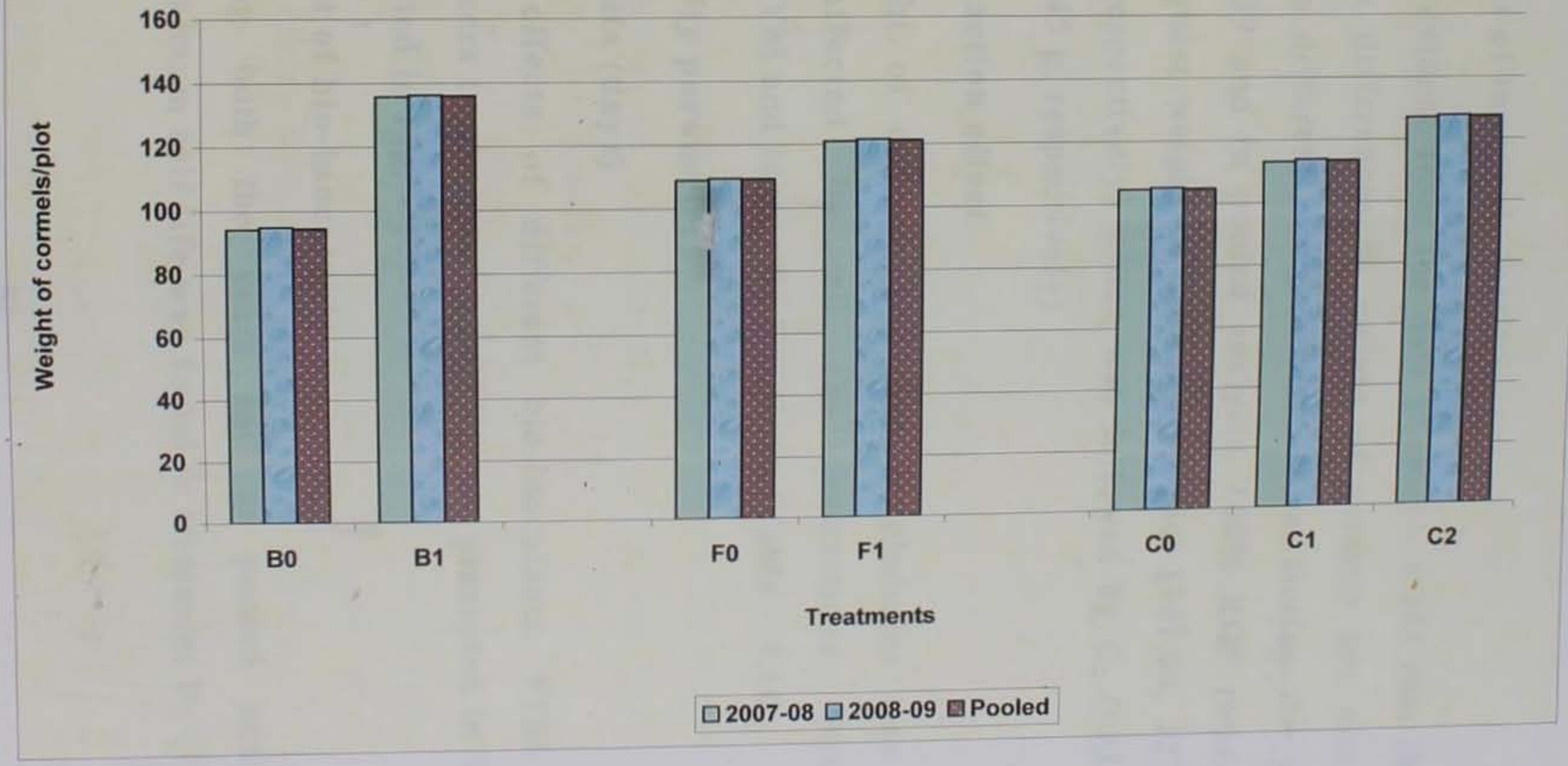
4.2.12.2 Effect of FYM

During both the years and in pooled, the data related to weight of cormels per plot of gladiolus as influenced by FYM was found to be significant. The application of FYM @ 5 kg/m^2 noted significantly higher weight of cormels per plot (120.94, 121.54 and 121.24 g, respectively) whereas F_0 recorded significantly lower (108.85, 109.41 and 109.13 g, respectively).

Table-4.16 : **Effect of bio-inoculants, FYM and inorganic fertilizers on weight of cormels per plot (g) of gladiolus cv. American Beauty**

Treatments		Weight of cormels per plot (g)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	94.15	94.80	94.47
B_1 :	AZT + PSB	135.65	136.16	135.90
	S. Em. ±	3.214	3.113	2.212
	C.D. at 5%	9.43	9.13	6.31
FARM YARD MANURE (F)				
F_0 :	No FYM	108.85	109.41	109.13
F_1 :	FYM 5 kg/m^2	120.94	121.54	121.24
	S. Em. ±	3.214	3.113	2.212
	C.D. at 5%	9.43	9.13	6.30
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	104.52	105.03	104.77
C_1 :	75% RDF	113.09	113.75	113.42
C_2 :	100% RDF	127.09	127.65	127.37
	S. Em. ±	3.936	3.812	2.680
	C.D. at 5%	11.55	11.18	7.63
INTERACTION EFFECT				
	B x F	Sig	Sig	Sig
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.87	11.44	11.65

Fi.g-16 : Effect of bio-inoculants, FYM and inorganic fertilizers on weight of cormels per plot (g) of gladiolus cv. American Beauty



4.2.12.3 Effect of inorganic fertilizers

It is evident from the data (Table – 4.16) that there were significant differences in weight of cormels per plot of gladiolus due to different inorganic fertilizers. During the year 2007-08, 2008-09 and in pooled analysis, 100% RDF recorded significantly highest weight of cormels per plot (127.09, 127.65 and 127.37 g, respectively) which was followed by C_2 (113.09, 113.75 and 113.45 g, respectively)

4.2.12.4 Interaction effect

Weight of cormels per plot in gladiolus was not significantly affected by all the interactions between bioinoculants, FYM and inorganic fertilizers (Table – 4.16).

4.3 Quality parameters

4.3.1 Self life (days)

The effects of different bio-inoculants, FYM and inorganic fertilizers treatments on self life are presented in Table - 4.17 and depicted in Fig. - 17.

4.3.1.1 Effect of bio-inoculants

During both the years and in pooled analysis, significantly maximum self life was found in treatment B_1 (15.11,

15.33 and 15.22 days, respectively) whereas B_0 recorded minimum self life (11.50, 11.83 and 11.67 days, respectively).

4.3.1.2 Effect of FYM

The self life of gladiolus was also significantly affected by application of FYM. Significantly maximum self life was recorded in F_1 (14.17 days) whereas F_0 noted significantly minimum self life (12.44 days) during the year 2007-08. During the year 2008-09 and in pooled similar trend of treatments was reported.

4.3.1.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers during study had also significantly influenced the self life. During both the years and in pooled, significantly maximum self life (14.25, 14.58 and 14.42 days, respectively, was recorded when 100 % RDF (C_2) was given which was on same bar with C_1 (13.33 and 13.58 days, respectively for both the years).

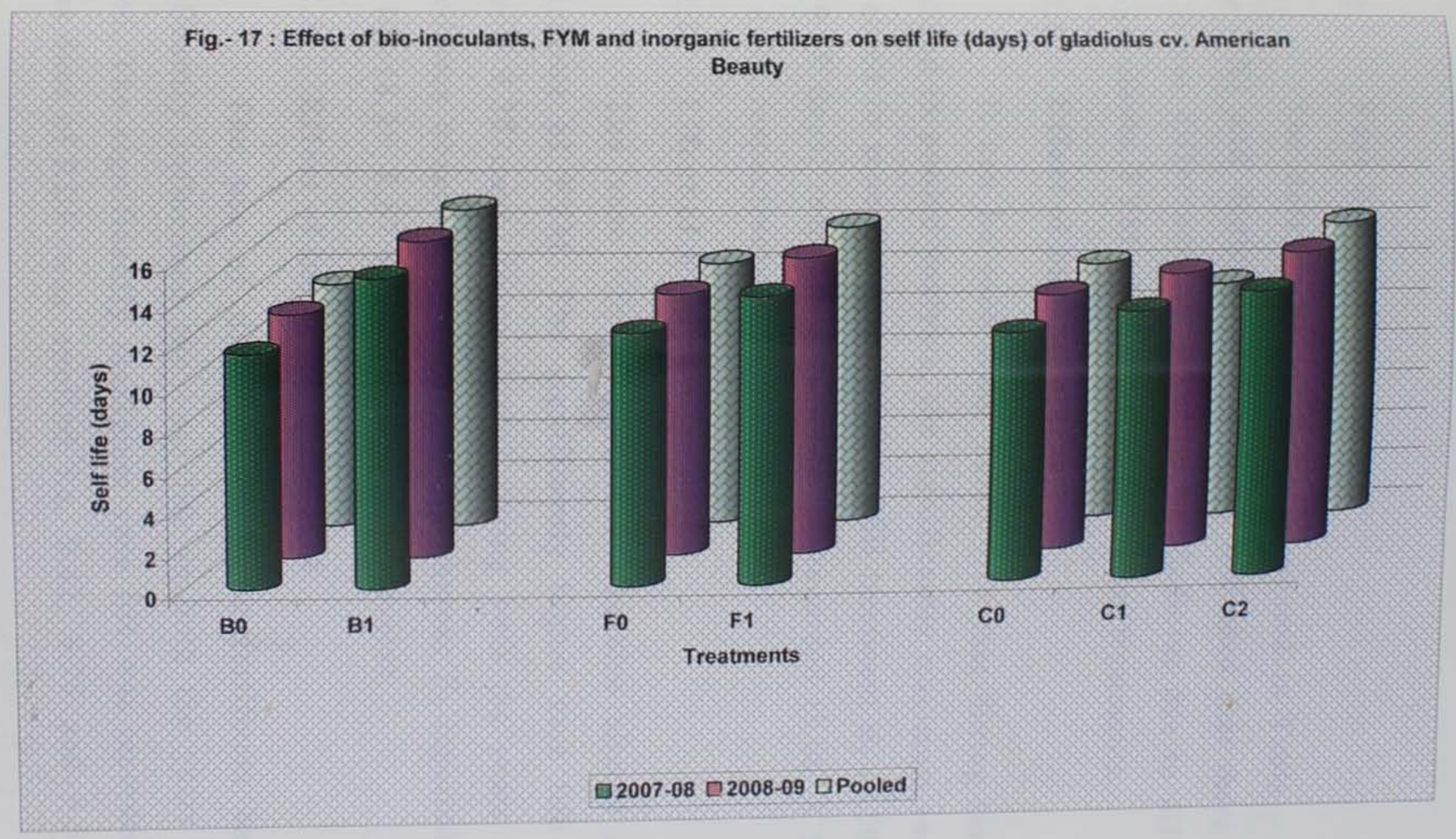
4.3.1.4 Interaction effect

The interactions effect between bio-inoculants, FYM and inorganic fertilizers in respect to self life were found to be non-significant during both the years and in pooled analysis also.

Table-4.17 : Effect of bio-inoculants, FYM and inorganic fertilizers on shelf life (days) of gladiolus cv. American Beauty

Treatments		Shelf life (days)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	11.50	11.83	11.67
B_1 :	AZT + PSB	15.11	15.33	15.22
	S. Em. ±	0.358	0.374	0.256
	C.D. at 5%	1.05	1.10	0.73
FARM YARD MANURE (F)				
F_0 :	No FYM	12.44	12.72	12.58
F_1 :	FYM 5 kg/m^2	14.17	14.44	14.31
	S. Em. ±	0.358	0.374	0.256
	C.D. at 5%	1.05	1.10	0.73
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	12.33	12.58	12.46
C_1 :	75% RDF	13.33	13.58	13.46
C_2 :	100% RDF	14.25	14.58	14.43
	S. Em. ±	0.438	0.459	0.310
	C.D. at 5%	1.28	1.34	0.88
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.40	11.69	11.55

Fig.- 17 : Effect of bio-inoculants, FYM and inorganic fertilizers on self life (days) of gladiolus cv. American Beauty



4.3.2 Vase life

The data on vase life are presented in Table – 4.18, plate - XI and depicted in Fig. – 18 indicated that there were significant differences in vase life of gladiolus due to different bio-inoculants, FYM and inorganic fertilizers treatments.

4.3.2.1 Effect of bio-inoculants

It can be seen from Table 4.18 that during both the years and in pooled analysis, the significantly maximum vase life was noted in inoculation of AZT + PSB treatment B_1 (9.50, 9.67 and 9.58 days, respectively) while B_0 recorded (8.06, 8.39 and 8.22 days, respectively).

4.3.2.2 Effect of FYM

The vase life of gladiolus was also altered due to application of FYM. The significantly higher vase life (9.17, 9.39and 9.28 days, respectively) during both the years and in pooled was observed in treatment F_1 whereas F_0 reported lower vase life (8.39, 8.67 and 8.53 days, respectively).

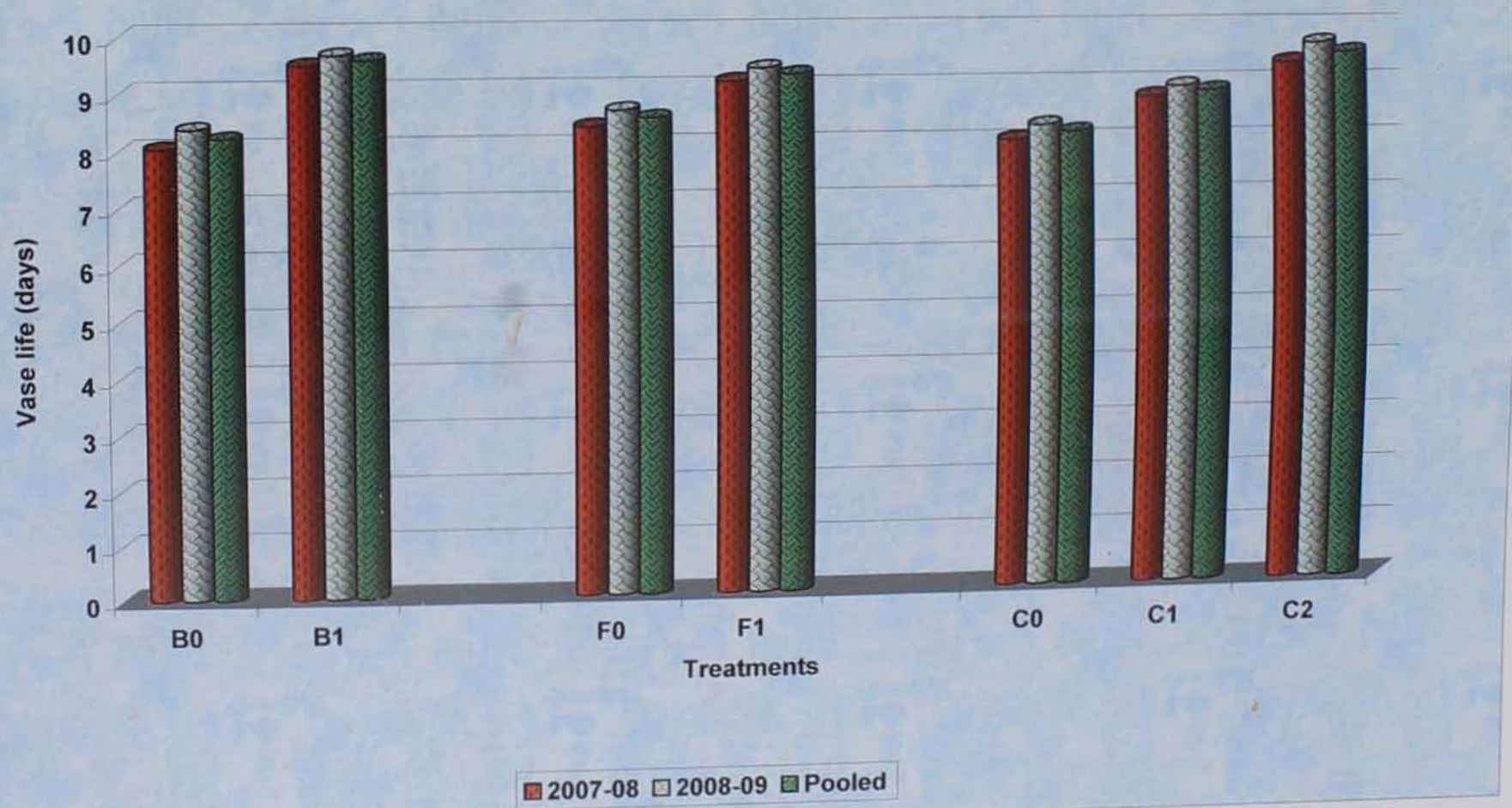
4.3.2.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers had also significantly influenced the vase life in both the years and in pooled. The significantly maximum vase life was recorded when higher dose of RDF was applied i.e. 9.42, 9.75 and 9.58 days

Table-4.18 : Effect of bio-inoculants, FYM and inorganic fertilizers on vase life (days) of gladiolus cv. American Beauty

Treatments		Vase life (days)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	8.06	8.39	8.22
B_1 :	AZT + PSB	9.50	9.67	9.58
	S. Em. ±	0.244	0.213	0.160
	C.D. at 5%	0.72	0.62	0.46
FARM YARD MANURE (F)				
F_0 :	No FYM	8.39	8.67	8.53
F_1 :	FYM 5 kg/m^2	9.17	9.39	9.28
	S. Em. ±	0.244	0.213	0.160
	C.D. at 5%	0.72	0.62	0.46
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	8.08	8.33	8.21
C_1 :	75% RDF	8.83	9.00	8.92
C_2 :	100% RDF	9.42	9.75	9.58
	S. Em. ±	0.299	0.261	0.194
	C.D. at 5%	0.88	0.76	0.55
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.80	10.00	10.92

Fig.- 18 : Effect of bio-inoculants, FYM and inorganic fertilizers on vase life (days) of gladiolus cv. American Beauty



Plate–XI: Vase life as influenced by bio-inoculants, FYM and inorganic fertilizers

which was statistically at par C_1 (8.83 and 9.00 days, respectively for the year 2007-08 and 2008-09). Whereas in pooled analysis, it was followed by C_2 (8.92 days).

4.3.2.4 Interaction effect

The interaction between between bio-inoculants, FYM and inorganic fertilizers in respect to vase life were found to be non-significant during both the years and in pooled analysis also.

4.4 Soil analysis

4.4.1 Available nitrogen (kg/ha)

The data pertaining to available N as influenced by bioinoculants, FYM and inorganic fertilizers was recorded during the experimentation and are presented in Table – 4.19 and graphically trace out in Fig. - 19.

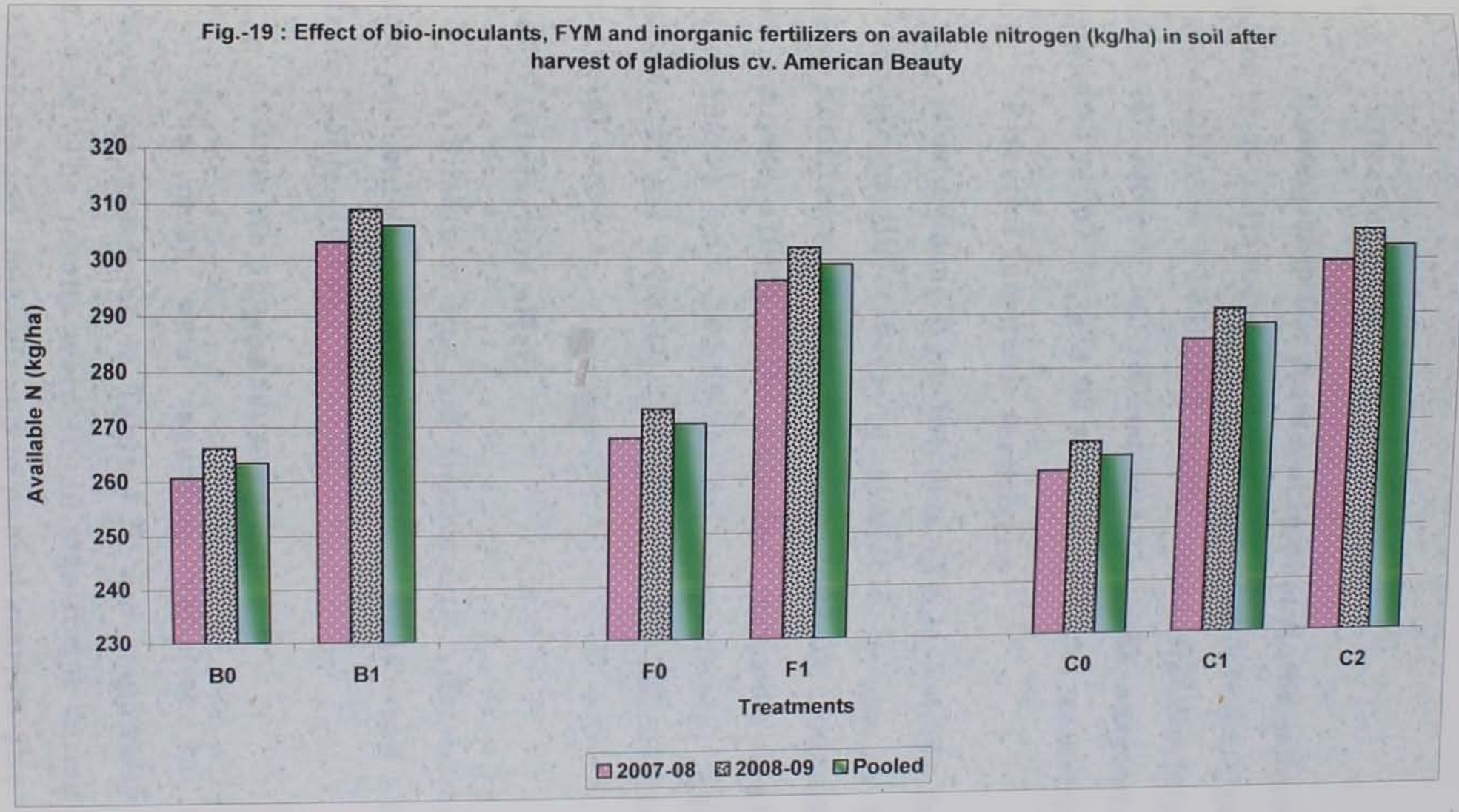
4.4.1.1 Effect of bio-inoculants

It is revealed from the data (Table – 4.19) that there were significant differences in available nitrogen. During the year 2007-08, 2008-09 and in pooled analysis, significantly maximum available N (303.33, 309.05 and 306.19 kg/ha, respectively) was recorded in B_1 (AZT+PSB) whereas uninoculated F0 recorded minimum available N (260.78, 266.22 and 263.50 kg/ha, respectively).

Table-4.19 : **Effect of bio-inoculants, FYM and inorganic fertilizers on available nitrogen (kg/ha) in soil after harvest of gladiolus cv. American Beauty**

Treatments		Available N (kg/ha)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	260.78	266.22	263.50
B_1 :	AZT + PSB	303.33	309.05	306.19
	S. Em. ±	8.481	8.473	5.993
	C.D. at 5%	24.87	24.85	17.08
FARM YARD MANURE (F)				
F_0 :	No FYM	267.79	273.09	270.44
F_1 :	FYM 5 kg/m^2	296.31	302.18	299.25
	S. Em. ±	8.481	8.473	5.993
	C.D. at 5%	24.87	24.85	17.08
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	261.10	266.46	263.78
C_1 :	75% RDF	285.38	290.95	288.16
C_2 :	100% RDF	299.68	305.51	302.59
	S. Em. ±	10.387	10.378	7.342
	C.D. at 5%	30.46	30.43	20.92
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	12.76	12.50	12.63

Fig.-19 : Effect of bio-inoculants, FYM and inorganic fertilizers on available nitrogen (kg/ha) in soil after harvest of gladiolus cv. American Beauty



4.4.1.2 Effect of FYM

During both the years and in pooled, the data related to available N as influenced by FYM was found to be significant. The application of FYM @ 5 kg/m^2 noted significantly higher available N (296.31, 302.18 and 299.25 kg/ha, respectively) as compared to F_0 (267.79, 273.09 and 270.44 kg/ha, respectively).

4.4.1.3 Effect of inorganic fertilizers

It is evident from the data (Table – 4.19) that there were significant differences in available N due to different inorganic fertilizers. During the year 2007-08, 2008-09 and in pooled analysis, 100% RDF recorded maximum available N (299.68, 305.51 and 302.59 kg/ha, respectively) which was statistically at par with C_2 (285.38, 290.95 and 288.16 kg/ha, respectively).

4.4.1.4 Interaction effect

Available N was not significantly affected by all the interactions between bio-inoculants, FYM and inorganic fertilizers (Table – 4.19).

4.4.2 Available phosphorus (kg/ha)

The mean data regarding variation in available phosphorus are presented in Table-4.20 and graphically depicted in Fig. 4.20. The results were found significant during both the years (2007-08 and 2008-09) and in pooled analysis also.

4.4.2.1 Effect of bio-inoculants

From Table – 4.20, it can be revealed that inoculation of AZT + PSB reported significantly maximum available phosphorus (68.90, 69.52 and 69.21 kg/ha, respectively for the year 2007-08, 2008-09 and in pooled) whereas uninoculated noted minimum 61.76, 61.98 and 61.87 kg/ha during year 2007-08 and 2008-09 and pooled analysis.

4.4.2.2 Effect of FYM

The significant differences in available phosphorus were found during year 2007-08, 2008-09 and in pooled analysis (Table – 4.20). An application of F_1 (FYM 5 kg/m^2) recorded significantly highest available phosphorus (67.98, 68.48 and 68.23 kg/ha, respectively for the year 2007-08, 2008-09 and in pooled). While F_0 minimum available phosphorus 62.67, 63.01 and 62.84 kg/ha during year 2007-08, 2008-09 and in pooled.

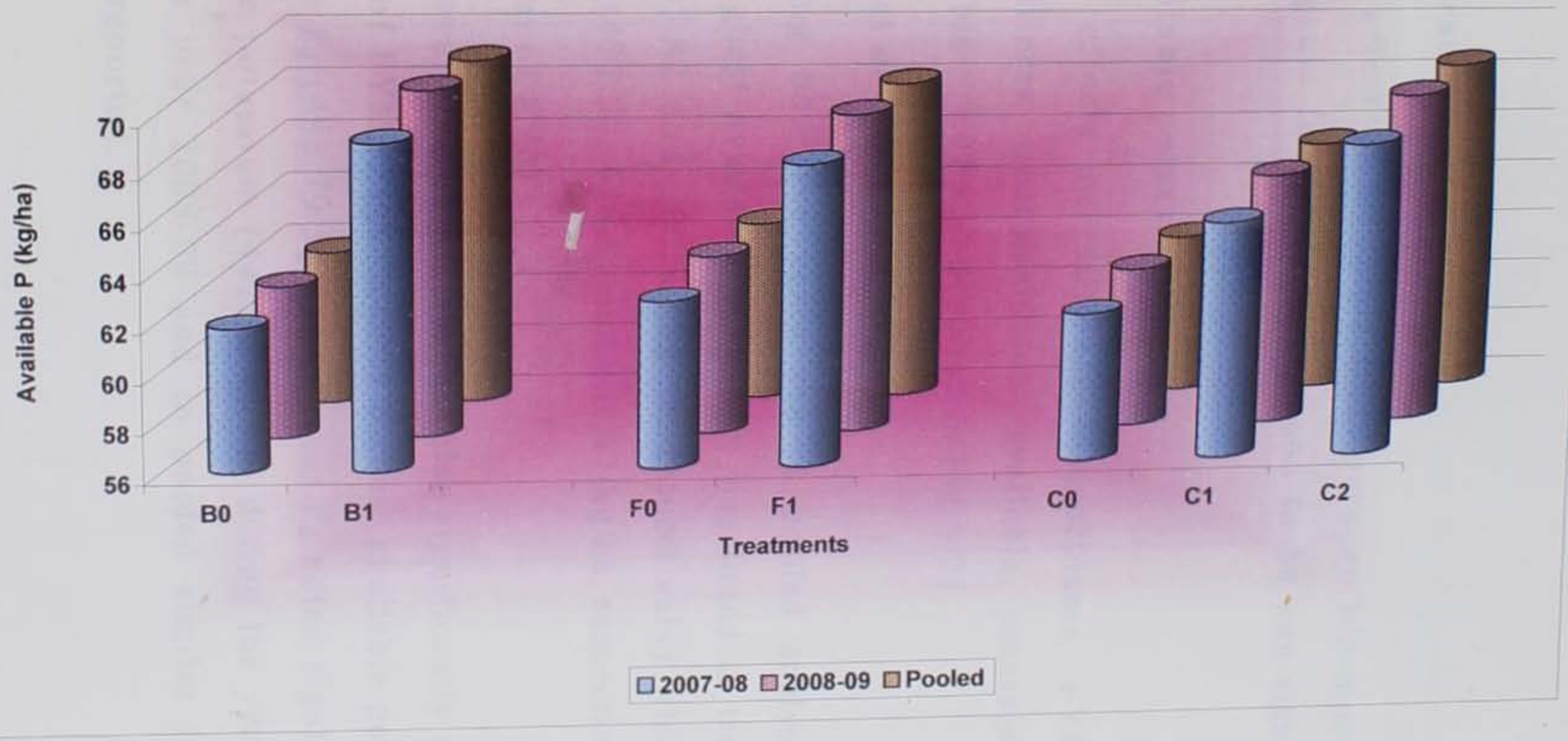
4.4.2.3 Effect of inorganic fertilizer

It is seen from the Table – 4.20 that there were significant differences in available phosphorus during the year 2007-08, 2008-09 and in pooled analysis. Significantly maximum available phosphorus was noted in C_2 (68.53, 69.03 and 68.78 kg/ha) which was statistically at par with C_1 (65.51, 65.93 and 65.72 kg/ha) during both the years and in pooled.

Table-4.20 : **Effect of bio-inoculants, FYM and inorganic fertilizers on available phosphorus (kg/ha) in soil after harvest of gladiolus cv. American Beauty**

Treatments		Available P (kg/ha)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	61.76	61.98	61.87
B_1 :	AZT + PSB	68.90	69.52	69.21
	S. Em. ±	1.447	1.480	1.035
	C.D. at 5%	4.24	4.34	2.95
FARM YARD MANURE (F)				
F_0 :	No FYM	62.67	63.01	62.84
F_1 :	FYM 5 kg/m^2	67.98	68.48	68.23
	S. Em. ±	1.447	1.480	1.035
	C.D. at 5%	4.24	4.34	2.95
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	61.94	62.28	62.11
C_1 :	75% RDF	65.51	65.93	65.72
C_2 :	100% RDF	68.53	69.03	68.78
	S. Em. ±	1.772	1.812	1.267
	C.D. at 5%	5.20	5.31	3.61
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	9.40	9.55	9.47

Fig.-20 : Effect of bio-inoculants, FYM and inorganic fertilizers on available phosphorus (kg/ha) in soil after harvest of gladiolus cv. American Beauty



4.4.2.4 Interaction effect

The effect of all interactions between bio-inoculants, FYM and inorganic fertilizers were found to be non-significant (Table – 4.20).

4.4.3 Available potassium (kg/ha)

The effects of different bioinoculants, FYM and inorganic fertilizers treatments on available potassium are presented in Table – 4.21 and depicted in Fig. - 21.

4.4.3.1 Effect of bio-inoculants

During both the years and in pooled analysis, the significantly highest available potassium was found in treatment B_1 (498.14, 503.82 and 500.98 kg/ha, respectively) which was followed by B_0 (431.57, 436.85 and 434.21 kg/ha, respectively).

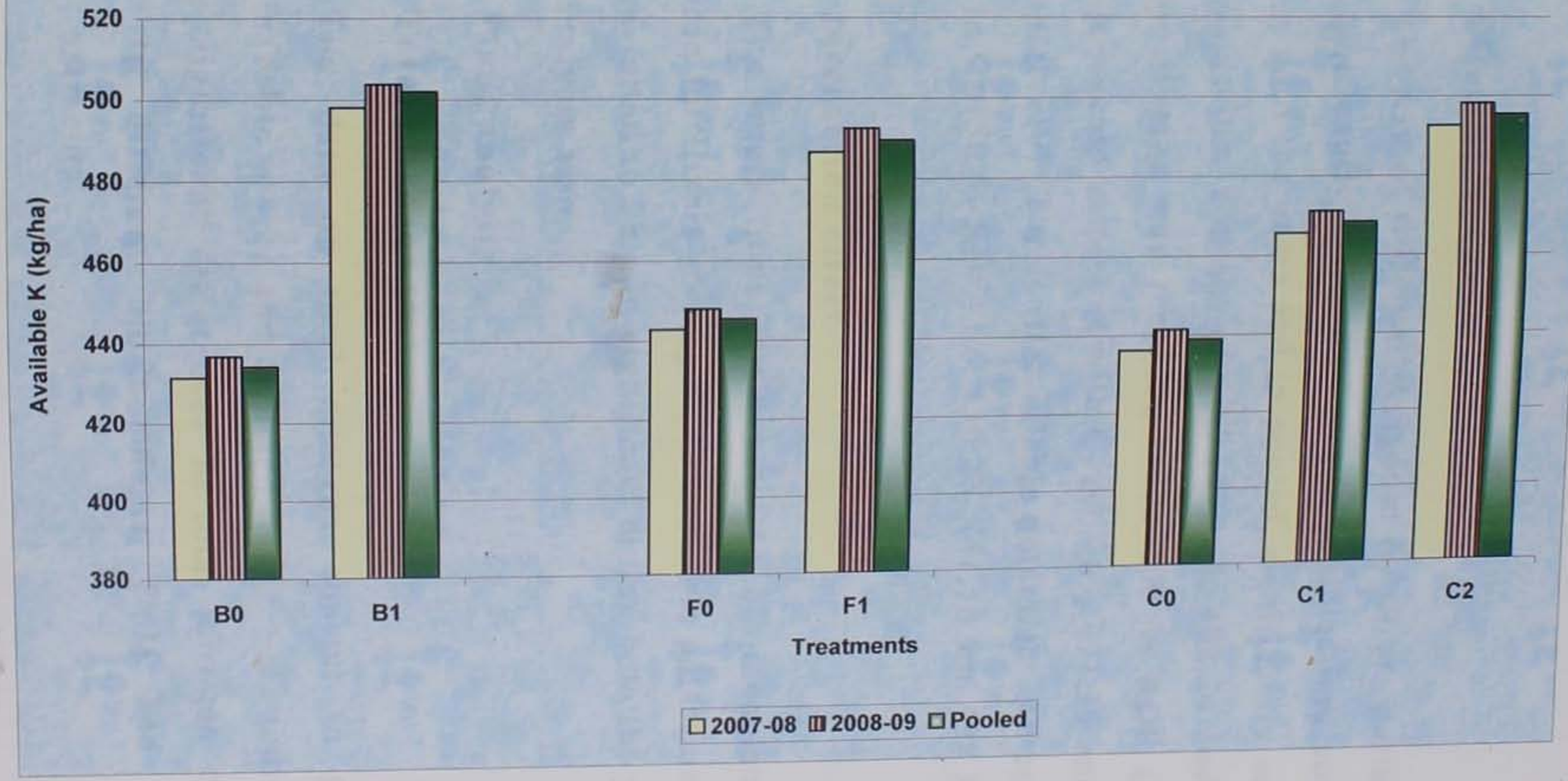
4.4.3.2 Effect of FYM

The available potassium was also.significantly affected by application of FYM. Significantly highest available potassium was recorded in F_1 (486.79 kg/ha) whereas F_0 noted significantly lowest available potassium (442.92 kg/ha) during the year 2007-08. During the year 2008-09 and in pooled similar trend of treatments was reported.

Table-4.21 : **Effect of bio-inoculants, FYM and inorganic fertilizers on available potash (kg/ha) in soil after harvest of gladiolus cv. American Beauty**

Treatments		Available K (kg/ha)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	431.57	436.85	434.21
B_1 :	AZT + PSB	498.14	503.82	501.98
	S. Em. ±	12.087	12.068	8.540
	C.D. at 5%	35.44	35.39	24.34
FARM YARD MANURE (F)				
F_0 :	No FYM	442.92	448.05	445.49
F_1 :	FYM 5 kg/m^2	486.79	492.61	489.70
	S. Em. ±	12.087	12.068	8.540
	C.D. at 5%	35.44	35.39	24.34
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	436.23	441.50	438.86
C_1 :	75% RDF	465.69	471.25	468.47
C_2 :	100% RDF	492.66	498.24	495.45
	S. Em. ±	14.804	14.780	10.459
	C.D. at 5%	43.41	43.34	29.81
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.03	10.89	10.96

Fig.-21 : Effect of bio-inoculants, FYM and inorganic fertilizers on available potash (kg/ha) in soil after harvest of gladiolus cv. American Beauty



4.4.3.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers during study had also significantly influenced available potassium content of soil. During both the years and in pooled, significantly maximum available potassium content of soil (492.66, 498.24 and 495.45 kg/ha, respectively) was recorded when 100 % RDF (C_2) was given which was on same bar with C_1 (465.69, 471.25 and 468.47 kg/ha, respectively). The least available potassium content of soil was noted in C_0 (50 % RDF) i.e. 436.23, 441.50 and 438.86 kg/ha, respectively.

4.4.3.4 Interaction effect

The interactions effect between bio-inoculants, FYM and inorganic fertilizers in respect to available potassium content of soil were found to be non-significant during both the years and in pooled analysis also.

4.5 Plant analysis

4.5.1 Total nitrogen (%)

The data on total nitrogen content in plant are presented in Table – 4.22 and depicted in Fig. – 22 indicated that there were significant differences in total nitrogen content in plant due to different bio-inoculants, FYM and inorganic fertilizers treatments.

4.5.1.1 Effect of bio-inoculants

It can be seen from Table 4.22 that during both the years and in pooled analysis, significantly highest total nitrogen content in plant was noted in inoculation of AZT + PSB treatment B_1 (3.24, 3.26 and 3.25 %, respectively) which was followed by B_0 (2.72, 2.78 and 2.73 %, respectively).

4.5.1.2 Effect of FYM

The total nitrogen content in plant was also altered due to application of FYM. Significantly highest total nitrogen content in plant (3.10, 3.13 and 3.11 %, respectively) during both the years and in pooled was observed in treatment F_1 which was followed by F_0 (2.86, 2.88 and 2.87 %, respectively).

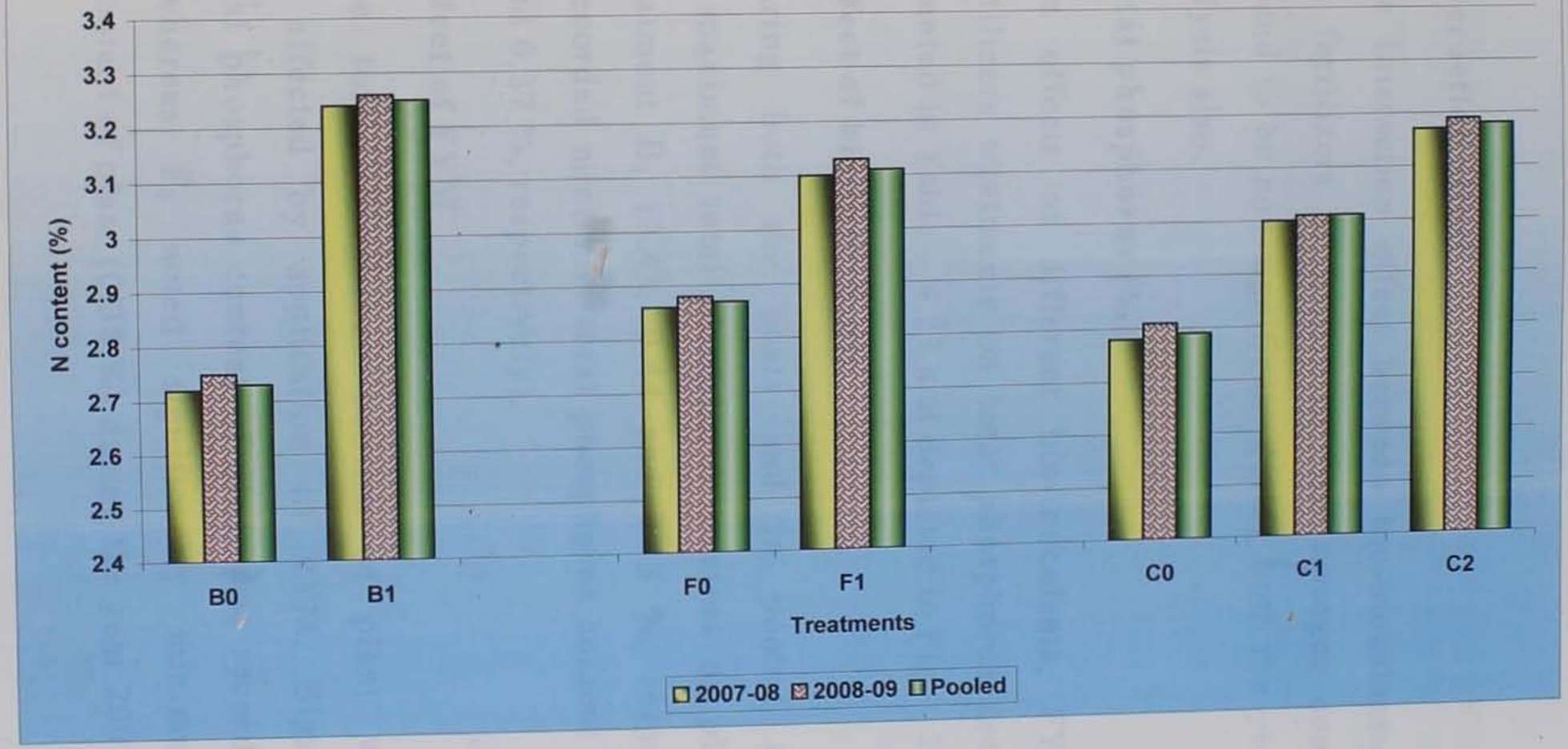
4.5.1.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers had also significantly influenced the total nitrogen content in plant in both the years and in pooled. The significantly higher total nitrogen content in plant was recorded when higher dose of RDF was applied i.e. 3.17, 3.19 and 3.18 % which was statistically at par C_1 (3.00, 3.01 and 3.01 %, respectively).

Table-4.22 : Effect of bio-inoculants, FYM and inorganic fertilizers on nitrogen content (%) in plant of gladiolus cv. American Beauty

Treatments		Nitrogen content (%)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	2.72	2.75	2.73
B_1 :	AZT + PSB	3.24	3.26	3.25
	S. Em. ±	0.078	0.082	0.057
	C.D. at 5%	0.23	0.24	0.16
FARM YARD MANURE (F)				
F_0 :	No FYM	2.86	2.88	2.87
F_1 :	FYM 5 kg/m^2	3.10	3.13	3.11
	S. Em. ±	0.078	0.082	0.057
	C.D. at 5%	0.23	0.24	0.16
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	2.78	2.81	2.79
C_1 :	75% RDF	3.00	3.01	3.01
C_2 :	100% RDF	3.17	3.19	3.18
	S. Em. ±	0.096	0.100	0.069
	C.D. at 5%	0.28	0.29	0.20
INTERACTION EFFECT				
	B x F	NS	NS	Sig
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	11.10	11.56	11.34

Fig.-22: Effect of bio-inoculants, FYM and inorganic fertilizers on nitrogen content (%) in plant of gladiolus cv. American Beauty



4.5.1.4 Interaction effect

The interaction effect between bio-inoculants, FYM and inorganic fertilizers in respect to total nitrogen content in plant were found to be non-significant during both the years and in pooled analysis also.

4.5.2 Total phosphorus (%)

The effects of different bio-inoculants, FYM and inorganic fertilizers treatments on total phosphorus content of plant are presented in Table – 4.23 and depicted in Fig. - 23.

4.5.2.1 Effect of bio-inoculants

During both the years and in pooled analysis, significantly maximum total phosphorus content of plant was found in treatment B_1 (0.43, 0.44 and 0.43 %, respectively) whereas B_0 recorded minimum total phosphorus content of plant (0.37, 0.37 and 0.37 %, respectively).

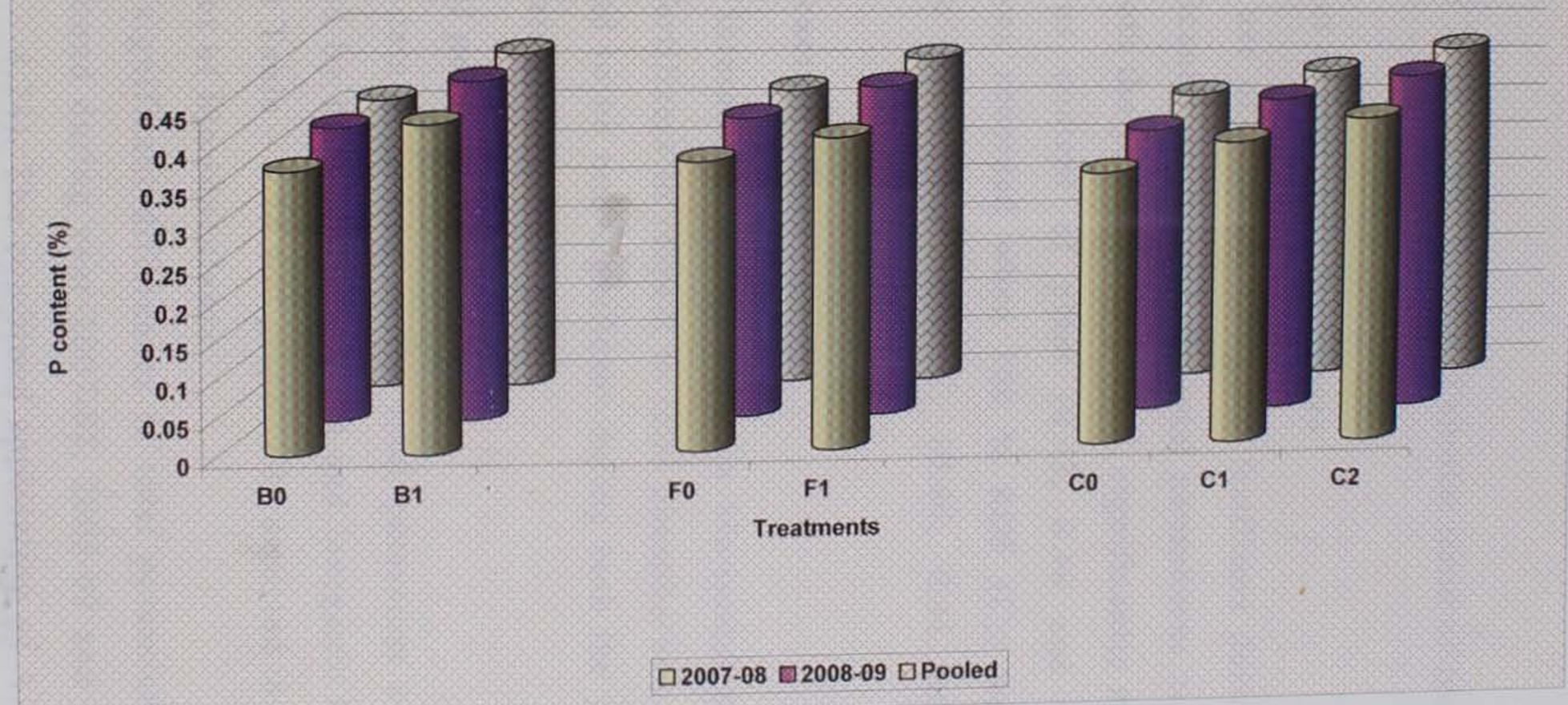
4.5.2.2 Effect of FYM

The total phosphorus content of plant was also significantly affected by application of FYM. Significantly maximum total phosphorus content of plant was recorded in F_1 (0.41 %) whereas F_0 noted significantly minimum total phosphorus content of plant (0.38 %) during the year 2007-08.

Table-4.23 : **Effect of bio-inoculants, FYM and inorganic fertilizers on phosphorus content (%) in plant of gladiolus cv. American Beauty**

Treatments		Phosphorus content (%)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	0.37	0.38	0.37
B_1 :	AZT + PSB	0.43	0.44	0.43
	S. Em. ±	0.012	0.013	0.009
	C.D. at 5%	0.03	0.04	0.03
FARM YARD MANURE (F)				
F_0 :	No FYM	0.38	0.39	0.38
F_1 :	FYM 5 kg/m^2	0.41	0.43	0.42
	S. Em. ±	0.012	0.013	0.009
	C.D. at 5%	0.03	0.04	0.03
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	0.36	0.37	0.37
C_1 :	75% RDF	0.40	0.41	0.40
C_2 :	100% RDF	0.43	0.44	0.43
	S. Em. ±	0.014	0.016	0.011
	C.D. at 5%	0.04	0.05	0.03
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	12.57	13.79	13.21

Fig.-23 : Effect of bio-inoculants, FYM and inorganic fertilizers on phosphorus content (%) in plant of gladiolus cv. American Beauty



During the year 2008-09 and in pooled similar trend of treatments was reported.

4.5.2.3 Effect of inorganic fertilizers

The use of different inorganic fertilizers during study had also significantly influenced the total phosphorus content of plant. During both the years and in pooled, significantly maximum total phosphorus content of plant (0.43, 0.44 and 0.43 %, respectively) was recorded when 100 % RDF (C_2) was given which was on same bar with C_1 (0.40, 0.41 and 0.40, respectively).

4.5.2.4 Interaction effect

The interactions effect between bio-inoculants, FYM and inorganic fertilizers in respect to total phosphorus content of plant were found to be non-significant during both the years and in pooled analysis also (Table - 4.23).

4.5.3 Total potassium (%)

The data regarding to the total potassium content of plant as affected by bioinoculants, FYM and inorganic fertilizers are presented in Table – 4.24 and graphically depicted in Fig.-24.

4.5.3.1 Effect of bio-inoculants

The significant differences in total potassium content of plant were found during year 2007-08, 2008-09 and in pooled analysis (Table – 4.24). The combined application of AZT + PSB

(3.74 %) recorded significantly maximum total potassium content of plant as compared to uninoculated (3.38 %) during the year 2007-08. Similar trends of results were recorded in the year 2008-09 and pooled analysis also.

4.5.3.2 Effect of FYM

It is evident from the data presented in Table – 4.24 that application of FYM significantly altered total potassium content of plant. An application of FYM @ 5 Kg/m^2 recorded significantly highest total potassium content of plant (3.68, 3.73 and 3.70 %, respectively) in F_1 whereas F_0 (No FYM) noted significantly lowest total potassium content of plant (3.44, 3.48 and 3.46, respectively) during both the years and in pooled also.

4.5.3.3 Effect of inorganic fertilizers

In both the years and in pooled, 100 % RDF recorded significantly maximum total potassium content of plant (3.82, 3.85 and 3.84 %, respectively) which was statistically at par with treatment C_1 (75 % RDF) i.e. 3.57 and 3.61 %, respectively in the year 2007-08 and 2008-09. While, incase of pooled analysis it was followed by C_1 (3.59 %).

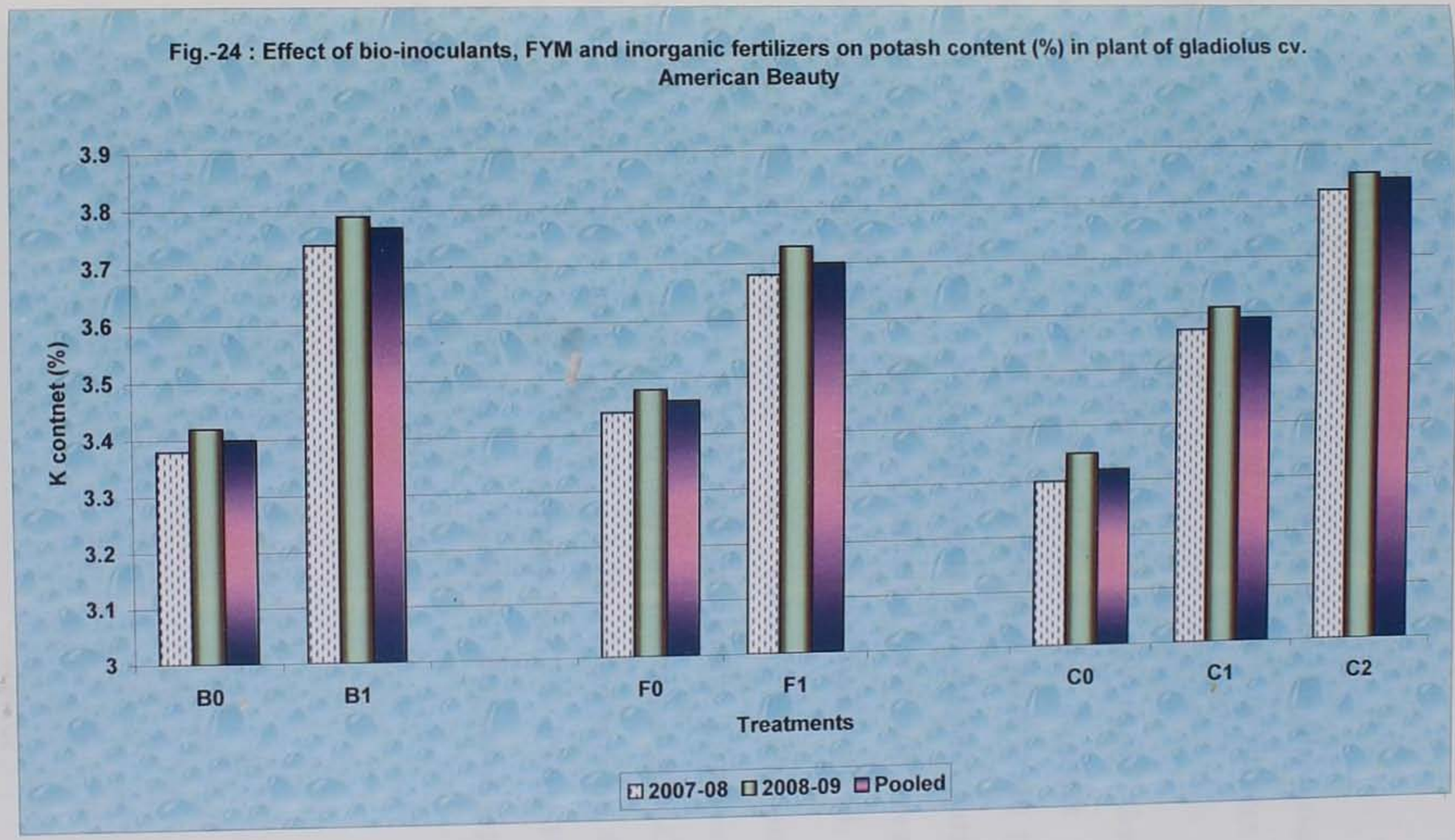
4.5.3.4 Interaction effect

Interaction effect of different bio-inoculants, FYM and inorganic fertilizers and their higher order interaction were found to be non-significant in respect to total potassium content of plant for both years and in pooled analysis (Table – 4.24)

Table-4.24 : **Effect of bio-inoculants, FYM and inorganic fertilizers on potash content (%) in plant of gladiolus cv. American Beauty**

Treatments		Potash content (%)		Pooled
		2007-08	2008-09	
BIO-INOCULANTS (B)				
B_0 :	No inoculation	3.38	3.42	3.40
B_1 :	AZT + PSB	3.74	3.79	3.77
	S. Em. ±	0.079	0.083	0.057
	C.D. at 5%	0.23	0.24	0.16
FARM YARD MANURE (F)				
F_0 :	No FYM	3.44	3.48	3.46
F_1 :	FYM 5 kg/m^2	3.68	3.73	3.70
	S. Em. ±	0.079	0.083	0.057
	C.D. at 5%	0.23	0.24	0.16
INORGANIC FERTILIZERS (C)				
C_0 :	50% RDF	3.30	3.35	3.32
C_1 :	75% RDF	3.57	3.61	3.59
C_2 :	100% RDF	3.82	3.85	3.84
	S. Em. ±	0.097	0.102	0.070
	C.D. at 5%	0.29	0.30	0.20
INTERACTION EFFECT				
	B x F	NS	NS	NS
	B x C	NS	NS	NS
	F x C	NS	NS	NS
	B x F x C	NS	NS	NS
	C.V. %	9.47	9.77	9.62

Fig.-24 : Effect of bio-inoculants, FYM and inorganic fertilizers on potash content (%) in plant of gladiolus cv. American Beauty



4.6 Cost Benefit Ratio

The data on CBR as influenced by combination of various bio-inoculants, FYM and inorganic fertilizers are presented in Table – 4.25.

The data presented in Table 4.25 revealed that the treatment combination $B_1F_1C_2$ resulted in the highest gross realization of spikes (521742.00 Rs/ha), corms (782613.00 Rs/ha) and cormels (3670.23 Rs/ha) giving maximum net realization of Rs. 1034407.11 /ha. This clearly indicated that the treatment combination $B_1F_1C_2$ was most beneficial for gladiolus yield.

The data regarding CBR values work out for biofertilizer (AZT + PSB), FYM and inorganic fertilizers are presented in Table 4.25. It revealed that the treatment $B_1F_1C_2$ gave the highest net return and CBR (1 : 3.78) followed by $B_1F_1C_1$ treatment (1 : 3.25), it was bio-inoculants (AZT + PSB), FYM (5 kg/m^2) and inorganic fertilizers (75 % RDF) appeared optimum for economic gladiolus production.

Table – 4.25 : Influence of bio-inoculants, FYM and inorganic fertilizers on Cost Benefit Ratio of gladiolus c
American Beauty

Treatment combination	Treatment Cost (Rs/ha)	Total Expenditure (Rs/ha)	Gross realization of			Total Gross realization (Rs/ha)	Net realization (Rs/ha)	CBR
			Spikes (Rs/ha)	Corms (Rs/ha)	Cormels (Rs/ha)			
$B_0F_0C_0$	4068	229351	260871.00	280001.54	1757.54	542630.08	313279.52	1.37
C_1	6101	231384	304349.50	299711.79	2052.83	606114.12	374729.78	1.62
C_2	8135	233418	347828.00	357393.27	2248.56	707469.83	474051.71	2.03
F_1C_0	44068	269351	347828.00	347828.00	3015.03	698671.03	429320.47	1.59
C_1	46101	271384	391306.50	444350.27	3226.02	838882.79	567498.45	2.09
C_2	48135	273418	413045.75	483480.92	3516.16	900042.83	626624.71	2.29
$B_1F_0C_0$	4268	229551	304349.50	338262.73	2315.19	644927.42	415376.86	1.81
C_1	6301	231584	391306.50	347828.00	2446.19	741580.69	509996.35	2.20
C_2	8335	233618	391306.50	454205.40	2871.07	848382.97	614764.85	2.63
F_1C_0	44268	269551	391306.50	666670.33	3035.28	1061012.12	791461.56	2.94
C_1	46301	271584	456524.25	695656.00	3233.35	1155413.60	883829.26	3.25
C_2	48335	273618	521742.00	782613.00	3670.23	1308025.23	1034407.11	3.78

Selling Price: 1. Spike @ 2.00 Rs./Spike 2. Corm @ 2.00 Rs./Corm 3. Cormels @ 10.00 Rs/kg

DISCUSSION

V DISCUSSION

The present research work on "Influence of bio-inoculants, FYM and inorganic fertilizers in gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was carried out at Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during late Kharif of 2007-08 and 2008-09. The effects of different bio-inoculants, FYM and inorganic fertilizers and their interactions were recorded and the results obtained are discussed in this chapter. The data on weather parameters prevailed during the course of study (Appendix - I) revealed that the weather conditions during the period of experimentation were more or less normal. Therefore, the difference of observed in growth, yield and nutrient content and uptake could be attributed to the treatment effects. Further, there was also no severe incidence of insect, pest and disease during growth of the crop in both the years. The attempt in this chapter is to assign the reasons for the changes in growth attributes, yield, quality parameters, soil and plant analysis due to imposition of different treatments and to substantiate these with the findings of earlier workers from the literature in order to understand the effect of relationship.

The entire discussion has been divided in to the following heads.

5.1 Effect on growth attributes

5.2 Effect on yield parameters

5.1 Effect on growth parameters

5.1.1 Effect of bio-inoculants

During the year 2007-08, 2008-09 and in pooled analysis, the maximum plant height (61.89, 63.67 and 62.78 cm, respectively), number of leaves per plant (8.94, 9.17 and 9.06, respectively) and leaf area (63.89, 64.22 and 64.06 cm^2, respectively) and earlier sprouting (8.78, 8.78 and 8.78 days, respectively) were recorded with B_1 (AZT + PSB) (Table 4.1 to 4.4).

The probable reason for significant increase in growth attributes would be the favorable effect of bio-fertilizers which are microbial inoculants of selective microorganisms that help in improving soil fertility by the way of accelerating biological nitrogen fixation from atmosphere, solubalization of the insoluble nutrients already present in soil, decomposing plant residues, stimulating plant growth and production. The process consumes less energy and provides cheap nutrients to plants without polluting the nature. Phosphorus solubilizing bacteria encourages early root development and it also helps in rapid cell development in the plants and consequently increases the growth of the plant.

The findings on growth attributes are in accordance with Dubey and Misra (2006), Singh (2006) in rose, Singh and Jauhari (2005) in rose.

5.1.2 Effect of FYM

An application of FYM @ 5 kg/ha significantly increased plant height (60.89, 62.11 and 61.50 cm, respectively), number of leaves (8.94, 9.17 and 9.06, respectively) and leaf area (60.44, 60.79 and 60.62 cm^2, respectively) and reported earlier sprouting (8.94, 8.94 and 8.94 days, respectively) during the year 2007-08, 2008-09 and in pooled analysis (Table 4.1 to 4.4).

This may be due to fact that FYM provides a rich source of organic carbon and humus for better water holding capacity and mineral mobilization. Moreover, the FYM also increases the water holding capacity of the soil, stimulate activity of micro-organisms that made plant food elements in the soil readily to plants, mobilizing existing soil nutrients so that good growth is achieved with lower nutrient densities while wasting less, releasing nutrients at a slower rate (more consistent) and improved soil fertility.

More or less the above findings are in agreement with the results of Jhon *et al.*, (2007) in tulip and Singh (2006) in rose.

5.1.3 Effect of inorganic fertilizers

The data given in Table 4.1 to 4.4 showed that highest plant height (63.92, 64.42 and 64.17 cm), number of leaves per plant (9.08, 9.33 and 9.21), leaf area (59.83, 60.12 and 59.98 cm^2,

and minimum days taken to sprout (8.67, 8.58 and 8.63) were registered in C_2 (100 % RDF), respectively for the year 2007-08, 2008-09 and in pooled analysis.

This might be due to the fact that growth and development of above ground parts of plant are determined primarily by the activity of apical meristem, because the leaf primordial is formed there. Stem elongation depends initially on the new tissue formed at the apex and many of the hormonal signals which determine the later growth and development of all plant parts. It becomes clear that higher dose of inorganic fertilizers increased availability of nutrients which ultimately increased the vegetative growth. These nutrients also play an important role in metabolic activities of the plant resulting in the synthesis of chlorophyll and cytochromes which are essential for photosynthesis and respiration process in the plants.

More or less the above findings are in agreement with the results of Barad *et al.*, (2008) in gladiolus, Patel *et al.*, (2008) in chrysanthemum, Jhon *et al.*, (2007) in tulip, Sharma and Singh (2007) in gladiolus, Dubey and Misra (2006) in gladiolus , Singh (2006) in rose, Sharma *et al.*, (2006) in African marigold, Haokip and Singh (2005) in gladiolus, Khandelwal and Nagda (2005) in henna and Kumar and Mishra (2003) in gladiolus.

5.2 Yield parameters

5.2.1 Effect of bio-inoculants

The data presented in Table 4.5 to 4.16 revealed that, significantly earlier spike emergence (60.33, 58.94 and 59.64 days) and first floret opening (66.50, 65.39 and 65.94 days) and significantly higher spike length (65.44, 66.11 and 65.78 cm), number of spikes per plant (3.17, 3.28 and 3.22), number of florets per spike (11.22, 11.44 and 11.33), weight of florets per spike (75.56, 75.94 and 75.75 g) and floret diameter (7.67, 7.73 and 7.70 cm), size of corm (5.24, 5.28 and 5.26 cm), number of corms per plant (3.24, 3.32 and 3.28), weight of corms per plant (31.87, 32.00 and 31.94 g), number of cormels per plant (44.27, 44.55 and 44.41) and weight of cormels per plot (135.65, 136.16 and 135.90 g) were recorded with B_1 (AZT + PSB) respectively for the year 2007-08, 2008-09 and in pooled analysis.

It might be due to the fact that azotobacter an associative living diazotroph has been certified as potential microbial inoculants for increasing the productivity of various crops. These organisms besides fixation synthesize and secrete many amino acids, which influence plant growth that ultimately affects the various yield parameters. Phosphorus solubilizing bacteria play an important role in converting insoluble phosphatic compound such as rock phospohate, bone meal and basic slag particularly the chemically fixed soil phosphorus into available form. It also produce organic acids like malic, succinic, fumaric,

citric, tartaric and alpha ketoglutaric acid which hastens the maturity and thereby increases yield.

The above findings are in agreement with the results of Bhatia and Gupta (2007) in carnation, Dubey and Misra (2005) in gladiolus, Syamal *et al.*, (2006) in marigold and Yadav *et al.*, (2005) in tuberose.

5.2.2 Effect of FYM

The data presented in Table 4.5 to 4.16 revealed that, significantly earlier spike emergence (61.94, 60.83 and 61.39 days) and first floret opening (66.67, 65.22 and 65.94 days) and significantly higher spike length (60.11, 60.83 and 60.47 cm), number of spikes per plant (3.11, 3.17 and 3.14), number of florets per spike (10.72, 10.89 and 10.81), weight of florets per spike (72.33, 72.78 and 72.56 g) and floret diameter (7.46, 7.52 and 7.49 cm), size of corm (4.74, 4.78 and 4.77 cm), number of corms per plant (3.11, 3.19 and 3.15), weight of corms per plant (31.78, 31.91 and 31.84 g), number of cormels per plant (37.84, 38.19 and 38.02) and weight of cormels per plot (120.94, 121.54 and 121.24 g) were registered with F_1 (FYM 5 kg/plot) respectively for the year 2007-08, 2008-09 and in pooled analysis.

The probable reason for significant increase in yield attributes would be due to the fact that FYM increase the organic matter in the soil. Organic matter in turn releases the plant food in available form for the use of crops. However, organic manures

should not be seen only as carriers of plant food. These manures also enable a soil to hold more water and also help to improve the drainage in clay soils. They provide organic acids that help to dissolve soil nutrients and make them available for the plants which ultimately enhanced the yield attributes. The yield attributes findings are in accordance with theses reported by Jhon *et al.*, (2007) in tulip.

5.2.3 Effect of inorganic fertilizers

It is evident from the data presented in Table 4.5 to 4.16 revealed that, significantly the minimum days taken to spike emergence (59.83, 59.25 and 59.54 days), days taken for first floret opening (65.92, 65.00 and 65.46 days), length of spike (60.75, 61.42 and 61.08 cm), number of spikes per plant (3.17, 3.25 and 3.21), number of florets per spike (10.58, 10.83 and 10.71), weight of florets per spike (71.75, 72.75 and 72.26 g) and floret diameter (7.63, 7.68 and 7.66 cm), size of corm (4.65, 4.70 and 4.68 cm), number of corms per plant (2.95, 3.03 and 2.99), weight of corms per plant (32.75, 32.88 and 32.81 g), number of cormels per plant (40.25, 40.65 and 40.45) and weight of cormels per plot (127.09, 127.65 and 127.37 g) respectively for the year 2007-08, 2008-09 and in pooled analysis were registered with C_2 (100 % RDF).

This was due to the significant improvement in growth characters of gladiolus which favourably reflected on yield attributes with increased level of fertilizer application. This might be also due to the fact that nitrogen is a starting material

for biological synthesis and that it is also plays an important role in plant metabolism by virtue of being an essential constituent of diverse types of metabolically active compounds like amino acids, proteins, nucleic acids, porphyrins, flavins, purine and phyrimidine nucleotides, flavin, nucleotides, enzymes, co-enzymes and alkaloids. Thus, that increased availability of photosynthates finally results into large storage of these compounds. This type of situation is ultimately reflected through the increased good flowering and yield of gladiolus.

Above results are in accordance with those recorded by Barad *et al.*, (2008), Jhon *et al.*, (2007) in tulip, Patel *et al.*, (2008) in chrysanthemum, Sharma and Singh (2007) in gladiolus, Dubey and Misra (2006) in gladiolus, Singh (2006) in rose, Sharma *et al.*, (2006) in gladiolus, Singh and Singh (2003) in rose, Kumar and Mishra (2003) in gladiolus and Kumar and Singh (1998) in tuberose.

5.3 Quality parameters

5.3.1 Effect of bio-inoculants

From the Table 4.17 and 4.18, it is evident that, significantly higher shelf life (15.11, 15.33 and 15.22 days) and vase life (9.50, 9.67 and 9.58 days) respectively for the year 2007-08, 2008-09 and in pooled analysis recorded with B_1 (AZT + PSB). The minimum shelf life (11.50, 11.83 and 11.67 days) and vase life (8.06, 8.39 and 8.22 days) respectively for the year

2007-08, 2008-09 and pooled analysis noted in uninoculated plants.

The probable reason for this is that the inoculation of bio-inoculants increased growth and yield parameters which ultimately increased shelf and vase life of plants. Present findings are accordance with the reports of Srivastava and Govil (2005) in gladiolus, Padmadevi *et al.*, (2004) in anthurium and Chang (1993).

5.3.2 Effect of FYM

The data presented in Table 4.17 and 4.18 revealed that, significantly higher shelf life (14.17, 14.44 and 14.31 days) and vase life (9.17, 9.39 and 9.28 days) respectively for the year 2007-08, 2008-09 and pooled analysis registered with F_1 (FYM 5 kg /m^2. The minimum shelf life (12.44, 12.72 and 12.58 days) and vase life (8.39, 8.67 and 8.53 days) respectively for the year 2007-08, 2008-09 and pooled analysis recorded in no FYM.

The significant increased in shelf and vase life of gladiolus might be due the superior growth and yield parameters that ultimately increased stored food content in plant which finally increased shelf and vase life of plant. No such evidence was earlier recorded by any worker.

5.3.3 Effect of inorganic fertilizers

It is evident from the data presented in Table 4.17 and 4.18 that, the maximum shelf life (14.25, 14.58 and 14.42 days) and vase life (9.42, 9.75 and 9.58 days) respectively for the year

2007-08, 2008-09 and in pooled analysis was found in C_2 (100 % RDF).

It might be due the fact that the application of 100 % RDF significantly increased plant growth and yield parameters like plant height, spike length and weight of florets per spike of plant that ultimately increased reserve food in plant that finally increased shelf and vase life of gladiolus. Above finding is in accordance with reports of Padmadevi *et al.*, (2004) in anthurium.

5.4 Interaction effect

Interaction between bio-inoculants and FYM (B x F) gave significant results for floret diameter, number of corms per plant, size of corm, weight of florets per spike and weight of cormels per plant and interaction between bio-inoculants and inorganic fertilizers (B x C) produced significant effect on floret diameter and size of corm in pooled analysis whereas interaction between FYM and inorganic fertilizers (F x C) gave significant results for weight of florets per spike. The rest of interactions and higher order interaction between (B x F x C) on growth parameters, yield, quality, available N, P and K and total N, P and K content in plant were found non significant.

It might be due the fact that FYM increased water holding capacity of soil which ultimately increased growth of bio-inoculants which in turn increased availability of nutrients that finally increased growth and yield parameters of gladiolus. Similar results were earlier reported by Gurav *et al.*, (2008) in

rose, Bhalla *et al.*, (2007) in carnation, Priyadarshini and Anburani (2007) in jasmine ; Yadav *et al.*, (2005), Barman *et al.*, (2003), Swaminathan *et al.*, (1999) and Wange and Patil (1994) in tuberose.

5.5 Available N, P and K content of soil

5.5.1 Effect of bio-inoculants

The data given in Table 4.19 to 4.21 indicated that, significantly higher available N (303.33, 309.05 and 306.19 kg/ha), P (68.90, 69.52 and 69.21 kg/ha) and K (498.14, 503.82 and 500.98 kg/ha), respectively for the year 2007-08, 2008-09 and in pooled analysis was noticed in dual inoculation B_1 (AZT + PSB).

It might be due to the fact that Azotobacter is free-living non-symbiotic aerobic nitrogen fixing bacteria that ultimately increased available N content in soil. Moreover phosphate solubilizing bacteria play an important role in converting insoluble phosphatic compound such as rock phospohate, bone meal and basic slag particularly the chemically fixed soil phosphorus into available form.

These findings are more or less in agreements with those findings of Das *et al.*, (2008) in stevia and Stephen and Nybe (2003) black pepper.

4.5.2 Effect of FYM

From the Table 4.19 to 4.21, it is evident that significantly higher available N (296.31, 302.18 and 299.25

kg/ha), P (67.98, 68.48 and 68.23 kg/ha) and K (486.79, 492.61 and 489.70 kg/ha) respectively for the year 2007-08, 2008-09 and in pooled analysis was noted in F_1 (FYM 5 kg/m^2).

The probable reason for this is that it stimulates activity of micro-organisms that made plant food elements in the soil readily to crops. FYM in turn releases the plant food in available form for the use of crops. However, FYM should not be seen only as carriers of plant food. These may also enable a soil to hold more water and also help to improve the drainage in clay soils. They provide organic acids that help to dissolve soil nutrients and make them available for the plants.

Above findings are in agreement with the earlier findings of Stephen and Nybe (2003) black pepper.

5.5.3 Effect of inorganic fertilizers

The data presented in Table 4.19 to 4.21 indicated that, significantly the highest available N (299.68, 305.51 and 302.59 kg/ha), P (68.53, 69.03 and 68.78 kg/ha) and K (492.66, 498.24 and 495.45 kg/ha) respectively for the year 2007-08, 2008-09 and in pooled analysis were recorded with C_2 (100 % RDF).

The improvement in available N, P and K could be ascribed to addition of N, P and K through fertilizers. More or less the results are in conformity with Thakor *et al.*, (2008) in African marigold and Singh *et al.*, (2005) in rose.

5.6 Total N, P and K content in plant

5.6.1 Effect of bio-inoculants

The data given in Table 4.22 to 4.24 indicated that, significantly higher N (3.24, 3.26 and 3.25 %), P (0.43, 0.44 and 0.43 %) and K (3.74, 3.79 and 3.77 %) content in plant respectively for the year 2007-08, 2008-09 and in pooled analysis were noticed in dual inoculation B_1 (AZT + PSB).

It might be due to the fact that Azotobacter is free-living non-symbiotic aerobic nitrogen fixing bacteria that ultimately increased total N content in plant. Moreover phosphate solubilizing bacteria play an important role in converting insoluble phosphatic compound such as rock phospohate, bone meal and basic slag particularly the chemically fixed soil phosphorus into available form which finally increased total P content in plant. These findings, more less agreements with those findings of Singh (2006) in rose.

5.6.2 Effect of FYM

From the Table 4.22 to 4.24, it is evident that significantly higher N (3.10, 3.13 and 3.11 %), P (0.41, 0.43 and 0.42 %) and K (3.68, 3.73 and 3.70 kg/ha) content in plant respectively for the year 2007-08, 2008-09 and in pooled analysis was noted in F_1 (FYM 5 kg/m^2).

It might be due the fact that it has ability to improve the soil, tilth, aeration and water holding capacity that stimulate activity of micro-organisms and made plant food elements in the

soil readily to crops which ultimately increased total N, P and K content in plant. Above findings are agreement with the findings of Singh (2006) in rose and Prakash *et al.*, (2002) in rice.

5.6.3 Effect of inorganic fertilizers

The data presented in Table 4.22 to 4.24 indicated that, significantly the highest N (3.17, 3.19 and 3.18 %), P (0.43, 0.44 and 0.43 %) and K (3.82, 3.85 and 3.84 %) content in plant respectively for the year 2007-08, 2008-09 and in pooled analysis were recorded with C_2 (100 % RDF).

This might be due to the fact that the rate of nutrient uptake is dependent to a limited extent upon the external nutrient concentration. The application of higher nutrients favoured the optimum plant growth and extensive root system resulting in higher feeding power and nutrient absorption by plant, ultimately resulting in increased uptake by root and shoot.

More or less the results are in conformity with Thakor *et al.*, (2008) in African marigold, Singh (2006) in rose, Prakash *et al.*, (2002) in rice and Patil and Biradar (2001).

5.7 Economics

The net realization in rupees per hectare was worked out form number of flower per hectare by taking in to consideration the prevailing price of gladiolus spikes and inputs used during experimentation. The data presented in Table 4.25 revealed that the treatment combination $B_1F_1C_2$ resulted in the highest gross realization of spikes (521742.00 Rs/ha), corms

(782613.00 Rs/ha) and cormels (3670.23 Rs/ha) giving maximum net realization of Rs. 1034407.11 /ha. This clearly indicated that the treatment combination $B_1F_1C_2$ was most beneficial for gladiolus yield.

The data regarding CBR values work out for biofertilizer (AZT + PSB), FYM and inorganic fertilizers are presented in Table 4.25. It revealed that the treatment $B_1F_1C_2$ gave the highest net return and CBR (1 : 3.78) followed by $B_1F_1C_1$ treatment (1 : 3.25), it was bio-inoculants (AZT + PSB), FYM (5 kg/m^2) and inorganic fertilizers (75 % RDF) appeared optimum for economic gladiolus production.

SUMMARY & CONCLUSION

VI SUMMARY AND CONCLUSION

The present experiment entitled, "Influence of bio-inoculants, FYM and inorganic fertilizers in gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty" was carried out during late *Kharif* season of 2007-08 and 2008-09 at Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat).

The experiment was laid out in a Randomized Block Design with Factorial concept (FRBD) with three replications and twelve treatment combinations, comprising of two treatments of Bio-inoculants (Inoculation of AZT + PSB and No inoculation), two treatments of FYM (FYM @ 5.0 kg/plot and No FYM) and three treatments of inorganic fertilizers (50 % RDF, 75 % RDF and 100 % RDF). The salient features of the results presented and discussed in preceding chapter are epitomized hereunder.

6.1 Growth parameters

6.1.1 Effect of bio-inoculants

Significantly higher plant height (61.89, 63.67 and 62.78 cm, respectively), number of leaves per plant (8.94, 9.17 and 9.06, respectively) and leaf area (63.89, 64.22 and 64.06 cm^2, respectively) and earlier sprouting (8.78, 8.78 and 8.78 days, respectively) for the year 2007-08, 2008-09 and in pooled analysis were recorded with B_1 (AZT + PSB).

6.1.2 Effect of FYM

An application of FYM @ 5 kg/ha during the year 2007-08, 2008-09 and in pooled analysis significantly increased plant height (60.89, 62.11 and 61.50 cm, respectively), number of leaves (8.94, 9.17 and 9.06, respectively) and leaf area (60.44, 60.79 and 60.62 cm^2, respectively) and reported earlier sprouting (8.94, 8.94 and 8.94 days, respectively).

6.1.3 Effect of inorganic fertilizers

The highest plant height (63.92, 64.42 and 64.17 cm, respectively), number of leaves per plant (9.08, 9.33 and 9.21, respectively), leaf area (59.83, 60.12 and 59.98 cm^2) and minimum days taken to sprout (8.67, 8.58 and 8.63) respectively for the year 2007-08, 2008-09 and in pooled analysis were registered in C_2 (100 % RDF).

6.2 Yield parameters

6.2.1 Effect of bio-inoculants

An application of dual inoculation of AZT + PSB recorded significantly earlier spike emergence (60.33, 58.94 and 59.64 days) and first floret opening (66.50, 65.39 and 65.94 days) and significantly higher spike length (65.44, 66.11 and 65.78 cm), number of spikes per plant (3.17, 3.28 and 3.22), number of florets per spike (11.22, 11.44 and 11.33), weight of florets per spike (75.56, 75.94 and 75.75 g) and floret diameter (7.67, 7.73 and 7.70

cm), size of corm (5.24, 5.28 and 5.26 cm), number of corms per plant (3.24, 3.32 and 3.28), weight of corms per plant (31.87, 32.00 and 31.94 g), number of cormels per plant (44.27, 44.55 and 44.41) and weight of cormels per plot (135.65, 136.16 and 135.90 g) respectively for the year 2007-08, 2008-09 and in pooled analysis as compared to B_0 (No inoculation).

6.2.2 Effect of FYM

The earlier spike emergence (61.94, 60.83 and 61.39 days) and first floret opening (66.67, 65.22 and 65.94 days) and significantly higher spike length (60.11, 60.83 and 60.47 cm), number of spikes per plant (3.11, 3.17 and 3.14), number of florets per spike (10.72, 10.89 and 10.81), weight of florets per spike (72.33, 72.78 and 72.56 g) and floret diameter (7.46, 7.52 and 7.49 cm), size of corm (4.74, 4.78 and 4.77 cm), number of corms per plant (3.11, 3.19 and 3.15), weight of corms per plant (31.78, 31.91 and 31.84 g), number of cormels per plant (37.84, 38.19 and 38.02) and weight of cormels per plot (120.94, 121.54 and 121.24 g) respectively for the year 2007-08, 2008-09 and in pooled analysis were registered with F_1 (FYM 5 kg/plot) as compared to F_0 (No FYM).

6.2.3 Effect of inorganic fertilizers

Significantly the minimum days taken to spike emergence (59.83, 59.25 and 59.54 days), days taken for first floret opening

(65.92, 65.00 and 65.46 days), length of spike (60.75, 61.42 and 61.08 cm), number of spikes per plant (3.17, 3.25 and 3.21), number of florets per spike (10.58, 10.83 and 10.71), weight of florets per spike (71.75, 72.75 and 72.26 g) and floret diameter (7.63, 7.68 and 7.66 cm), size of corm (4.65, 4.70 and 4.68 cm), number of corms per plant (2.95, 3.03 and 2.99), weight of corms per plant (32.75, 32.88 and 32.81 g), number of cormels per plant (40.25, 40.65 and 40.45) and weight of cormels per plot (127.09, 127.65 and 127.37 g) respectively for the year 2007-08, 2008-09 and in pooled analysis were registered with C_2 (100 % RDF).

6.3 Quality parameters

6.3.1 Effect of bio-inoculants

Dual inoculation of AZT + PSB (B_1) significantly increased shelf life (15.11, 15.33 and 15.22 days) and vase life (9.50, 9.67 and 9.58 days) respectively for the year 2007-08, 2008-09 and in pooled analysis as compared to B_0 (No inoculation).

6.3.2 Effect of FYM

Significantly maximum shelf life (14.17, 14.44 and 14.31 days) and vase life (9.17, 9.39 and 9.28 days) respectively for the year 2007-08, 2008-09 and in pooled analysis were registered with F_1 (FYM 5 kg /m^2).

6.3.3 Effect of inorganic fertilizers

Shelf life (14.25, 14.58 and 14.42 days) and vase life (9.42, 9.75 and 9.58 days) respectively for the year 2007-08, 2008-09 and in pooled analysis can be extended by C_2 (100 % RDF).

6.4 Nutrient content in soil (Available N, P and K)

6.4.1 Effect of bio-inoculants

Significantly higher available N (303.33, 309.05 and 306.19 kg/ha), P (68.90, 69.52 and 69.21 kg/ha) and K (498.14, 503.82 and 500.98 kg/ha), respectively for the year 2007-08, 2008-09 and in pooled analysis was noticed in dual inoculation B_1 (AZT + PSB).

6.4.2 Effect of FYM

An application of FYM @ 5 kg/m^2 significantly increased available N (296.31, 302.18 and 299.25 kg/ha), P (67.98, 68.48 and 68.23 kg/ha) and K (486.79, 492.61 and 489.70 kg/ha) respectively for the year 2007-08, 2008-09 and in pooled analysis.

6.4.3 Effect of inorganic fertilizers

The highest available N (299.68, 305.51 and 302.59 kg/ha), P (68.53, 69.03 and 68.78 kg/ha) and K (492.66, 498.24 and 495.45 kg/ha) respectively for the year 2007-08, 2008-09 and in pooled analysis were recorded with C_2 (100 % RDF).

6.5 Nutrient content in plant (Total N, P and K)

6.5.1 Effect of bio-inoculants

Dual inoculation of AZT + PSB (B_1) recorded significantly higher N (3.24, 3.26 and 3.25 %), P (0.43, 0.44 and 0.43 %) and K (3.74, 3.79 and 3.77 %) content in plant respectively for the year 2007-08, 2008-09 and in pooled analysis as compared to B_0 (No inoculation).

6.5.2 Effect of FYM

Significantly maximum N (3.10, 3.13 and 3.11 %), P (0.41, 0.43 and 0.42 %) and K (3.68, 3.73 and 3.70 kg/ha) content in plant respectively for the year 2007-08, 2008-09 and in pooled analysis were noted in F_1 (FYM 5 kg/m^2).

6.5.3 Effect of inorganic fertilizers

The highest N (3.17, 3.19 and 3.18 %), P (0.43, 0.44 and 0.43 %) and K (3.82, 3.85 and 3.84 %) content in plant respectively for the year 2007-08, 2008-09 and in pooled analysis were recorded with C_2 (100 % RDF).

6.6 Economics

The economics of treatments indicating gross realization per hectare and net realization have been worked out from the number of flower per hectare, taking into account the prevailing market price of flower at the time of harvesting of the crop.

As per economics point of view the treatment combinations $B_1F_1C_2$ was found better as compared to other treatment combinations. The highest net realization of Rs. 1219331.80 per hectare was obtained with treatment combination $B_1F_1C_2$ (AZT + PSB Inoculation, FYM @ 5 kg/m^2 and 100 % RDF) along with CBR 1 : 4.46 followed by $B_1F_1C_1$ (Rs. 1034407.11 per hectare along with CBR 1 : 3.78). The lowest net realization (Rs. 313279.52 per hectare along with 1 : 1.37 CBR) was obtained with the treatments $B_0F_0C_0$.

Conclusion :

It could be concluded from the present experiment that incase of bio-inoculants, an inoculation of corms in dual culture of AZT + PSB (B_1) enhanced growth, yield and quality parameters as well as soil and plant nutrient content as compared to no inoculation. However incase of FYM, application of FYM @ 5 kg/m^2 significantly increased growth, yield and quality parameters and also soil and plant nutrient content as compared to no application. Whereas incase of inorganic fertilizers, among different levels of inorganic fertilizers an application of 100 % RDF significantly increased growth, yield and quality parameters as well as soil and plant nutrient content which was statistically at par with 75 % RDF in many parameters which ultimately decreased the further application of inorganic fertilizers. The combined application of $B_1F_1C_2$ (AZT + PSB Inoculation, FYM @ 5 kg/m^2 and

100 % RDF) resulted in the highest net realization of Rs. 1034407.11 per ha with 1 : 3.78 CBR which was closely followed by $B_1F_tC_1$ (1: 3.25) that may ultimately reduced excessive application of inorganic fertilizers.

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* - Original not seen

APPENDIX

Appendix – I (a) : Meteorological data recorded during crop season for the year 2007- 08 (Oct- 07- Mar -08) (Weekly mean).

Month & Year	Std. Met. week	Temperature (°C)		Relative humidity (%)		Sun shine hours day^{-1}	Rain-fall (mm)
		Max.	Min.	Max.	Min.		
Oct- 07	42	34.6	18.5	76.6	25.1	9.6	0.0
	43	35.1	19.1	70.4	27.1	9.7	0.0
	44	34.3	21.9	80.0	49.1	7.4	1.0
Nov -07	45	32.9	21.0	87.0	28.0	5.2	0.0
	46	33.4	17.3	79.8	26.5	8.7	0.0
	47	32.5	14.8	59.0	17.0	9.4	0.0
	48	32.1	15.8	70.7	28.0	8.4	0.0
Dec -07	49	30.9	16.4	73.2	26.6	6.1	0.0
	50	28.8	15.3	74.7	44.7	6.1	0.0
	51	31.2	18.4	65.6	38.3	7.7	0.0
	52	31.1	13.7	82.0	35.0	9.3	0.0
Jan -08	1	29.8	12.2	87.4	34.0	8.4	0.0
	2	30.8	14.6	78.7	33.1	7.6	0.0
	3	30.5	14.5	78.1	39.4	8.6	0.0
	4	26.9	9.8	80.3	26.7	8.9	0.0
	5	27.5	12.3	78.0	31.0	9.4	0.3
Feb -08	6	23.3	9.8	70.3	35.1	9.1	0.0
	7	31.4	13.7	64.1	31.7	9.8	0.0
	8	32.4	14.1	89.0	44.3	9.8	0.3
Mar -08	9	34.4	14.3	68.0	23.5	9.1	0.0
	10	34.6	15.9	83.1	39.8	8.7	0.0
	11	33.4	18.8	88.5	42.8	6.3	0.0
	12	34.7	19.2	84.4	35.7	8.6	0.0
	13	32.2	21.5	89.2	49.7	8.1	0.0

Appendix – I (b): Meteorological data recorded during crop season for the year 2008- 09 (Oct- 08- Mar -09) (Weekly mean).

Month & Year	Std. Met. week	Temperature (°C)		Relative humidity (%)		Sun shine hours day^{-1}	Rain-fall (mm)
		Max.	Min.	Max.	Min.		
Oct- 08	42	36.5	21.7	88	57	9.5	0.0
	43	35.2	18.7	87	38	9.6	0.0
	44	33.4	18.2	87	41	9.4	0.0
Nov -08	45	34.9	17.2	83	44	9.4	0.0
	46	33.2	18.6	84	44	7.1	0.0
	47	33.5	20.5	89	47	6.8	0.0
	48	31.2	20.0	67	47	5.8	4.0
Dec -08	49	34.4	19.0	73	30	9.1	0.0
	50	32.2	18.5	82	44	6.9	0.0
	51	31.3	18.8	78	49	5.0	3.0
	52	30.9	12.3	87	34	9.3	0.0
Jan -09	1	30.0	13.2	82	31	8.9	0.0
	2	29.7	16.1	83	42	6.7	0.0
	3	32.3	17.6	82	37	5.7	0.0
	4	33.2	15.8	78	30	8.1	0.0
	5	31.6	12.4	82	24	9.0	0.0
Feb -09	6	31.6	13.8	83	31	9.7	0.0
	7	32.0	14.4	77	27	9.6	0.0
	8	35.2	17.5	81	31	8.6	0.0
Mar -09	9	36.2	17.5	78	23	9.9	0.0
	10	34.8	18.3	82	22	8.8	0.0
	11	36.2	19.7	76	27	8.1	0.0
	12	35.1	20.2	90	43	8.8	0.0
	13	36.7	21.8	80	29	9.2	0.0

Appendix – II : Cost of cultivation along with treatment cost (Rs/ha)

Cost of planting material 87000 corms (2 Rs/corm)				174000.00
Land preparation	Tractor	4 hrs	400 Rs/ha	1600.00
Irrigation charges	4	4 Labour	100 Rs/day	1600.00
Weeding charges	4	10 Labour	100 Rs/day	4000.00
Plant protection measures	3	3 Labour	150 Rs/day	1350.00
Harvesting cost	15	15 Labour 3/4 day	100 Rs/day	5625.00
				188175.00
Land revenue 4%				7527.00
Interest on working capital 12%				22581.00
			TOTAL COST	**225283.00**

Treatment cost

Bio-inoculants

B_1 : AZT+PSB	100 g/l	50 l	5 kg AZT + PSB	200.00
AZT and PSB @ 10 Rs/250 g				

FYM

F_1: FYM @ 5 kg/m^2	5	10000	50000	
1000 KG FYM @ 800 RS		40000		40000.00

Inorganic fertilizers

RDF of fertilizer 200 : 200: 200 kg/ha

Urea	434.78	5 Rs/kg	2173.91	8135.12
SSP	1250.00	3.5 Rs/kg	4375.00	
M O P	344.83	4.6 Rs/kg	1586.21	

C_O : 4067.56
C_1 : 6101.34
C_2 : 8135.12

Pesticides/fungicides spray : 7000 Rs/ha

Appendix – III : Number of spikes & corms and weight of cormels per plot and hectare

Treatments	Number of spikes/plot	Number of spikes/ha	Number of corms/plot	Number of corms/ha	Weight of cormels (g/plot)	Weight of cormels (kg/ha)
$B_0F_0C_0$	72.0	173914.0	58.0	140000.8	72.8	175.8
C_1	84.0	202899.7	62.0	149855.9	85.0	205.3
C_2	96.0	231885.3	74.0	178696.6	93.1	224.9
F_1C_0	96.0	231885.3	72.0	173914	124.8	301.5
C_1	108.0	260871.0	92.0	222175.1	133.6	322.6
C_2	114.0	275363.8	100.1	241740.5	145.6	351.6
$B_1F_0C_0$	84.0	202899.7	70.0	169131.4	95.9	231.5
C_1	108.0	260871.0	72.0	173914	101.3	244.6
C_2	108.0	260871.0	94.0	227102.7	118.9	287.1
F_1C_0	108.0	260871.0	138.0	333335.2	125.7	303.5
C_1	126.0	304349.5	144.0	347828	133.9	323.3
C_2	144.0	347828.0	162.0	391306.5	152.0	367.0

CERTIFICATE

This is to certify that I have no objection to supply one copy of any part of this thesis at a time to any scientist through reprographic process for rendering reference services in a library or documentation centre.

Place : Navsari

Date : 13th October, 2009

(S.R. Chaudhari)