EFFECT OF SPACING AND PHOSPHORUS ON THE GROWTH AND YIELD OF BRINJAL (*Solanum melongena* L.)

BY

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A Thesis

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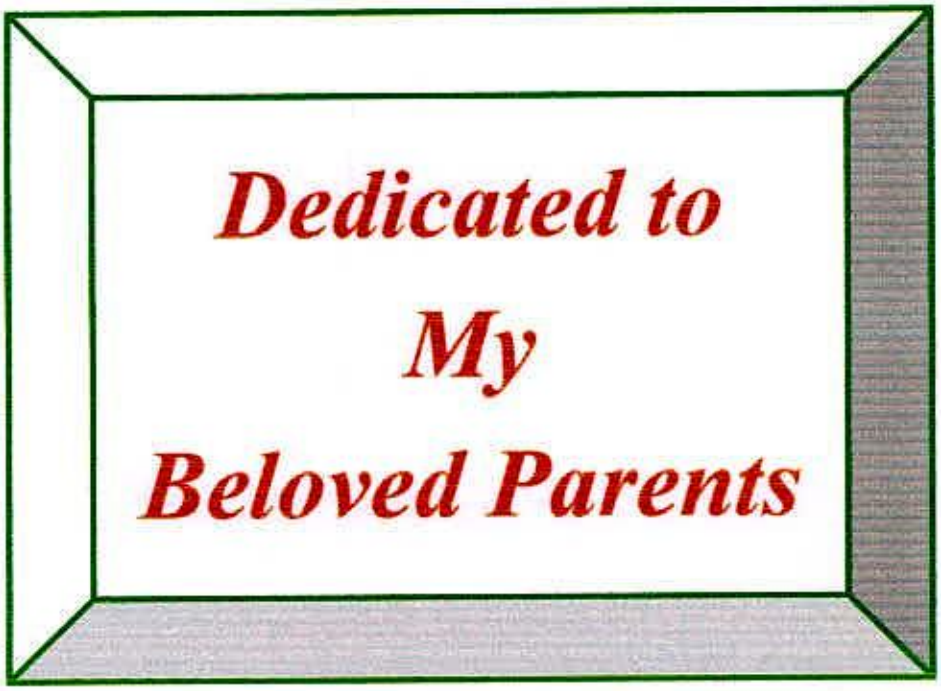

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CERTIFICATE

This is to certify that the thesis entitled, "EFFECT OF SPACING ANDPHOSPHORUS ON THE GROWTH AND YIELD OF BRINJAL (Solanum melongena L.)" submitted to the Department of Horticulture and Postharvest Technology, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in HORTICULTURE, embodies the result of a piece of bona fide research work carried out by MD. REZAUL HASSAN, Registration No. 01016 under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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ABSTRACT

An experiment was conducted to study the effect of spacing and phosphorous on the growth and yield of brinjal at the central farm of Sher-e-Bangla Agricultural University, Dhaka, during the period of September 2007 to March 2008. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications to investigate the growth and yield of brinjal cv "Kajla". The experiment was conducted with two factors; Factor A: Three Spacing i.e. S_1 = 75 cm × 50 cm, S_2 = 75 cm × 60 cm, S_3 = 75 cm × 70 cm and Factor B: Four levels of Phosphorous i.e. P_0 = Control, P_1 = 70 kg P_2O_5/ha, P_2 = 90 kg P_2O_5/ha and P_3 = 110 kg P_2O_5/ha. In case of Plant spacing, the highest yield (54.08 t/ha) was recorded from the spacing S_2 and the lowest yield (50.64 t/ha) was from S_3. In case of Phosphorous, the maximum yield (53.87 t/ha) was obtained from P_2 and the minimum yield (49.54 t/ha) was from P_0. For combined effect, the highest yield (60.02 t/ha) was observed from the treatment combination of S_2P_2. It may be concluded that 75 cm × 60 cm spacing with 90 kg P_2O_5/ha is best for the growth and yield of brinjal cv "Kajla".

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LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATION	FULL NAME
%	Percent
@	At the rate of
0^C	Degree Celsius
AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
cm	Centimeter
CV	Coefficient of Varience
DMRT	Duncan's Multiple Range Test
EC	Electrical conductivity
et al.	And others
etc	Et cetera
ETe	Evapo transpiration
FYM	Farm Yeard Manure
g	Gram
GN	Granular
ha	Hectare
I.U	International Unit
K_2O	Potassium Oxide
kg	Kilogram
KNO_3	Potassium Nitrate
LSD	Least Significant Difference
m	Meter
mg	Milligram
MKP	Mono Potassium Phosphate
ml	Milliliter
mm	Millimeter
MP	Murate of Potash
MT	Metric Ton
NPK	Nitrogen, Phosphorus and Potassium
NS	Not significant
P_2O_5	Phosphorous Penta Oxide
Pdff	Phosphorus derived from fertilizer
ppm	Perts Per Million
RCBD	Randomized Complete Block Design
RH	Relative Humidity
SAU	Sher-e-Bangla Agricultural University
SRDI	Soil Resources and Development Institute
TSP	Triple Superphosphate

Chapter I

Introduction

CHAPTER I

INTRODUCTION

Brinjal is one of the major Solanaceous crops under the botanical name *Solanum melongena* L. It is also known as Aubergine or Guinea squash or garden egg. Brinjal is the second most important vegetable crop next to potato in Bangladesh in respect of acreage and production (BBS, 2005). Brinjal is a native crop of Indian sub-continent. A wide genetic diversity is found here due to the availability of different land races and their wild relatives. It is one of the most common, popular and principle vegetable crops grown in Bangladesh and others parts of the world due to its diversified uses. It is cultivated as a populous and commercial vegetable throughout the tropical and sub tropical regions of the world.

The brinjal or eggplant is a crop of uncertain origin. The cultivated brinjal is undoubtedly of Indian origin and has been in cultivation for a long time (Thompson and Kelly, 1957). The domesticated types of brinjal spreaded eastward from India to China by fifth Century B. C. So, the center of origin is the India sub-continent with a secondary center of origin in China and South-East Asia. According to Purewal (1957), it is still found growing wild in India. Different forms, colours, sizes and shapes of brinjal are found throughout the Southeast Asia suggesting that this area is an important centre of diversity and possibly of origin. Now, the brinjal is of great importance in the warm areas of Far East, being grown more extensively in India, Bangladesh, Pakistan, China

and Philippines. It is also grown in Nepal, Japan, France, Italy, USA, the Mediterranean and Balkan area (Bose and Som, 1986).

Brinjal is grown commonly in almost all parts of the country and liked both poor and rich. It is a main vegetable to the plains and is available more or less throughout the year. Country to the common belief, it is quite high in nutritive value and can be compared with tomato (Choudhury, 1976). Brinjal is nutritious vegetable and has got multifarious use as a dish item (Bos and Som, 1986 and Rashid, 1993). It has higher calorie, iron, phosphorus and riboflavin contents than tomato (Shaha, 1989). Brinjal contains 92.7% moisture, 1.4 g protein, 0.3 g fat, .3 g minerals, 4 g carbohydrates, 18 mg iron, 44 mg sulfur, 16 mg magnesium, 18 mg oxalic acid, 47 mg phosphorus, 124 I.U. vitamin A, 0.04 mg Thiamine, 0.11 mg Riboflavin, 0.09 mg Nicotinic acid, 12.0 mg Vitamin C etc. (www. Agridept.gov.ik).It has been a staple vegetable in our diet since ancient times. It is quite high in nutritive value. It has potentially as raw material in pickle making and in dehydration industries (Singh *et al.* 1963). Fried brinjal in till has some medicinal value to cure liver problem (Chauhan, 1981)Brinjal is a familiar vegetable crop for its easier cooking quality, better taste and lower market price. It is largely cultivated in almost all districts of Bangladesh. It can be grown at homestead area and kitchen garden because of its popularity especially for urban people. About 8 million farm families are involved in brinjal cultivation (Islam, 2005). This gives small, marginal and landless farmers a continuous source of income provides employment facilities for the rural people. In rabi 2003-2004 the total area covered by brinjal

cultivation was 37.65 thousand hectares with the production of 240 thousand metric tons and in kherif (summer), the hectares and production was 22.67 thousand and 118 thousand metric tons respectively (Appendix I). So, as single vegetables crop in the year 2003-04 brinjal were cultivated 22.44% of total area under vegetables cultivation and the production was 20.59% of the total vegetables production (Appendix II). Yield expression of a genotype is mainly governed by environment and other management factors. Yield differences may also be occurred due to variation in cultural practices. Plant density is an important cultural practice which may be the limiting factors of yield. By the proper management of cultural practices such as optimum spacing, influence the yield and yield contributing characters of brinjal. By applying proper spacing, plant growth continues perfectly and ultimate yield become higher than that of done in normal cultural practices. Development of suitable economic and high quality vegetable production technique can make a significant contribution in vegetable production. Use of proper doses of fertilizer is one of the most important ways of quality vegetable production. Nitrogenous, phosphorous and potassic fertilizers have a great effect in this respect. Vizayakumar *et al.* (1995) reported that NPK fertilizers increase the vegetable growth and fruit yield of brinjal. Phosphorus is a constituent of nucleic acids and phospholipids which are important constituents of cell membrane (Sharma, 1992).

Considering the above facts, the present study was undertaken to find out the optimum plant population, proper fertilizer dose for higher yield, better quality of brinjal and to reduce the production cost.

Objectives of the present study were:

i. To find out the optimum spacing for growth and yield of brinjal;
ii. To find out the effect of proper doses of phosphorus on growth and yield of brinjal; and
iii. To find out the interaction effect of spacing and phosphorus on growth and yield of brinjal.

Chapter II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

The growth and yield of brinjal are influenced by different spacing and different levels of phosphorus. The review of literature includes reports as studied by several investigators who found pertinent in understanding the problems which may help in the explanation and interpretation of results of the present investigation. In this chapter, an attempt has been made to review the available information in home and abroad on the effect of spacing and different levels of phosphorus fertilizer on the growth and yield of brinjal.

2.1 Effect of spacing on growth and yield of brinjal

Paturde *et al.* (2002) conducted an experiment for the performance of Arka Mahima (Tetraploid) against Arka Sanjeevini (Diploid) varieties of wild brinjal under different plant spacing 60 × 30 or 30 × 30 cm^2 and two fertility levels (60:40:40 and 90:60:60 kg N, P_2O_5 and K_2O per ha . Arka Sanjeevini recorded significantly drier berry yield than Arka Mahima. However, solasodine content (%) and solasodine yield were significantly higher in Arka Mahima than Arka Sanjeevini. Plant spacings had no significant effect on dry berry yield and solasodine yield. The solasodine content was significantly higher upon treatment with the 30 × 30 cm^2 than the 60 × 30 cm^2 spacing.

Tai *et al.* (2001) found that total yield increased as plant density increased. The highest yield was obtained from plant density at 1.11 plant/m^2 while the ratio of grade a fruit number to total fruit number decreased from 64.5% to 61.1% as plant density increased from 0.56 to 1.11 plant/m^2 . There is no significant effect on fruit length and diameter among different density treatments. However, based on the consideration of both total yields and fruit quality, the plant density at 0.67-0.84 plant/m^2 was recommended for aubergines with V-type training.

Chandha *et al.* (1997) conducted an experiment in rabi (winter) 1993-94 on a sandy loam soil at Jabalpur, India, to determine the effect of levels of NPK and plant spacing on yield and economics of brinjal (*Solanum melongena* L.). Brinjal cv. JB 64-1-2 were planted at 75 × 50, 75 × 70 or 75 × 90 cm and supplied with N at 0, 75 or 150 kg/ha, P_2O_5 at 0, 30, or 60 kg/ha and K_2O at 0, 30, or 60 kg/ha. One-third of the N and the full dose of P and K were applied basally, and the remainder of the N was applied in 2 equal splits at 30 and 50 days after transplanting. Crop yield was the highest (237.88 q/ha) at the closest plant spacing (75 × 50 cm). This yield was reduced by 38.06 and 77.59% at 75 × 70 and 75 × 90 cm respectively.

Harminder *et al.* (1997) conducted a field experiment in Punjab, India to determine the effect of various plants spacing on plant growth and yield of two aubergine hybrids (BH-1 and BH-2). The treatments were: 5 plant spacing (45 × 45, 60 × 45, 75 × 45, 90 × 45, and 105 × 45 cm) with corresponding plant

densities (4.9, 3.7, 2.9, 2.4 and 2.1 plants/m^2) arranged in all possible combinations. Plant spacing at 105 × 45 cm had maximum plant height (80.66 cm), number of branches/plant (7.88), plant spread (69.50 cm), days to first fruit picking (60.50), average fruit weight (129.3 g) and average number of fruits/plant (18.50). Plant spacing at 45 × 45 had maximum dry matter accumulation (66.58 q/ha), marketable yield/ha (663.0 q/ha) and total yield/ha (716.8 q/ha) while plant spacing at 75 × 45 had maximum days to 50% flowering.

Singh and Syamal (1995) conducted an experiment to find out the effect of nitrogen and spacing on and quality attributes of brinjal. Transplanting at the widest spacing (60 cm × 90 cm) resulted in the highest number of fruits, fruit weight as well as ascorbic acid content. However, the yield was the highest at the closest spacing (60 cm × 60 cm).

Vijayakumar *et al.* (1995) conducted an experiment to find out the influence of mother crop nutrition and spacing on seed yield and quality in brinjal. Seeds under the experimental treatments exhibited the highest percentage germination. Of the 3 spacing tested that of 75 × 60 cm produced the highest seed yield.

Hassan (1993) conducted an experiment at El-Minia University. Egypt to find out the effect of plant density and additional dose of nitrogen after the first harvest on eggplant cv. "Black Beauty". Increasing plant density significantly reduced early fruit weight/plant (2^{nd} season only), total number and weight of

fruit/plant and increased the average fruit weight. Spacing 80 cm apart without additional N fertilizer was recommended.

Barbieri and Deveronica (1989) mentioned that plant densities of 1.6, 3.1, 4.6, 6.2, 7.8, or 9.4 plant/m^2 was irrigated at rates of 50, 100, 150% of estimated evapo transpiration (ETe, Class A pan). There were significant interactions between plant density and irrigation regime. The best results (a marketable yield of 65 t/ha) were obtained with a plant density of 4.6.

Abutiates (1988) reported that the two closer spacing of 90 × 60 and 75 × 60 cm significantly out yielded all other treatments in terms of number and weight of marketable fruits. The yield of unmarketable fruits increased sharply with the closest spacing. The widest spacing (100 × 90 cm) gave the lowest yields of both marketable and unmarketable fruits. He also reported that total yields were increased from the first to the fourth harvest and declined thereafter.

Reddy *et al.* (1988) reported that Pusa Kranti was planted at 4 spacings: 75 × 60 cm (S_1), 60 × 60 cm, (S_2), 60 × 45 cm (S_3) and 60 × 30 cm (S_4), with 3 rates of NPK fertilizer application: 62:50:25 (F_1), 125:100:50 (F_2) and 187:150:75 (F_3) in kg/ha. The highest mean fruit yield (17.57 t/ha) was obtained with a 60 × 30 cm spacing and 187: 150:75 kg NPK/ha (S_4F_3). This was overall similar to the results of the S_4F_3 treatment and it is suggested that due to the ease of cultivation at the 60 × 60 cm spacing, the latter treatment combination should be used for cultivation of Pusa Kranti.

Vadivel and Balasubramanian (1988) reported that plants of the aubergine cultivar Annamalai and Pattabiram, spaced at 90 × 60 or 90 × 90 cm received N at 0, 100, 200, 300 or 400 kg/ha. In both cultivars the highest yields (28.5-299.6 t/ha) were obtained with 300 kg N/ha applied to plants spaced at 90 × 60 cm.

Shukla and Prabhakar (1987) studied the effect of plant spacing on yield and attack by insect pests, such as the pyralid (*Leucinodes orbonalis)* and fungi with brinjal in the field in Karnataka, India. The lowest yield (67 q/ha) was recorded with a row spacing of 100 cm compared with a yield of 132 q/ha with a row spacing of 50 cm. The highest yield (154 q/ha) was recorded with a density of 50000 plants/ha (50 cm × 40 cm).

Butter (1961) in a tomato spacing trial observed that the yields of tomatoes increased as the spacing in the rows decreased from 15 to 19 inches. He also found that the size of the fruit was reduced by closer spacing.

Campbell and Hodnett (1961) conducted an experiment on the egg-plant and observed that among the square spacing ranging from 18" to 36" closer spacing resulted in increased yields.

Thompson and Kelly (1957) suggested that eggplant should be spaced 3 to 4 ft. between rows while 2 to 3 ft. between plants and for small growing varieties row to row distance should be 2.5 to 3 ft. and 1.5 to 2 ft. between plants.

Roy *et al.* (1954) in an experiment with Marglobe Sabour variety of tomato observed that the highest yield was obtain from the spacing of 4' × 2' while yield per plant was the highest at 4' × 4' and the lowest at 4' × 2'. Increase spacing resulted in a slight increase of weight per fruit and number of fruits per plant.

Richharia and Roy (1944) in a spacing trial on brinjal found that, if distance varied from 2 to 3 ft. between both plant to plant and line to line, depending upon the soil, manure and variety.

2.2 Effect of phosphorus for growth and yield of brinjal

The requirement of nutrients for different vegetables varieties, for example, leafy vegetables require more nitrogen than others, and phosphorus requirement of fruit producing vegetable is higher. Phosphorus is also more important for seed production (HRDP, 1995). In seed, a lot of phosphorus lies as a compound of phytin, which is important for plumpness of seed. Phosphorus is an important constituent of nucleoprotein and nucleic acids of every plant cell. It helps to accomplish many metabolic activities in every cell of plant body (Pandy and Sinha, 1981). So phosphorus is physiologically important element and it has a miscellaneous effect on vegetative and reproductive stages in plant body. Mertia and Chauhan (1970) conducted a fertilizer experiment to study the effect of NPK fertilizers on growth, development and yield of brinjal. They reported that maximum height, highest number of leaves, maximum number of fruits, and maximum diameter of fruit,

maximum length of fruit and weight of fruits per plant were obtained from 67 kg P_2O_5 level. The levels of phosphorus were 0, 22, 45 and 67 kg P_2O_5/ha. As regards the investigation on NPK in brinjal fertilizer.

Chandrasekhram and George (1973) found that there was an increasing trend in flower production with increased doses of phosphorus. An experiment was conducted at Joydebpur during the rabi season to evaluate the response of brinjal (var. Uttara) to fertilizer elements. Different fertilizer elements caused significant changes in yield. Nitrogen and phosphorus were more effective in increasing the yield. The highest yield (53.26 t/ha) was obtained from 100 kg P_2O_5 /ha. The levels of phosphorus were 0, 50, 100 and 150 kg/ha (BARI, 1992).

As major nutrient phosphorus has a great influence on vegetable growth as well as on seed yield and its quality. Some researchers worked in this aspect and they found noticeable influence of phosphatic fertilizer on it. In determining the influence mother crop nutrition and spacing on seed yield and quality in brinjal (cv Palur). Vizayakumar *et al.* (1995) found that plant height, fruit number, seed yield per plant and seed yield per hectare were increased with increasing rates of nitrogen and phosphorus. While studying the effects of phosphorus and potassium levels on fruit characteristic and quality of tomato seeds. Seno *et al.* (1987) stated that the number of seed per fruit was increased with increasing P level although fruit weight and length were decreased. They also mentioned that seed weight per fruit and 1000 seed weight were influenced

by P and K but seed germination and seed vigour were higher in the absence of phosphorus.

The effect that application of nitrogen-phosphorus (NP) rates exerts on some parameters of phosphorus metabolism in eggplant (*Solanum melongena* cv. *Bonica*) was studied. All plants were grown under controlled conditions in an experimental greenhouse. The treatments consisted of the combination of three rates of N in the form of KNO_3 (N_1 = 15 g m-2; N_2 = 22.5 g m^{-2}; and N_3 = 30 g m^{-2}) together with two rates of P in the form of H_3PO_4 (P_1 = 24 g m^{-2} and P_2 = 36 g m^{-2}), for a total of six treatments. The results obtained show a positive effect of NP fertilization on the nutritional status of P in the plants, clearly reflected in the response of bioindicators of the P (acid phosphatase activity and carbohydrates). The plants treated with N_3P_2 registered greater integration or assimilation of inorganic P to organic P, a fact that may be related to the maximum total and commercial yield in these plants and minimum noncommercial yield (Lopez-Cantarero *et al.*, 1998).

Eggplant (*Solanum melongena* L.) grown under winter conditions in unheated polyethylene covered greenhouse displays unmarketable red color fruit skin. The purpose of this work was to study the effect of potassium (K), phosphate and total salinity levels in the irrigation solution on the quality of eggplant fruit grown at winter and spring seasons. The fertigation solutions were composed of three levels of P: 18, 36, and 54 g P m^{-3}, using mono K phosphate (MKP). Each level of P was applied on two levels of total K concentrations, 475 and

920 g K m^{-3} composed of K nitrate, MKP, and K chloride (KCl). The KNO_3 fertilizer was used in all treatments at 150 g N m^{-3}. Increasing the KCl concentration increased the average electrical conductivity (EC) in the irrigation solution from 2.3 to 3.9 dS m^{-1}, reduced class a fruit number and weight, but had no effect on the skin color. During the cold winter period the intensity of the skin color was weaker than in the normal hot growing period. Increasing the average phosphorus (P) concentration in the irrigation solution throughout the growing season from 36 to 54 g m^{-3} increased the number of fruit per plant, the number of class a fruits but has no significant effect on total fruit yield. Increasing the total electrical conductivity of the nutrient solutions by K fertilizers above 3.8 dS m^{-1} decreased fruit yield and total dry matter in the spring growth period (Zipelevish *et al.*, 2000).

The effects of phosphorus, sulfur and farmyard manure (FYM) application on yield, availability of phosphorus from fertilizer sources, its uptake and utilization by the crop were studied by a pot culture experiment with brinjal (*Solanum melongena*) in a typic Ustocrept soil of IARI farm, New Delhi, India. Four levels of phosphorus viz. 0, 5.95, 11.90 and 17.85 mg kg^{-1} (0, 30, 60 and 90 kg P_2O_5 ha^{-1}), three levels of sulfur viz. 0, 6.82 and 13.64 mg kg^{-1} (0, 15 and 30 kg S ha^{-1}) and two levels of FYM viz. 0 and 77.78 g pot^{-1} (0 and 25 tones ha^{-1}) were applied in all possible combinations. Maximum beneficial effect with respect to fruit yield on dry weight basis was noted in the combined application of 11.90 mg kg^{-1} phosphorus, 6.82 mg kg^{-1} sulfur with FYM. Percent utilization of added phosphorus was maximum when lowest level of phosphorus was

applied with highest level of sulfur. Available phosphorus content in soil both at pre-flowering and harvesting stages increased due to application of highest levels of phosphorus, FYM and sulfur but synergistic effect was found only up to 6.82 mg kg^{-1} level of sulfur. Combined application of phosphorus with FYM and sulfur was beneficial as percent phosphorus derived from fertilizer (Pdff) values increased in soil at both stages of crop growth (Bhattacharyya and Ghosh, 2001).

Chapter III

Materials and Methods

CHAPTER III

MATERIALS AND METHODS

In this chapter, the details of different materials used and methodologies followed during the experiment are described.

3.1. Experimental site

The research work was carried out at the Sher-e-Bangla Agricultural University farm, Dhaka, during the period from September, 2007 to March, 2008. The experimental site was located in the center of Madhupur Tract ($23^0 41^/$ and $90^0 22^/$) having an elevation of 8.5 m above sea level. (Fig. 01)

3.2. Soil of the experimental field

Initial soil samples from 0-15 cm depth were collected from experimental field. The collected samples were analyzed at Soil Resources Development Institute (SRDI), Dhaka, Bangladesh. The physio-chemical properties of the soil are presented in Appendix IV. The soil of the experimental plots belonged to the agro ecological zone of Madhupur Tract (AEZ-28) as shown in Fig. 02.

3.3. Climate of the experimental area

The experimental area was under the subtropical climate. Usually the rainfall was heavy during *Kharif* season and scanty in *Rabi* season. The weather conditions during experimentation such as monthly mean rainfall (mm), mean temperature (^{0}C), sunshine hours and humidity (%) are presented in Appendix IV.

3.4. Planting material

The variety of brinjal used for the present study was Kajla. The seeds of this variety were collected from the Horticultural Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. Before sowing, the seeds were tested for germination in the laboratory and the percentage of germination was found to be over 90%.

3.5. Germination test

Germination test was performed before seed sowing in the field. Three layers of filter papers were placed on Petri dishes. Each Petridis contained 100 seeds. Germination percentage was calculated by using the following formula.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds}} \times 100$$

3.6 Raising of seedlings

Brinjal seedlings were raised in two seedbeds situated on a relatively high land adjacent to the Horticultural Farm Office. The size of each seedbed was 3 m × 1 m. the soil was well prepared and converted into loose, friable and dried mass by spading. All weeds and stubbles were removed and the soil was mixed with 5 kg well rotten cowdung. The seeds were sown on the seedbed on 1st October, 2007. After sowing the seeds were covered with light soil. Complete germination of the seed took place within 10 days after sowing seeds in the beds. Necessary shading by bamboo mat (chatai) was provided over the seedbed to protect the young seedlings from scorching sunshine and heavy rain.

Weeding, mulching and irrigation were done from time to time as and when needed.

3.7 Treatments of the experiment

The treatments were tested as follows:

Factor A: Spacing (3 types)

i) 75 cm × 50 cm (S_1)

ii) 75 cm × 60 cm (S_2)

iii) 75 cm× 70 cm (S_3)

Factor B: Phosphorous (4 level)

i) Control (P_0)

ii) 70 kg P_2O_5/ha (P_1)

iii) 90 kg P_2O_5/ha (P_2)

iv) 110 kg P_2O_5/ha (P_3)

For which there were 12 treatment combinations

S_1P_0	S_2P_0	S_3P_0
S_1P_1	S_2P_1	S_3P_1
S_1P_2	S_2P_2	S_3P_2
S_1P_3	S_2P_3	S_3P_3

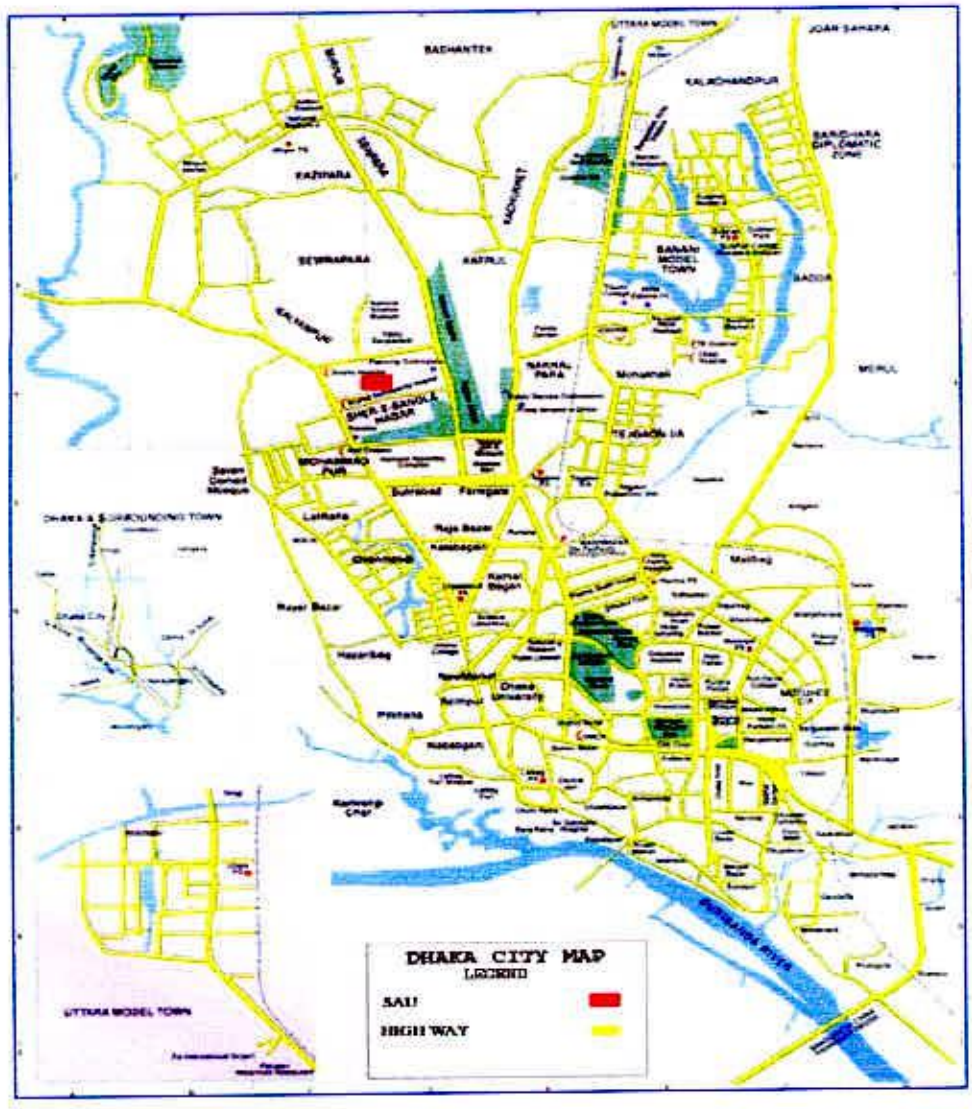

Figure 01. Location of the Experimental Field

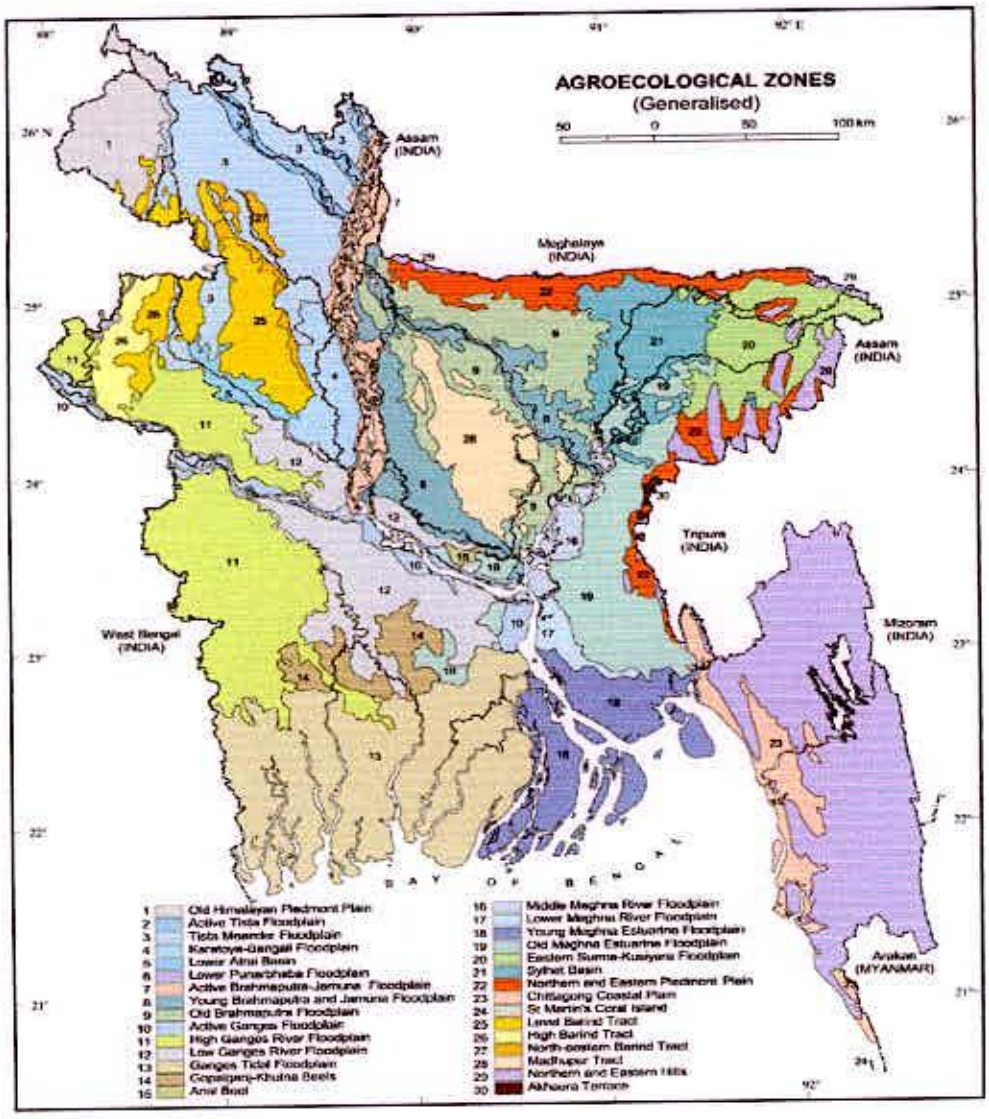

Figure 02. The map of Agro-ecological Zones of Bangladesh

3.8 Experimental design and layout

The experiment was laid out in a Randomized Complete Block Design (RCBD). Each treatment was replicated for three times. The size of each plot was 2.25 m × 3.0 m. The distance between two adjacent replications (block) was 1.0 meter and plot-to-plot distance was 0.5 meter. The intra block and plot spaces were used as irrigation and drainage channels. A layout of the experiment has been shown in Fig. 03.

3.9 Cultivation procedure

3.9.1 Land preparation

The land was irrigated before ploughing. After having "zoe" condition the land was first opened with the tractor drawn disc plough. Ploughed soil was then brought into desirable tilth by six operations of ploughing, harrowing and laddering. The stubble and weeds were removed. The first ploughing and the final land preparation were done on 5 October and 15 October 2007, respectively. Experimental land was divided into unit plots following the design of experiment. The plots were spaded one day before planting and the basal dose of fertilizers were incorporated thoroughly.

3.9.2 Manuring and Fertilization

The entire quantity of cowdung (15 ton/ha) was applied just after opening the land. Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) were used as a source of nitrogen (N), phosphorous and potassium respectively. TSP was applied in the experiment as per treatment. Urea and MP were applied at

the rate of 370 kg and 250 kg per hectare respectively following the BARI recommendation (Sattar *et al.*, 2005).

3.9.3 Transplantation and after care

Healthy and uniform sized seedlings of 45 days were taken separately from the seedbed and were transplanted in the experimental plots in the afternoon of 15 November, 2007 maintaining different as per treatment between the rows and plants. The seed bed was watered before uprooting the seedlings from the seedbed to minimize damage of the roots. The seedlings were watered after transplanting and continued for several days for their early establishment. Seedlings were also transplanted around the border of the experimental plots for gap filling.

3.9.4 Intercultural operations

After transplanting the seedlings, different intercultural operations were accomplished for better growth and development of the plants.

3.9.4.1 Gap filling

When the seedlings were established, the soil around the base of each seedling was pulverized. A few gap filling was done by healthy seedlings of the same stock previously planted in boarded area on the same date of transplanting.

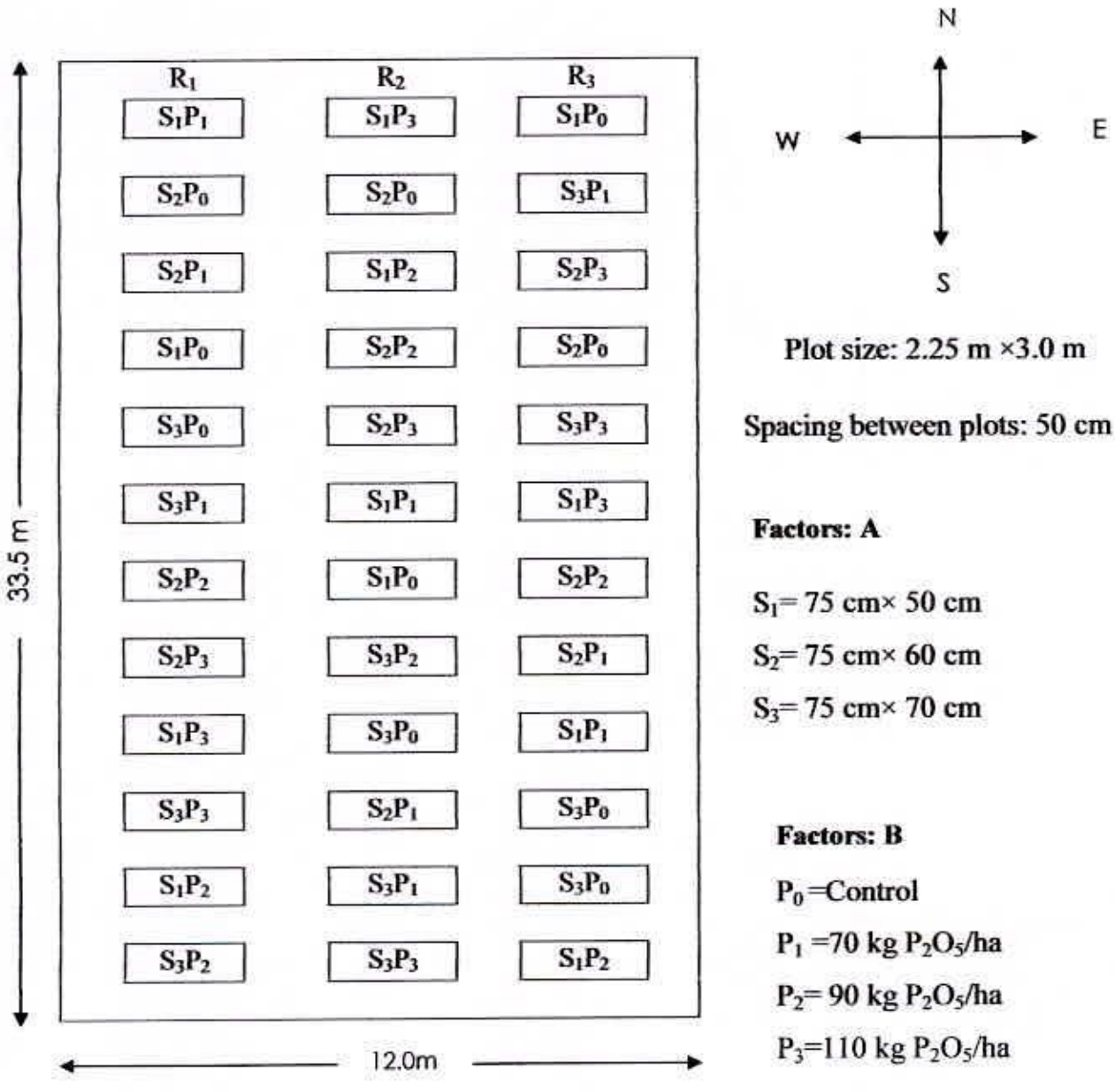

Figure 03. Field layout of the two factors experiment in the Randomized Complete Block Design (RCBD)

3.9.4.2 Weeding

Weeding was done at every 15 days interval after planting and followed upto peak flowering stage. As the land was covered by plant canopy by that time weeding was discontinued.

3.9.4.3 Irrigation

Two irrigations were given throughout the growing period. The first irrigation was given 40 days after planting followed by another irrigation 20 days after the first irrigation.

3.9.4.4 Plant Protection

Insect pests: As preventive measure against the insect pests like cut worms, shoot and fruit borer, leafhopper etc. Malathion 57 EC was applied at the rate of 2 ml/L. The insecticide applications were done weekly as a routine work from a week after transplanting to early growth stage of fruit and then applications were done every three days after upto nature stage of the fruit. Miral 3 GN was also applied during final land preparation as soil insecticide.

Disease: Precautionary measures against disease infection especially Phomopsis fruit rot of brinjal, was taken by spraying Bavistin fortnightly @ 2 g/L.

3.10 Harvest

Fruits were harvested when they attained full maturity indicating deep violet in color and hard in consistency. Harvesting was done from 23 March, 2008 to 16 April, 2008.

3.11 Data collection

The following data were recorded

3.11.1 Plant height

The heights of pre-selected ten plants were measured with a meter scale from the ground level to the top of the plants and the mean height was expressed in cm.

3.11.2 Number of leaves per plant

The leaves were counted from ten plants at the time of harvesting. The average number of leaves per plant was determined.

3.11.3 Number of branches per plant

The number of branches was counted from ten plants. The average number of branches per plant was determined.

3.11.4 Length of lamina

Length of lamina was recorded from selected length of lamina and the average of lamina length of leaf was recorded.

3.11.5 Number of flower per plant

At peak flowering time this was counted from sample plants and then the average number of flowers produced per plant was recorded.

3.11.6 Number of fruits per plant

It was recorded by the following formula

$$\text{Number of fruits per plant} = \frac{\text{Total number of fruits from ten sample}}{10}$$

3.11.7 Length of fruit

The length of fruit was measured with a scale from the neck of the fruit to the bottom of 10 randomely selected marketable fruits from each plot and there average was calculated and expressed as cm.

3.11.8 Diameter of fruit

Diameter of fruit was measured at the middle portion of 10 selected marketable fruit from each plot with a slide calipers and there average was taken in cm.

3.11.9 Weight of individual fruit

Among the total number of fruits harvests during the period from first to final harvest, the fruits, except the first and last harvests, were considered for determining the individual fruit weight in gram.

3.11.10 Weight of fruits per plant

It was measured by the following formula

$$\text{Weight of fruits per plant (kg)} = \frac{\text{Total wt of fruits from ten sample plant}}{10}$$

3.11.11 Yield of fruits per plot

A per scale balance was used to take the weight of fruits per plot. It was measured by totaling the fruit yield of each unit plot separately during the period from fruit to final harvest and was recorded in kilogram (kg).

3.11.12 Yield of fruits per hectare

It was measured by the following formula

$$\text{Fruit yield per hectare (ton)} = \frac{\text{Fruit yield per plot (kg)} \times 1000}{\text{Area of plot in square meter} \times 1000}$$

3.12 Statistical analysis

The data collected on different parameters were statistically analyzed to obtain the level of significance using the MSTAT-computer package program developed by Russell (1986). The means were separated following Duncan's Multiple Range Test (DMRT) at 0.05 levels of significance.

Chapter IV

Result and Discussion

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Plant height (cm)

Plant height was significantly affected due to the different spacing (Appendix V). The tallest plant height (74.72 cm) was obtained from S_3 and the shortest plant height (68.62 cm) was obtained from S_1 (Fig. 04). The plant height was increased with the increase in spacing. This might be due to receiving sufficient amount of light and nutrients.

Plant height was influenced by different doses of phosphorus used (Appendix V). The tallest plant height (74.20 cm) was obtained from P_2 treatment and the shortest (70.94 cm) was with the control (Fig. 05). Phosphorus is an element which helps to occur many physiological processes like photosynthesis, respiration and glycolysis in plants body (Pandy and Sinha, 1981). Higher doses of phosphorus application might have increased those physiological processes and caused more vegetative growth of plants.

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix V) on plant height. The tallest plant height (77.67 cm) was obtained from S_2P_2 treatment while the shortest (68.07 cm) in this regard was observed with the control (S_1P_0) combination (Table 1).

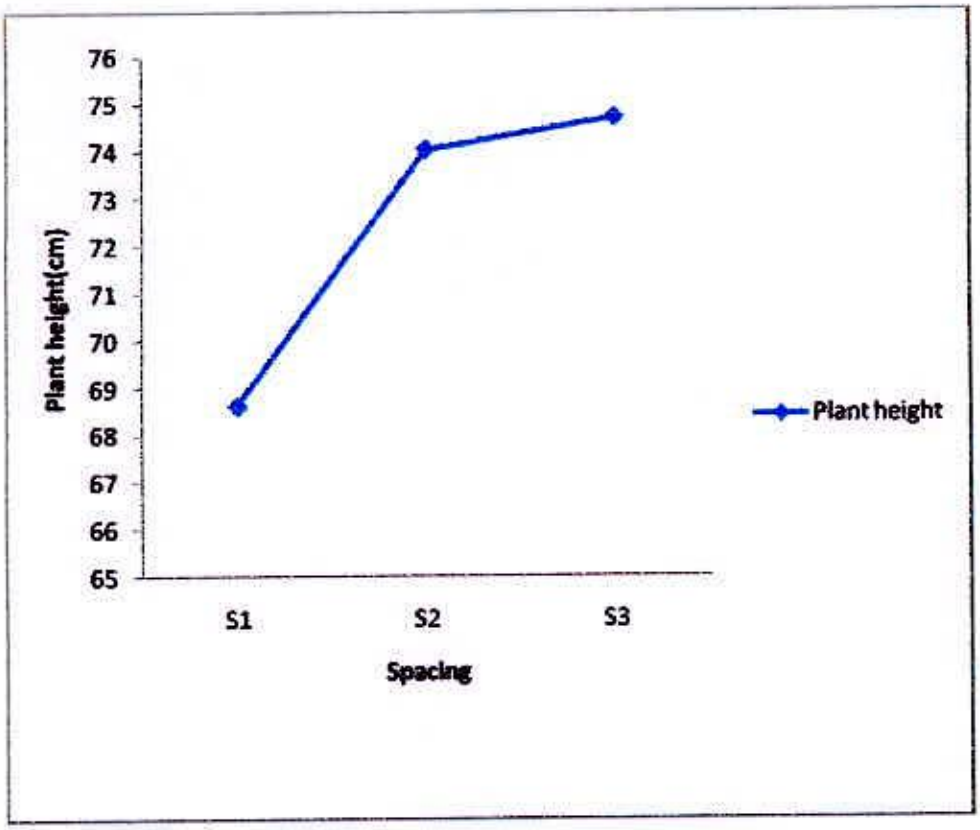

Figure 04. Effect of spacing on the plant height of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

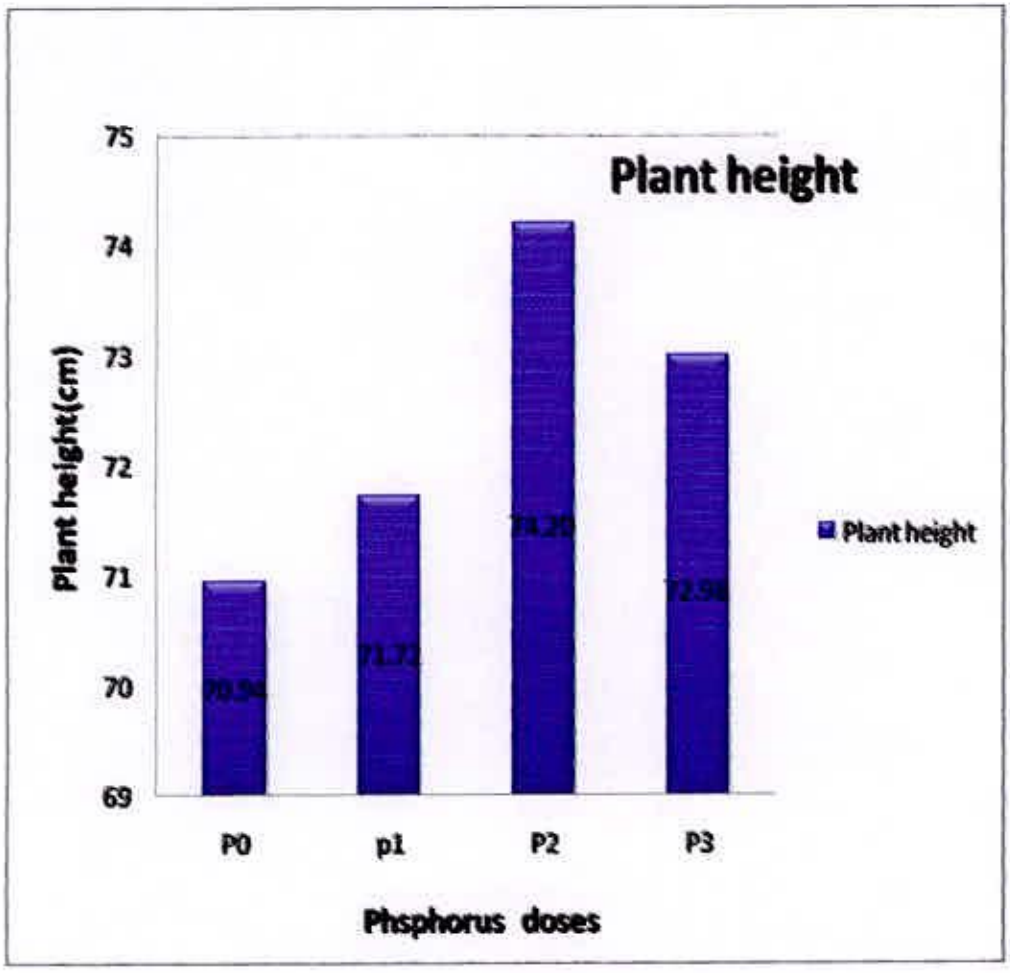

Figure 05. Effect of phosphorus on the plant height of brinjal.

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

Table 1. Interaction effect of spacing and different level of phosphorus on the plant height, number of branch, length of lamina and number of leaves

Treatment	Plant height (cm)	Number of branch	Length of lamina (cm)	Number of leaves
S_1P_0	68.07e	16.67gh	16.00e	86.00b
S_1P_1	69.07de	13.00i	17.57de	81.67b
S_1P_2	69.07de	20.00de	17.63de	83.33b
S_1P_3	68.30e	18.00efg	17.83cde	87.67b
S_2P_0	70.90cde	18.67efg	18.33a-d	88.33b
S_2P_1	72.90bcd	15.00hi	19.03a-d	89.00b
S_2P_2	77.67a	25.00a	19.10a-d	98.00a
S_2P_3	74.73abc	21.00cd	18.17bcd	100.67a
S_3P_0	73.87abc	19.00def	18.63a-d	98.33a
S_3P_1	73.20bcd	17.00fgh	19.77abc	96.67a
S_3P_2	75.87ab	22.33bc	20.13a	98.00a
S_3P_3	75.93ab	24.00ab	19.83ab	98.67a
Level of significance	*	*	*	*
$LSD_{(0.05)}$	**3.95**	**2.02**	**1.71**	**7.58**
CV (%)	**3.22**	**6.23**	**5.46**	**4.85**

Means bearing the common letter (s) in a column do not differ significantly at 5% level

*significant at 5% level of probability

NS- non significant

S_1= 75 cm × 50 cm

S_2= 75 cm × 60 cm

S_3= 75 cm × 70 cm

P_0: Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.2 Number of leaves per plant

Number of leaves was significantly influenced by spacing (Appendix V). S_3 produced maximum number of leaves (97.92) followed by S_2 (94) and the minimum (84.67) number of leaves were recorded in S_1 (Fig. 06). As the spacing was increased number of leaves was found to be increased. This might have been due to the absorption of more nutrients, getting off more sunlight on larger leaf area and better aeration influenced by the gradual increase in the spacing.

Significant difference was observed among various levels of phosphorus in respect of number of leaf per plant (Appendix V). The highest number of leaves (95.67) was obtained from P_3 treatment and the minimum (89.11) was obtained in P_1 (Fig. 07). It is revealed that more dose phosphorus produced more number of leaves. This result is in agreement with the previous findings of Mertia and Chauhan (1970).

Interaction effect of different spacing and different doses of phosphorus had significant variation (Appendix V) on number of leaves. The highest number of leaves (100.67) was obtained from S_2P_3 treatment while the minimum (81.67) in this regard was observed with the control (S_1P_1) combination (Table 1).

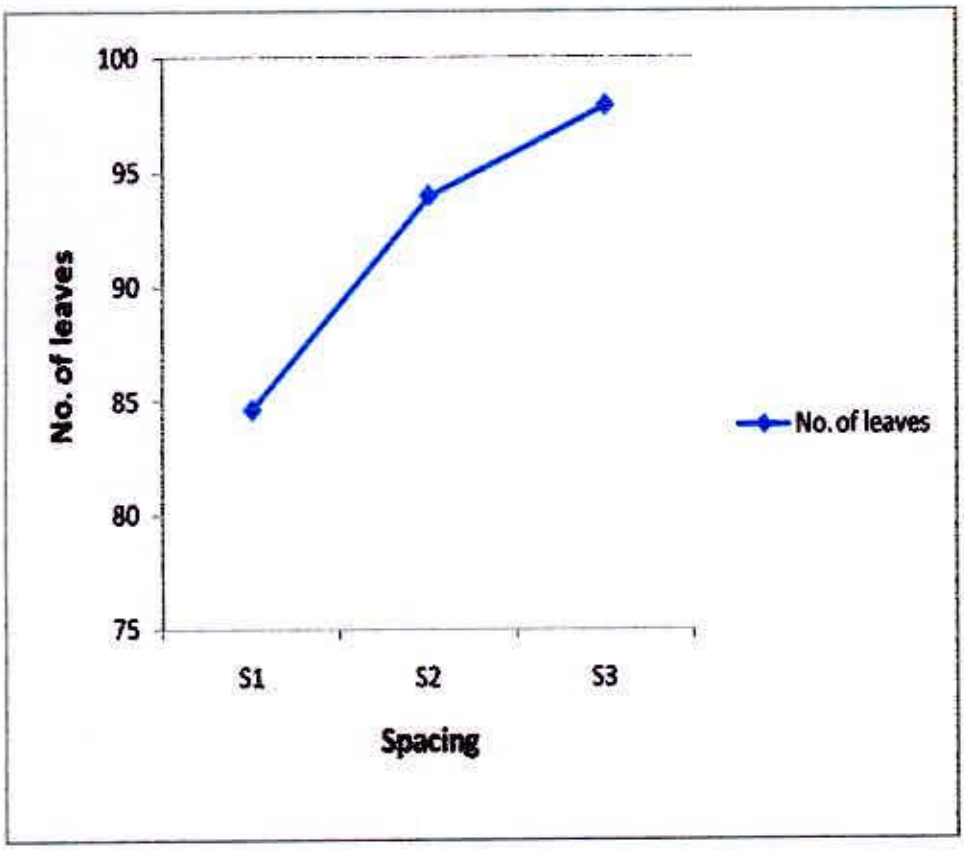

Figure 06. Effect of spacing on the number of leaves of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

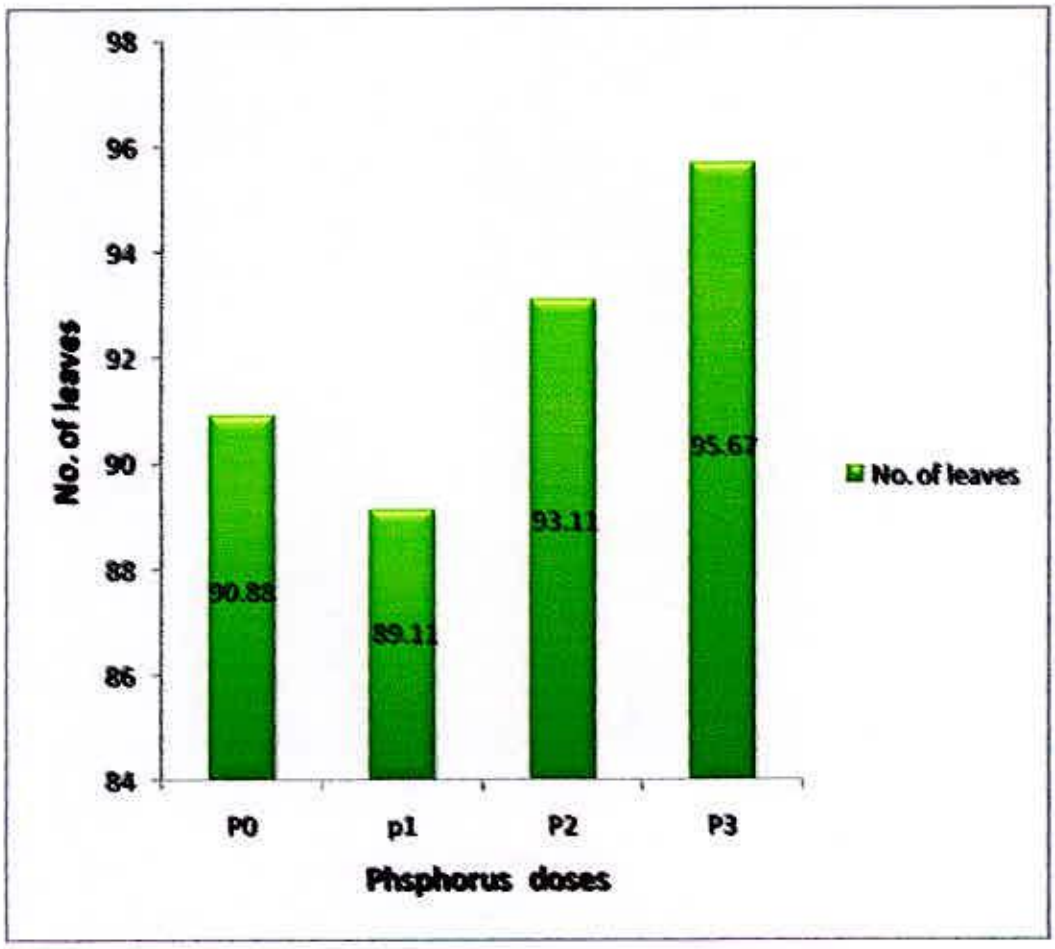

Figure 07. Effect of phosphorus on the number of leaves of brinjal.

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.3 Number of branches per plant

There had no significant variation on Number of branches due to spacing (Appendix V). The maximum number of branches per plant (20.58) was recorded in S_3 and the minimum (16.62) number of branches were recorded in S_1 (Fig. 08). As the spacing was increased number of branches was found to be increased.

Significant difference was observed among various levels of phosphorus in respect of number of branches per plant (Appendix V). The highest number of branches per plant (22.44) was obtained from P_2 treatment and the minimum (15.00) was obtained in P_1 (Fig. 09).

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix V) on number of leaves. The highest number of branches per plant (25.00) was obtained from S_2P_2 treatment while the minimum (13.00) in this regard was observed with the control (S_1P_1) combination (Table 1).

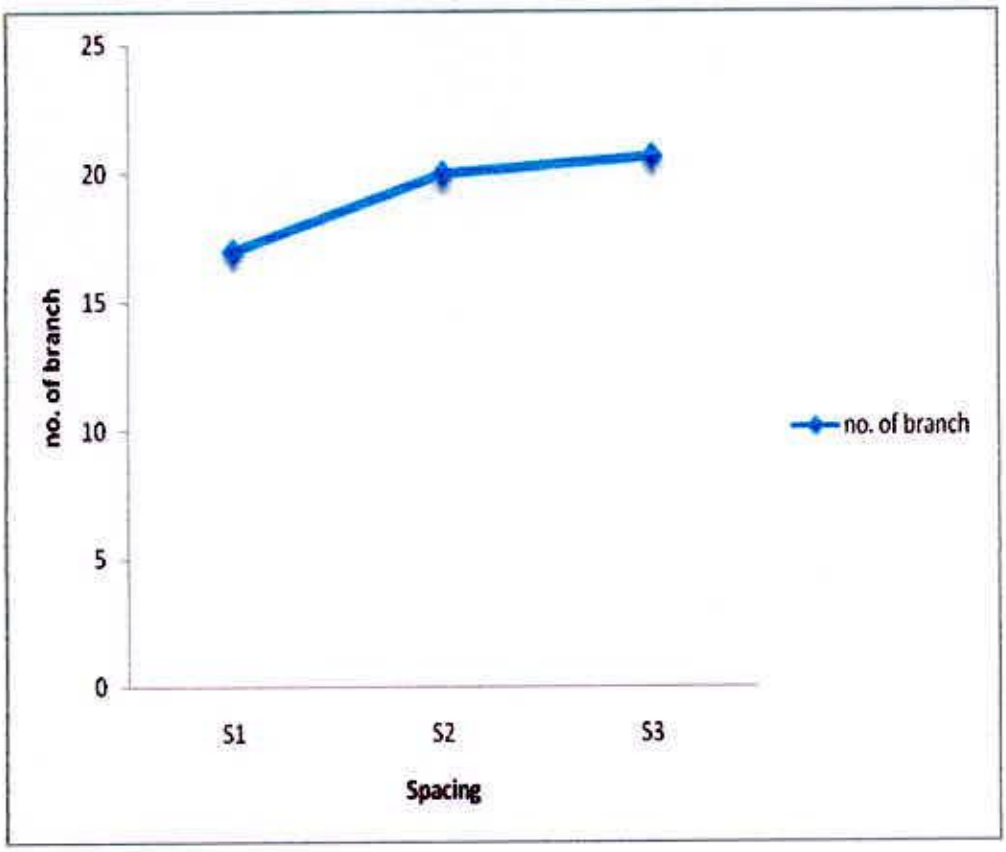

Figure 08. Effect of spacing on the number of branches of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

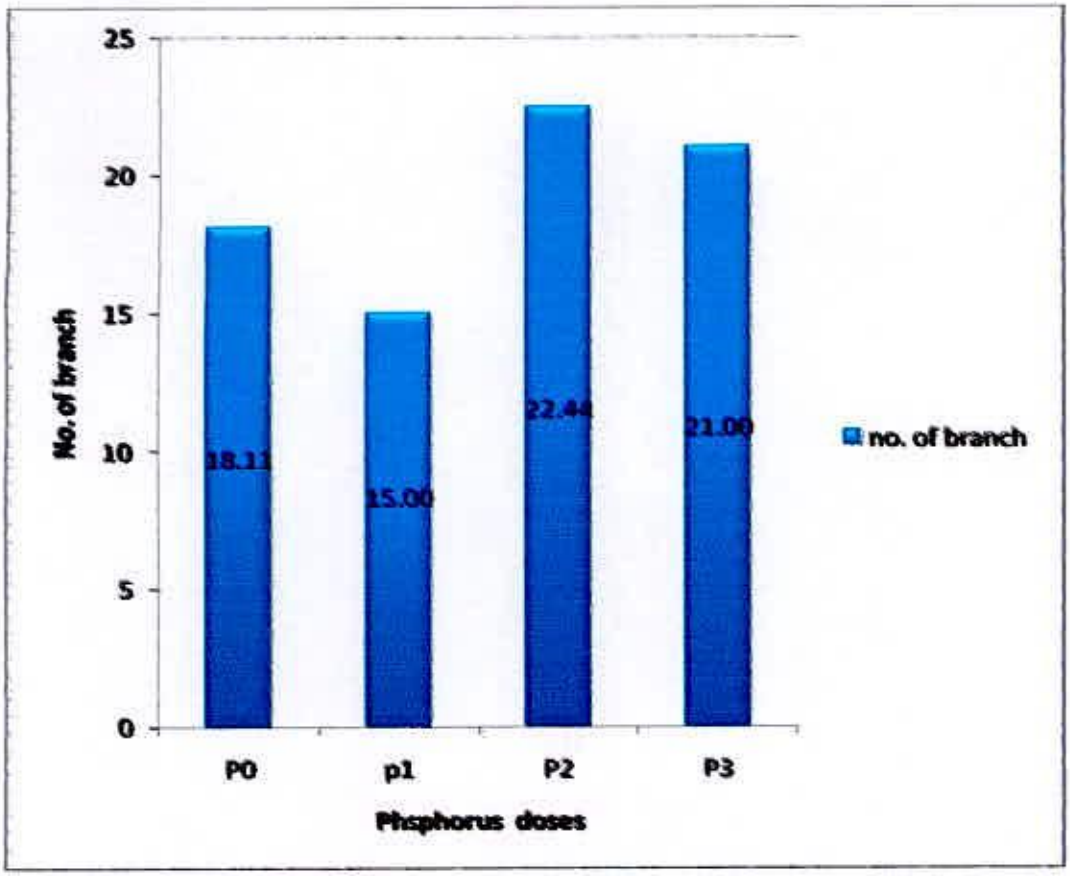

Figure 09. Effect of phosphorus on the number of branches of brinjal.

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.4 Length of lamina (cm)

Length of lamina was not significantly influenced by spacing (Appendix V). The highest length of lamina (19.59 cm) was recorded in S_3 and the minimum (17.26 cm) number of branches were recorded in S_1 (Fig. 10). As the spacing was increased length of lamina was found to be increased.

No Significant difference was observed among various levels of phosphorus in respect of length of lamina (Appendix V). The highest Length of lamina (18.91 cm) was obtained from P_2 treatment and the minimum (17.66 cm) was obtained in P_0 (Fig. 11).

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix V) on Length of lamina. The highest Length of lamina (20.13 cm) was obtained from S_3P_2 treatment while the minimum (16.00 cm) in this regard was observed with the control (S_1P_0) combination (Table 1).

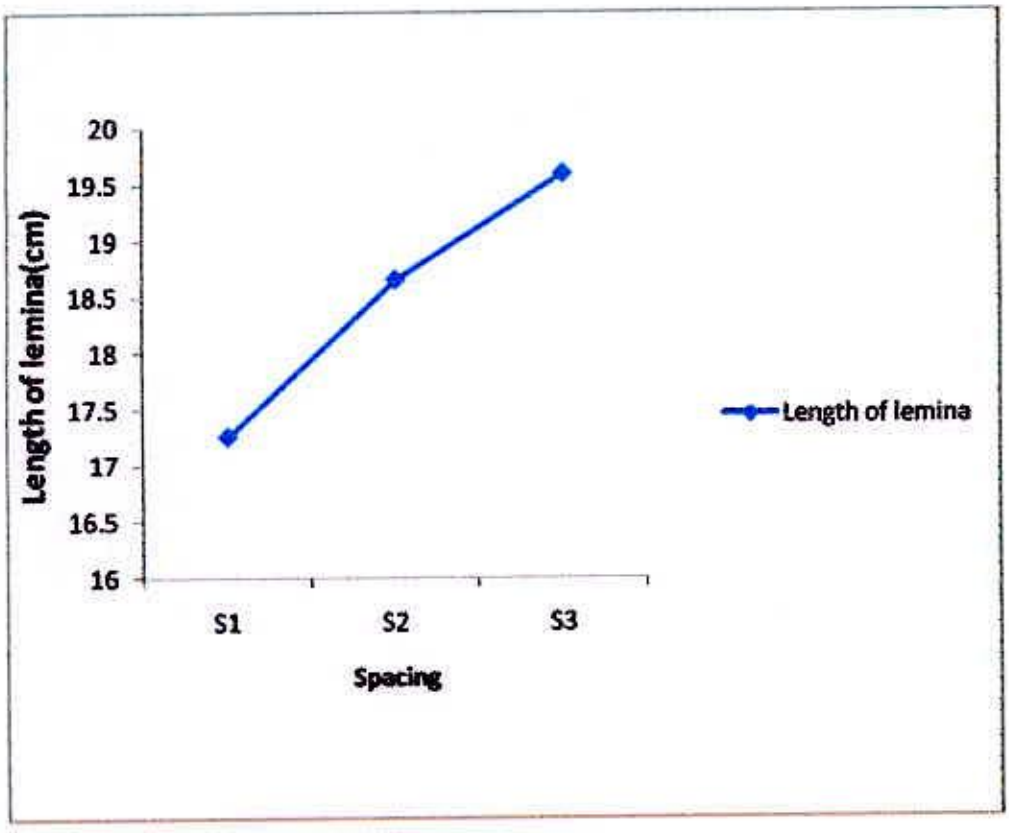

Figure 10. Effect of spacing on the length of lamina of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

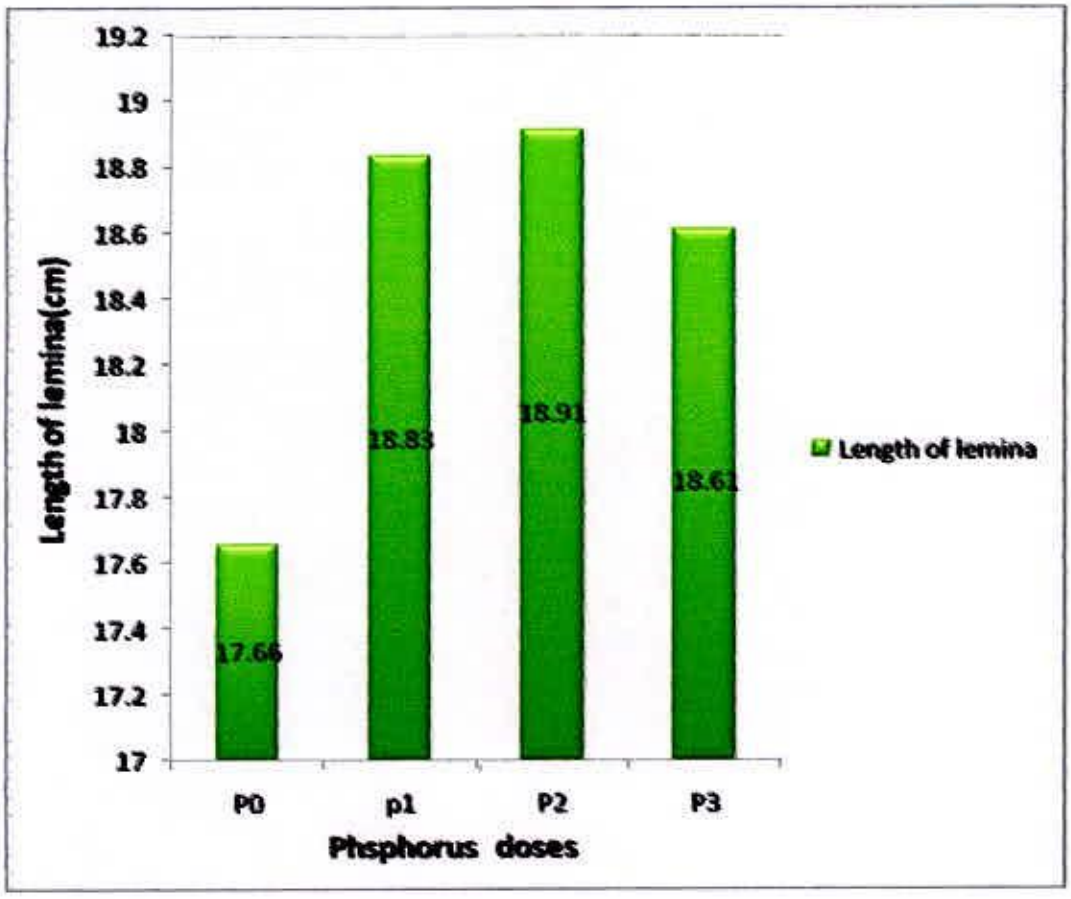

Figure 11. Effect of phosphorus on the length of lamina of brinjal.

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.5 Number of flowers per plant

Number of flowers per plant was significantly influenced by spacing (Appendix VI). The highest number of flowers per plant (80.5) was recorded in S_3 and the minimum (59.6) number of flowers per plant were recorded in S_1 (Fig. 12). As the spacing was increased number of flowers per plant was found to be increased. This may be due to the opportunity of getting more nutrients from the soil, manufacturing of more carbohydrates from the exposure of more leaf area to the sunlight and better aeration.

Application of various levels of phosphorus had significant effect on the number of flowers per plant (Appendix VI). The highest number of flowers per plant (75.84) was obtained from P_2 treatment and the minimum (69.80) was obtained in P_0 (Fig. 13). The result indicated that number of flowers was increased with the increasing rates of phosphorus. These results were in conformity with the findings of Rastogi *et al.* (1979).

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix VI) on number of flowers per plant. The highest number of flowers per plant (86.50) was obtained from S_2P_2 treatment while the minimum (56.80) in this regard was observed with the control (S_1P_0) combination (Table 2).

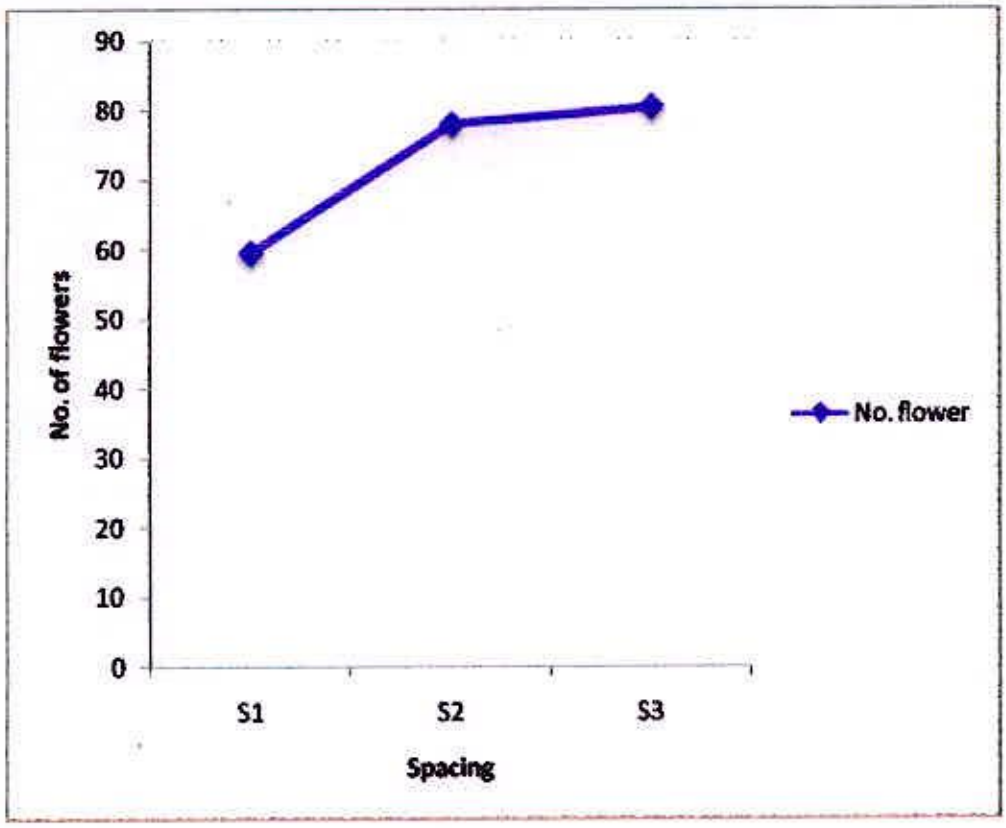

Figure 12. Effect of spacing on the number of flowers per plant of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

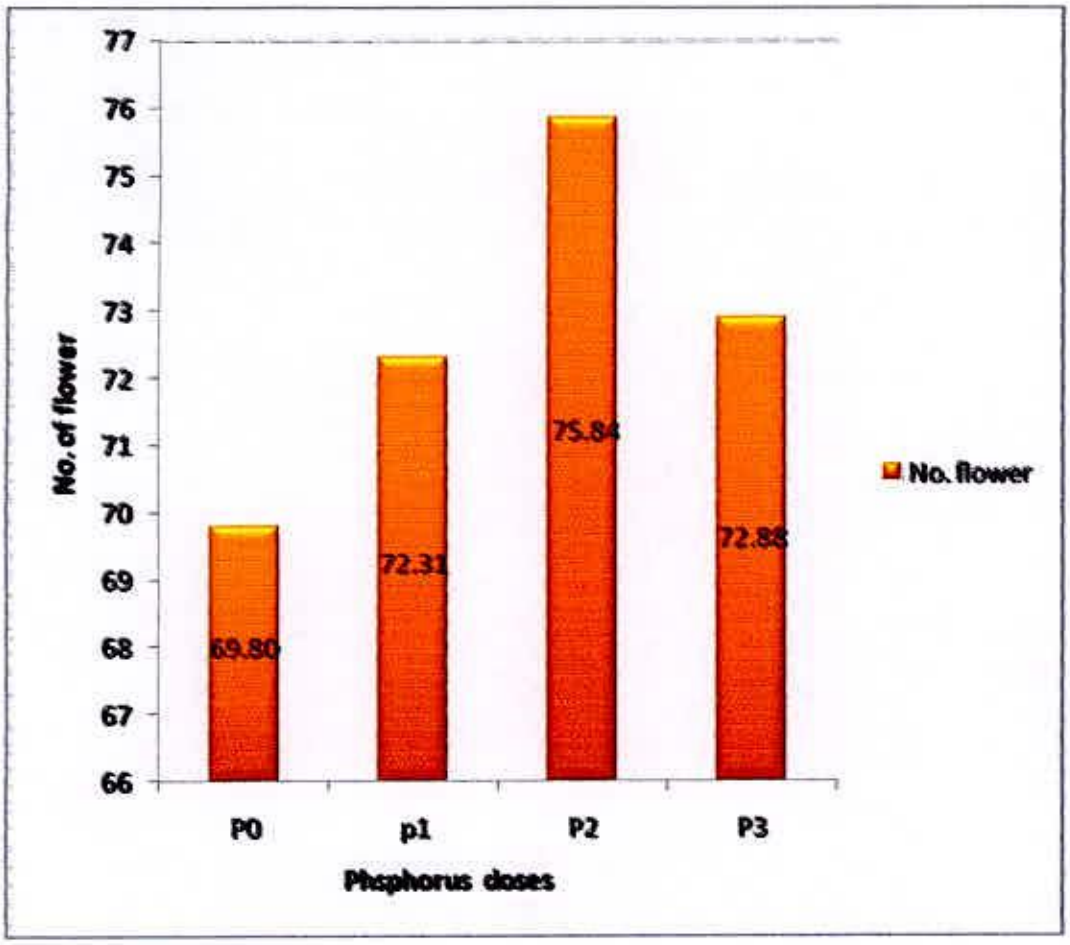

Figure 13. Effect of phosphorus on the number of flowers per plant of brinjal.

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

Table 2. Interaction effect of spacing and different level of phosphorus on the number of flower, number of fruit, length of fruit and diameter of fruit

Treatment	Number of flower	Number of fruit	Length of fruit (cm)	Diameter of fruit (cm)
S_1P_0	56.80c	42.33f	8.27e	2.67g
S_1P_1	59.73c	44.00ef	8.23e	3.00f
S_1P_2	61.17c	44.67ef	8.90e	3.37e
S_1P_3	60.70c	43.00f	9.97d	3.80d
S_2P_0	71.43b	47.67de	10.60bcd	4.10bcd
S_2P_1	76.37a	49.67cd	10.20cd	4.03cd
S_2P_2	86.50a	57.00a	11.87a	4.63a
S_2P_3	77.83a	52.33bc	11.03a-d	4.23bc
S_3P_0	81.17a	54.33ab	10.73bcd	4.27bc
S_3P_1	80.83a	52.00bc	11.37ab	4.37abc
S_3P_2	79.87a	53.00abc	11.50ab	4.43ab
S_3P_3	80.13a	53.33abc	11.23abc	4.33ab
$LSD_{(0.05)}$	4.65	3.70	0.97	0.30
Level of significance	*	*	*	*
CV (%)	3.82	4.42	5.57	4.50

Means bearing the common letter (s) in a column do not differ significantly at 5% level

*significant at 5% level of probability

NS- non significant

S_1= 75 cm × 50 cm

S_2= 75 cm × 60 cm

S_3= 75 cm × 70 cm

P_0: Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.6 Number of fruits per plant

Spacing had significant variation on number of fruits per plant (Appendix VI). As the spacing was increased the average number of fruits per plant was increased due to the opportunity of getting more nutrients from the soil and getting more sunlight and better aeration. The highest number of fruits per plant (53.17) was recorded in S_3 and the minimum (43.50) number of fruits per plant were recorded in S_1 (Fig. 14). The results are in conformity with Vittum and Tapley (1957) and Uddin *et al.* (1997).

Significant difference was observed among various levels of phosphorus in respect of number of fruits per plant (Appendix VI). The highest number of fruits per plant (51.56) was obtained from P_2 treatment and the minimum (48.11) was obtained in P_0 (Fig. 15). The result was almost similar to the findings of Mertia and Chauhan (1970).

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix VI) on number of fruits per plant. The highest number of fruits per plant (57.00) was obtained from S_2P_2 treatment while the minimum (42.33) in this regard was observed with the control (S_1P_0) combination (Table 2).

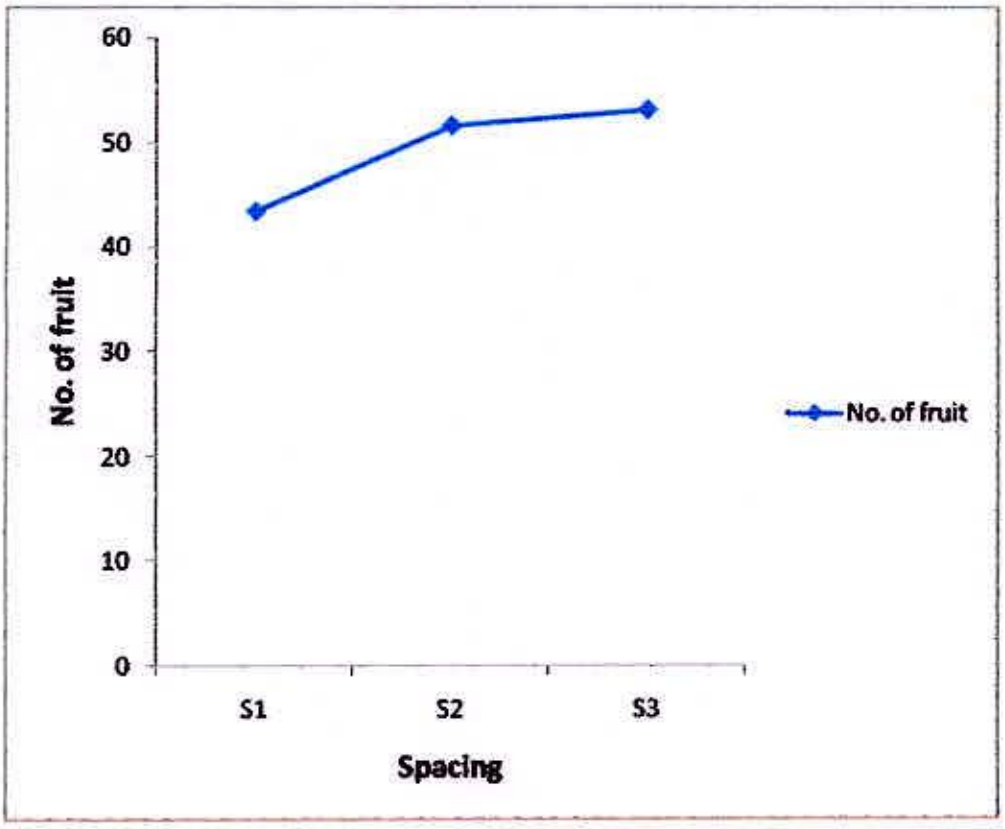

Figure 14. Effect of spacing on the number of fruits per plant of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

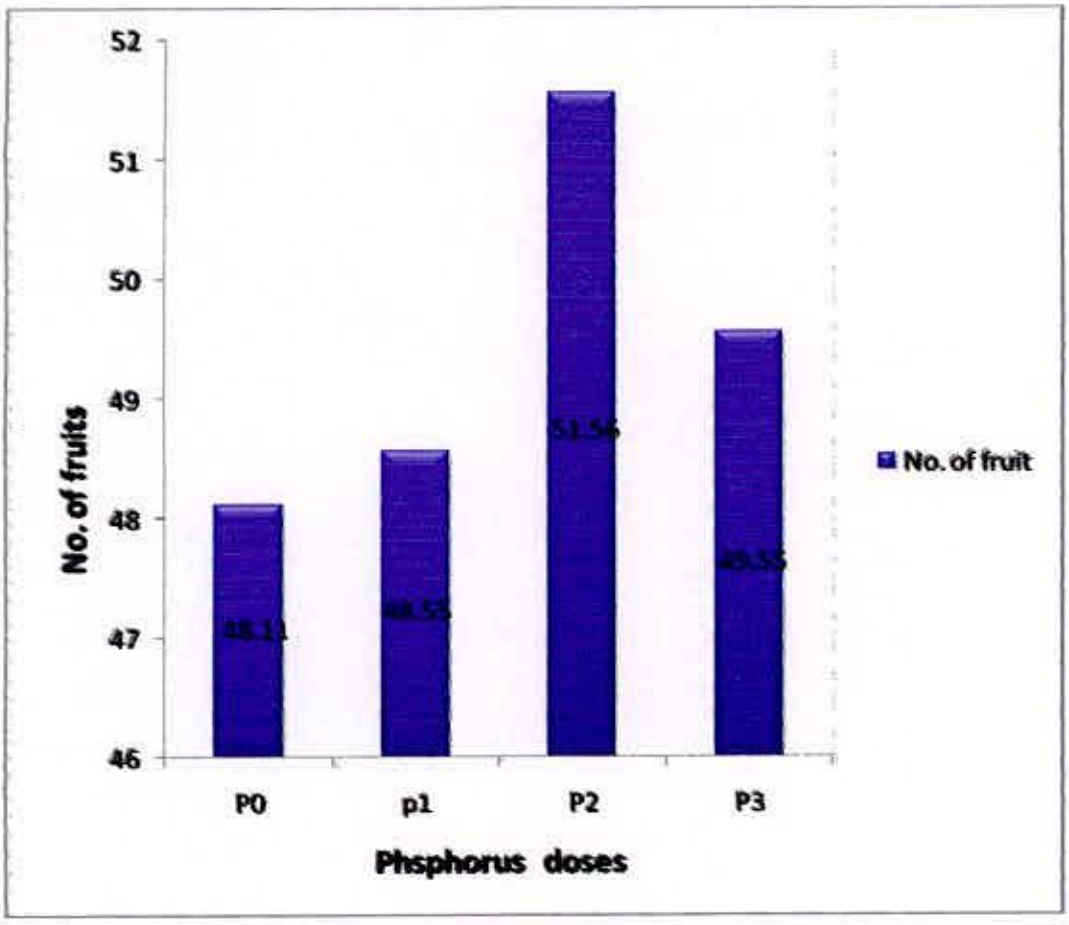

Figure 15. Effect of phosphorus on the number of fruits per plant of brinjal

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.7 Length of fruit (cm)

Spacing had significant variation on length of fruit (Appendix VI). The highest length of fruit (11.21 cm) was recorded in S_3 and the minimum (8.88 cm) length of fruit was recorded in S_1 (Fig. 16).

No significant variation was observed in respect of fruit length due to the application of different levels of phosphorus (Appendix VI). The highest length of fruit (10.76 cm) was obtained from P_2 treatment and the minimum (9.87 cm) was obtained in P_0 (Fig. 17). There were no significant difference between P_2 and P_3 treatment. This result agreed with the findings of Mamun (1999).

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix VI) on length of fruits. The highest length of fruit (11.87 cm) was obtained from S_2P_2 treatment while the minimum (8.23 cm) in this regard was observed with the control (S_1P_1) combination (Table 2).

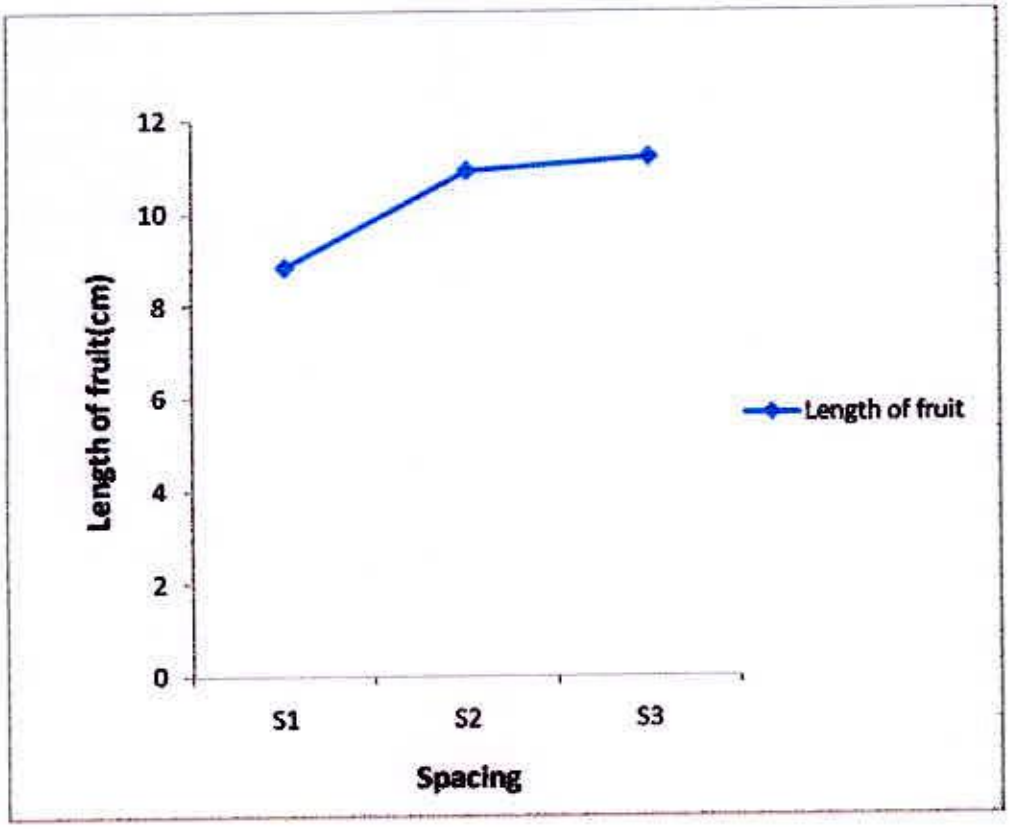

Figure 16. Effect of spacing on the length of fruit of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

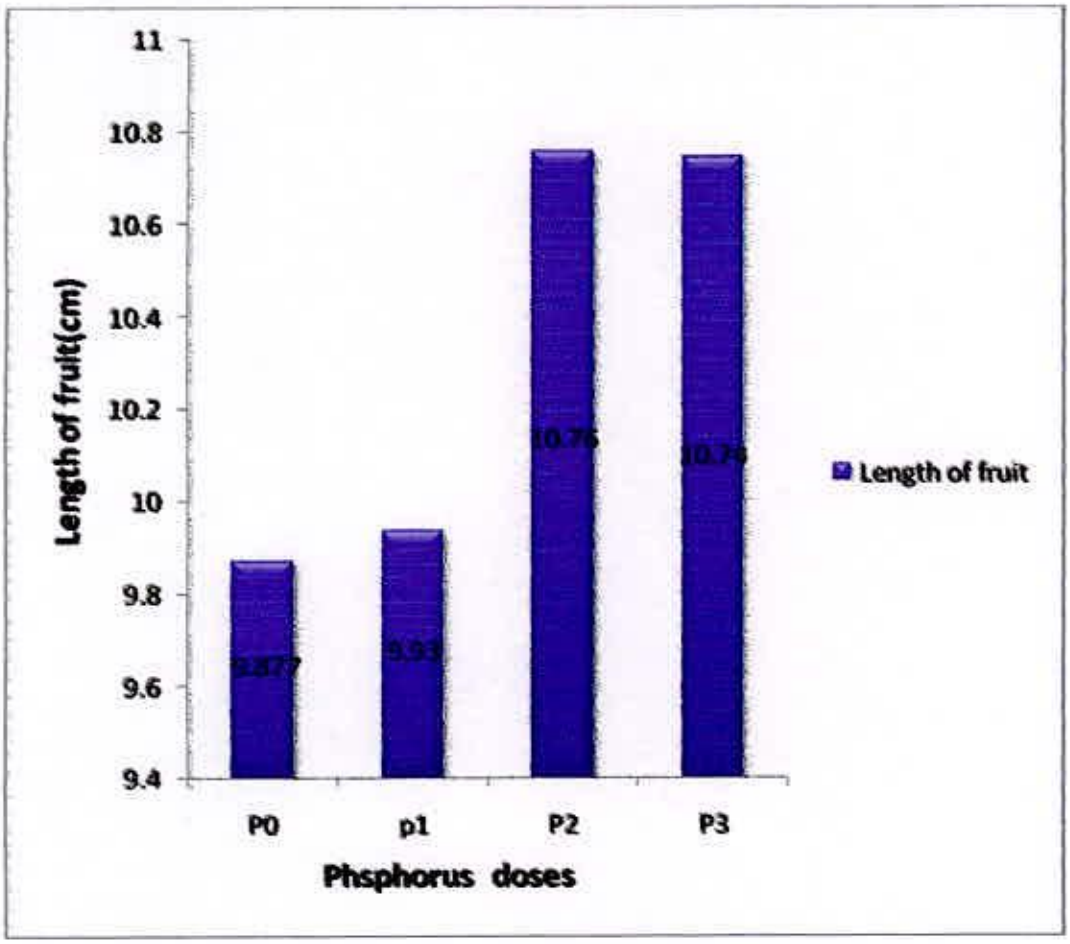

Figure 17. Effect of phosphorus on the fruit length of brinjal

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.8 Diameter of fruit (cm)

Diameter of fruit was significantly influenced by the different spacing (Appendix VI). The highest diameter of fruit (4.35 cm) was recorded in S_3 and the minimum (3.21cm) diameter of fruit was recorded in S_1 (Fig. 18).

The application of different levels of phosphorus had also significant effect on the diameter of fruit (Appendix VI). The highest diameter of fruit (4.14 cm) was obtained from P_2 treatment and the minimum (3.68 cm) was obtained in P_0 (Fig. 19). This result agreed with the findings of Mamun (1999).

Interaction effect of different spacing and different doses of phosphorus had significant variation (Appendix VI) on diameter of fruit. The highest diameter of fruit (4.63 cm) was obtained from S_2P_2 treatment while the minimum (2.67 cm) in this regard was observed with the control (S_1P_0) combination (Table 2).

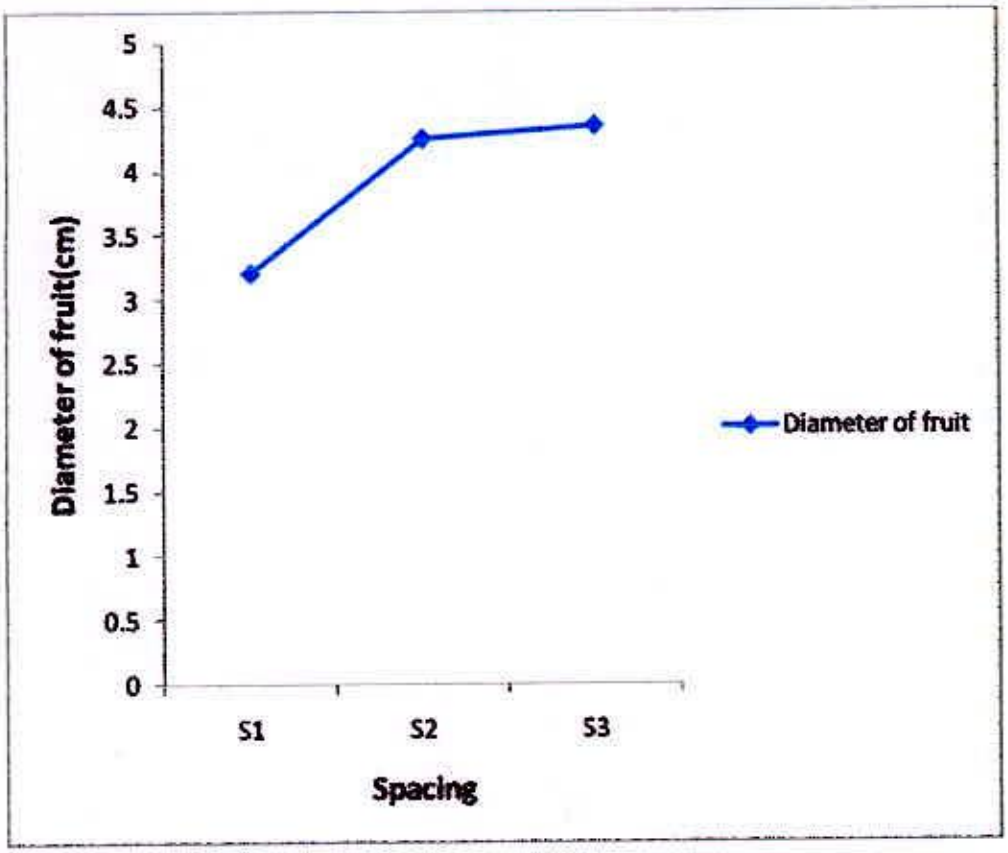

Figure 18. Effect of spacing on the diameter of fruit of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

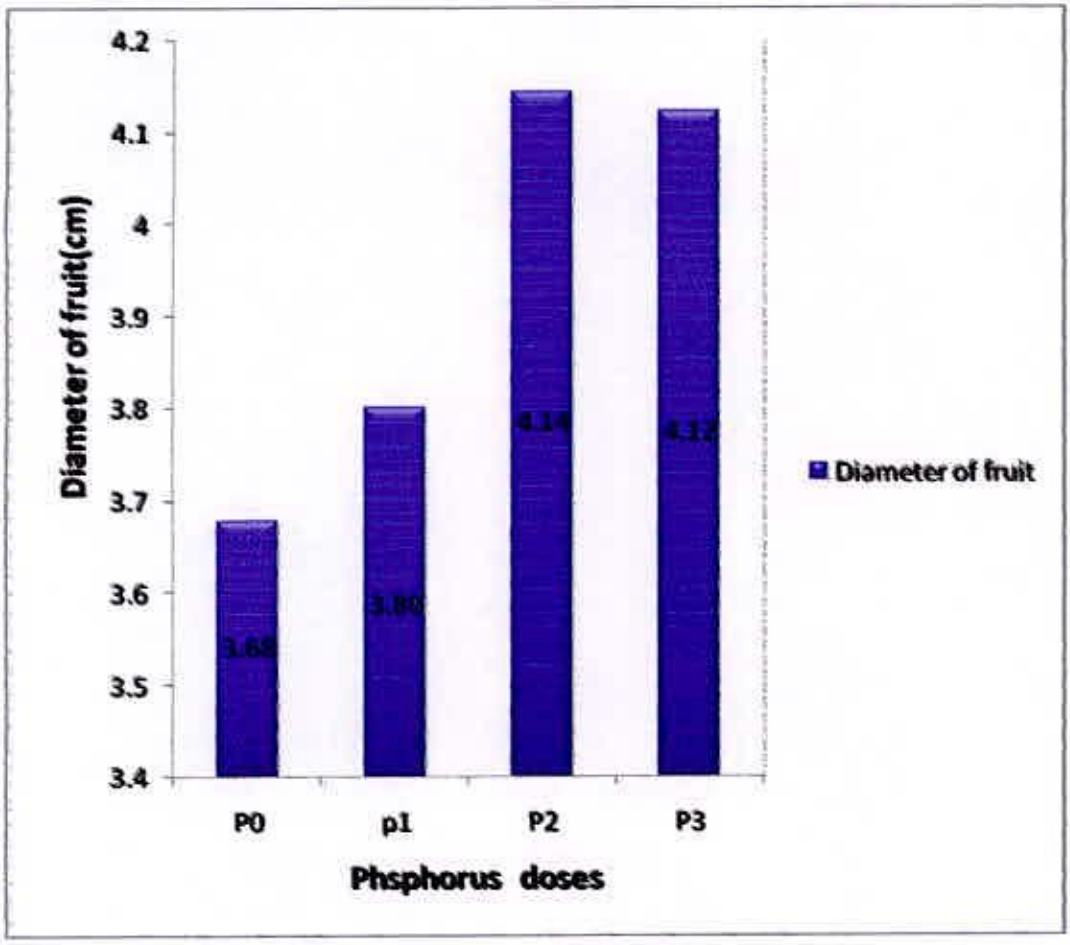

Figure 19. Effect of phosphorus on the diameter of fruit of brinjal.

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.9 Weight of individual fruit (g)

Spacing had a significant variation on the weight of individual fruit (Appendix VII). The highest weight of individual fruit (53.58 g) was recorded in S_3 and the minimum (43.55 g) weight of individual fruit was recorded in S_1 (Fig. 20).

There was a significant variation in the weight of individual fruit due to the application of different levels of phosphorus (Appendix VII). The maximum weight of individual fruit (50.96 g) was obtained from P_2 treatment and the minimum (47.09 g) was obtained in P_0 (Fig. 21). The result were similar with the finding of Mertia and Chauhan (1970) who reported that different phosphorus level significantly increased the individual fruit weight of brinjal.

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix VII) on weight of individual fruit. The highest weight of individual fruit (56.60 g) was obtained from S_2P_2 treatment while the minimum (41.20 g) in this regard was observed with the control (S_1P_0) combination (Table 3).

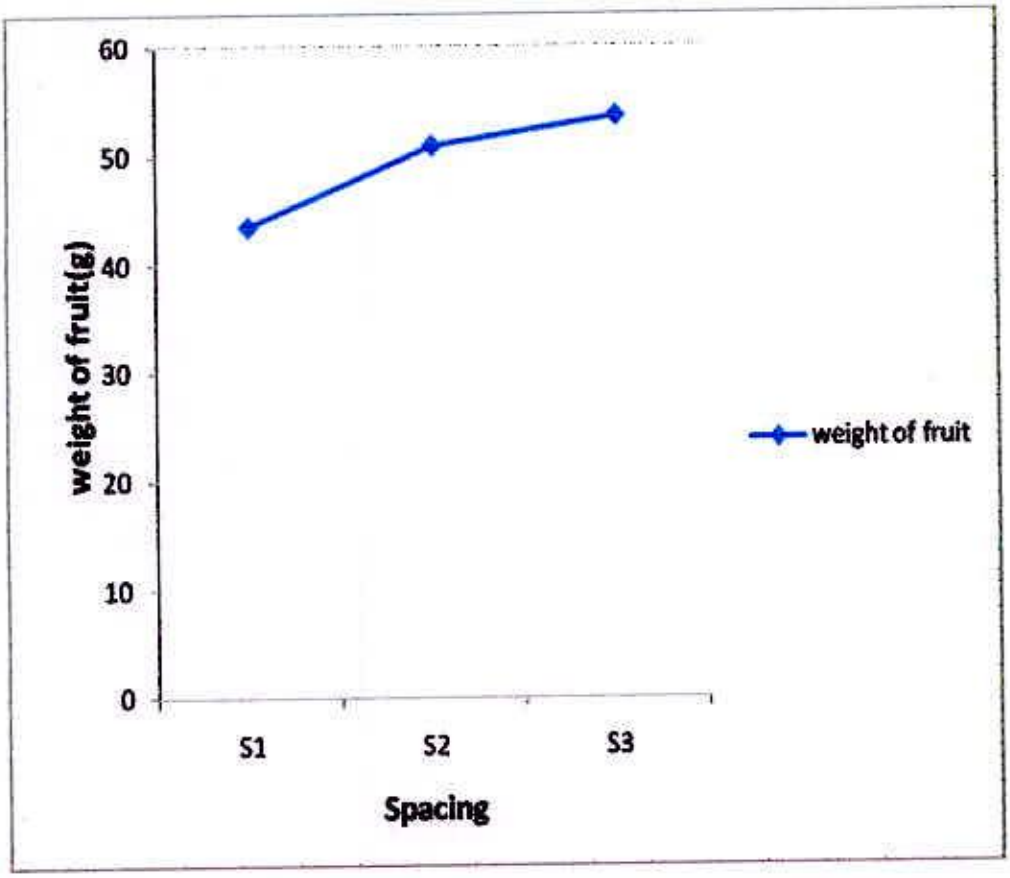

Figure 20. Effect of spacing on the weight of individual fruit of brinjal.

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

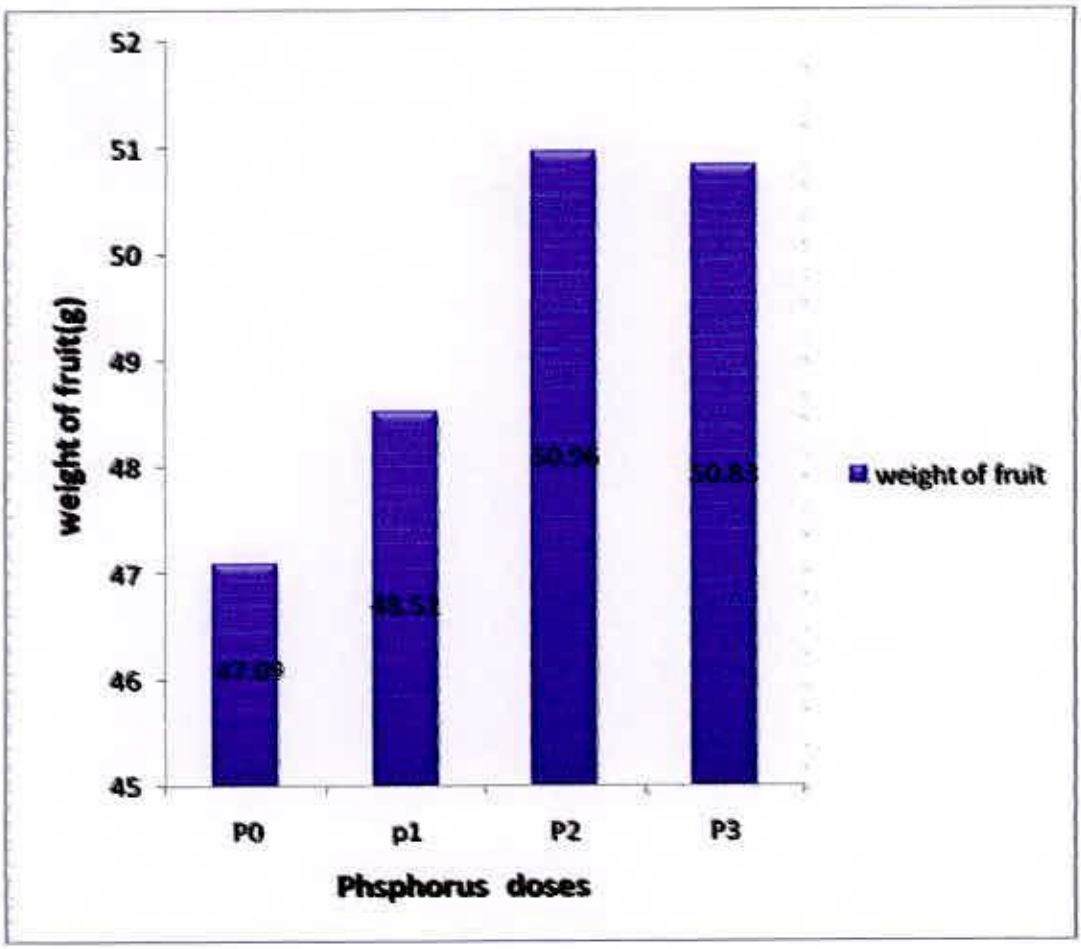

Figure 21. Effect of phosphorus on the weight of individual fruit of brinjal

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

Table 3. Interaction effect of spacing and different level of phosphorus on the weight of fruit, yield/plant, yield/plot and yield (t/ha)

Treatment	weight of fruit (g)	Yield/Plant (kg)	Yield/Plot (kg)	Yield (t/ha)
S_1P_0	41.20d	1.78e	31.93c	47.66c
S_1P_1	43.87cd	1.93e	34.73bc	51.43bc
S_1P_2	43.97cd	1.93e	35.30bc	52.33bc
S_1P_3	45.17c	1.95e	35.03bc	51.90bc
S_2P_0	46.40c	2.21d	33.13bc	49.11bc
S_2P_1	47.00c	2.33cd	35.00bc	51.85bc
S_2P_2	56.60a	2.92a	40.50a	60.02a
S_2P_3	53.67ab	2.49bc	37.37ab	55.33ab
S_3P_0	53.67ab	2.70ab	35.00bc	51.84bc
S_3P_1	54.67ab	2.84a	34.07bc	50.54bc
S_3P_2	52.30b	2.77a	33.30bc	49.28bc
S_3P_3	53.67ab	2.86a	34.37bc	50.90bc
$LSD_{(0.05)}$	**2.92**	**0.25**	**3.82**	**5.52**
Level of significance	*	*	*	*
CV (%)	**3.49**	**6.46**	**5.99**	**6.28**

Means bearing the common letter (s) in a column do not differ significantly at 5% level

*significant at 5% level of probability

NS- non significant

S_1= 75 cm × 50 cm

S_2= 75 cm × 60 cm

S_3= 75 cm × 70 cm

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.10 Yield of fruit per plant

Spacing had a significant variation on the yield per plant (Appendix VII). The highest yield per plant (2.85 kg) was recorded in S_3 and the minimum (1.9 kg) yield per plant was recorded in S_1 (Fig. 22).

There was a significant variation in the yield per plant due to the application of different levels of phosphorus (Appendix VII). The maximum yield per plant (2.47 kg) was obtained from P_2 treatment and the minimum (2.30 kg) was obtained in P_0 (Fig. 23). The result were similar with the finding of Mertia and Chauhan (1970) who reported that different phosphorus level significantly increased the individual fruit weight of brinjal.

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix VII) on yield per plant. The highest yield per plant (2.92 kg) was obtained from S_2P_2 treatment while the minimum (1.78 kg) in this regard was observed with the control (S_1P_0) combination (Table 3).

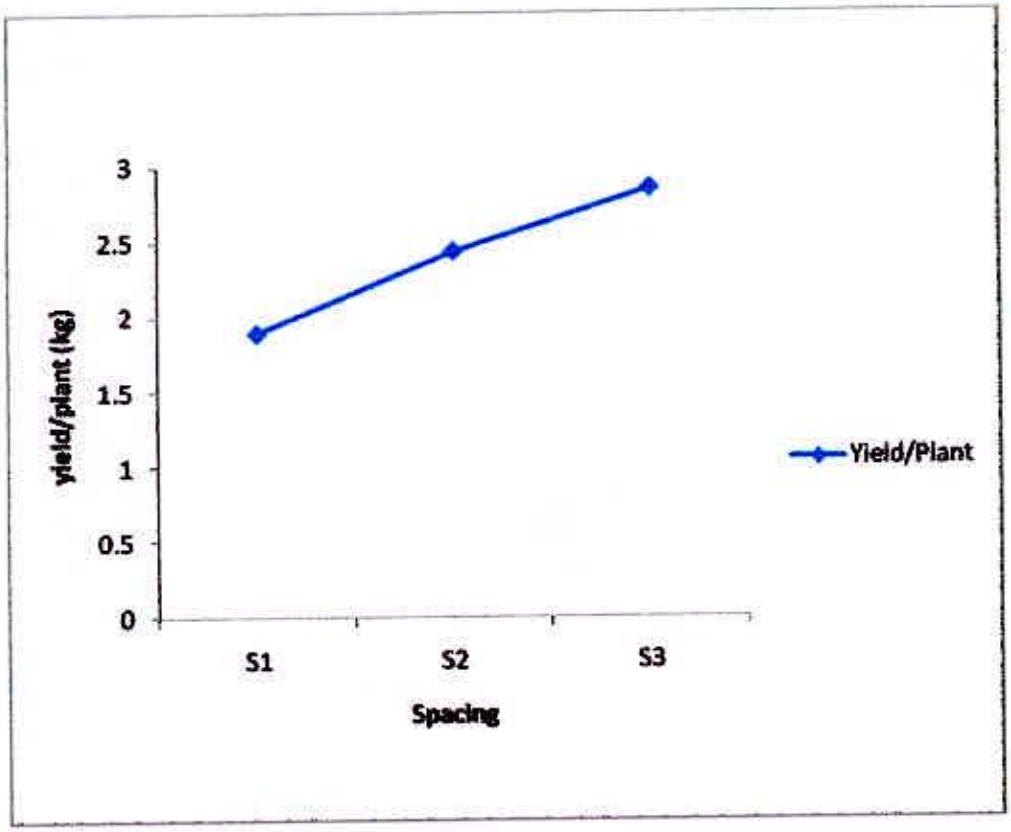

Figure 22. Effect of spacing on the yield of fruit per plant of brinjal

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

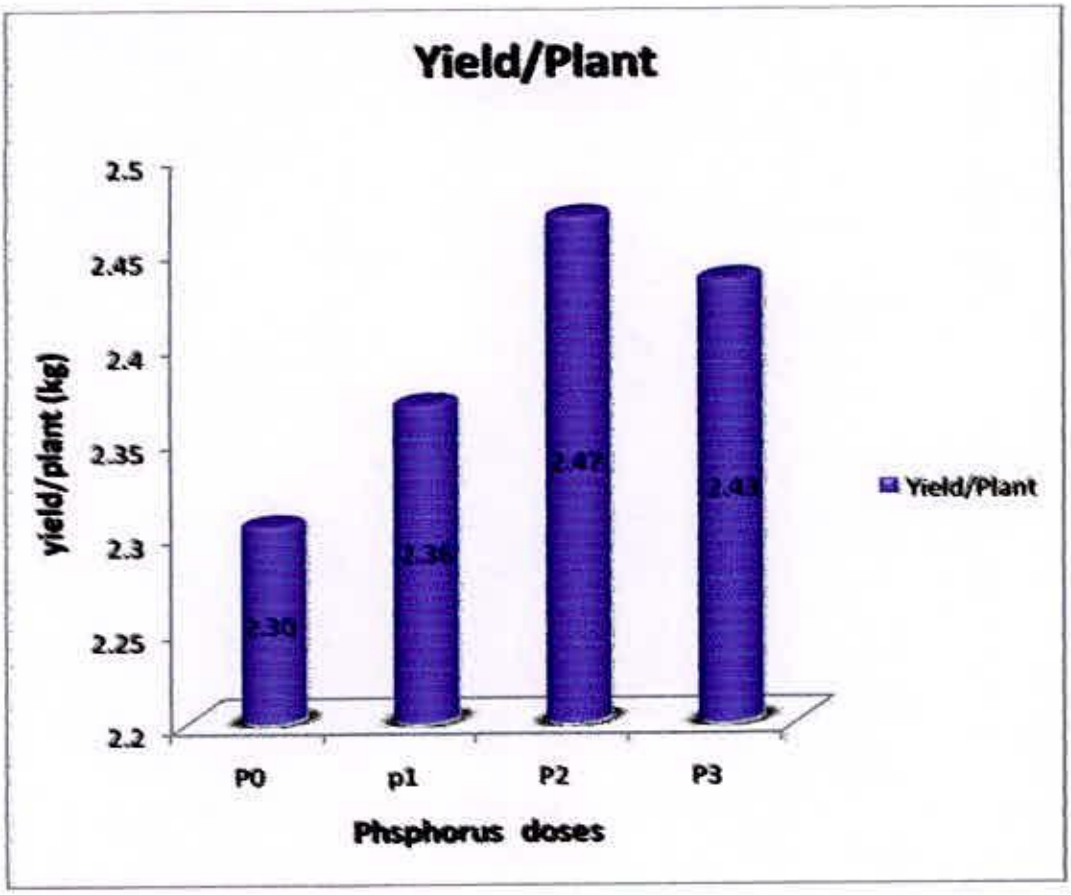

Figure 23. Effect of phosphorus on the yield of fruit per plant of brinjal.

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.11 Yield of fruit per plot (kg)

Spacing had a significant variation on the yield per plot (Appendix VII). The highest yield per plot (36.50 kg) was recorded in S_2 and the minimum (34.18 kg) yield per plot was recorded in S_3 (Fig. 24).

There was a significant variation in the yield per plot due to the application of different levels of phosphorus (Appendix VII). The maximum yield per plot (36.37 kg) was obtained from P_2 treatment and the minimum (33.36 kg) was obtained in P_0 (Fig. 25). This result is about to be similar with the result of Mamun (1999)

Interaction effect of different spacing and different doses of phosphorus had a significant variation on yield per plot (Appendix VII). The highest yield per plot (40.50 kg) was obtained from S_2P_2 treatment while the minimum (31.93 kg) in this regard was observed with the control (S_1P_0) combination (Table 3).

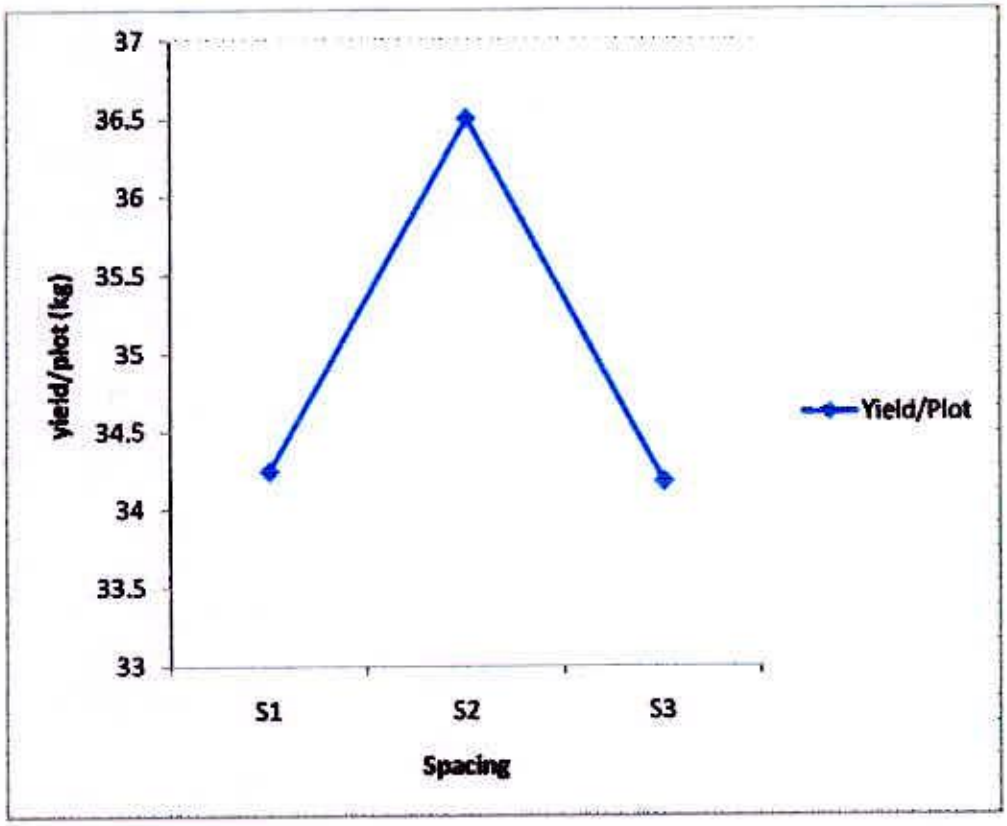

Figure 24. Effect of spacing on the yield of fruit per plot of brinjal

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

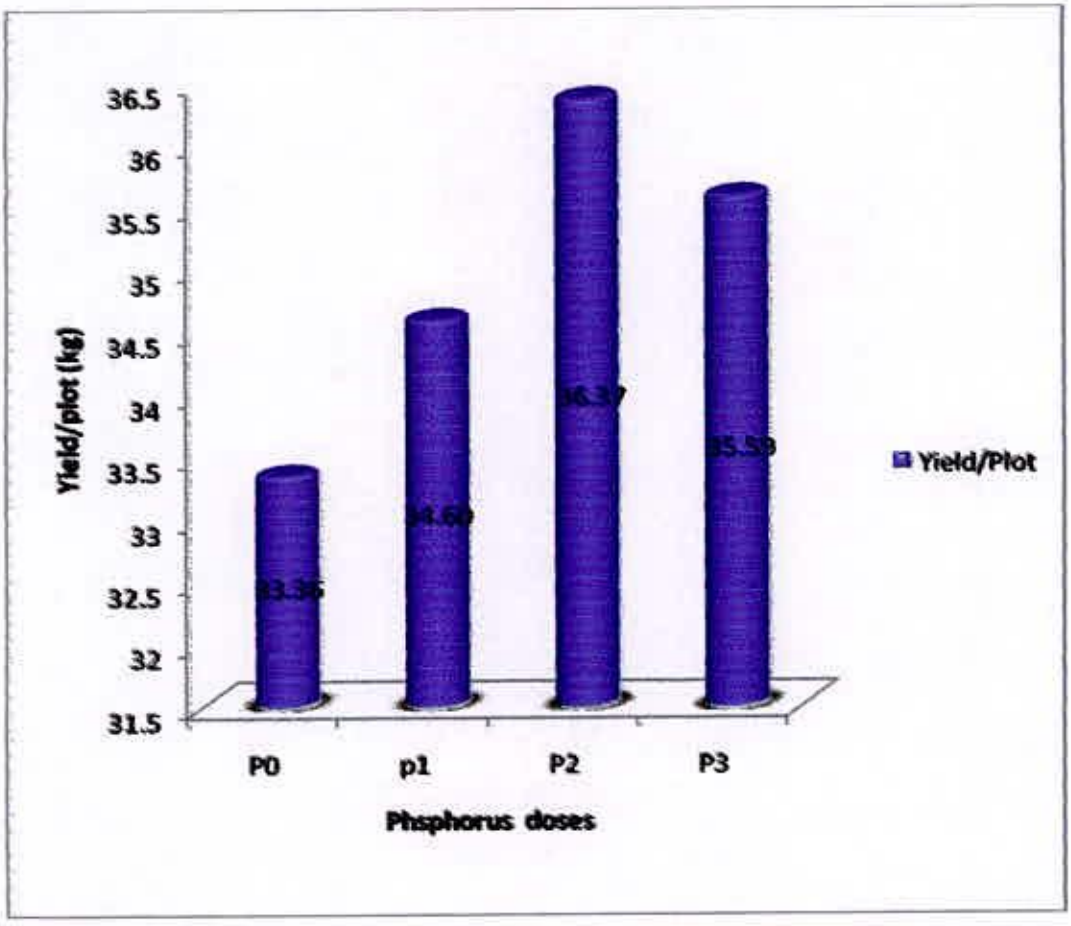

Figure 25. Effect of phosphorus on the yield of fruit plot of brinjal

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

4.12 Yield of fruit per hectare (t)

Spacing had a significant variation on the yield per hectare (Appendix VII). The highest yield per hectare (54.08 t) was recorded in S_2 and the minimum (50.64 t) yield tons per hectare were recorded in S_3 (Fig. 26).

There was a significant variation in the yield per hectare due to the application of different levels of phosphorus (Appendix VII). The maximum yield per hectare (53.87 t) were obtained from P_2 treatment and the minimum (49.54 t) was obtained in P_0 (Fig. 27). This result is about to be similar with the result of Chandrasekhram and Georage (1973), they reported that highest yield (53.26 t/ha) was obtained from 100 kg P_2O_5/ha.

Interaction effect of different spacing and different doses of phosphorus had a significant variation (Appendix VII) on yield per hectare. The highest yield per hectare (60.02 t) was obtained from S_2P_2 treatment while the minimum (47.66 t) in this regard was observed with the control (S_1P_0) combination (Table 3).

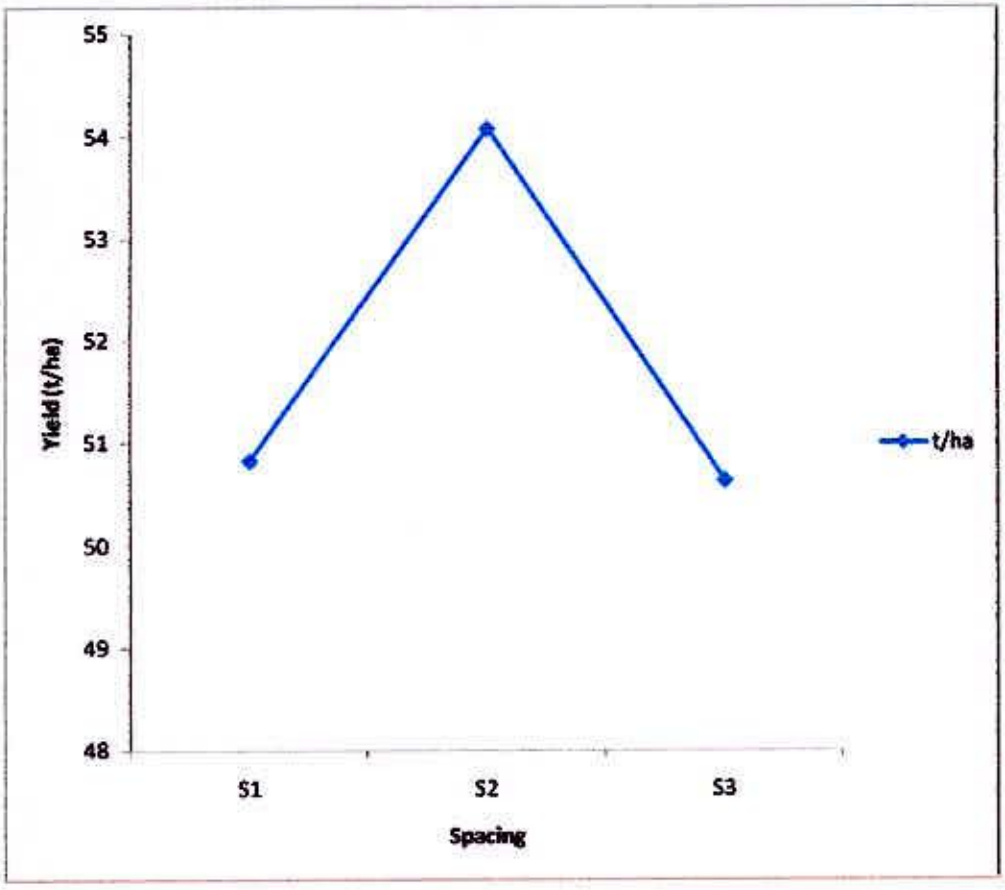

Figure 26. Effect of spacing on the yield of fruit per hectare of brinjal

S1:75 cm × 50 cm

S2:75 cm × 60 cm

S3:75 cm × 70 cm

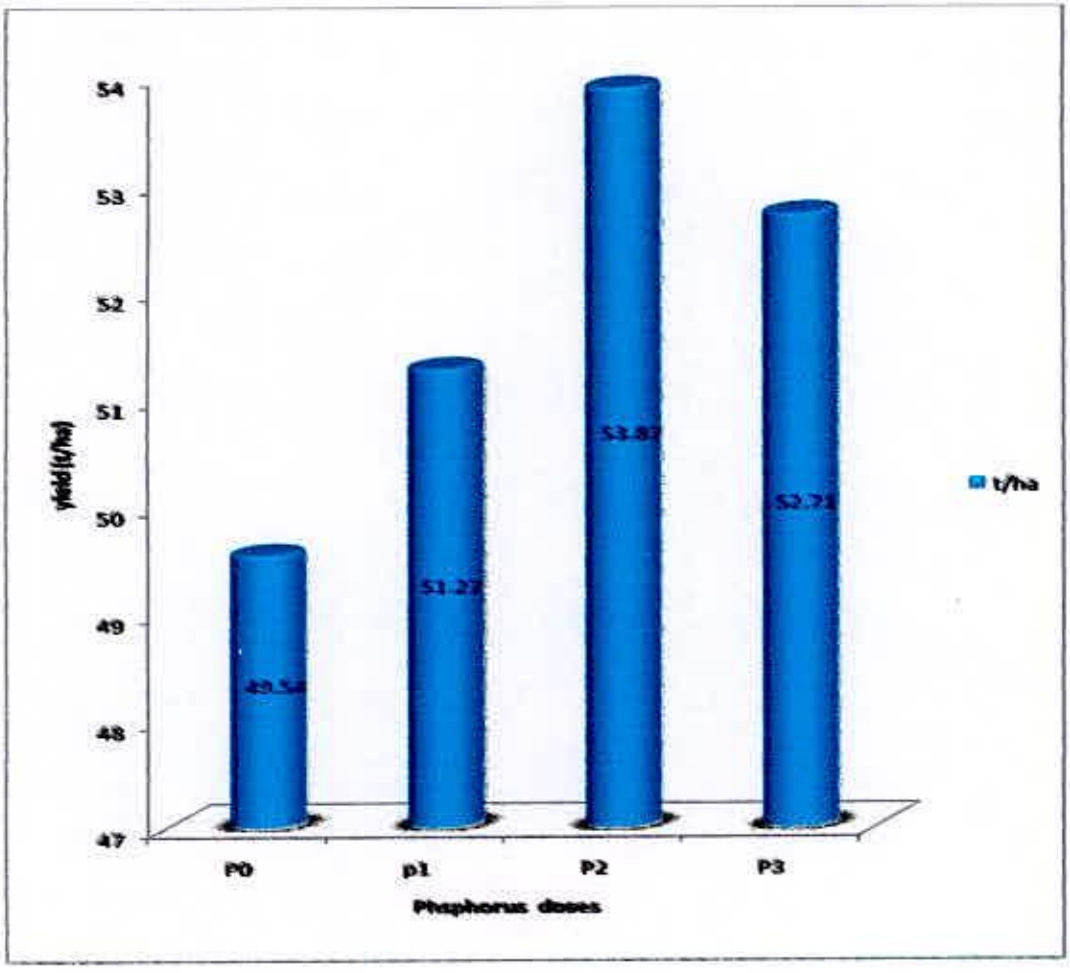

Figure 27. Effect of phosphorus on the yield of fruit per hectare of brinjal

P_0 : Control

P_1: 70 kg P_2O_5/ha

P_2: 90 kg P_2O_5/ha

P_3: 110 kg P_2O_5/ha

Chapter V

Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSION

This experiment was conducted at the Sher-e-Bangla Agricultural University farm, Dhaka, during the period from September to March, 2008 to investigate on the effect of spacing and phosphorus on the growth and yield of brinjal "Kajla". In experiment, the treatments consisted of different spacing viz. S_1 (75 cm × 50 cm), S_2 (75 cm × 60 cm), S_3 (75 cm × 70 cm) and there were four levels of phosphorus viz. Control (P_0), 70 kg P_2O_5/ha (P_1), 90 kg P_2O_5/ha (P_2) and 110 kg P_2O_5/ha (P_3). A significant variation was observed among the treatments with respect majority of the observed parameters.

Result showed that the plant height was significantly affected due to the different spacing. The tallest plant height (74.71 cm) was obtained from spacing S_3 (75 cm × 70 cm). The tallest plant (74.22 cm) was obtained from P_2 (90 kg P_2O_5/ha) treatment and the shortest (70.94 cm) was with the control. The tallest plant (77.67 cm) was obtained from S_2P_2 treatment while the shortest (68.07 cm) in this regard was observed with the control (S_1P_0) combination.

Number of leaves, number of branches per plant, number of flowers and number of fruits per plant were significantly influenced by spacing. The highest number of leaves(97.92) and number of branches(20.58) per plant was obtained from S_3 (75 cm × 70 cm) and the minimum (84.67) number of leaves and (16.62) number of branches

was recorded in S_1. Number of leaves and number of branches per plant was significantly influenced by various levels of phosphorus. The highest number of leaves (95.67) was obtained from P_3 (110 kg P_2O_5/ha). The highest number of branches (22.44), number of flowers (75.84) and number of fruits (51.56) per plant were obtained from P_2 (90 kg P/ha). The minimum Number of leaves (89.11) and number of branches (15.00) per plant was obtained in P_1. Interaction effect of different spacing and different doses of phosphorus had a significant variation on number of leaves, number of branches per plant, number of flowers and number of fruits per plant. The highest number of leaves (100.67) was obtained from S_2P_3 treatment. The highest number of branches (25.00), number of flowers (86.50) and number of fruits (57.00) per plant was obtained from S_2P_2 treatment. The minimum number of leaves (81.67), number of branches (13.00) in this regard was observed with the control (S_1P_1) combination. The minimum number of flowers (56.80) and number of fruits per plant (42.33) was observed with the control (S_1P_0) combination

Length, diameter and weight of individual fruit were significantly influenced by different spacing. The highest length of fruit (11.21 cm), diameter (4.35 cm) and weight of individual fruit (53.58 g) was recorded in S_3 (75 cm × 70 cm). Length, diameter and weight of individual fruit were significantly influenced by various levels of phosphorus. The highest length of fruit (10.76 cm), diameter (4.14 cm) and weight of individual fruit (50.96 g) was recorded in P_2 (90 kg P_2O_5/ha). Different phosphorus level also showed remarkable effect and values of these parameters

gradually increased up to 90 kg P_2O_5/ha and then declined. Interaction effect of different spacing and different doses of phosphorus had a significant variation on length, diameter and weight of individual fruit. The highest length (11.87 cm), diameter of fruit (4.63 cm) and weight of individual fruit (56.60 g) were obtained from S_2P_2 treatment.

There was a significant variation in the weight of fruit per plant, yield per plot by the different spacing. The highest weight of fruit per plant (2.85 kg) was recorded in S_3 and. The highest yield per plot (36.50 kg) was recorded in S_2 and minimum (34.18 kg) yield per plot was recorded in S_3. Weight of fruit per plant and yield per plot were significantly influenced by various levels of phosphorus. The maximum yield per plot(36.37 kg) and weight of fruit per plant(2.47 kg) was obtained from P_2 (90 kg P_2O_5/ha) and the minimum yield per plot (33.36 kg) and weight of fruit per plant (2.30 kg) was obtained in P_0. Interaction effect of different spacing and different doses of phosphorus had a significant variation on weight of fruit per plant, yield per plot. The highest yield per plant (2.92 kg) and the highest yield per plot (40.50 kg) was obtained from S_2P_2 treatment. The minimum yield per plot (31.93 kg) and weight of fruit per plant (1.78 kg) was observed with the control (S_1P_0) combination. The highest yield per hectare (54.08 t) was recorded in S_2 (75 cm× 60cm). Different levels of phosphorus showed marked effect on the fruit yield per hectare. The maximum yield per hectare (53.87 t) were obtained from P_2 (90 kg P_2O_5/ha). The combined effect of spacing S_2 with 90 kg P_2O_5/ha gave the best yield of 60.02 ton.

Further study could be under taken with the spacing S_2 (75 cm × 60 cm) with P_2 (90 kg P_2O_5/ha).For regional adaptability further experiment is needed in different agro ecological zones(AEZ).Therefore it can be suggested that spacing 75 cm × 60 cm and 90 kg P_2O_5/ha dose of phosphorus are the best for brinjal production.

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Appendices

Appendix I. Area, Production and Yields of Brinjal in Bangladesh from 2001-2002 to 2003-2004

Name of Crops	Name of Season	2001-2002			2002-2003			2003-2004		
		Area '000' Ha.	Per Ha. Yield (Kg)	Prodution' 000' M.Tons	Area '000' Ha.	Per Ha. Yield (Kg)	Prodution' 000' M.Tons	Area '000' Ha.	Per Ha. Yield (Kg)	Prodution '000' M.Tons
Total Brinjal Production	Rabi (Winter)	40.89	6476.34	264	40.49	6305.91	256	37.65	6397.30	240
	Kharif (Summer)	22.27	5137.60	114	22.27	5174.65	114	22.67	5248.75	118
Total		**63.16**	**-**	**378**	**62.75**	**-**	**370**	**60.32**	**-**	**356**

Source:BBS,(2004)

Appendix II. Trend of brinjal production in Bangladesh

Year	Season	Area(Ha.) %	Production(MT) %
2001-2002	Rabi	26.65	24.60
	Kharif	21.24	21.35
2002-2003	Rabi	26.11	24.06
	Kharif	20.45	21.07
2003-2004	Rabi	23.54	21.22
	Kharif	19.74	19.41

Source:BBS,(2004)

Appendix III. Results of Physical and chemical properties of soil of the experimental plot

Physical properties

Constituents	Percent
Sand,	32.45
Silt,	61.35
Clay,	6.10
Textural class	Sandy loam

Chemical analysis

Soil properties	Amount
Soil pH	5.6
Organic carbon (%)	1.32
Total nitrogen (%)	0.075
Available P (ppm)	19.5
Exchangeable K (%)	0.2

Appendix IV. Monthly Average Air Temperature, Total Rainfall, Relative Humidity and Sunshine Hours of the experimental site during the period from September 2007 to March 2008

Year	Month	Average Air temperature (^{0}C)			Total rainfall (mm)	Average RH (%)	Total Sun shine hours
		Maximum	Minimum	Mean			
2007	September	32.7	26.0	29.3	183	81	144
	October	30.5	24.3	27.4	417	80	142
	November	29.7	20.1	24.9	5	65	192.20
	December	26.9	15.8	21.35	0	68	217.03
2008							
	January	24.6	12.5	18.7	0	66	171.01
	February	27.1	15.8	21.05	09	66	168.60
	March	30.2	18.4	24.3	12	68	165.02

Source: Dhaka Metrological Centre (Climate Division)

Appendix V. Analysis of variance of the data on plant height, number of branch, length of lamina and number of leaves of brinjal as influenced by Spacing and Phosphorus

Source of variance	Degrees of Freedom	Mean Square			
		Plant height	Number of branch	Length of lamina	Number of leaves
Replication	2	17.402	0.361	2.225	1.361
Factor A (spacing)	2	133.967*	45.778 ^{NS}	16.551 ^{NS}	556.028 *
Factor B (Phosphorus)	3	18.445*	97.731*	3.017 ^{NS}	72.324 *
A×B	6	6.49*	5.593*	0.559*	34.546*
Error	2	5.437	1.422	1.02	20.028

*: Significant at 0.05 level of probability NS=Non Significant

Appendix VI. Analysis of variance of the data on Number of flower, Number of fruit, length of fruit and Diameter of fruit of brinjal as influenced by spacing and phosphorus

Source of variance	Degrees of Freedom	Mean Square			
		Number of flower	Number of fruit	Length of fruit	Diameter of fruit
Replication	2	395.961	0.778	0.023	0.005
Factor A (spacing)	2	1427.07*	324.778*	20.043*	4.797*
Factor B (Phosphorus)	3	17.391*	21.111 *	2.174 ^{NS}	0.49 *
A×B	6	9.195*	16.889*	0.831*	0.227*
Error	2	7.541	4.778	0.331	0.031

*: Significant at 0.05 level of probability NS=Non Significant

Appendix VII. Analysis of variance of the data on weight of fruit, yield per plant, yield per plot, yield (ton/ha) of brinjal as influenced by spacing and phosphorus

Source of variance	Degrees of Freedom	Mean Square			
		Weight of fruit	Yield per plant	Yield per plot	Yield (ton/ha)
Replication	2	14.002	0.032	4.879	11.588
Factor A (spacing)	2	323.67*	2.723*	20.868*	44.931*
Factor B (Phosphorus)	3	31.783*	0.047*	15.23*	31.607*
A×B	6	27.532*	0.058*	11.958*	26.037*
Error	2	2.964	0.021	5.1	10.609

*: Significant at 0.05 level of probability