6th Meeting of the Asian Cotton Research & Development Network Dhaka, Bangladesh, June 18 – 20, 2014

Effect of Poultry Manure and Inorganic Fertilizer on the Productivity of Cotton in Bangladesh

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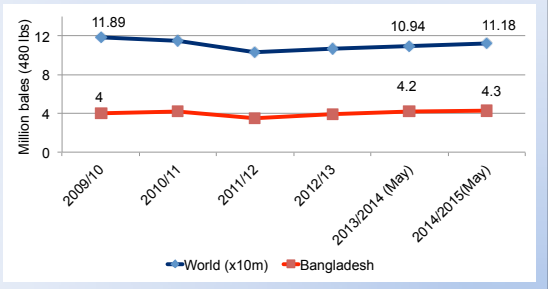
Bangladesh Cotton Consumption

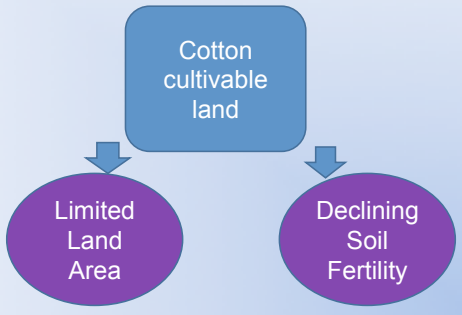


MONTHLY ECONOMIC LETTER | MAY 2014

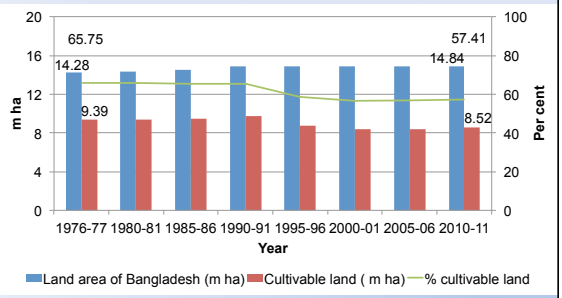
Cotton Incorporated

Bangladesh Cotton Production and Growth Rate

Main constraint in increasing domestic production

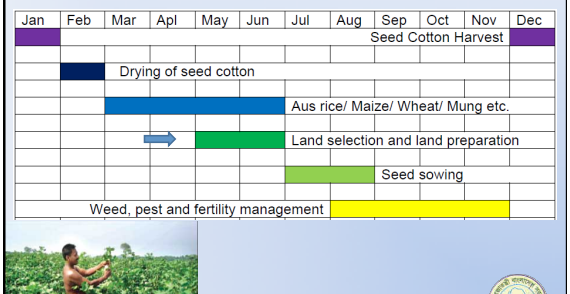


Availability of agricultural land during 1976-77 to 2010-11



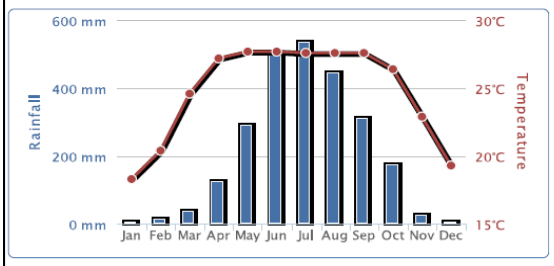
(source: BBS, 2011).

Cotton Crop Calendar in Bangladesh



Introduction 7

AVERAGE MONTHLY TEMPERATURE AND RAINFALL FOR BANGLADESH FROM 1900-2009

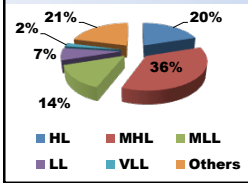


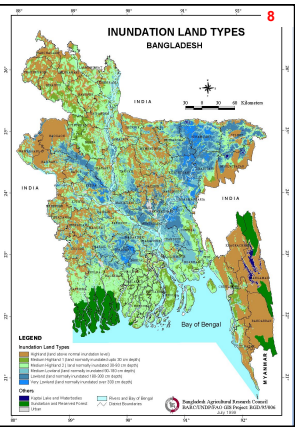
THE WORLD BANK GROUP Climate Change Knowledge Portal

Introduction 8

Inundation Land Types of Bangladesh

Highland (HL)	: No Flood
Medium Highland (MHL) 1	: >30 cm
Medium Highland (MHL) 2	: 30-90 cm
Medium Lowland (ML)	:90-180 cm
Lowland (LL)	:180-300 cm
Very Lowland (VLL)	:<300 cm





Introduction 9

Soil Fertility Status of Bangladesh

Thirty agro-ecological zones and 88 sub-zones have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential. These layers are:

- Physiography (land forms and parent materials)
- Soils
- Depth and duration of seasonal flooding and
- Agro-climatology [it comprises four elements: length of kharif and rabi growing seasons, length of the pre-kharif transition period, number of days below certain winter critical temperatures (<15 °C) and number of days with extremely high summer temperature (> 40 °C)]

Introduction 10

Soil Test Values in Relation to Critical Limit

Soil test value	% C.L.	Expected crop response
Very low	≤ 75	Very definite
Low	75.1-150	Definite
Medium	150.1-225	Likely/Probable
Optimum	225.1-300	Less likely
High	300.1-375	Unlikely
Very high	> 375	Very unlikely

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Emergence of new nutrient deficiency with time

							?
						Mg	Mg
					B	B	B
				Zn	Zn	Zn	Zn
			S	S	S	S	S
		K	K	K	K	K	K
	P	P	P	P	P	P	P
N	N	N	N	N	N	N	N
1951	1957	1960	1980	1982	1995	2000	2010

Agricultural Research Priority : Vision-2030 and beyond

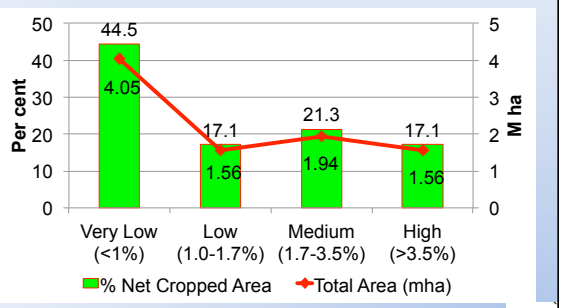
Introduction 12

NPKS Application Rate, Application Time and Method for Cotton in Bangladesh

Application time	Application method	N kg ha^{-1}	P kg ha^{-1}	k kg ha^{-1}	S kg ha^{-1}
0 DAS	Basal	10.4	18	13.8	6.6
25 DAS	Side dressing	10.4	0	20.7	0
45 DAS	Side dressing	31.2	13.5	34.5	8.8
60 DAS	Side dressing	31.2	13.5	41.4	6.6
80 DAS	Side dressing	20.8	0	27.6	0
	Recommended dose	104	45	138	22

Introduction 13

Organic Matter Status of Bangladesh Soils



Source: BARC, 1999

Introduction 14

Trend in the Number of Poultry Farms in Bangladesh

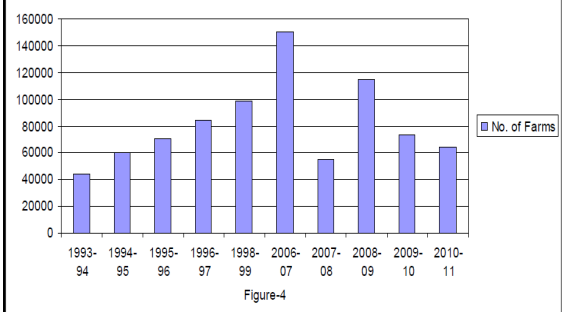


Figure-4

European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.6, No.7, 2014
www.iiste.org

Introduction 15

COMPOST (ORGANIC FERTILIZER) STANDARD OF BANGLADESH

Physical Properties

Sl. No.	Parameters	Standard Condition
1	Color	Dark gray to black
2	Physical condition	Non granular form
3	Odor	Absence of foul odor
4	Moisture Content	Maximum 15 %
5	Inert materials	Maximum 1 %

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COMPOST (ORGANIC FERTILIZER) STANDARD OF BANGLADESH

Chemical Properties

Sl. No.	Parameters	Standard Condition
1	pH	6.0 – 8.5
2	Organic Carbon	10 – 25 %
3	Nitrogen (N)	0.5 – 4.0 %
4	C:N	Maximum 20:1
5	Phosphorus (P)	0.5 – 1.5 %
6	Potassium (K)	1.0 – 3.0 %
7	Sulfur (S)	0.1 – 0.5 %
8	Zinc (Zn)	Maximum 0.1 %
9	Copper (Cu)	Maximum 0.05 %
10	Chromium (Cr)	Maximum 50 ppm
11	Cadmium (Cd)	Maximum 5 ppm
12	Lead (Pb)	Maximum 30 ppm
13	Nickel (Ni)	Maximum 30 ppm

Materials and Methods 17

Cotton Research, Training and Seed Multiplication Farm Jagadishpur, Jessore

AEZ 11: High Ganges River Floodplain

Major Land Type	Soil pH	Soil OM	Nutrient status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland (43%)	4.5-7.9	L-M	VL-L	VL-L	L-M	VL-L	M-H	M-H	L-M	VL-L	M
Medium Highland (32%)	5.6-8.1	L-M	VL-L	VL-L	L-M	VL-L	M-H	M-H	L-M	VL-L	M
Medium Lowland (12%)	6.5-8.3	L-M	VL-L	VL-L	L-M	VL-L	M-H	M-H	L-M	VL-L	M

Materials and Methods 18

Cotton Research, Training and Seed Multiplication Farm Sadarpur, Dinajpur

AEZ 25: Level Barind Tract

Major Land Type	Soil pH	Soil OM	Nutrient status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland (30%)	4.3-6.1	L-M	VL-L	VL-L	L-M	L-M	L-M	L-M	L-M	VL-L	L-M
Medium Highland (55%)	4.7-7.2	L	VL-L	VL-L	L-M	L-M	L-M	L-M	L-M	VL-L	L-M

Materials and Methods 19

Cotton Research, Training and Seed Multiplication Farm
Sreepur, Gazipur

AEZ 28: Madhupur Tract

Major Land Type	Soil pH	Soil OM	Nutrient status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland (56%)	4.0-6.1	L-M	VL-L	VL-L	L-M	L-M	L-M	L-M	L-M	VL-L	L-M
Medium Highland (18%)	4.3-6.4	L-M	VL-L	VL-L	L-M	L-M	L-M	L-M	L-M	VL-L	L-M

Materials and Methods 20

Properties of poultry manure used in the experiment

Color	Odour	Organic carbon	pH	N	P	K	S
		(%)		(%)	(%)	(%)	(%)
Grey	Absence of foul odour	19.7	8.5	2.52	1.90	1.14	0.33

Experiment 1 Experiment 1 21

Combined Effect of Organic Fertilizer on Cotton Yield and Yield Contributing Characters

- **Objectives: To know effect of applying organic fertilizer in addition to inorganic fertilizer on cotton yield and yield contributing characters**
- **Treatment**
  - **T1- Recommended dose of inorganic fertilizer (RD)**
  - **T2- RD + 1 t ha^{-1} Organic Fertilizer (Poultry manure)**
  - **T3- RD + 2 t ha^{-1} Organic Fertilizer (Poultry manure)**
  - **T4- RD + 3 t ha^{-1} Organic Fertilizer (Poultry manure)**
  - **T5- RD + 4 t ha^{-1} Organic Fertilizer (Poultry manure)**
  - **T6- RD + 5 t ha^{-1} Organic Fertilizer (Poultry manure)**
- **Replication- 3**
- **Design- RCBD**
- **Location - Sreepur Farm**
- **Season- 2012-2013**

Experiment 1 22

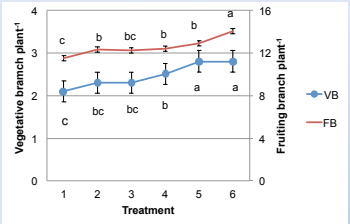
ANOVA (P values) for treatment and replication for some observed parameters

Variable	df	VG[1]	FB[2]	PH[3]	BN[4]	BW[5]	YD[6]
TRT	5	**0.019**	**0.011**	**0.011**	**0.000**	0.136	**0.001**
REP	2	0.554	0.611	0.615	0.977	0.380	0.883

[1]–Vegetative Branch Plant^{-1}, [2]-Fruiting Branch Plant^{-1},
[3]- Plant Height (cm), [4]- Boll Number Plant^{-1}
[5]-Individual Boll Weight (g) and [6]- Seed Cotton Yield (kg ha^{-1})

Experiment 1 23

Effect of Treatment on Cotton Vegetative and Fruiting Branch

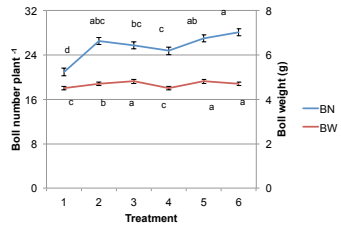


Dissimilar letters indicate significant differences (p<0.05), values are means (n=3), error bars are ± standard error, CV%= 6.11 for vegetative branch and 3.42 for fruiting branch

1- Without organic fertilizer, 2-1 t ha^{-1} organic fertilizer, 3- 2 t ha^{-1} organic fertilizer, 4- 3 t ha^{-1} organic fertilizer, 5- 4 t ha^{-1} organic fertilizer, 6- 5 t ha^{-1} organic fertilizer

Experiment 1 24

Effect of Treatment on Boll plant^{-1} and individual boll weight (g)

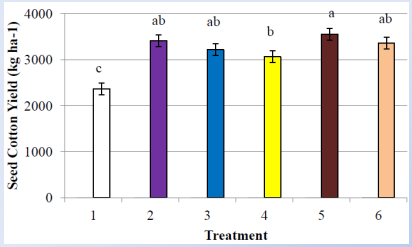


Dissimilar letters indicate significant differences (p<0.05), values are means (n=3), error bars are ± standard error, CV%= 4.53 for boll plant^{-1} and 9.20 for boll weight

1- Without organic fertilizer, 2-1 t ha^{-1} organic fertilizer, 3- 2 t ha^{-1} organic fertilizer, 4- 3 t ha^{-1} organic fertilizer, 5- 4 t ha^{-1} organic fertilizer, 6- 5 t ha^{-1} organic fertilizer

Experiment 1 25

Effect of Treatment on Seed Cotton Yield (kg ha^{-1})



Dissimilar letters indicate significant differences (p<0.05) , Values are means (n=3)
Error bars are ± standard error, CV%= 6.89

1- Without organic fertilizer, 2-1 t ha^{-1} organic fertilizer, 3- 2 t ha^{-1} organic fertilizer, 4- 3 t ha^{-1} organic fertilizer, 5- 4 t ha^{-1} organic fertilizer, 6- 5 t ha^{-1} organic fertilizer

Experiment 1 26

Conclusion

To sustain the cotton production in Bangladesh, incorporation of organic manure together with the inorganic fertilizer is utmost necessary. In this regard, the application of poultry manure is found to be useful in our study. However, to optimize the yield advantage from the poultry manure application, the adjustment of poultry manure application rate is needed.

Reference

Islam, M.K., Voumik, R.K., Ibrahim,K.M., Akhteruzzaman, M.(2013).Combined effect of poultry manure and inorganic fertilizer on upland cotton yield in Bangladesh. Bangladesh Journal of Progressive Science & Technology, 11(1): 005-012.

Experiment 2 27

Effect of Poultry Manure and Inorganic Fertilizer on Cotton Productivity in Bangladesh

- **Objectives:**
  The objective of this research was to determine the effect of poultry manure combined with inorganic NPKS fertilizers at the rate of deficient to recommended to excessive on cotton yield and yield contributing characters.
- **Treatments:**

Treatment	Combinations
Treatment 1	Control (without fertilizer)
Treatment 2	Recommended doses of inorganic fertilizer (104-45-138-22 kg NPKS ha^{-1} respectively)
Treatment 3	75% of recommended doses of inorganic fertilizer
Treatment 4	75% of Treatment 2 + 2 t ha^{-1} poultry manure
Treatment 5	75% of Treatment 2 + 4 t ha^{-1} poultry manure
Treatment 6	75% of Treatment 2 + 6 t ha^{-1} poultry manure

Experiment 2 28

Materials and Methods

Design	RCBD
Replication	3
Spacing	90 cm × 45 cm
Variety	CB-12
Location	Sreepur, Sadarpur and Jagadishpur Farm
Season	2012-2013

Experiment 2 29

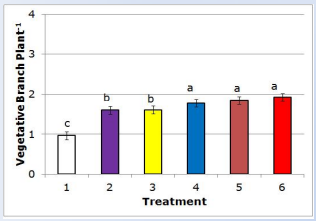
ANOVA (P values) for treatment, replication, location and interaction for some observed parameters

Variable	df	VG[1]	FB[2]	PH[3]	BN[4]	BW[5]	YD[6]
Treatment (T)	5	0.000	0.002	0.055	0.000	0.890	0.000
Replication (R)	2	0.283	0.983	0.462	0.098	0.507	0.472
Location (L)	2	0.000	0.000	0.009	0.000	0.001	0.000
T × R	10	0.213	0.639	0.662	0.285	0.084	0.342
R × L	4	0.171	0.962	0.555	0.283	0.600	0.704
T × L	10	0.056	0.467	0.707	0.000	0.054	0.003

[1]–Vegetative Branch Plant^{-1}, [2]-Fruiting Branch Plant^{-1},
[3]- Plant Height (cm), [4]- Boll Number Plant^{-1}
[5]-Individual Boll Weight (g) and [6]- Seed Cotton Yield (kg ha^{-1})

Experiment 2 30

Effect of Treatment on Cotton Vegetative Branch

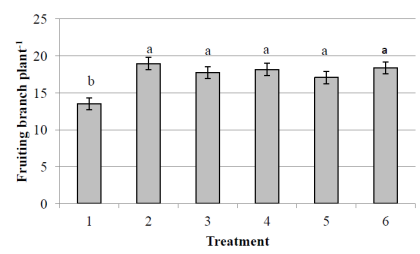


1- Without fertilizer,
2- 100% of recommended dose of fertilizer
3- 75% of recommended dose of fertilizer
4- 75% of recommended dose of fertilizer + 2 t ha^{-1} poultry manure
5- 75% of recommended dose of fertilizer + 4 t ha^{-1} poultry manure
6- 75% of recommended dose of fertilizer + 6 t ha^{-1} poultry manure

Dissimilar letters indicate significant differences (p<0.05),
Values are means (n=9),
Error bars are ± standard error ,

Experiment 2 31

Effect of Treatment on Cotton Fruiting Branch



Dissimilar letters indicate significant differences (p<0.05), values are means (n=9), error bars are ± standard error (CV%= 14.0)

1- Without fertilizer, 2- 100% of recommended dose of fertilizer, 3- 75% of recommended dose of fertilizer, 4- 75% of recommended dose of fertilizer + 2 t ha^{-1} poultry manure, 5- 75% of recommended dose of fertilizer + 4 t ha^{-1} poultry manure, 6- 75% of recommended dose of fertilizer + 6 t ha^{-1} poultry manure

Experiment 2 32

Treatment × Location interaction effect on Boll Number Plant^{-1}

Treatment	Sreepur		Sadarpur		Jagadishpur	
1	19.0	g	22.0	efg	12.3	h
2	24.1	defg	30.8	bc	26.2	cde
3	23.1	efg	23.8	defg	25.1	def
4	24.3	defg	41.5	a	23.7	defg
5	22.0	efg	41.3	a	28.9	bcd
6	19.6	fg	33.5	b	29.2	bcd

values are means (n=3), CV%= 12.5

1- Without fertilizer, 2- 100% of recommended dose of fertilizer, 3- 75% of recommended dose of fertilizer, 4- 75% of recommended dose of fertilizer + 2 t ha^{-1} poultry manure, 5- 75% of recommended dose of fertilizer + 4 t ha^{-1} poultry manure, 6- 75% of recommended dose of fertilizer + 6 t ha^{-1} poultry manure

Experiment 2 33

Treatment × Location interaction on Seed Cotton Yield (kg ha^{-1})

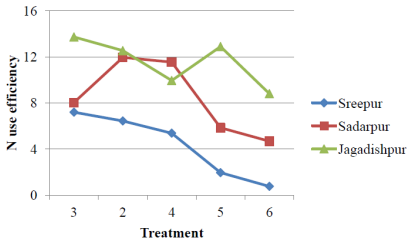
Treatment	Sreepur		Sadarpur		Jagadishpur	
1	1975	h	2979	def	1097	i
2	2644	efg	4222	ab	2400	fg
3	2536	efg	3605	bc	2167	gh
4	2665	efg	4460	a	2373	fgh
5	2323	gh	4024	ab	3401	cd
6	2149	gh	4049	ab	3113	cde

Dissimilar letters indicate significant differences (p<0.05)
Values are means (n=3)
CV%= 12.5

1- Without fertilizer, 2- 100% of recommended dose of fertilizer, 3- 75% of recommended dose of fertilizer, 4- 75% of recommended dose of fertilizer + 2 t ha^{-1} poultry manure, 5- 75% of recommended dose of fertilizer + 4 t ha^{-1} poultry manure, 6- 75% of recommended dose of fertilizer + 6 t ha^{-1} poultry manure

Experiment 2 34

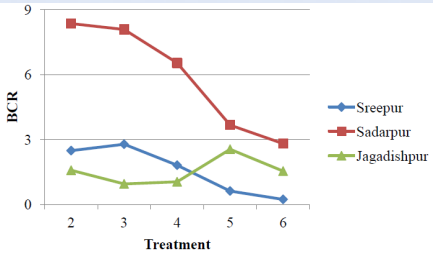
Agronomic Efficiency of N Use



2-Recommended doses of inorganic fertilizer, 3-75% of recommended doses of inorganic fertilizer, 4-75% of Treatment 2 + 2 t ha^{-1} poultry manure, 5-75% of Treatment 2 + 4 t ha^{-1} poultry manure, 6-75% of Treatment 2 + 6 t ha^{-1} poultry manure, error bar represents the standard error.

Experiment 2 35

Benefit to Cost Ratio



2-Recommended doses of inorganic fertilizer, 3-75% of recommended doses of inorganic fertilizer, 4-75% of Treatment 2 + 2 t ha^{-1} poultry manure, 5-75% of Treatment 2 + 4 t ha^{-1} poultry manure, 6-75% of Treatment 2 + 6 t ha^{-1} poultry manure,

Experiment 2 36

Conclusion

In Bangladesh, cotton cultivation requires high quantity of NPKS fertilizers and the requirements are only me by inorganic fertilizer. On the other hand, indiscriminate disposal of poultry litter is growing concern although it contain valuable plant nutrients. Our study suggested that inorganic fertilizer use can be replace with the use of poultry manure in cotton cultivation that simultaneously reduce the risk of environment pollution due to the indiscriminate disposal of poultry litter.

Reference

Islam, M. K., Akhteruzzaman, M., Ullah, M.S. (2013). Effect of poultry manure and inorganic fertilizer on the productivity of cotton. Journal of Agroforestry and Environment, 7(1):31-36.

Experiment 3 37

Effect of Organic and Inorganic source of N on Cotton Yield

Experiment 3 38

Objectives

- To reduce chemical fertilizer application rate
- To improve soil health
- To increase cotton yield

Experiment 3 39

Materials and methods

- Location: Sreepur, Sadarpur and Jagadishpur Farm
- Season: 2013-2014
- Treatments:
  - 100% N from Urea
  - 90% N from Urea + 10% N from Poultry Manure
  - 80% N from Urea + 20% N from Poultry Manure
  - 70% N from Urea + 30% N from Poultry Manure
  - 60% N from Urea + 40% N from Poultry Manure

Experiment 3 40

- Design : RCBD
- Replication:4
- Plot size: 4.5m × 3.6m
- Spacing: 90 cm × 45 cm
- Cotton variety: CB-12

Experiment 3 41

ANALYSIS OF VARIANCE SUMMARY TABLE

Variate	Obs. No.	CV%	F-PROBABLIITY VALUES			
			Loc	Trt	Rep	Loc*Trt
NFB	60	6.9	**0.0000**	0.5165	0.7384	0.7240
PH	60	7.1	**0.0000**	0.1552	0.0014	0.9501
VB	60	22.1	**0.0000**	0.6728	0.0030	0.9123
SFB	60	20.5	**0.0000**	0.2108	0.0488	0.4971
PFB	60	7.2	**0.0000**	**0.0253**	0.0000	0.5867
BN	60	6.0	**0.0000**	**0.0008**	0.5171	0.1065
YIELD	60	4.1	**0.0000**	**0.0000**	0.2697	**0.0000**
BW	60	5.6	**0.0000**	**0.0000**	0.6188	**0.0154**

NFB- Node number of 1st fruiting branch, PH- Plant height, VB- Vegetative branch, SFB- Secondary Fruiting Branch, PFB- Primary fruiting branch, BN- Boll number/plant, BW- Individual boll weight, Loc- location, Trt- Treatments, Rep- Replication,

Experiment 3 42

Effect of location

LOC	NFB	PH	VB	SFB	PFB	BN
Sreepur	7.8	75.0	0.8	1.7	12.7	17.6
Sadarpur	7.0	103.3	3.1	5.8	14.2	28.6
Jagadishpur	6.1	98.2	1.5	8.3	14.6	17.3
SE	0.1	1.5	0.1	0.2	0.2	0.3
5%LSD	0.31	4.18	0.25	0.69	0.63	0.81

Loc- location, NFB- Node number of 1st fruiting branch, PH- Plant height, VB- Vegetative branch, SFB- Secondary Fruiting Branch, PFB- Primary fruiting branch, BN- Boll number/plant, BW- Individual boll weight,

Experiment 3 — 43

Effect of Treatment

Treatment	NFB	PH	VB	SFB	PFB	BN
1	6.9	91.6	1.8	5.1	13.8	19.9
2	7.1	88.6	1.7	5.0	13.8	21.1
3	7.1	91.4	1.8	5.3	13.1	21.1
4	6.9	95.1	1.8	4.9	14.2	22.4
5	6.8	94.0	1.9	5.9	14.4	21.4
SE	0.14	1.89	0.11	0.31	0.29	0.37
5%LSD	NS	NS	NS	NS	0.82	1.04

1- 100% N from Urea, 2- 90% N from Urea + 10% N from Poultry Manure, 3- 80% N from Urea + 20% N from Poultry Manure, 4- 70% N from Urea + 30% N from Poultry Manure 5- 60% N from Urea + 40% N from Poultry Manure

NFB- Node number of 1st fruiting branch, PH- Plant height, VB- Vegetative branch, SFB- Secondary Fruiting Branch, PFB- Primary fruiting branch, BN- Boll number/plant, BW- Individual boll weight,

Experiment 3 — 44

Location × Treatment interaction effect on single boll weight(g)

	Sreepur	Sadarpur	Jagadishpur
T1	4.1	5.3	4.9
T2	3.7	4.5	4.0
T3	4.2	4.5	4.2
T4	3.9	4.6	4.4
T5	4.0	4.8	4.3
	5% LSD	0.3	

T1- 100% N from Urea,
T2- 90% N from Urea + 10% N from Poultry Manure,
T3- 80% N from Urea + 20% N from Poultry Manure,
T4- 70% N from Urea + 30% N from Poultry Manure
T5- 60% N from Urea + 40% N from Poultry Manure

Experiment 3 — 45

Location × Treatment interaction effect on seed cotton yield (kg/ha)

	Sreepur	Sadarpur	Jagadishpur
T1	1573	3543	2006
T2	1622	3148	1734
T3	1749	3120	1858
T4	1803	3481	1941
T5	1894	3395	1727
	5% LSD	135	

T1- 100% N from Urea,
T2- 90% N from Urea + 10% N from Poultry Manure,
T3- 80% N from Urea + 20% N from Poultry Manure,
T4- 70% N from Urea + 30% N from Poultry Manure
T5- 60% N from Urea + 40% N from Poultry Manure

Experiment 3 — 46

Conclusion

To sustain the cotton production in Bangladesh, incorporation of organic source of N together with the inorganic fertilizer source i.e. urea is utmost necessary. In this regard, the application of poultry manure as an organic source of N is found to be useful. In our study, we observed that application of 40% N from poultry manure at Sreepur farm and application of 30% N from poultry manure at Sadarpur and Jagadishpur farm were resultant the statistically similar seed cotton yield with 100% of N from urea only.

New Research Program — 47

Experiment 4:

Effect of Inorganic Fertilizers and Integrated Nutrient Management Practices on Cotton Productivity, Nutrient Uptake and Soil Fertility

Objectives:

1. To determine the long term effect of poultry manure and inorganic fertilizer on cotton yield.
2. To determine the cotton nutrient uptake as affected by combined application of poultry manure and inorganic fertilizer
3. To determine the postharvest soil fertility as affected by combined application of poultry manure and inorganic fertilizer

New Research Program — 48

Experiment Details

Treatment:	
T1	No fertilizer
T2	Recommended doses of inorganic fertilizer (104-45-138-22 kg NPKS ha^{-1} respectively)
T3	Poultry manure 2 t ha^{-1} + (Recommended doses of inorganic fertilizer – quantity of NPKS available in 2 t ha^{-1} poultry manure)
T4	Poultry manure 4 t ha^{-1} + (Recommended doses of inorganic fertilizer – quantity of NPKS available in 4 t ha^{-1} poultry manure)
T5	Poultry manure 6 t ha^{-1} + (Recommended doses of inorganic fertilizer – quantity of NPKS available in 6 t ha^{-1} poultry manure)

New Research Program

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Design	:	RCBD
Replication	:	4
Season	:	2014-15 to 2016-2017
Variety	:	CB-12
Unit Plot size	:	10 m × 10 m.
Spacing	:	90 cm × 45 cm
Location	:	4 cotton research farms of CDB located at Sreepur, gazipur; Sadarpur, Dinajpur; Jagadishpur, Jessore and Balaghata, Bandarban

My Deepest Gratitude to:

Dr. M. Rafiq Chaudhry

And To the

Organizing Committee