

3. Combination of Crops for Triple Cropping on Paddy Field (1975—1976)

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As a trial to develop triple cropping system on paddy field, several crop combinations consisting of double cropping of upland crops in dry season and succeeding rice culture in wet season were examined in their productivity.

Material and method

1. Combination of crops:

<u>Dry season</u>		<u>Wet season</u>	
1st crop	2nd crop		
Maize	Soybean		Rice
"	Peanut		"
"	Mungbean		"
Soybean	Maize		"
"	Peanut		"
"	Mungbean		"
Peanut	Maize		"
"	soybean		"
"	Mungbean		"

Mungbean was grown only in the 2nd crop since it usually did not yield high in the 1st crop season.

2. Layout: The 1st crop was disposed in the main plot of 540 m² (24 m × 22.5 m); the main plot was divided into three sub-plots of 180 m² (24 m × 7.5 m) for the 2nd crop and wet season rice. One replication was applied.
3. Variety:

Maize:	Suwan No.1	Soybean:	SJ2
Peanut:	Tainan No.6	Mungbean:	SPR No.1
Rice:	RD 7		
4. Seeding time:
 - 1st crop: December 30, 1975
 - 2nd crop: April 24, 1976
 - rice (transplanting): August 17, 1976 (21 day seedling)
5. Fertilizer application: Every plot planted to upland crops was divided into two plots of F₁ and F₂ as follows, but rice was cultivated uniformly in every plot.

Plot	Maize			Leguminous crops			Rice		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
F ₁	50 + 50	75	37.5	10	75	37.5	20 + 17.5	25	0
F ₂	75 + 75	75	37.5	10 + 10	75	37.5			

Remarks: Figures in the column of N show the amount of basal dressing plus top dressing.

6. Spacing:

Maize: 75 cm × 30 cm (2 plants/hill in 1st crop and
1 plant/hill in 2nd crop)

Leguminous crops: 75 cm × 20 cm (2 plants/hill)

Rice: 25 cm × 25 cm (3 seedlings/hill)

Result

1. Growth and yield of each crop
- 1) Although the 1st crop of maize grew inferior to the 2nd one in the initial growth stage as shown in Fig. 3-1, the yield of maize was almost same in both the growing seasons (Table 3-1). There was not seen a difference in the growth and yield of maize between both the plots in which maize was grown as the 2nd crop succeeding to soybean and peanut respectively. There was found a clear difference in growth of maize between two rates of nitrogen application, resulting in 0.7 to 0.9 ton/ha of the yield difference between F₁ and F₂ plots.
- 2) The growth and yield of soybean were shown in Fig. 3-1 and Table 3-1. The 1st crop of soybean grew inferior to the 2nd one throughout the growing period. In the 2nd crop, soybean succeeding to peanut grew far better than that succeeding to maize and yielded highest. Top dressing of nitrogen did not induce a clear effect on soybean crop.
- 3) The 1st crop of peanut also grew less vigorously in the initial growth stage but recovered later, as seen in Fig. 3-2. The growth of the 2nd crop of peanut was better in the plot succeeding to soybean than that succeeding to maize. Yield of peanut was high in the 1st crop but low in the 2nd crop. The effect of rate of nitrogen application was not clear on the peanut crop.
- 4) The growth and yield of mungbean did not show much difference among the plots, but were somewhat better in the plot succeeding to soybean than others. The rate of nitrogen application did not clearly affect the mungbean crop.
- 5) The growth and yield of rice were shown in Fig. 3-3 and Table 3-2. Damages by brown plant hopper happened to occur at about 10 days before harvest in the plots where maize and soybean were respectively grown as the 1st crop. Although dry weight of plant, ripening percentage and grain yield were decreased by the hopper burn, the following were found:

The growth and yield of rice in the plot where maize was grown as the 2nd crop, was inferior to those in the plots where leguminous crops were grown as the same. The effect of these leguminous crops on the succeeding rice crop was in the line of soybean>peanut>mungbean, in case they were grown as the 2nd crop.

The rate of nitrogen application for the preceding upland crops did not induce a clear difference in the succeeding rice crop.

Among the plots where the leguminous crops were grown as the 2nd crop, better crop of rice was obtained in the plots where those crops were grown successively in the 1st and 2nd crop of dry season as compared with the plot where those crops were grown only in the 2nd crop.

2. Growth duration of each crop

The growth duration of the crops in the field was as shown in the following table.

	1st crop	2nd crop	Wet crop
	days	days	days
Maize	111	95	
Soybean	111	108	
Peanut	111	102	
Mungbean		87*	
Rice			97

*: Out of total yield of mungbean shown in Table 3-1, 95% was harvested at 73 days after seeding.

It was noted that, the 1st crop of peanut and the 2nd crop of soybean should be grown about 5 days more for full maturing. But, in either case, it was surely possible to introduce two upland crops in dry season preceding to wet season rice for the triple cropping system on paddy field.

3. Combination of crops

- 1) As shown in Fig. 3-4, a comparison was made on the yields of the crops in the different cropping systems consisting of the same kind of crops with different orders.
- 2) When maize and soybean were introduced as dry season upland crops in a cropping system, the combination of maize—soybean—rice was better than soybean—maize—rice from the viewpoint of increasing the rice yield.
- 3) When maize and peanut were introduced, the combination of peanut—maize—rice was better to increase the yields of peanut and rice as compared with the combination of maize—peanut—rice.
- 4) When soybean and peanut were introduced, the highest yields of all the three crops such as 1.4 ton/ha of peanut, 2.7 ton/ha of soybean and 5.2 ton/ha of rice were obtained from the combination of peanut—soybean—rice.
- 5) When mungbean was introduced as the 2nd crop in dry season, mungbean yield was somewhat high in the plot succeeding to soybean; a better crop of the succeeding rice was obtained when peanut was grown as the 1st crop in the combination such as peanut—mungbean—rice.

Discussion

As for the combination of crops in a cropping system, the following two factors should

be taken into consideration: these are, the growth response of each crop to the seasonal change of climate, and the effect of the preceding crop on the succeeding crop. The growth and yield of the crops in the various combinations tested in the experiment were affected by those factors as follows:

While the different growing seasons did not affect the yields of maize and soybean, the effect of these crops on the succeeding crop varied. Therefore, the following pattern of cropping system; cereal crop (maize) — leguminous crop (soybean) is desirable for raising high yield of the succeeding rice crop in wet season.

On the other hand, peanut crop was affected by the growing season yielding better in the 1st crop. In addition, both peanut and soybean could favorably affect the succeeding crop. Thus, the combination of peanut — soybean — rice seemed to have yielded better than the other when peanut and soybean were picked up as the dry season crops.

Mungbean is sensitive to the growing season, judging from the result obtained in the previous experiments. The 2nd crop seems more favorable for mungbean growing. However, there will be still some possibility to succeed in mungbean growing as the 1st crop by late planting, making good use of the short growth duration of mungbean.

Summary

1. In order to develop the cropping system on paddy field in the Central Plain, some crop combinations for triple cropping a year were examined.
2. When maize was introduced, the pattern of cropping system consisting of maize as the 1st crop and leguminous crop such as soybean as the 2nd crop in dry season was good to raise high yield of the succeeding rice in wet season.
3. However, when maize was combined with peanut, the order of peanut — maize — rice brought higher yields of peanut and rice than the contrary order (maize—peanut), because of the growth response of peanut to the seasonal changes of climate.
4. The combination of peanut — soybean — rice induced the highest yield of all the three crops among the all combinations tested.
5. Mungbean could be grown as the 2nd crop combined with any kind of upland crops mentioned above with less difference in yield in any case.

Table 3-1. Yield of upland crops in relation to combination of crops

Growing season	Maize		Soybean		Peanut		Mungbean	
	Preceding crop	Grain yield	Preceding crop	Grain yield	Preceding crop	Grain yield	Preceding crop	Grain yield
1st crop (Sown on Dec. 30)	—	kg/ha (F ₁) 1,792 (F ₂) 2,686	—	kg/ha 1,671 1,772	—	kg/ha 1,401** 1,457**		
2nd crop (Sown on Apr. 23)	Soybean	(F ₁) 1,796	Maize	1,688	Maize	716	Maize	833
		(F ₂) 1,674*		1,465		530		836
	Peanut	(F ₁) 1,712	Peanut	2,424	Soybean	638	Soybean	1,032
		(F ₂) 2,401		2,932		734		885
		(F ₁)					Peanut	783
		(F ₂)						973

Remarks: * : Damaged by wet injury

** : Damaged by rat.

The moisture content of grain was 9% for peanut and 13% for others.

Table 3-2. Yield and its component of rice in relation to combination of crops

1st	Preceding crop	Fertilizer	Yield	No. of panicles	No. of spikelets	Ripening percentage	Weight of 1,000 grains
	2nd		t/ha	/hill	/panicle	%	g
Maize	— Soybean	F ₁	4.03	10.7	113.0	72.2	28.7
		F ₂	4.02	10.9	109.2	73.9	28.6
"	— Peanut	F ₁	3.60	10.7	110.9	67.4	28.1
		F ₂	3.81	10.3	112.3	72.0	28.4
"	— Mungbean	F ₁	3.62	10.8	119.9	66.0	28.5
		F ₂	3.56	9.8	109.3	71.8	28.8
Soybean	— Maize	F ₁	3.92	9.9	121.8	71.4	28.4
		F ₂	3.40	9.8	125.0	63.0	27.5
"	— Peanut	F ₁	4.24	10.7	114.7	75.4	28.7
		F ₂	4.11	10.7	115.4	73.6	28.2
"	— Mungbean	F ₁	4.03	10.4	114.8	73.1	28.8
		F ₂	4.03	10.6	113.8	72.6	28.7
Peanut	— Maize	F ₁	4.72	10.9	117.4	79.6	28.9
		F ₂	4.42	10.9	116.3	76.8	28.4
"	— Soybean	F ₁	5.14	11.8	115.0	81.7	28.8
		F ₂	5.18	12.3	114.4	78.3	29.2
"	— Mungbean	F ₁	4.75	11.3	117.0	78.7	28.6
		F ₂	4.44	10.7	115.4	77.9	28.8

Moisture content of grains was 14%.

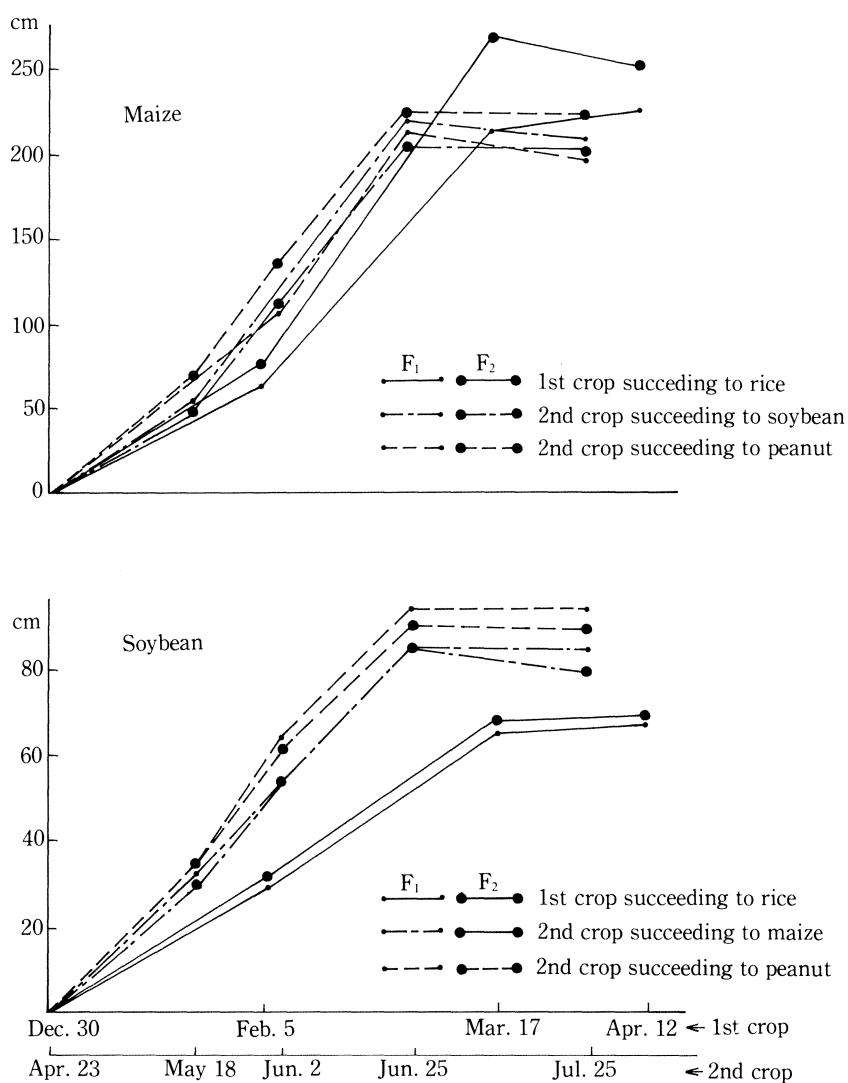


Fig. 3-1. Changes of plant height (1)

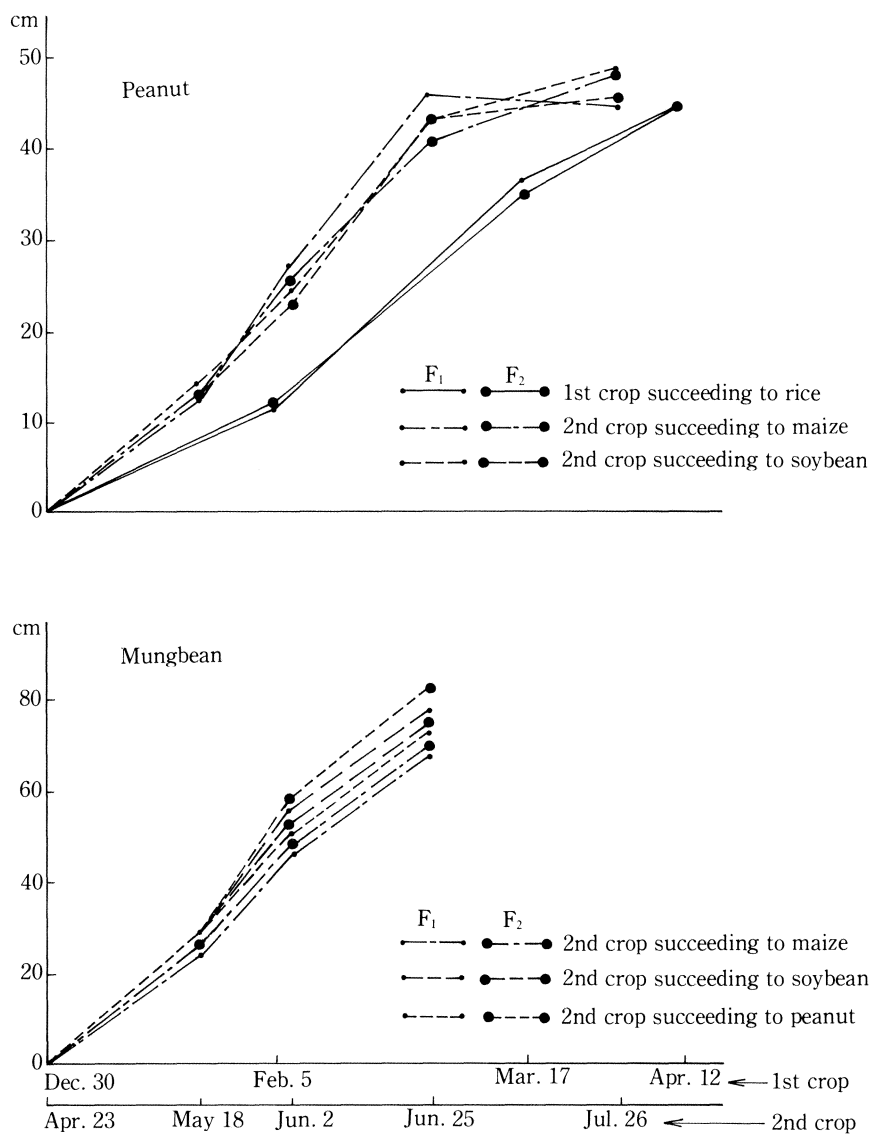


Fig. 3-2. Changes of plant height (2)

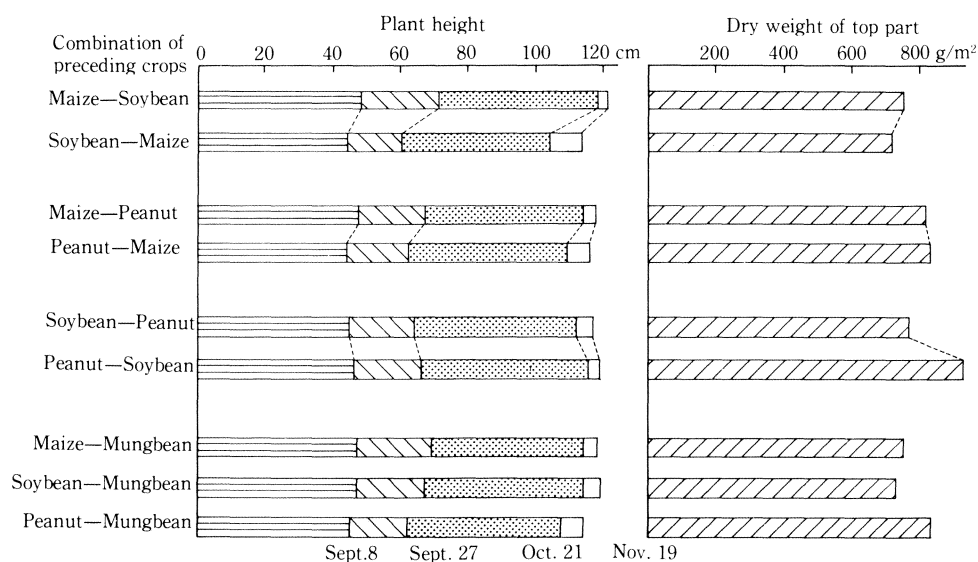


Fig. 3-3. Growth of rice plant in relation to combination of crops
(in average of 2 levels of fertilizer application for preceding crops)

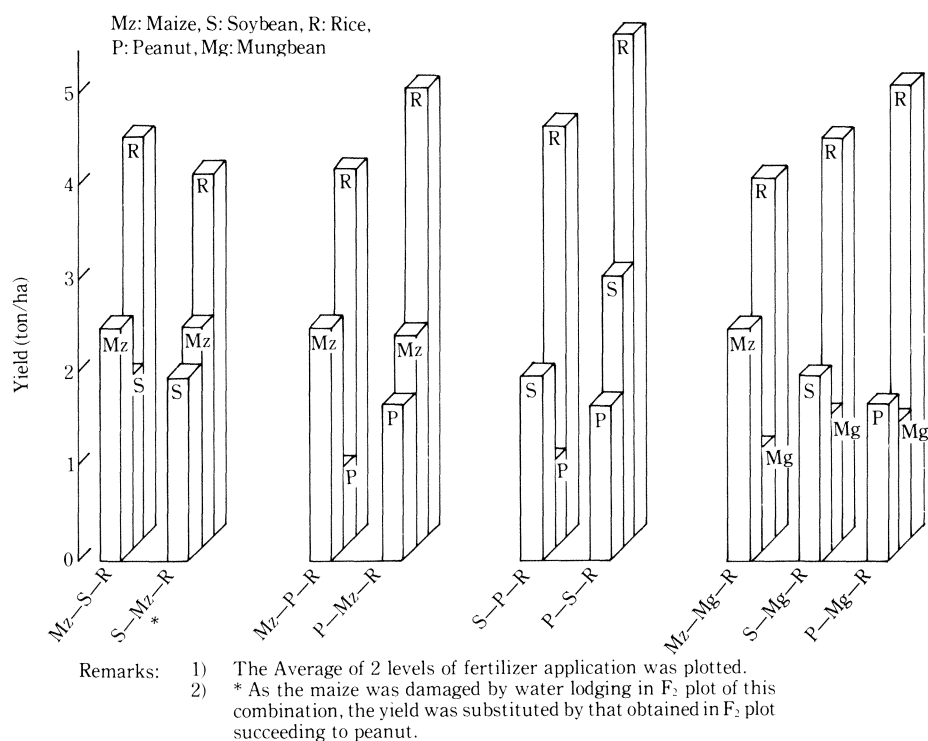


Fig. 3-4. Yields in relation to combination of crops