

Agrochemical-free, direct-sowing culture of a paddy with non-woven fabric mulch: Effects of sowing time and fertilizer type

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Abstract

Direct-sowing culture of paddy using non-woven fabric mulching system is a new rice cultivation method in Japan. The present study was conducted to compare the effect of time of sowing (May 08 and June 10: early and late sowing, respectively) and nature of fertilizers (organic fertilizer: rape seeds and poultry manure and chemical fertilizer) on a rice yield in 2004. In comparison to early mulching, delayed mulching significantly reduced the crop growth and rice grain yield. Also, early sowing had a positive impact on grain yield than early transplanting irrespective of usage fertilizers type. Furthermore, organic fertilizer mulching treatment increased the grain yield and dry matter production than the chemical fertilizer in the both sowing time. The higher grain yield was obtained because of the higher panicle and grain numbers possibly due to increased cumulative mean value of temperature and sunshine hour due to early sowing.

Key words

organic rice, cloth mulch, sowing date, weather, yield potential

Introduction

Organic farming responsible for recycling of organic material in agricultural ecosystem and enhances crop production with a minimal environmental load by keeping ecological balance. Agricultural contaminants such as inorganic fertilizers, herbicides and insecticides from conventional agriculture are a major concern all over the world. The efficiency of non-woven fabric (mulch) in rice production system has been proved in different previous studies for weed control, lodging and better yield (Sugimoto et. al. 2003).

This paper highlights some important findings from a research program examining the effect of sowing date and as well as types of fertilizer in the production system.

Methods

The field experiment was conducted in the year 2004 at Matsuyama-shi, Ehime-ken, Japan. The P^H of the soil was 6.24 and the electrical conductivity was 0.028 mS/cm. Rice (*Oryza sativa* L. cv. Koshihikari) seeds used and the procedure of non-woven fabric mulching system was followed as Hossain et.al. (2005). Mulching (sowing) was done on May 08, 2004 (for early sowing) and June 10, 2004 (for late sowing). The treatments were chemical fertilizer, organic fertilizer i.e. rapeseeds (5.3% N, 2.0% P₂O₅, 1.0% K₂O) and poultry manure (2.7% N, 6.9% P₂O₅, 3.9% K₂O), and without fertilizer. Fertilizers were applied at the rate of 6 gN/m² as basal fertilizer and 3 gN/m² as topdressing. The experimental design was a randomized complete block in a split-plot treatment arrangement with two replications. The main plot factor was sowing time and sub-plot factor was fertilizer type. This new production system also compared with transplanting method. Leaf area index (LAI), dry matter and yield components were calculated as our previous study (Hossain, et. al. 2005) and the statistical analysis were done by ANOVA. Meteorological data was taken from <http://www.data.kishou.go.jp/etrn/index.html>.

Results and Discussion

Heading stage of rice plant was observed 85 DAS (days after sowing) and 70 DAS for early and late sowing, respectively. Whereas, heading time has no difference among the treatments within the sowing.

Highest LAI was observed at heading time and in Table 1, the higher LAI was found in early sowing treatments compared to late sowing. Organic fertilizer treatments obtained higher LAI than chemical fertilizer in both sowing time. Final top dry weight was significantly higher in early sowing treatments compared to in those of late sowing. In the both sowing time organic fertilizer treatment produced higher top dry matter than chemical fertilizer. Among the fertilizer treatment, organic fertilizer produced better grain yield than chemical supported by Brye et al. (2004) in both sowing time, due to the slow release fertilizer (organic) the plants could uptake the nutrients slowly for long growth period compared to chemical fertilizer. From Figure 1, the cumulative mean air temperature and sunshine hour up to heading time was significantly higher in the early sowing rather than late sowing. Grain yield was obtained better in early sowing compared to late sowing irrespective of all treatments. It was observed that at early growth stage of late sowing the cumulative mean air temperature and sunshine hour were lower than that of early sowing, which effects on growth and yield of rice, supported by Shimotubo et al. (1995). It may, therefore, be assumed that less sunshine hour resulted with low grain number per panicle and also early stage low temperature caused slow release of soil N and as a result, the number of stem and panicle were less at late sowing treatments.

Sowing date and method	Fertilizer type	Planting density hill/m ²	Panicles /m ²	Spiclets /panicle	Grain no. /m ²	Ripening ratio %	1000 grain weight# g	Yield# g/m ²	Highest LAI (at heading)	Final top dry wt. g/m ²
Transplanting										
Early	Organic	16.7	340	75.2	24717	73.0	25.6	458	3.55	1244
Late	Organic	16.7	295	76.4	22342	74.6	25.7	425	2.66	1013
Mulch										
Early sowing	No Fertilizer	101.4	401	46.7	17962	74.9	25.1	337	3.80	1189
	Chemical	95.1	447	62.9	27221	71.8	24.9	485	4.90	1418
	Organic	96.5	471	60.2	28431	74.1	25.3	534	5.47	1549
Late sowing	No Fertilizer	94.8	259	61.4	15680	77.5	24.6	296	1.87	609
	Chemical	96.4	311	63.1	19478	85.4	25.0	415	2.72	816
	Organic	95.3	355	60.3	21885	77.6	25.0	424	2.63	902
F-test	Sowing Date (a)	ns	**	ns	**	**	ns	**	**	**
	Fertilizer (b)	ns	**	ns	**	ns	ns	ns	*	*
	a × b	ns	ns	ns	ns	*	ns	ns	ns	ns

#: Rough rice with 15% moisture content. ns: not significant *: Significant at the 0.05 probability level .

** : Significant at the 0.01 probability level. Statistics analysis done within mulch treatments only.

Table 1. Effects of sowing time and fertilizer on LAI, dry matter, yield and yield components.

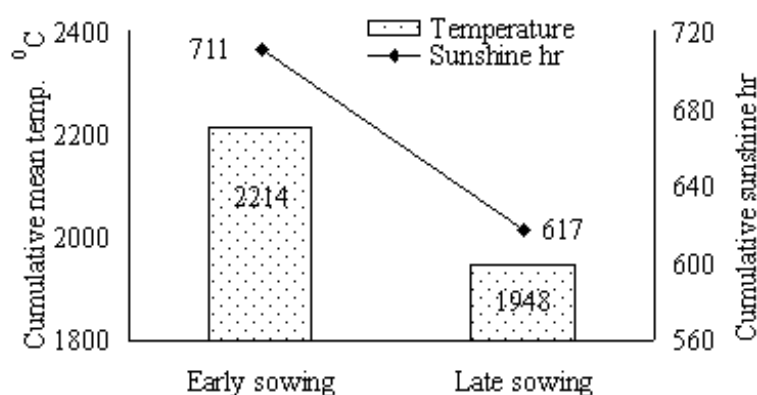


Figure 1. Cumulative mean temperature and sunshine hour up to heading time at early and late sowing.

Conclusion

Early sowing performed better and organic manures (rapeseeds and poultry manure) were found effective in the production method. Therefore, rice cultivation using non-woven fabric mulch would be useful for organic farming system because of attaining sustainability in agriculture.

References

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