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

Minimum tillage and increased residue retention improves soil physical conditions and wheat root growth in a rice-based cropping system

M. A. Islam[1], R. W. Bell[1], C. Johansen[2], M. Jahiruddin[3], M. E. Haque[1]

[1]*Murdoch University, Australia, M.Islam@murdoch.edu.au ; R.Bell@murdoch.edu.au ; enamul.haque71@gmail.com*
[2]*Consultant, Leeming, Australia, cjo41802@bigpond.net.au;*
[3]*Bangladesh Agricultural University, Mymensingh, Bangladesh, m_jahiruddin@yahoo.com*

Introduction

Wheat (*Triticum aestivum* L.) is grown in rice-based cropping systems of the eastern Indo-Gangetic Plain in soils subjected to repeated tillage to prepare puddled soil for preceding monsoon rice (*Oryza sativa* L.). Such soils commonly have a hard plough-pan layer (10-15 cm depth) which limits root growth and yield of wheat (Mohanty et al., 2006). Conservation agriculture offers the potential for improved soil physical properties and increased root growth and yield of wheat (Aggarwal et al., 2006). However, it is unclear whether such changes will occur in intensive rice-based cropping sequences and the dependence of improvement on crop residue retention. A field experiment assessed changes in soil physical properties after 7 consecutive crops in relation to minimum tillage and crop residue retention levels.

Materials and methods

The study was conducted at Digram village in Rajshahi, Bangladesh (24°31 N, 88°22 E) in the drought-prone ancient alluvial plain (High Barind Tract) during 2010-13. Only data of 2012-13 are presented here. Wheat was the first crop grown, followed by mungbean (*Vigna radiata* L.) and rice. The sequence was repeated and ended with a 3rd wheat crop (crop number 7 in the sequence). Main plots consisted of strip tillage (ST), bed planting (BP) and conventional tillage (CT) while high residue (HR) and low residue (LR) levels were retained on sub-plots. Each treatment was replicated four times. Volumetric soil water contents (SW) were measured with a capacitance sensor and penetration resistance (PR) with a hand penetrometer. In this study, SW and PR values for conventional tillage were compared with the average of in-the-strip and between-the-strip values; and on top of the bed. Root volume (RV) was recorded by water displacement and root length by the grid intercept method. When the F-test was significant (GenStat 15th ed.), treatment means were separated by least significant difference (lsd, $P \leq 0.05$).

Results and Discussion

Regardless of tillage method and residue management, PR and SW increased with soil depth which may reflect the existence of a plough pan (Fig. 1a and 1b). At 0-5 cm and 5-10 cm soil depth, the lowest PR value was obtained in the BP-system and the greatest PR obtained with CT treatment. High residue decreased the penetration resistance and increased the SW level.

Regardless of treatments, wheat root volume and RLD decreased with increasing soil depth (Fig. 2a), which might be related to increasing PR (Fig. 1b). In the surface layers (0-10 cm soil depth), significantly greater root volume and root length density were found in beds than other tillage treatments. High residue also enhanced the root growth in the surface layer of soil (Fig. 2). At 10-20 cm depth, the root growth followed the order: BP > ST > CT. Below 20 cm soil depth, treatment variation in RV and RLD disappeared.

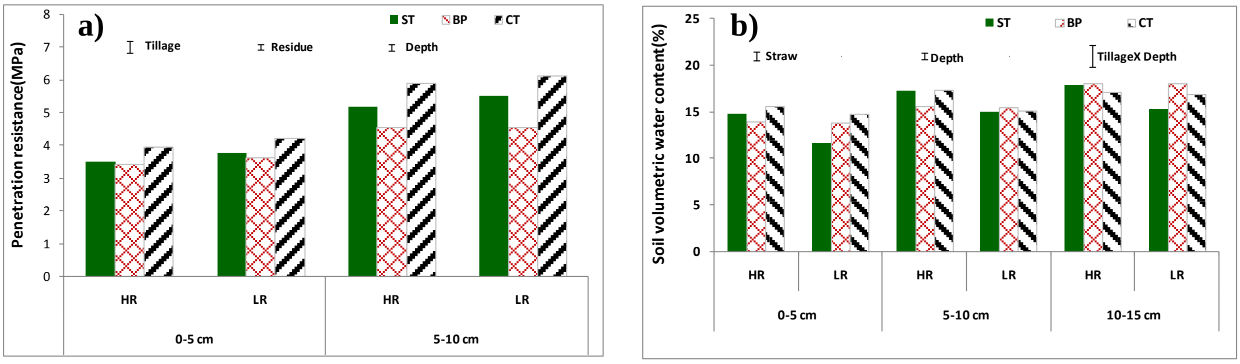

Figure 1. The mean of a) PR and b) SW with increasing depth under different tillage and residue treatments. Floating bars represent lsd for significant treatment differences.

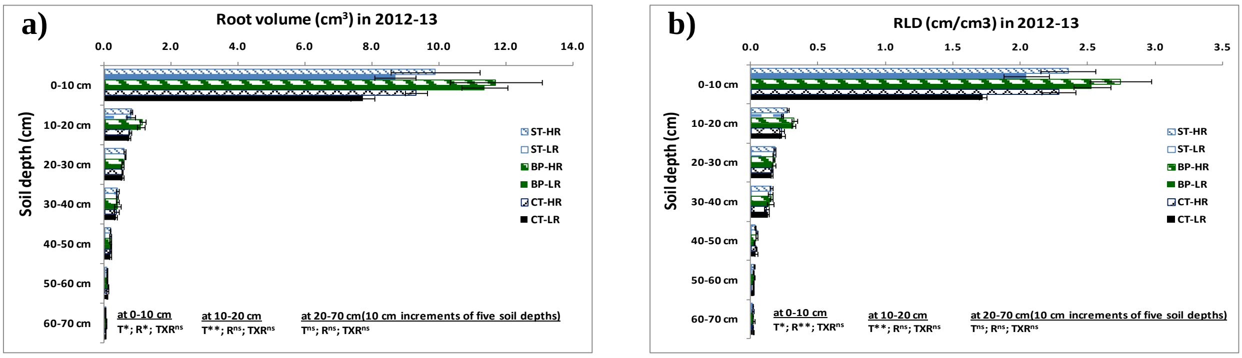

Figure 2. The mean of a) root volume (cm^3) and b) root length density (cm/cm^3) under different tillage and residue treatments. Error bars indicate ± 1 standard error.

Conclusions

Initial bed forming followed by minimum tillage planting for six consecutive crops decreased soil impedance to root growth of wheat. Strip tillage for 7 consecutive crops also increased root growth of wheat at 10-20 cm depth. High residue retention for six consecutive crops increased SW and decreased mechanical impedance which led to increased root growth of wheat. None of the tillage or residue retention treatments affected root growth or soil properties below 20 cm after 7 consecutive crops. In an intensive (3 crops/year) rice-based cropping system, the beneficial effects of CA on physical properties of the surface soil and on root growth have developed relatively quickly.

References

Aggarwal P, Choudhary KK, Singh AK, Chakraborty D (2006) Variation in soil strength and rooting characteristics of wheat in relation to soil management. *Geoderma* 136: 353-63.

Mohanty M, Painuli DK, Misra AK, Bandyopadhyaya KK, Ghosh PK (2006) Estimating impact of puddling, tillage and residue management on wheat (*Triticum aestivum* L.) seedling emergence and growth in a rice–wheat system using nonlinear regression models. *Soil Till. Res.* 87: 119-130.