Soil Compaction Varies by Long-Term Application of Barley Straw in Paddy field

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Introduction

- Cropping system and organic matter affect crop productivity and soil chemical-physical properties.
- In Korea, most rice and barley straw are utilizing as feeds and mat to livestock by removing them from the fields.
- Crop residue management practices are key factor in improving soil fertility for agricultural production.
- The depth to the hardpan was limited up to only about 17.6 cm, hardness of compaction layers index was 21.1 mm and thickness of plow pan were distributed from 5 to 17 cm.
- Crop residue management practices need of soil management practices beneficial not only for crop production, but also for sustainable agricultural and the environment.

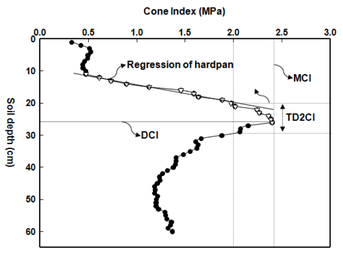
Methods

❖ Soil Properties
- Soil series: Pyeongtaeg (mixed mesic, Typic Haplaquepts)
- Fine silty loam (somewhat poorly drained fine silty)

❖ Cropping systems and straw treatment for 20 years since 1990
- Rice : with rice straw
- Rice-barley(Removal) : with rice straw, without barley straw
- Rice-barley(Incorporation) : with rice and barley straw

Photo 1. Experiment Fields. a: Rice mono cropping system, b: rice- barley double cropping system (Straw removal) c: rice- barley double cropping system (Straw incoporation).

Photo 2. Measurement of cone index by digital cone penetrometer and segment of soil profile.



(1)Min CI (Min CI, MPa)
(2) Maximum CI (MCI, MPa)
(3) Depth to the MCI (DCI, cm)
(4) Depth to 2 MPa (D2CI, cm)
(5) Thickness of the soil layer with CI > 2 MPa (TD2CI, cm))

Fig. 1. Penetration resistance classified the shapes of cone index for analysis the effect of crop residue management.

Results

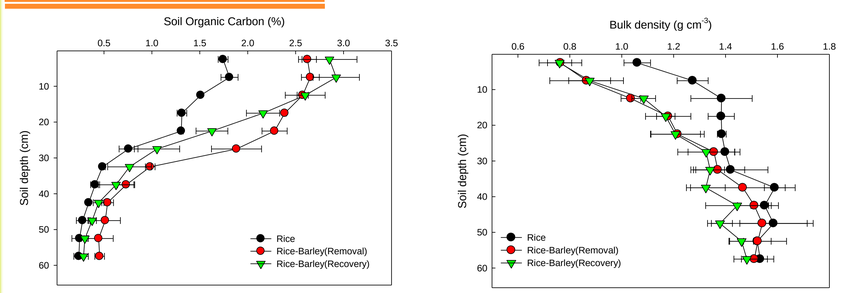


Fig 2. Changes of soil organic carbon and bulk density under different cropping in paddy field .

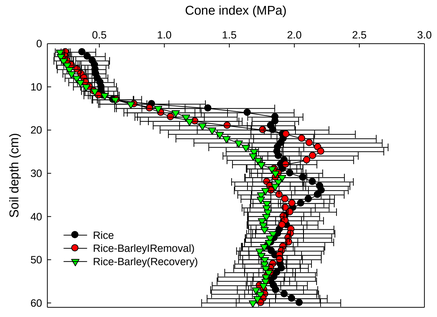


Fig 3. Changes of cone index under different cropping in paddy field.

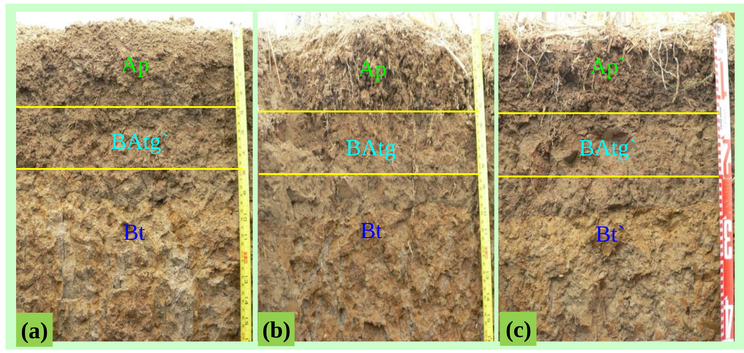


Photo 3. Changes of soil profile under different rice-barley cropping system and straw recovery for 20 years in paddy field . a: Rice mono cropping system, b: rice- barley cropping system(Straw removal), c: rice- barley cropping system(Straw incorporation).

Table 1. Analysis of variance and main effect means for CI measurements

Cropping system	Max PR	Depth to Max PR	Depth to 2 MPa	Thickness 2 MPa	Compaction layer type
	(MPa)	(cm)	(cm)	(cm)	
Rice mono Cropping system	2.21±0.19	34±0.61	15±1.67	21±1.09	Clear
Rice-Barley (Straw removal)	2.20±0.27	25±1.57	19±2.39	11±1.80	Gradual
Rice-Barley (Straw incorporation)	1.90±0.23	29±1.97	23±1.41	10±3.22	Gradual

Conclusions

- Rice-barley double cropping system is much more effective to increase soil organic carbon than mono-rice cultivation in paddy field.
- Rice-barley double cropping system with barley straw incoporation showed the least maximum CI, the deepest layer to 2 MPa and 2 MPa-thickness compare to the rice-barley system without barley straw and mono-rice cultivation.
- Rice-barley double cropping system could be a good management practice to increase soil organic carbon storage and to enhance soil physical properties in paddy field.

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