

# Synergising Straw Biochar with Control-released Fertilizer Enhances Rice Grain and N Use Efficiency Under Non-flooding Plastic Film Mulching Cultivation



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RESEARCH

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## Introduction

- Non-flooding plastic film mulching cultivation (NFMC) is an important water-saving rice production technology for mountainous area in China.
- NFMC increased rice yield and water/nitrogen use efficiency to preserve resources and assure food security.
- However, two obvious disadvantages need to be modified for its wider application: technical difficulties for later application of fertilizer and loss of soil carbon.
- Our hypotheses for the present study were:
  - 1) the use of straw biochar and polymer coated urea (PCU) could increase in grain yield and N use efficiency significantly;
  - 2) straw biochar enhanced the effect of PCU to improve rice growth.

## Method

Field experiment with four treatments conducted in 2018 and 2019.

- 1) No N fertilizer (Hereafter: Control);
- 2) 120 kg N ha<sup>-1</sup> urea (N=46%) (Hereafter: UREA);
- 3) 120 kg N ha<sup>-1</sup> 30% urea+70% PCU (N=42%) (Hereafter: PCU);
- 4) 120 kg N ha<sup>-1</sup> 30% urea+70% PCU, with 2.8 t ha<sup>-1</sup> straw biochar (Hereafter: PCU-C).



NFMC system



Monitoring



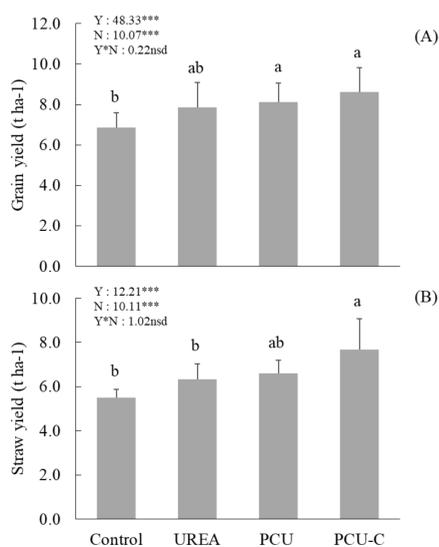
Sampling



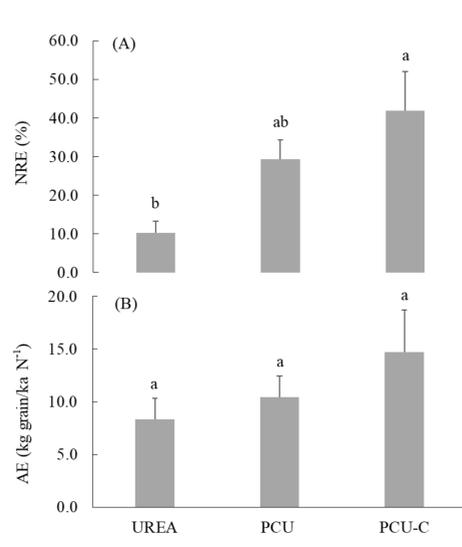
Harvesting

## Results

- Compared to the Control, the two-years' average rice grain yield was significantly improved by 14.5% in UREA, 18.3% in PCU, and 25.8% in PCU-C. PCU and PCU-C increased yield by 3.2% and 7.6% compared to UREA, but not significantly. Significant differences of straw yield were detected between PCU and the other treatments.
- The value of N recovery efficiency (NRE) reached 42% in PCU-C. No significant differences among the three N fertilizer treatments on agronomic efficiency were detected.

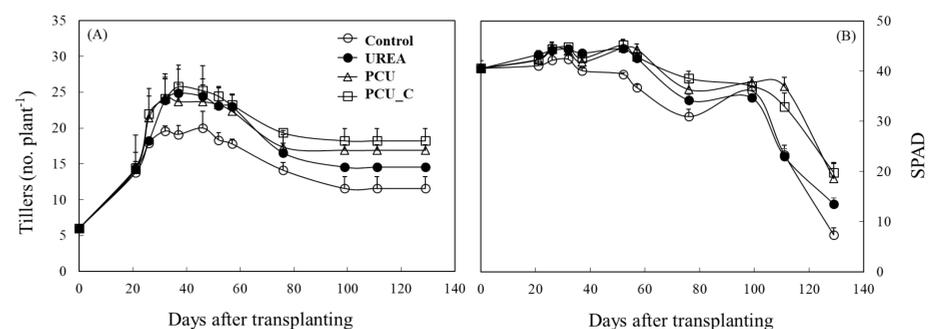


**Fig. 1** Rice grain and straw yield as affected by N treatments, shown are two-year averages (n=6).



**Fig. 2** Nitrogen recovery efficiency (NRE) and agronomic efficiency (AE) as affected by N treatments, shown are two-year averages (n=6).

- Significant differences on numbers of tillers with and without N fertilizer were observed 30 days after rice transplanting. PCU-C had higher tiller numbers than the other treatments.
- The SPAD value was significantly higher in PCU treatments in the middle and the end of the rice-growing season.



**Fig. 3** Dynamics of tiller number and SPAD during the rice growing season in 2019 (n=3).

## Conclusions

- ❖ The combination of control-released urea and straw biochar improved rice growth, increased yield and nitrogen use efficiencies under NFMC condition.
- ❖ For further research, soil organic carbon content and fractions need to be monitored. We also would like to test different rates of straw biochar to maintain the soil carbon balance in the production system.

## Acknowledgements

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