

No-tillage Direct Seeding Cultivation in Rice with Single Basal Application of Controlled Release Fertilizer in Poorly Drained Paddy Soil

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No-tillage direct seeding cultivation of rice using single basal application of controlled release fertilizer (CRF) is efficient to reduce labor costs and environmental degradation in poorly drained paddy soils. The nitrogen release patterns of CRF are synchronized with the growth rate of the crops, and the recoveries of CRF by the crops are considerably higher compared with rapidly available fertilizer (RAF). Therefore, sufficient amount of CRF for the entire growing season can be applied together with seed (so called, "co-situs application"). The objective of this study is to investigate growth characteristics and yield of rice plant grown under no-tillage direct seeding culture with single basal application of CRF.

MATERIALS AND METHODS

The pot (1.6 x 1.0 x 0.6 m) experiment was conducted at Faculty of Agriculture, Niigata University in 2008. The germinated seeds were sown with CRF in holes of 4 cm diameter and 2cm length under no-tillage soil (gley alluvial soil) condition. The treatments consisted of 1) POCU-1: POCUs-100 (sigmoid type of polyolefin coated urea) was applied 70 kg N ha⁻¹, 2) POCU-2: POCU-100 was applied 70 kg N ha⁻¹, 3) POCU-3: POCU-40 and POCUs-100 was applied at a rate of 20 kg N ha⁻¹ and 50 kg N ha⁻¹, respectively. 4) POCU-4: POCU-70 and POCUs-100 was applied at a rate of 20 kg N ha⁻¹ and 50 kg N ha⁻¹, respectively. The experiment was conducted with three replications.

RESULTS AND DISCUSSION

The plant age and plant length of POCU-1 plot was lower at early growth stage, however, no differences were observed among the plots at harvesting. Tiller numbers per m² in POCU-3 plot showed higher among the treatments during the growing season (Fig. 1). The panicle numbers per m² of the POCU-3 plot were significantly increased among the plots. Total number of grains per m² of POCU-1 and POCU-3 plots were higher than those of POCU-2 and POCU-4 plots. As a consequence, the yield of POCU-3 was significantly (P<0.05) increased among the treatments (Table 1). Since significant (P=0.001) correlation between total grains and yield was observed, sufficient total grains is important to obtain higher yield in this culture (Table 2). Considering the results, we suggest that no-tillage direct seeding cultivation in rice with single basal application of fertilizer is possible without salt injury caused the fertilization using proper combination of CAF.

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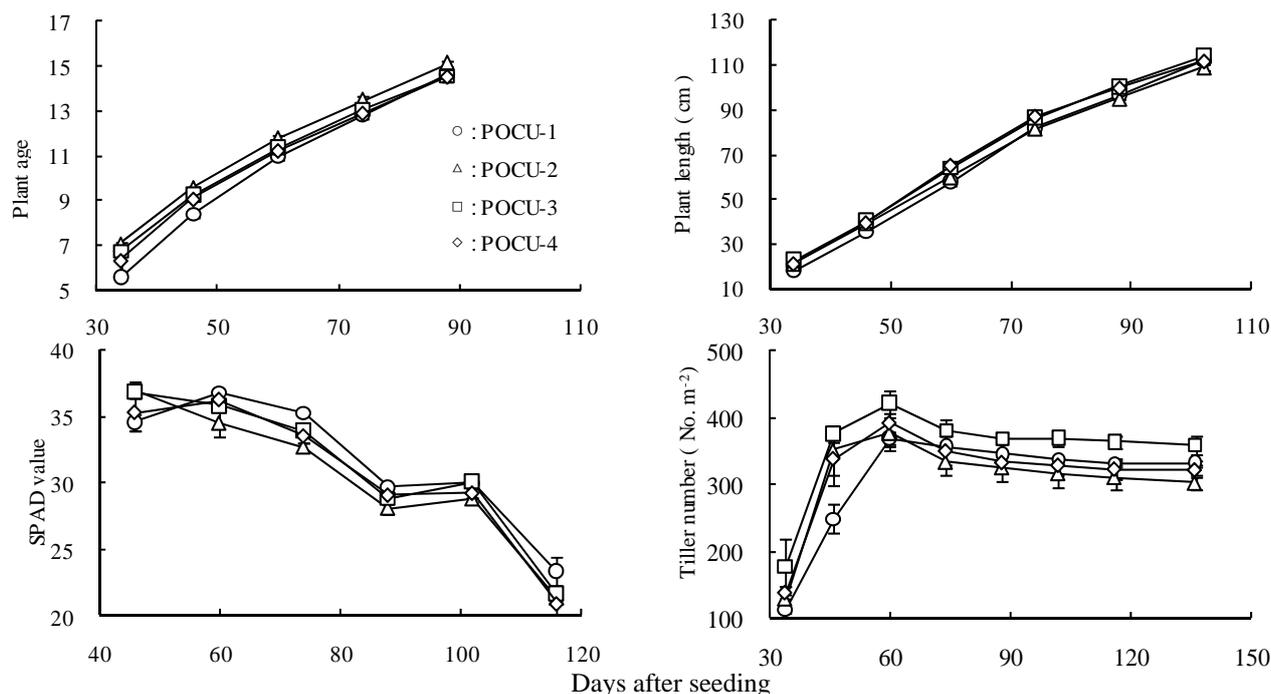


Fig. 1. Effects of nitrogen treatments for the plant age, plant length, SPAD value and tiller number.

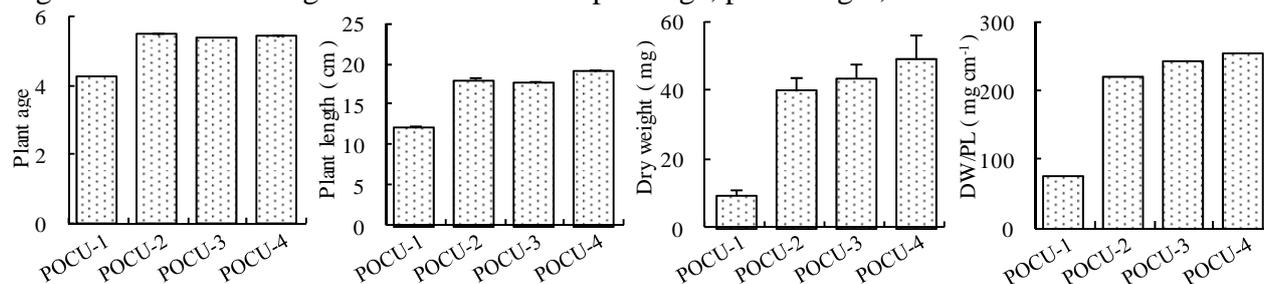


Fig. 2. Effects of nitrogen treatments for the plant age, plant length, dry weight and dry weight per plant length of seedlings.

Table 1. Yield and yield components

| | Yield (Mg ha ⁻¹) | Panicles (No. m ⁻²) | Grains (No. panicles ⁻¹) | Total grains (No. m ⁻²) | 1,000 grain weight (g) | Percentage of ripened grains (%) |
|--------|---------------------------------|------------------------------------|-----------------------------------------|----------------------------------------|---------------------------|----------------------------------------|
| POCU-1 | 5.46 ab | 332.5 ab | 76.2 a | 25316 a | 22.9 a | 94.3 a |
| POCU-2 | 4.76 c | 302.9 b | 71.6 a | 21721 b | 23.0 a | 95.4 a |
| POCU-3 | 5.79 a | 359.7 a | 72.5 a | 26049 a | 23.2 a | 95.7 a |
| POCU-4 | 4.91 bc | 322.6 bc | 70.4 a | 22627 b | 22.9 a | 94.8 a |

Means followed same alphabets are not significantly different (p=0.05, Fisher's protected LSD.)

Table 2. Correlation between yield and yield components.

| | Yield (Mg ha ⁻¹) | Panicles (No. m ⁻²) | Grains (No. panicles ⁻¹) | Total grains (No. m ⁻²) | 1,000 grain weight (g) | Percentage of ripened grains (%) |
|--------------------------------------|---------------------------------|------------------------------------|-----------------------------------------|----------------------------------------|---------------------------|----------------------------------------|
| Yield (Mg ha ⁻¹) | 1.000 | 0.808** | 0.580* | 0.990*** | 0.312 | 0.300 |
| Panicles (No. m ⁻²) | | 1.000 | 0.012 | 0.787** | 0.427 | 0.154 |
| Grains (No. panicles ⁻¹) | | | 1.000 | 0.625* | -0.202 | 0.127 |
| Total grains (No. m ⁻²) | | | | 1.000 | 0.214 | 0.210 |
| 1,000 grain weight (g) | | | | | 1.000 | 0.048 |
| Percentage of ripened grains (%) | | | | | | 1.000 |

***, ** and * mean significant correlation exists in p=0.001, 0.01 and 0.05, respectively.