Journal of **Kim Il Sung** University (Natural Science)
Vol. 3 No. 2
Juche103(2014)

The Sprouting Rate Increase Method by Roller Sowing in Rice Dry Direct Sowing Cultivation on Ridge

Ri Kwang Sik, O Sung Bom and *Ri Jong Gang*

Abstract We increased the sprouting rate of rice seed which was a bottleneck of rice direct sowing by means of roller sowing.

Roller sowing provides with good soil humidity of rice seed layer, affecting on the volume density and capillary pore rate of soil, and makes good condition for germination of rice seed, increasing soil temperature of 0.5～1cm layer is 1.0 and 2.5℃ higher than that of 3, 5cm layer, respectively.

Key words rice, direct sowing, roller sowing, sprouting rate

Introduction

The great leader Comrade **Kim Il Sung** said as follows.

"For rice to be sown directly, we should further investigate the question of getting deeply-rooted rice plants and produce rice seeds of a new, early-ripening variety."
("**KIM IL SUNG** WORKS" Vol. 22 P. 384)

Nowadays, many countries in the world are concerning about direct sowing, and many successes are achieved and introduced to practice according to rapid development of agricultural science and technology. But direct sowing is not widely introduced until now, because its stability is very low contrasting to transplanting cultivation and yield fluctuation per ha are very serious every year according to condition. One of the important causes of low stability is that primary plants could not provide, variation is severe, seed amount increases and seedlings become weak, because we do not increase the sprouting rate of rice seeds safely [1, 3].

To safely increase the yield per ha, providing with the panicle number per Phyong ($3.24m^2$)which is the most important factor of the yield component, we have to secure the aimed primary number of plant per Phyong, increasing the sprouting rate of rice seed in direct sowing cultivation.

As for the major causes decreasing the rice yield in rice dry direct sowing cultivation in the last years, firstly, rice seeds are soaked in water after it rains and buried deeply, because the fields could not be ploughed horizontally, fields being harrowed in dry condition after ploughing, secondly, sprouting rate becomes lower and sprouting period becomes longer.

So, we provided with environmental condition that rice seeds could sprout, making fields horizontally without water harrow, carrying out the ploughing, ridging and harrowing simultaneously with ridge plough “Phungnyonbo No. 5” [2].

And we made bright prospect for the safe and high yield using direct sowing culture, making the sprouting period short, increasing the sprouting rate, removing the variation, providing with the primary number of plant per Phyong, because we burying seeds evenly with hardening method by means of NC sower.

1. Materials and Methods

1.1. Materials

We trialed “Phyongdo No. 14, 15” as major rice variety, in majority of the splendid medium species of the local area.

1.2. Methods

We did micro-plot exact trial and production trial simultaneously, and arranged separately the exact trial plot in the centre, considering the characteristics of mechanization work. We carried out the micro-plot trial as 4 repetitions in scale of $10m^2$, macro-plot trial in scale of 50～100ha. We did ridge ploughing from 20^{th} to 25^{th} of April according to sowing schedule and sowed on 5^{th} of May 100kg per ha. We observed the temperature per soil layer at 6, 12, 18 o’clock, installing thermometer in depth of 0.5, 3, 5cm, and calculated average value.

We observed the soil density and humidity, sampling the soil of the corresponding part.

Technical characters of NC sower

Technical index	Value
Fuel consumption per ha.	5～6kg/ha
Dimension	2 200mm×1 500mm×1 200mm
Distance between rows	12.5cm, 25cm
Work width	210cm
Work capacity	4ha/shift work
Seed amount control range	40～200kg/ha
Machine weight	300kg

2. Results and Discussion

First of all, we analyzed the yield components according to seed burying depth in direct sowing cultivation, the result is as following (table 1).

As shown in table 1, difference of yield per ha. is about 3% when seed burying depth is 1～2cm, 15%(1 200kg)－3cm, more than 2 500kg－4～5cm. The correlation between panicle number per Phyong and yield is r=0.998, and correlation between ripen kernel number and yield is r=0.45, so it is shown that the relation between yield and panicle number is close but the relation between yield and ripen kernel number is not close. This means that burying

Table 1. Effect of burying depth of seed on yield of direct sowed rice

Depth /cm	Survey index					
	Number of ears per Phyong	Number of kernels per ear	Maturing rate /%	Mass of 1 000 kernels/g	Yield /(kg·ha^{-1})	Yield rate /%
1	1 280	79.9	79.4	30.1	7 400	100
2	1 205	79.9	79.4	30	7 150	96.6
3	1 068	80.5	79.8	29.6	6 200	83.8
4	896	80.7	80.0	29.4	5 000	67.7
5	739	81.0	80.1	29	4 050	54.7

spot: Haksan farm, soil type: clay loam paddy field, fluvial alluvium, variety: "Phyongdo No. 14", $LSD_{0.05}$=550kg field exact test.

seeds evenly in 1cm depth in the rice dry direct sowing cultivation on ridge increase the yield, securing safely the panicle number per Phyong which is most important for yield.

Because the environmental conditions such as humidity and temperature necessary for seeds to sprout are changed with depth, we investigated the effect of burying depth of seed on sprouting period and rate (table 2).

Table 2. Effect of burying depth of seed on sprouting rate

Depth /cm	Survey index		
	Sprouting date ,mon. day	Sprouting period/d	Sprouting rate/%
1	5.19	14	83.4
2	5.20	15	78.9
3	5.26	21	65.2
4	5.30	25	51.8
5	6.2	28	30.3

Sowing date: 5th May, variety: "Phyongdo No. 14"

As shown in table 2, sprouting period is 14～15days and sprouting rate is very high as 80% in 1～2cm seed burying plot, but sprouting period becomes long and sprouting rate is severely low in 3cm seed burying plot. Especially in 5cm seed burying plot sprouting period is very long as 28 days, sprouting rate is less more than 30%. It shows that roller seed burying method to increase the sprouting rate of rice seeds, burying rice seeds in 1cm layer is very excellent.

The result of observing the seed burying status per soil depth according to seed burying methods is as follows (table 3).

As shown in table 3, almost all seeds are buried in 1～2cm layer, seeds buried in 1cm layer being 70%, no seeds being buried under 4cm and bare seeds on the out layer being 8% in roller seed burying plot.

Roller seed burying is more efficient method providing with the proper soil condition for sprouting of rice seed than other seed burying method.

Table 3. seed burying rate per soil depth according to seed burying method/%

Burying method	Survey depth/cm					
	Surface	1	2	3	4	5
Mechanical	—	2.79	20.56	37.2	32.8	6.65
Natural	14.5	19.4	42.6	20.8	2.7	—
Roller	8.4	69.8	12.6	9.2	—	—

Soil: loam

Next, we investigated the effect of roller seeds burying on the sprouting of naked seeds, the result is as following (table 4).

Table 4. Effect of roller seed burying on the sprouting of naked seeds.

Item	Seeds	Num. of sprouted seeds	Sprouting rate/%
Naked seed plot of natural burying	100	60.5	60.5
Naked seed plot of roller seed burying	100	78.5	78.5
Buried seed plot of roller seed burying	100	83.0	83.0

Trial condition: field exact test, Sowing date: 5th May, variety: "Phyongdo No. 14"

As shown in table 4, sprouting rate of rice seed in roller sowing plot is higher remarkably and growth of rice is better than other seed burying plot, it is closely correlated to soil temperature.

On the condition that air temperature of spring is low in general and unfavorable weather conditions are formed sometimes by the abnormal weather in recent years, it is important to increase the temperature of soil to make sprouting and initial growth of rice seeds better.

From this, we found the soil temperature per soil layer on levee of paddy field (table 5).

As shown in table 5, the average temperature of out layer of soil is as 1.0, 2.5 ℃ higher than the temperature of 3cm and 5cm layer, respectively. It means that seeds buried in 0～1cm layer sprout better than seeds in 3, 5cm layer.

Table 5. Soil temperature per soil layer on levee of paddy field(℃)

Soil layer	Obs. time				
	6	12	18	Average	Difference
0.5cm	11.1	27.7	21.5	20.1	2.5
3cm	13.2	21.8	22.2	19.1	1.5
5cm	13.2	18.7	20.9	17.6	—

Trial condition: clay loam paddy field, fluvial alluvium, observation: 7th～10th May

The result of observing the effect of roller sowing on the density and pore rate of soil is as table 6.

Table 6. Effect of roller sowing on the density and pore rate

Plot	Density /(g·cm^{-3})	Volume density /(g·cm^{-3})	Gross pore rate/%	Capillary pore rate/%
Natural	2.51	1.01	60	60.1
Roller	2.51	1.21	52	65.4
Difference	—	0.2	−8	5.3

Trial condition: clay loam paddy field, fluvial alluvium

As shown in table 6, the volume density of soil of roller sowing plot increased as 0.2g/cm^3 higher, gross pore rate of soil decreased as 8% lower, on the other hand capillary pore rate increased as 5.3% higher than natural burying plot. It means that rice seeds of roller sowing plot could be provided with more moisture.

We observed the effect of roller sowing on the water content of soil in 0～2cm layer in the sprouting period of rice, the result is as following (table 7).

As shown in table 7, soil humidity in 0～2cm layer of roller sowing plot is as 4.5% higher within 5 days, 5.6% higher within 9 days after irrigation than that of out layer of natural sowing plot.

Table 7. Effect of roller sowing on the water content of soil in the sprouting period of rice seed(%)

Plot	Survey date		
	1 day after irrigation	5 days after irrigation	9 days after irrigation
Natural	98	75.0	70.8
Roller	98	80.5	76.4
Difference	—	4.5	5.6

Trial condition: clay loam paddy field, fluvial alluvium, sowing: 5th May

As a result, roller sowing method is more efficient in providing moisture condition necessary for sprouting of rice than other seed burying method, improving soil capillary connection and capillary pore rate of soil.

Lastly, we found the technical and economic efficacy of roller sowing and mechanical burying in rice dry direct sowing on levee (table 8).

Table 8. Technical & economic efficacy of roller sowing in rice dry direct sowing on levee.

Item	Index			
	Seed amount /(kg·ha^{-1})	Labor consumption /(man-day·ha^{-1})	Yield /(kg·ha^{-1})	Profit /won
Mechanical	180	136.7	5 650	122 547
Roller	120	89.9	7 100	178 229

As shown in table 8, mechanical burying consumes more 60kg per ha of rice seeds than roller sowing and requires additional seedling planting and many thinning labor, because its sprouting rate is low.

So, when we introduce roller sowing, it is possible to save more than 30% of seed and consumption labor necessary for weeding and additional planting as less as 65.8% than mechanical burying. Especially, roller sowing could make the yield as the same level as transplanting, increasing yield as 125.7% more than mechanical burying, accelerating sprouting period, making rice growth better, and removing the variation. After all, on the same condition, returns per ha. of roller sowing is higher as 55 682 won than that of mechanical seed burying.

So, roller sowing increases yield per ha. in contrast to transplanting cultivation, saving fuel as much as 56%, never using the farming materials such as plastic film. Also, roller sowing could give high actual profit, cooperative farm itself could do farm works, because it consumes as 25% less than transplanting cultivation.

Conclusion

1) Almost all seeds are buried in 1～2cm layer, seeds buried in 1cm layer being 70%, no seed being buried under 4cm and bare seeds on the out layer being 8% in roller seed burying plot.

2) Roller sowing makes proper condition for sprouting of rice seed, improving the soil volume density and capillary pore rate of soil, providing good soil humidity of seeds layer, the average temperature of 0.5～1cm layer of soil is as 1.0, 2.5℃ higher than the temperature of 3, 5cm layer, respectively.

After all, roller sowing method could provide with stability of direct cultivation, burying rice seeds in 1～2cm depth evenly, making sprouting period of rice seed as long as 14～15days, sprouting rate－more than 80%, and intensifying the initial growth direct of sowed rice.

References

[1] Y. Singh; Direct Seeding of Rice and Weed Management in Theirrigated Rice-Wheat Cropping System of the Indo-Gangetic Plains, Directorate of Experiment Station, IRRI, 39, 2005.

[2] 湯川智行; 北農, 67, 2, 146, 2000.

[3] 大下泰生; 北農, 67, 2, 122, 2000.