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Rice Culture in the Central Plain of Thailand (II)

Yield Components Survey in the Saraburi-Ayutthaya Area, 1967

by

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The senior author has had the chance to conduct field work in Thailand since April 1967 under the auspices of the Center for Southeast Asian Studies of Kyoto University. Two different approaches toward the understanding of rice culture in this part of the world were undertaken; one encompassed field experiments at the experimental station, the other encompassed field surveys of the rice plant and its environments in the farmers' fields. Part of the latter approach is reported and discussed in this paper.

I Purpose of the Survey

Although the rice cultivation in Thailand has a long history, little data, giving "figures" for rice grown under the habitual planting system of Thai formers, is available. (WATABE, T., 1965, WATABE, T., 1967, FUKUI, H. and TAKAHASHI, E., 1969)

The first objective of this study was to draw a profile of the rice plant by "figures", as it is grown by farmers in the Central Plain of Thailand. Growth is mainly determined by variety, cultivation techniques and surrounding conditions which differ considerably from place to place in the study area. The second objective was to investigate how intra-area variations of these factors work on the growth of rice plant. The results and discussion of this second objective will be reported in another occasion.

II Selection of the Study Area

Rice cultivation and the conditions surrounding it on this plain have been reviewed and reported by the authors. (FUKUI, H. and TAKAHASHI, E., 1969) In that report, the results of a preliminary survey of yield and the components of rice plants grown by farmers on this plain were also reported. The results of a survey, which covers such a vast area as the Central Plain by one unit of people during one harvesting season, gives only limited information because of the scant density of sampling plots. In 1967, the authors made a case study on which a certain smaller portion of the plain was selected. The ratio of transplanted and broadcast paddy areas in the Central Plain is approximately

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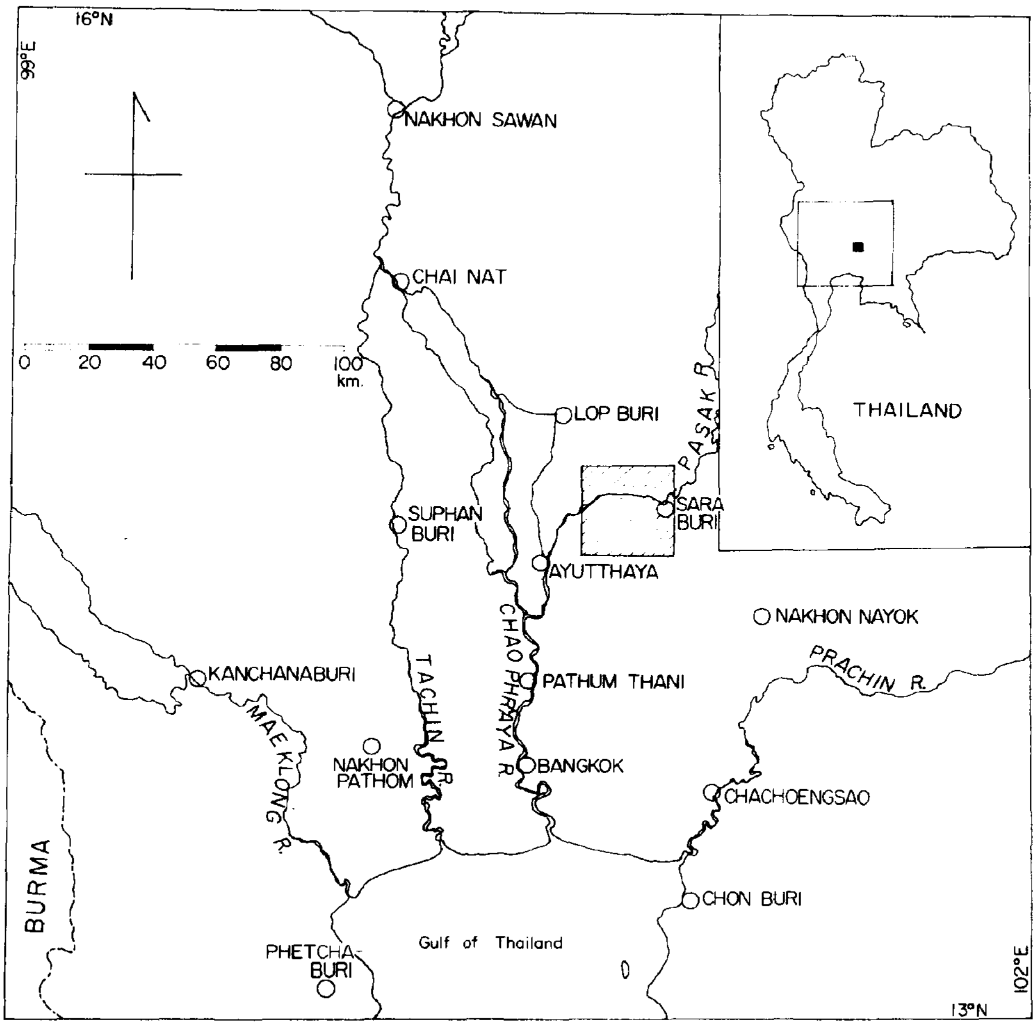
one to one when the "Central Plain" is defined as south of Chai Nat. (FUKUI, H. and TAKAHASHI, E., 1969) If a study area includes both types of cultivation methods, the influences by other factors, such as water supply, soil fertility, fertilizer application etc. on the growth of rice plants will be difficult to be analysed. A study area must be located either in the fully transplanted or in the broadcast region. It is preferable that the physiography, water supply, soil conditions etc. are very widely within the area. Accessibility is another important requisite. Considering these factors, a transplanted area in the middle part of the Central Plain, covering a part of Changwat Saraburi and Ayutthaya, was finally chosen.

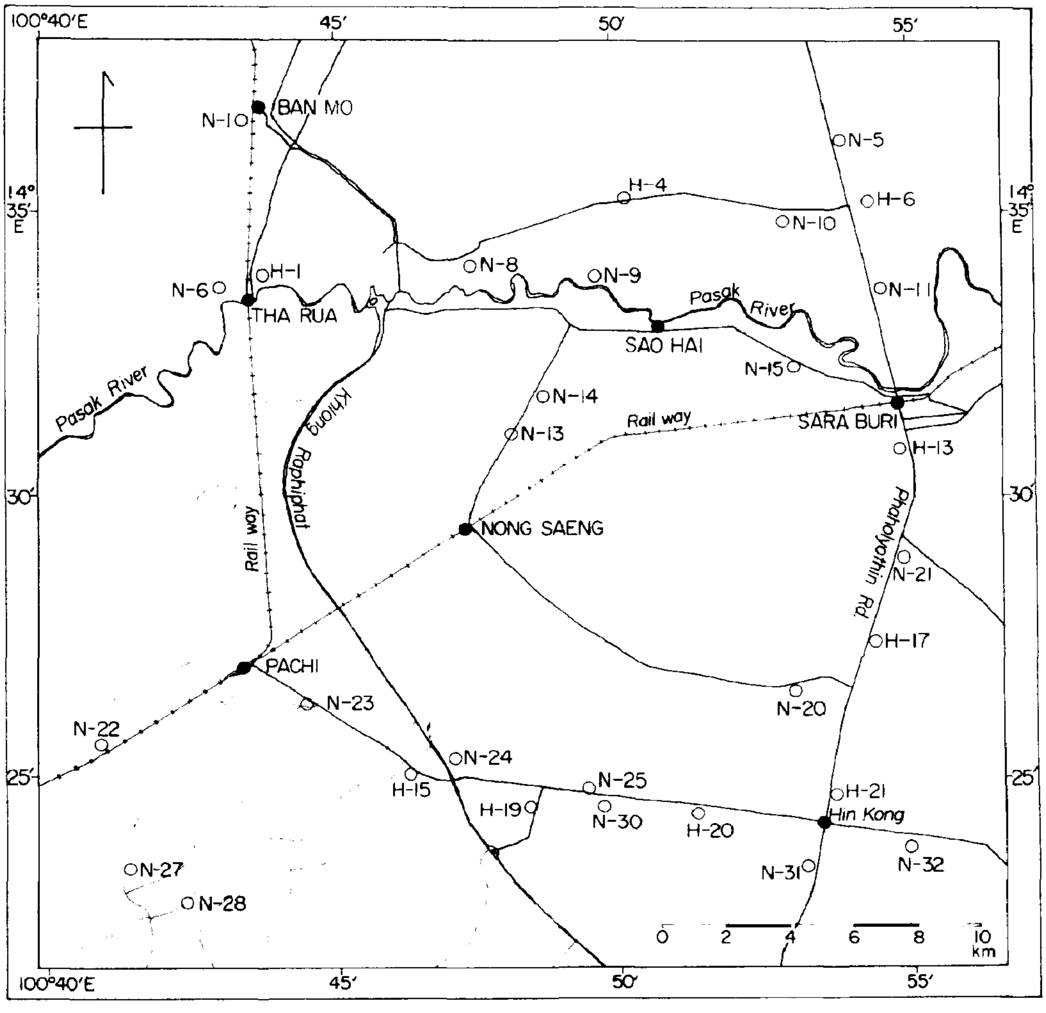
The study area consists of a square with a side of ca. 30 kilometers, bounded by 14°23' and 38' N latitudes and 100°40' and 57' E longitudes. The Pa-sak river, one of the tributaries of the Chao Phraya river, runs westerly through the area. The greater part of the area is situated on the alluvial fan of this river, which inclines from northeast



Map I The Central Plain of Thailand Showing the Saraburi-Ayutthaya Study Area to southwest. The Raphiphat canal which crosses the Pa-sak river in the area, is excavated along the contour, supplying water mainly to its southwestern side. One can reach the town of Saraburi by car from Bangkok along the Phaholyothin road within two hours. From this trunk route which passes the eastern edge of the study area, several minor roads, which are passable by car through all seasons, branch off to the west. The sampling plots were selected within half a kilometer from the nearest road, except for several plots in the southwestern part of the area, which were accessible only by boat.

The authors proposed twelve sub-divisions of the Central Plain, based on rice culture, utilizing the available data concerning yield, cultivation methods, soils and other environmental factors. (Fukui, H. and Takahashi, E., 1969) According to this sub-divisioning, the study area belongs to the "Saraburi Area", where the average yield is between 250-349 kg of paddy per rai; a medium yield on the plain.

The study area includes the following administrative units: in Changwat Saraburi; Amphoe Muang, Sao Hai, Nong Saeng, Ban Mo and Nong Khae and in Changwat Phra



Map II Saraburi-Ayutthaya Area Showing 30 Sampling Plots of 1967

Table 1 Average Paddy Yields of Eight Amphoes in the Study Area, 1962–1966[1)]

Changwat	Amphoe	average paddy yield kg./rai						
		1962	1963	1964	1965	1966	mean	max.-min.
Saraburi	Muang	302	333	303	329	303	314	31
	Sao Hai	394	404	303	314	303	344	101
	Nong Saeng	340	202	303	277	322	289	138
	Ban Mo	303	300	491	301	304	340	191
	Nong Khae	274	276	281	258	305	279	47
Ayutthaya	Tha Rua	268	258	291	296	330	289	72
	Phachi	303	363	302	303	352	325	61
	Uthai	252	402	202	302	321	296	200

—— maximum ······· minimum

1) From Department of Rice

Nakhon Si Ayutthaya; Amphoe Tha Rua, Phachi and Uthai. The annual average yields of these Amphoes during the five years from 1962 to 1966 are shown in Table 1. The averages of these five years are around 300 kg per rai. Although each Amphoe has a considerably large paddy area, the annual fluctuation is so significant that the difference between the maximum and minimum yields during the five years was 200 kg per rai in some Amphoes. The year in which the maximum or minimum yields were obtained in some Amphoes does not necessarily coincide with the years of the others, irrespective of the proximity of Amphoes. The annual rainfall observed at three places on the plain, as shown below, does not seem to explain this annual fluctuation of yield.

Annual Rainfall in mm.

year	Lop Buri	Bangkok	Chachoengsao
1963	1,253	1,540	1,428
1964	1,655	1,864	1,291
1965	1,385	1,703	1,196

III Selection of Sampling Plots

In this area, single crop of rice is the common practice. Harvesting is concentrated between the middle of November and the middle of December. Thirty to forty sampling plots seem a reasonable unit for people to survey during that period, if interviewing is also included. If the thirty plots are uniformly distributed in a study area of ca. 900 square kilometers, the density of sampling plots becomes one plot per 30 square kilometers or ca. 5.5 km × 5.5 km. Actually the plots could not be distributed completely uniformly because of the poor accessibility in some parts of the area.

Regions or fields damaged through various causes were omitted but several plots, which had partly suffered from a water shortage, were also included where harvesting was possible.

IV Sampling Method

A brief interview with the cultivator took place at each plot. The questionaire is shown in Table 2. The chemical fertilizer if any is used for paddy, is common throughout the whole kingdom; Ammo-Phos (16-20-0). The rate of its application is not always available. The interviewers asked the total amount of fertilizer applied and the total planted or fertilizer-applied area, and calculated the rate of application supposing that application was done uniformly. The names of rice varieties were also obtained by interview. Whether or not different varieties were sometimes called by identical names or whether identical varieties were sometimes called by different names could not be determined.

All rice plants inside a frame (2 m by 2 m), which was placed in the middle of a plot, were sampled. After threshing and drying, good paddy grain was separated by controlled winnowing. It was then weighed and taken as paddy yield. The number of

Table 2 The Form of Questionaire

Location No.		Cultivator's Name
Address: Mu ban Amphoe		Tambon Changwat
Topography		
Irrigation		
Single/Double Cropping		Second Crop
Landed/Tenant	Rent	Area
Variety	Date of Harvest	
Buffalo/Tractor	Cost of Tractor	
Fertilizer: Kind Time	Amount Price	
Other Chemicals: Kind Time	Amount Price	
Weeding		
Map	Note	

spikelets and the percentage of good grain were calculated based on the weight of 1,000 good and incomplete grains and their mean weight per panicle, which was obtained by dividing the total weight of each grain in 2 m × 2 m by total number of effective panicles. The surface soils inside the frame were sampled, dried and sieved as usual.

V Results and Discussion

The average yield of the thirty plots in this survey is compared with averages of several other similar surveys conducted in Thailand and Malaya, together with some statistical figures of paddy yield. (Table 3) The average yield appearing in statistical data is usually lower than yields of the actual surveys, because the former is based on planted area, not on harvest, and the difference between them is not small in these countries. However, the relatively high yields in northern Thailand and in Malaya are reflected in the results of surveys in those areas. The average yield of the Amphoes in the study area for the last five years, as shown in Table 1, is 300 kg per rai or 188 grams per sq.m. while the average from this survey is 209 grams per sq.m.

The averages of yield components for the six surveys are summarized for comparison in Table 4. The number of panicles per sq.m. is around one hundred in most cases, that is, less than one third that for Japan. Three hundred twenty-one panicles per sq.m. was the average for all Japan for 1963-1965. (The average yield of brown rice was 398

Table 3 Comparison of Average Paddy Yields from Various Sources

yield survey	paddy yield gr./m^2
31 samples in the Central Plain, 1966[1]	213
12 samples in Chai Nat, 1963[2]	153
11 single cropping fields in northern Thailand, 1965[3]	272
14 double cropping fields in northern Thailand, 1965[3]	328
17 samples in Province Wellesley, Malaya[4]	321
30 samples in S-A area, 1967	*209*
statistics	
Production divided by area planted in the "Central Region" of Thailand[5]	
1963/64	181
1964/65	165
1965/66	163

1) Fukui, H. and E. Takahashi, 1969
2) Watabe, T., 1965
3) Watabe, T., 1967
4) Moriya, M., 1967
5) *Agriculture Statistics of Thailand, 1965*

grams per sq.m. for the same period.) (MINISTRY of AGRICULTURE and FORESTRY, Japan, 1966). The number of panicles per hill in Malaya is rather high and nearly equals that of Japan, 17.0. In Thailand, however, less than 10.0 panicles per hill seems to be common. The planting density seems more sparse in the relatively higher yield regions in southeast Asia, such as double cropping fields in northern Thailand and in Malaya, while that of the Central Plain, where the average yield in approximately two tons per ha., is above 12.0 hills per sq.m. The average for Japan, 18.9 hills per sq.m., is much denser than any average from the tropics. The average number of spikelets per panicle found in this survey is fewer than found in the others. One possible explanation is the difference in regional characteristics. Methodological factors, also, such as the counting method of grains or the separation of effective panicles from non-effective ones, should also be considered. In any case, the number of spikelets per panicle in southeast Asia is about two times greater than that for Japan, which is 78.7.

Comparison of the absolute percentage values of filled or fertile grain and one thousand grain weight is limited because differences in measureing methods by surveyers might affect these values more significantly than it might other components. Nevertheless a rough comparison is possible, particularly if it is true that unfertile spikelets are the main cause of incomplete grain in southeast Asia. On this basis the percentage of filled grain in this region seems at least as high as that of Japan. As for one thousand grain weight, glutinous rice varieties in northern Thailand show higher values while those of Malaya show lower values than the others.

From the above figures we estimated that the thirty samples of the study are probably typical of rice plants grown by farmers on the Central Plain and are perhaps also typical of rice cultivation in the whole of southeast Asia, especially when compared with Japanese

Table 4 Comparison of the Results of Several Yield Components Surveys

Average of	yield gr./m^2	No. of panicles /m^2	No. of panicles /hill	No. of hills/m^2	No. of spklts /pncl	Percent filled grain	1000 grain wt. gr.
12 in Chai Nat[1]	153	79	7.5	12.1	183	80.4	30.0
23 in the Central Plain[2]	233	108	8.2	14.4	104	77.6	27.7
11 single cropping fields in northern Thailand[3]	272	87	7.2	12.0	150	73.4	35.8
14 double cropping fields in northern Thailand[3]	328	90	11.2	8.4	176	77.2	34.1
17 in P. Wellesley[4]	321	99	15.5	6.5	152	79.4	22.9
30 in S-A area, 1967	*209*	*95*	*8.2*	*11.9*	*106*	*78.1*	*27.8*

1) WATABE, T., 1965
2) FUKUI, H. and E. TAKAHASHI, 1969
3) WATABE, T., 1967
4) MORIYA, M., 1967

plants, which are in a good contrast with the others.

The coefficients of variation for yield components were also calculated and are compared among the four surveys. (Table 5) The coefficient of variation values for yield, number of panicles per unit area and per hill, and planting density are, roughly speaking, more or less the same within each survey and among the different surveys. WATABE's results in Chai Nat, which show greater values because of the extremely low yield of some samples are an exception. The coefficient of variation values for percentage of filled grain and one thousand grain weight are around 10%, approximately

Table 5 Comparison of Coefficients of Variation of Yield Components

Area surveyed	No. of samples	Yield	No. of pncls /unit area	No. of pncls /hill	planting density	No. of spklts /pncl	Percent filled grain	1,000 grain wt.
S-A area, 1967	*30*	*36*	*31*	*24*	*28*	*31*	*11*	*8%*
Northern Thailand[1]	25	29	29	41	26	21	9	11
P. Wellesley[2]	17	36	27	31	11	24	13	15
Chai Nat, 1963[3]	12	78	34	49	28	18	7	7

1) WATABE, T., 1967
2) MORIYA, M., 1967
3) WATABE, T., 1965

Table 6 Comparison of Correlation Coefficients among Yield Components from Various Surveys

	S-A area 1967	Central Plain 1966[1]	Chai Nat 1963[2]	Northern Thailand[3]	P. Wellesley Malaya[4]
n=	*30*	23	12	25	17
yield-no. of pncls/sq.m.	*0.350*	0.575**	0.949**	0.543**	0.565*
yield-no. of pncls/hill	*0.305*	0.047	0.803**	0.640**	0.634**
yield-no. of hills/sq.m.	*0.147*	0.271	−0.366	−0.341	0.382
yield-no. of spklts/pncl	*0.439**	0.423*	−0.224	0.527**	0.666**
yield-percentage of filled grain	*0.587***	0.236	0.163	0.386	0.529*
yield-1,000 grain wt.	*0.601***	0.173	0.403	0.025	0.029
no. of pncl/sq.m.-no. of spklts/pncl	*−0.619***	0.261	−0.189	−0.114	0.008
no. of hills/sq.m.-no. of pncls/hill	*−0.294*	−0.569**	−0.749**	−0.653**	
paddy area per one sample × 1,000 ha (approx.)	*3*	87	4	16	1

1) FUKUI, H. and E. TAKAHASHI, 1969
2) WATABE, T., 1965
3) WATABE, T., 1967
4) MORIYA, M., 1967

one third of the values for other components.

Simple correlation coefficients between yield and its components were calculated for the five different surveys in Thailand and the Malayan survey. The results are shown in Table 6. In the Saraburi-Ayutthaya area, no significant correlation was observed between yield and number of panicles per unit area or per hill, but the correlation between yield and number of panicles per unit area is significant in the other four areas. This

Table 7 Yield and its Components of 30 Samples in S-A Area, 1967

Location	No. of hills /sq.m.	No. of pncls /hill	No. of pncls /sq.m.	No. of spklts /pncl	No. of spklts /sq.m.	% of filled grain	No. of f.g./sq.m.	1,000 grain wt. gr.	yield gr./sq.m.
					$\times 10^2$		$\times 10^2$		
N-24	11.5	8.48	98	158	154	83.7	129	30.7	395
N-28	16.3	6.26	102	140	143	87.9	125	27.0	338
N- 1	16.3	10.29	167	61	102	93.4	95	33.5	320
H-15	12.8	7.96	102	133	135	78.8	106	30.0	319
H- 1	13.3	9.72	129	97	125	85.5	107	28.9	310
N- 8	14.3	7.33	105	130	136	73.5	100	26.9	268
N-10	11.8	8.05	95	125	118	72.9	86	28.5	246
N-31	9.0	8.92	80	124	99	87.4	87	27.5	239
H-21	5.3	15.90	84	132	110	83.4	92	26.0	238
N-15	10.8	10.49	113	103	116	70.1	82	28.2	230
H- 4	8.8	10.89	95	111	104	80.1	84	27.1	227
N-22	15.0	7.83	118	85	100	80.9	81	28.1	227
N- 9	9.3	6.68	62	166	102	79.0	81	27.8	225
N-23	18.5	7.28	135	76	103	76.6	79	28.1	221
H-19	11.8	9.51	112	89	100	77.7	77	27.4	212
N-14	11.3	6.53	74	127	94	77.1	72	27.9	202
N-32	9.0	7.61	69	114	78	83.1	65	30.8	201
N- 6	17.8	8.89	158	43	68	86.9	60	29.8	178
H-17	4.8	8.74	42	174	72	85.1	61	28.7	176
H-20	12.3	6.63	81	97	79	80.3	63	27.8	176
N-27	14.3	8.02	114	66	76	82.6	63	27.1	170
N-26	9.8	8.10	79	94	74	80.1	59	28.5	169
N-11	7.5	7.60	57	135	77	80.5	62	27.2	168
N- 5	13.0	8.56	111	93	104	58.7	61	24.2	148
N-21	8.5	6.03	51	123	63	81.7	51	27.8	143
H-13	11.8	6.53	77	82	63	80.2	51	27.6	139
N-30	15.0	6.13	92	69	64	68.5	44	25.6	112
N-13	11.5	5.22	60	93	56	72.2	40	26.1	105
H- 6	10.5	7.07	74	79	59	56.8	33	27.0	89
N-25	14.3	8.26	118	53	63	57.6	36	21.3	77
Mean	11.9	8.18	95	106	95	78.1	74	27.8	209

positive correlation, often observed, suggests that southeast Asian yields may be increased through panicle number by means of denser planting. The denser planting usually accompanies fewer number of panicles per hill which is shown as significantly negative correlation coefficients in the other four cases. The correlation between yield and the average number of spikelets per panicle is significant at the 5% level in this study; the same correlation was observed in the other three cases. But the correlation between number of panicles per unit area and that of spikelets per panicle is negatively significant, again, only in this study.

Thus, it seems that no general tendency in correlation coefficients common to the five surveys exists, although, as it has been stated, the average values of yield and the components and coefficients of variation differed only slightly from one survey to another.

The actual values of yield and its components for each of the thirty samples are shown in Table 7 in order of their yields. This table indicates that the samples may be grouped into several types, i.e. panicle-weight, panicle-number, dense-planting or sparse-planting types. There seems to be no relationship between yield and type, as panicle-weight type does not necessarily give high or low yields. It would be of great convenience if the nine items of yield and its components were drawn graphically. Fortunately, this was attempted by the Department of Agricultural Economics, Ministry of Agriculture and Forestry, and reported in "*Crop Statistics*, No. 10" (*Sakumotsu Tohkei* No. 10). The authors have followed their method with some modification.

First, the following equation is assumed.

No. of hills/sq.m. × No. of panicles/hill × No. of spikelets/panicle × Percentage of filled grain ($\times 10^{-2}$) × 1,000 grain wt. ($\times 10^{-3}$) × paddy yield/sq.m.

No. of panicles/sq.m.

No. of spikelets/sq.m.

No. of filled grain/sq.m.

The five horizontal lines, each of which represents the number of hills, panicles, spikelets, filled grain and yield per sq.m., respectively from the bottom in this order, are drawn in such way that the line connecting the points which indicates the standard values becomes a straight vertical line. One, the number of hills per sq.m. is represented on the lowest line by equal intervals. Two, the number of panicles per sq.m. is represented on the second lowest line in such manner that the values obtained by multiplying the number of hills per sq.m. on the lowest line, by the standard number of panicles per hill, take their positions exactly above the corresponding values on the lowest line. This is repeated for the other three lines, using standard number of spikelets per panicle, percentage of filled grain and one thousand grain weight as multipliers. Five out of the total nine items for individual samples are plotted on these five horizontal lines. Other items are shown by the angles formed by the lines connecting the points on the horizontal lines and the horizontal lines themselves. A slant line inclining to the right or to the left between an interval means that the said component is greater or less than the standard, respectively.

Figure 1 was drawn by plotting the values of the thirty samples on one graph, taking the average values as standard. The incline of the lines between the upper two intervals, which show one thousand grain weight and the percentage of filled grain, is smaller than that of the lines between the other two intervals, which show number of spikelets per panicle and number of panicles per hill. In the lower two intervals the slanted lines cross each other in a more complex manner. The thirty samples in this study were grouped into six types according to the shapes of the broken lines in the lower two spaces. These are shown in Fig. 2.

Some additional data for each sample, on total dry matter production, grain/straw ratio, plant height, water supply conditions and fertilizer application are shown in Table 8. Considering these facts, each of the six types would be characterized as follows: *Type A* : Although the planting density of this type is medium to high, the yield is medium to low and most of the lower yield samples belong to this type. This lower yield is caused by the inferior numbers of both panicles per hill and spikelets per panicle. Though

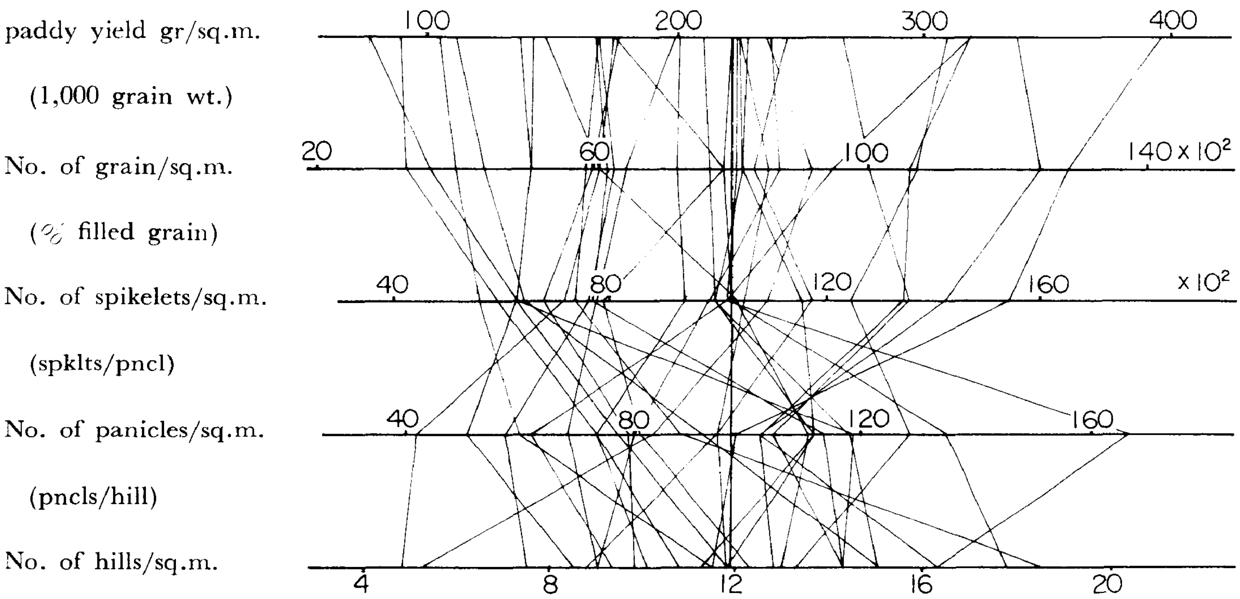


Fig. 1 Graphic Presentation of Yield and its Components of 30 Samples in S-A Area, 1967

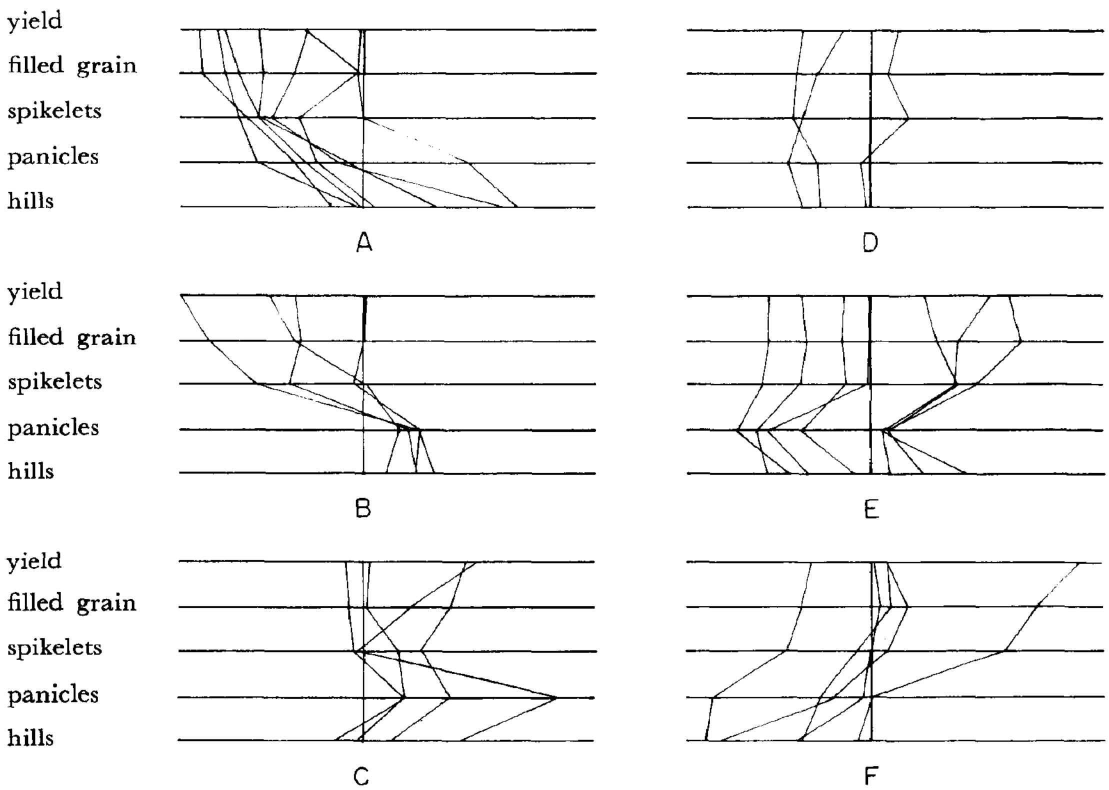


Fig. 2 Six Types of Yield Component Pattern among 30 Samples in S-A Area, 1967

total dry matter production is medium to low, the grain/straw ratio is not necessarily low but often rather high. Plant height is usually rather low and water supply is poor. Thus, type A is considered as one of the drought types, which suffered a water shortage from an early stage of growth and whose transplanting may also be delayed. Correlation between yield and planting density within this type seems significant, which may justify dense planting as a counterplan to water shortage.

Type B : This type resembles type A with the exception that the number of panicles per hill is not as poor as in type A. This may be the result either of an adequate water supply at an early stage of growth or a greater number of plants per hill. It seems that an increased number of panicles per hill could not result in a yield increase because of partial drought at a later stage of growth or other damage caused by pests and diseases.

Type C : Both of planting density and the number of panicles per hill are medium to high but the number of spikelets per panicle is very poor. This type can be called the "dense planting-small panicle" type, which means that the "sparse planting-large panicle" type is not always the type of rice plant found in the tropics. Nevertheless, grain/straw ratio can not be said to be high nor plant height low. The possible direction within this type to increase yield would be a greater number of spikelets per panicle.

Type D : Lines showing the yield components of this type are nearly vertical lines. All the actual values of the components of this type are medium to low.

Table 8 Some Additional Data on 30 Samples in S-A Area, 1967

Type	Location	Total dry wt. gr./sq.m.	Grain/Straw ratio	Height cm.	Variety	Water supply[1]	Fertilizer kg/ha[2] N	P_2O_5
A	N-23	601	0.70	125	Khao Plung	2	17	21
	N- 6	433	0.74	114	Khao Nan Mong	3	0	0
	H-20	489	0.68	162	Chek Choey	2	13	16
	H-13	425	0.60	154	Chek Choey	3	0	0
	N-30	383	0.57	131	Chek Choey	3	17	21
	N-13	258	0.87	134	Chek Choey	1	0	0
	H- 6	336	0.50	128	Chek Choey	2	0	0
B	N-22	561	0.76	128	Khao Phuang	2	7	9
	N-27	630	0.41	138	Thon Ma-eng	4	25	31
	N- 5	490	0.56	—	Chek Choey	1	0	0
	N-25	286	0.49	103	Hin Kong	1	0	0
C	N- 1	912	0.57	146	Khao Nan Mong	4	7	9
	H- 1	—	—	142	Khao Nan Pluang	3	15	19
	N-15	735	0.53	181	Chek Choey	3	8	10
	H-19	624	0.59	158	Khao Suphan	3	15	19
D	N-10	639	0.76	151	Chek Choey	3	5	6
	N-32	631	0.52	176	Khao Khonri	3	0	0
	N-26	545	0.54	174	Chek Choey	3	13	16
E	N-28	1017	0.55	178	Khao Kot	4	0	0
	H-15	807	0.76	152	Khao Thaheng	3	23	29
	N- 8	614	0.91	159	Chek Choey	3	10	13
	N- 9	613	0.67	187	Chek Choey	4	0	0
	N-14	491	0.80	155	Chek Choey	2	0	0
	N-11	506	0.55	166	Chek Choey	3	11	14
	N-21	396	0.66	162	Chek Choey	3	8	10
F	N-24	1218	0.56	185	Phan Nong	5	15	19
	N-31	—	—	—	Chek Choey	3	9	11
	H-21	705	0.63	182	Pet Ruang	3	0	0
	H- 4	480	1.06	143	Chek Choey	3	11	14
	H-17	769	0.32	200	Khao Khao	4	0	0

1) Water supply condition was graded into four based on the occasional observations made throughout the growing period. *Grade* 1; severe drought at least once during the growing period. *Grade* 2 ; water depth never exceeded 10 cm. usually 0-5cm. *Grade* 3 ; 10-20cm. *Grade* 4 ; more than enough water, 50 cm or more.
2) Applied as ammo-phos (16-20-0).

Type E : This type is one of the two whose number of spikelets per panicle is characteristically great. But this type has fewer panicles per hill. Correlation between yield and planting density seems high. Many of the samples of this type show great height which does not necessarily accompany low grain/straw ratio. Seven samples belong to each of Types A and E. The name of five of these seven varieties of each type is "Chek Choey". The fewer number of panicles per hill in both of these types may be caused by varietal characteristics of "Chek Choey".

Type F : Sparse density in planting and a greater number of spikelets per panicle are the characteristics of this type. Type F may be called a "sparse planting-large panicle" type, which differs from type E in number of panicles per hill. The highest yield among the thirty was with type F.

Summary

A case study survey on yield and its components in the Central Plain of Thailand was conducted in the Saraburi-Ayutthaya area during the harvesting season of 1967. The average values of yield components of the thirty plots of this study were compared with those of other surveys done in Thailand and Malaya. Basing on these data an attempt to figure out the yield components of rice plants actually grown by farmers in southeast Asian countries was made. Simple correlation coefficients among yield components were also calculated and compared for the results of several surveys including this one. However, no general rule of correlation coefficients common for southeast Asia was found. All the yield components of the samples were presented graphically. According to the shapes of the yield component patterns of each sample on this graph, the thirty samples were grouped into six types. Their characteristics were discussed.

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References

Fukui, H. and E. Takahashi, 1969. "Rice Culture in the Central Plain of Thailand, Subdivision of the Central Plain and the Yield Components Survey of 1966," *Tonan Ajia Kenkyu* (*The Southeast Asian Studies*) Vol. VI, No. 4, pp. 962–990.

Ministry of Agriculture (Thailand), 1965. *Agriculture Statistics of Thailand, 1965*, Bangkok.

Ministry of Agriculture and Forestry (Japan), 1968. *Sakumotsu Tokei* (*Crop Statistics*) No. 10, Tokyo.

Moriya, M. 1968. "Productivity of *Indica* Rice Viewed from the Field Survey," *Tonan Ajia No Inasaku* (*Rice Culture in Southeast Asia*), Tokyo.

Watabe, T. 1965. "A Note on Productivity of Paddy Rice in Thailand," *Nettai Nogyo* (*Tropical Agriculture*), Vol. VIII, No. 2, pp. 76–81.

Watabe, T. 1967. *Glutinous Rice in Northern Thailand*, Kyoto.