

Project ID 584

Competitive Research Grant

Sub-Project Completion Report

on

[Development of Eco-friendly Management of Sucking insects of Cotton]

Project Duration

July 2017 to September 2018

Cotton Development Board

Khamarbari, Farmgate, Dhaka-1215



Submitted to
Project Implementation Unit-BARC, NATP 2
Bangladesh Agricultural Research Council
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Project Implementation Unit
National Agricultural Technology Program-Phase II Project (NATP-2)
Bangladesh Agricultural Research Council (BARC)
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Acronyms

BARC Bangladesh Agricultural Research Council

CDB Cotton Development Board

CRG Competitive Research Grand

PCR Project Completion Report

Eco-friendly Environment friendly

Table of Contents

SI No.	Subject	Page No.
01.	Executive Summary	06
A	Sub-project Description	07-26
03.	Methodology	09
04.	Result & Discussion	10
05.	Implementation location	26
06.	Financial and physical progress	27
07.	Achievement of Sub-project by objectives	28
08.	Materials Development/Publication made under the Sub-project	28
09.	Technology/Knowledge generation/Policy Support	28
11.	Information regarding Desk and Field Monitoring	28
12.	Lesson Learned	29
13.	Challenges	29

Executive Summary

The experiment was conducted at five different Cotton Research Farm of CDB and its adjacent five locations to develop environment friendly management practice against sucking pest of cotton. It consisted of 6 treatments, T₁- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap, T₂ – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap, T₃-Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap, T₄- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) +Yellow sticky trap, T₅-FarmersPractice(Hemidor @ 0.3 gm/litre), T₆ -Untreated control following RCB design with three replication. The treatment included. Five spraying of each treatment were conducted based on ETL. Observation on population of sucking pests (Jassids, Aphid, and Whitefly) was recorded before spraying and 24, 48 and 72 hr after each spraying. Overall maximum mean reduction was recorded in T₅-Farmers Practice (Hemidor @ 0.3 gm/litre). In case of Jassid population T₃-Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap give the highest reduction rate and in white fly population T₁- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap showed better next performance. Highest yield was found in T₅ followed by T₃. Highest BCR (2.84) observed in T₃. In environmental point of view we may consider T₃ as best management practices for Jassid and T₁ for whitefly. Pest management approaches were developed to control sucking insect pests of cotton and for benefit of farming community. Use of safe botanical pesticides remained effective against sucking pests and may be recommended against cotton pests, which showed less effective to natural enemies and environment friendly.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. Title of the CRG sub-project: Development of Eco-friendly Management of Sucking insects of Cotton
2. Implementing organization: Cotton Development Board, Khamarbari, Dhaka.
3. Name and full address with phone, cell and E-mail of PI/Co-PI (s):

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4. Sub-project budget (Tk):
 - 4.1 Total: 1800000/-
 - 4.2 Revised (if any):
5. Duration of the sub-project:
 - 5.1 Start date (based on LoA signed): 1st July 2017 End date: 30 September 2018

6. **Justification of undertaking the sub-project:**

Cotton is an important commercial crop in Bangladesh. It is a pest loving crop. Sucking pests are quite serious from seedling stage of cotton. Their heavy infestation reduces the crop yield to a great extent. The estimated loss due to sucking pests is up to 21.20% (Dhawan et al., 1988). Among the sap feeders jassid (*Amrasca biguttula*), aphids (*Aphis gossypii*) and whitefly (*Bemisia tabaci*) are deadly pests. Climate is an important determinant of the abundance and distribution of biological species. The climate has profound effects on population of invertebrate pests like insects, mites, and other species; and affects their development, reproduction, and

dispersal. Climate change is expected to have significant impacts on the distribution, phenology, and abundance of many species over the next few decades. Change in the global climate may, thus, affect the crop yields, incidence of pests, and economic costs of agricultural production. Cotton farmers in Bangladesh depend largely on synthetic pesticides to control sucking pests. At least 5-7 chemicals are sprayed directed against sucking pests. Due to continuous use of synthetic insecticides, insects become resistance and hence the efficacy has become less reliable. Indiscriminate use of insecticide especially for jassid, aphid, white-fly, red cotton bug causes environmental pollution. Incremental use of toxic chemicals take place in the food chain and ecosystem through bio-magnification and cause hazards. To overcome this problem application of biochemical substances are needed. Biochemicals are effective and have less exposure in the environment. Azadirachtin is a bio-chemicals with active ingredient of neem which is suitable to many crops. - Akondo leaf extract (50%) + Tobacco Leaf extract (50%) are botanicals. This investigation has been evaluated for their effectiveness against sucking pests of cotton and their impact on natural enemies.

7. Sub-project goal: To develop environment friendly management practice against sucking pest of cotton.
8. Sub-project objective (s):
 - i) To develop suitable sucking insect-pest management practices.
 - ii) To reduce dependency on chemical approaches.
9. Implementing location (s):

Five research centers of Cotton Development Board located at Sreepur, Gazipur; Sadarpur, Dinajpur; Jagadishpur, Jessore; Mahigonj, Rangpur; Balaghata, Bandarban and their adjacent five locations viz. Nagarpur, Tangail; Chowgacha, Jessore, Rangpur Sadar, Dinajpur Sadar and Bandarban Sadar .

10. Methodology in brief:

Experiment: Eco-friendly Management of Cotton sucking pest under climate change.

Treatments:

T₁- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap

T₂ – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap

T₃-Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Yellow sticky trap + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap

T₄- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) + Yellow sticky trap

T₅-FarmersPractice(Hemidor @ 0.3 gm/litre)

T₆ – Untreated control (especially in CDB Farm)

[The pesticides mentioned by the reviewer such as Azadiractin (Fylomax 3% EC) and potassium salt of fatty acid (Fytoclean) are not available in the market. So those pesticides are not included in treatments.]

Design: RCBD

Replication : 3

Location: 5 Cotton research Farm of CDB and their adjacent 5 different location

Plot size: 4.5 m x 3.6 m

Targetinsects:Aphid,Jassid, Whitefly,Redcottonbug,mealybug etc.

Variety: CB- 12.

Cotton was planted on 1st week of July. After thinning one seedling was kept per hill. N, P, K, S, Zn, Mg, and B fertilized in the form of urea, triple superphosphate, muriate of potash, gypsum zinc sulphate, magnesium sulphate and boric acid were 120, 52, 131, 27, 3.3, 1.5 and 1.5 kg/ha. Total amount of triple super phosphate, gypsum, zinc sulphate, magnesium sulphate, boron, one fourth of urea and half of the muriate of potash was applied in the furrows during the final land preparation as basal dose. The

rest amount of urea was applied in three equal splits at 20, 40 and 60 days after sowing as top dressing. Similarly, the rest muriate of potash was applied at the time of second and third split of nitrogen application. The experimental field was kept weed free up to 60 days after emergence of seedling by hand weeding. Mulching between two rows was done by spade. Spray was done by knapsack sprayer. Harvesting of seed cotton from the net plot and border was done in three number of picking. Pest management was done according to the treatments. Yellow sticky trap was set after 15 m distance. Application of 1st pesticide was sprayed when visible infestation of targeted sucking pests crossing ETL. Then the second pesticide was sprayed after 12-15 days of 1st spray. In this way 5 sprays was maintained an alternative schedule.

C. Data recorded

Data was recorded for each pest separately like Aphid, Jassid, and Whitefly. Five plants were selected randomly. Scouting of each pests and beneficial insects were done before and after spray from upper lower and middle leaf.

- Weekly scouting of pest
- Spray log
- Count beneficial insect
- Number of infested plant/plot
- Number of each pest/plant
- DAS of infestation of each pest
- Yield and yield contributing characters.
- Fibre quality data
- BCR
- Climatic data

D. Statistical analysis: Statistical analysis LSD value was calculated by Crop states software.

11. Results and discussion:

Temperature & Rainfall pattern of trial location

Average monthly rainfall of Chuadanga, Rangpur, Sayedpur is different in 2017 (Fig 1). In all location highest rainfall occur from June to September. In Chuadanga similar rainfall occur in year round. Among three locations maximum rainfall was found in sayedpur. In Rangpur and Sayedpur highest rainfall occur in August that is 500 mm and 750 mm respectively. Rainfall pattern of last 90th decade and 20th decade in Chuadanga are different from each other (Fig 3). Highest rainfall found in the month of June 112.97 mm. In 1991-96 more amounts of rains was fallen than 2012-17.

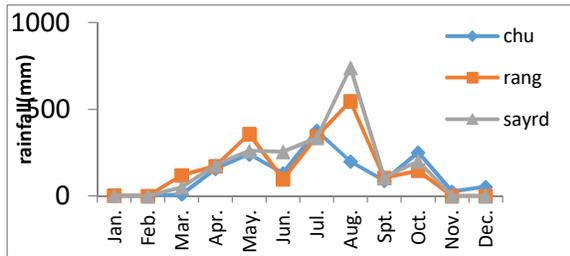


Fig 1: Average monthly rainfall 2017

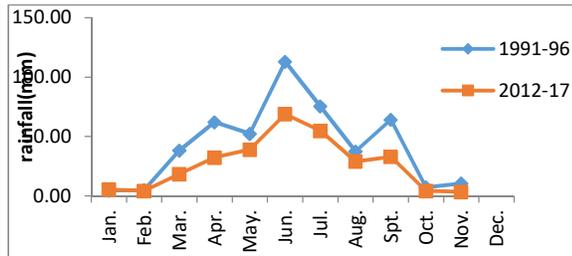


Fig 2: Rainfall difference in Inchuadanga

Rainfall distribution pattern in 1991-96 and 2012-17 in Rangpur was different from other (Fig 3). In 2012-17 more or less even rainfall occurs from the month of April to October. But in 1991-96 there was a decrease of rainfall in July to August. Opposite rainfall distribution pattern observed in Seyedpur (Fig 4). In 1991-96 there was a dramatic decrease of rainfall from July to August but in 2012-17 there is an opposite situation.

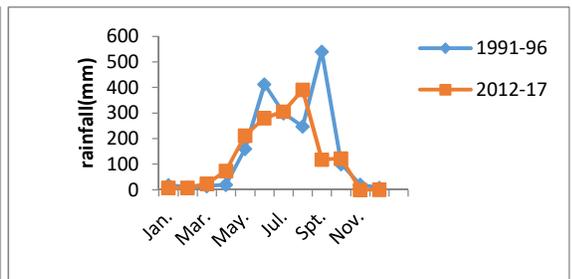
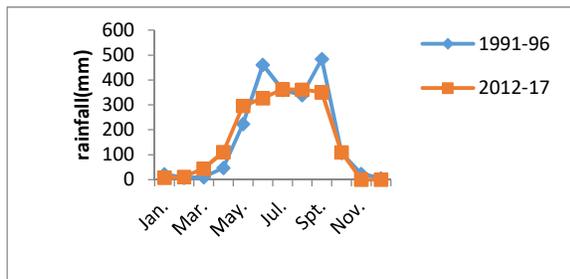


Fig 3: Rainfall difference in Rangpur Fig 4: Rainfall difference in Seyedpur.

One of the most important climate changing factor is maximum temperature. Monthly temp difference were observed in above two locations in 1991-95 and 2013-17 (Table 1 and 2). there was 1⁰c temp difference from last few years to recent few year. Elevated global temperatures were found to create favorable conditions for the survival and reproduction of many insect pests such as the cottonsap-sucking pests whiteflies, thrips, aphids, mealybugs, etc. Among various sap-sucking pests the whitefly, (*B. tabaci*) B biotype causes serious yield losses to cotton (Kranthi K.R., 2014). High temperatures resulted in a decline in the efficacy of insecticides such as the synthetic pyrethroids.

The jassid first appeared in 3rd week after sowing (WAS) in the month of July. Its population increased gradually and maximum population reached during 5 to 7 WAS under different dates of sowing (Dehariya S.K. *et al*, 2018) As the temperature increased the population of pest was found to increases. Patel et al. (1997) also obtained significant positive relationship between jassid population and maximum temperature as well as bright sunshine hours.

Table 1: Temperature difference in Rangpur.

Month	1991-95		2013-17	
	Maxi. temp	Min. temp	Maxi. temp	Min. temp
July	29.13	24.02	29.92	24.7
August	29.63	23.78	29.88	24.54
September	28.97	21.92	29.60	24.46
October	28.08	18.96	29.23	19.08
November	25.82	13.48	26.28	12.52
December	23.05	9.48	24.20	8.9

Table 2: Temperature difference in Chuadanga.

Month	1991-95		2013-17	
	Maxi. temp	Min. temp	Maxi. temp	Min. temp
July	29.32	24.28	29.92	24.7
August	29.88	23.32	29.92	24.54
September	29.95	23.06	29.92	24.46
October	29.58	18.8	29.92	19.08
November	27.80	12.9	29.92	12.52
December	24.28	9.02	28.82	8.9

At the end of the year there was 5% relative humidity difference in three locations (Fig:5,6,7). Recent monthly sunshine vary from the past.(Fig: 8,9,10)

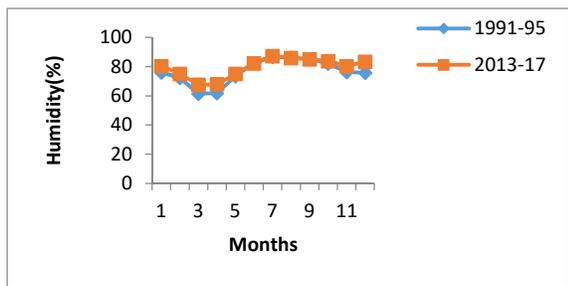


Fig 5: Humidity difference in Chuadanga.

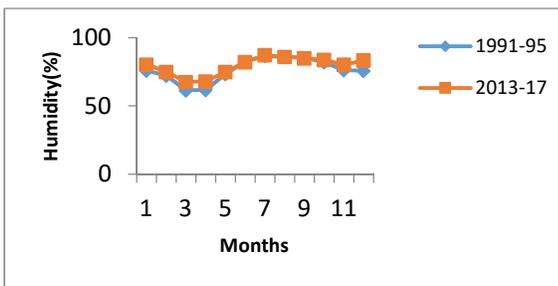


Fig 6: Humidity difference in Rangpur.

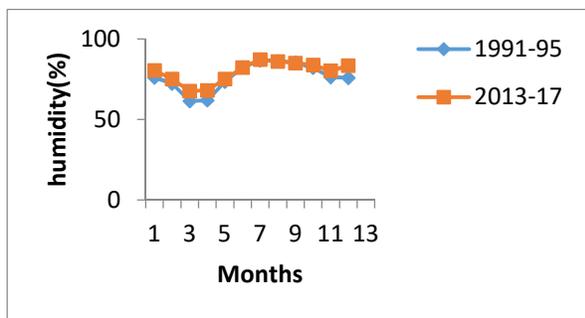


Fig 7: Humidity difference in Sayedpur

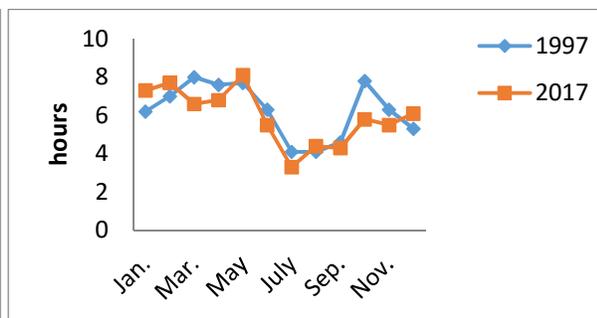


Fig 8: Sunshine difference in Chudanga

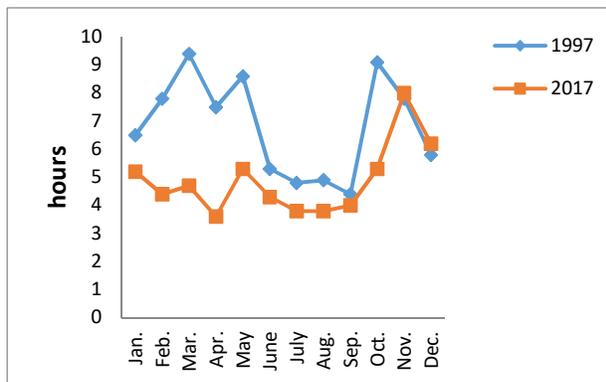


Fig 9: Sunshine difference in Rangpur

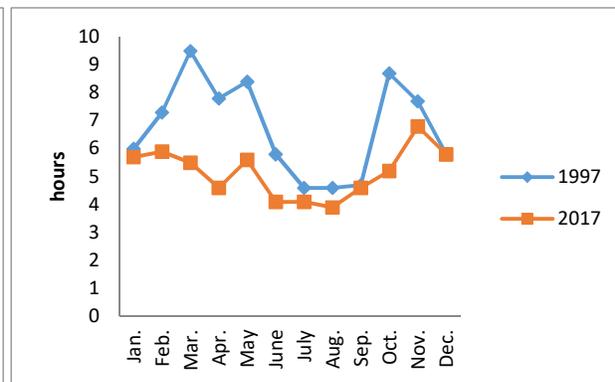


Fig 10: Sunshine difference in Sayedpur

Jassid population

Cotton Jassid (*Amrasca biguttata*) is most dominant in cotton growing areas of Bangladesh. Jassids apparently introduce a toxin that impairs photosynthesis by feeding and this causes the edges of leaves to curl downwards, the leaf becomes yellowish and then reddens. Severe 'hopperburn' leads to shedding of reproductive parts and can severely stunt young plants and reduce yields.

The effect of management practices on jassid population in five Cotton Research Farms of CDB were observed in present work (Table 3). At Sreepur farm, the season long jassid population ranges between 2.09 to 6.6 per plant. The population of jassid did not vary significantly in all the plots before imposing treatments. After 24 hours of spray, jassid population ranges between 0.97 to 6.83 per plant. After 48 hours of spray jassid population ranges between 0.54 to 7.2 and after 72 hr jassid population ranges from 0.29 to 7.8. At Jashore farm, the season long jassid population ranges between 2.15 to 6.81 per plant. After 24 hours of spray jassid population ranges between 0.72 to 7.2 per plant. After 48 hours of spray population ranges between 0.42 to 7.83 and after 72 hr it ranges from 0.29 to 7.8. At Dinajpur farm, the season long jassid population ranges between 1.95 to 6.26 per plant. After 24 hours of spray population ranges between 1.29 to 6.48 per plant. After 48 hours of spray jassid population ranges between 0.53 to 6.41 and after 72 hr jassid population ranges from 0.25 to 7.26. At Rangpur farm, the season long jassid population ranges between 1.91 to 6.23 per plant. The population of jassid did not vary significantly in all the plots before imposing treatments. After 24 hours of spray jassid population ranges between 1.04 to 6.58 per plant. After 48 hours of spray jassid population ranges between 0.88 to 6.75 and after 72 hr population ranges from 0.25 to 7.26. At Bandarban farm, jassid population ranges between 2.32 to 6.51 per plant. After 24 hours of spray jassid population ranges between 0.77 to 6.89 per plant. After 48 hours of spray jassid population ranges between 0.4 to 7.2 and after 72 hr jassid population ranges from 1.34 to 8.24. In all research farms, the population of jassid did not vary significantly in all the plots before imposing treatments. In five farms, the significantly lowest number of jassid population was found in T₃, i.e. Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap, and highest population obtained from T₆ (control).

There is no significant difference in case of all management practices. All the management approaches are effective against jassid population in all farms of CDB. As they are contained of botanic like bioneem. The combination packages are mainly based on azadiractin, yellow sticky trap, tobacco and akondo leaf extracts. As there is no significant difference among the treatments but highest reduction occurs in

T₅Farmer's practices (Hemidor) followed by T₃. As there no significant difference among the treatment in environmental aspect T₃ may eradicate cotton jassid population.

Maximum reduction percent(71.97%) was recorded in Neem extract after 96hrs.ofbotanical pesticides application followed by (70.06%), (68.15%) and(23.33%) in Neemoil, Asafoetida andtobacco respectively. (Abdul.*et al*, 2016) Itisgenerally observed that synthetic pesticides reduce insectinfestation immediately butafter development resistance against these pesticides the cotton farmer is helpless. However,biopesticidesare naturalsubstancesandthe insectsnevertoleratetheefficacyof biopesticid.*Meranoplus bicolor*wasfoundeffectivetocontrolinsectfeedingon theflowersandatthebaseof immaturebollsof cotton (Sivakumar, 2004). Applicationof Neemoil,garlicemulsionat 2%and tobaccodecoctiondeterredtheantsfor4-5 daysin severely affected plots.Bio-pesticides were most effective to control suckingcomplexpopulationon cotton (Ali*et al.*, 2005). Sprayingbiopesticidesi.e.usingNeem,dhatura,tobacco andeucalyptusextractshasprovedto behighlybeneficial inmultipledimensions.The*Azadirachtaindica*produces thebiodegradable and insecticidal liminoid (PraveenPM,DhandapaniN, 2001)Botanical insecticides have been found effective against mealy bug, partiazadirachtin (Isman MB).

Earlier workersalso tested theplant productsagainst jassidsandfound reductioninthe pest populationby twoplantextractsneemand karanjderivativesalsoobtained population reduction of jassids in neem treated plots whichalsoproducedhigheryieldthan other treatments.Somefindingswere reportedby previous workers Dimetry *et al.*,1996, SabillonandBustamante (1995)Somsekara, *et al.*,1997, Singh *et al.*, 2006.

Table-3: Effect of different treatments on Jassid (*A. biguttala*) population at five Cotton Research Farm in 2017-18

treatm ents	Spr ay- nos	Sreepur				Jashore				Dinajpur				Rangpur				Bandarban			
		BS	After spray population			BS	After spraypopulation			BS	After spray population			BS	After spray population			BS	After spray population		
			24h	48h	72h		24h	48h	72h		24h	48h	72h		24h	48h	72h		24h	48h	72h
T ₁	5	2.62	1.42	1.02	0.70	2.48	1.23	0.88	0.64	2.38	1.45	0.93	0.56	2.58	1.60	1.12	0.70	2.57	1.28	0.80	1.32
T ₂	5	2.40	1.55	1.12	0.77	2.42	1.50	1.00	0.71	2.42	1.43	0.99	0.75	2.61	1.50	1.01	0.67	2.31	1.19	0.89	1.32
T ₃	5	2.39	1.29	0.68	0.36	2.74	1.15	0.50	0.37	2.17	1.32	0.48	0.45	2.42	1.27	0.97	0.60	2.75	1.17	0.48	1.30
T ₄	5	2.70	1.69	1.28	0.98	2.93	1.42	1.26	0.92	2.36	1.57	1.24	1.03	2.71	1.4	1.14	0.77	2.95	1.26	1.16	1.50
T ₅	5	2.09	0.97	0.54	0.29	2.15	0.83	0.42	0.24	1.95	1.29	0.53	0.25	1.91	1.04	0.88	0.60	2.32	0.77	0.40	1.34
T ₆	5	6.60	6.83	7.20	7.80	6.81	7.20	7.83	8.21	6.26	6.48	6.81	7.26	6.23	6.58	6.75	6.99	6.59	6.89	7.20	8.24
SE		0.69	0.59	0.60	0.60	0.60	0.58	0.59	0.58	0.37	0.34	0.34	0.29	0.38	0.38	0.35	0.36	0.51	0.46	0.40	0.57
LSD		1.99	1.75	1.78	1.79	1.78	1.71	1.76	1.71	1.10	1.00	1.01	0.88	1.14	1.13	1.05	1.07	1.50	1.36	7.20	1.69

T₁- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap

T₂ – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap

T₃-Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Yellow sticky trap + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap

T₄- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) + Yellow sticky trap

T₅-FarmersPractice(Hemidor @ 0.3 gm/litre)

T₆ – Untreated control (especially in CDB Farm)

BS- Before spray population.

Whitefly population

The effect of management practices on whitefly population were observed in this experiment (Table 4). All the treatments had less leaf infestation than untreated control. Prior to the treatment imposition uniform distribution of whitefly population was observed and was above ETL. At Sreepur farm, the season long whitefly population ranges between 5.71 to 8.46 per plant before spray. Highest population found in T₆ and lowest population observed in T₅ i.e. Farmer's practices (Hemidor). After 24 hours of spray whitefly population ranges between 2.05 to 7.6 per plant. After 48 hours of spray whitefly population ranges between 1.42 to 8.24 and after 72 hr it ranges from 0.93 to 8.93 per plant. At Jashore farm, the season long whitefly population ranges between 5.56 to 8.02 per plant. After 24 hours of spray whitefly population ranges between 1.6 to 7.3 per plant. After 48 hours of spray whitefly population ranges between 0.42 to 7.83 and after 72 hr population ranges from 1.37 to 7.76. At Dinajpur farm, the season long whitefly population ranges between 5.35 to 6.8 per plant. After 24 hours of spray whitefly population ranges between 1.5 to 6.22 per plant. After 48 hours of spray population ranges between 1.42 to 6.4 and after 72 hr whitefly population ranges from 1.07 to 6.66. At Rangpur farm, the season long whitefly population ranges between 5.44 to 7.02 per plant. After 24 hours of spray whitefly population ranges between 1.77 to 6.3 per plant. After 48 hours of spray population ranges between 1.39 to 6.6 and after 72 hr whitefly population ranges from 1.06 to 7. At Bandarban farm, the season long whitefly population ranges between 5.63 to 6.94 per plant. After 24 hours of spray whitefly population ranges between 1.71 to 7.74 per plant. After 48 hours of spray whitefly population ranges between 1.24 to 7.82 and after 72 hr it ranges from 1.3 to 8.24. In all research farm, the population of whitefly did not vary significantly in all the plots before imposing treatments. In this farm, the significantly lowest number of whitefly population was found in T₅, i.e. Farmer's practices (Hemidor) and highest population obtained from T₆ (control). In all research farm, second lowest whitefly observed in T₁ i.e. application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap. So in environmental point of view T₁ may be an option to control whitefly.

That maximum reduction percentage (59.03%) of whitefly population was recorded in Asafoetida followed by Neemoil (61.85%), Neem extract (60.20%) and the least mean reduction percentage (40.38%) of whitefly population was recorded in tobacco application during 2007. (Abdul *et al*, 2016).

Table-4: Effect of different treatments on whitefly (*Bemisia tabaci*) population at five Cotton Research Farm in 2017-18

treatments	Spray nos	Sreepur				Jashore				Dinajpur				Rangpur				Bandarban			
		BS	After spray population			BS	After spray population			BS	After spray population			BS	After spray population			BS	After spray population		
			24h	48h	72h		24h	48h	72h		24h	48h	72h		24h	48h	72h		24h	48h	72h
T ₁	5	6.02	3.37	1.89	1.39	5.63	3.23	1.72	1.21	6.09	3.99	1.83	1.10	5.93	2.27	1.63	1.06	5.83	2.14	1.52	1.32
T ₂	5	5.92	2.61	2.10	1.78	5.56	2.88	1.83	1.52	5.99	2.73	1.9	1.56	6.01	2.37	1.58	1.27	5.63	2.33	1.48	1.32
T ₃	5	5.71	2.45	1.90	1.50	5.58	2.34	1.79	1.37	5.95	2.42	1.8	1.24	6.17	2.12	1.72	1.18	5.82	1.99	1.60	1.30
T ₄	5	5.53	2.93	2.44	1.96	5.88	2.24	2.47	1.47	5.86	2.37	1.83	1.47	6.07	2.09	2.22	1.61	6.07	2.17	2.29	1.50
T ₅	5	5.86	2.05	1.42	0.93	5.83	1.60	1.37	0.90	5.35	1.50	1.42	1.07	5.44	1.77	1.39	1.16	5.92	1.71	1.24	1.34
T ₆	5	8.46	7.60	8.24	8.93	8.02	7.30	7.76	8.50	6.80	6.22	6.40	6.66	7.02	6.30	6.66	7.00	6.94	7.74	7.82	8.24
SE		0.64	0.86	0.58	0.54	0.61	0.71	0.64	0.59	0.34	0.42	0.39	0.38	0.43	0.56	0.41	0.42	0.66	0.51	0.49	0.57
LSD		1.35	1.86	1.72	1.60	1.82	1.48	1.91	1.74	0.71	1.26	1.15	1.13	1.27	1.18	1.23	1.25	1.37	1.50	1.45	1.69

T₁- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap

T₂ – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap

T₃-Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Yellow sticky trap + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap

T₄- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) + Yellow sticky trap

T₅-FarmersPractice(Hemidor @ 0.3 gm/litre)

T₆ – Untreated control (especially in CDB Farm)

BS- Before spray population.

The efficacy of Neem oil against thrips has also been reported by others. (Arain, 2008, Singh *et al.* 2002) .Efficacy of Neembased pesticides against thrips on the basis of cost:benefit ratio, NSKE(3%) ranked first (1:10.70) among all pesticide treatments (Khaskheli, 2007)

Aphid population

In all farm, there were negligible amount of aphid were found. After imposing treatment there were no aphid on field. Jayakumar and Uthamasamy (1997) also reported that neem oil 3% and mahua oil 3% caused 93.3 percent and 90 percent larval mortality of *Myzus persicae*. Viraktamath *et al.*, (1993) also reported the effectiveness of neem seed kernel extract 4% against *Liriomyza trifolii* on tomato. Azam (1991) reported that the neem oil 1.0 and 1.25 per cent caused more than 80 per cent mortality of the larvae and pupae of *L. trifolii* and other similar findings were reported by Murthy and Prasad (1996) Wankhede *et al.*, (2007) Mishra and Shantipriya (2008). There was no remarkable infestation of Aphid population in allocated locations.

Impact of management practices on different farmer's field are different (Table: 5). T₅ perform best among all the treatments. T₃ perform better next than control. No of jassid population ranges from 4.42 to 19.6. After 24 hr spray it ranges from 21.6 to 1.91. After 48 hours it ranges from 22.8 to 0.85 and after 72 hr spray it ranges from 24 to 0.38. Negligible amount of aphid found in early stage. No of whitefly population ranges from 16.4 to 5.52. After 24 hr spray it ranges from 18.2 to 1.12. After 48 hours it ranges from 19.2 to 0.97 and after 72 hr spray it ranges from 36.3 to 0.65.

Table-5: Effect of different treatments on Jassid (*A. biguttata*), whitefly (*Bemisia tabaci*) and Aphid (*A. gossypii*) population at trial allocation locations in 2017-18

treatment s	Spray- nos	Jassid				Aphid				Whitefly			
		BS	After spray population			BS	After spray population			BS	After spray population		
			24h	48h	72h		24h	48h	72h		24h	48h	72h
T ₁	5	4.42	2.62	1.90	1.19	0.46	0.00	0.00	0.00	6.02	2.80	1.91	1.32
T ₂	5	5.44	2.75	2.12	1.64	0.05	0.00	0.00	0.00	5.92	2.74	1.97	1.70
T ₃	5	6.59	1.91	0.94	0.45	0.10	0.00	0.00	0.00	5.71	1.71	1.26	0.98
T ₄	5	7.82	2.69	1.90	1.09	0.18	0.00	0.00	0.00	5.52	2.93	2.35	1.93
T ₅	5	8.70	2.15	0.85	0.38	0.19	0.00	0.00	0.00	5.86	1.13	0.97	0.65
T ₆	5	19.6	21.6	22.8	24.0	0.40	0.26	0.16	0.19	16.4	18.2	19.2	36.3
SE		2.17	2.2	2.1	2.10	0.13	0.15	0.09	0.58	0.08	1.60	1.76	9.32
LSD		4.54	4.70	4.42	4.30	0.28	0.31	0.19	1.71	0.18	3.50	3.60	19.4

T₁- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap

T₂ – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap

T₃-Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Yellow sticky trap + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap

T₄- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) + Yellow sticky trap

T₅-FarmersPractice(Hemidor @ 0.3 gm/litre)

T₆ – Untreated control (especially in CDB Farm)

BS- Before spray population.

Beneficial insect

Impact of management practices on natural enemies are prominent. (Table: 7). In T₅ are solely chemical spray. As a result natural enemies are disappear from treated plot. In control plot LLB and spider number are more than other treatment. There was an increasing tendency in other treatment in case of natural enemies. Use of these natural compounds in place of conventional insecticides could reduce environmental pollution, preserve non-target organisms, and avert insecticide-induced pest. (Rausell C, Martínez-Ramírez AC, García-Robles I, Real MD, 2000). The above discussion leads to conclude that priority adoption of botanical pesticides in cotton is necessary, not only to control the insect pests, but also to save the natural enemies i.e. predator etc. and to protect the environment from pollution due to synthetic pesticides.

Table 6: Impact different treatments on natural enemies in 2017-18

Treatment	Spray-nos	LBB				Spider			
		BS population	After spray population			BS	After spray population		
			24h	48h	72h		24h	48h	72h
T ₁	5	0.22	0.20	0.21	0.41	0.14	0.04	0.01	0.01
T ₂	5	0.21	0.18	0.20	0.17	0.42	0.05	0.00	0.01
T ₃	5	0.25	0.26	0.26	0.20	0.40	0.04	0.06	0.05
T ₄	5	0.29	0.28	0.28	0.70	0.10	0.08	0.02	0.05
T ₅	5	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00
T ₆	5	0.43	0.55	0.63	0.71	0.26	0.03	0.34	0.37
SE		0.08	0.09	0.11	0.29	0.09	0.12	0.12	0.12
LSD		0.17	0.20	0.23	0.61	0.18	0.26	0.25	0.26

T₁- Application of Azadiractin (Bioneem plus 1% EC) @ 1ml/litre of water + Yellow sticky trap

T₂ – Application of Abameatin (Biomax-M 1.2% EC) @ 1ml/ litre + Tobacco leaf extract + Yellow sticky trap

T₃-Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Yellow sticky trap + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap

T₄- Akondo leaf extract (50%) + Tobacco Leaf extract (50%) + Yellow sticky trap

T₅-FarmersPractice(Hemidor @ 0.3 gm/litre)

T₆ – Untreated control (especially in CDB Farm)

BS- Before spray population.

Yield

At Sreepur farm, the seed cotton yield ranges between 1.5 to 2.8 t/ha while the highest seed cotton yield (2.8 t/ha) obtained from T₅ i.e. farmers practice (hemidor) and lowest at T₆(control) (Fig:9). At joshore farm, the seed cotton yield ranges between 1.45 to 3.07 t/ha while the highest seed cotton yield (3.07 t/ha) obtained from T₃ i.e. application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap and lowest at T₆(control) (Fig:10). At Dinajpur farm, the seed cotton yield ranges between 1.06 to 2.94 t/ha while the highest seed cotton yield (2.94 t/ha) obtained from T₃ i.e. application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap and lowest at T₆(control) (Fig:11). At Rangpur farm, the seed cotton yield ranges between 1.18 to 3.03 t/ha while the highest seed cotton yield (3.03 t/ha) obtained from T₃ i.e. application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap and lowest at T₆(control) (Fig:12).. At Bandarban farm, the seed cotton yield ranges between 1.12 to 2.87 t/ha while the highest seed cotton yield (2.87 t/ha) obtained from T₅ i.e. farmers practice (hemidor) and lowest at T₆ (control) (Fig:13). At Sreepur and bandarban farm, the second highest seed cotton yield found in T₃ .

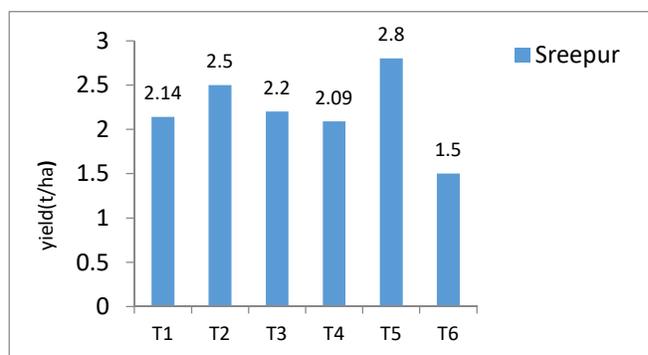


Fig 9:Effect of diff. treatments on yield,Sreepur,2018

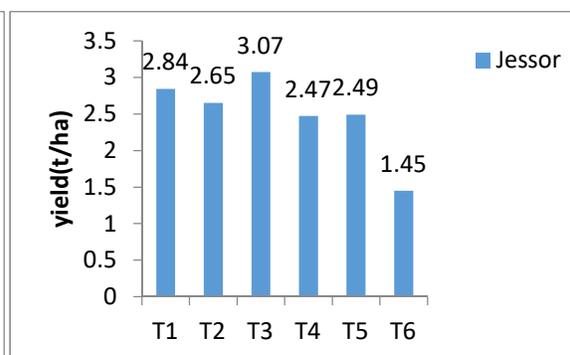


Fig 10:Effect of diff. treatments on yield, Jashore,2018

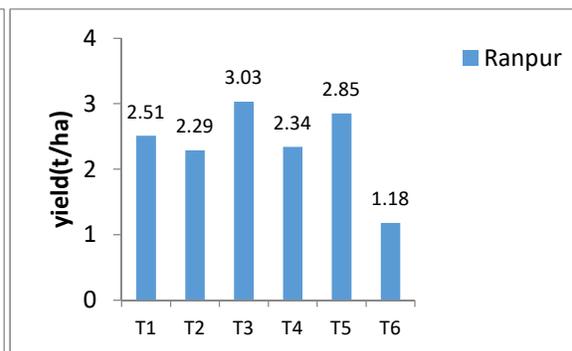
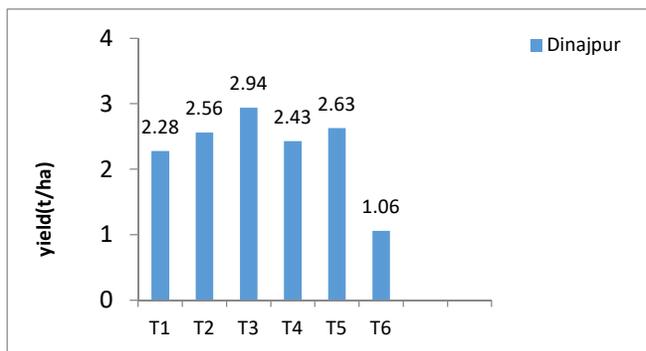


Fig 11: Effect of diff. treatments on yield, Dinajpur, 2018

Fig 12: Effect of diff. treatments on yield, Ranpur, 2018

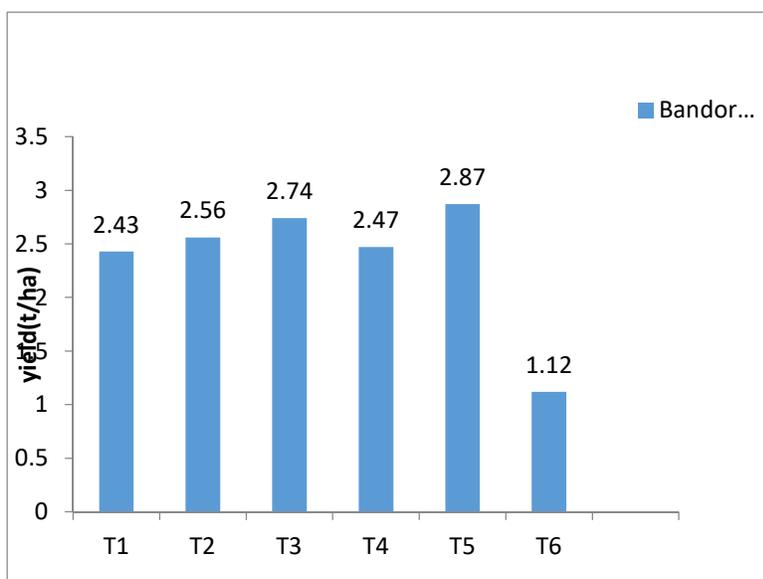


Fig 13: Effect of diff. treatments on yield, Babdarban, 2018

Ginning out turn (GOT)

Ratio of lint and fibre is termed as GOT. Highest GOT was recorded in T₁ where 100 seed weight was 11.5 (Table: 7). In control plot GOT was 38.5 and 100 seed wt. was 12.1

Table 7: Ginning Out Turn of seed cotton under different treatment.

Treatment	seed cotton(wt/kg)	lint (wt/kg)	seed (wt/kg)	GOT%	100 seed wt. (gm)
T ₁	1.00	0.390	0.608	39.00	11.5
T ₂	1.00	0.385	0.614	38.50	12.3
T ₃	1.00	0.385	0.612	38.50	11.8
T ₄	1.00	0.388	0.609	38.80	12.1
T ₅	1.00	0.381	0.610	38.10	11.9
T ₆	1.00	0.385	0.613	38.50	12.1

Economic Analysis

Economics analysis revealed that highest gross margin of Tk 101576 and highest benefit cost ratio (2.85) was obtained from the treatment T₃ (application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap) although its variable cost Tk. 55000/ha. The lowest gross margin (Tk 21720) and lowest benefit cost ratio (1.39) were recorded from T₂ which is followed by T₆ (Table:8).

Table 8: Economic Analysis of different treatments.

Treatment	Seed cotton yield(kg/ha)	Gross Return (Tk/ha)	Total Variable Cost (Tk/ha)	Grossmargin(Tk/ha)	BCR
T ₁	2440	136640	52500	84140	2.6
T ₂	2512	140672	53000	87672	2.65
T ₃	2796	156576	55000	101576	2.84
T ₄	2360	132160	52000	80160	2.54
T ₅	2728	152768	65000	87768	2.35
T ₆	1370	76720	55000	21720	1.39

12. Research highlight:

In Sreepur farm, a healthy plant in untreated control plot were observed where every plant is in hopper burn stage. It may be tolerant to Jassid population. We collect the seed cotton of that plant separately and go for line sowing for further observation in current year.

13. ht/findings :

- Treatment 3, Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap is effective against jassid population.
- Treatment 1, Application of Azadiractin (Bioneem plus 1% EC) @1ml/litre of water + Yellow sticky trap is effective for whitefly population.

B. Implementation Position

1. Procurement: (As Revised DPP)

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Lab &field equipment		3,72,000.00		3,72,000.00	
(b) Office equipment		1,89,000.00		1,89,000.00	
(c) Other capital items		0.00		0.00	

2. Establishment/renovation facilities:

No renovation facilities.

3. Training/study tour/ seminar/workshop/conference organized:

No training facilities taken.

C. Financial and physical progress (As Revised DPP)

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	174340	174340	174340	0	100	
B. Field research/lab expenses and supplies	1234637	1194193	1194193	0	96.72	Budget required
C. Operating expenses	133723	125711	124313	1398	94	Budget required
D. Vehicle hire and fuel, oil & maintenance	0	0	0	0	0	
E. Training/workshop/seminar etc.	0	0	0	0	0	
F. Publications and printing	50000	0	0	0	0	Budget required
G. Miscellaneous	18300	18300	18300	0	100	
H. Capital expenses	189000	189000	189000	0	100	
	1800000	1701544	1700146	1398	98.14	

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
To develop suitable sucking insect-pest management practices under climate change	10 experiments were set up throughout the country with six different treatments	Two best management packages were effective against sucking insects of cotton.	Two management packages obtained against jassid and whitefly
To reduce dependency on chemical approaches.	Bio-pesticide were applied according to treatments.		A tolerant line developed.

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/booklet/leaflet/flyer etc.			
Journal publication			
Information development			
Other publications, if any		100 templates has published and distributed	

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

- Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap is effective against jassid population.
- Application of Azadiractin (Bioneem plus 1% EC) @1ml/litre of water + Yellow sticky trap is effective for whitefly population.

ii. Generation of new knowledge that help in developing more technology in future

In Sreepur farm, a healthy plant in untreated control plot were observed where every plant is in hopper burn stage. It may be tolerant to Jassid population. We collect the seed cotton of that plant separately and go for line sowing for further observation in current year.

iii. Technology transferred that help increased agricultural productivity and farmers' income

- Application of Azadiractin (Bioneem plus 1% EC) @ 1 ml/ L of water + Spinosad (Success 2.5 SC) @ 1 ml / litre of water + Yellow sticky trap is effective against jassid population.
- Application of Azadiractin (Bioneem plus 1% EC) @1ml/litre of water + Yellow sticky trap is effective for whitefly population.

iv. Policy Support

Cotton Development Board, Khamarbari, Dhaka-1215.

G. Information regarding Desk and Field Monitoring

i) Desk Monitoring [description & output of consultation meeting, monitoring workshops/seminars etc.):

ii) Field Monitoring (time& No. of visit, Team visit and output):

Internal monitoring team visited research plot several times and field monitoring team visited research field at Bandarban. They emphasize on accurate data collection.

I. Lesson Learned/Challenges (if any)

- i) Measurement of weather parameters were comparatively tough.
- ii) Preparation of bio-pesticides were laborious.

J. Challenges (if any)

Too much reporting sometimes reduce working hours.

Signature of the Principal Investigator

Date

Seal

Counter signature of the Head of the
organization/authorized representative

Date

Seal