PROJECT COMPLETION REPORT

Project Title: Validation and Up-scaling of High Value Vegetable Crops production in Sylhet Region

Project Code No: TF 01-C

Project Duration: 39 Months: From May 2013 To August 2016

CGP Project: KGF BKGET 1st Call

Submitted to:
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Full names of Abbreviations and Acronyms

ANOVA	Analysis of Variance
BARI	Bangladesh Agricultural Research Institute
BCR	Benefit Cost Ratio
CI	Co Investigator
CV	Co-efficient of Variation
DAE	Department of Agriculture Extension
FIVDB	Friends in Village Development Bangladesh
HVVC	High Value Vegetable Crops
NGO	Non Government Organization
PI	Principal Investigator
RCBD	Randomized Complete Block Design
RFQ	Request for Quotation
Stdev	Standard Deviation
SAU	Sylhet Agricultural University
UAO	Upazila Agriculture Officer

Project Completion Report on "Validation and Up-scaling of High Value Vegetable Crops Production in Sylhet Region"

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A. Basic Project Information:

i. Project Title: **"Validation and Up-scaling of High Value Vegetable Crops production in Sylhet Region"**
ii. Project Code/ID Number: **TF 01-C**
iii. Name of Coordinator with designation: Not applicable
iv. Name of Principal Investigator with designation: Dr. Md. Shahidul Islam, Professor
v. Name of Co-investigator with designation: Md. Mahfuzur Rahman, Assistant Professor
vi. Name of the applying organization with address: Department of Horticulture, Sylhet Agricultural University, Sylhet.
vii. Name of associate/collaborating organization: Not applicable
viii. Project duration (year/months): 3 yr 3 months; From 20 May 2013 to 31 August 2016
ix. Project commencement date (As per MOU): 20 May 2013
x. Project locations/sites with name: Sylhet Division (SAU campus and Sylhet, Moulavibazar, Sunamganj and Habiganj districts, 2-4 upazilas per district). District Map sowing selected upazila for project activities during the project period (Annexure 1).
xi. Project size: No of participatory farmers per site: 3-5, Total number of Farmers involved during project period: 20 (winter 2014), 22 (summer 2015), 24 (winter 2015 and 20 for tomato, 50 for country bean (summer 2016).
Land area/farmer/season: 5 decimal
Total land area used in decimal/hectare: 500 decimal for on farm and 250 decimal for on station research study during project period.
Crop season with crop varieties used: Summer and winter season for each year. Variety used with sweet pepper (BARI Mistimorich-1, California Wonder, Yolo Wonder), Broccoli (Premium, imperial, Green magic, Top green etc), summer tomato (BARI hybrid tomato-4, BARI hybrid tomato-3, NHC-1, TCH-1) and summer country bean (BARI sheem-7, BP003, IPSA sheem 2 etc).
xii. Project cost (total) TK: 37.67 lakh (Year-1: TK-:1025000, Year-2: TK 1244500
Year-3: TK: 1497500)
xiii. Fund received in TK: 3244.05 thousand and Expenditure made in TK. 3243.313 thousand during the reporting period.

B. Summary/Executive Summary:

Cultivation of high value vegetable crops viz., sweet pepper (capsicum), broccoli, summer tomato, summer country bean is very limited in Bangladesh especially in Sylhet region although the demand and prices are very high. The low production of high value vegetable crops in Sylhet region is attributed due to absence of suitable variety, production technology, quality seeds etc and above all farmers are not familiar with high value vegetable crops. For proper conduction and completion of the project activities a base line survey, selection and preparation of on station experimental field, collection of quality seeds of high value vegetable crops, inception and progress workshop, selection of farmers for adaptive trials, trainings of stakeholders, recruitment of project personnel etc were made timely.

At the beginning of the present project, a base line survey was conducted with the help of DAE (Department of Agriculture Extension) personnel among ninety farmers of nine upazilas of Sylhet, Moulavibazr and Habiganj districts to understand the present status of vegetable production, consumption, and problems associated with vegetable cultivation in Sylhet region. Base line survey indicated that production of high value vegetable crops like sweet pepper, broccoli, summer tomato and summer bean was almost absent in the surveyed upazilas. This is due to the non familiarity of the crop, absence of suitable variety, absence of production technology, high rainfall, high labour cost, lack of irrigation facilities, absentee farmers, less interest in agriculture etc. To identify the suitable variety and production technology, to popularize the high value vegetable crops, to improve knowledge, skill, farm income and nutrition in Sylhet region several on station and on farm research activities were conducted during the whole project period. On station validation of genotypes and production technologies of sweet pepper and broccoli were conducted at the experimental field of Sylhet Agricultural University during the winter season of 2013-2014 and 2014-2015 under RCB design. Results revealed that the genotypes BARI Mistimorich-1 (1.24 kg/plant) and California Wonder (1.08 kg/plant) performed very well under net protected production system. Among different broccoli genotypes, Imperial, Green Giant and Green Magic were found very promising for Sylhet region. Production of broccoli from 25 October (80 kg/decimal) and 10 November (84 kg/decimal) sowing were better than that of 10 October (64 kg/decimal) sowing. Seedling raising and initial establishment of broccoli seedling in September or first fortnight of October sowing was found difficult due to rainfall in Sylhet region. To select suitable heat tolerant tomato variety(s) and photo insensitive country bean variety(s) for summer season production, on station investigations were made at the experimental field of Sylhet Agricultural University during two consecutive summer seasons of 2014 and 2015. In which BARI Sheem-7, BP003 and SB010 were found more productive at March sowing. Based on the performance of the advance lines BP003 and SB010 were registered as variety from the Ministry of Agriculture in 2015 and named as “Sikribi sheem-1” and Sikribi sheem-2” which were evaluated and selected from segregating generations during project period. Among different heat tolerant tomato hybrids, BARI hybrid tomato-4 (29.24 t/ha) was found more productive which was closely followed by two newly developed hybrids viz., NHC-1 (27.2 t/ha) and TCH-1 (28.5 t/ha). Moreover, BARI hybrid tomato- 4 was also evaluated under different types of

seedlings (normal, polybag and grafted seedling) with hormone and without hormone application system. Use of grafted tomato seedlings on wild brinjal was found more effective to ensure higher tomato yield during rainy summer since it protected the plants from bacterial wilt infection. Mortality of grafted plants was much lower (3.5%) compared to that of normal (non grafted) seedlings (20%) caused significant variation in per decimal fruit yield (180 kg and 128 kg per decimal for grafted and non grafted seedling). Application of tomatone hormone also found effective to increase tomato yield.

To popularize the promising variety and production technology of sweet pepper and broccoli, on farm adaptive trials were made in winter seasons of 2014-15 (20 farmers) and 2015-16 (24 farmers) in which farmers were selected with help of DAE personnel of Sylhet, Habiganj, Moulavibazar and Sunamganj district. Each farmer grew sweet pepper under open, net and net with polythene protection system. Yield of sweet pepper and BCR in the farmer's field indicated that production of sweet pepper under only net protection system would be more profitable. Yield of broccoli at farmer's field and reaction of consumers revealed that expansion of broccoli can be made in Sylhet region. Similarly for summer tomato (BARI hybrid tomato-4) and summer country bean (BARI sheem-7) adaptive trials were conducted in the farmers field during the summer seasons of 2015 (22 farmers) and 2016 (20 farmers for summer tomato and 50 farmers for summer country bean) in four districts of Sylhet Division. Yield of summer country bean (45-50 kg/decimal) and summer tomato (130-137 kg/decimal) at farmer's field revealed that their production during summer would be profitable. To improve knowledge, skill and for proper conduction of adaptive trials ten farmers training, two Trainers Training were organized in which farmers, Upazila Agriculture Officer Sub Assistant Agriculture Officer, NGO workers were attended. Four Field Days were also conducted to popularize variety and production technology of high value vegetables crops. In consequences of the project activities, 18-20 farmers of Sylhet region started commercial cultivation of sweet pepper, broccoli, summer tomato and summer country bean in large scale (40- 45 decimal) which in turn ensures the availability of high value vegetables crops in Sylhet region. Besides, 10-15 farmers from other part of the country like Bandarban, Pabna, Iswardi, Bogra, Narayanganj, Comilla etc collected seeds of Summer country bean from the project office for cultivation and more than 60-80 farmers asked for seed for broccoli and sweet pepper cultivation for next winter seasons indicated that production of high value vegetable crops can be increased countrywide provided quality seeds and production technology are properly disseminated among the growers.

A laptop, electric motor with hose pipe for irrigation, file cabinet, digital camera, electric dry oven etc were also purchased following the purchase rules. A Field Assistant and a Research Associate were recruited for proper management of the project activities. An inception workshop (21 November 2013) and Progress Workshop (27 August 2016) were organized at the campus of Sylhet Agricultural University where DAE officers, Scientists, NGO workers and university teachers were attended. Total Tk. 32,44,050 (Thirty two lakh forty four thousand and fifty) was released while expenditure up to 31 August 2016 was Tk. 32,43,313 (Thirty two lakh forty three thousand three hundred thirteen) only. Bank statement of expenditure is given at the end of the present report.

C. Introduction.

Sylhet is considered as a special agricultural zone in Bangladesh. This region is famous for tea and citrus cultivation. Various kinds of vegetables are also grown in Sylhet region but in a limited scale. Demand of the high value vegetable crops like sweet pepper (Capsicum), broccoli, tomato and bean during summer in Sylhet region is very high. This demand is mostly met from the other part of the country. This demand can be met through increasing production of high value vegetable crops in Sylhet region. About 24%, 20% and 15% of cultivable land remain fallow during rabi, kharif-1 and kharif-2 season, respectively in Sylhet region which are the largest in comparison to other districts of the country (Anonymous 2012). High rainfall, high humidity during summer season, lack of irrigation facilities during winter season, absentee farmers, high labour cost etc are the prime obstacles of vegetable production in Sylhet region. On the other hand, high value vegetable crops like sweet pepper, broccoli, summer country bean or summer tomato are not well known by the growers in Sylhet region. However, these entire problems can be addressed through appropriate intervention with adaptive research and validation of newly developed varieties and production technologies. Near past very few research or extension efforts were made to validate or to popularize high value vegetable production in Sylhet region. It is obvious that the vast fallow land as well the high land of Sylhet region can be brought under high value vegetable crop production through identification of suitable varieties and production technologies.

Tomato is a novel vegetable crop around the world. It is a cheap source of vitamins and minerals. This crop is mostly grown in winter season in Bangladesh due to presence of congenial climatic conditions (Rashid, 1999). Production of tomato during summer season in Bangladesh is limited due to presence of high temperature and high humidity. However, Bangladesh Agricultural Research Institute (BARI) has developed some heat tolerant hybrids (Anon, 2009) which were not assessed properly in the Sylhet region. Farmers will be very much benefited if the technology is disseminated in Sylhet region. Being a high value crop the wide spread cultivation will uplift the income and there will be employment generation for both men and women in this region. Country bean is rich of protein and mostly available during winter. Very recent Horticulture Research Centre has developed some photo-insensitive country bean lines which were found very suitable for summer season cultivation (Anon, 2011). These lines can be validated under Sylhet condition to select best one for adaptation.

Sweet pepper (*Capsicum annum L.*) is one of the most important vegetable crops grown extensively throughout the world especially in the temperate countries. Sweet pepper is a minor vegetable in Bangladesh and its production statistics is not available. Small scale cultivation is found in peri-urban areas primarily for the supply of some city markets in Bangladesh (Saha & Salam, 2004). However, capsicum is becoming popular in Bangladesh day by day. The demand is increasing and capsicum is available in the supermarkets of big cities. But main constraint of capsicum cultivation in Bangladesh is non-availability of suitable technologies. The crop is very sensitive to environmental factors (Bhatt *et al*., 1999). In Bangladesh, October is found the best

month for sowing of seeds. From December to January during vegetative and fruiting stage of the crop, night temperature gradually decreased, below 10^{o}C or less. In that situation, vegetative and reproductive stage of capsicum plants become ceased or stunted, fruit and flower drops may occur. So, for proper growth and production at low temperature under poly tunnel may be effective because at night capsicum plants covered with polythene sheet prevent cold injury and enhance proper growth and production. Under poly tunnel at night temperature inside polythene cover raises higher than outside. Therefore, development of appropriate production practices for quality produce is very important.

Broccoli (*Brassica oleracea* var. *Italica*) is a temperate crop and usually does not produce seeds under Bangladesh condition. The crop is gaining popularity very fast in this country due to its high nutrition, taste and anti-cancerous properties. It has great export potentiality too. The winter climate of Bangladesh is very congenial for the production of broccoli. But the unavailability of good varieties as well as production techniques is the major constraints of broccoli production. Most of the farmers and growers grow exotic hybrid broccoli varieties. The collected lines of broccoli can be tested under Sylhet condition. Keeping all these views in mind the present project was undertaken to popularize and to increase productivity of high value vegetable crops in Sylhet region.

D. Specific project objective(s): (As per FRP/PIR)

- To select/identify best variety and production technology of high value vegetable crops for Sylhet region.
- To popularize the selected best varieties and production technology of high value vegetable crops in Sylhet region
- To increase household consumption level of vegetable and cash income of the farmers of Sylhet region
- To improve knowledge and skill of the farmers and to create awareness among the farmers of the project area on high value vegetable production technology.

E. Detailed Technical Report:

a. Statement of the Researchable Problem:

Sylhet is considered as a special agricultural zone in Bangladesh. Total cultivable land of this region is 798528 ha of which in Rabi season 228980 ha, Kharif-1 season 216453 ha and in Kharif-2 season 93588 ha of cultivable land remain fallow (Anon., 2012). Various kinds of vegetables are also grown in Sylhet region but in a limited scale. Base line survey among 90 farmers of nine upazilas of Sylhet divisin revealed that only 2 and 10 farmers are involved in summer country bean and summer tomato cultivation in limited scale. None of the farmers are familiar with sweet pepper and broccoli cultivation. Although the demand of high value vegetable crops like capsicum, broccoli, summer tomato and summer bean is increasing day by day in the country as well in Sylhet region. Market survey indicated that the demand and prices

of these vegetables (summer tomato 80-120 taka, sweet pepper 270-350 taka, broccoli 90-100 taka and summer country bean 100-120 taka per kg) are very high in Sylhet region. This demand is mostly met from the other part of the country. High rainfall, high humidity during summer season, lack of irrigation facilities during winter season, absentee farmers, high labour cost, absence of high yielding variety and production technology, absence of quality seed less intervention for dissemination etc are the prime hindrance for high value vegetable crops production in Sylhet region. However, these entire problems can be addressed through appropriate intervention with adaptive research and adaptation of newly developed varieties and production technologies. Near past very few research or extension efforts were made to validate or to popularize high value vegetable production in Sylhet region. Therefore, the vast fallow land as well the high land of Sylhet region can be brought under high value vegetable crop production through identification of suitable varieties and production technologies. Researchers recently have developed some high yielding and hybrid varieties of these vegetable crops along with their production technologies. Bangladesh Agricultural Research Institute (BARI) has developed some heat tolerant hybrids which are gaining popularity around the country but not properly assessed in the Sylhet region. Very recent Horticulture Research Centre has developed some photo-insensitive country bean lines which were found very suitable for summer season cultivation. Sweet pepper (*Capsicum annum L.*) and broccoli are minor vegetable in Bangladesh and their production is found in peri-urban areas primarily for the supply of some city markets in Bangladesh. Validation of the developed varieties/genotypes and their production technologies were not made in near past in Sylhet region. Therefore, adaptation of the high value vegetable crops in Sylhet region may be a good option for boost up production which in turn ensures availability of these vegetables for Sylhet region. This research project is, therefore, designed to validate and up scaling of production of high value vegetable crops in Sylhet region.

b. Research Approaches and Methodologies:

iii. Approaches:

1. **Base line survey** on vegetable production, consumption and problem of high value vegetable production: Ninety farmers of nine upazilas of Sylhet, Moulavibazar and Habiganj districts were interviewed with the help of DAE people to collect information about land utilized for vegetable production, per day vegetable consumption, vegetable sale in the market, and problems associated with vegetable production (Annexure 2).
2. **Collection of seeds**: Seeds of targeted high value vegetable crops like sweet pepper, broccoli, tomato and country bean were collected from Olericulture Division, HRC, BARI, Gazipir. BARI Mistimorich-1 was collected from BARI and two other popular varieties purchased from Market. Seeds of two popular sweet pepper variety eg. California wonder and Yolo wonder produced by "Bakker Brothers" while seeds of two broccoli varieties produced by "Taki Seed" . Other two broccoli lines were collected locally. For validation of summer tomato hybrids and summer country bean genotypes seeds of BARI Hybrid tomato-4, BARI Hybrid tomato-3 and BARI Sheem-7 were collected from HRC, BARI while seeds of summer country bean advance lines were

produced at experimental field of SAU, Sylhet during winter season of 2013-2014. Besides, some early country bean variety viz., Rupvan, Kanchan, Auto were collected from Iswardi, Pabna for on station evaluation.

3. **Recruitment of project personnel:** A three member's recruitment committee was formed upon approval of Vice Chancellor. This committee selected one Field Assistant and one Research Associate. After approval of the University authority they (FA, RA) were given appointment letter by PI of the project for smooth running of the project activities.
4. **Selection of site for on station validation**: Research Field for on station validation trial of the variety(s) and production technology was selected inside the campus of Sylhet Agricultural University. Ten decimal of land was also selected in the research field of a NGO named Friends in Village Development Bangladesh (FIVDB) at Khadimnagar, Sylhet for on station validation trial. Weather condition of the project site in given in Annexure 3
5. **Inception Workshop**: One inception workshop about the project was organized on 21 November 2013 at SAU Campus. Twenty five participants including DAE personnel, Scientists, NGO workers and teachers of SAU were attended in the workshop. Contents of the workshop were, project briefing, importance and scopes of high value vegetable crop production in Sylhet region, Variety and production technology of high value vegetable crops, selection criteria of the farmers for on farm adaptation trial, open discussion etc. Additional Director, Deputy Director and UAO of DAE, Sylhet region opined that the following issues are to be addressed before going to the adaptive trial in the farmer's field. These are (i) Selected farmers and extension workers are to be trained about production technology of HVVC. (ii) Arrangement of field visit of all stakeholders in the activities which are already going on in the experimental field of Sylhet Agricultural University (iii) Selection of farmer for adaptive trial should be done carefully. Instead of marginal farmer, mid level farmers having experience on vegetable production are to be selected. (iv) Supply of healthy seedlings instead of seeds of selected crops might be more effective for establishment of adaptive trial (v) Close supervision etc.
6. **Procurement of Research material**: A three member's purchase committee approved by University Authority was involved in procurement activities. Direct purchase method was followed since the amount in each purchase event was less than 25000/ Taka. RFQ was followed for Laptop and Electric dry oven purchasing.
7. **Training of Trainer's (TOT):** Upon approval of Director (Research), Sylhet Agricultural University, two Trainer's Training was organized on, "Production technology of high value vegetable crops" in which Upazila Agriculture Officer, NGO workers, Scientific Officers and University Lecturers were attended. Additional Director of DAE, Sylhet Region was requested to nominate Upazlla Agriculture Officer for this training program. Hono'ble Vice-Chancellor, Sylhet Agriculture University was present as Chief Guest while Dean, Faculty of Agriculture, SAU Sylhet was present as Special Guest in these program. Varietal development of high value vegetable crops, production technology, seed production, diseases and insect management etc were discussed in this training program.
8. **Farmer's Training:** Upon prior approval of Director (Research), SAU, Sylhet, ten Farmer's Training was conducted at different upazilas of Sylhet division where farmers,

SAAO, NGO workers were attended. In all trainings, production technology covering seedling raising, land preparation, manure and fertilizer management, poly-tunnel preparation, management of diseases and insect etc were discussed.

9. **Selection of farmers:** For on farm adaptive trials farmers were selected with the help of upazila agriculture office. Besides, Project PI, CI, Field Assistant were visited the farm house of the preliminary listed farmers for final selection of the farmers for adaptive trials of high value vegetable crops. In winter 2014-15, twenty farmers and summer 2015, twenty two farmers from Habiganj (Sadar, Nabiganj and Bahubol upazila) and Sylhet (Biswanath and Sadar upazila) Districts were selected. For winter 2015-2016 adaptive trial on sweet pepper and broccoli, twenty four farmers from Sylhet, Moulavibazar, Habiganj and Sunamganj districts were selected with the help of DAE personnel while in summer 2016 twenty farmers for summer tomato and fifty farmers for summer country bean adaptive trials were selected of the four districts.
10. **Establishment of adaptive trial in the study areas:** For establishment of adaptive trials each selected farmer was given necessary seed, seedlings, rope, sutoli, polythene, mosquito net, fertilizer, cash for purchasing bamboo, pesticide etc well ahead for proper conduction of the adaptive trials. Selected farmers were also given training on production technology of high value vegetable crops. A data sheet was also given to the farmers for recording information.
11. **Organizing field day:** With the help of upazila agriculture office four Field Days on high value vegetable crops were organized at farmer's field in which farmers, SAAO and NGO workers were attended.
12. **Data recording and analysis:** Related data/information from on station research activities and on farm adaptive trials from farmers field, PI, CI, Field Assistant, Research Associate and Masters Students of Horticulture Department were collected carefully. Collected data were compiled for analysis. Data were analyzed using MSTAT and MS Excel based on nature of the study.
13. **Reporting:** Project report covering research results, farmer's reaction about variety and production technology, photographic documentation, financial statement etc were made half yearly, yearly and project completion report of the project. Preparation of leaflet, booklet etc were also be made for better circulation of the developed technologies.

iv. **Methodologies**:

Year-I

Activity 1.1. Evaluation of sweet pepper (capsicum) genotypes under Sylhet condition

Objective(s): To identify suitable genotypes for Sylhet region

Materials and methods:

Design	RCB with four replications
Number of lines	3 genotypes
Capsicum genotypes	BARI Mistimorich 1, Carlifonia wonder, Yolo wonder
Net protection	Nylon net (120 mesh), Mosquito net (40 mesh), open
Production methodology	As per crop

Date of initiation	October 2013
Data to be recorded	Capsicum: Days to flower, days to harvest, no. of fruit per plant, fruit yield per plant, disease and insect reaction
Location	SAU, Sylhet
Statistical analysis	ANOVA, mean separation using MSTAT software

Activity 1.2. Production of sweet pepper (capsicum) under different protective structures

Objective(s): To find out suitable growing techniques of capsicum.

Materials and methods:

Varieties	:	BARI Mitimorich 1
Treatments	:	Poly tunnel without net, poly tunnel with net, Only net, open field.
Design	:	RCB
Replication	:	3
Fertilizer dose and application		As per recommendation
Date of initiation	:	October 2013
Data to be recorded		Days to flower, days to harvest, no. of fruit per plant, fruit yield per plant, Individual fruit weight, disease and insect reaction
Statistical analysis		ANOVA, mean separation using MSTAT software

Activity 1.3. Evaluation of broccoli genotypes under Sylhet condition

Objective(s): To identify suitable genotypes for Sylhet region

Materials and methods:

Design	RCB with four replications
Number of lines	3 genotypes (Premium, BR001 and BR002)
Production system	Organic and inorganic system
Production methodology	As per crop
Date of initiation	October 2013
Data to be recorded	Broccoli: Days to curd initiation, no. of leaves/plant, plant height, curd weight, curd breadth, no. of secondary curd, yield/plant.
Location	SAU, Sylhet

Statistical analysis	ANOVA, mean separation using MSTAT software

Activity 1.4. Production of tomato under varied seedling type and hormone application during summer season

Objective(s): To observe the influence of seedling types and hormone application

Materials and methods:

Design	RCB with three replications
Tomato genotypes	BARI hybrid tomato 4
Production methodology	As per crop
Date of initiation	April 2014
Data to be recorded	Tomato: Days to flower, days to harvest, per plant yield, quality, % bacterial wilt infection
Location	Sylhet Agricultural University (SAU) field
Statistical tool	ANOVA, mean separation using MSTAT software

Activity 1.5. Evaluation of heat tolerant tomato hybrids under Sylhet condition

Objective(s): To identify suitable hybrids.

Materials and methods:

Variety	:	BARI Hybrid tomato 3, BARI hybrid tomato 4, NHC-1, NHC-2, NHC-3
Design	:	RCBD
Unit plot	:	3.0m X 2.3 m
Plant spacing	:	60cm X 40cm
Fertilizer dose and application		Recommended
Date of initiation	:	April 2014
Data to be recorded	:	Yield and yield contributing characters
Location	:	SAU, Sylhet
Statistical tool	:	ANOVA, mean separation using MSTAT software

Activity 1.6. On station evaluation of photo-insensitive country bean genotypes

Objective(s): To identify suitable genotypes for Sylhet region

Materials and methods:

Design	:	RCB with three replications

Number of lines	:	3 (BP003, SB010 and BARI sheem 7)
Production methodology	:	As per production technology
Date of initiation	:	April 2014
Location	:	Sylhet Agricultural University (SAU) field
Statistical tool	:	ANOVA, mean separation using MSTAT software

Year-2

Activity 2.1. Evaluation of broccoli genotypes under varied sowing dates

Objective(s): To find out suitable variety and sowing time

Materials and methods:

Varieties	:	Three (Green magic, Premium and Imperial)
Sowing dates	:	Three (10 October, 25 October and 10 November)
Design	:	RCBD (Factorial)
Replication	:	3
Unit plot	:	1.0m X 3.0m
Plant spacing	:	60cm X 50cm
Date of initiation	:	October 2014
Data to be recorded	:	Days to curd initiation, no. of leaves/plant, plant height, curd weight, curd breadth, no. of secondary curd, yield/plant.
Fertilizer dose and application	:	Recommended
Date of initiation	:	September 2014
Statistical tool	:	ANOVA, mean separation using MSTAT software

Activity 2.2. Production of sweet pepper under different tunnel covers

Varieties	:	BARI Mistimorich 1
Structures	:	Fine net, Coarse net, Fine net+ polythene, Coarse net+ polythene, Only polythene and Open condition
Design	:	RCBD
Replication	:	3
Unit plot	:	1.0m X 3.0m
Plant spacing	:	60cm X 50cm
Data to be recorded		Days to flower, days to harvest, no. of fruit per plant, fruit yield per plant, disease and insect reaction
Fertilizer dose and application	:	Recommended

Date of initiation	:	September 2014
Statistical tool		ANOVA, mean separation using MSTAT software

Activity 2.3. On farm adaptive trial of sweet pepper and broccoli.

Objective(s): To demonstrate the production practices sweet pepper and broccoli

Materials and methods:

Cultivars	:	Capsicum: BARI Mistimorich 1 Broccoli: Two (Imperial, Green magic)
Location	:	20 farmers of Sylhet and Habiganj district
Data to be recorded	:	Capsicum: Days to flower, days to harvest, no. of fruit per plant, fruit yield per plant, Individual fruit weight, disease and insect reaction Broccoli: Days to curd initiation, no. of leaves/plant, plant height, curd weight, curd breadth, no. of secondary curd
Area	:	5 decimal (2.5 decimal +2.5 decimal)
Date of initiation	:	Winter season of 2014
Statistical tool	:	Simple statistics: Mean, range, Stdev, CV%

Activity 2.4. Evaluation of photo-insensitive country bean at varied sowing dates of summer season

Objectives: To observe yield performance at different planting dates

Genotype	:	Three lines (BARI Sheem7 (SB003), BP003 and SB010)
Treatments	:	Three sowing dates (15 Jan, 15 March and 15 May)
Design	:	RCBD (Factorial)
Replication	:	3
Unit plot	:	2.0m X 6.0m
Plant spacing	:	2.0m X 1.5
Date of initiation	:	April 2015
Data record		Yield and yield attributes, insects and disease
Statistical tool		ANOVA, mean separation using MSTAT software

Activity 2.5. Evaluation of tomato hybrids during summer

Objective: To select promising tomato hybrid for summer

Materials and methods:

Variety	:	Six tomato hybrids (TCH1, TCH2, DCH1, DCH2, DCH3 and BARI hybrid tomato 4)
Hormone	:	With and without hormone application
Design	:	RCBD
Unit plot	:	3.0m X 2.3 m
Plant spacing	:	60cm X 40cm
Fertilizer dose and application		Recommended
Date of initiation	:	April 2015
Data to be recorded		Yield and yield contributing characters
Location	:	SAU, Sylhet
Statistical tool	:	ANOVA, mean separation using MSTAT software

Activity 2.6. On farm adaptive trial of summer tomato and summer country bean

Objective(s): To demonstrate the production practices summer tomato and summer country bean

Materials and methods:

Cultivars	:	Tomato (BARI hybrid tomato 4)
		Bean: (BARI sheem 7)
Location	:	22 farmers of Sylhet and Habiganj district
Data to be recorded		Yield and yield attributes for both the crops
Area	:	5 decimal (2.5 decimal +2.5 decimal)
Date of initiation	:	Summer of 2015
Statistical tool		Simple statistics: Mean, range, Stdev, CV%

Year-3

Activity 3.1. On station evaluation of exotic broccoli hybrids

Objective(s): To find out suitable variety and sowing time

Materials and methods:

Varieties	:	Three (Green giant, Green magic, Top green, Green crown)
Sowing dates	:	Three (25 October, 15 November)
Design	:	RCBD (Factorial)
Replication	:	3

Unit plot	:	1.0m X 3.0m
Plant spacing	:	60cm X 50cm
Date of initiation	:	October 2015
Data to be recorded		Days to curd initiation, no. of leaves/plant, plant height, curd weight, curd breadth, no. of secondary curd, yield/plant.

Activity 3.2. Seed production potentiality of photo-insensitive country bean genotypes under Sylhet condition.

Materials and methods:

Variety	:	4 (BARI sheem 7, IPSA sheem 2, BP003 and SB010
Crop		Photo-insensitive country bean
Design	:	RCB
Replication	:	3
Date of initiation	:	September 2015
Data record		Seed yield and yield attributes
Statistical tool		MSTAT software

Activity 3.3. On farm adaptation of sweet pepper (capsicum) and broccoli

Objective(s): To demonstrate the production practices of capsicum and broccoli

Materials and methods:

Cultivars	:	Capsicum: BARI Mistimorich 1 Broccoli: Green magic
Treatments	:	24 farmers of Sylhet division
Area	:	5 decimal (2.5 decimal + 2.5 decimal)
Fertilizer dose and application	:	Recommended
Data to be recorded	:	Capsicum: Days to flower, days to harvest, no. of fruit per plant, fruit yield per plant, Individual fruit weight, disease and insect reaction Broccoli: Days to curd initiation, no. of leaves/plant, plant height, curd weight, curd breadth, no. of secondary curd
Date of initiation	:	Winter season of 2015
Statistical tool	:	Simple statistics: Mean, range, Stdev, CV%

Activity 3.4. On farm adaptation of tomato and country bean during summer

Objective(s): To demonstrate the production practices summer tomato, summer bean

Materials and methods:

Cultivars	:	Tomato (BARI hybrid tomato-4) Bean: BARI sheem-7
Treatments	:	20 farmers for tomato and 50 farmers for summer country bean
Area	:	5 decimal (2.5 decimal+2.5 decimal)
Fertilizer dose and application		Recommended
Method	:	Standard recommended dose and application method
Date of initiation	:	Summer 2016
Statistical tool		Simple statistics: Mean, range, Stdev, CV%

c. Results and Benefits:

(i). List objective-wise activities clearly, resulting in specific output(s), such as

Specific Project Objective(s)	Planned activities performed against each objective	State progress made clearly during the reporting period against each activity	Outputs/results achieved during this period
1. To select/ identify best variety and production technology of high value vegetable crops for Sylhet region	**1.1.** Selection and preparation of on station experimental field for verifying genotypes and production technologies of vegetable crops under this project **1.2.** Conducted quick survey on existing vegetable crops with production practices, yield, income, household consumption etc. (Survey made during July to September 2013). **1.3.** On station validation of variety and production technologies of sweet pepper and broccoli made during winter seasons of 2013-2014, 2014-2015 and 2015-2016 while validation for summer tomato and summer country bean was made on summer season of 2014 and 2015.	**1.1** Experimental site/land was selected and prepared properly adding dolomite, cow dung, and some other chemical fertilizer for conduction of on station studies. **1.2.** A quick survey on vegetable production, problem and consumption was made in nine upzilas (90 farmers) with the help of DAE personnel. **1.3.** Validation of variety(s) and production technologies of capsicum, broccoli, summer hybrid tomato and summer country bean was completed successfully during the project period. **1.4.** Data collection on seedling characteristics, plant growth, yield and yield attributes, diseases and insect infestation, etc of sweet pepper, broccoli, summer hybrid tomato and summer country bean were collected during the experimental period. Statistical analysis of the	Cultivation of high value vegetables in the surveyed upzillas is almost absent except summer tomato. -This is due to absence of knowledge about variety and technology, high rainfall, labour crisis, non availability of seeds etc. BARI Mistimorich 1 and California wonder (More or less 1.0 kg/plant) were found very promising. Performance of sweet pepper under net protected system was most effective (1.08-1.24 kg/plant) than that of open field condition (Only 0.25 kg/plant). Broccoli variety(s), Imperial and Green magic, Green giant were the most promising (62-110 kg/decimal. BARI hybrid tomato-4 (29.2 t/ha), NHC-1(27.2 t/ha), TCH-1 (28.5 t/ha), BARI sheem-7 and BP003 (bean) were found very promising (50-55 kg/ decimal) while March sowing is most promising. Grafted tomato seedling was

	1.4. Collection of relevant key data from the experimental field. Compilation and statistical analysis of collected data. **1.5.** Scientific report writing of the research activities.	collected data was made. **1.7.** Scientific report writing was completed.	most effective against bacterial wilt (3.5% in grafted while 20 % in non-grafted). Half yearly and Annual progress reports are available describing project output/results One scientific paper is published and four manuscripts are ready for submission for publication. Two MS Theses are available
2. To popularize the selected best varieties and production technology of high value vegetable crops in Sylhet region	**2.1.**On station validation trial of promising genotypes of sweet pepper (capsicum) , broccoli, summer tomato hybrid, summer country bean with production technology **2.2.** On farm adaptive trials for broccoli and sweet pepper were made at the farmers field during winter seasons of 2014-2015 (20 farmers) and 2015-2016 (24 farmers) adaptive trials of summer tomato and summer country bean were made during summer season of 2015 (22 farmers) and 2016 (20 for tomato and 50 for summer country bean.	**2.1.** Validation trials on genotypes and production technology of the selected vegetables were completed. **2.2.** Adaptive trials on selected vegetable crops (Sweet pepper, Broccoli, summer tomato and summer country bean) in the farmer's field were completed during the project period. **2.3.** Visit on station experimental field by the different stakeholders was made during workshop and trainings in every season. 2.4. Different NGO and Upazila Agriculture Office arranged field visit by their own interest. Reporters of daily news paper and television	Eighteen to twenty (18-20) farmers started commercial cultivation of high value vegetable crops (>40 decimal) BARI hybrid tomato-4, BARI sheem-7, BP003, BARI Mistimorich-1, Green magic of broccoli have got popularity in Sylhet region Four motivational tour organized by UAO by their own interest Up-scaling/adaptation at 40+40+40+80 farm fields during summer and winter seasons of 2015 1nd 2016 At least 80-100 new farmers came to project office for seeds of high value vegetable crops while more than 20 farmers from Sylhet region went to HRC, BARI Office for seeds of BARI

	2.3. Arrangement of field visit for different stakeholders (DAE, NGO). 2.4. Publicity of project success story	visited on station and on farm research activities	mistimorich-1 and BARI hybrid tomato-4 for commercial cultivation. Popular articles were published in the daily news paper about the success of sweet pepper, summer tomato, summer country bean and broccoli production (Annexure 4) Channel 24, Jamuna TV and Channel I telecasted success of project activities
3. To increase household consumption level of vegetable and cash income of the farmers of Sylhet region	3.1. Development of awareness through discussion in the training program and field visit. 3.2. Supply seeds for commercial cultivation 3.3. Market exploration 3.4. Training of the farmers	Importance of vegetable in human nutrition and profitability of vegetable production was discussed in the training program. Arrangements were made to supply quality seeds of sweet pepper and summer country bean and summer hybrid tomato New wholesale vegetable were identified and informed to the farmers for selling their produce	Per capita consumption is improved from 142 g (n=90) to 160 g (n=60) Two to three times higher income is available than their traditional crop. One farmer earned more than four lakh taka in two consecutive years from sweet pepper Five farmers earned 3000-50,000 taka from summer country bean in summer 2016. Some nearby farmers of the selected farmers are showing keen interest to grow high value vegetable crops. Participants are convinced about the importance of vegetable cultivation.

4. To improve knowledge and skill of the farmers and to create awareness among the farmers of the project area on high value vegetable production technology.	**4.1** Organized two workshops with relevant stakeholder on research projects **4.2.** Two Trainer's Training (TOT) **4.3.** Ten Farmer's Training (FT) 4.4 Organizing four field day 4.5. Publication of booklet and leaflet of high value vegetable crops	**4.1.** Inception workshop and progress workshop were organized on 21 November and 22 August 2016, respectively where participants from DAE, NGO, University and Research Organizations were attended. **4.2.** Two Trainer s training (TOT) already made and discussion was made on promising varieties and production technology. **4.3.** Ten farmers training on production technology of high value vegetable crops were made. **4.4.** Four field day were organized at farmer's field on high value vegetable crops production	Farmers are able to choose right variety of high value vegetable crops. Growers have clear cut knowledge on production technology 257 farmers and 47 Officers trained Participants present in the workshop are more interested to involve in the present project activities. Awareness about high value vegetable crops was created among UAO, NGO workers, SAAO (Sub Assistant Agriculture Officer) and farmers etc. Booklet for summer tomato production and leaflet for broccoli and sweet pepper production already published (Annexure 5)

(ii). Outputs/Results:

Activity 1.1. Evaluation of capsicum (sweet pepper) genotypes under Sylhet condition

In this research activity three capsicum genotypes viz., BARI Mistimorich 1, California wonder and Yolo wonder were evaluated under fine net (120 mesh), coarse net (40 mesh) and open field conditions in RCB design with three replications during winter season of 2013–2014 at the experimental field of Sylhet Agricultural University. Seeds of all capsicum genotypes were sown on 15 October 2013 in seed bed and 35 days old seedlings were transplanted in the main field on 20 November 2013. Relevant data on yield and yield attributes were taken properly and collected data compiled and analyzed using MSTAT software for interpretation of results.

Effect of genotype

Yield and yield attributes like plant growth, number of fruits per plant and fruit yield per plant were largely affected by the genotypes (Table 1.1.1). The genotype California wonder produced the highest number of fruits per plant (13.61) and fruit yield per plant (0.77 kg) followed by BARI Mistimorich 1 (0.71 kg/plant). The other genotype Yolo wonder produced 0.59 kg of fruits per plant. Similar variation (0.35 kg -0.49 kg) in fruit yield among 8 sweet pepper genotypes was noticed in study made at BARI, Gazipur in 2007-2008.

Table 1.1.1. Main effect of capsicum genotypes on yield and yield attributes

Genotype	Days to flower	Plant height at flowering (cm)	Plant height at final harvest (cm)	Fruit length (cm)	Fruit breadth (cm)	Number of fruit/plant	Fruit yield/plant (kg)
BARI Mistimorich 1	64.44	20.07a	48.74b	9.32	5.83	12.07b	0.71b
California wonder	64.77	18.76b	53.26a	10.01	5.90	13.61a	0.77a
Yolo wonder	65.00	14.36c	47.90b	9.22	5.58	11.94b	0.59c
F-test	ns	**	**	ns	ns	**	**
CV%	2.47	2.91	2.26	6.78	8.85	4.81	3.92

Means followed by same letter(s) in a column do not differ significantly by LSD
**=Significant at 1% level of probability, ns= Not significant

Effect of net covering

Use of net covering for capsicum production had significant influence on growth and yield (Table 1.1.2). The maximum number of fruits per plant (16.14) was harvested from the plants grown under fine net covering followed by coarse net covering (13.55) while it was the lowest (7.94) for the plants grown under open field condition. Similarly, the highest fruit yield per plant was recorded from the plants of fine net covering (0.94 kg/plant) followed by the plants grown under coarse net covering (0.86 kg/plant). The plants grown under open field condition produced the lowest fruit yield per plant and it was only 0.26 kg/plant. This result indicated that the production of capsicum is largely depends upon the net covering of the plants which protect the plants from different biotic (aphid. mite) and abiotic stresses. Islam and Halim (2014) also reported significant effect of nylon net and polythene covering on sweet pepper production.

Table 1.1.2. Main effect of net covering on yield and yield attributes of capsicum

Net covering	Days to flower	Plant height at flowering	Plant height at final harvest	Fruit length (cm)	Fruit breadth (cm)	Number of fruit/plant	Fruit yield/plant (kg)
Fine net	61.33b	21.44a	58.62a	10.58a	6.29a	16.14a	0.94a
Coarse net	66.88a	16.93b	56.63b	9.96a	5.71ab	13.55b	0.86b
Open	66.00a	14.80c	34.64c	8.02b	5.31b	7.94c	0.26c
F-test	**	**	**	**	**	**	**
CV%	2.47	2.91	2.26	6.78	8.85	4.81	3.92

Interaction effect between genotype and net covering

Growth and yield of capsicum was largely affected by the interaction between genotype and net covering (Table 1.1.3). The highest number of fruits per plant (19.18) as well highest fruit yield per plant (1.24 kg) was recorded from the plants of BARI Mistimorich 1 when grown under fine net covering while the genotypes California wonder and Yolo wonder performed very well under coarse covering and produced 1.08 kg and 0.80 kg of fruits per plant, respectively. All the genotypes exhibited very poor growth and yield performance when grown under open field condition (V_1P_3, V_2P_3 and V_3P_3).

Table 1.1.3. Interaction effect between genotypes and net protection on yield and yield attributes of capsicum

Treatment	Days to flower	Plant height at flowering (cm)	Plant height at final harvest (cm)	Fruit length (cm)	Fruit breadth (cm)	Number of fruit/ plant	Fruit yield/plant (kg)
V_1P_1	60.67	25.50a	54.40e	11.20a	6.33	19.18a	1.24a
V_1P_2	67.33	17.00d	57.30c	8.63cd	5.57	11.44d	0.72d
V_1P_3	65.33	17.70cd	34.53g	8.13d	5.60	5.57f	0.17f
V_2P_1	61.67	23.57b	62.23a	10.37ab	6.37	14.62bc	0.79cd
V_2P_2	66.00	18.43c	56.30d	10.17a-c	5.67	15.67b	1.08b
V_2P_3	66.67	14.27e	41.23f	9.50b-d	5.67	10.55d	0.43e
V_3P_1	61.67	15.27e	59.23b	10.17a-c	6.17	14.60bc	0.77cd
V_3P_2	67.33	15.37e	56.30d	11.07ab	5.90	13.57c	0.80c
V_3P_3	66.00	12.43f	28.17h	6.43e	4.67	7.68e	0.18f
F-test	ns	**	**	**	ns	**	**
CV%	2.47	2.91	2.26	6.78	8.85	4.81	3.92

Means followed by same letter(s) in a column do not differ significantly by DMRT

Where, P_1=Fine net, P_2=Coarse net, P_3=Open and
V_1=BARI Mistimorich-1, V_2=California Wonder, V_3=Yellow Wonder

Individual fruit weight at different harvest

Individual fruit weight at different harvest was found remarkably different (Table 1.1.4). Individual fruit weight was almost remaining similar up to third harvest while it was drastically decreased in the delayed harvest. The mean individual fruit weight of all treatment combinations at first harvest was 93.07 g and 97.56 g at third harvest while it was reduced to 64.74 g at fifth and 47.55 g at seventh harvest. The biggest individual fruit was harvested from the genotype BARI Mistimorich-1 (221.0 g) followed by California wonder (217.5 g) and Yolo wonder (200 g) when grown under fine net covering system.

Table 1.1.4. Average individual fruit weight of capsicum (sweet pepper) at different harvest

	Average individual fruit weight (g)					
Treatment	First harvest	Third harvest	Fifth harvest	Seventh harvest	Mean (g)	Biggest fruit weight at first harvest (g)
V1P1	113.7	117.8	64.15	80.0	93.912	221.0
V1P2	80.6	88.4	98.0	80.0	86.75	101.0
V1P3	49.4	44.4	29.18	20.0	35.74	86.0
V2P1	109.8	132.8	34.77	50.0	81.84	217.5
V2P2	134.0	144.6	117.6	45.0	110.3	150.0
V2P3	77.6	67.6	46.81	22.0	53.50	90.5
V3P1	81.2	77.85	42.2	40.0	60.31	200.0
V3P2	126.4	122.6	110.4	80.0	109.85	167.0
V3P3	65.0	82.0	39.63	11.0	49.40	105.0
Mean	**93.07**	**97.56**	**64.74**	**47.55**		**148.66**
Max	134.0	144.6	117.6	80.0		221.0
Min	49.4	44.4	29.18	11.0		86.0
Stdev	28.98	33.40	34.65	27.33		55.26

Economic analysis

Economic analysis for production of different capsicum genotypes grown under different types of net covering was made (Taka/acre). Total cost for different net protection system is given in Table 1.1.5. Cost of production under fine net covering system (287900/acre) and coarse net covering (202900/acre) were much higher compared to open field system (46400/acre).

Estimation of BCR (Table 1.1.6) revealed that the highest BCR (11.2) was recorded from the genotype of California wonder grown under coarse net protection followed by the genotype BARI mistimorich-1 when grown under fine net protection (9.04). The genotypes BARI Mistimorich-1, California wonder and Yolo wonder exhibited very poor BCR when grown under open field condition (1.37, 3.42 and 1.45, respectively). This result indicated that production of capsicum under net covering system was much profitable than that of open field cultivation. Plate 1.1.1 is displaying the status of sweet pepper production under net protected condition.

Table 1.1.5. Cost of production (Taka/acre) of capsicum under various net protection technique

Sl no.	Item	Cost for different net covering		
	Input cost	Fine net (P1)	Coarse net (P2)	Open field (P3)
1	Labour @250/ 120 labor for P1 and P2 and 100 for P3	30000	30000	25000
2	Seed	2000	2000	2000
3	Manure and Fertilizer			
	a. Urea 100 kg @ Tk. 22	2200	2200	2200
	b. TSP 142 kg@ Tk.25	3500	3500	3500
	c. MoP 100 kg @ Tk 17	1700	1700	1700
	d. Cow dung 4000 kg@ Tk 1.0	4000	4000	4000
4	Bamboo	60000	60000	-
5	Fine net	150000	-	-
6	Coarse net	-	70000	-
7	Stitching of net	18500	18500	-
8	Pesticide	1000	1000	4000
9	Miscellaneous	15000	10000	4000
	Total	**287900**	**202900**	**46400**

Table 1.1.6. Benefit cost ratio estimation for capsicum cultivation under different treatment combination

Treatment	Yield (kg/acre)	Rate Tk/kg)	Gross income (Tk)	Cost (Tk)	Gross margin (Tk)	BCR
V1P1	18600	140	2604000	287900	2316100	9.04
V1P2	10800	140	1512000	202900	1309100	7.45
V1P3	2550	25	63750	46400	17350	1.37
V2P1	11850	140	1659000	287900	1371100	5.76
V2P2	16200	140	2268000	202900	2065100	11.2
V2P3	6350	25	158750	46400	112350	3.42
V3P1	11550	140	1617000	287900	1329100	5.62
V3P2	12000	140	1680000	202900	1477100	8.28
V3P3	2700	25	67500	46400	21100	1.45

P1: Fine net
P2: Coarse net
P3: Open field

V1: BARI Misti morich 1
V2: California wonder
V3: Yolo wonder

Plate 1.1.1. Sweet pepper production in net protected condition

Activity 1.2. Production of capsicum under different protective structures

In this study BARI Mistimorich 1 was evaluated under different protective structures (Plate 1.2.1). Different protective structures comprising polytunnel, poly tunnel with net, only net and open condition had significant influence on the growth and yield of BARI Mistimorich 1 (Table 1.2.1). In poly tunnel system (T1) plants were given complete covering with transparent polythene sheet during the night while remain open during day time. In polytunnel+ nylon net protection system plants were grown under nylon net covering where polythene sheet covering was given for night time. In nylon net system (T3) the plants were covered with nylon net during the whole growing season. Under open condition (T4) the plants were grown in open field condition. In this study the highest number of fruits per plant was recorded (16.67) from the plant grown under nylon net which was statistically identical to that of the plant grown under poly tunnel+ nylon net (13.33). The corresponding fruit yield per plant was also the highest (0.82 kg/plant) when the crops grown under nylon net protection followed by the plants grown under poly tunnel + nylon net protection (0.77 kg/plant)

Table 1.2.1. Yield and yield components of capsicum under different protective structures

Treatment	Plant height at flowering	Plant height at final harvest	Fruit length (cm)	Fruit breadth (cm)	Number of fruit/plant	Fruit yield/plant (kg)
Poly tunnel (T_1)	20.17	45.87bc	9.30	5.37ab	7.42b	0.33b
Poly tunnel+ Nylon Net (T_2)	21.13	75.10a	6.67	6.13a	13.33a	0.77a
Only nylon net (T_3)	19.53	60.23ab	9.17	5.43ab	16.67a	0.82a
Open (T_4)	16.47	40.03c	8.80	4,67b	8.52b	0.32b
F-test	ns	**	ns	*	**	*
CV%	18.38	10.95	12.64	8.76	9.59	14.93

Plate 1.2.1. Protective structure, temperature recording and deformed fruit harvested from open field.

Activity 1.3. Evaluation of broccoli genotypes under Sylhet condition

Three broccoli genotypes viz., BR001, BR002 and Premium were evaluated during winter season of 2013-2014 under inorganic and organic production system in RCB design with three replications. Seeds of broccoli genotypes were sown on 27 October to raise seedlings and transplanted in the main field on 19 November 2013 at 60 X 40 cm between row to row and plant to plant respectively. Under inorganic production system the land was given with both organic and inorganic fertilizers (cowdung, urea, TSP, MP and gypsum) while under organic production system the land was fertilized with only cowdung at land preparation and cow urine was applied in three installments at 15, 30 and 45 days after transplanting. Relevant yield and yield contributing characters were recorded and statistically analyzed for interpretation of results.

Effect of genotype

Among the genotypes Premium produced the highest main curd yield per plant (183.87 g). Secondary curd yield was also the highest for the genotype of premium (136.05 g) (Table 1.3.1). The other two genotypes were found very poor in relation to main curd and secondary curd production.

Table 1.3.1. Main effect of genotype on curd yield and yield attributes of Broccoli

Genotype	Days to first curd initiation	Days to first harvest	Main curd yield/plant (g)	Curd length (cm)	Curd diameter (cm)	Plant height at harvest (cm)	Secondary curd yield/ plant (g)
BR001 (V1)	57.33a	67.00a	54.60b	9.03b	7.04b	61.31a	70.39b
BR002 (V2)	57.17a	67.17a	63.40b	8.08b	6.88b	59.63ab	73.37b
Premium (V3)	50.17b	63.50b	183.87a	11.62a	12.27a	57.42b	136.05a
F-test	**	**	**	**	**	ns	**
CV%	2.48	3.72	5.75	6.51	5.81	2.10	8.70

Effect of production system

Between the two production systems, production of broccoli was found better under inorganic production system (Table 1.3.2). Both the main curd yield per plant (138.01 g) and secondary curd yield per plant (144.81 g) were comparatively higher when broccoli grown under inorganic production system than that of organic production system. Since the plant of inorganic production system was given both organic and inorganic fertilizers hence the production of broccoli was much higher than that of organic production system.

Table 1.3.2. Main effect of production system on yield and yield attributes of Broccoli

System	Days to first curd initiation	Days to first harvest	Main curd yield/plant (g)	Curd length (cm)	Curd diameter (cm)	Plant height at harvest (cm)	Secondary curd yield/ (g)
S1 (Inorganic)	54.44	65.67	138.01	10.56	10.07	61.96	144.81
S2 (Organic)	55.33	66.11	63.23	8.59	7.40	56.94	41.73
F-test	ns	NS	**	**	**	**	**
CV%	2.48	3.72	5.75	6.51	5.81	2.10	8.70

Interaction effect

Significant interaction between genotype and production system was found for growth and yield of broccoli (Table 1.3.3.). The highest main curd yield (265.67 g) and secondary curd yield (216.36 g) were recorded from the genotype of premium when grown under inorganic production system followed by the same genotype when grown under organic production system. Therefore, among the three genotypes, premium was more promising in both of the production system.

Table 1.3.3. Interaction effect between genotype and system on Broccoli production

System× Genotype	Days to first curd initiation	Days to first harvest	Main curd yield/plant (g)	Curd length (cm)	Curd diameter (cm	Plant height at harvest (cm)	Secondary curd yield/plant (g)
V1S1	57.33a	67.00	69.91c	10.20	7.70c	63.85	106.98b
V1S2	57.33a	67.00	39.29d	7.87	6.39c	58.76	33.81d
V2S1	57.33a	67.00	78.46c	8.86	7.40c	62.76	111.10b
V2S2	57.00a	67.33	48.33d	7.29	6.36c	56.50	35.65cd
V3S1	48.67c	63.00	265.67a	12.64	15.11a	59.28	216.36a
V3S2	51.67b	64.00	102.07b	10.61	9.44b	55.57	55.73c
F-test	**	ns	**	ns	**	ns	**
CV%	2.48	3.72	5.75	6.51	5.81	2.10	8.70

V1=Premium, V2=BR001, V3=BR002, S1=Inorganic, S2=Organic system

Activity 1.4. Production of tomato under varied seedling type and hormone application during summer season

Tomato is a winter season crop. It likes cool and dry weather condition for better growth and development. Poor fruit set and bacterial wilt are the major problems for tomato production during rainy summer. Plant growth regulator and use of grafted seedling have been reported very effective for tomato production during summer (Ahmed, 2011; Kuo, 1989). Therefore, in the present study three different types of seedling of BARI hybrid tomato-4 was evaluated under hormone and without hormone application conditions. Three different types of seedlings viz., polybag seedling (seedling produced in polybag), normal seedling (seedling grown in seedbed)

and grafted seedling (tomato seedling grafted on *Solanum sisymbrifolium*) were planted on 1 June 2014 at 60 X 40 cm between row to row and plant to plant distance, respectively. The growth regulator tomatotone (PCPA) at the rate of 2% was sprayed on plants having 4-5 flower clusters at full bloom stage. Plant received three sprays at 5-6 days interval. Two rows in each plot were kept unsprayed. Data were recorded for yield and yield attributes and statistically analyzed using MSTAT software.

Results and Discussion

Main effect of type of seedling

Types of seedling had significant influence on growth and yield of tomato during summer season (Table 1.4.1). The highest fruit yield per plant was recorded from the plant raised from grafted seedling (0.93 kg) followed by normal seedling (0.83 kg). This is attributed due to longer harvesting duration from the grafted plants compared to the other types of seedling. Again mortality of the grafted plants was much lower (3.5%) compared to the plants of polybag seedling (18.0%) and normal seedling (20.0%) causing significant variation in per decimal fruit yield. Similar better performance of BARI hybrid tomato-4 was found when grafted on BARI begun-8 during summer season of 2010 at BARI (Anon., 2011).

Table 1.4.1. Main effect of seedling type on growth and yield of BARI hybrid tomato-4

Type of seedling	Days to first harvest	N0. of fruit/plant	Wt. of fruit/plant (g)	Length of fruit (cm)	Breadth of fruit (cm)	Individual fruit wt. (g)	Harvesting duration (days)	Yield (kg/ decimal)	Bacterial wilt (%)
Polybag	80.50B	20.99B	785.45B	3.97	2.92B	37.70	29.16B	128.0	18.0
Normal	81.83AB	20.11B	835.02B	4.24	2.68B	40.70	30.83B	131.5	20.0
Grafted	87.16A	24.86A	935.49A	4.24	3.48A	37.46	39.33A	180.0	3.5
F-test	**	**	*	NS	**	NS	**	NA	NA
CV%	3.63	8.48	8.14	7.35	5.29	8.63	8.02		

Effect of hormone

Application of tomatotone hormone on flower had significant influence on tomato yield during summer season (Table 1.4.2). In this study hormone treated plant produced 0.98 kg of fruits per plant while untreated plant produced 0.72 kg of fruits per plant. Hormone treated plants produced significantly higher number of fruits per plant (23.10) with heavier individual fruit weight (42.53 g) compared to the untreated plant. This indicates that farmer can ensure higher fruit yield of tomato during summer through hormone application. Similar results were also reported by several workers (Ahmed, 2011; Patwary, 2009).

Table 1.4.2. Effect of hormone on summer tomato production

Hormone	Days to first harvest	N0. of fruit/plant	Wt. of fruit/plant (g)	Length of fruit (cm)	Breadth of fruit (cm)	Individual fruit wt. (g)	Harvesting duration (days)	Yield (kg/ decimal)	Bacterial wilt (%)
With hormone	81.22	23.10	979.50	4.19	3.38	42.53	35.00	165.6	15.3
Without hormone	85.11	20.88	724.48	4.10	2.67	34.72	31.22	127.3	12.3
F-test	*	*	**	NS	**	**	*		
CV%	3.63	8.48	8.14	7.35	5.29	8.63	8.02		

Interaction effect

Interaction effect between seedling type and hormone application is presented in Table 1.4.3. Fruit yield was largely affected due to interaction of seedling type and application of hormone. Number of fruits per plant was the maximum for the grafted plants applied with hormone (26.26). The highest fruit yield was recorded from the grafted tomato plants (1.06 kg/plant) and normal seedling plants (1.08 kg/plant) when applied with hormone.

Table 1.4.3. Interaction effect of seedling and hormone on growth and yield of BARI hybrid tomato-4

	Days to first harvest	No. of fruit/plant	Wt. of fruit/plant (g)	Length of fruit (cm)	Breadth of fruit (cm)	Individual fruit wt. (g)	Harvesting duration (days)	Yield (kg/ decimal)	Bacterial wilt (%)
S1H1	79.00	20.06CD	798.56B	4.03	3.20AB	40.03	31.66	128	19.0
S1H0	82.00	21.91BC	772.33B	3.90	2.65B	35.38	26.66	128	17.0
S2H1	80.66	22.96ABC	1080.40A	4.32	2.77B	47.10	33.66	164	24.0
S2H0	83.00	17.27D	589.65C	4.16	2.58B	34.30	30.00	99	16.0
S3H1	84.00	26.26A	1059.53A	4.23	4.17A	40.45	41.66	205	3.0
S3H0	90.33	23.45AB	811.45B	4.25	2.78B	34.47	37.00	155	4.0
F-test	NS	*	**	NS	**	NS	NS	NA	NA
CV%	3.63	8.48	8.14	7.35	5.29	8.63	8.02		

Here,

S1=Polybag, S2=Normal and S3=Grafted

H1= With hormone and H0=Without hormone, NS: Not significant, NA: Not analyzed

Plate 1.4.1. Grafted, polybag grown and non grafted plants of summer tomato

Activity 1.5

Evaluation of heat tolerant tomato hybrid under Sylhet condition

The present study was conducted at the experimental field of Horticulture Department, Sylhet Agricultural University during the summer season of 2014 under RCB design with three replications. Seeds of five heat tolerant tomato hybrids were sown on 14 May and 25 day old seedlings were transplanted in the main field. The plants were spaced at 60 cm X 40 cm between row to row and plant to plant, respectively. Each replication consisted of 24 plants.

Results and Discussion

Variations in relation to growth, yield and yield attributes were noticed among the hybrids. Days to first flower ranged from 47 to 54 days (Table 1.5.1). The highest number of fruits per plant was recorded from BARI hybrid tomato-3 (25.5) while it was the lowest for the hybrid NHC-2

(18.4) but it had the heaviest individual fruit weight (43.2 g). Fruit yield per plant among the hybrids varied from 0.74 kg to 0.96 kg of which BARI Hybrid tomato- 4 had the highest fruit yield per plant (Table 1.5.2). The corresponding fruit yield of BARI hybrid tomato-4 per hectare was 29.24 tons which was relatively lower compared to the yield of other part of the country. Several workers reported that the yield of most of heat tolerant hybrid tomato was around 37 to 45 ton per hectare (Ahmed, 2011, Yesmin, 2011). Low organic matter content and acidity of the soil of the experimental field might attribute the lower yield of the tomato crop. However, economic analysis (Table 1.5.2) revealed that farmer can harvest maximum gross margin from BARI hybrid tomato-4 (5320 tk per decimal) followed by NHC-1 (4600/ tk per decimal).

Table 1.5.1. Fruit characteristics of the of five tomato hybrids

Hybrids	Days to flower	Days to harvest	No. of fruits /plant	Individual fruit wt. (g)	Fruit length (cm)	Fruit breadth	TSS (%)
BARI Hybrid tomato-4	47	85	24.0	40.1	4.2	3.1	5.12
BARI hybrid tomato-3	50	87	25.5	35.4	4.5	3.4	5.3
NHC-1	48	86	25.3	38.6	4.3	3.6	4.8
NHC-2	53	87	18.4	43.2	4.8	3.5	5.2
NHC-3	54	86	22.4	35.3	3.8	3.0	5.1
Mean	50.4	86.2	22.68	38.52	4.32	3.32	5.10
Range	47-54	85-87	18.4-25.5	35.3-43.2	3.8-4.8	3.0-3.6	4.8-5.3
Stdev	3.04	0.83	2.61	3.33	0.37	0.25	0.18

Table 1.5.2. Yield and profitability of tomato hybrids during summer

Hybrids	Fruit yield/ plant (kg)	Fruit yield/ Decimal (kg)	Yield (t/ha)	Bacterial wilt (%)	Cost of production/ decimal (tk)	Gross return (@70 tk/kg	Gross margin/ decimal
BARI Hybrid tomato-4	0.96	172	29.24	11	5000/ (Bamboo, polythene, sutoli, nylon rope etc)	10320	5320
BARI hybrid tomato-3	0.89	156	26.52	13		9360	4360
NHC-1	0.89	160	27.2	10		9600	4600
NHC-2	0.79	140	23.8	12		8400	3400
NHC-3	0.74	135	22.1	13		8100	3100
Mean	0.85	152.2	25.77	11.8		5156	4156
Range	0.74-0.96	135-172	22.1-29.24	10-13		8100-10320	3100-5320
Stdev	0.87	15.09	2.82	1.30		905	905

Activity 1.6
On station evaluation of photo-insensitive country bean genotypes

Four photo-insensitive country bean genotypes were evaluated during summer season of 2014 at the experimental field of Horticulture Department, Sylhet Agricultural University. This study was made in RCB design with three replications. Seeds of all genotypes were sown on 14 April 2014 in raise bed at 2.0 m X 1.0 m respectively.

Results and Discussion

Remarkable variation was found among the genotypes in relation to growth and yield (Table 1.6.1). Days to flower varied from 48.0 days to 62.0 days of which IPSA sheem-2 was delayed in flowering. The genotype BP003 produced the maximum number of pods per plant (204.25) closely followed by SB010 (194.16). The genotype BP003 also had the heaviest individual pod weight (6.07 g) while it was the lowest for IPSA Sheem-2 (4.73 g). The pod of BARI sheem-7 and BP003 was longer in size compared to the pods other two genotypes. Days to harvest was little longer to IPSA sheem-2 (92.5 days) than that of other three genotypes (Table 1.6.2). Among the genotypes, BP003 performed very well in relation to per plant (1.25 kg) and per decimal (45.20 kg) pod yield exhibiting the highest net return (2640 tk) followed by BARI sheem-7 (1710 tk).

Table 1.6.3 presented the weather condition during the growing period of the crop. Country bean grows well under cool and dry condition. However, during the growing period the temperature was recorded more than 30^0C and rainfall was also found severe. Under this adverse condition BARI sheem-7, BP003 and SB010 performed well indicating bright scope for expansion of summer country bean production in Sylhet region.

Table 1.6.1. Some growth parameters of country bean genotypes

Genotype	Days to first flower	No. of pod/plant	Individual pod wt (g)	Pod length (cm)	Pod breadth (cm)	No. of seed/ pod
BARI Sheem-7	51.0	170.38	5.32	10.16	2.44	4.46
SB010	48.0	194.16	4.46	7.91	2.51	4.66
BP003	50,0	204.25	6.07	9.14	2.92	4.2
IPSA Sheem 2	62.0	168.16	4.73	7.34	2.12	4.8
Average	52.75	184.2	5.15	8.63	2.49	4.53
Range	48.0-62.0	168.1-204.2	4.46-6.0	7.3-10.1	2.1-2.9	4.2-4.8
Stdev	6.3	17.83	0.71	1.26	0.32	0.26

Table 1.6.2. Yield and yield attributes of country bean genotypes during summer

Genotype	Days to first harvest	Pod yield /plant (kg)	Pod yield/ decimal (kg)	Cost (Tk/ decimal)	Return/ decimal (@ 75 Tk/ kg)	Gross margin
BARI Sheem-7	82.0	0.91	32.80	750/	2460	1710
SB010	81.5	0.87	31.32	(only	2349	1599
BP003	84.5	1.25	45.20	bamboo	3390	2640
IPSA Sheem 2	92.5	0.80	28.80	sticks are required)	2160	1410
Average	85.12	0.96	34.53		2589.75	1839.75
Range	81.5-92.5	0.80-1.25	28.8-45.2		2160-3390	1410-2640
Stdev	5.08	0.20	7.30		547.63	547.63

Table 1.6.3: Monthly maximum, minimum temperature and rainfall during summer season of 2014

Year	Month	Average temperature (^{0}c)		Average rainfall (cm)
		Max. temperature(^{0}c)	Min. temperature(^{0}c)	
2014	April	34.6	21.9	3.91
	May	32.4	23.3	17.42
	June	32.1	25.5	24.71
	July	34.2	26.0	10.04
	August	32.5	25.5	25.51
	September	32.2	24.9	24.05
	October	33.1	23.1	1.06

Genotypic reaction against diseases and insects

To record incidence of diseases and insects for the country bean genotypes close observation was made during growing period of the crop. Infestation of aphid, fruit borer, bean common mosaic virus and cercospora leaf spot was noticed at different growth stages of the crop. A brief description of the incidence of diseases and insects and their management is presented in Table 1.6.4.

Table 1.6.4. Incidence of disease and insects in summer country bean genotypes

Insects/Diseases	Description
1. Aphid	All the genotypes were infested at 45 day after sowing. Hand destruction and application insecticide twice (Malataf @ 2ml per litre of water) effectively prevented the plants from further infestation.
2. Pod borer	During harvest infested fruit was counted. Per cent fruit borer infestation was found higher in BARI sheem-7 (10.4 %) followed by SB010 (6.8%) while it was 5.2% and 4.4% for IPSA sheem-2 and BP003, respectively.
3. Bean common mosaic virus	Only two plants of each genotype BP003 and BARI sheem-7 were infected with virus at later stage of growth (75 day after sowing). Infected twigs were immediately after infection were pruned off and destroyed. No further infection was found in the field.
4. Cercospora leaf spot	Lower leaves of all genotypes were infected by cercospora leaf spot at 75 day after sowing. Application of secure (fungicide 2%) was found effective to reduce the incidence.

BP003


SB003 (BARI sheem-7)


SB010

Plate 1.6.1. Photo-insensitive country bean lines

On station research achievements on high value vegetable crops are published in daily news paper (Plate 1.6.2)

Plate 1.6.2. Success stories published in daily news paper

Second Year

Activity 2.1.Evaluation of broccoli genotypes under varied sowing dates

Broccoli (*Brassica oleracea* var. *italica* L.) is a cole crop belonging to the family cruciferae. It is originated from West Europe (Prasad and Kumar, 1999). It is more nutritious than other cole crops such as cabbage, cauliflower and kohlrabi (Thompson and Kelly, 1985). It is an excellent source of vitamin C and dietary fibre. It is a good source of potassium and vitamin A. So it can contribute significantly to improve our diet. It is also fat and cholesterol free. It is now growing successfully in some areas of Bangladesh. Like other vegetable crops, production of broccoli was largely affected by genotype, sowing dates, fertilizer application etc. Again shelf life of broccoli is very short. After harvesting, head become unfit for consumption within a couple of days. To overcome this situation staggered planting may be the best option to make broccoli available for longer period in the market. Therefore, to increase broccoli production, selection of suitable genotype and suitable sowing dates for specific genotype is very much important. Keeping this view in mind the present investigation comprising three broccoli genotypes along with three sowing dates (October 10, October 25 and November 10) was considered to select suitable variety and sowing dates. This study was made at the experimental field of Sylhet Agricultural University (SAU) during the winter season of 2014-2015.

Results and Discussion

Main effect of genotype

Significant variations were observed among the broccoli genotypes in respect of curd yield and yield attributes (Table 2.1.1). Days to first curd initiation (68.33) and days to first harvest (84.22) were the minimum for the genotype Green magic while both of these were the maximum for Imperial. The genotype Imperial had the highest individual curd weight (608.3 gm) since the curd length (16.87 cm) and curd diameter (16.61 cm) were the maximum for this genotype. The genotype Imperial produced the maximum curd yield (110.2 kg/decimal) followed by Green magic (62.11 kg/decimal).

Table 2.1.1. Main effect of genotype on yield and yield attributes of broccoli

Variety	Days to first curd initiation	Days to first harvest	Individual curd wt. (gm)	Curd breadth (cm)	Curd height (cm)	Curd yield/decimal (kg)
Green magic	68.33b	84.22b	343.8b	13.96c	13.89b	62.11b
Premium	75.67a	91.22a	314.1c	15.07b	15.02b	55.70c
Imperial	78.67a	92.67a	608.3a	16.87a	16.61a	110.2a
F-test	**	**	**	**	**	**
CV%	3.44	3.10	4.95	2.34	5.89	5.23

Main effect of sowing dates

Sowing dates had significant influence on yield and yield attributes of broccoli (Table 2.1.2). The minimum number of days to first curd initiation (70.67 days) and first harvest (83.33 days) were recorded from 25 October sowing while these were the maximum for 10 October sowing. But the highest individual curd weight (471.5 g) was measured from 10 November sowing. The maximum curd yield/decimal was recorded from 10 November sowing (84.08 kg) followed by 25 October sowing (79.78 kg). Weather data given in Annexure 3 revealed that the crops grown from the 10 October sowing experienced severe rainfall during seedling and early growth stage which ultimately affect the growth and yield of plant.

Table 2.1.2. Main effect of planting time on yield and yield attributes of broccoli

Planting time	Days to first curd initiation	Days to first harvest	Individual curd wt. (gm)	Curd breadth (cm)	Curd height (cm)	Curd yield/decimal (kg)
10 October	77.33a	93.33a	354.7c	13.95b	14.08b	64.10b
25 October	70.67b	83.33b	440.0b	15.43ab	15.87a	79.78a
10 November	74.67a	91.44a	471.5a	16.53a	15.57a	84.08a
F-test	**	**	**	**	**	**
CV%	3.44	3.10	4.95	2.34	5.89	5.23

Interaction effect

Interaction effect between genotype and sowing dates is presented in Table 2.1.3. Individual curd weight largely affected due to interaction effect of genotype and sowing dates. Individual curd weight was the maximum for Imperial when grown from 25 October sowing (628.9 g) followed by the same genotype when grown from 10 November sowing (608.6 g) and 10 October sowing (587.4 g), while

the individual curd weight was the minimum for Premium when coupled with 10 October sowing (207.1 g). The highest curd yield/decimal was recorded from the genotype Imperial when sown in 25 October (114.2 kg) followed by the same genotype coupled with 10 November sowing (110.5 kg) and 10 October sowing (105.7 kg). The curd yield/decimal was minimum (37.77 kg) for treatment combination V_2T_1 (Premium when coupled with 10 October sowing).

Table 2.1.3. Interaction effect of genotype and sowing dates on yield and yield attributes of broccoli

Variety × Planting time	Days to first curd initiation	Days to first harvest	Individual curd wt. (gm)	Curd breadth (cm)	Curd height (cm)	Curd yield/decimal (kg)
V_1T_1	66.00de	84.00d	269.6e	12.79d	13.62c	48.80e
V_1T_2	61.00e	76.67e	307.4de	13.54d	14.45bc	55.53de
V_1T_3	78.00b	92.00bc	454.6b	15.54c	13.60c	81.99b
V_2T_1	79.67b	94,33b	207.1f	12.90d	12.42c	37.77f
V_2T_2	75.67bc	87.33cd	383.7c	16.31b	16.17ab	69.57c
V_2T_3	71.67cd	92.00bc	351.4cd	16.01bc	16.48ab	59.77d
V_3T_1	86.33a	101.7a	587.4a	16.16bc	16.19ab	105.7a
V_3T_2	73.33bc	86.00cd	628.9a	16.43b	17.00a	114.2a
V_3T_3	74.33bc	90.33bcd	608.6a	18.03a	16.63a	110.5a
F-test	**	**	**	**	**	**
CV%	3.44	3.10	4.95	2.34	5.89	5.23

Here,

V_1=Green magic, V_2= Premium and V_3= Imperial

T_1=10 October, T_2=25 October and T_3=10 November

Plate 2.1.1. Experimental field and two promising broccoli lines

Activity 2.2. Production of sweet pepper under different tunnel covers

Sweet pepper (*Capsicum annuum* L) is one of the most important vegetable crops grown extensively throughout the world especially in the temperate countries. The crop is very sensitive to environmental factors (Bhatt *et al.,* 1992). Its production in Bangladesh is largely affected by high infestation of mite, aphid and low night temperature (Anon, 2008). Night temperature below 16 °C and day temperature above 32 °C also causes blossom dropping (Boswell, 1964). In Bangladesh, during December to

January, night temperature gradually declined below 10 °C or less. Under this situation vegetative and reproductive growth stages of sweet pepper plants become ceased or stunted and also, fruit and flower drops may occur. So for proper growth and yield of sweet pepper in winter at low temperature under netted poly tunnel or poly house may be an effective way to grow them because it protect the plants from pest infestation and from cold injury since night temperature inside poly covers raises higher than outside. There are reports that shading of plants or partial reduction in solar radiation increases the yield and yield contributing characters particularly number of fruits and fruit size (Bose and Som, 1986; Bose *et al.,* 1993). However, information regarding use of protective structures for sweet pepper production in Bangladesh is very scanty.

The present study was conducted at the experimental field of Horticulture Department, Sylhet Agricultural University during the winter season of 2014 under RCB design with three replications. In this study, BARI Mistimorich 1 was evaluated under different protective structures. Different protective structures comprising fine net+polytunnel, fine net, Coarse net+polytunnel, coarse net, polythene and open condition had the significant influence on growth and yield of BARI Mistimorich 1. In polythene system, plants were given complete covering with transparent polythene sheet during the night while remained open during day time. In fine net+ polytunnel and Coarse net+ polytunnel protection system plants were grown under net covering for whole season where polythene sheet covering was given during the month of December and January only for night time. In fine net and coarse net system the plants were covered with net during the whole growing season. Under open condition the plants were grown in open field condition.

Results and Discussion

Growth and yield of sweet pepper grown under different protected systems are presented in Table 2.2.1. In this study the highest number of fruits per plant was recorded (11.35) from the plant grown under fine net+polythene protected system followed by coarse net+polythene protected system (9.77) while it was the minimum for open condition (4.63). The corresponding fruit yield per plant was also the highest (1.117 kg/plant) when the crops grown under fine net+polythen protection followed by the plants grown under coarse net+polythen protection (0.902 kg/plant). Results revealed that the yield of sweet pepper under protected condition was higher compared to that of plants grown under open field condition 0.268 kg/plant). Protective structures provide congenial atmospheric conditions and also protected the plants from pest attack. Again polythene covering found more effective because at night, plants covered with polythene sheet prevent the crop from cold injury and enhance proper growth and development. In winter season of 2013-14 minimum and maximum temperature of protective structure (inside) and from open field was measured using a thermometer. Recorded (Table 2.2.2) temperature indicated that the minimum temperature under protective structure was 2-3^{0}C higher than that minimum temperature of open field. Plants grown under net with polythene protected system experienced warmer condition during the month of December and January compared to the plants grown in open field condition which was helpful for the growth of the plants. Halim and Islam (2013) also recorded the minimum temperature was around 14^{0}C from 15 December 2007 to 15 January 2008 while it was around 11^{0}C in open field condition of sweet pepper field at Gazipur.

Table 2.2.1. Growth and yield of sweet pepper grown under different protective system

Treatment	Days to first flower	Days to first harvest	No. of fruits/ plant	Individual fruit wt. (gm)	Fruit yield/ plant (kg)
Fine net	59.00	93.00bc	6.52bc	106.00a	0.672bc
Fine net+polythene	62.00	90.00c	11.35a	98.40a	1.117a
Coarse net+	58.67	93.33ab	7.25bc	100.70a	0.727bc
Coarse net+polythene	57.00	92.67bc	9.77ab	93.33a	0.902ab
Polythene	59.00	94.67ab	6.31bc	85.00ab	0.537c
Open	61.00	96.67a	4.63c	59.00b	0.268d
F-test	NS	**	**	**	**
CV%	5.7	1.13	18.47	13.01	14.09

Table 2.2.2. Fortnight temperature (^{0}C) data (outside and inside of protective structures) during December to January.

Period	Open field		Net + Polythene	
	Max (^{0}C)	Min (^{0}C)	Max (^{0}C)	Min (^{0}C)
Dec 1-15	34.5	12.7	39.2	14.8
Dec 16-30	29.7	12.1	37.0	14.7
Jan 1-15	33.0	11.6	38.4	13.35
Jan 16-31	23.0	12.4	39.6	14.7

Diseases and insects

Information regarding disease and insect infestation in plants and fruits were recorded at 60, 75 DAS and during harvest. A magnifying glass was used to detect aphid, mite and thrips. Table 2.2.3 revealed that the plants grown under open field condition were severely infected with aphid and thrips. All the plants of open field were found twisted and stunted (plate 2.2.1). Infestation of aphid, thrips, scorching sunlight etc mostly responsible for the poor and stunted growth of the plants grown under open field condition caused very poor yield of the plants with improper shape and size of the fruits. The plants grown under net and net+polythene protection system was not infested with insects and experienced warmer condition during cooler month and partial shade which enhance the plants for better growth and development resulting higher and quality fruit production of the plants.

Table 2.2.3. Pest infestation in sweet pepper grown under different protection system at 75 DAS

Treatment	Aphid (% plant infestation)	Mite	Anthracnose (% fruit infestation)	Remark
Fine net	2.1	Not found	1.46	In open field condition all plants were very much stunted and twisted in growth (plate 2.2.1).
Fine net Polythene	0		1.98	
Coarse net	4.2		1.50	
Coarse net Polythene	2.1		0.51	
Only polythene	25.0		2.57	
Open	95.8		6.75	

Plate 2.2.1 Very stunted plants in open field condition

Activity 2.3. On farm adaptive trial of sweet pepper and broccoli

Adaptive trial on sweet pepper and broccoli at farmer s field of different upazilas of Sylhet and Habiganj districts were completed during the winter season of 2014-2015. For sweet pepper adaptive trial selected farmers grew sweet pepper under three protective structure viz., net+ polythene covering system, only net covering system and open field condition. In net + polythene covering system the plants remained under net protection for whole cropping period while polythene cover was given only two coldest months of December and January. In net covering system the plants remained under only net covering system during the whole cropping period. Data on different growth and yield parameters were collected and analyzed for interpretation of results. Details of the collected information presented below-

Sweet pepper

Some phenological information on sweet pepper production at selected farmer s field of Habiganj and Sylhet districts are presented in Table 2.3.1 and 2.3.2. From the table it is observed that the seed sowing and transplanting were done in the month of October and November, respectively. The average number of days to first flower (55.8 days) and days to first harvest (95.7 days) were recorded from the adaptive trial in Habiganj district while the average number of days to first flower (55.71 days) and days to first harvest (91.29 days) were recorded from the adaptive trial in Sylhet district.

Table 2.3.1. Phenological information on sweet pepper production in Habiganj district

Farmer's name	Date of seed sowing	Date of transplanting	Days to first Flower	Days to first Harvest
1. Md. Imran Hossain	28.10.2014	27.10.2014	59	96
2. Md. Mosahid Mia	28.10.2014	22.11.2014	52	93
3. Md. A. Salam	28.10.2014	21.11.2014	50	97
4. Md. Abdullah	25.10.2014	21.11.2014	54	95
5. Md. Toyib Ali	28.10.2014	25.11.2014	59	96
6. Md. Samaj Ali	28.10.2014	23.11.2014	58	96
7. Md. Uster Mia	28.10.2014	23.11.2014	54	97
8. Md. Abdul Qaium	23.10.2014	18.11.2014	57	97
9. Md. A. Kadir	24.10.2014	27.11.2014	59	94
10. Md. Polahs Mia	27.10,2014	21.11.2014	56	96
Average			55.8	95.7

Table 2.3.2. Phenological information on sweet pepper production in Sylhet district

Farmer's name	Date of seed sowing	Date of transplanting	Days to first Flower	Days to first Harvest
1. Md. Wahab Ali	25.10.14	18.11.14	56	88
2. Belal Ahmed	15.10.14	12.11.14	58	92
3. Md. Mokuddos	25.10.14	18.11.14	54	90
4. Md. Sabuj Mia	25.10.14	20.11.14	55	95
5. Md. Wahab Ali	25.10.14	23.11.14	59	92
6. Md. Koisor	25.10.14	26.11.14	53	94
7. Md. Delowar	15.10.14	18.11.14	55	88
Average			55.71	91.29

Yield and yield performance of sweet pepper among different farmers at Habiganj district under different protective structures are presented in Table 2.3.3. Production of sweet pepper under net+polythene or only net protected condition for all farmers was much higher compared to that of open field condition. From the table it is observed that the average number of fruit/plant (9.3) and individual fruit weight (87.7 g) were the maximum when the crop grown under the protective structure of net+polythene while both of these were the minimum for open condition. The average fruit yield/plant was also recorded the highest from net+polythene (826.4 g) while it was the lowest for open condition (333.3 g). However, a pronounced variation in yield for specific protection system (312 g to 1116 g/plant for net+poly, 215g to 980 g/plant for net and 81 g to 536 g for open condition) was noticed among different farmers and this might be attributed due to the variation of management practices of the farmers.

Table 2.3.3. Yield and Yield attributes of sweet peeper under different protective structures in Habiganj district

Farmer's name	Number of fruits/plant			Individual fruit weight (g)			Fruit yield per plant (g)		
	Net+Poly	Net	Open	Net+Poly	Net	Open	Net+Poly	Net	Open
1. Md. Imran Hossain	12	9	8	89	97	67	1068	873	536
2. Md. Mosahid Mia	7	6	4	101	102	68	707	612	272
3. Md. A. Salam	10	9	6	93	91	70	930	819	420
4. Md. Abdullah	8	5	7	91	86	44	728	430	308
5. Md. Toyib Ali	10	9	6	84	72	41	840	648	246
6. Md. Samaj Ali	6	5	3	52	43	27	312	215	81
7. Md. Uster Mia	10	8	5	97	101	61	970	808	305
8. Md. Abdul Qaium	9	7	6	89	80	66	801	560	396
9. Md. A. Kadir	9	10	5	88	92	67	792	920	335
10. Md. Polash Mia	12	10	7	93	98	62	1116	980	434
Average	9.3	7.8	5.7	87.7	86.2	57.3	826.4	686.5	333.3
Max	12	10	8	101	102	70	1116	980	536
Min	6	5	3	52	43	27	312	215	81
Stdev	1.95	1.93	1.49	13.43	17.91	14.67	227.10	240.12	124.34

Yield and yield performance of sweet pepper among different farmers at Sylhet district under different protective structures are presented in Table 2.3.4. From the table it is observed that the average number of fruit/plant (10.14) and individual fruit weight (84.43 g) were the maximum from the crop grown under the protective structure of net+polythene while both of these were the minimum for open condition. The average fruit yield/plant was also recorded the maximum from net+polythene (861 g) while it was the minimum for open condition (362.29 g).

Table 2.3.4. Yield and yield attributes of sweet pepper under different protective structures in Sylhet district

Farmer's name	Number of fruits/plant			Individual fruit weight (g)			Fruit yield per plant (g)		
	Net+Poly	Net	Open	Net+Poly	Net	Open	Net+Poly	Net	Open
1. Md. Wahab Ali	9	10	6	86	82	57	774	820	342
2. Belal Ahmed	14	11	8	92	83	56	1288	913	448
3. Md. Mokuddos	9	10	7	82	78	48	738	780	336
4. Md. Sabuj Mia	8	9	6	84	80	45	672	720	270
5. Md. Wahab Ali	10	11	6	76	81	64	760	891	384
6. Md. Koisor	11	9	8	85	75	62	935	675	496
7. Md. Delowar	10	8	5	86	74	52	860	592	260
Average	10.14	9.71	6.57	84.43	79.00	54.86	861.00	770.14	362.29
Max	14	11	8	92	83	64	1288	913	496
Min	8	8	5	76	74	45	672	592	260
Stdev	1.95	1.11	1.13	4.83	3.46	6.99	206.73	116.12	87.35

Comparison on sweet pepper production between Habiganj and Sylhet district is presented in Table 2.3.5. Different protective structures comprising net+poly, net and open condition had remarkable influence on number of fruits/plant, individual fruit weight and yield/plant. Performance of the crop over two locations indicated that the crop grown in the farmers field of Sylhet district performed better (but not much profound) in relation to number of fruits per plant and fruit yield per plant for all treatments. However, plants grown under net+polythene and only net protected system performed much better than crop grown in open field condition for both of the districts.

Table 2.3.5. Comparison of sweet pepper production between Habiganj and Sylhet

District	Numbers of fruit/plant			Individual fruit weight (g)			Fruit yield per plant (g)		
	Net+Poly	Net	Open	Net+Poly	Net	Open	Net+Poly	Net	Open
Habiganj	9.30	7.80	5.70	87.70	86.20	57.30	826.40	686.50	333.30
Sylhet	10.14	9.71	6.57	84.43	79	54.86	861.0	770.14	362.29
Average	9.72	8.76	6.14	86.07	82.60	56.08	843.70	728.32	347.80

Economic analysis on sweet pepper production under different protective structures is given in Table 2.3.6. Different protective structures had the significant influence on yield of sweet pepper. In this on farm adaptive trial, the highest number of fruits/plant (9.72) was recorded from the plant grown under net+polythene followed by the crops grown from only net protective structure (8.76). The corresponding fruit yield was also the highest (134 kg/decimal) when the crops grown under net+polythene protection followed by the plant grown from only net protection (115 kg/decimal), while the average yield/decimal was 100 kg. The market prices of per kg fruit harvested from net+polythene and only net were maximum (110 Tk/kg) while it was the minimum for open condition (50 Tk/kg) because of small and improper shape of the fruit. From the table it is observed that the BCR was maximum (5.06) for the sweet pepper grown from only net protection but gross income was maximum (14740 Tk/decimal) for net+polythene protection. It was due to the higher cost of production (4200 Tk/decimal) under net+polythene protection system compared to only net protection (2500 Tk/decimal) system.

Table 2.3.6. Yield and economic analysis of capsicum production under different protection system

Production system	No. of fruit /plant	Yield/ plant (kg)	Yield (kg/ decimal)	Rate (Tk/kg)	Gross income (Tk/ decimal)	Cost (tk/ decimal)	Gross Margin (Tk/ decimal)	BCR
Net+Polythene	9.72	0.84	134	110	14740	4200	10540	3.50
Only net	8.76	0.72	115	110	12650	2500	10150	5.06
Open	6.14	0.34	51	50	2550	1000	1550	2.55
Average	8.21	0.63	100	90	9980	2566.67	7413.33	3.70

Plate 2.3.1. Up-scaling of sweet pepper in farmers' field

Broccoli

Table 2.3.7 displaying the yield and yield attributes of broccoli (Var. Green magic) at farmer s field of Habiganj district. From the table it is observed that the number of days to first curd initiation was varied from 69-80 days while average number of days was 75. The number of days to first harvest ranged from 76 to 95 days. The average curd yield per decimal was 84.6 kg where the maximum curd yield/decimal was 99.54 kg and the minimum curd yield/decimal was 60.3 kg.

Table 2.3.7. Yield and yield attributes of broccoli at farmers field of Habiganj district

Farmer's name	Date of Sowing	Days to curd initiation	Plant height at curd initiation (cm)	No. of leaves at curd Initiation	Days to harvest	Curd yield/ plant (g)	Curd yield kg/decimal
1. Md. Imran Hossain	26.10.14	76	29.5	12	93	542	97.56
2. Md. Mosahid Mia	26.10.14	75	40.2	11	89	402	72.36
3. Md. A. Salam	28.10.14	71	41.5	10	90	553	99.54
4. Md. Abdullah	25.10.14	75	29.1	11	92	447	80.46
5. Md. Toyib Ali	26.10.14	75	41.5	12	91	423	76.14
6. Md. Samaj Ali	28.10.14	69	46.1	16	76	335	60.3
7. Md. Uster Mia	28.10.14	76	26.7	12	92	545	98.1
8. Md. Abdul Qaium	25.10.14	76	31.5	12	92	506	91.08
9. Md. A. Kadir	23.10.14	77	38.2	13	94	452	81.36
10. Md. Polash Mia	20.10.14	80	29.9	12	95	495	89.1
Average		75	35.42	12.1	90.4	470	84.6
Max		80	46.1	16	95	553	99.54
Min		69	26.7	10	76	335	60.3
Stdev		3.06	6.79	1.60	5.36	71.13	12.80

Table 2.3.8 displaying the yield and yield attributes of broccoli (Var. Imperial) at farmer s field of Sylhet district. Average number of days to first curd initiation was 75.75 days while it was ranged from 74 to 80 days. The curd yield/decimal was ranged from 112.5 kg to 149.4 kg while average curd yield per decimal was 133.15 kg.

Table 2.3.8. Yield and yield attributes of broccoli at farmers field of Sylhet district

Farmer's name	Date of Sowing	Days to curd initiation	Plant height at curd initiation (cm)	No. of leaves at curd initiation	Days to harvest	Curd yield/ Plant (g)	Curd yield kg/decimal
1. Md. Wahab Ali	25.10.14	77	38.6	11	91	650	117.0
2. Belal Ahmed	25.10.14	74	45.3	12	87	810	145.8
3. Md. Mokuddos	25.10,14	75	44.6	13	87	823	148.1
4. Md. Sabuj Mia	25.10.14	74	40.3	11	87	780	140.4
5. Md. Wahab Ali	25.10.14	75	40.5	14	90	750	135.0
6. Md. Koisor	25.10.14	75	38.5	12	87	650	117.0
7. Md. Delowar	10.10.14	80	43.1	13	92	625	112.5
8. Raju Ahmed	15.10.14	76	42.5	14	89	830	149.4
Average		75.75	41.675	12.5	88.75	739.75	133.155
Max		80	45.3	14	92	830	149.4
Min		74	38.5	11	87	625	112.5
Stdev		1.98	2.60	1.20	2.05	85.37	15.37

Comparison of broccoli production at farmer's field between Habiganj and Sylhet district is presented in Table 2.3.9. From the table it is observed that the average number of days to first curd initiation was 75.4 days and average number of days to first harvest was 89.6 days. The curd yield per plant was the maximum (739.75) recorded from Sylhet district compared to Habiganj district (470 g). The corresponding curd yield/decimal was higher (133.15 kg/decimal) in Sylhet over Habiganj district (84.6 kg/decimal). This variation might be attributed due to the varietal difference as well variation in management practices among the farmers between two districts and thus further yield improvement of broccoli in Habiganj district can be made providing suitable variety and better management practices in the farmers field.

Table 2.3.9. Yield comparison of broccoli between Habiganj and Sylhet district

District	Days to curd initiation	Plant height at curd initiation (cm)	No. of leaves at curd Initiation	Days to harvest	Curd yield/ Plant (g)	Curd yield kg/decimal
Habiganj	75.0	35.42	12.1	90.4	470.0	84.60
Sylhet	75.75	41.67	12.5	88.75	739.75	133.15
Average	75.4	38.5	12.3	89.6	604.9	108.9

Plate 2.3.2 Up-scaling of broccoli in farmers' field

Activity 2.4. Evaluation of photo-insensitive country bean at varied sowing dates in summer season

Country bean *(Lablab purpureus*) is leguminous vegetable rich in protein. To meet the nutritional requirement of the people in our country this crop can play an important role since it is rich in protein, vitamin and minerals. However, this crop is mostly grown during winter season due to its photo sensitivity nature. Since scientists were able to develop some photo-insensitive country bean lines (Anon., 2010) hence their cultivation during off-season can play an important role for human diet. Besides, growing country bean during summer season can ensure high return to the growers since the price is much higher as compared to that of winter season crop. Considering aforesaid issues three photo-insensitive country bean genotypes were evaluated at the experimental field of Sylhet Agricultural University at 15 of January, March and May 2015 under RCB design with three replications.

Effect of genotype

Significant variations were observed among the country bean genotypes in respect to days to flowering, number of pods per plant, individual pod weight and pod yield per plant (Table 2.4.1). The number of pods/plant (283.00), individual pod weight (5.53 g) and pod yield per plant (1.64 kg) were the maximum for the genotype BP003 which was identical to that of SB003 (BARI Sheem-7) while all of these were the minimum for SB010.

Table 2.4.1. Effect of genotype on growth and yield of summer country bean

Genotype	Days to Flower	Days to Harvest	Number of Pods/ Plant	Pod Yield/Plant (kg)	Individual Pod Weight (g)
BP003	59.00b	85.67	283.00a	1.64a	5.53a
SB003(BARI sheem -7)	59.44b	85.67	281.78a	1.60a	5.79a
SB010	61.55a	86.67	211.11b	0.97b	4.72b
F-test	**	ns	**	**	**
CV%	2.42	1.44	17.08	18.93	7.99

Effect of sowing date

Sowing date had the significant influence on yield and yield attributes of country bean (Table 2.4.2). Days to first harvest (84.44 days) was recorded from 15 May sowing. Number of pods per plant and pod yield per plant was largely affected by sowing dates. The highest number of pods per plant was recorded from the plants of 15 March sowing (416.89) while it was 192.56 and 166.44 for January 15 and May 15 sowing, respectively. Similar trend was also observed for pod yield per plant. The highest pod yield per plant was recorded from March 15 sowing (2.20 kg) while it was

1.14 kg per plant for January sowing and 0.85 kg per plant for 15 May sowing. Yields of pod at January and May sowing were much lower than that of March sowing. The crop sown in January month experienced much colder situation caused slow initial vegetative growth and the plants grown from May sowing were largely affected by heavy rain during the month of July - August might be the reason for low yield compared to that of March sowing. However, for more conformation of the result this study will be repeated in the next year.

Table 2.4.2. Effect of sowing dates on growth and yield of summer country bean

Sowing date	Days to Flower	Days to Harvest	Number of Pods/ Plant	Pod Yield/Plant (kg)	Individual Pod Weight (g)
15 January	60.11	85.33b	192.56b	1.14b	5.80a
15 March	59.88	88.22a	416.89a	2.20a	5.12b
15 May	60.00	84.44b	166.44b	0.85b	5.13b
F-test	ns	**	**	**	**
CV%	2.42	1.44	17.08	18.93	7.99

Interaction effect between genotype and sowing date

Significant interactions were found between genotypes and sowing date in case of off season country bean production in respect to yield and yield attributes (Table 2.4.3). The highest number of pod per plant (474.00) was harvested from the treatment combination V1T2 (BP003 when coupled with 15 March sowing), followed by (470.00) for V2T2 (SB003 when coupled with 15 March sowing). Similar trend also found in case of pod yield per plant. The pod yield per plant was the maximum (2.80 kg) for the treatment combination V1T2 while it was the minimum (0.68 kg) for V3T3 (SB010 when coupled with 15 May sowing).

Table 2.4.3. Interaction effect between genotype and sowing date on growth and yield of summer country bean

Genotype× Sowing date	Days to Flower	Days to Harvest	Number of Pod/ Plant	Pod Yield/Plant (kg)	Individual Pod Weight (g)
V1T1	59.00bc	84.00	184.00cd	1.09bc	5.38b
V1T2	59.00bc	89.00	474.00a	2.80a	5.61b
V1T3	59.00bc	84.00	191.00cd	1.03bc	5.61b
V2T1	57.33c	85.00	231.00bc	1.43b	6.4a
V2T2	61.00ab	88.00	470.00a	2.52a	5.30b
V2T3	60.00bc	84.00	144.33d	0.84c	5.58b
V3T1	64.00a	87.00	162.67cd	0.89c	5.52b
V3T2	59.66bc	87.67	306.67b	1.38b	4.45c
V3T3	61.00ab	85.33	166.00cd	0.68c	4.20c
F-test	**	ns	*	**	*
CV%	2.42	1.44	17.08	18.93	7.99

V1=BP003, V2=SB003,V3=SB010,T1=15 Jan,T2=15 March,T3=15 May.

After evaluation of promising advance lines BP003 and SB010 were registered as variety for commercial cultivation by the Ministry of Agriculture in 2015 and name was given “Sikribi sheem-1” and “Sikribi sheem-2” (Plate 2.4.1)

(a) Sikribi eheem-1

(b) Sikribi sheem-2

Plate 2.4.1. Pictorial views of (a) Skribi sheem-1 and (b) Sikribi sheem 2

Activity 2.5. Evaluation of tomato hybrids during summer

Tomato is a winter season crop. Production of tomato during summer is getting popularity among many farmers of the country. Though the variety BARI Hybrid tomato-4 is the most popular variety among the farmers for summer cultivation, often farmers are asked for the new variety with higher number of fruits per plant with bigger fruit size. Plant growth regulator and use of grafted seedling have been reported very effective for tomato production during summer (Ahmed, 2011; Kuo, 1989). Therefore, in the present study 5 tomato hybrids along with BARI hybrid tomato-4 were evaluated under hormone and without hormone application conditions. Seeds of all hybrids were sown on 5 May 2015 and 25 day old seedlings were transplanted in the main field at 60 cm X 40 cm spacing. The growth regulator tomatotone (PCPA) at the rate of 2% was sprayed on plants having 4-5 flower clusters at full bloom stage. Plant received three sprays at 5-6 days interval. Two rows in each plot were kept unsprayed. Data were recorded for yield and yield attributes and statistically analyzed using MSTAT software.

Results and Discussion

Main effect of hybrid

Significant variations for yield and yield attributes were observed among the tomato hybrids when grown during summer season (Table 2.5.1). The highest number of fruits (22.67) per plant was recorded from the BARI hybrid tomato-4 closely followed by the hybrid THC1 (19.68). Although the hybrid DCH3 produced the heaviest individual fruit (46.65 g) but its corresponding fruit yield per plant was the lowest (0.63 kg) since it produced the lowest number of fruits per plant. Among the hybrids, BARI hybrid tomato-4 and THC1 exhibited better performance in relation to fruit yield per plant (0.89 kg and 0.84 kg per plant, respectively).

Table 2.5.1. Effect of hybrids on yield and yield attributes of tomato during summer

Hybrids	Days to flower	Days to harvest	Number of fruits/plant	Individual fruit wt (g)	Fruit yield/plant (kg)	Pericarp Thickness (mm)	locule	TSS
BHT-4	51.17c	90.17	22.67a	39.35b	0.89a	6.88a	2.93b	5.32
DCH1	52.00bc	90.00	18.28b	41.66b	0.76bc	5.97b	4.77a	5.11
DCH2	51.67bc	89.83	17.89b	40.45b	0.72cd	6.19b	3.95a	5.01
DCH3	55.33a	91.83	13.62c	46.65a	0.63d	6.19b	4.77a	5.17
THC1	53.33a-c	90.00	19.68ab	42.33b	0.84ab	5.80b	4.98a	5.40
THC2	54.17ab	89.33	16.44bc	38.96b	0.64cd	5.86b	4.60a	5.30
F-test	*	ns	**	**	**	**	**	ns
CV%	4.18	1.85	12.14	6.18	9.77	5.28	13.37	6.25

BHT-4= BARI hybrid tomato-4

Main effect of hormone

Yield and yield attributes of summer tomato production were significantly affected by the application of hormone (Table 2.5.2). The highest number of fruits per plant (19.25) was harvested from the plant when applied with hormone while it was only 16.97 for the plants when grown without hormone. Similar trend was also observed for the parameters of individual fruit weight and fruit yield per plant. Individual fruit weight of hormone treated plant was 43.03 g while it was 40.06 g for non treated plant. The fruit yield per plant showed significant difference with hormone application which was 0.82 kg per plant while the plants of non treated with hormone produced 0.68 kg of fruit per plant. Similar variation was also reported by several workers (Ahmad *et al*., 2011).

Table 2.5.2. Effect of hormone application on yield and yield attributes of tomato during summer

Hormone	Days to flower	Days to harvest	Number of fruits/plant	Individual fruit wt (g)	Fruit yield/plant (kg)	Pericarp Thickness (mm)	locule	TSS (%)
H1	52.89	88.94	19.25	43.08	0.82	6.26	4.23	5.03
H0	53.00	91.44	16.94	40.06	0.68	6.04	4.44	5.13
F-test	ns	**	ns	**	**	ns	ns	ns
CV%	4.18	1.85	12.14	6.18	9.77	5.28	13.37	6.25

Interaction effect

Interaction effect between hybrids and hormone had significant influence on yield and yield attributes of tomato during summer season (Table 2.5.3). The highest number of fruits per plant (25.67) was harvested from the treatment combinations V1H1 (BHT-4 treated with hormone), while it was lowest (13.03) for V4H0 (DCH3 without hormone treatment). Similar trend was also observed for the parameter of fruit yield per plant. The fruit yield was highest (1.03 kg/plant) for the treatment combination V1H1 (BHT-4 treated with hormone), followed by (0.92 kg/plant) for the combination V5H1 (TCH-1treated with hormone). The interaction between hybrids and hormone also had the significant influence on pericarp thickness. The pericarp thickness (7.47 mm) was the maximum for BHT-4 treated with hormone.

Table 2.5.3. Interaction between hybrids and hormone on yield and yield attributes of tomato during summer

Hybrids/ Hormone	Days to flower	Days to harvest	Number of fruits/plant	Individual fruit wt (g)	Fruit yield/plant (kg)	Pericarp Thickness (mm)	locule	TSS
V1H1	51.33	89.33	25.67a	40.31	1.03a	7.47a	2.97	5.28
V1H0	51.00	91.00	19.67cd	38.39	0.75cd	6.30b	2.90	5.36
V2H1	52.00	88.00	18.61cde	44.16	0.83bc	5.93b	4.10	5.16
V2H0	52.00	92.00	17.95ef	39.16	0.69d	6.00b	5.43	5.06
V3H1	51.67	88.33	17.77ef	40.67	0.72cd	6.07b	4.33	5.22
V3H0	51.67	91.33	18.01de	40.23	0.72cd	6.32b	3.57	4.80
V4H1	55.00	90.33	14.20gh	50.41	0.71d	6.35b	4.67	5.04
V4H0	55.67	93.33	13.03h	42.90	0.56e	6.04b	4.87	5.29
V5H1	53.00	89.67	21.77bc	42.50	0.92b	5.74b	4.95	5.63
V5H0	53.67	90.33	17.60ef	42.16	0.77cd	5.85b	5.00	5.16
V6H1	54.33	88.00	17.47ef	40.42	0.70d	6.00b	4.33	5.47
V6H0	54.00	90.67	15.40gh	37.49	0.58e	5.72b	4.87	5.12
F-test	ns	ns	*	ns	**	*	ns	ns
CV%	4.18	1.85	12.14	6.18	9.77	5.28	13.37	6.25

Plate 2.5.1. On station evaluation of summer tomato hybrids

Activity 2.6. On farm adaptive trial of Summer Country bean and Summer Tomato

Adaptive trial on summer country bean and summer tomato at farmer s field of different upazilas of Habiganj and Sylhet districts were completed during the summer season of 2015. Out of 22 selected farmers, 17 farmers were successfully completed the trials for both of the crops. High rain fall, mismanagement, flash flood and fed by cattle caused to damage of some trials in the farmers field. For country bean adaptive trial selected farmers were given seeds of BARI Sheem-7. Farmers grew country bean through direct seed sowing in the pits. For summer tomato trial grafted seedlings of BARI hybrid tomato-4 were given to the farmers. Data on different growth and yield parameters were collected and analyzed for interpretation of results. Details of the collected information presented below-

Country bean

Some phenological information, yield and yield attributes on country bean production at selected farmer s field of Habiganj and Sylhet districts are presented in Table 2.6.1 and 2.6.2. From the table it is observed that the seed sowing was made in the month of April. The average number of days to flower (59.75 days) and days to first harvest (84.38 days) were recorded from the adaptive trial in Habiganj district while it was 60.89 days and 85.56 days for Sylhet district.

Production of country bean during summer was largely affected by the farmers. Pod yield per plant at Habiganj district was varied from 0.9 kg to 1.71 kg (Table 2.6.1). The corresponding pod yield per decimal was also varied from 32.4 kg to 61.5 kg. The variation of pod yield among different farmers might be attributed due to the variation of management practices and other factors like soil fertility, shady place etc. All farmers sold some portion of their produce in the market and market price of country bean during summer varied from 65 to 90 tk per kg depending upon harvesting time and location.

Table 2.6.1. Production of country bean during summer at farmers field of Habiganj district

Farmer Name	Date of sowing	Days to flower	Days to harvest	yield/ plant (kg)	Yield/ decimal	Highest price Tk/kg	%sale
1. Md. Shamoj Ali	23.4.2015	61	87	1.22	43.2	It varies	
2. Md. Taib Ali	27.4.2015	59	84	0.9	32.4	from **65-90**	
3. Md. Imran Hossain	28.4.2015	62	86	1.51	54.3	tk at	
4. Salam Mia	28.4.2015	61	84	1.25	45.0	different	
5. Md. Polash Mia	25.4.2015	60	85	1.21	43.56	harvesting	
6. Syed A. Kadir	30.4.2015	60	84	1.71	61.5	time and	
7. Md. Faruk	10.5.2015	58	83	1.45	52.2	different	
8. Md. Mosahid Mia	5.5.2015	57	82	1.3	46.8	locations	
Average		59.75	84.38	1.32	47.37		
Range		58-62	82-87	0.9-1.71	32.4-61.5		
Stdev		1.67	1.60	0.24	8.73		

Country bean production during summer at Farmers field of Sylhet district is given in Table 2.6.2. The highest pod yield per plant (1.60 kg) and per decimal (57.60 kg) was recorded from one farmer while the average yield among the farmers was 50.88 kg per decimal. Price of pod in the market nearby to each farmer varied from 65 to 85 Tk per kg.

Table 2.6.2. Production of country bean during summer at farmers field of Sylhet district

Farmer Name	Date of sowing	Days to flower	Days to harvest	yield/ plant (kg)	Yield/ decimal	Price Tk/kg
1. Saidur Rahman	29.3.2015	60	85	1.60	57.60	
2. Md. Mortuza Ali	31.3.2015	61	87	1.40	50.40	It varies
3. Abdus Sabur	30.3.2015	63	84	1.50	54.00	from **65-**
4. Md. Wahab Ali	10.4.2015	60	84	1.25	45.00	**85** tk at
5. Md. Zaher Mia	15.4.2015	61	85	1.40	50.40	different
6. Mokaddas Ali	15.4.2015	62	87	1.55	55.80	harvesting
7. Md. Kiosor Ahmad	15.4.2015	60	83	1.37	49.32	time and
8. Belal Ahmad Imran	3.4.2015	58	87	1.42	51.12	different
9. Safura Begum	10.4.2015	63	88	1.23	44.28	locations
Average		60.89	85.56	1.41	50.88	
Range		58-63	83-88	1.23-1.60	44.28-57.60	
Stdev		1.62	1.74	0.12	4.47	

Comparison of summer country bean production and benefit cost estimation at farmer's field between Habiganj and Sylhet district is presented in Table 2.6.3. From the table it is observed that there is a very minor variation in relation to pod yield is existed. Estimation of benefit cost revealed that one can earn more than 2000 tk per decimal by growing country bean during summer season.

Table 2.6.3. Variation in pod yield and economic return between Habiganj and Sylhet district

District	Yield/ Plant (kg)	Yield Kg/decimal	Rate (Tk/kg)	Gross income (Tk/decimal)	Cost Tk/decimal)	Gross margin (Tk/decimal)	BCR
Habiganj	1.32	46.88	70	3281	1350	1931	2.43
Sylhet	1.41	50.88	70	3561	1350	2211	2.64
Average	1.365	48.88	70	3421	1350	2071	2.53

Observation was made to estimate the incidence of diseases and insects during the growing period of the crop and presented in Table 2.6.4. Among the insect, aphid was found most common among the trials. Hand destruction and spraying pirimor were made to control this pest. Bean common mosaic virus also found at eight different adaptive trials. To control this pest hand destruction was mostly advised. One fungal disease cercospora leaf spot also observed at 12 adaptive trials. To minimize this disease indofil and/or secure was sprayed by the farmers. At harvest of green pod, at 15 trials infestation by pod borer was noticed. Aphid and bean common mosaic infected picture in given in plate 2.6.1.

Table 2.6.4. Diseases and insect infestation at farmer's field

Item	No. of affected trial	% infestation	Remark
1. Aphid	16	5-8	Manual destruction and use of pirimor were found effective
2. Bean common mosaic virus	8	2-5	Destruction of infective twigs was made
3. Cercospora leaf spot	12	10-15	Black and irregular spot on leaves. Indofil and secure
4. pod borer	15	2-10	fruits were unfit for consumption.

Aphid affected plant

Bean common mosaic virus

Plate 2.6.1. Aphid and virus affected country bean plant

Summer tomato

Yield and yield attributes for tomato production during summer season at farmers field of Habiganj district is given in Table 2.6.5. All the farmers planted seedlings in the main field on July 28, 2015. Number of fruits per plant was largely varied from 15 to 25 among the farmers. Consequently fruit yield per plant as well fruit yield per decimal also varied among the farmers. The average fruit yield per plant among the farmers was 0.86 kg. A remarkable variation for tomato yield was noticed (113.6 kg to 153.6 kg/decimal) among the farmers and it was mostly attributed due to the mismanagement by the farmers and infection of plants with yellow leaf curl virus. After harvest of the fruit, some portion was sold in the market and market price varied Taka 80 to 110 from place to place and time of harvesting.

Table 2.6.5. Summer tomato production during at farmers field of Habiganj district

Farmer Name	Date of planting	Days to harvest	No. Of fruits/plant	yield/ plant (kg)	Yield/ decimal	Price Tk/kg
1. Md. Shamoj Ali	28.06.15	31.08.15	19	0.83	132.8	80-110
2. Md. Taib Ali	28.06.15	30.08.15	18	0.83	132.8	
3. Md. Salam Mia	28.06.15	30.08.15	25	0.96	153.6	
4. Md. Polash Mia	28.06.15	2.09.15	15	0.71	113.6	
5. Syed A. Kadir	28.06.15	29.08.15	23.5	0.9	147.2	
6. Md. Ustar Mia	28.06.15	29.08.15	22.5	0.9	144.0	
7. Md. Kaium	28.06.15	31.08.15	24	0.86	137.6	
Average			21.00	0.86	137.37	
Range			15-25	0.71-0.96	113.6-153.6	
Stdev			3.71	0.08	12.98	

Yield and yield attributes for tomato production during summer season at farmers field of Sylhet district is given in Table 2.6.6. Some of the selected farmers transplanted their seedling during the month of June while some other on July. Variation in relation to number of fruits per plant, fruit yield per plant was recorded from farmer's field. The highest number of fruits per plant was recorded from the field of Junab ali (25) while it was the lowest for Rasendra Talukdar (16). Average fruit yield per plant was varied from 0.80 kg to 0.94 kg. During the harvesting period of tomato farmers sold their produce at 70 to 100 taka per kg.

Table 2.6.6. Summer tomato production during at farmers field of Sylhet district

Farmer Name	Date of planting	Days to harvest	No. Of fruits/plant	yield/ plant (kg)	Yield (kg/ decimal)	Price Tk/kg
1. Saidur Rahman	10.6.15	15.08.15	17	0.82	131.20	
2. Md. Samir Ali	12.06.15	20.08.15	22	0.81	129.60	70-100
3. Md. Jonab Ali	10.7.15	08.09.15	25	0.83	132.80	
4. Md. Wahab Ali	10.07.15	12.09.15	23	0.89	142.40	
5. Md. Zaher Mia	10.07.15	12.09.15	22	0.87	139.20	
6. Mokaddas Ali	15.07.15	14.09.15	18	0.84	134.40	
7. Md. Kiosor Ahmad	12.07.15	15.09.15	21	0.78	124.80	
8. Belal Ahmad Imran	15.6.15	18.08.15	23	0.87	139.20	
9. Rasendra Talukdar	07.06. 15	09.08.15	16	0.76	121.60	
10. Safura Begum	20.06.15	21.08.15	19	0.75	120.00	
Average			20.6	0.82	131.52	
Range			16-25	0.80-0.94	128-156	
Stdev			2.95	0.05	7.65	

Comparison between two districts (Table 2.6.7) about summer tomato production during summer season at farmers field revealed that yield per plant was little higher at Habiganj district (0.86 kg/plant). Although the calculated BCR was found lower but one can earn more than 4000/ taka per decimal from summer tomato cultivation in Sylhet region provided the crop is grown successfully.

Table 2.6.7. Comparison between two districts about yield and monetary return

District	Yield/ Plant (kg)	Yield Kg/decimal	Rate (Tk/kg)	Gross income (Tk/decimal)	Cost Tk/decimal)	Gross margin (Tk/decimal)	BCR
Habiganj	0.86	137.37	70	9615.9	5000	4615.9	1.92
Sylhet	0.82	131.52	70	9206.4	5000	4206.4	1.84
Average	0.84	134.445	70	9411.15	5000	4411.15	1.88

Diseases, insect attack and physiological disorder of tomato grown at farmers field during summer season of 2015 are presented in Table 2.6.8. Wilting of plants was almost common for all adaptive trials and its severity ranged from 5 to 12% of plants. Wilting was caused due to infection of bacteria, fungus and moist condition of the soil. Leaf spot of the plant was also noticed among different trials and it was appear at fruiting stage of plants. Tomato yellow leaf curl virus was seen at five farmers' field and the infected plants were removed during field visit by the PI and CI. Some physiological disorder like blossom end rot, concentric cracking were also found at the time of harvesting. Picture of diseases infected and healthy tomato plot is given in plate 2.6.2.

Table 2.6.8. Disease, insect infestation and physiological disorder of tomato at farmers field

Item	No of affected trial	% plant or fruit infestation	Remarks
Wilting at 60 DAS	16	5-12	• Caused mostly due to moist condition, Bacterial and fungal infection. Incidence was found at early growth stage (45 day after sowing)
Pseudo-cercospora leaf spot	10	10-30	• Spraying fungicide (Secure) was found effective
TYLCV	5	5-15	• Uprooting and spraying insecticide were made at initial stage
Fruit borer	12	8-10	• Larvae bore into the fruit and feed inside
Blossom end rot	6	4-15	• Blackish lesion was found at blossom end
Concentric cracking	4	minor	• Cracking was found in the shoulder

Pseudo-cercospora leaf spot **TYLCV** **Healthy Field**

Plate 2.6.2. Diseases infected and healthy tomato plot

Year 3 Activities

Activity 3.1. On station evaluation of exotic broccoli hybrids

Introduction

Broccoli (*Brassica oleracea* var. *italica* L.) is an excellent source of vitamin C dietary fibre, potassium and vitamin A. It can contribute significantly to improve our diet. It is now growing successfully in some areas of Bangladesh. Growers are mostly used imported broccoli seed since new improved broccoli variety yet to develop in Bangladesh. Seeds of different hybrid varieties of broccoli are imported from Japan, India, China Thailand etc. Their performance was not properly assessed under Sylhet condition. Therefore, the present study was undertaken.

Materials and Methods

The present study comprising four exotic hybrids of broccoli (Green Giant, Top Green, Green Magic and Green Crown) were evaluated at two different sowing dates (October and November) under RCB design during winter season of 2015-2016 at the experimental field of Sylhet Agricultural University to select suitable hybrids for Sylhet region. Seeds of all varieties were sown on two different dates of 25 October and 15 November 2015 and 30 days old seedlings were transplanted in the main field at 60 cm X 40 cm planting distance. Manures and fertilizers were applied as recommended. Data on yield attributes were collected for interpretation of results.

Results and Discussion

Main effect of variety

Yield and yield attributes of broccoli varieties are presented in Table 3.1.1. No significant variation was found for days to curd initiation among the varieties. Result revealed that one can harvest broccoli curd from field at around 85 day after sowing. Significant variation among the varieties was observed for individual curd weight. The highest individual curd weight was recorded from the variety Green giant (569.16g) followed by Green Crown (549.66 g) while it was the lowest for Top green (302.33 g). Calculated per decimal yield of the varieties exhibited the similar yield performance.

Table 3.1.1. Effect of broccoli hybrids on curd yield

Variety	Days to curd initiation	Days to curd harvest	Individual curd wt (g)	No. of leaves at harvest	Yield (kg/ decimal)
Green Giant	69.33	86.00a	569.16a	15.16	102.5a
Top Green	67.66	82.00b	302.33c	16.16	55.0c
Green Magic	70.33	87.33a	511.83b	16.16	92.0b
Green Crown	68.50	87.16a	549.66ab	16.33	98.8b
F-test	ns	**	**	ns	**
CV%	2.72	3.64	6.25	7.8	6.7

Main effect of sowing dates

Sowing dates had significant influence on curd yield of broccoli (Table 3.1.2). The crop grown from November sowing performed much better (588.33g/decimal) than that of October sowing crop. The plants from October sowing experienced severe rainfall in seedling and early growth stage might be the reason for low yield than that of November sowing.

Table 3.1.2. Effect of sowing dates curd yield of broccoli

Variety	Days to curd initiation	Days to curd harvest	Individual curd wt (g)	No. of leaves at harvest	Curd yield/ decimal
October 25	68.41	86.33	378.16	14.83	68.0
November 15	69.50	84.91	588.33	17.08	105.8
F-test	ns	*	**	**	**
CV%	2.72	3.62	6.25	6.25	6.7

Interaction effect

Curd yield of broccoli was significantly interacted due to variety and sowing dates (Table 3.1.3). The highest individual curd weight (710.0 g) was recorded from the variety Green Giant (710.0 g) and Top Green (698.33 g) when grown from November 15 sowing. Per decimal curd yield indicated that all the broccoli varieties performed much better than that of October 25 sowing.

Table 3.1.3 Interaction effect of hybrids and sowing dates on broccoli production

Variety	Days to curd initiation	Days to curd harvest	Individual curd wt (g)	No. of leaves at harvest	Curd yield Kg/ decimal
V1T1	69.33	86.66bc	428.33cd	13.66	77.0cd
V1T2	69.33	85.33cd	710.00a	16.66	127.8a
V2T1	66.66	80.33e	229.66e	15.33	41.2e
V2T2	68.66	83.66d	375.00d	17.0	67.5d
V3T1	68.33	88.66ab	453.66c	14.66	81.5c
V3T2	72.33	86.00bcd	570.00b	17.66	102.6b
V4T1	69.33	89.66a	401.00cd	15.66	72.0cd
V4T2	67.66	84.66cd	698.33a	17.00	125.6a
F-test	ns	**	**	ns	**
CV%	2.72	3.64	6.25	6.25	6.7

Activity 3.2. Seed production potentiality of photo-insensitive country bean genotypes

Introduction

Country bean is a protein rich self pollinated crop. Due to its photo-sensitive nature it is mostly grown during winter in Bangladesh. Some of the country bean varieties/genotypes are available which are photo-insensitive in nature and can be grown in summer condition in Bangladesh. Quality seed is the prerequisite for successful production of country bean. Since winter is most congenial for seed production for country bean hence seed production of photo-insensitive country bean is to be done in winter instead of summer. Therefore, the present study was undertaken to evaluating seed potentiality of four country bean genotypes under Sylhet condition.

Materials and Methods

The present study was conducted at the experimental field of Sylhet Agricultural University during winter season of 2015-2016. Four photo-insensitive country bean genotypes viz., SB010, SB003 (BARI sheem 7), BP003 and IPSA Sheem-2 were included in this study. The experiment was conducted in RCB design with three replications. Seeds of all genotypes were sown on 8 September 2015 in raise bed. Plants were spaced at 1.0 m X 1.5 m between plant to plant and row to row, respectively. After germination of seeds, bamboo made staking was given for climbing of the plants. Fertilizer application, irrigation, weeding etc were done as and when required. Data on some characteristics of genotypes and seed yield attributes were taken properly. Collected data were analyzed for interpretation of results.

Results and Discussion

Some characteristics features of country bean genotypes are given in Table 3.2.1. No significant difference was found for days to first flowering. It was varied from 41 to 46 days. The flower colour of the genotype SB010 was violet while the remaining genotypes had white coloured flower. Inflorescence length varied 38.0 cm to 41.2 cm. Pod colour of SB010 and IPSA sheem-2 was light green while deep green for SB003 and BP003. The genotypes SB003, BP003 and IPSA sheem-2 had seed reddish brown in color while this was black for SB010. Flower and pod colour of the genotypes are given in plate 3.2.1 and 3.2.2, respectively.

Table 3.2.1. Some characteristics features of country bean varieties

Genotypes	Days to flower	Flower color	Inflorescence length (cm.)	Pod color	Seed color
SB010	46	violet	38.0	Light green	Black
SB003*	41	White	41.2	Deep green	Reddish Brown
BP003	46	White	40.1	Deep green	Reddish Brown
IPSA Sheem-2	46	White	39.5	Light green	Reddish Brown
F-test	ns	-	ns	-	-
CV%	4.95	-	2.72	-	-

*BARI Sheem 7

SB010 **SB003** **BP003** **IPSA-2**

Plate 3.2.1 Color of flower and flower wings of four genotypes during late sowing.

SB010 **SB003** **BP003** **IPSA Sheem-2**

Plate 3.2.2 Seed color and seed shape of four genotypes during late sowing.

Seed yield and yield attributes are presented in Table 3.2.2. Number of dry pods/plant varied significantly among the four genotypes. The highest number of dry pod/plant was recorded in the genotype of SB010 (155.5) followed by the genotype of IPSA-2 (91.30). Other genotypes SB003 and BP003 had 68.30 and 81.77 number of dry pods/plant. Mollah *et al.* (1995) and Khan (2003)

observed that the variation in number of pod per/plant might be due to the difference in number of inflorescence per plant, pods/raceme, flower dropping tendency of the genotypes. There was no significant difference among the four genotypes for number of dry seeds/pod. Number of dry seeds/pod ranged from 4.73 to 4.93. In hundred seed weight, statistically significant difference was found among the four genotypes. The highest hundred seed weight was recorded in the genotype of SB010 (35.67 g.) followed by the genotype BP003 (32 g.). Other genotypes SB003 and IPSA Sheem-2 had 29.0 g and 27 g., respectively. The highest seed yield/plant was found (229.1 g) in the genotype of SB010 followed by the genotype of BP003 (118.5 g) where other genotypes SB003 and IPSA Sheem-2 had 70.33 and 90.90 g, respectively.

Table 3.2.2. Seed yield and yield attributes of country bean genotypes

Genotypes	Number of dry pods/plant	Number of dry seeds/pod	100 seed weight (g)	Seed yield (g)/plant
SB010	155.5a	4.73	35.67a	229.1a
SB003	68.30b	4.76	29.00c	70.33b
BP003	81.77b	4.8	32.00b	118.5b
IPSA Sheem-2	91.30ab	4.93	27.00c	90.90b
F-test	**	ns	**	**
CV%	21.46	1.66	3.10	12.61

Ns = Non-significant

** Significant at 1% level of probability; ns= non-significant.

Seed yield (t/ha)

The highest seed yield was measured from the genotype of SB010 (1.75 t/ha) followed by the genotype of BP003 (0.9 t/ha). Seed yield of other two genotypes SB003 and IPSA Sheem-2 had 0.52 and 0.62 t/ha, respectively (Figure 3.2.1).

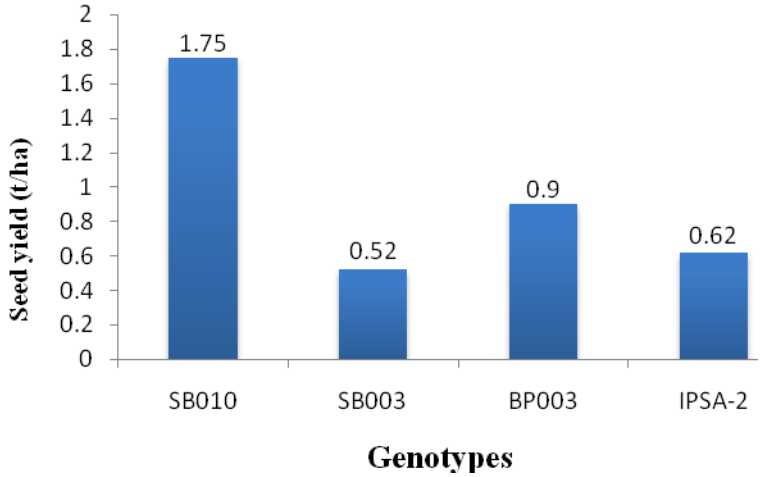

Figure 3.2.1 Seed yield of four lablab bean genotypes

Activity 3.3

On farm adaptive trial of sweet pepper and broccoli during winter of 2015-16

Adaptive trial on broccoli and sweet pepper at farmer s field of different upazilas of Sylhet, Habiganj, Sunamganj and Moulavibazar districts were completed during the winter season of 2015-2016. Seeds and other research inputs were given to the selected farmers well ahead for timely establishment of the trials. For broccoli adaptive trial (variety Green Magic), 25-30 days old seedlings were transplanted in the main field at 60 cm X 40 cm planting distance. For sweet pepper adaptive trial (BARI Misti morich 1), selected farmers grew sweet pepper under net and polythene covering system. In this system the plants remained under net covering system during the whole cropping period while polythene covering was given at night during the month of December and January to protect the plants from cold injury. Data on different growth and yield parameters were collected and analyzed for interpretation of results. Details of the collected information presented below-

Broccoli

Some phenological data on broccoli adaptive trial are given in Table 3.3.1. Farmers had sown broccoli seeds in the last week of October to mid November 2015. Mean performance among the farmers revealed that 70 days and 88 days were required to first flower and first harvest, respectively. However, days to first harvest varied from 81 days to 96 days. This variation might be attributed due to differences of sowing dates among the farmers, location etc. Number of leaves per plant at curd initiation ranged from 14 to 17.

Table 3.3.1. Some phenological information on broccoli adaptive trial

Farmer's name	Date of sowing	Days to curd initiation	Days to first harvest	No. of leaves at curd initiation
Moulavibazar				
1. Gazi Moinuddin	30.10.15	71	89	15
2. Nilmoni Singh	13.11.15	72	91	16
3. Rajendra Singh	30.10.15	69	87	15
4. Bajendra Singh	30.10.15	74	89	16
5. Khairul Islam	10.11.15	73	91	16
Sylhet				
1. Md. Kamrul Bhuiyan	20.10.15	64	83	15
2. Md. Salim Ahmed	25.10.15	78	96	16
3. Md. Shahjan Ahmed	04.11.15	73	94	14
4. Saidur Rahman	08.11.15	67	83	17
5. Samir Ahmed	01.11.15	66	83	16
6. Md. Sabur	11.11.15	69	82	16
Sunamganj				
1. Saidur Rahman	08.11.15	69	83	16
2. Afroza Begum	15.11.15	70	81	14
3. Rubel Ahmed	20.11.15	70	82	17
4. Abdur Rashid	12.10.15	77	89	16
5. Kuddus Mia	10.10.15	71	94	15
Habiganj				
1.Ostar Mia	27.10.15	70	90	14
2. Somoj Ali	27.10.15	68	88	16
3. Abdul Kadir	27.10.15	69	89	14
4. Polash Mia	27.10.15	67	89	15
5. Julash Mia	27.10.15	68	88	16
Mean		70.24	87.67	15.48
Max		78	96	17
Min		64	81	14
Stdev		3.42	4.37	0.93

Yield, market price and consumption of broccoli from the adaptive trials are presented in Table 3.3.2. Individual curd weight was ranged from 450 g to 690 g among the trials. Average curd yield of broccoli was 102.02 kg. Market price of broccoli for different locations was remarkably different and it was varied from 40 Tk to 70 Tk per kg. Most of the growers (63.5 %) of the trials sold major portion of their produce in the local market. Besides, some portion of the produce also consumed by the growers and their relatives.

Table 3.3.2. Yield, market price and consumption of broccoli at adaptive trials

	Individual curd wt. (g)	Curd yield kg/decimal	Market price (Tk/kg)	Sale (%)	Consumption (%)
Moulavibazar					
1. Gazi Moinuddin	632	113.76	45	60	40
2. Nilmoni Singh	628	113.04	40	70	30
3. Rajendra Singh	646	116.28	40	50	50
4. Bajendra Singh	651	117.18	50	60	40
5. Khairul Islam	640	115.2	40	40	60
Sylhet					
1. Md. Kamrul Bhuiyan	660	118.8	50	85	15
2. Md. Salim Ahmed	630	113.4	40	70	30
3. Md. Shahjan Ahmed	580	104.4	40	65	35
4. Saidur Rahman	500	90.0	40	40	60
5. Samir Ahmed	690	124.2	40	60	40
6. Md. Sabur	500	90.0	40	70	30
Sunamganj					
1. Saidur Rahman	680	122.4	50	50	50
2. Afroza Begum	450	81.0	60	60	40
3. Rubel Ahmed	650	117.0	60	70	30
4. Abdur Rashid	610	109.8	45	60	40
5. Kuddus Mia	625	112.5	50	60	40
Habiganj					
1.Ostar Mia	600	108.0	50	50	50
2. Somoj Ali	690	124.2	70	70	30
3. Abdul Kadir	520	93.6	60	80	20
4. Polash Mia	500	90.0	60	85	15
5. Julash Mia	520	93.6	60	80	20
Mean	600.10	108.02	49.05	63.57	36.43
Max	690	124.2	70	85	60
Min	450	81.0	40	40	15
Stdev	72.16	12.99	9.30	13.05	13.05

Comparison for yield and economic analysis among four districts of Sylhet division is given in Table 3.3.3. More than 100 kg of broccoli was harvested from one decimal of land from each district. Noticeable variation in market price of broccoli was observed among four districts. The highest market price of broccoli was achieved by the growers of Habiganj district (60 Tk/kg) followed by Sunamganj district (53.0 Tk/kg). While market price of broccoli was very low in Moulavibazar (43 Tk/kg) and Sylhet district (42 Tk/kg). Therefore, the highest BCR (4.08) was calculated from Habiganj district closely followed by Sunamganj district (3.83). Average gross

margin clearly indicated that growers can ensure profit more than 3800 taka per decimal from broccoli cultivation.

Table 3.3.3. Mean performance of broccoli at different districts

Districts	Days to first harvest	Individual curd wt. (g)	Curd yield kg/decimal	Market price (Tk/kg)	Gross income	Cost (Tk/decimal)	Gross margin (Tk/decimal)	BCR
1. Moulavibazar	89.4	639.4	115.0	43	4945.0	1500	3445.0	3.30
2. Sylhet	86.8	593.3	106.8	42	4485.6	1500	2985.6	2.99
3. Sunamganj	85.8	603.0	108.5	53	5750.5	1500	4250.5	3.83
4. Habiganj	88.8	566.0	101.9	60	6114.0	1500	4614.0	4.08
Mean	87.7	600.425	108.05	49.5	5323.78	1500	3823.78	3.55

Sweet pepper

Yield and yield attributes of sweet pepper from the trials are presented in Table 3.3.4. Variation in relation to fruit yield and yield attributes among the farmers of four different districts were remarkable. Average performance of the growers indicated that around three months was required from sowing date to first harvest of green sweet pepper. Number of fruits per plant was largely varied from 6.0 t0 13.0. Fruit yield per plant was also remarkably different among the growers. One farmer harvested 0.99 kg of fruits per plant while it was the lowest (0.51 kg/plant) for another farmer. However, average fruit yield per plant among the farmers was 0.85 kg.

Table 3.3.4. Adaptive trials of sweet pepper at farmers field

Farmer's name	Sowing date	Days to first flower	Days to first Harvest	No. of fruits/ plant	Fruit yield/plant (g)
Moulavibazar					
1. Rajendra Singh	30.10.15	55	90	12	980
2. Bajendra Singh	05.11.15	59	94	10	930
3. Khairul Islam	28.10.15	55	99	11	950
4. Md. Manik	28.10.15	58	92	9	765
Sylhet					
1. Md. Kamrul Bhuiyan	20.10.15	51	95	8	700
2. Md. Salim Ahmed	02.11.15	55	98	11	890
3. Md. Shahjan Ahmed	16.11.15	53	91	10	850
4. Saidur Rahman	08.11.15	50	85	6	510
5.Samir Ahmed	01.11.15	53	89	11	920
6. Md. Sabur	17.11.15	54	98	12	980
Sunamganj					
1. Saidur Rahman	05.11.15	54	96	7	660
2. Rubel Ahmed	20.11.15	53	95	10	840
3. Afroza Begum	15.11.15	51	88	8	710
4. Abdur Rashid	24.10.15	58	86	12	975
5. Kuddus Mia	14.10.15	51	87	13	990
Habiganj					
1. Oster Mia	27.10.15	53	90	10	870
2.Somoj Ali	27.10.15	55	89	9	860
3. Abdul Kadir	27.10.15	56	92	11	920
4. Polash Mia	27.10.15	54	91	12	930
Average		54.11	91.84	10.11	854.21
Min		50	85	6.0	510
Max		59	99	13.0	990
Stdev		2.49	4.17	1.88	130.07

Comparison among four districts for sweet pepper yield and economic profitability is presented in Table 3.3.5. The highest fruit yield per plant (906 g) as well per decimal (144.96 kg) was recorded from Moulavibazar district closely followed Habiganj district. Average market price of sweet pepper was recorded 90 taka per kg. Average fruit yield per decimal was ranged from 129 kg to 144 kg. Economic analysis revealed that per decimal cost for sweet pepper production was 4500 taka while average per decimal gross return varied from 7135.2 taka to 8546.4 taka. Calculated BCR ranged from 2.59 to 2.90. Due to success of adaptive trials, almost four upazila agriculture office organized motivation tour (comprising 40-50 farmers) of their own arrangement to popularize high value vegetable crops to other upazilas of Sylhet division (Plate 3.3.1)

Table 3.3.5. Comparison for sweet pepper production among four districts

Districts	No. of fruits/ plant	Fruit yield/plant (g)	Fruit yield/ decimal (kg)	Gross return (90 tk/kg)	Cost/ decimal (Tk.)	Gross margin (Tk.)	BCR
Moulavibazar	10.5	906	144.96	13046.4	4500	8546.4	2.90
Sylhet	9.67	808	129.28	11635.2	4500	7135.2	2.59
Sunamganj	10	835	133.60	12024.0	4500	7524.0	2.67
Habiganj	10.5	895	143.20	12888.0	4500	8388.0	2.86
Mean	**10.1675**	**861**	**137.76**	**12398.4**	**4500**	**7898.4**	**2.76**

Plate 3.3.1. Motivation tour to popularize high value vegetable crops

Activity 3.4. Title: On farm adaptive trials on tomato and country bean during summer

Country bean

For adaptive trial of summer country bean, seeds of BARI sheem-7 were given to the 50 selected farmers in Sylhet Division. Most of the farmers sown seed in their field during the month of March or April 2016. Among the 50 selected farmers, 7 farmers were not able to complete their trail, because the crops were damaged due to rainfall or mismanagement of the farmers. Mean performance in relation to yield and profitability among four districts is presented in Table 3.4.1. District wise detail information is incorporated in Annexure 6.

The highest average pod yield per decimal was recorded from Habiganj district (52.6 kg) which was similar to that of Moulavibazar district (52.28 kg) followed by Sylhet (49.4 kg) and Sunamganj district (47.9). Benefit cost ratio analysis revealed that more or less 2000/ taka can be earned from one decimal of land through summer country bean cultivation.

Tabl1 3.4.1. Variation in pod yield economic return among four districts of Sylhet division

District	Yield/ plant (kg)	Yield kg/decimal	Rate Tk/kg	Gross income tk/decimal	Cost (Tk/decimal	Gross margin Tk/decimal	BCR
Habiganj (n=7)	1.46	52.6	70	3682	1500	2182	2.45
Sylhet (n=11)	1.37	49.4	70	3458	1500	1958	2.31
Sunamganj (n=10)	1.33	47.9	70	3353	1500	1853	2.24
Moulavibazar (n=15)	1.45	52.28	70	3659.6	1500	2159.6	2.44
Average	1.40	50.55	70	3538.15	1500	2038.15	2.36

Price of country in the market ranged 65-100 taka/kg depending upon locations and time of harvesting

Insect and diseases of country bean

Information in relation to insect pest infestation is presented in Table 3.4.2. Aphid, thrips, virus, cercospora leaf spot, pod borer were observed at varying level among the adaptive trials. Manual destruction of infected portion, use of pesticide and use of soap dust solution were advised to the farmers to prevent/minimize the problem.

Table 3.4.2. Diseases and insect infestation at farmer's field (Average of all trials)

Item	No. of affected trial	% Plant infested	Remark
1. Aphid	37	15-75	Manual destruction and use of powder soap solution, pirimor were found effective
2. Thrips	12	5-16	Use of maladan, soap powder solution spray made
3. Bean common mosaic virus	6	2-5	Destruction of infective twigs was made
4. Cercospora leaf spot	32	30-55	Most found later stage of growthBlack and irregular spot on leaves. Indofil and secure
5. pod borer	26	5-10	Fruits were unfit for consumption.

Tomato

Total 20 farmers of three districts were given grafted seedlings of BARI hybrid tomato-4 for conduction of adaptive trial during summer season of 2016. Among them 17 farmers were able to complete their trials. Mean comparison among three districts and benefit cost ratio is given in Table 3.4.3. Average yield of summer tomato (157 kg/decimal) in Moulavibazar was much higher than that of Sylhet region (126 kg/decimal). Farmers of Kamalganj upazila

(Moulavibazar) at which adaptive trials were made much familiar with summer tomato production than that of Sylhet and Sunamganj Districts resulted superior production in their field. Benefit cost ration analysis revealed that one can earn around 6000 taka provided crop is grown efficiently. Mortality rate also lower at Kamalganj (5-9%) in comparison to the other two districts (Annexure 7). More information of the summer tomato adaptive trials are given in Annexure 7.

Table 3.4.3. Comparison among three districts for summer tomato production

District	Yield/ Plant (kg)	Yield kg/ decimal	Price Tk/kg	Gross income (Tk/decimal	Cost Tk/ decimal	Gross Return	BCR
Moulavibazar	0.92	157	70	10990	5000	5990	2.20
Sylhet	0.74	126	70	8820	5000	3820	1.76
Sunamganj	0.8	135	70	9450	5000	4450	1.89
Average	0.82	139.33	70.00	9753.33	5000.00	4753.33	1.95

Plate 3.4.1. Success stories of adaptive trials

(iii). Benefit/Outcome:

- Production and availability of high value vegetable crops increased significantly. This is very encouraging to mention here that the local demand of sweet pepper and broccoli for Sylhet region was mostly met form the production of farmers' field of Sylhet division.
- One farmer involved in this project supplied their surplus produce to the other districts of the country and made significant profit from their production.
- One of the important outputs for country bean is that green pods were found to selling in many local markets of Sylhet during the month of June, July and August which indicated that the production of country bean during summer is increasing in Sylhet region.
- By selling and consuming the produce, growers are benefitted for both nutritionally and financially.
- Farmers are started cultivation of broccoli and sweet pepper in their fallow land during winter season.
- Seeing project activities more or less 80-100 farmers are contacted Sylhet Agricultural University for seeds and production technology for sweet pepper and summer country bean. Olericulture Division of BARI, Gazipur, also informed that several farmers of Sylhet region came to the Office (BARI) and requested for seeds of BARI Mistimorich-1 and BARI hybrid tomato-4.
- Prior to the project activities, sweet pepper and broccoli were almost unknown to the growers and consumers, but now it is well known to many rural farmers.

d. Technology Developed:

- Three sweet pepper genotypes were validated of which BARI Mistimorich-1 and California Wonder most suitable for Sylhet region
- Refinement of protective structure for sweet pepper production technology. In Sylhet region coarse net (mosquito net) protection system for sweet pepper production is more profitable.
- Two photo-insensitive country bean lines have been registered by the Ministry of Agriculture in 2015 for commercial cultivation and named as "Sikribi sheem-1" and "Sikribi sheem-2" (Although hybridization followed by subsequent selection from segregating generations initiated from winter 2005-2006 and as a result one advance line was released as BARI sheem-7 when the PI of this project worked at HRC, BARI. The rigorous selection and evaluation of other important segregating lines made during the present project period and released as variety).
- Considering the climatic condition of Sylhet region, sowing of summer country bean seed in the month of March is most suitable for pod production.
- BARI hybrid tomato-4 is validated in different upazilas of Sylhet division. While two advance lines are selected as promising
- The broccoli variety, Imperial, Green Magic, Green giant were validated for Sylhet region.

e. Publications made/under process

Yes,

- One booklet for summer tomato production, one leaflet for broccoli and one leaf let for sweet pepper production were already published
- One scientific paper already published in national journal
- Four manuscripts are almost ready for submission

Booklet (Annexure 5.1)

১. উচ্চ তাপ সহিষ্ণু টমেটোর জাত ও উৎপাদন প্রযুক্তি: সিলেট অঞ্চল

Leaflet (Annexure 5.2, 5.3)

১. সিলেট অঞ্চলে মিষ্টি মরিচ চাষ

২. ব্রোকলি উৎপাদনের উন্নত কলাকৌশল.

Scientific paper (Annexure 5.4)

1. Debnath, D., **M. S.Islam** and B. Debnath. 2015. Performance of broccoli under inorganic and organic culture system. J. Sylhet Agril. Univ. 2(1): 55-58.

Scientific manuscripts are under process for publication

1. Yield and yield attributes of sweet pepper under different protective structures
2. Production of summer country bean at varied sowing dates
3. Tomato production in summer at varied seedling types and hormone application
4. Production of broccoli in Sylhet at varied sowing dates

f. Training/workshop organized:

Workshop: 2

Sl.no	Title	Date	Subject	Participants with no.	No. of lectures
1	Inception workshop on "High value vegetable crop production in Sylhet region"	21 November 2013	Importance, scopes and production of high value vegetable crops in Sylhet region,	DAE, NGO, Research and University Number: 25	5
2.	Progress workshop on Research under the project of "Validation and upscaling of high value vegetable crops production in Sylhet region"	27 August 2016	Progress and achievements of the project	Farmers, DAE, NGO, Research and University Number: 25	5

Training of Trainers: 2

Sl.no	Title	Date	Subject	Participants with no.	No. of lectures
1	Improved variety and Production Technology of high value vegetable crops in Sylhet region	27 February 2014	Problems and scopes, variety, production technology etc	DAE, NGO, Researcher and University lecturer Number: 25	5
2.	Improved variety and Production Technology of high value vegetable crops in Sylhet region	22 August 2015	Problems and scopes, variety, production technology etc	Farmers, DAE, NGO, Research and University Number: 22	5

Farmers Training: 10

Sl.no	Title and Venue	Date	Subject	Participants with no.	No. of lectures
1	Production Technology of high value vegetable crops in Sylhet region Venue: Sylhet Agricultural University	14 March 2014	-Importance -Summer tomato production -Summer country bean production -Broccoli and sweet pepper production -Seedling raising, bed and poly-tunnel preparation - Disease and Insect management	Farmers, SAAO, NGO worker, Number: 25	6
2.	Production Technology of high value vegetable crops in Sylhet region Venue: Habiganj Sadar	17 April 2014	Do	Farmers, SAAO, NGO worker, Number: 30	5
3.	Production Technology of high value vegetable crops in Sylhet region	15 September 2014	Do	Farmers, SAAO, NGO worker,	

	Venue: Bahubol			Number:28	
4.	Production Technology of high value vegetable crops in Sylhet region Venue: Biswanath	8 November 2014	Do	Farmers, SAAO, NGO worker, Number: 27	
5.	Production Technology of high value vegetable crops in Sylhet region Venue: Sylhet Agricultural University	17 May 2015	Do	Farmers, SAAO, NGO worker, Number: 25	
6.	Production Technology of high value vegetable crops in Sylhet region Venue: Golapganj	29 August 2015	Do	Farmers, SAAO, NGO worker, Number: 22	
7.	Production Technology of high value vegetable crops in Sylhet region Venue: Sunamganj	11 October 2015	Do	Farmers, SAAO, NGO worker, Number: 25	
8.	Production Technology of high value vegetable crops in Sylhet region Venue: Kamalganj	19 October 2015	Do	Farmers, SAAO, NGO worker, Number: 25	
9.	Production Technology of high value vegetable crops in Sylhet region Venue: Sunamganj	5 March 2016	Do	Farmers, SAAO, NGO worker, Number: 25	
10	Production Technology of high value vegetable crops in Sylhet region Venue: Goainghat	29 March 2016	Do	Farmers, SAAO, NGO worker, Number: 25	

Field Day: 4

Sl.no	Title	Date	Subject	Participants with no.	Number of lectures
1	Field Day on Broccoli and Sweet pepper	14 March	Demonstration Discussion	Farmers, SAAO	2

	production Venue: Sylhet Agricultural University	2015		Number: 25	
2.	Field Day on Broccoli and Sweet pepper production Venue: Kamalganj	4 February 2016	Demonstration Discussion	Farmers, SAAO Number: 26	2
3.	Field Day on summer country bean production Venue: Paniumda (Nabiganj)	3 June 2016	Demonstration Discussion	Farmers, SAAO Number: 40	2
4	Field Day on summer tomato and summer country bean production	6 August 2016	Demonstration Discussion	Farmers, SAAO Number: 35	2

Plate F. 1. Pictorial views of training activities

g. Graduate Studies: Two Research Associates of this project completed MS in Horticulture (Top pages are enclosed in annexure 8.1 and 8.2)

These are

1. **Asma Akter, 2015.** Production of sweet pepper under protective structure in Sylhet. Dept of Horticulture, Sylhet Agricultural University, Sylhet. Registration No. 0682, ID: 1302020501
2. **Md. Habibul Hosain, 2016.** Influences of Seedling types and hormone application on production performance of tomato hybrids in summer. Dept of Horticulture, Sylhet Agricultural University, Sylhet. Registration No. 918, ID: 1402020503

h. Linkages Developed: None

i. Equipment/Appliances Parched: List of equipments/appliances purchased

Sl. No.	Name	Cost	Remark
1	Digital Camera	16,500	
2	Laptop	43,750	
3	Multi-functional printer	14,850	
4	File cabinet (Steel)	5,000	
5	File cabinet (Wood)	9,800	
6	Electronic balance	8,700	
7	Electric water pump	7,500	
8	Electric dry oven	1,15,000	
9	Compound microscope	10,000	
10	Knapsack sprayer/mini sprayer	7,500	
11	Glassware	LS	

F. Highlight of Research Findings:

Sweet pepper

Varietal evaluation

Three sweet pepper genotypes viz., BARI Mistimorich 1, California wonder and Yolo wonder were evaluated under fine net (120 mesh), coarse net (40 mesh) and open field conditions in RCB design with three replications during winter season of 2013–2014 at the experimental field of Sylhet Agricultural University. Results obtained under this study exhibited that the highest number of fruits per plant (19.18) as well as highest fruit yield per plant (1.24 kg) was recorded from the plants of BARI Mistimorich 1 when grown under fine net covering while the genotypes California wonder performed very well under coarse covering and produced 1.08 kg of fruits per plant. Since the market price of coarse net (mosquito net) is almost one third, therefore, production of sweet pepper will be more useful and profitable to the growers.

Production under protective structures

In this study BARI Mistimorich 1 was evaluated under different protective structures. Results revealed that the highest number of fruits per plant was recorded (16.67) from the plant grown under nylon net which was statistically identical to that of the plant grown under poly tunnel+ nylon net (13.33). The corresponding fruit yield per plant was also the highest (0.82 kg/plant) when the crops grown under nylon net protection followed by the plants grown under poly tunnel + nylon net protection (0.77 kg/plant). Polythene covering is used to protect the plants from cold temperature during winter. Since the night temperature in Sylhet region is not so low in comparison to other part of the country, hence, only net covering system for sweet pepper production in Sylhet region is more useful to reduce cost of production.

On farm adaptive trial

On farm adaptive trial for sweet pepper were made at farm fields of Sylhet division in two consecutive winter season of 2014-2015 (20 farmers) and 2015-2016 (24 farmers). Average fruit yield per plant was 0.84 kg, 0.73 kg and 0.36 kg when the plants grown under coarse net+polythene covering system, only coarse net covering system and open condition, respectively**.** Economic analysis of sweet pepper production under different protective structures was also done. The BCR was maximum (5.06) for the crop grown from only net protection system but gross income was maximum (14740 Tk/decimal) for net+polythene protection. It was due to the higher cost of production (4200 Tk/decimal) under net+polythene protection compared to only net protection (2500 Tk/deimal). Therefore, farmers in Sylhet region can grow sweet pepper only under net protection system for their net income.

Broccoli

Varietal evaluation

Three broccoli genotypes viz., BR001, BR002 and Premium were evaluated during winter season of 2013-2014. Among the genotypes Premium produced the highest main curd yield per plant (183.87 g). Secondary curd yield was also the highest for the genotype of premium (136.05 g). The other two genotypes were found very poor in relation to main curd and secondary curd production.

Three broccoli genotypes viz., Green magic, Premium and Imperial were evaluated during winter season of 2014-2015. Among the three genotypes Imperial had the highest individual curd weight (608.3 gm) followed by Green magic (343.8 gm). The corresponding curd yield/decimal was also the maximum for Imperial (110.2 kg/decimal) while it was minimum for Premium (55.70 kg/decimal)

In the next winter season (2015-16) four exotic hybrids of broccoli (Green Giant, Top Green, Green Magic and Green Crown) were evaluated at under RCB design at the experimental field of Sylhet Agricultural University to select suitable hybrids for Sylhet region. Result revealed that one can harvest broccoli curd from field at around 85 day after sowing. Significant variation among the hybrids was observed for individual curd weight. The highest individual curd weight was recorded from the variety Green giant (569.16g) followed by Green Crown (549.66 g) while it was the lowest for Top green (302.33 g). Calculated per decimal yield of the varieties exhibited the similar yield performance.
Genotypic evaluation of broccoli indicated that the variety Imperial, Green magic, and Green giant would be the more productive in Sylhet region.

Influence of sowing dates

Different broccoli varieties were evaluated at different sowing dates under Sylhet condition in RCB design with three replications in the winter season of 2014-2015 and 2015-2016. Mean performance of sowing dates had significant influence on broccoli production. The highest individual curd weight (471.5 g) was measured from 10 November sowing. In 2014-2015 season the maximum curd

yield/decimal was recorded from 10 November sowing (84.08 kg) followed by 25 October sowing (79.78 kg).

While crop grown 2015-2016 winter season, November sowing performed much better (588.33g/decimal) than that of October sowing crop. In Sylhet region, rainfall during the month of October is most common which largely affected the quality seedling production which ultimately affects crop establishment and crop growth. Therefore, the plants from October sowing experienced severe rainfall in seedling and early growth stage might be the reason for low yield than that of November sowing. So for broccoli production in Sylhet region seed sowing the seed bed in second fortnight of October or first week of November is more useful and can ensure successful crop production

On farm Adaptive trial of Broccoli

Adaptive trials of broccoli were made at the farmers field of Sylhet division. In winter 2014-2015 season 20 farmers from Sylhet and Habiganj district completed their adaptive trials. Yield and yield attributes of broccoli at farmer s field of Habiganj district indicated that the number of days to first curd initiation was varied from 69-80 days while average number of days was 75. The number of days to first harvest was ranged from 76 to 95 days. The average curd yield per decimal was 84.6 kg where the maximum curd yield/decimal was 99.54 kg and the minimum curd yield/decimal was 60.3 kg. While in Sylhet district it was observed that the average number of days to first curd initiation was 75.75 days while it was ranged from 74 to 80 days. The curd yield/decimal was ranged from 112.5 kg to 149.4 kg while average curd yield per decimal was 133.15 kg.

Results obtained from adaptive trials from 24 farmers field in winter 2015-2016 at Moulavibazar, Sylhet, Sunamganj and Habiganj districts were 115 kg, 107 kg, 108 kg and 102 kg, respectively. These yield performance was almost similar with that of the yield of other part of the country. Production of broccoli is easier than any other high value vegetable crops and disease and insect infestation is very insignificant, therefore, dissemination of broccoli production can be done provided quality seed is available.

Tomato

Varietal evaluation

Five heat tolerant tomato hybrids were evaluated under RCB design during the summer season of 2014 at the experimental field of Horticulture Department, Sylhet Agricultural University. The highest number of fruits per plant was recorded from BARI hybrid tomato-3 (25.5) while it was the lowest for the hybrid NHC-2 (18.4) but it had (NHC-2) the heaviest individual fruit weight (43.2 g). Fruit yield per plant among the hybrids varied from 0.74 kg to 0.96 kg of which BARI Hybrid tomato- 4 had the highest fruit yield per plant. The corresponding fruit yield of BARI hybrid tomato-4 per hectare was 29.24 tons followed by the hybrid NHC-1 (27.2 t/ha). In summer 2015, five newly developed heat tolerant advance hybrid lines of tomato were evaluated along with BARI hybrid tomato-4 under RCB design. Among the hybrids, BARI hybrid tomato-4 exhibited better yield performance (30.26 t/ha)

followed by the hybrid TCH1 (28.6 t/ha). Economic analysis indicated that farmer can harvest maximum net return from BARI hybrid tomato-4 (5320 Tk per decimal) followed by the hybrids TCH1 and NHC1. Therefore, farmers of Sylhet region can easily be use BARI hybrid tomato-4 like other part of the country for summer season cultivation. The other two advance hybrid lines will be taken for further evaluation (both on station and on farm) with a view to releasing new variety for summer season cultivation in Sylhet region.

Influence of seedling types

High rainfall is most common in Sylhet. Bacterial wilt is the most drawbacks for tomato production during rainy summer in Sylhet region. To assessing the growth and yield of summer tomato three different types of seedlings of BARI hybrid tomato-4 viz., polybag seedling (seedling produced in polybag), normal seedling (seedling grown in seedbed) and grafted seedling (tomato seedling grafted on *Solanum sisymbrifolium*) were during summer season of 2014 at experimental field of Sylhet Agricultural University. Type of seedling had significant influence on growth and yield of tomato during summer season. The highest mean fruit yield per plant was recorded from the plant raised from grafted seedling (0.93 kg) followed by normal seedling (0.83 kg). This is attributed due to longer harvesting duration from the grafted plants compared to the other types of seedling. Again mortality of the grafted plants was much lower (3.5%) compared to the plants of polybag seedling (18.0%) and normal seedling (20.0%) causing significant variation in per decimal fruit yield. To protect the plant from bacterial wilt and to ensure higher yield of tomato during summer in Sylhet region is almost mandatory.

Influence of tomatotone hormone

The growth regulator tomatotone (PCPA) at the rate of 2% was sprayed on plants having 4-5 flower clusters at full bloom stage is reported to be effective. Keeping this view in mind, six tomato hybrids were evaluated with and without hormone application system during summer season of 2014. Mean performance of hormone application indicated that hormone treated plant produced 0.98 kg of fruits per plant while untreated plant produced 0.72 kg of fruits per plant. Hormone treated plants produced significantly higher number of fruits per plant (23.10) with heavier individual fruit weight (42.53 g) compared to the untreated plant. This indicates that farmer can ensure more profit from tomato cultivation during summer through hormone application.

On farm Adaptive trial

Adaptive trials of summer tomato were made in the farmer's field during summer season of 2015 and 2016. Number of fruits per plant was largely varied from 15 to 25 among the farmers. Consequently fruit yield per plant as well fruit yield per decimal also varied among the farmers. The average fruit yield per plant among the farmers was 0.86 kg. A remarkable variation for tomato yield was noticed (113.6 kg to 153.6 kg/decimal) among the farmers and it was mostly attributed due to the mismanagement by the farmers like improper preparation of raise bed,

polythene shelter, intercultural operations and infection of plants with yellow leaf curl virus. Similar trend was also found in 2016.

Country Bean

Varietal Evaluation

Four photo-insensitive country bean genotypes were evaluated during summer season of 2014 at the experimental field of Horticulture Department, Sylhet Agricultural University. The genotype BP003 produced the maximum number of pods per plant (204.25) closely followed by SB010 (194.16). The genotype BP003 also had the heaviest individual pod weight (6.07 g) while it was the lowest for IPSA Sheem-2 (4.73 g). Among the genotypes, BP003 performed very well in relation to per plant (1.25 kg) and per decimal (33.20 kg) followed by BARI sheem-7 (0.91 kg/plant) pod yield exhibiting the highest net return (1740 Tk) followed by BARI sheem-7 (1030 Tk).

Influence of sowing dates

Three photo-insensitive country bean genotypes were evaluated at the experimental field of Sylhet Agricultural University at 15 of January, March and May 2015 under RCB design with three replications. Mean performance of sowing dates had the significant influence on yield and yield attributes of country bean. Number of pods per plant and pod yield per plant was largely affected by sowing dates. The highest number of pods per plant was recorded from the plants of 15 March sowing (416.89) while it was 192.56 and 166.44 for January 15 and May 15 sowing, respectively. Similar trend was also observed for pod yield per plant. The highest pod yield per plant was recorded from March 15 sowing (2.20 kg) while it was 1.14 kg per plant for January sowing and 0.85 kg per plant for 15 May sowing. Yields of pod at January and May sowing were much lower than that of March sowing. The crop sown in January month experienced much cooler situation caused slow initial vegetative growth and the plants grown from May sowing were largely affected by heavy rain during the month of July - August might be the reason for low yield compared to that of March sowing. Therefore, it is much better to sow seeds of summer country bean by the farmers of Sylhet region in the month of March for better production and profitability.

Adaptive trial of summer country bean

In 2015 summer season, 22 farmers of Sylhet and Habiganj district were given seeds of BARI sheem -7 for adaptive trial. Pod yield per plant at Habiganj district was varied from 0.9 kg to 1.71 kg (Table 3.1). The corresponding pod yield per decimal was also varied from 32.4 kg to 61.5 kg. All farmers sold some portion of their produce in the market and market price of country bean during summer varied from 65 to 90 tk per kg depending upon harvesting time and location. In Sylhet district, the highest pod yield per plant (1.60 kg) and per decimal (57.60 kg) was recorded from one farmer while the average yield among the farmers was 50.88 kg per decimal. Price of pod in the market nearby to each farmer varied from 65 to 85 Tk per kg.

Estimation of benefit cost revealed that one can earn more than 2000 tk per decimal by growing country bean during summer season. In summer 2016, total 50 farmers of Sylhet division (Sylhet, Moulavibazar, Habiganj and Sunamganj) were given seeds of BARI sheem-7 for cultivation. Similar yield performance was noticed this year also. In the adaptive trials in both of the year Aphid, cercospora leaf spot, Bean common mosaic virus and pod borer were found in adaptive trials. Therefore, farmers should be advised to take proper measures to protect their crop from the infestation of diseases and insects.

In 2016 summer season, 7-8 farmers commercially grew summer country bean in their field (>40 decimal) and sold in the market at the rate of 65 to 100 taka per kg. Again more or less 80 farmers (beyond the selected 50) from different upazila (Goainghat, Golapganj, Nabiganj, Jaintapur, kamalganj etc) of Sylhet division and other part of the country (Pabna, Bogra, Banderban, Mymensingh, Comilla etc) collected seed in small amount for cultivation.

G. Conclusion:

On station and on farm research activities were conducted from May 2013 to August 2016 to select suitable variety and production technology and to popularize the variety and production technology of high value vegetable crops viz., sweet pepper, broccoli, summer tomato and summer country bean in Sylhet region under the financial support of KGF BKGET 1st Call. Fruit yield of sweet pepper variety BARI mistimorich-1 and California wonder grown under net protected condition was around 1.0 kg while this was only 0.26 kg when the plants grown under open field condition. Net protected condition protected the plants from aphid, mite and scorching sunlight caused better plant growth and yield. Similar advantage in yield was also found in farmer's field in net protected system. Production of broccoli from 25 October (80 kg/decimal) and 10 November (84 kg/decimal) sowing was better than 10 October (64 kg/decimal) sowing. Seedling raising and initial establishment of broccoli seedling in September or first fortnight of October sowing was found difficult due to rainfall in Sylhet region. Farmer's reaction revealed that broccoli cultivation is easier since this crop is less affected by different insects and diseases. Summer tomato cultivation was largely affected by types of seedling. The highest fruit yield per plant was recorded from the plant raised from grafted seedling (BARI hybrid tomato-4 grafted onto wild brinjal). Again mortality of grafted plants was much lower (3.5%) compared to that of plants raised from non-grafted seedlings (18-20%) caused significant variation in per decimal fruit yield (180kg and 128 kg per decimal for grafted and non-grafted seedling, respectively). Among different heat tolerant tomato hybrids, production of BARI hybrid tomato-4 (29.24 t/ha) and newly developed hybrids NHC-1 (27.2 t/ha) and TCH-1 (28.5 t/ha) were found very promising under Sylhet condition. Evaluation of four photo-insensitive country bean genotypes during summer in Sylhet region indicated that the genotypes BARI sheem-7 (1.60 kg/plant), BP003 (1.64 kg/plant) and SB010 (0.97 kg/plant) could successfully be grown since their yields were appreciably high. Based on the performance of the advance lines BP003 and SB010, these lines were registered as variety from Ministry of Agriculture in 2015 and named as "Sikribi sheem-1" and "Sikribi sheem-2" which were evaluated and selected from segregating

generations during project period. Sowing dates had largely affected country bean production during summer. The highest pod yield per plant was recorded from 15 March sowing (2.20 kg) while it was 1.14 kg and 0.85 kg/plant for 15 January and 15 May sowing, respectively. The crop sown in January experienced much cooler situation caused slow initial vegetative growth and the plants grown from 15 May sowing were largely affected by heavy rain during the month of July-August caused severe flower and pod dropping might be the reason for low yield compared to that of 15 March sowing. Economic analysis from on station and on farm studies revealed that farmer can ensure more profit from sweet pepper, broccoli, summer country bean and summer tomato cultivation. As a result of project activities of adaptive trials, enthusiastic farmers (18-20) in Sylhet region started commercial cultivation summer country bean (40-45 decimal of land) and sweet pepper (10 to 45 decimal), broccoli and summer tomato.

H. Recommendation:

- Production of BARI Mistimorich-1 and California wonder under net (mosquito net) protected condition in Sylhet region. However, use of polythene covering during night time under severe cold during the month of December and January is also useful
- Sowing of seed of broccoli after mid October could ensure successful production of broccoli
- The variety(s) Imperial, Green magic, Top green are highly productive in Sylhet region
- BARI hybrid tomato-4 with grafted seedling is the pre-requisite for summer tomato production in Sylhet region
- BARI sheem-7, Sikribi sheem-1 and Sikribi sheem-2 are suitable for commercial cultivation during summer season in Sylhet region
- Sowing of seeds of country bean in the month of March for summer season cultivation in Sylhet region is more preferable
- Newly developed photo-insensitive country bean variety (Sikribi sheem-1 and Sikribi sheem-2 could be disseminated to the other part of the country through a research project.
- Exploration of new area for dissemination of high value vegetable crops.
- Create awareness for family nutrition and economic profitability through training and motivational tour
- Facilitate for market development
- Quality seed production and supply of high value vegetable crops is required

Future research need

- Hybridization and hybrid variety development of sweet pepper to avoiding protective structure during cultivation. Because in Sherpur and Bogra, some farmers collected hybrid seeds from neighboring country and put in to cultivation without protective structure.

- Selection of appropriate pesticide (preferably miticide) to control mite, aphid etc.
- Variety development program for broccoli is needed to avoid dependency on imported seed.
- Development of heat tolerant tomato variety with bigger size, taste and higher number of fruits per plant.
- Quality improvement research program is needed for summer country bean through hybridization.

I. (1) Financial Statement: Fund received and Expenditure made during the reporting period (in thousand Tk)

Particulars/Line Items							Actual Fig. in Tk.	
A. Fund Received in Installment								
1st install.	2nd Install.	3rd install.	4th Install.	5th install.	6th install.	7th install.	8th Install	Total
205.0	307.5	410.0	475.85	248.9	497.8	599.0	500.0	**3244.05**

Particulars/Line Items		Approved Total Budget	Exp. Upto previous Report (From 1 June 2013 to 30 Nov 2015)	Current Exp. (Reporting period) From 1 Dec 2015 to 31 Aug 2016	Cumulative Exp.	Rest of Budgeted Amount
Sl. No	**B. I. Expenditure: Recurring (Operational cost)**	1	2	3	4=(2+3)	5=(1-4)
1.	1.1 Remuneration for Contractual Staff (Res. Associate and Field Assistant 1.2 Remuneration of Accounting (part time basis-consolidated)	610.5 36.0	342.419 26.0	185.0 10.0	527.419 26.0	83.081 0
2.	2.1 Research & Development (R&D) related cost i.e. all inputs, lab./ farm chemicals & other necessary supplies 2.2 Contractual Services (special nature, if any, i.e. soil, plant & fertilizer analysis; pesticide residue analysis etc.)	1697.5	891.49 0	481.545	1373.035	324.465
3.	Maintenance and repairing of lab. /field equipment, etc.	85.0	45.8	38.8	84.6	0.4
4.	Training	278.0	188. 8	36.2	225.0	53.0
5.	Workshop/Seminar/Meeting etc.	130.0	39.5	90.5	130.0	0
6.	6.1 Travel expenses (TA/DA) as per own organizational rules (Public Sector) 6.2 Vehicle hiring/oil & fuel for organization's	132.0 130.0	97.34 72.585	36.58 52.35	133.92 124.935	-1.92 5.065
7.	Office supplies and contingency (not exceedng 15% of the total cost for stationeries, publica., printing of reports, internet, mailing etc.)	72.0	28.57	44.76	73.33	-1.33
8.	Any items (please specify with justification)					
9.	Institutional Overhead Charge (if any, max 10% of total operating cost)	318.0	83.5	170.1	253.6	64.4
	B.I. Sub-total B.I (1-9)	***3489.0***	***1816.004***	***1145.835***	***2961.839***	***527.161***
B. II:	**Non-recurring (Capital cost)**					
10.	Equip & Appliances (upon approval of KGF) 10.1. Lab. and Field Equipment 10.2. Office Equipment	 188.0 90.0	 168.2 89.901	 18.5	 186.7 89.901	 1.3 0.099
	B.II. Sub-total (10)	***278.0***	***258.101***	***18.5***	***276.601***	***1.399***
	Bank duty charge		*3.17305*	*1.7*	*4.87305*	*-4.87305*
Grand Total Expenditure: GT(B.I+B.II)		**3767.0**	**2077.27805**	**1164.335**	**3243.31305**	**523.68695**

Balance (A-GT)= 3244.05 -3243.31305=0.73695 as per Bank Statement 0.73695

Financial Progress: (a) Fund Received in Tk: **3244.05**... (b) Fund utilized as per SoE in Tk **3243.31305**

% achieved = **99.977** $\frac{b}{a}$ X 100

.....

Signature of PI with seal

J. Self Assessment of the Project: [Please answer the following questions precisely and clearly.]

1. Have you been able to achieve all specific objectives of your project? Yes (however, PI is not claiming in full confident that the objective to improve consumption and nutrition level is achieved, because at base line survey only 90 farmers and at the end of the project only 60 selected farmers interviewed about consumption of vegetable. Average consumption of vegetable per day per was increased slightly from 142 g to 160 g. This does not reflected the consumption level of whole Sylhet region.

2. Who is/are the target beneficiary group/s of your project?

Farmers/Agri. Businessmen

3. How the project outputs/results obtained would benefit the target beneficiary group/s? and how these could be transferred to the that/those target group/s? Through best uses of variety and production system and facilitate wholesale/retail market would ensure target beneficiary group.

4. Do you think that you have successfully completed the project? Yes/No; If yes, please provide one page success story/communication brief of your project in simple language with relevant pictures where applicable.

Prior to the project activity production of sweet pepper, broccoli, summer country bean was completely absent in Sylhet region while very few farmers involved in summer tomato production only in Kamalganj upazila as was reflected in the base line survey. The demand of the sweet pepper, broccoli and tomato during summer mostly met from the other part of the country. During the second year of the project an enthusiastic farmer started sweet pepper production in large scale. In winter 2014-15 this farmer grew sweet pepper more than 40 decimal land and sold his produce over 4.5 lakh taka while his cost was 70 thousand taka. Having this profit this farmer again cultivated around 100 decimal land in winter 2015-16 and made significant profit. Due to bumper production of sweet pepper the local demand is mostly met from local production and at the pick harvesting period sweet pepper also supplied to the market of Karwanbazar, Dhaka and Chittagong. Few more farmers (5-6) from Sylhet and Moulavibazar district started sweet pepper production in large scale. Broccoli production is also getting momentum in Sylhet region. In Golapganj upazila, one farmer informed that at the time marketing it was too difficult to sell his produced. However, 15 days later, almost all his product was sold out from his field. Viewing this situation, Upazila Agriculture Officer requested more and more seeds of broccoli for the coming winter (2016-17). Production of country bean during summer season is introduced solely by this project. During the last two years green country bean was found to sell in the local and city market from the month of June onward. At this time none can find green country bean in the country. In the last summer season (2016), 7-8 farmers from

Habiganj and Molavibazar district cultivated country bean in large scale and made prolific profit. One of the important successes of the present KGF project and also Department of Horticulture of Sylhet Agricultural University is that two advance lines of photo-insensitive country bean were registered from the Ministry of Agriculture in 2015 and named as "Sikri sheem-1" and "Sikribi sheem-2" (Annexure 9). These lines were developed through hybridization and subsequent evaluation and selection from segregating generations were made during this project period. Several researchers and universities requested the seeds of these two varieties over face book, email and telephone etc for future research program. Besides, farmers from Bandarban, Bogra, Pabna, Iswardi, Brahmaonbaria, Netrokona collected seed from Project office and cultivated in their field in last summer season. ACI seed also have shown interest to produce quality seeds of newly developed photo-insensitive country bean. Summer tomato production already commercialized in Kamalganj upazila (Moulavibazar) while in Sylhet district it was not familiar, however observing the production techniques 5-6 farmers have been cultivating in large scale (more than 50 decimal of land) indicating bright scope to of summer tomato production. Having the success news of adaptive trials of the project, different Upazila Agriculture office (beyond selected upazila for project activities) organized motivation tour comprising 40 to 50 farmers. More than 30 success stories of the project activities were published in daily newspaper (Annexure 4) while live TV program (Channel 24, Jamuna TV, Channel I) also telecasted several times. During last few months almost 80-100 unknown farmers contacted for seeds of high value vegetable crops. Several farmers also visited Olericulture Division for the seeds of BARI Mistimorich-1 and BARI hybrid tomato-4. Success history of some famers who made remarkable profit from his crop is given the following Table (J.1). Pictorial views of commercial cultivation of high value vegetable crops are also given below (Plate J. 1.)

Table J.1. Land utilized and total sale of the produce of some farmers

Name	Crop	Area (Decimal)	Total sale (Taka)	Sale period	Remark
Md. Samaj Ali, Bahubol, Habiganj. 01724758885	Summer country bean	47	1.47 lakh	June-September	-
Md. Mehraj Hossain, Nabiganj, Habiganj, 01766858000	Summer country bean	15	35 thousand	June-September	Distribution and consumption also high
Md. Manik, Kamalganj, Moulavibazar, 01764854212	Summer tomato	20	2.1 lakh	July-September	-
Md. Kamrul Hossain, Golapganj, Sylhet, 01743624797	Broccoli	5	25 thousand	Jan-March	Almost 60 kg consumed and distributed
Belal Ahmed Imran, Biswanath, Sylhet, 01712164339	Sweet pepper	100	9.0 lakh	Jan-March	Supplied Dhaka, Khulna and Chittagong

Sweet pepper (Biswnath)

Summer country bean (Nabiganj)

Summer country bean (Bahubol)

Broccoli (South Surma)

Summer tomato (Kamalganj)

Summer tomato (South Surma)

Sweet pepper (Biswanath)

Broccoli (Sunamganj)

Plate J 2. Large scale high value vegetable crop production in Sylhet region

5. Please describe briefly the outcome/benefit and likely impact of your project on the productivity, policy, society, economy and environment.

Mono cropping system is mostly common in Sylhet region. Incorporating vegetable crops in the present cropping pattern can increase cropping intensity as well farm income. The outcome of the project will help to increase the production of summer tomato, summer country bean, sweet pepper and broccoli to the concerned growers. It will create new employment and over all ameliorate socio-economic condition of the growers of Sylhet region. Women will be involved in the different activities like production in home stead areas, processing, packaging and marketing of high value vegetables. Finally, socio-economic and nutritional status of the farmers as well as consumers will be enriched.

K. Acknowledgement:

PI of the project would like to covey his heartfelt thanks and gratitude to KGF Authority for awarding this project otherwise it would not possible to conduct a series of research activities. PI is deeply indebted to the Authority of Sylhet Agricultural University (SAU) for accommodating research field and other logistic supports for conduction of research activities of the project. The Sincere thanks to Director (Research), SAU, Sylhet for his valuable advice, constructive and informative suggestions in course of project activities. The PI would like to express his best regards to project personnel, DAE personnel from different districts, upazilas, NGO workers for their support and encouragement. Finally the PI extends his cordial thanks to all farmers who worked hard for the sake of success of the project.

L. Endorsement:

Principal Investigator (PI)	Head of Organization/Authorized Person
Name: Prof. Dr. Md. Shahidul Islam	Name: Prof. Dr. A. F. M. Saiful Islam, Director (Research), SAU, Sylhet
Signature:	Signature:
Seal with date:	Seal with date:

M. References

Ahmed, S, M. S. Islam and M. A. Hoque. 2011. Performance of heat tolerant tomato hybrids during rainy season.Bangladesh J. Agril. Res., 36(2): 189-196.

Anonymous. 2008. Annual Research Report on vegetable crops 2007-2008.Olericulture Division, Horticulture Research Center, BARI, Gazipur.

Anonymous. 2009. Annual Research Report on vegetable crops 2008-2009.Olericulture Division, Horticulture Research Center, BARI, Gazipur, p110

Anonymous. 2010. Annual Research Report on vegetable crops 2009-2010.Olericulture Division, Horticulture Research Center, BARI, Gazipur, p116

Anonymous. 2011. Annual Report on vegetable crops 2010 -2011. Olericulture Division, Horticulture Research Center, BARI, Gazipur, p120

Anonymous. 2012. Status of horticultural Crop production in Sylhet Region. Paper presented in the workshop on, "Prospect of horticultural crop production in Sylhet region" held on 17 November 2012, Sylhet Agricultural University, Sylhet

Bhatt, R. M.; N. K. S. Rao and N. Anand. 1992. Response of bell pepper to irradiance photosynthesis, reproductive attributes and yield. Indian J. Hort., 56(1):62-66.

Bose, T. K. and M. G. Som. 1986.Vegetable Crops in India. Naya Prokash. Calcutta, India.

Bose, T. K., M. G. Som and J. Kabir. 1993. Vegetable Crops. 1993. Naya Prokash, Calcutta, India. P. 343

Boswell, V. R. 1964. Pepper Production. In: Spices, Vol 1(ed). Longman Scientific Technical, John Willy and Sons Inc. New York. p.331

Halim, G.M.A. and Islam, M.S. 2013. Performance of sweet pepper under protective structure in Gazipur of Bangladesh. International J. Env., 1(1): 1-8'

Islam and Halim. 2014. Effect of different tunnel covers on growth and yield of sweet pepper. J. Sylhet Agril. Univ. 1(1): 11-14.

Kuo, C. G., M. H. Chou, B. J. Sen and H. C. Chen. 1989. Relationship between hormonal levels in pistils and tomato fruit set in hot and cool season. In Green, S. K. (ed). Tomato and pepper production in the Tropics. AVRDC, Taiwan, 136-149.

Patwary, M. A. 2009. Genetic diversity and heterosis in heat tolerant tomato. Ph. D Thesis, Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur. p. 201.

Prasad, S. and U. Kumar, 1999. Principles of Horticulture. Agrobotanica. 4E 176. J.N. Vyas Nagar India. p .6.

Rashid, M. M. 1999. Sabji bIggan (In Bengali), Rashid Publishing House,94, Old DOHS, Dhaka, p526

Thompson H. C. and W. C. Kelly. 1985. Vegetable crops. Fifth edition, Mcgrow Hill Book Co. New York, Tornoto, London. p. 307.

Saha, S. R. and M. A. Salam 2004. Modern techniques of sweet pepper cultivation. A booklet published by plant physiology section, HRC, BARI, Gazipur

Yesmin, L. 2011. Characterization and evaluation of tomato genotypes for inbred and hybrid seed production potentiality. MS Thesis, Dept. of Horticulture, BSMRAU, Gazipur. 120p.

Annexure 1.0. Location Map for on farm research activities

Fig. 1.1.Four Districts of Sylhet Division

Fig. 1.2. Displaying selected upazila of Sylhet Division for project activities.

Selected Upazila

Sylhet	Habiganj	Moulavibazar	Sunamganj
Sadar, Biswanath, S. Surma and Golapganj	Sadar, Bahubal and Nabiganj	Sadar and Kamalganj	Sadar, S. Sunamganj and Jagannathpur

Annexure 2.0. Base line information about vegetable production (Average of 10 vegetable growers in each upzilla)

Name of upzilla	Family members	Yearly land used for vegetable production (decimal)	Approximately vegetable consumption /day/person (g)	% vegetable sale in the market	Farmers involved with HVVC* production	Remarks	Problems of vegetable crop
Sylhet Sadar	7.2	60	135	72.5	None	-Almost all farmers are not familiar with variety and production technology of HVVC* except Komolgonj upzilla. -Seeds of the HVVC are not available in the market	-Monoculture -High labour cost - Lack of irrigation facilities -Flash flood during kharif -Absentee farmers -Lack of knowledge about vegetable production. -High seed cost
Jaintapur	6.6	87	105	76.0	Four farmers involved in summer tomato and summer bean production with 2 decimal land		
Biswanath	7.8	150	109	83.0	One farmer involved		
South Surma	6.6	45	120	70.0	None		
Moulavibazar	5.8	66	140	75.0	None		
Komolgonj	6.4	106	145	81.0	All farmers involved in summer tomato production		
			142.7 g				

*HVVC= High value vegetable crop

Annexure 3. Weather data for project area

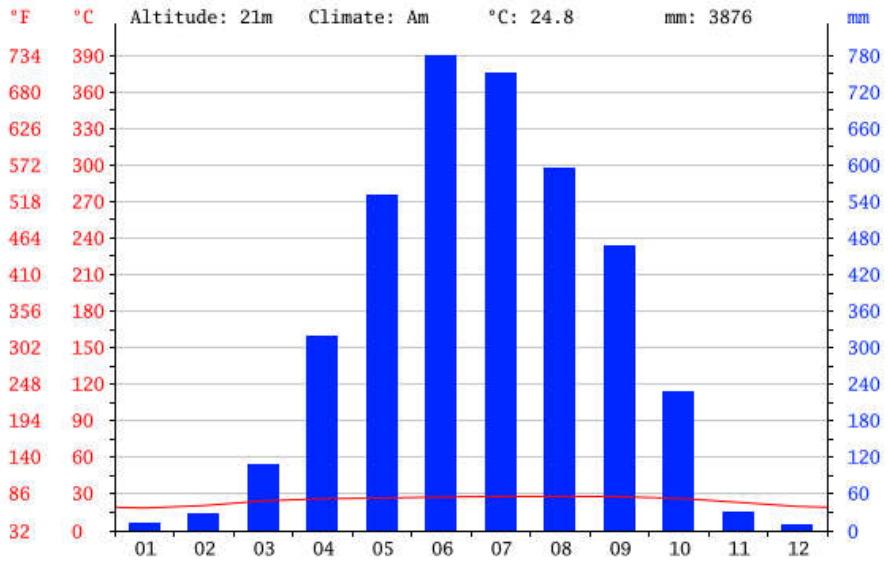

Fig : Average rainfall pattern in Sylhet

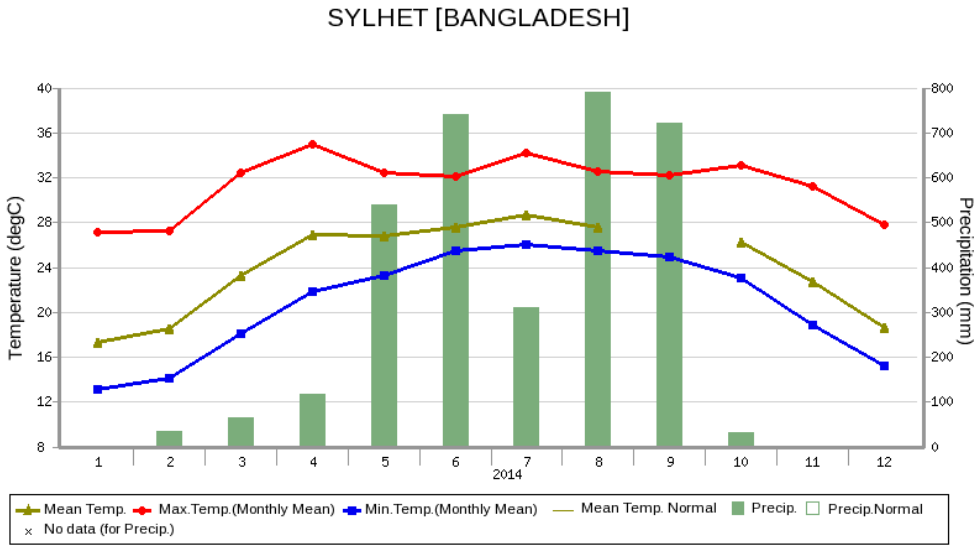

Fig: Mean, Max and Minimum temperature and rainfall in Sylhet for 2014

Annexure 4. Popular article of the project activities published in daily news paper

Annexure 6. Details adaptive trial results of four districts for summer 2016

1. Adaitve trials result of coubtry bean in Sylhet district

Farmer's name	Date of sowing	Days to first harvest	Yield/plant (kg)	yield (kg/decimal	Consumption and distri (%) (%)	Sale (%)
1. Abdus Sabur	5.4.16	83	1.35	48.6	100	0
2. Md. Syadur Rahman	20.3.16	80	1.28	46.08	65	35
3. Md. Samir Ahmed	25.3.16	81	1.42	51.12	85	15
4. Md. Musabbir	15.3.13	78	1.37	49.32	25	75
5. Md. Anwar Hossain	25.3.16	84	1.25	45.0	85	15
6. Md. Salim Ahmed	25.3.16	80	1.47	52.9	70	30
7. Kamrul Bhuyan	20.3.16	85	1.48	53.28	90	10
8. Ansar Ahmed	6.4.16	84	1.34	48.24	90	10
9. MR Choudhury	5.5.16	80	1.32	47.52	100	0
10. Moslem uddin	27.3.16	82	1.46	52.56	75	25
11. Md. MahiburRahman	22.3.16	83	1.35	48.6	75	25
Average		81.82	1.37	49.39	78.18	21.82
Max		85	1.48	53.28	100	75
Min		78	1.25	45	25	0
Stdev		2.18	0.08	2.77	21.01	21.01

Price of country bean varies from 65 taka to 85 taka depending upon location and harvesting dates

2. Adaitve trials result of coubtry bean in Moulavibazar district

Farmer's name	Date of sowing	Days to first harvest	Yield/plant (kg)	yield (kg/decimal	Consumption and distri (%)	Sale (%)
1.Rubel Kapali	10.316	75	1.61	57.96	75	25
2. Joydeb Kapali	16.3.16	78	1.52	54.72	55	45
3. Debasis Kapali	15.3.16	74	1.62	58.32	50	50
4. Nirendro Kapali	16.3.16	77	1.43	51.48	70	30
5. Bidhu Kapali	23.3.16	76	1.32	47.52	45	55
6. Gukul Kapali	17.316	82	1.45	52.2	55	45
8. Nitai Kapali	20.3.16	74	1.34	48.24	100	0
9. Gopal Kapali	18.3.16	73	1.55	55.8	60	40
10. Nikhil Kapali	16.3.16	72	1.65	59.4	100	0
1. Ranjan Singha	7.3.16	78	1.35	48.6	22	78
2. Manik Mia	30.3.16	75	1.36	48.96	70	30
3. Rajendra	20.3.16	75	1.52	54.72	65	35
4. Gazi	25.3.16	77	1.27	45.72	55	45
5. Brajendra	22.3.16	80	1.34	48.24	45	45
Average		76.14	1.45	52.28	61.93	37.36
Max		82	1.65	59.4	100	78
Min		72	1.27	45.72	22	0
Stdev		2.74	0.13	4.53	20.88	20.42

Price of country bean varies from 60 taka to 100 taka depending upon location and harvesting dates

3. Adaitve trials result of coubtry bean in Habiganj district

Farmer's name	Date of sowing	Days to first harvest	Yield/plant (kg)	yield (kg/decimal	Consumption and distri (%) (%)	Sale (%)
1. Syed Abdul Kadir	25.3.16	82	1.56	56.16	20	80
2. Md. Polash Mia	20.3.16	83	1.47	52.92	100	0
3. Md. Samaj Ali	4.4.16	84	1.58	56.88	10	90
4. Md. Uster Mia	30.3.16	78	1.32	47.52	60	40
5.Mehraj Hossain Imran	20.3.16	76	1.45	52.2	8	92
6. Md. Amir Hossain	22.3.16	84	1.48	53.28	12	88
7. Bidhu Bhusun Deb	15.3.16	81	1.37	49.32	15	85
Average		81.14	1.46	52.61	32.14	67.86
Max		84	1.58	56.88	100	92
Min		76	1.32	47.52	8	0
Stdev		3.08	0.09	3.37	34.88	34.88

Price of country bean varies from 60taka to 90 taka depending upon location and harvesting dates

4. Adaitve trials result of coubtry bean in Sunamganj district

Farmers name	Date of sowing	Days to harvest	Pod yield/ plant (kg)	Yield kg/decimal	Consumption and distri (%) (%)	Sale (%)
1. Md. Abul Basar	20.3.16	80	1.23	44.28	100	0
2. Md. Sohail Mia	22.3.16	88	1.42	51.12	100	0
3. Abdul Ahad	25.3.16	83	1.34	48.24	100	0
4.Md. Nasiruddin	25.3.16	86	1.28	46.08	85	15
5. Abdul Matin	16.3.16	81	1.37	49.32	80	20
6. Abdur Rashid	20.3.16	80	1.42	51.12	60	40
7. Abdul Kuddus	22.3.16	78	1.36	48.96	65	35
8. Afroza Begum	20.3.16	84	1.27	45.72	100	0
9. Khairul Basar	21.3.16	83	1.39	50.04	70	30
10. Abdul Karim	22.3.16	83	1.24	44.64	75	25
Average		82.6	1.332	47.952	83.5	16.5
Max		88	1.42	51.12	100	40
Min		78	1.23	44.28	60	0
Stdev		2.99	0.07	2.59	15.82	15.82

Price of country bean varies from 65 taka to 85 taka depending upon location and harvesting dates

Annexure 7. Tomato Adaptive trial results of three districts during summer 2016

1. Tomato Adaptive trial results for Moulavibazar district of summer 2016

Farmer name	Date of planting	No of fruits/ plant	Fruit yield/ plant (kg)	Yield kg/Decimal	Mortality
1. Gazi Moinuddin	10.7.16	22	0.98	166.6	5-9%
2. Siraj Mia	5.7.16	21	0.88	149.6	
3.Abu Bakkar	5.7.16	21	0.85	144.5	
4.Chandra Kisor	12.6.16	17	0.76	129.2	
5.Nilmoni Singh	15.6.16	18	0.95	161.5	
6. Protap Kumar	22.6.16	26	1.03	175.1	
7. Manik Mia	20.6.16	28	1.15	195.5	
8. Anup Kumar	20.6.16	22	0.78	132.6	
Average		21.875	0.92	156.83	
Max		28	1.15	195.5	
Min		17	0.76	129.2	
Stdev		3.68	0.13	22.36	

2. Tomato Adaptive trial results for Sylhet district of summer 2016

Farmer name	Date of planting	No of fruits/ plant	Fruit yield/ plant (kg)	Yield kg/Decimal	Mortality
1. Md. Moslem	28.6.16	15	0.67	113.9	8-15%
2. Riaz Uddin	28.6.16	14	0.72	122.4	
3.Md. Atik Mia	24.6.16	28	0.88	149.6	
4. Ishak Ali	24.6.16	24	0.83	141.1	
5. Md. Kamrul	25.6.16	23	0.75	127.5	
6. Md. A. Razzak	2.7.16	16	0.72	122.4	
7. Belal Ahmed	2.7.16	13	0.62	105.4	
Average		19	0.74	126.04	
Max		28	0.88	149.6	
Min		13	0.62	105.4	
Stdev		5.89	0.09	15.19	

3. Tomato Adaptive trial results for Sunagganj district of summer 2016

Farmer name	Date of planting	No of fruits/ plant	Fruit yield/ plant (kg)	Yield kg/Decimal	Mortality
1. Md. Faruk Mia	15.6.16	27	0.81	137.7	7-10%
2. Md. Sujan Mia	15.6.6	25	0.78	132.6	
Average		26	0.80	135.15	