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LOW COST RICE PRODUCTION AND MACHINE SYSTEM IN JAPAN

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ABSTRACT

Retail prices of agricultural products such as rice in Japan are very high relative to the international standard. Rice prices in Japan are ranged from 5 to 20 times as high as the U.S., India and Thailand. one of the reasons of such expensive prices in Jpaan is deeply related to small farm sizes. The average farm size in Japan is 0.7 hectares, while the average size of each field is 0.06 hectares. Size sof agricultural machines are also very small relative to the U.S. and European countries. Therefore, productivity of rice prouction is very low.

To improve productivity of rice production and to make the rice prices cheaper, it is indispensable to create large sale farm and make each stage of the production process more labor-efficient.

In this research, we tested the working efficiency level of three new direct-seeding machines, which still are in the process of development. We also compared the results with the situation in the U.S. The results indicated that the direct seeding machine may enable to cut down labor hours by half from 420 hours per hectare to 210 hours.

INTRODUCTION

Production costs of rice, which is the staple food in Jpaan, are quite high relative to other nations. Average retail price is 5,000 yen per 10 kg, milled rice, about 5 to 20 times as expensive as those prices in the U.S. and China, respectively. Accordingly, it is important for Jpaan to reduce their production costs.

Farm sizes in Japan are much smaller than the scales in the U.S. and Australia, and labor productivity is very low relative to the U.S. Especially, the labor hours on rice production in hilly and mountainous areas are longer than flat/delta areas.

The labor time for raising and transplanting seedling is quite large in Japan. Especially, the labor hours for seeding, transplanting and tilling are much longér than the one in the U.S. So, we tried to introduce a direct planting method to save the labor hours. But in the past,

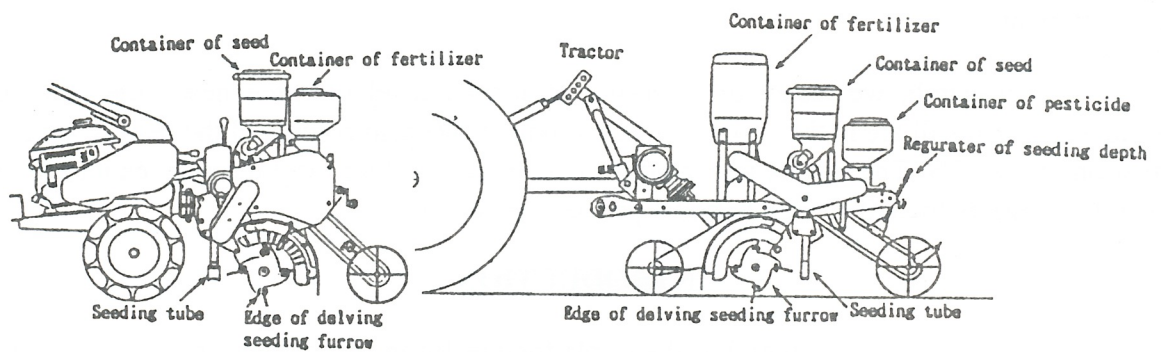
because of the problems with birds, weeds and low yields and quality, direct planting methods have not been exercised at a large scale for a long time in Japan. However, unless Japanese agricultural system shifts towards the methods used in the U.S. and Australia, it might be difficult to continue to economically produce rice in Japan.

Lots of paddy fields in hilly and mountainous areas, which account for approximately 40% of total land in Japan, are surrounded by many mountains, and the one in flat/delta areas are surrounded by houses and buildings. Unlike the U.S. or Australia, therefore, we are not allowed to use large scale machines, such as air planes or helicopter for direct seeding.

Given such circumstances, we explored the application efficiency of direct planting using three methods, then compared the growing conditions, labor hours, yields, quality of rices and production costs. We also investigated the working efficiencies of a walking-type power-tiller, a tractor and a helicopter. A walking-type power-tiller may be more useful in small scale fields in hilly and mountain areas, while tractors and remote-controlled helicopters are more useful in flat/delta areas.

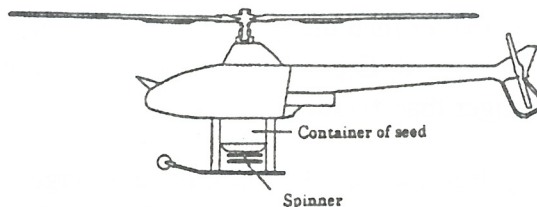
APPARATUS AND PROCEDURE

We tried the direct planting of three method susing three kinds of machines (a walking type power tiller for non-tillage, a tractor for non-tillage and a remote-controlled helicopter). For using the remote controlled helicopter, at first, we cultivated the soil finely and leveled the land, then irrigated the field holding water about 5 cm deep. In this conditon, we sowed the



(a) Power tiller

(b) Tractor



(c) Remote controlled helicopter

rice seeds in the paddy field using a remote controlled helicopter. Operations using a tiller and a tractor were done under non-tillage in the dry field.

Fig. 1 shows schematic diagram of the used machines and table 1 shows main specifications of the used machines.

Table 1 : Main specifications of the used machines

Machine		Minoru non-tillage direct planting machine		Yamaha R.C. helicopter
Type		PFK-21K	PFT-6	R-50
Size of body	Full length (mm)	1860	1450	3580
	Full width (mm)	620	1720	700
	Full height (mm)	1040	1030	1080
Weiht (kg)		125	330	44
Engine	Displacement (cc)		98	
	Biggest power (ps)			12
Number of rows (row)		2	6	
Interrow space (cm)		30		
Intrarow spacing (cm)		12, 21 (18 option)		
Sowing depth (cm)		0_5		
Seed hopper capacity (l)		9x1	9x3	10
Travel speed (m/s)			over 0.6	
Efficiency (min/10a)		60	25	
Tractor horse power (ps)		20_30		
Grain spreader	Length (mm)			360
	Width (mm)			685
	Height (mm)			395
	Weight (kg)			7.0
	Chemical capacity (kg)			10
	Dust system			spinner
	Spiner speed (rpm)			716
	Biggest dust quantity (kg/min)			11
	Kind of chemical			grain

RESULTS AND DISCUSSION

Table 2 shows the working items and each working hours on japonica rice production in Japan, the U.S. and China. The working hours related to raising and transplanting of seedling in Japan is so long relative to the one in the U.S. We anticipate that whole working hours on rice production would be shorten 10~20 hours per 0.1 hectare by employing direct seeding.

Tbale 2 : Labor hours on production

(h/ha/10)

Country	Japan				China	U.S.
	Whole C.	Tottori	Tottori-F	Tottori-M		
Seed treatment	0.4	0.6	0.4	0.6	0.5	0.2
Nursery bed	4.5	3.7	3.6	5.3	8.2	
Tilling, Leveling	5.5	4.9	3.0	7.0	9.1	0.6
Basal application	1.4	1.7	1.5	2.9	3.2	0.1
Direct seeding						0.1
Transplanting 5.8	4.2	1.7	5.2	22.8		
Additional manure	1.2	1.1	0.9	2.0	2.1	0.1
Weeding	1.9	1.7	0.7	3.4	5.6	0.1
Watering, Drainage	7.4	6.2	4.2	6.3	10.9	0.3
Pest Control	1.5	0.87	0.5	1.9	2.5	0.1
Harvesting, Threshing	6.7	8.3	3.2	12.8	15.8	0.4
Transportation						0.2
Drying, Hulling	2.3	2.9	2.3	3.6	22.6	1.0
Production control	1.0	1.5	1.1	1.4	1.5	0.2
Total	39.6	37.6	23.1	52.4	104.8	3.4

Table 3 shows working process on rice production using transplanting machine, which is generally practiced in Japan today, plowing dry direct seeding and non-tillage direct seeding in Tottori district.

Table 4 shows the results of working efficiency tests using three kinds of machines. Seeding using a remote-controlled helicopter took less than 10 min. per hectare.

Fig. 2 shows the distribution of seeds, scattered by remote-controlled helicopter. In this test, seeds were fairly uniformly scattered.

Table 3 : Working process on raising

Date	Transplanting		Plowing dry direct seeding	Non-tillage dry direct seeding
Jan.				
Feb.				Herbicide application
Mar.			Plowing	
Apr.	Plowing		Plowing	
May				
10			Readjustment	Herbicide application
			Direct seeding	Direct seeding
20	Seeding	Raising of seeding	Fertilization	Fertilization
	Plowing		(Emergence of seeds)	(Emergence of seeds)
30			Herbicide application	Herbicide application
June	Fertilization		on upland condition	on upland condition
10	Irrigation and puddling		Irrigation	Irrigation
	Transplanting		Herbicide application	Herbicide application
20	Herbicide application			
July				
Aug.	Herbicide application		Herbicide application	Herbicide application
Sep.	Pest control		Pest control	Pest control
Oct.	Surface drainage		Surface drainage	Surface drainage
	Harvesting		Harvesting	Harvesting
Nov.				
Dec.	Plowing		Plowing	Plowing

Table 4 : Results of operating efficiency test

Machine		Tiller (PFK-21K)	Tractor (PFT-6)	Helicopter (R-50)
Travel speed	(m/s)	0.59	0.64	4.8
Efficiency	(min/10a)	51	26	0.78
Slippage	(%)	4.5	3.2	
Seeded depth	(cm)	2~3	2~3	0
Germination	(%)	47.6	58.2	51.2
per cent				

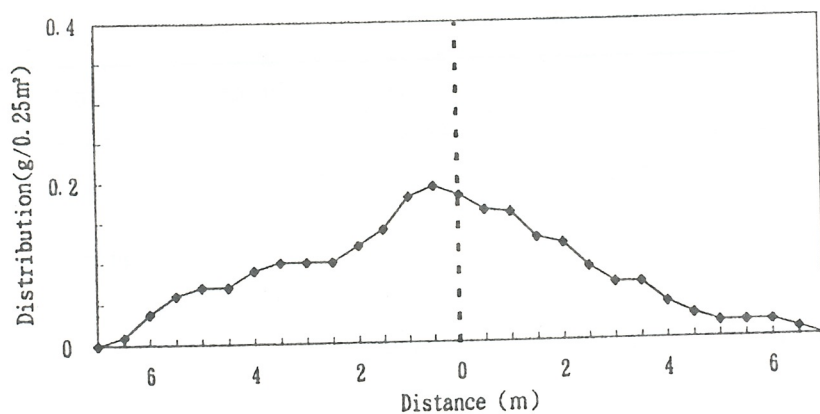


Fig. 2 : Distribution of seed scattered by remote-controlled helicopter

CONCLUSION

A great deal of paddy fields in Japan are surrounded by mountains. Agriculture in Japan is generally characterized as small scale. Rice production costs and retail prices in Japan are the highest in the world. Japan should improve its rice production system by enlarging the farm size and by shortening labor hours to enhance labor productivity and to make rice production costs lower.

This research was conducted to improve the direct seeding on rice production process using remote-controlled helicopter, power tiller, and tractor for non-tillage method. In this research, it was found that labor hours on rice production would be shortened from around 420 hours of conventional methods to 210-300 hours per hectare by introducing direct seeding.

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