Conference on Conservation Agriculture for Smallholders in Asia and Africa

7-11 December, 2014

CONFERENCE PROCEEDINGS

Proceedings of the Conference on Conservation Agriculture for Smallholders in Asia and Africa

Published in 2014

Published as an e-book on USB. For enquiries please contact Prof. Richard Bell

The committee thanks the following people for reviewing papers

Dr. C. Johansen
Dr. Md. E Haque
Prof. Dr. M. Rahman
Dr. T. Krupnik
Dr. Md. A. Hashem
Dr. Y. Niino
Mr J. Esdaile
Prof. R. W. Bell
Prof. Dr. M Jahiruddin
Dr. J. McHugh
Dr. J. Desbiolles
Dr. K. Flower
Dr. I. Malik
Dr. S. Mann
Dr. W.H. Vance

Citation

The correct reference for papers presented at this conference is:

Entire proceedings
Vance WH, Bell RW, Haque ME (2014) Proceedings of the Conference on Conservation Agriculture for Smallholders in Asia and Africa. 7-11 December 2014, Mymensingh, Bangladesh. Published as an E-book. p xx.Paper in proceedings

Paper in proceedings
[Authors] (2014) [Title of Paper] In: Proceedings of the Conference on Conservation Agriculture for Smallholders in Asia and Africa. 7-11 December 2014, Mymensingh, Bangladesh. (Eds. WH Vance, RW Bell, ME Haque). pp xx-xx.

Conference Host

Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
http://www.bau.edu.bd/

Conference Organizers

Conference Sponsors

Effects of Minimum Tillage Practices and Crop Residue Retention on Soil Properties and Crop Yields under a Rice-based Cropping System

N. Salahin[1], M. Jahiruddin[2], M.R. Islam[2], R.W. Bell[3], M.E. Haque[3] and M.K. Alam[1]

[1]*Bangladesh Agricultural Research Institute (BARI), Gazipur, salahin@yahoo.com, nuranyam@yahoo.com*
[2]*Bangladesh Agricultural University (BAU), Mymensingh.m_jahiruddin@yahoo.com, mrislam58@yahoo.com*
[3]*Murdoch University, Australia* r.bell@murdoch.edu.au, *enamul.haque71@gmail.com*

Introduction

Average cropping intensity is 191% in Bangladesh but cropping patterns are mainly rice-based (BBS, 2012). Depletion of soil organic matter as well as other plant nutrients is one of the most serious threats to the sustainability of agriculture in Bangladesh (Rijpma and Jahiruddin, 2004). Hence, conservation agriculture (CA) practices such as minimal soil disturbance, crop residue retention with suitable crop rotations could be a good option for Bangladesh. However, the effects of CA practices in intensive rice-based rotations on soil properties along with crop yields have not been adequately assessed in Bangladesh. The present study was undertaken to determine the effects of minimum tillage practices and crop residue retention on soil properties and crop yields under a rice-based cropping system.

Materials and Methods

The experimental site is located at Baliakandi upazilla, Rajbari district, in a sub-tropical, wet and humid climate, characterized by distinct wet and dry seasons on the Low Ganges River Floodplain. The soils are calcareous type with sandy loam to loamy texture. The four tillage practices- zero tillage (ZT), strip tillage (ST), bed planting (BP) and conventional tillage (CT) were allocated to the main plots and two levels of crop residue retention of rice and legume residue i) low (20%), comparable to farmer's retention practices and ii) high (50%) were allocated to the sub-plots in a split-plot design with four replications in a rice-lentil-jute cropping sequence. Soil samples were collected at the initiation of the experiment as well as at the end of each cropping cycle in rice-lentil-jute cropping sequence from 0-5, 5-10 and 10-15 cm and analyzed by standard methods for soil physico-chemical properties. Rice equivalent yield (REY) of lentil and jute crops was computed as the yield of lentil and jute crop divided by current market price of rice and multiplied by market price of lentil and jute crop. The software package MSTATC was followed for statistical analysis.

Results and Discussion

The highest available P was in ZT followed by ST, CT and the lowest result was in BP practice whereas the highest available Zn was found in ST followed by BP, ZT and CT practices. All other nutrients remained unchanged (data not shown). Retention of increased amounts of previous crop residues (>6.0 t ha^{-1} $year^{-1}$) significantly increased SOC and other plant nutrients after 1-crop cycle under the rice–lentil-jute cropping sequence (data not shown).

Soil bulk density and soil penetration resistance followed the sequence, ZT>ST>BP>CT, while increased crop residue retention significantly decreased soil penetration resistance at 0-5 and 5-10 cm after the 4th crop harvest. Soil moisture content was inversely related to soil bulk density and penetration resistance after 4th crop harvest due to different tillage and residue management (Table 1).

In the first cropping year, the highest rice and lentil grain yield was attained in CT and the lowest in ZT. However in the second year, the highest grain yield of rice and lentil was attained in ST and BP. Lowest rice and lentil yields were obtained in CT (Table 2). The fibre yields of jute followed the sequence: ST>ZT>CT>BP in both years. Higher crop residue retention increased rice and jute yield in the second year but the opposite results were found with lentil in the second year. Rice equivalent yield was significantly higher in ST compared to other tillage practices whereas higher residue retention increased REY in the second cropping year. Strip tillage with higher residue retention are showing promising results after 4 crops in terms of soil properties and crop yield in the intensive rice-lentil-jute crop sequence.

Table 1. Effects of tillage practices and crop residue retention levels on soil bulk density, penetration resistance and soil water content after the harvest of the 4th crop

Treatments	Bulk density (g cm^{-3})			Penetration resistance (N/cm^2)			Soil water content (%)		
	0-5 cm	5-10 cm	10-15 cm	0-5 cm	5-10 cm	10-15 cm	0-5 cm	5-10 cm	10-15 cm
Tillage practices									
ZT	1.54 a	1.56 a	1.57 a	87 a	179 a	249	33.4 b	32.9 b	32.0
ST	1.51 ab	1.52 ab	1.54 ab	67 b	158 a	230	33.7 b	33.0 b	32.7
BP	1.49 b	1.51 b	1.52 b	86 a	118 b	224	33.4 b	33.3 ab	33.1
CT	1.48 b	1.50 b	1.53 ab	58 b	116 b	206	35.5 a	34.2 a	34.0
P	*	*	*	*	*	NS	*	**	NS
Previous crop residue retention levels									
Low	1.51	1.53	1.55	80	152	237	33.8	32.9	32.8
High	1.49	1.51	1.53	69	134	218	34.2	33.7	33.1
P	NS	NS	NS	**	**	NS	NS	*	NS

Table 2. Effects of tillage practices and crop residue retention levels on crop yields (t ha^{-1})

Treatments	Rice grain 2012	Lentil seed 2012-13	Jute fibre 2013	Rice grain 2013	Lentil seed 2013-14	Jute fibre 2014	REY 1st year	REY 2nd year
Tillage practices								
ZT	2.66 b	1.40 b	4.61 a	5.81 bc	1.45 bc	4.62ab	21.8	22.5b
ST	3.24ab	1.76ab	4.69 a	6.71 a	1.65 ab	4.87 a	24.7	24.8 a
BP	2.88 b	1.51 b	2.98 c	6.28ab	1.93 a	3.39 b	18.8	22.5 b
CT	3.70 a	1.98 a	3.54 b	5.38 c	1.19 c	3.52 b	23.7	18.5 c
P	*	*	*	*	**	*	Ns	**
Previous crop residue retention levels								
20%	-	1.70	4.08	5.82	1.62	3.85	22.8	21.6
50%	-	1.63	3.83	6.27	1.49	4.35	21.7	22.5
P	-	ns	ns	**	*	*	Ns	*

References

BBS (2012) Statistical Bulletin-Bangladesh, Bangladesh Bureau of Statistics, Dhaka.

Rijpma J, Jahiruddin M (2004) National strategy and plan for use of soil nutrient balance in Bangladesh. A consultancy report, SFFP, Khamarbari, Dhaka.