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EFFECT OF SEEDING METHODS ON RICE YIELD IN MEKONG DELTA

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Abstract

The study was conducted to determine appropriate sowing methods for Mekong Delta rice system during dry season, from November 2018 to April 2019. We used the sowing methods including broadcasting, drilling and dibbling seeding for OM5451 rice variety with the quantity of 80, 70 and 60 kg per ha, respectively. The experimental design was the randomized completely block design (RCBD) with three replications. Data were recorded mainly on yield and yield components along with growing and developing parameters.

The results revealed that the sowing methods significantly affected flowering days, 1000GW and actual yield. The latest flowering day was recorded in case of dibbling seeding, which resulted in delayed maturity of rice. And similar theoretical yield was attained under the three seeding methods in spite of the facts that 1000GW of drilling sowing was significantly higher than others. The actual yield showed significant higher of drilling sowing as compared with dibbling sowing, but not significant as compared with broadcasting method.

One more thing, the rice seed quantity of the drilling was 12.5% lower than that of the broadcasting that is the current popular seeding method in Mekong Delta while the yield of the drilling was a little higher than other methods.

Key words: Rice seeding methods, broadcasting, drilling, dibbling.

Introduction

Rice (*Oryza sativa* L.) is primary food for human life. It is the main livelihood of rural population living in sub-tropical and tropical Asia [1]. Rice also is a major agricultural product in Mekong Delta.

The total land area of the Mekong Delta is around 4.0 million ha, which is 12.3% total land area of Vietnam. The agricultural production land in Mekong Delta is 2,622,900 ha. But the rice cultivation area is 4,276,000 ha, which is 63.0% more than the agro-production land due to being possible to grow rice two to four times a year in the Mekong Delta. The 4,276,000 ha is equivalent to 55.3% of Vietnam's total rice plantation area of 7,737,100 ha. However, the paddy yield per unit area is 5.62 ton per ha, which is 77.7% of Korea's 7.23 tons per ha [2, 3]. It is reported that quality seeds, cultivation techniques and cultivation management were main reasons caused low productivity.

Days to flowering and days to maturity of rice were recorded earlier in broadcasting and drilling sowing than in other methods, due to better root establishment from the day of germination leads to early flowering and maturity[4]. Direct seeding of rice resulted in early maturity [5]. The direct seed drilling method recorded early flowering and shorter maturity days because it had better crop establishment, with higher intra-competition due to shorter spacing and plant density per unit area, triggering quicker reproductive phase responses[6]. Therefore, planting methods had a significant effect on the growth duration of rice. The rice crop established with direct seeding of the dry and sprouted seed matured 7 days earlier than transplanting[7].

The official statistical data on the methods of sowing rice seeds in Mekong Delta could not be gained in spite of my doing best efforts. As far as I myself have observed rice farming of the region, all most of farmers there have sown rice seeds on the paddy field directly by broadcasting method, except for the experiment-research and special purpose. It is totally different from the rice plantation in Korea where rice transplanting by the machines and direct drilling & dibbling sowing methods are common. In addition to, there was study on dibbling sowing method using sharp sticks or pointed metal rods frequently involve seed rates per hill of 4-5 seeds for maize and 8-10 seeds for small seeded crops such as sorghum and rice. Dibbling excess seeds per hill reduce the risk of poor seedling emergence either due to poor seed vigor, soil born disease, insect pests, rodents and bird attacks. However, it is costly to the farmers owing to high seeding rate and wastage of land due to undetermined space between hills[8].

It was therefore required to study the effect of rice seeding methods on yield in Mekong Delta for improving the current system of rice cultivation.

Materials and Methods

Treatment

The experiments was performed during dry season, November 2018 to April 2019 at Cuu Long Delta Rice Research Institute (CLRRI). The rice variety (OM5451) was used with three sowing methods (Table 1). The area of each plot is 40 m^2 and total area of experiment was 360 m^2. The experiment was arranged in the randomized completely block design (RCBD) with three replications. Fertilizer application followed the ratio 100N2O: 40K2O: 30P2O5 kg/ha.

Table 1: Treatment

Treatment	Seeding method	Seed quantity (kg/ha)
T1 (Control)	Broadcasting seeding	80
T2	Drilling seeding: Space between lines is 30cm	70
T3	Dibbling seeding: Space between lines is 30cm, space between holes 15cm, 3-6seeds/hole planted	60

Seeding methods Broadcasting seeding method was done by hands as the current method in Mekong Delta.

Drilling seeding was carried out by using our designed machine (Fig. 1). The sowing machine is consisted of one hand-puller, two-wheel system and three seed containers spaced 30 cm apart. The operating principle is that if the user pulls the sowing machine by the hand-puller, wheel system will move along with the rotating of seed containers and seeds were distributed in a continuous stream in furrows.

Dibbling seeding was conducted by using our designed machine (Fig. 2). The sowing machine is consisted of one hand-puller, two wheel system, five seed containers & five seed dispensers spaced 30cm wide. The operating principle is that when the operator pulls the sowing machine by the hand-puller, 3-6 seeds are planted in the hole at 15cm intervals along the rows by the seed dispenser (Fig. 2).

Fig. 1 The machine for drilling sowing

Fig. 2 The machine for dibbling sowing

Indicators and Yield Calculation Formula

Growing and developing parameters: Flowering time, plant height (cm), falling ratio (%) at 20 and 30 days after heading, days of maturing.

Yield components: Panicle number/m^2 (PN), 1000 grain weight (1000GW), filled grain number/panicle (FG).

Theoretical yield (TY): Calculated at 14% moisture using data of yield components obtained by a survey and an analysis during the experiment. The formula is like below;

$$\text{TY(tons/ha)} = \frac{FG * PN * 1000GW(g)}{1000 * 100}$$

*Notes: 100 is converting ratio from g/m^2 to tons/ha.

Actual yield (AY): Calculated on base of the grains gained from sampling area 5 m^2. The sample was taken at the middle of plot according to the sampling method of CLRRI. The applied formula is as following;

$$AY\,\text{(tons/ha)}\frac{\text{Grain weight of } 5m^2(kg) * 10 * 14(\%)}{5(m^2) * \text{Grain weight moisture}}$$

*Notes: 10 is converting ratio from kg/m^2 to tons/ha.

Data for yield and yield components were analyzed for RCBD by Least Significant Different (LSD) test using Microsoft Excel software.

Results and Discussion

Growing and Developing Parameters

Data for growing and developing parameters were presented below (Table 2). No falling rice plant was observed, therefore, falling ratio was zero in all treatments. Flowering time was recorded by the number of days from seeding to 50% of plot flowered, which was influenced by different sowing methods.

We found that the dibbing plot shown the slowest flowering time of 64.7 days, while the broadcasting exhibited the fastest at 60.3 days. The slow flowering time resulted from the delayed maturity. The maturity was recorded at the time that 85% of grains on panicles were ripened from seeding. Similar to the flowering time, the ripening time was the shortest for broadcasting at 88.0 days and the longest for dibbling at 92.3 days. However, this variation was not significant. Ripening duration was about 6-7 days.

Plant height was measured as the average length in centimeters from the soil surface to the panicle tip of the main tiller of ten plants. Plant height was not significant difference for all sowing methods. But it tended to be taller when rice was sown by dibbling sowing as compared to when it was sown by broadcasting or drilling sowing.

Table 2: Growing and developing parameters

Treatment	Flowering time (Days)	Falling ratio (%)	Maturing time (Days)	Plant height (cm)
T1	60.3 b	0	88.0 a	87.1 a
T2	62.3 ab	0	89.7 a	87.7 a
T3	64.7 a	0	92.3 a	92.2 a
$LSD_{0.05}$	4	-	7.6	11
C.V (%)	2.8	-	3.7	5.4

Notes: Values with the same letter(s) are not significantly different at the 5% level of probability determined by LSD.

These results were in good agreement with previous studies. Days to flowering and days to maturity of rice were recorded earlier in broadcasting and line sowing than in other methods, due to better root establishment from the day of germination leads to early flowering and maturity[4]. Direct seeding of rice resulted in early maturity[5]. The direct seed drilling method recorded early flowering and shorter maturity days because it had better crop establishment, with higher intra-competition due to shorter spacing and plant density per unit area, triggering quicker reproductive phase responses[6]. Planting methods had a significant effect on the growth duration of rice. The rice crop established with direct seeding of the dry and sprouted seed matured 7 days earlier than transplanting[7].

Yield Components and Yield

The statistical analysis for yield and yield components revealed that there was significant variation among sowing methods for 1000GW only while others were not different significantly (Table 3).

Tiller number as well as panicle number (productive tillers) per m^2 was not influenced significantly by sowing method in this experiment (Table 3). It was in conformity with the other research result [9]. The highest number of tillers and panicles was obtained at drilling sowing method. And even if dibbling sowing method had more tiller number per m^2, it had less productive tillers than broadcasting (Table 3).

There was a significant influence of sowing methods for 1000GW. The highest 1000GW was recorded in the treatment of drillling sowing. This result was also in line with the other similiar study [4].

Another important component that contributes grain yield is the number of filled grains per panicle. Both number of the filled grains per panicle and the filled grain ratio tended to be greater when rice seeds were sown in row. Filled grain ratio known as spikelet fertility affected also on yield. The higher the filled grain ratio was, the lesser the sterility percentage was in panicle (Table 3). Spikelet sterility is quite common in rice, and any improvement of this component is directly translated into productivity. However, the differences were not significant among treatments.

Table 3: Effect of sowing methods to yield components

Treat	Tiller No. /m^2	Panicle No. /m^2	1000GW (g)	F-grains /panicle	F-grain ratio (%)	Theoretical yield (tons/ha)
T1	488.7 a	452.7 a	25.2 b	69.7 a	76.6 a	8.0 a
T2	532.7 a	453.3 a	25.5 a	72.1 a	80.8 a	8.3 a
T3	508.0 a	433.3 a	25.0 b	69.6 a	74.5 a	7.5 a
$LSD_{0.05}$	64	44.3	0.3	5.5	6.5	0.9
C.V (%)	5.5	4.4	0.5	3.4	3.7	4.8

Notes: Values with the same letter(s) are not significantly different at the 5% level of probability determined by Least Significant Difference (LSD)

No statistical difference was observed for the theoretical (Or expecting) yield of rice among the three sowing methods. The similar theoretical yield was attained under the three sowing methods in spite of the fact that 1000GW of drilling sowing method was significantly higher than others (Table 3). There were other similar research results on rice[10] and on wheat[9].

Although theoretical yield showed the non-significant difference among the three sowing methods, the actual yield showed significantly higher in drilling sowing method as compared with dibbling, but did not show significant difference as compared with broadcasting method (Table 4). Luzes (1991) and Majid (1989)[11, 12] also obtained higher yield of rice when sown directly in lines. Drilling sowing gave the effectiveness due to easy intercultural operation

Table 4: Actual yield of different sowing methods

Treatment	Actual yield (tons/ha)	Notes
T1	5.5 ab	Values with the same letter(s) are not significantly different at the 5% level of probability determined by LSD.
T2	6.1 a	
T3	5.1 b	
LSD0.05	0.9	
CV (%)	7.2	

like weeding, spraying and uniform plant stand[13]. Base on the data of growing and developing in this study, the lowest yield of dibbling method might be due to the lack of a proper sowing machine and late maturing. During the experiment, weed problem was observed. Dibbling sowing treatment had more weeds as compared with broadcasting and drilling sowing. This might be by dibbling sowing weeds have more spaces to develop. The development of weeds led to loss of rice yield due to competition of nutrition, light and water etc.

Conclusions

This study revealed that there was significant variation among rice sowing methods for flowering days, 1000GW and actual yield while other parameters differed non-significantly.

The latest flowering day was recorded in case of dibbling seeding, which resulted in the delayed maturity of rice.

And similar theoretical yield was attained under the three sowing methods in spite of the fact that 1000GW of drilling sowing treatment was significantly higher than others.

The actual yield showed the significant higher of drilling sowing as compared with dibbling sowing, but not significant as compared with broadcasting method.

It was also found out that the rice seeding quantity of the drilling was 12.5% lower than that of the broadcasting which is the current popular seeding method in Mekong Delta, but the yield was a little higher than other methods.

Suggestions

It could be considered to reflect the results on the rice production policy in the Mekong Delta. However, since the study was conducted during the dry season which is a good condition for growing rice, another research is hoped to be done in other seasons of bad conditions.

At the same time, the drilling machine suitable for the paddy field in the Mekong Delta should be developed.

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