EFFECT OF SEED PRIMING AND PLANT GROWTH REGULATORS ON GROWTH AND YIELD OF YARD LONG BEAN

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DHAKA-1207

DECEMBER, 2021

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A Thesis

Submitted to the Department of Horticulture,

Sher-e-Bangla Agricultural University, Dhaka,

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE (MS)

IN

HORTICULTURE

SEMESTER: JULY- DECEMBER, 2021

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*This is to certify that the thesis entitled "**EFFECT OF SEED PRIMING TREATMENTS AND PLANT GROWTH REGULATORS ON GROWTH AND YIELD OF YARD LONG BEAN**" submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M.S.)** in **HORTICULTURE**, embodies the results of a piece of bona fide research work carried out by **NUSRAT JAHAN SUNNY**, Registration. No.**19-10180** under my supervision and guidance. No part of this 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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ACKNOWLEDGEMENT

All praises to the Almighty Allah, the great, the gracious, merciful and supreme ruler of the universe who enables me to complete this present piece of work for the degree of Master of Science (MS) in the Department of Horticulture.

The author would like to express his deepest sense of gratitude, respect to his research supervisor, ***Prof. Dr. Md. Nazrul Islam****, Department of Horticulture, Sher-e-Bangla Agricultural University, for his kind and scholastic guidance, untiring effort, valuable suggestions, inspiration, extending generous help and encouragement during the research work and guidance in preparation of manuscript of the thesis.*

The author sincerely expresses his deepest respect and boundless gratitude to his co-supervisor ***Assoc. Prof. Dr. Shormin Choudhury****, Department of Horticulture, for her helpful suggestion and valuable advice during the preparation of this manuscript.*

It is highly appreciating words for ***Prof. Dr. Khaleda Khatun****, Chairman, Department of Horticulture, Sher-e-Bangla Agricultural University, for the facilities provided, in carrying out this work. The author also acknowledges with deep regards the help and cooperation received from his respected teachers and stuff of the Department of Horticulture, Sher-e-Bangla Agricultural University while carrying out this work.*

The author feels proud to express his sincere appreciation and gratitude to Ministry of Science and Technology, The People's Republic of Bangladesh for awarding his National Science and Technology (NST) fellowship and also very thankful to Md. Sumon Chowdhury for his cordial help.

At last but not the least, the author feels indebtedness to his beloved parents and friends whose sacrifice, inspiration, encouragement and continuous blessing paved the way to his higher education and reach at this stage. May Allah bless us all.

The Author

EFFECT OF SEED PRIMING AND PLANT GROWTH REGULATORS ON GROWTH AND YIELD OF YARD LONG BEAN

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ABSTRACT

An experiment was conducted during the period of April to June 2021 at Horticulture farm of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh to evaluate the effect of seed priming and different growth regulators on growth and yield of yard long bean. The experiment was laid out in the Randomized Complete Block Design with three replications. Treatment as four levels of seed priming treatments i.e. Control (P_0), Hydro priming (P_1), Halo priming 1% $CaCl_2$ (P_2), Osmo priming 10% PEG (P_3), and three levels of growth regulators i.e. Control (G_0), Application of NAA (G_1), Application of Kinetin (G_2), which in combination made 12 treatment combinations. In case of effect of priming treatment P_3 showed the highest value of Germination percentage (74.1%), Shoot length of seedlings (28.36cm), Root length of seedlings (9.98cm), Fresh weight of seedlings (5.38g), Dry weight of seedlings (2.68g). Again, the days to first flowering was lowest in P_0 (41.3) and highest in P_3 (47.2) treatment. In the case of effect of plant growth regulators in, treatment G_1 showed the highest value of No of branch/plant (7.60), No of pods plant^{-1} (17.50), Pod length (30.07cm), Individual pod weight (17.30g), Yield plant^{-1} (4.75t/ha). But the days to first flowering was lowest in G_0 (43.3) and highest in G_1 (45.3) treatment. Again the effect of different combination between seed priming and plant growth regulators, treatment P_3G_1 showed the highest value of No of branch/plant (9.42), No of pods plant^{-1} (32.33), Pod length (38.44cm), Individual pod weight (22.25g), Yield plant^{-1} (6.34t/ha) compared to other treatment. The days to first flowering was lowest in P_0G_0 (40.6) and highest in P_3G_1 (49.3) treatment. So the combination of P_3G_1 found the best for cultivate yard long bean.

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LIST OF ABBREVIATIONS

ABBREVIATIONS	FULL WORD
AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
ha^{-1}	Per hectare
RCBD	Randomized Complete Block Design
CV%	Percentage of coefficient of variance
LSD	Least Significant Difference
PEG	Polyethylene glycol
$CaCl_2$	Calcium chloride
DAS	Days after sowing
et al.	And others
NAA	Naphthalene acetic acid
PGRs	Plant growth regulators
Kn	Kinetin
MoP	Muriate of Potash
TSP	Triple Super Phosphate
NS	Non-significant
SAU	Sher-e-Bangla Agricultural University
^{0}C	Degree Celsius
Wt.	Weight

CHAPTER I

INTRODUCTION

Yard long bean (*Vigna unguiculata*) is quite possibly of the most well-known vegetable in numerous nations of Southeast Asia. It is a significant leguminous vegetable which are developed beneficially all over Bangladesh. Being eaten as green pods is developed. It is otherwise called asparagus bean, string bean, snake bean or vegetable cowpea (Purseglove, 1977). It is generally filled in Chattragram, Chattragram Hill Tracts (CHTs), Faridpur, Noakhali, Cumilla and Rangpur locale. As of now, it is widely filled in Dhaka, Chattragram, Cumilla, Narsingdi, and Joshore locale and furthermore different areas of Bangladesh. It is cultivated broadly in kharif season. Yard long bean is wealthy in protein, calcium, iron, riboflavin, phosphorus, potassium, and vitamin A. Likewise, it also contains L-ascorbic acid, folate, magnesium, and manganese (Asian Vegetable Research Development Center (AVRDC). A serving of 100 g of yard long bean contains 50 calories, 9.0 g of complete sugars, 3.0 g of proteins, 0.2 g all out fat and 0.8 g of minerals (Anon., 2013). Yard long bean is one of the financially significant vegetable yields in Bangladesh. The area occupied by this crop was 17680.08 acres and the production was 33281.75MT during the year 2020-2021 (BBS 20-21).

Out of numerous requirements in regards to low production of yard long bean, seed germination, development and improvement, yield and quality of crops are of prime significance. By providing some special pre-sowing treatments, seeds can be invigorated. Common priming techniques include osmopriming (soaking seeds in osmotic solutions such as polyethylene glycol), halopriming (soaking seeds in salt solutions) and hydropriming soaking seeds in water (Choudhary *et al*., 2004) studied the effect of priming and ageing on seed quality parameters of bean. Maximum increase in germination and other seedling parameters was witnessed in halopriming and in osmopriming. It could also improve the performance of crop by alleviating the effect of salts under saline soil conditions. The polyethylene glycol (PEG) induce effect on drought stress in germination and things related to germinated and after seed germination; the percentage of water absorb, its water content (Koskosidis *et al*., 2020). Seed priming is a generic technology and that it addresses a fundamental requirement for crop production need to have a field full of vigorous plants. Thus, it can be incorporated with almost any other technology or process that can be used to improve crop performance. Increased emergence of primed seeds over unprimed seeds is in accordance with the findings of (Afzal *et al.*, 2005). His findings also shown that seed priming also induced salt tolerance in beans seedlings. Seed priming with different salts, especially $CaCl_2$, NaCl, KNO_3 have shown to improve germination and growth of many crops under stressed conditions (Sivritepe and Sivritepe, 2003).

Application of plant growth regulators has been widely recommended to overcome problems such as low flowering and poor pod set in vegetable crops (Reshmi and Gopalakrishnan, 2004). Plant growth regulators play an important role in high value horticultural crops to increase yield, enhance crop quality and management (Emonger, 2007). The potential use of growth regulators can increase its growth and yield. The plant growth regulator (PGRs) have therefore, been known to be one of the quick means of increasing production (Maity *et al*., 2016). Auxins are considered an important group of PGRs which play a vital role in cell multiplication and enlargement, adventitious roots formation (Majda and Robert, 2018), apical dominance (Abdoli *et al.*, 2013), and inducing flowering (Malik, 1999). Naphthalene acetic acid (NAA) is among one of the most beneficial plant growth regulators (PGRs) in auxin family. Studies have shown that NAA plays a key function in improving the growth, yield as well as quality of the produce (Singh *et al.*, 1982). Cytokinins promotes cell division, cell enlargement and cell differentiation, stimulate bud initiation and root growth, translocation of nutrients, prolong storage life of flowers and vegetables, prevent chlorophyll degradation, morphogenesis, lateral bud development, delay of senescence. Treatment with NAA as Auxin and Kinetin as Cytokinin can increase plants growth and yield. An optimum rate of application of growth regulators can ensure better growth and yield of Yard long bean which ultimately will lead general farmers for commercial application of these substances (Maity *et al*., 2016).

Quite a good number of works have been done on seed priming and growth regulators effect on yard long bean but under Bangladesh condition such works are scanty. The seed priming and growth regulator technology can enhance seedling emergence and ensure good plant stand and overall production which in turn can maximize yield and improve quality of the crop. Since the effect of seed priming and plant growth regulator on field emergence of yard long bean is poorly documented, the present study was undertaken to investigate the effects of priming and growth regulators on seed germination and field performance of yard long bean with the following-

Objectives:

1. To find out the effect of priming treatments on the germination, growth and yield of yard long bean,
2. To evaluate the effect of plant growth regulators on the growth and yield of yard long bean,
3. To find out the best combination of priming and plant growth regulators on growth and yield of yard long bean.

CHAPTER II

REVIEW OF LITERATURE

2.1 Effect of Priming

Saeidi *et al*. (2008) observed that priming of mustard with different solutions increased the mean stem and root dry weight or mean germination rate at suitable priming times can cause better and faster seedling establishment in the early season and thus can improve the plant tolerance against unfavorable environmental conditions.

Golezani *et al*. (2008b) concluded that hydropriming is a simple, low cost and environmentally friendly technique for improving seed and seedling vigour of lentil. Seedling emergence rate was also enhanced by priming seeds with water. Hydropriming significantly improved imbibition rate, germination rate, seed vigour index, shoot, root and seedling dry weights, compared to other seed treatments.

A field experiment on a sandy soil in Rajasthan, India showed that emergence of pearl millet was only around 50 %, even in moist soils. However, primed seeds emerged better across a range of soil moisture levels and the relative increase due to priming increased from 15 % in moist soil to 45 % in dry soil. Priming was not able to compensate completely for the effects of low soil moisture at sowing but made a significant contribution across a range of soil moisture contents and was relatively more effective in drier soils (Harris, 2006).

Maiti *et al*. (2006) reported that simple technique of hydro priming (involving 15hrs of soaking the seeds in water followed by drying in room temperature for 3 days) was effectively utilize to break seed dormancy in seeds of sunflower.

Omidi *et al*. (2005) showed that osmopriming of rape seed under water stress condition had a significant effect on seedling parameters including seedling dry weight, rate and period of germination.

Priming seeds of six cultivars of finger millet with water for 8 hrs in eastern India resulted in taller, earlier-maturing plants that produced more yield than plants from non-primed seed in two on-station trials in 2000 and 2001 (Kumar *et al*., 2002). Priming significantly reduced the mean time to flowering and the mean time to maturity by about 6 days, increased mean plant height by 9 cm and resulted in 14 % extra grain yield.

Harris *et al*. (2001a) reported the germination of maize without priming from less than 40hr to more than 70hr in laboratory experiment. Priming seeds of maize for 12hr reduced the time for germination. The treatment reduced the range of germination times to between 20hr and 40hr in the field experiments, primed maize seed in water for 16hr or 18hr resulted in statistically significant positive benefits. Where priming was effective, the extra produce varied from 0.3 t/ha to about 14 t/ha and represented increases ranging from 17% to 76%.

Chivasa *et al*. (2000) in Zimbabwe reported that priming sorghum seeds for 10 hours speeded up seedling emergence by 23 % and increased final emergence percent. Fourteen-day-old seedlings from primed seeds also had significantly more leaves and root axes and were taller and heavier than nonprimed seedlings. In two field sowings in Botswana in 1991-92, primed sorghum seed gave similar results.

Harris *et al*. (1999) demonstrated that on-farm seed priming (soaking seeds overnight in water) markedly improved establishment and early vigor of upland rice, maize and chickpea, resulting in faster development, earlier flowering and maturity and higher yields. This simple, low-cost, low-risk intervention also had positive impacts on the wider farming system and livelihoods and the technology has proved highly popular with farmers. Its value has already been shown for many crops, chickpea (Kaur *et al*., 2005), maize (Ashraf and Rauf, 2001), mungbean (Rashid *et al*., 2004), pigeonpea (Jyotsna and Srivastava, 1998), sunflower (Kaya *et al*., 2006).

Sun *et al*., (2010) also concluded that PEG priming with moderate concentration resulted in higher tolerance to drought stress than hydro-priming, while higher concentrations of PEG had negative effects on seed germination. It was reported seed priming had significant effect on increment of germination percent; germination speed and seedling dry weight of sunflower vice versa of producing abnormal seedling decrement in drough.t

Ascorbic acid, another important vitamin is also used for priming due to its antioxidant nature. It has already been proved that a high level of endogenous acrobat is essential to maintain the antioxidant capacity that protects plants from oxidative stress (Zhou *et al*.,2006).

In many crops, seed germination and early seedling growth are the most sensitive stages of water limitation and the water deficit may delay the onset and reduce the rate and uniformity of germination, leading to poor crop per dormance and yield (Demir *et al*., 2006).

Priming treatments are being used to shorten the time between planting and emergence and to protect seeds from biotic and abiotic factors during critical phase of seedling establishment. Such earlier and synchronized emergence often leads to uniform stands and improved yield (Afzal *et al*., 2013)

Seed performance under drought or salt stress is also affected by the concentration of priming materials. It has been reported that, NaCl priming generally requires long term treatment periods using solutions with relatively high concentrations of NaCl; however, short term seed priming with a low NaCl concentration also increases germination rate, field emergence and acquired stress tolerance (Nakaune *et al*., 2012).

Sun *et al.* (2010) also concluded that PEG priming with moderate concentration resulted in higher tolerance to drought stress than hydropriming, while higher concentrations of PEG had negative effects on seed germination.

Zheng *et al.* (2002) reported earlier and uniform emergence in rice (*Oryza sativa*) seeds osmoprimed with KCl and $CaCl_2$ and mixed salts under flooded conditions. However, Nascimento and West (1999) reported early germination of primed seeds but not recorded any improvement in the growth of seedlings in muskmelon (*Cucumis melo*) seeds under laboratory conditions. Confounding results, where priming did not show any beneficial results, also reported by different research workers (Mwale *et al.,* 2003)

Priming with KNO3 can be used to increase watermelon germination (Demir and Mavi, 2004) and in tomato, seed priming with KNO3 increased germination percentage, germination index, root length, shoot length and seedling fresh weight (Nawaz *et al.*, 2011).It was reported that osmo and hydropriming of chickpea seeds with mannitol and water alleviated the adverse effects of water deficiency and salt stress on seedling growth. The treatment of seeds with water, 2 and 4 % mannitol increased the length and biomass of roots and shoots of chickpea seedlings as compared to non-primed controls under salt stressed conditions

Kathiresan *et al*. (1984) found similar findings and reported maximum root and shoot growth; seedling height and field emergence in sunflower seeds in response to priming with $CaCl_2$. Priming may improve germination by accelerating imbibition, which in turn would facilitate the emergence phase and the multiplication of radicle cells.

The increased shoot and root length in primed plants can be due to metabolic repair of damage during treatment and that change in germination events i.e., changes in enzyme concentration and formation and reduction of lag time between inhibition and radicle emergence (Bradford *et al*.,1990).

Sivritepe *et al*. (2003) evaluate the effect of salt priming on salt tolerance of melon seedling and reported that total emergence and dry weight were higher in melon seedlings derived from primed seeds and they emerged earlier than non-primed seeds. They also observed that total sugar and proline accumulation and prevented toxic and nutrient deficiency effects of salinity because less Na but more K and especially Ca was accumulated in melon in melon seedlings.

Priming of seeds with water promoted seedling vigor, yield and crop establishment of chickpea, maize and rice in India (Harris et.al., 1999).Harris *et al.* (1999) also found that hydropriming enhanced seedling establishment and early vigor of upland rice, maize and chickpea, resulting in faster development, earlier flowering and maturity and higher yields. The resulting improved stand establishment can reportedly increase drought tolerance, reduce pest damage and increase crop yield (Harris *et al.,* 1999).

2.2 Effect of Plant Growth Regulator on Yard Long Bean

Emonger (2007) carried out an experiment with plant growth regulators Auxin on Cowpea exogenously 7 days after emergence at 30, 60 and 90 mgl-1 significantly increased plant height, first node length, leaf area, leaf number, nodulation, pod number/plant, pod length, seed number/pod, plant dry matter accumulation, 100 seed weight.

Reshmi and Gopalakrishna (2004) carried out an experiment on Yardlong bean to study the effect of 4 growth regulators in Kerala. 4 plant growth regulators namely NAA (15, 30, 45 ppm), 2,4-D (2, 4 and 6 ppm), IAA (20, 40 and 60 ppm) and CCC (300, 400, 500 ppm) were sprayed on yard long bean at different growth stages to evaluate its impact on flowering and fruit set. Foliar spray of NAA of 15 ppm give the highest yield followed by IAA at 40 ppm and CCC at 300 ppm. 2,4-D had a strong depressing effect on growth and yield of yard long bean.

Mishriky (1990) conduct an experiment on pea and found that protein content increased when 50 ppm GA3 was applied at 30 DAS . The forgoing discussion indicates that growth regulators such as GA3 and IAA could increase the branches, grain yield as well as protein content of pea. The effectiveness of such growth regulators may however is applied in yard long bean.

Singh and Upadhaya (1967) studied the effect of IAA and NAA on tomato and reported that the regulators activated growth, increased the fruit set, size and yield of fruit and induced parthenocarpic fruit.

Sentelhas *et al.* (1987) showed that 200 ppm IAA increased the number of panicles/pot, the number of grains/ear and the weight of grains by foliar application with N fertilizer compared with N applied to the soil and found the highest yield with 200 ppm IAA and foliar N in wheat, the level was too high for Sesamum crop increased yield when 100 ppm GA, IAA or ascrobic acid applied at 40 days after sowing, the higher concentration being determental to yield. Biswas and Mandal (1988) reported that protein, free amino acid of the seeds and mobilization index for protein in wheat increased from application of foliar spray.

2.3 Effect of Plant Growth Regulator on other crop

The increase in vegetative growth could be due to stimulated cell multiplication and elongation of internodes (Dhage *et al.,* 2011).

Studies by Abdo and Abdel-Aziz (2009) and Kumar et al. (2018) also revealed that exogenous application of NAA up to 50 mg/L improved the overall vegetative growth and leaf area of the plant.

Furthermore, more pod yield with lower NAA concentrations (30 and 50 mg/L) might be due to better translocation of photo-assimilates to the developing pods and seeds (Ravat and Makani, 2015).

This could also be due to enhanced source sink relationship initiated by exogenous NAA application that in turn stimulated the heavier build-up of sufficient food reserves thereby helping in effective pod development and ultimately enhancing the pod yield (Huang *et al.,* 2018).

Various studies have reported the effectiveness of NAA towards inducing pod production in other crops including lablab bean (Uddin *et al.,* 1994), pigeonpea (Rao and Narayan, 1997), and chickpea (Karim, 2005).

Cytokinins have been shown to play an important role in the transportation of assimilates to wheat spikes (Darussalam *et al.,* 1998) .

As well, cytokinins are required for cell division during the early phase of grain filling

(Yang *et al.*, 2000)

Shalama *et al.* (2015) reported that the response of seed priming and foliar application of plant growth regulators (GA3), NAA and osmotic salicylic acid increase number of pod cluster per plant, 100 seed weight and seed yield per plants of the mung bean.

Studies have showed that external application of planofix (NAA) reduced the premature abscissions of flowers, young pods and thus increased the number of pods and consequently the yield of groundnut (Mani and Raja, 1976).

A foliar application of 40 ppm NAA on groundnut increased the number of pods perplant and eventually the pod yield (Gupta and Singh, 1982).

Singh *et al.* (1982) conducted an experiment on groundnut to determine the effect of NAA. They observed that two foliar spray of 100-ppm planofix (NAA) to groundnut at 40 and 50 days after sowing increased the number of leaves per plant.

Subbian and Chamy (1982) mentioned that two foliar sprays of 40-ppm planofix (NAA) when applied to summer mungbean at the flower initiation stage and 15 days later significantly increased the seed yield.

Subbian and Chamy (1984) carried out a field trial in summer with 2 foliar applications of 0, 20 or 40 ppm NAA to greengram. They found increased number of flowers and pods per plant with increasing NAA rate. They also reported that seed yield was increased from 0.8 to 1.2 t ha-1 with increasing NAA concentrations.

Venkaten *et al.* (1984) pointed out that both in rabi and in kharif seasons application of NAA at various concentrations sprayed at 30 and 50 days after sowing increased the number of pods per plant and 1000 seed weight in groundnut.

From the review as presented above, it is observed that seed priming techniques (hydro and osmopriming) and growth regulators favorably influence seed germination, seedling growth, yield and yield contributing characters of wheat and barley, okra and bean. This information is received mostly from aboard. Under Bangladesh conditions, therefore, studies are necessary for refinement of the techniques for adjustment and application of the seed priming and PGRs techniques.

CHAPTER III

MATERIALS AND METHODS

The experiment was directed at the experimental field of Sher-e-Bangla Agricultural University, Dhaka-1207 during the Kharif-1 time of March to June, 2021 to concentrate on the impact of seed priming and plant growth regulators on development and yield of Yard Long Bean. The materials utilized and strategy continued in the examination have been introduced subtleties in this part

3.1 Description of the Experimental Site:

3.1.1 Geographical location

The experimental area was situated at 23° 77′ N latitude and 90° 33′ E longitude at an altitude of 8.2 meter above the sea level (Anon., 2013).

3.1.2 Agro-ecological region

The experimental field has a place with the Agro-biological zone of "The Modhupur Tract", AEZ-28. This was a district of intricate help and soils created over the Modhupur earth, where floodplain silt covered the took apart edges of the Modhupur Tract leaving little hillocks of red soils as 'islands' encompassed by floodplain. The trial site was displayed in the guide of AEZ of Bangladesh in Appendix I

3.1.3 Soil

The soil of the trial site has a place with the general soil type, shallow red brown terrace Soils under Tejgaon Series. Top soils were earth soil in surface, clay loam in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. Soil pH went from 5.6-6.5 and had natural matter 1.10-1.99%. The exploratory region was level having accessible water system and seepage framework or more flood level.

3.1.4 Climate

The region has subtropical environment, described by high temperature, high relative dampness and weighty precipitation with periodic breezy breezes in Kharif season (April-September) and meager precipitation related with modestly low temperature during the Rabi season (October-March).

3.2 Details of the experiment

3.2.1 Treatments

The following treatments were included in the experiment:

Factor A: (Priming Treatments)

1. P_0 = Control
2. P_1 = Hydro priming at 6 hrs
3. P_2 = Halo priming (1% $CaCl_2$) at 6 hrs
4. P_3 = Osmo priming (10% PEG) at 6 hrs

Factor B: (Foliar Application of Plant Growth Regulator)

1. G_0 = Control,
2. G_1 = NAA (20 ppm)
3. G_2 = Kinetin (2 ppm)

Treatment combinations – Twelve treatment combinations were as follows:

P_0G_0, P_0G_1, P_0G_2, P_1G_0, P_1G_1, P_1G_2, P_2G_0, P_2G_1, P_2G_2, P_3G_0, P_3G_1, P_3G_2

3.2.2 Application of priming tretments

Procedures of pre-sowing seed treatments

Surface sterilized yard long bean (Borboti 1070) seeds were sub-divided into four groups. In each treatment 90 pieces of seeds were taken, one for control (unprimed), one for hydro priming, one for $CaCl_2$ priming and another for PEG priming. For hydro priming seeds were immersed in distilled water, for halo priming seeds were immersed into 1% $CaCl_2$ solution and for osmo priming seeds were immersed into 10% PEG solution for 6hrs independently at room temperature according to treatments. The excess moisture was removed moisture by using tissue paper and finally air dried in room temperature for 72 hours back the original moisture level.

30 pieces of seeds which are primed were planted on every plot 1.8 m^2 (1.8m x 1m) for seedling rise.

3.2.3 Preparation of PGRs

Naphthalene acetic acid (NAA) and Cytokinin (Kinetin) solution

NAA in various concentrations 20 ppm were arranged following the strategy mentioned beneath. 20 ppm solution of NAA was ready by dissolving 20 mg of it with water what is distilled. To make the volume 1 liter 20 ppm solution, then distilled water was added.

A glue Tween-20 @ 0.1% was added to every arrangement. Control plots were treated with distilled water alongside tween-20.

Cytokinin (Kinetin) solution

For preparing cytokinin solution, 2ppm cytokinin powder was taken and blended in with 2pallet of NaOH in 4ml distilled water. Then 4ml surfactant was added with the solution for expanding the added substance value. The arrangement was additionally made up to 1litre by adding water which was distilled and shaking it.

3.2.4 Application of PGRs

20 ppm NAA and 2 ppm kinetin was applied as a foliar application at 30 DAS and 45 DAS.

3.2.5 Experimental design and layout

In a randomized complete block design, the trial was set up with three replications. The plot size was 1.8 m^2 (1.8m x 1m). The distance between two plots was 50cm.

3.2.6 Planting materials

The materials utilized in the review were yard long bean seeds (Borboti 1070) which were gathered from Lal teer Seed Company, Dhaka. The initial seed dampness content in the middle between 10-12%. The seeds were healthy, clean, and infection and disease free.

3.2.7 Preparation of experimental land

A pre-planting irrigation system was given on 5 April, 2021. The land was opened with the assistance of a tractor drawn plate harrow on 7 April, 2021. All weeds and other plant buildups of past harvest were taken out from the field. Following last land arrangement, the field format was made on 10 April, 2021 as indicated by trial detail. Individual plots were cleaned lastly pre-arranged the plot.

3.2.8 Fertilizer application

Required doses of composts and fertilizers were Urea 50gm, TSP 150gm, MoP 150gm, Gypsum 100gm, ZnSO4 12.5gm, Borax 10gm and Cowdung 15000 kg ha^{-1} separately.

Half measure of Urea, half measure of Muriate of Potash, TSP, Gypsum, ZnSO4, Borax and Cowdung was all applied to the final land planning. The remain amount of the Urea and Muriate of Potash was top dressed following 30 days of seed planting at vegetative stage.

3.2.9 Seed sowing

The seeds of Yard long bean were planted manually in 30 cm separated lines persistently at around 3 cm depth at the rate of 10 kg ha^{-1} on 16 April, 2021.

3.2.10 Intercultural operations

3.2.10.1 Thinning

After 15 days of sowing the plots were thinned out so that a uniform plant stand can be maintained.

3.2.10.2 Weeding

The harvest field was swarmed for certain weeds during the beginning phase of yield foundation. Two hand weeding were finished; first weeding was finished at 15 days subsequent to planting followed by second weeding at 15 days after first weeding.

3.2.10.3 Application of irrigation water

Irrigation was given to each plot. In pre-sowing, first irrigation was done and before weeding other two was given at 2-3 days interval.

3.2.10.4 Drainage

Heavy rainfall occurred during the whole experimental period. Drainage channels were appropriately ready to simple and quick depleted out of overabundance water.

3.2.10.5 Plant protection measures

The crops were invaded by bugs and diseases. The insect spray Marshall 20 EC @ 30 ml/10L water was splashed during the later phase of crops to control bothers.

3.2.10.6 Harvesting

Development of yield was harvested when 80-90% of the pods become greenish in variety. Four gathering was finished while the first harvesting of Yard long bean was finished on 21 June, 25 June, 29 June and 3 July. The collecting was finished by picking pods from the plants which are selected for staying away from the border impacts. The weight of harvesting pods $plot^{-1}$ was added and changed over into t ha^{-1}.

3.2.10.7 Seed collection

The last harvesting of pods was collected and properly sun dried. The collected seeds were sun dried and weighted to a control moisture level. The seed weight of harvesting pods $plot^{-1}$ was added and converted into t ha^{-1}.

3.3 Recording of data

The accompanying information was recorded during the trial.

Data recorded for the effect of priming:

1) Germination percentage (%)
2) Root length (cm)
3) Shoot length (cm)
4) Fresh weight of seedling (g) and
5) Dry weight of seedling (g).

Data recorded for the effect of priming and PGRs:

1) Number of branch/plant
2) Days to 1^{st} flowering
3) No of pod/plant
4) Pod length (cm)
5) Individual pod weight (g),
6) Pod yield/plant (g)
7) Pod yield (t/ha)

3.4 Detailed procedures of recording data

A brief outline of the data recording procedure followed during the study given below:

3.4.1Germination and growth characters

3.4.1.1 Germination percentage

Quantities of seeds sprouted per plot were counted from the following day of day after sowing (DAS) to the furthest limit of germination when greatest seeds are developed and the mean values are determined in percentage.

3.4.1.2 Root length (cm) $seedling^{-1}$

Five plants $plot^{-1}$ were removed constantly from second line and root lengths were counted at 15 DAS and mean values are calculated at the end of harvest.

3.4.1.3 Shoot length (cm) seedling^{-1}

The shoot lengths were counted from same five plants those were gathered for root length estimation at 15 DAS and at collect and mean values are calculated at the end of harvest.

3.4.1.4 Fresh weight seedling^{-1} (g)

Five plants from each pot was gathered for each recording information at 15 days of day after sowing (DAS). Then, at that point, fresh weight of various plant parts was taken independently with an electric balance. The mean values were calculated.

3.4.1.5 Dry weight seedling^{-1} (g)

Five plants from each pot was gathered for each recording information. The plant parts were isolated and packed in discrete paper packets then, at that point, saved in the oven at 80^0 C for two days to arrive at a steady weight. Then dry load of various plant parts were taken independently with an electric balance. The values of mean calculated.

3.4.2 Yield contributing characters

3.4.2.1 No of branches plant^{-1}

The number of branches plant^{-1} from five arbitrarily chosen plants of each plot were counted at 45 days of day after sowing (DAS) and at gather and Mean values were determined.

3.4.2.2 No of pods plant^{-1}

At harvest, five chose plants plot^{-1} were taken to count the total number of pods and then record the average values.

3.4.2.3 Pod length (cm)

Length of pod was estimated from the five randomly chosen plants per plot and then the normal values of length were recorded.

3.4.2.4 Individual pod weight (g)

Weight of five chosen pods was estimated to measure the weight of pod from each plot. The average values were taken to consider as well.

3.4.2.5 Total yield (t ha^{-1})

As per experimental treatments, the pods are harvested and threshed. Seeds were cleaned and appropriately dried under sun. Then seed yield plot-1 was recorded at 12% dampness level and changed over into t ha^{-1}.

3.5 Analysis of data

The gathered information were ordered and organized. Statistical analysis was finished on different plant characters to figure out the meaning of significance of variance coming about because of the experimental treatments. All mean data were analyzed two way ANOVA via Statistics 10.

CHAPTER IV

RESULTS AND DISCUSSION

Impacts of seed priming and plant growth regulators on the field execution of yard long bean were concentrated on in this trial. Parameters of this experiment were analyzed statistically and the outcomes were presented in figures to consistent end results according to objectives of the review. The mean effects of the current analysis have been introduced in Table 1 through 5. The analysis of variance for various parameters have been introduced in Appendices III through XVI. A conversation on the consequence of the experiment has been made in this part according to parameter.

4.1 Influence of Priming

4.1.1 Germination Percentage (10 DAS)

Different seed priming treatments were significantly influenced germination percentage of yard long bean (Appendix III). The highest germination percentage (74.1%) was recorded in P_3 treatment. The lowest (62.5%) germination percentage was recorded in P_0 treatment which was statistically identical to P_2 Treatment. The treatments P_1 (66.8%) given the moderate germination percentage (Figure 1). The primed seed usually exhibit increased germination rate, greater germination uniformity and sometimes greater total germination percentage (Barsa *et al*., 2005).

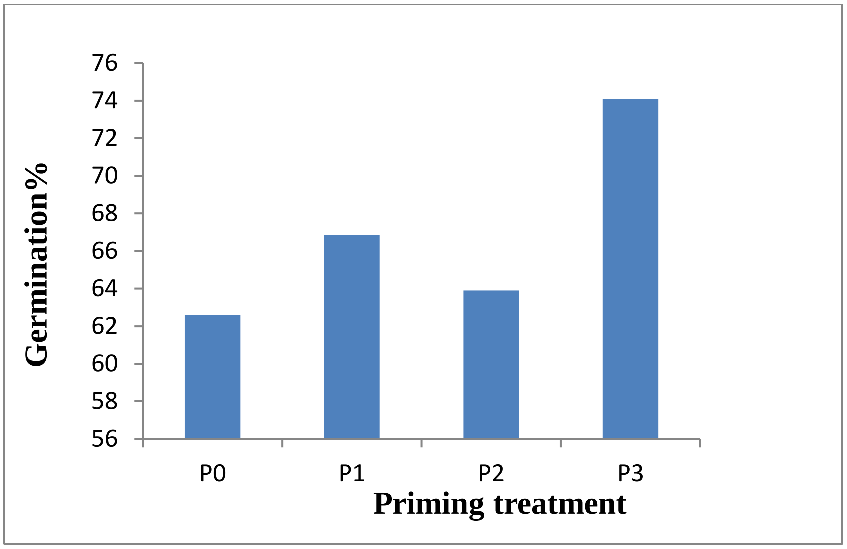

Figure 1. Effect of different seed priming treatments on germination (%)

Here, P_0:Control, P_1:Hydro priming, P_2:Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG)

4.1.2 Shoot Length of Seedlings (20 DAS)

Significant effect on shoot length of seedling had been seen by different priming treatment (Appendix IV). The highest shoot length (28.3cm) showed in P_3 treatment. The lowest (22.8cm) shoot length was recorded in P_0 treatment (Table1). Golezani *et al*. (2008) concluded that halopriming significantly improved imbibition rate, germination rate, seed vigour index, shoot, root and seedling dry weights, compared to other seed treatments.

Table 1. Effect of different seed priming treatments on Shoot Length (cm), Root Length(cm), Fresh Weight(g) and Dry Weight(g) of seedlings

Treatment	Shoot Length(cm)	Root Length(cm)	Fresh Weight(g)	Dry Weight(g)
P_0	22.8 c	8.04 c	3.9 c	2.07 c
P_1	25.2 b	9.5 a	4.8 b	2.3 bc
P_2	25.8 b	8.9 b	4.6 b	2.4 ab
P_3	28.3 a	9.9 a	5.3 a	2.6 a
CV	2.46	6.33	7.12	12.38
$LSD_{0.05\%}$	0.611	0.564	0.325	0.285

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

Here, P_0:Control, P_1:Hydro priming, P_2:Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG)

4.1.3 Root Length of Seedlings (20 DAS)

Significant impact on root length of seedling were recorded by different priming treatments (Appendix V). The root length was highest (9.9cm) in P_3 treatment which was statistically identical to P_1 treatment (9.5cm). The lowest (8.04cm) root length was showed in P_0 treatment (Table 1). Golezani *et al*. (2008) concluded that halopriming significantly improved imbibition rate, germination rate, seed vigour index, shoot, root and seedling dry weights, compared to other seed treatments.

4.1.4 Fresh Weight of Seedlings (20 DAS)

Different seed priming treatments have significantly influenced on fresh weight of seedling (Appendix VI). The highest fresh weight of seedling (5.3g) was recorded in P_3 treatment. The lowest (3.9g) fresh weight of seedling was found in P_0 treatment. The treatment P_0 (4.8g), showed the moderate fresh weight of seedling which is statistically identical to P_1 treatment (4.6g) (Table 1). Priming could be defined as controlling the hydration level within seeds so that the metabolic activity necessary for germination can occur but radical emergence is prevented. Different physiological activities within the seed occur at different moisture levels (Leopold and Vertucci, 1989).

4.1.5 Dry Weight of Seedlings (20 DAS)

Different seed priming treatments have significantly influenced on dry weight of seedlings (Appendix VII). The dry weight of seedling was showed the highest in P_3 (4.8g). The lowest (3.9g) dry weight of seedling was showed in P_0 treatment (Table 1). Omidi *et al*. (2005) showed that halopriming of bean seed under water stress condition had a significant effect on seedling parameters including seedling dry weight, rate and period of germination.

4.2 Influence of Priming and PGRs

4.2.1 No of Branch/Plant

4.2.1.1 Influence of Priming

Different seed priming treatments have significance influenced on no of branch (Appendix VIII).The highest no of branch of plant was recorded in P_3 (7.9). The lowest (5.8) no of branch was recorded in P_0 treatment (Table 2). Moderate no of branch was found in P_2 (6.8) and P_1 (6.02) which is statistically similar to one another. Rapid and uniform field emergences of seedlings are two essential prerequisites to increase yield and quality in annual crops (Finch-Savage, 1993).

4.2.1.2 Influence of PGRs

Plant growth regulator has a significant variation on no of branch in all the studied durations. (Appendix VIII and Table 3). Numerically highest no of branch (7.5) was found in S_1 treatment and which is statistically similar to G_1 treatment (6.3). Lowest no of branch (5.9) in G_0. Newaj *et al. (*2002) studied on effect of Indoleacetic Acid (IAA) on Yield of Mungbean (Vigna radiata L.). The effect of foliar application with 300, 600 and 900 ppm IAA was investigated on yield and yield contributing characters of two varieties of mungbean (BARI 2 and BARI 4).

4.2.1.3 Interaction between Seed Priming and PGRs treatments

The interaction effect of seed priming and plant growth regulator has a significant variation on no of branch/plant in all the studied durations (AppendixVIII and Table 4). The highest no of branch/plant (7.4) was recorded from the combination of P_3G_1 and the lowest (5.4) was found from the combination of P_0G_0 treatment.

Table 2. Effect of different Seed Priming treatments on No of Branch/Plant, Pod Length (cm), No of Pod/Plant and Individual Pod Weight (g) of plant

Treatment	No. of Branch/Plant	Pod Length(cm)	No of Pod/Plant	Individual Pod Weight(g)
P_0	5.8 c	20.4 d	7.4 d	12.4 d
P_1	6.02 c	29.9 c	10.6c	15.1 c
P_2	6.8 b	31.4 b	19.5 b	17.07 b
P_3	7.9 a	37.1 a	27.7 a	20.2 a
CV	6.31	1.33	2.72	2.82
$LSD_{0.05\%}$	0.408	0.384	0.433	0.445

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.
Here, P_0:Control, P_1:Hydro priming at 6 hrs, P_2:Halo priming (1%$CaCl_2$) at 6 hrs ,P_3:Osmo priming (10%PEG) at 6 hrs

4.2.2 Days to First Flowering/Plot

4.2.2.1 Influence of priming

Days to First Flowering of yard long bean was significantly influenced by different seed priming treatments (Appendix IX). The days to first flowering was higher in P_3 (47.2). The lowest (41.3) days to first flowering was found in P_0 treatment (Figure 2). The direct effects of seed priming in all crops can lead to better stand establishment, more vigorous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield (Harris *et al.*, 1999; 2001a; 2002).

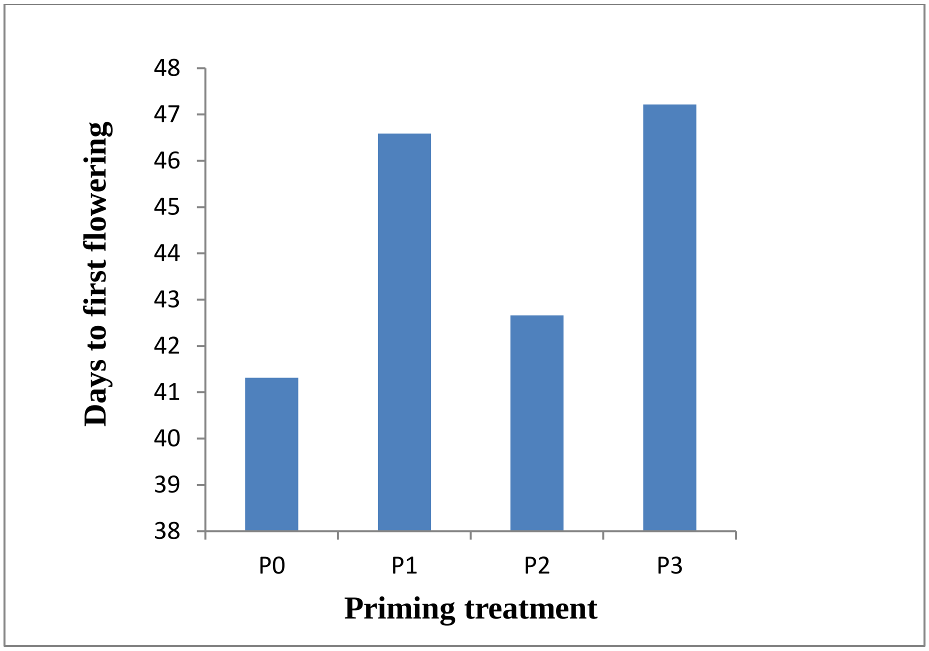

Figure 2. Effect of different seed priming treatments on days to first flowering

Here, P_0:Control, P_1:Hydro priming, P_2:Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG)

4.2.2.2 Influence of PGRs

Plant growth regulator has a significant variation on days to first flowering in all the studied durations. (Appendix IX and Figure 3). Numerically highest days to first flowering (45.372) was found in G_1 treatment and lowest days to first flowering (43.331) in G_0. Moderate days of first flowering was found from G_2 treatment (44.637). A comparison study of 40 cultivars of faba bean appeared significant differences in flowers and pods dropping percentage among the cultivars under studying (Zeng,2007).

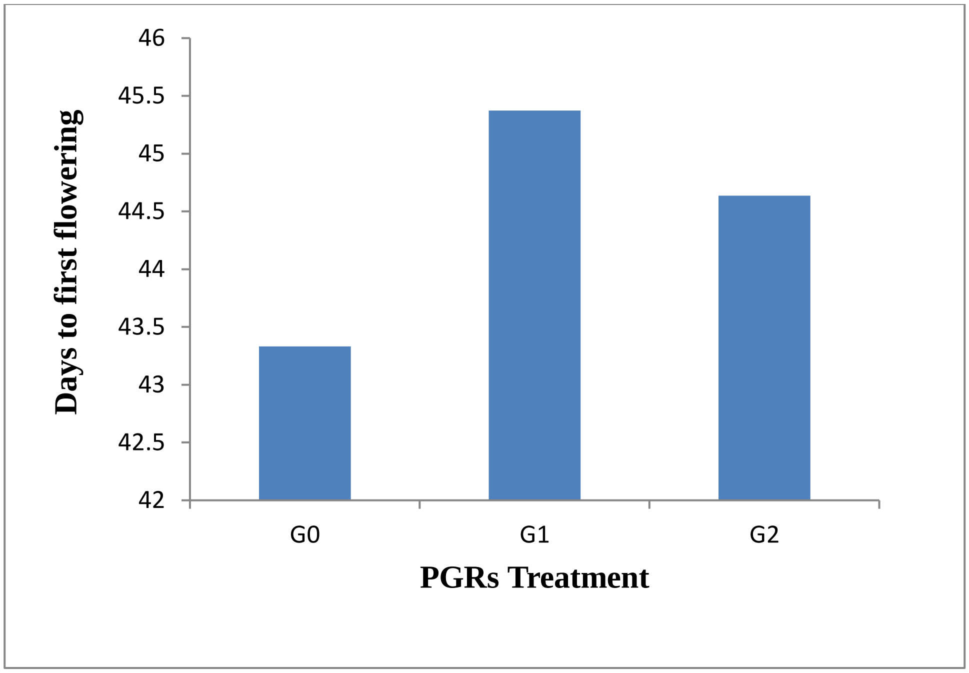

Figure 3. Effect of different PGRs treatments on days to first flowering

Here, G_0:Control, G_1:NAA, G_2:Kinetin

4.2.2.3 Interaction between seed priming and plant growth regulators treatment

The interaction effect of seed priming and plant growth regulator has a significant variation on days to first flowering in all the studied duration of yard long bean (Appendix IX and Table 3). Numerically highest days to first flowering (49.3) was found in P_3G_1 treatment and lowest days to first flowering (40.6) in P_0G_0.

Table 3. Days to first flowering of yard long bean as influenced by different interaction of priming and PGRs treatments

Treatment Combinations	Days to First Flowering
P_0G_0	40.6 g
P_0G_1	44.8 c
P_0G_2	45.5 c
P_1G_0	46.9 b
P_1G_1	45.6 c
P_1G_2	48.9 a
P_2G_0	43.3 d
P_2G_1	42.1 ef
P_2G_2	42.5 de
P_3G_0	41.8 ef
P_3G_1	49.3 a
P_3G_2	41.4 fg
CV	1.36
$LSD_{0.05}$	1.021

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.
Here, P_0 -Control, P_1-Hydro priming, P_2 -Halo priming (1%$CaCl_2$), P_3-Osmo priming (10%PEG), G_0:Control, G_1:Application of NAA, G_2:Application of Kinetin

4.2.3 No of pod/plant

4.2.3.1 Influence on priming

Different seed priming treatments have significant influence on no of pod per plant (Appendix XII). The no of pod/plant was higher recorded (27.7) in P_3 treatment. The lowest (7.4) no of pod/plant was showed in P_0 treatment. The treatments P_2 (19.5) and P_1 (10.6) showed the moderate no of pod/plant (Table 2). Priming is a non expensive and value added practice that greatly improves the yield. This might be due to some biochemical and physiological changes brought about by seed soaking (Khan *et al*., 2002).

4.2.3.2 Influence of PGRs

Plant growth regulator has a significant variation on no of pod/plant in all the studied durations. (Appendix XII and Table 4). The highest no of pod (17.4) was found from G_1 treatment and the lowest (15.2) was found in G_0 treatment. Arora et al. (1998) reported that NAA applied at 50% flowering stage to chickpea increased the number of flowers as compared with the untreated ones. Flowering and fruiting were also reported to be increased by foliar spraying with NAA on groundnut (Manikandan and Hakim, 1999).

Table 4. Effect of different PGRs treatments on No of Branch/Plant, Pod Length(cm), No of Pod/Plant and Individual Pod Weight(g)

Treatment	No of Branch/Plant	Pod Length(cm)	No of Pod/Plant	Pod Weight(g)
G_0	5.9 c	29.2 b	15.2 c	14.9 c
G_1	7.5 b	30.07 a	17.4 a	17.3 a
G_2	6.3 b	29.9 a	16.3 b	16.4 b
CV	6.31	1.33	2.72	2.82
$LSD_{0.05}$	0.353	0.332	0.375	0.386

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.
Here, G_0:Control, G_1:NAA, G_2:Kinetin

4.2.3.3 Interaction between seed priming and PGRs treatment

The interaction effect of seed priming and PGRs has a significant variation on no of pod/plant in all the studied durations (Appendix XII and Table 5). The highest no of pod (32.3) was found in the combination of P_3G_1 and the lowest (4.5) was showed in the combination of P_0G_0 treatment.

4.2.4 Pod Length (cm)

4.2.4.1 Influence of priming

Different seed priming treatments have significant influence on pod length (Appendix X). P_3 treatment showed higher pod length (37.1cm). The lowest (20.4cm) pod length was found in P_0 treatment (Table 2). The higher germination percentage in seeds primed with

$CaCl_2$ is according to Ashraf and Rauf (2001) for wheat and Afzal et al.(2008b) for maize who reported an increase in germination percentage of plants raised from seeds primed with calcium salt under salinity stress.

4.2.4.2 Influence of PGRs

Plant growth regulator has a significant variation on pod length in all the studied durations. (Appendix X and Table 4). The highest length of pod (30.07cm) was recorded from G_1 treatment and the lowest (29.2cm) was showed in G_0 treatment. Das and Prasad (2003) conducted a study on sandy clay loam soil in New Delhi, India, during summer 1999. The treatments comprised of three summer mungbean cultivars and two levels of NAA (20 and 40 ppm). NAA sprayed at 30 days after sowing and at flowering stages. Both the concentrations of NAA significantly increased the total dry matter production, number of leaves, number of flowers and number of pods per plant, pod length, number of seeds per pod, 1000 grain weight and grain yield of summer mungbean.

4.2.4.3 Interaction between seed priming and plant growth regulators treatment

The interaction effect of seed priming and plant growth regulator has a significant variation on pod length of yard long bean in all the studied durations (Appendix X and Table 5). The highest pod length (38.4cm) was found in the combination of P_3G_1 and the lowest (20.3cm) was found in the combination of P_0G_0 treatment.

Table 5. Effect of interaction between seed priming and PGRs treatments on No of Branch/Plant, No of Pod, Pod Length (cm) and Individual Pod Weight (g)

Interaction	No of Branch/Plant	No of Pod	Pod Length(cm)	Individual Pod Weight(g)
P_0G_0	5.4 e	4.5 k	20.3 g	10.5 i
P_0G_1	7.4 b	20.3 d	30.9 d	18.4 c
P_0G_2	6.5 cd	15.2 f	32.5 c	12.5 g
P_1G_0	6.4 cd	7.3 j	29.1 f	13.4 f
P_1G_1	6.1 de	9.9 hi	30.2 e	18.3 c
P_1G_2	7.0 bc	9.7 i	30.4 de	13.6 f
P_2G_0	6.1 de	10.5 h	30.9 d	15.5 e
P_2G_1	7.1 bc	12.3 g	20.6 g	20.2 b
P_2G_2	4.2 f	23.1 c	20.3 g	11.3 h
P_3G_0	7.4 b	19.4 e	36.5 b	16.6 d
P_3G_1	9.4 a	32.3 a	38.4 a	22.2 a
P_3G_2	6.4 cd	31.4 b	36.3 b	21.8 a
CV	6.31	2.72	1.33	2.82
$LSD_{0.05}$	0.707	0.750	0.665	0.772

In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.
Here, P_0:Control, P_1:Hydro priming, P_2:Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG), G_0:Control, G_1:Application of NAA, G_2:Application of Kinetin

4.2.5 Individual Pod weight (g)

4.2.5.1 Influence of priming

Different seed priming treatments have significant influence on individual pod weight (Appendix XI). The highest pod weight was (20.2g) found in P_3 treatment. The lowest (12.4g) pod weight was found in P_0 treatment. The treatment P_2 (17.07g) and P_1 (15.1g) showed the moderate pod weight (Table 2). Harris et al. (1999) also found that hydropriming enhanced seedling establishment and early vigor of upland rice, maize and 23 chickpea, resulting in faster development, earlier flowering and maturity and higher yields. The resulting improved stand establishment can reportedly increase drought tolerance, reduce pest damage and increase crop yield (Harris et al., 1999).

4.2.5.2 Influence of PGRs

PGRs has a significant variation on individual pod weight in all the studied durations. (Appendix XI and Table 4). The highest pod weight (17.3g) was showed in G_1 treatment and the lowest (14.9g) was showed in G_0 treatment. A foliar application of 40 ppm NAA on groundnut increased the number of pods per plant and eventually the pod yield (Gupta and Singh, 1982).

4.2.5.3 Interaction between seed priming and plant growth regulators treatment

The interaction effect of seed priming and plant growth regulator has a significant variation on individual pod weight in all the studied durations (Appendix XI and Table 5). The highest pod weight (22.2g) was found in the combination of P_3G_1 and the lowest (10.5g) was found from the combination of P_0G_0 treatment.

4.2.6 Pod yield/plant (g)

4.2.6.1 Influence on priming

Different seed priming treatments have significant influence on yield/plant (Appendix XIII). The yield/plant was higher (396.4g) in P_3 treatment. The lowest (183.2g) yield/plant was found in P_0 treatment. The treatments P_1 (269.5g), and P_2 (360.6g) showed the moderate yield per plant (Figure 4). Harris et al. (2001) reported that seed priming led to better establishment and growth, earlier flowering, increase seed tolerance to adverse environment and greater yield in maize. The beneficial effects of seed priming have been demonstrated for many field crops such as wheat, sweet corn, mung bean, barley, lentil, cucumber etc. (Sadeghian and Yavari, 2004).

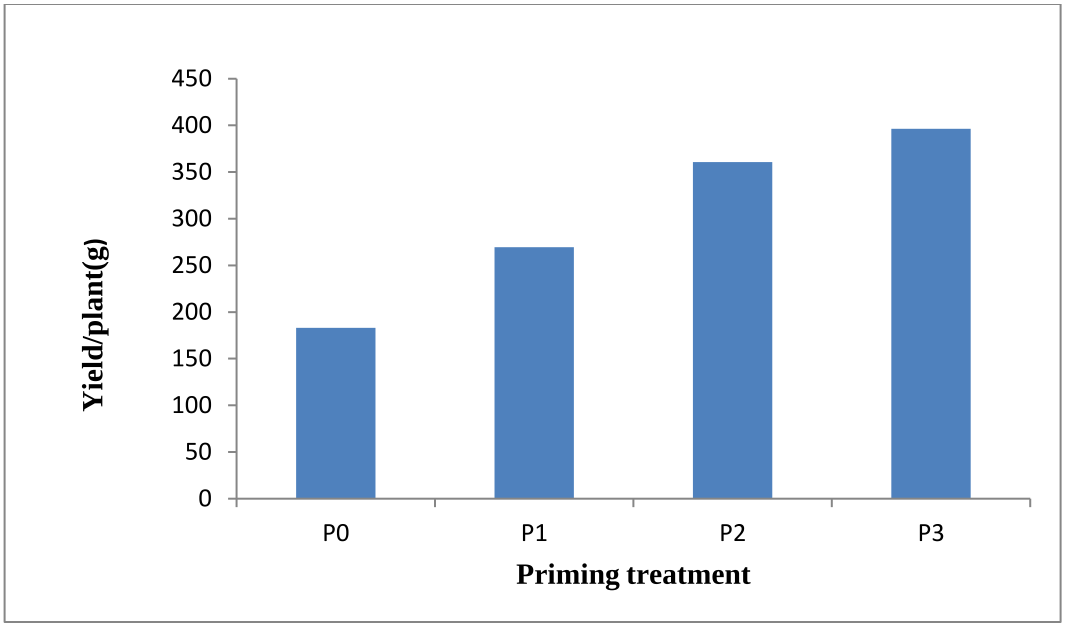

Figure 4. Yield/plant of yard long bean as influenced by different priming treatments

Here, P_0:Control, P_1:Hydro priming, P_2:Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG)

4.2.6.2 Influence of PGRs

PGRs has a significant variation on yield/plant in all the studied durations (Appendix XIII). The yield/plant was given highest value (318.4g) in G_1 treatment. The lowest (278.8g) yield per plant was found in G_0 treatment. The treatments G_2 (310.1g) showed the moderate yield per plant (Figure 5). Singh and Upadhaya (1967) studied the effect of IAA and NAA on tomato and reported that the regulators activated growth, increased the fruit set, size and yield of fruit and induced parthenocarpic fruit.

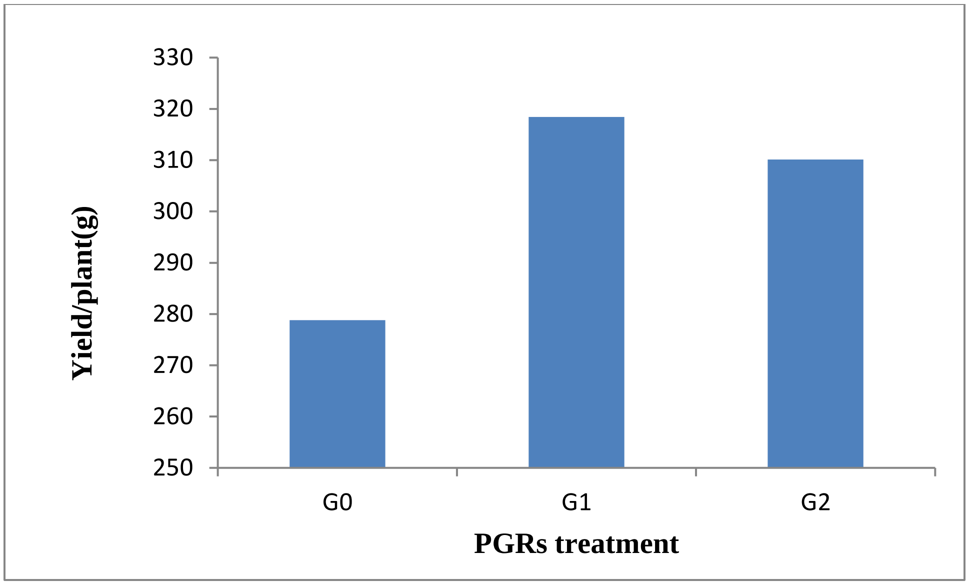

Figure 5. Yield/plant of yard long bean as influenced by different PGRs treatments

Here, G_0:Control, G_1:NAA, G_2 :Kinetin

4.2.6.3 Interaction between seed priming and plant growth regulators treatment

The interaction effect of seed priming and plant growth regulator has a significant variation on yield/plant of yard long bean in all the studied durations (Appendix XIII). The highest yield per plant was found (425.8g) in P_3G_1 treatment. The low (153.9g) yield per plant was showed in P_0G_0 treatment. (Figure 6)

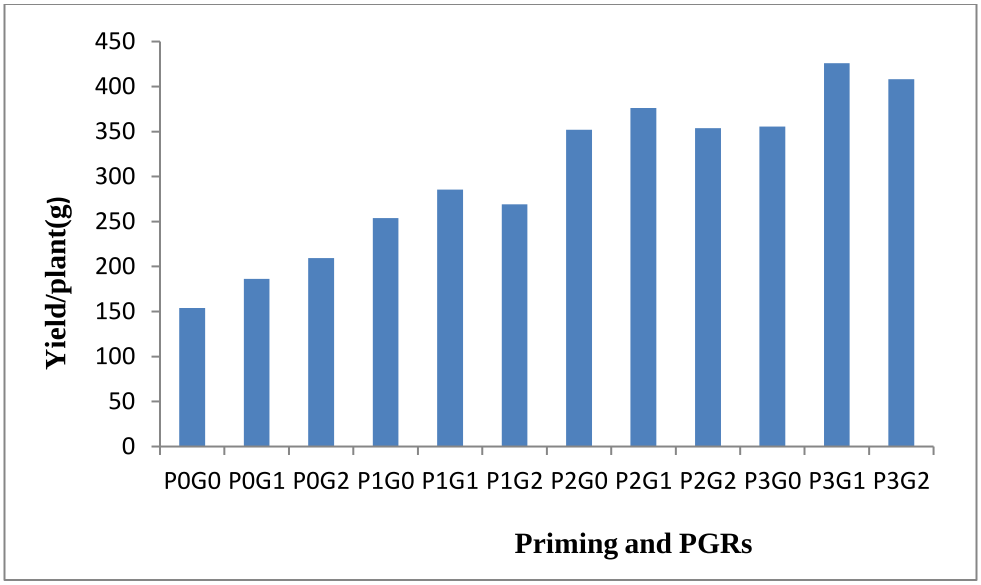

Figure 6. Yield/plant of yard long bean as influenced by interaction of different seed priming and plant growth regulators treatments

Here, P_0:Control, P_1:Hydro priming, P_2 :Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG), G_0:Control, G_1:NAA, G_2:Kinetin

4.2.7 Total yield (t/ha)

4.2.7.1 Influence on priming

Total **y**ield of yard long bean was significantly influenced by different seed priming treatments (Appendix XIV). The yield was highest (5.8 t/ha) in P_3 treatment. The lowest (2.7 t/ha) yield per plant was found in P_0 treatment. The treatments P_1 (3.7 t/ha), and P_2 (5.7 t/ha) showed the moderate yield per plant (Figure 7). The direct benefits of seed priming were reported by Harris et al. (2001b) in crops like wheat, rice and maize which included faster emergence, better and uniform stands, less need to re-sow, more vigorous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield.

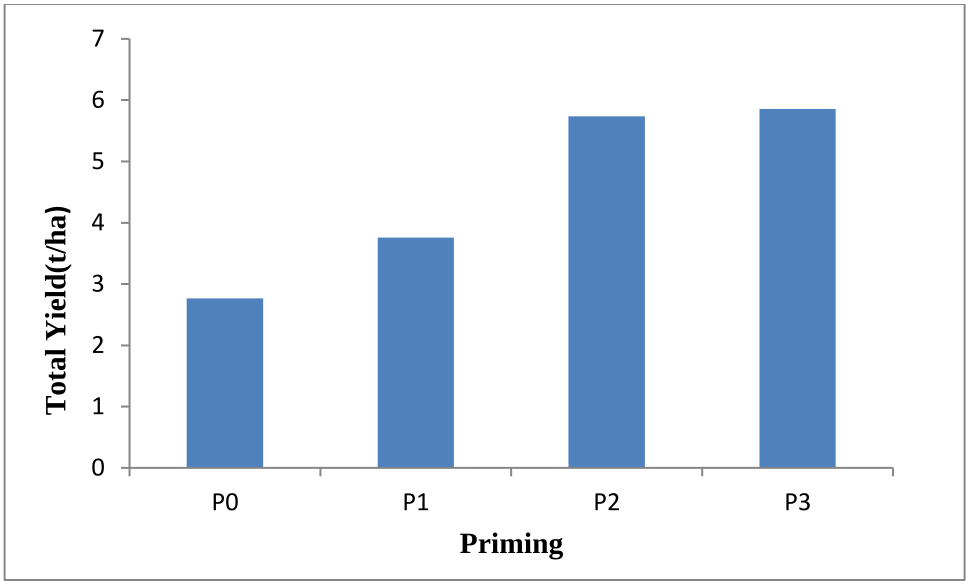

Figure 7. Total Yield of yard long bean as influenced by different priming treatments

Here, P_0:Control, P_1:Hydro priming, P_2:Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG)

4.2.7.2 Influence of PGRs

Plant growth regulator has a significant variation on total yield(t/ha) in all the studied durations (Appendix XIV). The highest yield (4.7t/ha) was found G_1 treatment. The lowest (4.1t/ha) yield per plant was showed in G_0 treatment. The treatments G_2 (4.7t/ha) showed the moderate yield per plant (Figure 8). Reshmi and Gopalakrishna (2004) carried out an experiment on Yardlong bean to study the effect of 4 growth regulators in Kerala. 4 plant growth regulators namely NAA (15, 30, 45 ppm), 2,4-D (2, 4 and 6 ppm), IAA (20, 40 and 60 ppm) and CCC (300, 400, 500 ppm) were sprayed on yard long bean at different growth stages to evaluate its impact on flowering and fruit set. Foliar spray of NAA of 15 ppm give the highest yield followed by IAA at 40 ppm and CCC at 300 ppm. 2,4-D had a strong depressing effect on growth and yield of yard long bean.

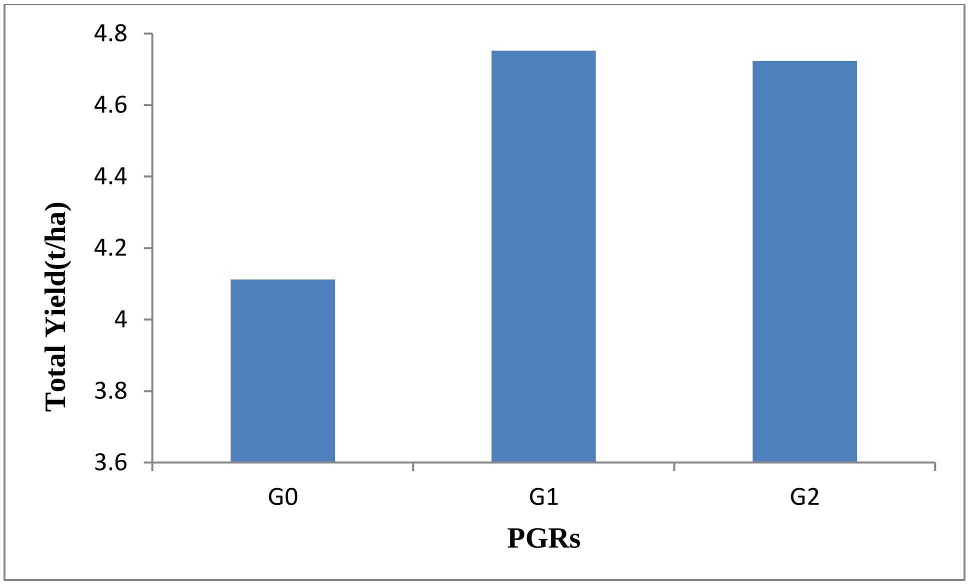

Figure 8. Total yield/plant of yard long bean as influenced by different plant growth regulators treatments.

Here, S_0:Control, S_1:NAA ,S_2 :Kinetin

4.2.7.3 Interaction between seed priming and plant growth regulators treatment

The interaction effect of seed priming and plant growth regulator has a significant variation on total yield of yard long bean in all the studied durations (Appendix XIV). The highest yield was (6.3t/ha) found in P_3G_1 treatment. The minimum (2.5t/ha) yield per plant was showed in P_0G_0 treatment (Figure 9).

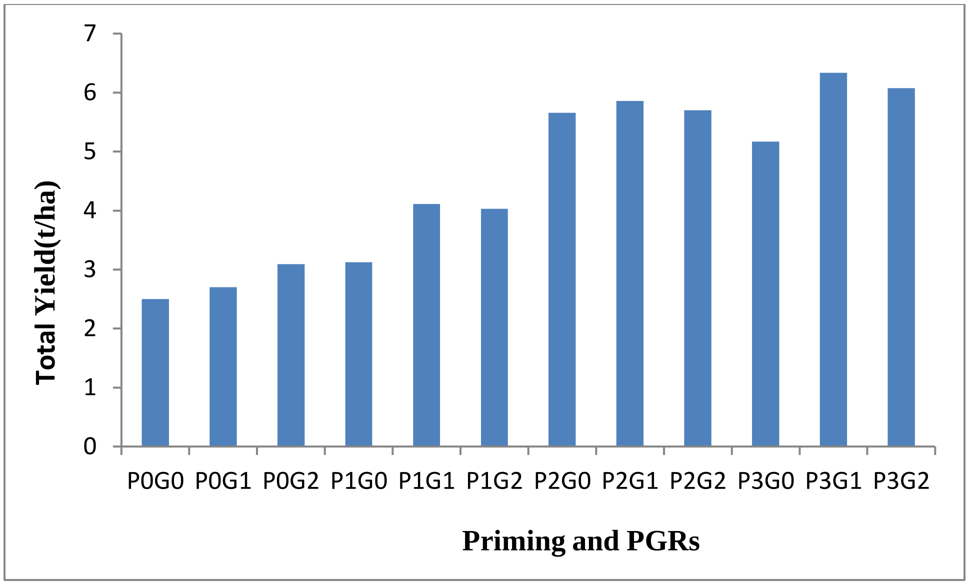

Figure 9. Total yield/plant of yard long bean as influenced by interaction of different seed priming and plant growth regulators treatments.

Here, P_0:Control, P_1:Hydro priming, P_2:Halo priming (1%$CaCl_2$), P_3:Osmo priming (10%PEG), G_0:Control, G_1:Application of NAA, G_2:Application of Kinetin

CHAPTER V

SUMMARY AND CONCLUSION

An experiment was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka to study the growth and yield of yard long bean as influenced by different seed priming and plant growth regulators treatments. The experiment was comprised of two different factors such as (1) four seed priming treatments viz. P_0 = Control, P_1=Hydro preparing at 6 hrs, P_2=Halo preparing (1% CaCl2) at 6 hrs, P_3= Osmo preparing (10% PEG) at 6 hrs, (2) three plant growth regulators treatments viz. G_0=Control, G_1=Application of NAA, G_2=Application of Kinetin. The experiment was laid out in randomized complete block design (RCBD) with three replications. Results showed all the parameters studied in the present study were significantly influenced by different treatments of seed priming and plant growth regulators.

Observation were made on germination percentage, root length, shoot length, fresh weight of seedling, dry weight of seedling, no of branches plant^{-1}, days to first flowering, no of pods plant^{-1}, pod length, individual pod weight, yield plant^{-1}.Germination percentage was recorded upto highest germination of seeds. Five plants were randomly selected from each unit plot for taking observations on first flowering of plant and no of branches plant^{-1} after 45 days after sowing. All mean data were analyzed one way ANOVA via Statistics 10.

In case of effect of priming in YLB, treatment P_3 (P_3= Osmo priming (10%PEG) showed the highest value of germination percentage, shoot length, root length, fresh weight of seedling, dry weight of seedlings, and no of branch/plant are (74.1 %, 28.36cm, 9.98cm, 5.38gm, 2.68gm, 7.95) as growth indicating parameter, and highest value of yield parameters as like number of pods plant^{-1}, pod length, individual pod weight, yield plant^{-1} are (27.72, 37.10cm, 20.26gm, 5.86t/ha) was found also in P_3 treatment. The lowest value of germination percentage, shoot length, root length, fresh weight of seedling, dry weight of seedling, and no of branch per plant are (62.5%, 22.82cm, 8.05cm, 3.91g, 2.07g, 5.82) and lowest value of no of pods plant^{-1},pod length, individual pod weight, yield plant^{-1} are (7.49, 20.41cm, 12.47g, 2.76t/ha) was found in P_0 treatment (No priming). Again, the days to first flowering was lowest in P_0 (41.3) and highest in P_3 (47.2) treatment.

In case of effect of plant growth regulators in YLB, treatment G_1 (G_1= Application of

NAA) showed the highest value of days to first flowering, no of branch/plant are (45.37, 7.60) and highest value of no of pods plant^{-1}, pod length, individual pod weight, yield plant^{-1} are (17.50, 30.07cm, 17.30gm, 4.75t/ha) was found also in G_1 treatment. But the lowest value of days of first flowering, no of branch/plant are (43.33, 5.99) and lowest value of no of pods plant^{-1}, pod length, pod weight, yield plant^{-1} are (15.24, 29.22cm, 14.94gm, 4.11t/ha) was found in G_0 treatment. Again, the days to first flowering was lowest in G_0 (43.3) and highest in G_1 (45.3) treatment.

In case of effect of different interaction between seed priming and plant growth regulators in YLB, treatment P_3G_1 (P_3= Osmo priming (10%PEG)+G_1=Application of NAA) showed the highest value of days to first flowering and no of branch/plant (49.33, 9.42) and highest value of no of pods plant^{-1},pod length, individual pod weight, yield plant^{-1} are (32.33, 38.44cm, 22.25g, 6.34t/ha) was found also in P_3G_1 treatment. But the lowest value of days of first flowering and no of branch per plant are (40.66, 5.47) and lowest value of no of pods plant^{-1},pod length, individual pod weight, yield plant^{-1} are (4.58, 20.33, 10.50g, 2.50t/ha) was found in P_0G_0 treatment. Again, the days to first flowering was lowest in P_0G_0 (40.6) and highest in P_3G_1 (49.3) treatment.

From this experiment it is concluded that P_3G_1 (P_3= Osmo priming (10% PEG) at 6 hrs) + G_1=NAA performed the best in case of vegetable reproduction and yield. This study was carried out only for one location even for one season. So, it can be concluded that, this experiment should have carried out in different locations of Bangladesh in different season.

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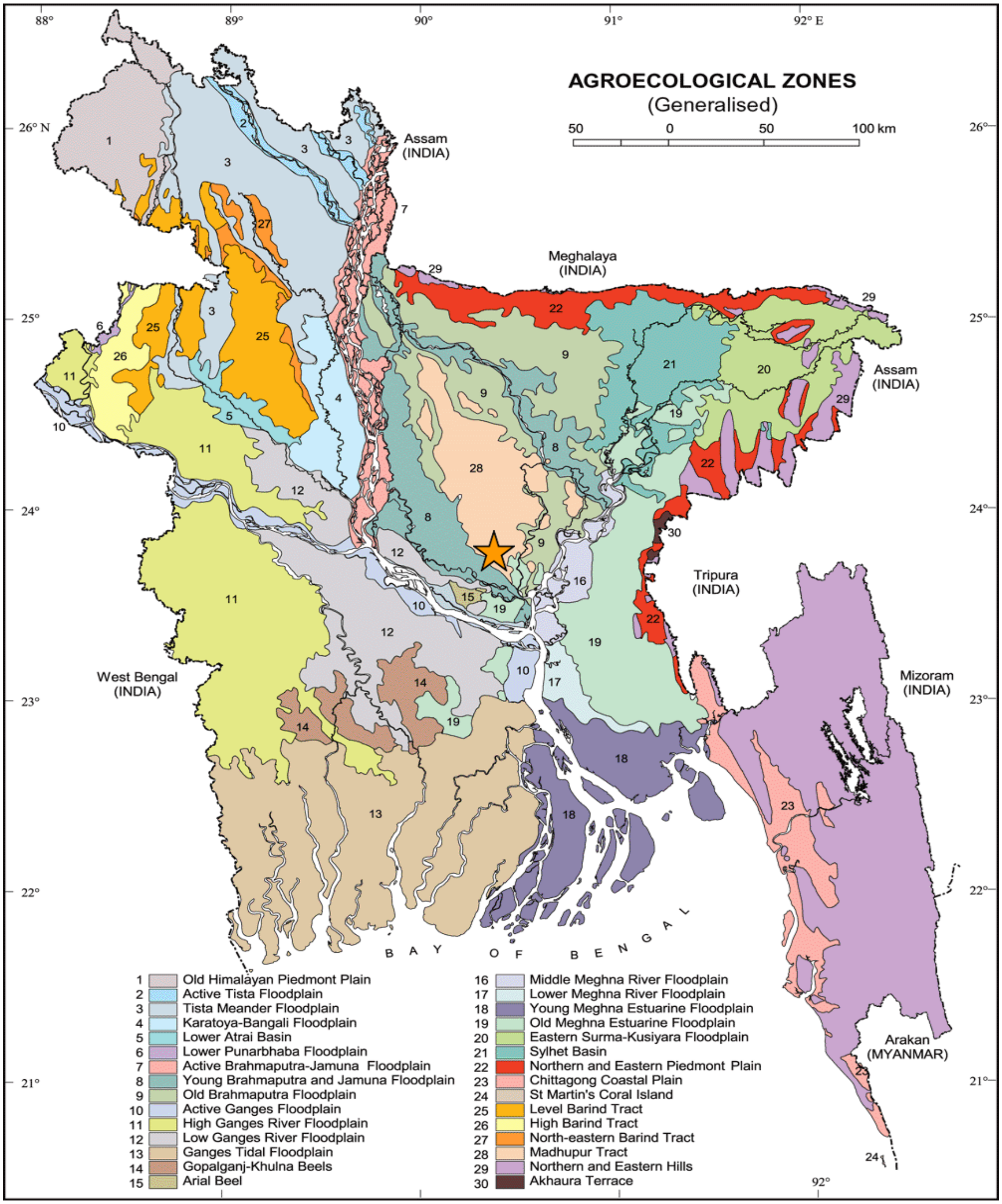
APPENDICES

Appendix I. Map showing the experimental sites under study



★ **The experimental site under study**

Appendix II. Monthly recorded the average air temperature, rainfall, relative humidity and sunshine of the experimental site during the period from April 2021 to July 2021.

Month	Air temperature (^0C)		Relative humidity (%)	Total rainfall (mm)	Sunshine (hr)
	Maximum	Minimum			
April,2021	32.5	20.4	64	65.8	5.2
May,2021	38.9	23.6	70	76.4	5.7
June, 2021	40.5	24.5	75	80.6	5.8
July, 2021	42	24	77	85.4	5.8

Source: Sher-e-Bangla Agricultural University Weather Station

Appendix III. Analysis of Variance on Germination Percentage of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.2047
Priming	3	9.5153
Error	24	0.1945
Total	36	--------------

Appendix IV. Analysis of Variance on Shoot Length(cm) of seedling of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.7553
Priming	3	46.4162
Error	24	0.3947
Total	35	----------

Appendix V. Analysis of Variance on Root Length(cm) of seedling of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.0570
Priming	3	6.3535
Error	24	0.3360
Total	35	----------

Appendix VI. Analysis of Variance on Fresh Weight(gm) of seedling of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.09110
Priming	3	3.41079
Error	24	0.11167
Total	35	----------

Appendix VII. Analysis of Variance on Dry Weight (g) of Seedling of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.37872
Priming	3	0.58624
Error	24	0.08611
Total	35	----------

Appendix VIII. Analysis of Variance on No of Branch per plant of Yard Long Bean

Source of Variance	Df	Mean Square
Replication	2	0.02534
Priming	3	8.36841
Treatment	2	8.49814
Pruning*Treatment	6	1.46775
Error	24	0.17624
Total	35	----------

Appendix IX. Analysis of Variance on First Days to Flowering of Yard Long Bean

Source of Variance	Df	Mean Square
Replication	2	0.09110
Priming	3	75.8196
Treatment	2	12.8301
Pruning*Treatment	6	5.0162
Error	24	0.3676
Total	35	----------

Appendix X. Analysis of Variance on Pod Length (cm) of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.076
Priming	3	430.870
Treatment	2	2.470
Pruning*Treatment	6	1.992
Error	24	0.156
Total	35	----------

Appendix XI. Analysis of Variance on Individual Pod Weight (g) of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.4352
Priming	3	96.7200
Treatment	2	17.1752
Pruning*Treatment	6	35.2642
Error	24	0.2100
Total	35	----------

Appendix XII. Analysis of Variance on Pod No Per Plant of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.040
Priming	3	751.334
Treatment	2	15.357
Pruning*Treatment	6	73.892
Error	24	0.198
Total	35	----------

Appendix XIII. Analysis of Variance on Yield Per Plant of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	36.2
Priming	3	82565.8
Treatment	2	5227.5
Pruning*Treatment	6	802.2
Error	24	45.1
Total	35	----------

Appendix XVI. Analysis of Variance on Total Yield (t/ha) of Yard Long Bean

Source of Variance	df	Mean Square
Replication	2	0.031
Priming	3	20.8366
Treatment	2	1.5691
Pruning*Treatment	6	0.2563
Error	24	0.0094
Total	35	----------

Plates

Plate 1: Selection of variety

Plate 2: Adding priming treatments

Plate 3: Primed seeds

Plate 4: Sowing primed seeds

Plate 5: Vegetative condition of yard long bean

Plate 6: Harvesting of yard long bean