14. RICE FERTILIZER USE IN AUSTRALIA

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Rice is grown commercially in the Murray and Murrimbidgee Irrigation areas (M. I. A) in Southern Australia, and experimentally at several localities in the North of the continent. In all areas there is a marked response to Nitrogen, the response being greater in the tropical North from applied Nitrogen than in the temperate South. This low response to applied Nitrogen in the M. I. A. is almost certainly due to the wide crop rotation practised, using clover-rye grass pasture. Rice yields in this area are very high and are continuing to show an upward trend.

Although Australian soils are generally low in available phosphorus, the response to applied phosphate is low in all areas where rice is grown.

No response has been obtained from the use of potash even with very high yielding crops. Potassium fertilizers are not used for commercial rice cropping.

Introduction

Rice growing in Australia is confined to the commercial rice producing areas on New South Wales, and to what are largely experimental crops in Northern Territory, North Western Australia, and Northern Queensland.

The M. I. A. sow an annual acreage of 30, 000 hectares, and the grain yield of approx. 7, 275kg/ha supplies the bulk of the Australian domestic market and permits some 75% of the production to be exported.

There appears to be considerable potential for the expansion of rice of the tropical North of Australia. Large compact areas of heavy clay soils occur, and recent experimental work has shown that high yields are possible.

In Northern Queensland, rice growing has progressed from small experimental plots to a total of 1, 000 hectares during a period of three years.

New South Wales

This rice growing area lies about 34°S and has a winter rainfall and a hot dry summer. Rice is grown during the summer months and is entirely irrigated. The varieties grown are largely japonica type, and the long daylength, high solar radiation and the high soil fertility status of the soil brought about by a wide crop rotation are important factors contributing to the high yield achieved.

Although rice has been grown commercially in New South Wales since 1924, none of the major fungal, bacterial or virus diseases are presnt. In addition, the major insect pests (stem borers, leaf hoppers) common to many rice producing countries are not a problem.

The normal method of sowing rice is with a combine seed drill using a seeding rate of 120 to 130kg/ha. The only fertilizer applied to the rice crop is Nitrogen, the application rate being about 22kg/ha. Phosphate fertilizer is usually applied to the clover-rye grass pasture in the years preceeding rice, but not with the rice crop.

The efficiency of clover-rye grass rotation in rice cultivation as a means of establishing and maintaining high soil fertility has been demonstrated by the results of Boerema (1964,

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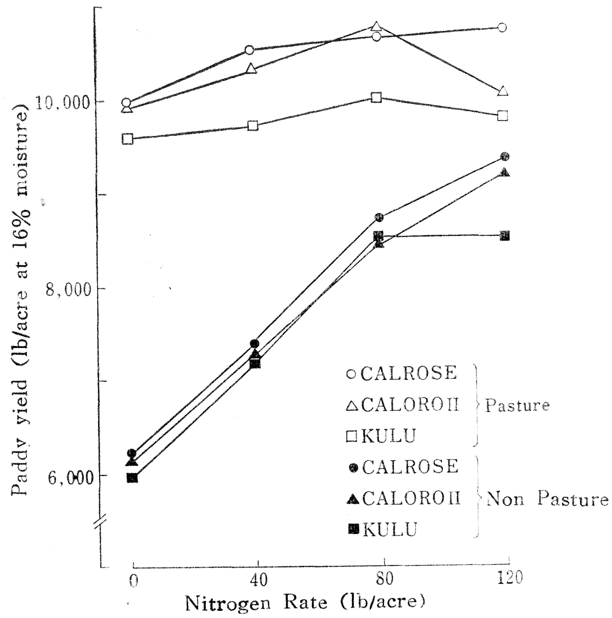

Fig. 1. Effect of pasture rotation on rice yield in New South Wales, Australia (1967-68)

Table 1. Fertilizer trial-sod seeded rice

Treatment (kg/ha)	Grain yield (kg/ha)
No fertilizer	11,917
22 kg N	12,469
44	12,768
66	12,070
88	13,774
LSD P=0.05	376

1968) which are shown in Tables 1, 2, and 3.

There has been no response in the M. I. A. from deep placement of ammonium nitrogen. This is in contrast with the results in the tropics obtained by Langfield (1962) at Kimberley Research Station, and by Boerema (1961) at Coastal Plains Research Station. The reason for the lack of response in the M. I. A. is undoubtedly due to the high fertility status of the soil brought about by the highly efficient crop rotation, and the slow nitrogen release following successive years of clover-rye grass pasture.

As would be expected, top dressing of Nitrogen has shown little increase in grain yield.

Table 2. Fertilizer trial-Drill seeded
(Grain yields kg/ha)

(kg/ha) Nitrogen	Leeton District Variety : Calrose				Kooba District			
	Am. sulphate	Urea	Anhydrous	Mean	Am. sulphate	Urea	Anhydrous	Mean
No fertilizer	7974	8053	7247	7760	8934	9200	7862	8665
22	8646	7985	8825	8485	9030	8551	10090	9224
44	8814	8691	9262	8920	9039	9003	9060	9044
66	9598	9498	9654	9583	9165	9111	9084	9120
88	10136	9890	10135	10114	9565	10100	8871	9512
Mean	9033	8824	9062		9147	9200	8994	

LSD P=0.05
Between N rates =411
N source=237

No analysis available

Table 3. Comparison of Ammonium sulphate, Urea and Nitrogen enriched Coal
(Grain yield kg/ha)

Nitrogen (kg/ha)	Ammonium sulphate	Urea	Nitrogen enriched coal	Mean
No fertilizer				11,424
50	11,138	11,040	11,588	11,259
56	11,855	11,450	11,006	11,437
84	11,282	11,548	11,608	11,480
112	10,976	11,352	11,353	11,226
Mean	11,313	11,348	11,392	

Treatment differences not significant

Northern Queensland

Systematic rice research in the Burdekin valley commenced only four years ago, and because of the relatively high yields obtained, a small but viable rice farming industry has been established.

The area at present under cultivation is of the order of 1,000 hectares. Reports indicate that experimental yields of 6,000-7,000kg/ha have been obtained with indica varieties, with a response from applied Nitrogen up to the level of 90kg/ha. There has been no response from either phosphate or potash.

It can be expected that higher yields can be obtained with improved varieties, and with the provision of adequate irrigation facilities there could be a considerable expansion in the area sown.

North Western Australia

Experiments have been conducted at the Kimberley Research Station (Lat. 15°) over a number of years using japonica varieties during the dry winter season, and indica varieties during the wet monsoon season. The soils are heavy textured clays which in their virgin state are low in Nitrogen (0.02-0.05) and in phosphate (HC/extraction 0.01-0.02%P_2O_5).

Table 4. Fertilizer response-Indica variety, Monsoon season
(Grain yield kg/ha)

Nitrogen (kg/ha)	P_2O_5 (kg/ha)				Mean
	0	44	88	132	
0	792	1822	2291	2112	1776
22	749	1921	2161	2484	1818
44	774	2586	2247	2536	2036
88	1023	2532	2009	2574	2085
Mean	835	2229	2215	2166	

Diff. for Sig. P=.05 N=241
P=241

Table 5. Fertilizer response-Japonica variety, Dry winter season
(Grain yield kg/ha)

Nitrogen (kg/ha)	P_2O_5 (kg/ha)		
	0	44	88
0	677	1113	967
44	483	1983	1693
88	1357	3823	3532
Mean	822	2322	2081

Diff. for Sig. P=.01
P=483
N=483
NP=822

Table 6. Effect of N placement-Japonica variety, Dry season

Treatment		Grain yield (kg/ha)
88 kg N	placed at 6–9 cm	7752
88 kg N	placed at 2–3 cm	6093
88 kg N	applied on surface	6014
88 kg N	21 days after emergence	4767

Diff. for Sig. P=.05 =709
.01 982

A major irrigation project is being established in this locality with cotton as one of the major crops. A dam which will impound some 4,000,000 acre feet of water is under construction, and as there is 30-35,000 hectares of land more suitable for rice than cotton there is a high potential for the establishment of a large rice growing area.

Early experiments conducted by Langfield (1962) using indica varieties in the monsoon season, and japonica varieties in the dry winter, show that there is a response to both phosphorous and Nitrogen. The response to phosphate dose not extend beyond an application rate of 45kg/ha P_2O_5. There is a marked response to Nitrogen, and placement of 6-9 cm in the soil has given yield increases of 20-30%.

Examples of fertilizer response at Kimberley Research Station are shown in Tables 4, 5, 6 and 7.

Table 7. Effect of N placement-Indica variety, Monsoon season

Treatment		Grain yield (kg/ha)
44 kg N	placed at 6-9 cm	5992
44 kg N	placed at 2-3 cm	4936
44 kg N	applied on surface	4879
44 kg N	21 days after emergence	4603

Diff. for Sig. P=.05=343
.01=414

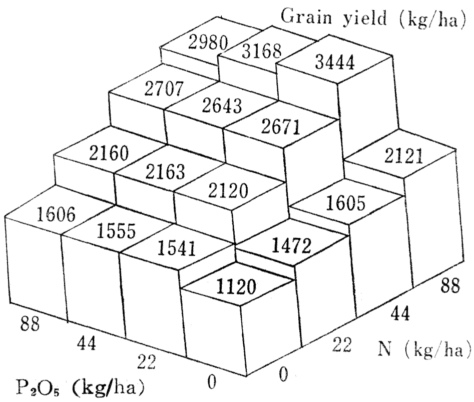

Fig. 2. Effect of N and P on grain yield
(Indica variety, monsoon season)

Northern Territory

Rice growing was first introduced into the Northern Territory around the Darwing region by the Chinese in the year 1884. Records are very scanty, and there is no reliable information as to the extent of the area sown, nor as to the production.

Very heavy (60-80%) clay soils are associated with the lower reaches of several major rivers in the Northern Territory. These heavy clay soil flood plains are treeless, and are subject to flooding during the monsoon season. They carry a denes growth of native rice species (Oryza australiensis and O. spontanea) and a variety of sedges. An early attempt at establishing a large scale mechanized rice scheme failed, largely because of imperect water control and the lack of suitable varieties. More recently it has been demonstrated at the Coastal Plains Research Station that high yields can be achieved with the use of high Nitrogen response varieties, and with sound agronomic practises.

The total area of heavy clay soils on these sub coastal plains has been estimated to be about 0.5 million hectares.

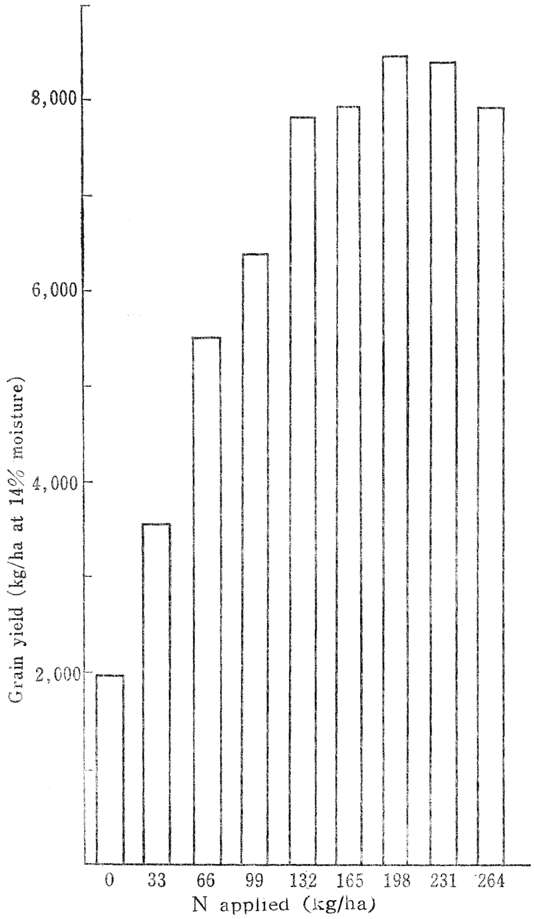

Fig. 3· **Nitrogen response of IR 8 1968, Dry Season**

Early experiments at the Coastal Plains Research Station with indica varieties gave a response to Nitrogen with applications up to 88kg/ha. There was no response to phosphate above the level of application of 22kg P_2O_5/ha.

More recent work (Chapman, unpublished records) using high fertilizer reponse varieties has confirmed this low response to phosphate, even though the grain yield level is more than double that obtained with the old indica varieties. It has also been found that with the high fertilizer response varieties developed by the International Rice Research Institute there is a significant response to Nitrogen application both in the monsoon season and in the dry winter season up to 135kg/ha. Placement of ammoniacal N fertilizer at 6-9 cm in the soil has proved to be more efficient than shallow or surface placement.

A number of experiments have failed to show a response to potash.

The results obtained by Boerema (1961), and Airey (1968), indicate the difference in response of a typical photoperiod sensitive indica variety and the photoperiod insensitive IRRI variety IR 8.

Conclusions

A highly efficient rice industry-although small by world standards-flourishes in the M. I. A. in New South Wales. It is located in the centre of the main irrigation area, and pastures and sheep are an important component of the rotational system. Prior to sowing with rice, a field may be sown to clover and rye grass for up to 5-6 years, and grazed at the rate of 15-20 sheep/ha. Under these conditions there is a considerable build up of soil fertility. Subsequently, only light applications of nitrogenous fertilizer are used. Phosphate is not applied to the rice crop. The average yield for the total area of 30, 000 hectares is 7, 275 kg/ha, and experimental yields of 11, 000kg/ha are common,

In Northerm Australia the response from applied Nitrogen to both monsoon and dry season crops appears to be significant at an application rate of about 130kg/ha when using photoperiod insensitive high response varieties. There has been no evidence of response in grain yield above an application of 22 lb P_2O_5/ha.

Discussion

T. Kiuchi, Japan : Will you please tell me the grain/straw ratio of sod-seeded rice? (I would like to know the grain/straw ratio on such a high yield of rice in Table 1.)

Answer : 1. 0 to 1. 2

A. Tanaka, Japan : How do you apply fertilizer to drill (sod) seeded field? The yield in New South Wales is extremely high. Two possible reasons may be considered : (1) high soil fertility, (2) high solar radiation. Which do you think more important?

Answer : (1) If fertilizer is applied to a sod seeded field it would be applied with the seed at the same time, at a depth of 2-3cm. (2) High soil fertility and high solar radiation are both important.

S. Tsunoda, Japan : What is meant by grain yield? It is brown rice yield of unhusked rice yield in your paper?

Answer : Rough rice (unhulled). Grain yields are calcurated at 16% moisture in the Murumbidges Irrigation areas.

H. Fukui, Japan : What is the reason of rather high yield of indica in Table 7? (Table 4 and Fig. 2 show little response of indica.)

Answer : Probably unproved farming technology. Table 4 and Fig. 2 are from experiments conducted in a new area where these research stations were first established. The high yields from the indica variety (Table 7) were obtained some seven or eight years later.

M. Hasegawa, Japan : You are growing rice in a rotation with grass-clover mixture and other upland crops, which is very different from the rice cultivation in other countries where rice is grown every year continuously for more than thousand years. Under such conditions, it would not be possible to assess plant response to the nutrients applied directly to rice only without knowing the previous treatments sufficiently.

Answer : Cropping history of fields is certainly kept.

T. Kiuchi, Japan : Please tell me the temperature during sod-seeding rice cultivation and the organic matter content of soil. Under the condition rich in organic matter, the soil redox potential will be lowered in water-logged status. How do you prevent the soil reduction?

Answer : Maximum air temperatures would be about 80-85° F. (27-29°C) Because of the large amount of organic matter present, some seedling mortality occurs ; plants being smothered by slime or algae growth.

S. Ishizawa, Japan : 1. Concrning the efficiency of clover-rye grass rotation in rice cultivation, how do you think about the residual effect of nutrients other than nitrogen? 2. What kind of fertilizer is applied to the pasture?

Answer : Only phosphate is applied to the pasture ; providing sufficient phosphate for the subsequent rice crop.

S. Mitsui, Japan : Looking into Fig. 2, P_2O_5 0-13, I feel rather strange there seems to be some optimum dose of P_2O_5…in other words due to rather heavy dose of P_2O_5 application the grain yields decreased.

This is unusual according to our experience in Japan. Do you have any observation to explain this ?

Answer : No. As application of phosphate above about 20kg/ha P_2O_5 has failed to give increased grain yield, little additional works has been done on phosphate requirement.

S. **Yoshida**, IRRI : Suppose you increase nitrogen rate beyond 120 lbs per acre, what would happen in grain yields of pasture versus non-pasture plots ? Would the non-pasture plots eventually reach the same grain yield level as the pasture plots ?

Answer : This has not been the case…pasture-rice has always proved superior.

S. **P. Chee**, Malaysia : The yields from the varieties you stated are relatively high. With these varieties, do you ever run into some lodging ? If so, would you expect, the use of a highly lodging resistant variety like IR8 to give even much higher yields under your obviously favorable rotational system and climatic conditions ?

Answer : Yes, lodging is a problem. IR8 is quite unsuitable to conditions in New South Wales (climatic). Maturation period of IR8 in New South Wales is almost 200 days. The same has been found in Texas, U. S. A.

Y. Takijima, Japan (**Comment**) : Phosphorus-deficient soils dominate in the Tropics due to lateritic soil formation, and phosphorus deficiency symptoms are commonly observed. According to my survey and experiments in Ceylon when I worked as a Colombo Plan Expert, 1967-1968, high correlation was obtained between dificiency symptom and available soil phosphorus. Rock phosphate was found less effective on the growth and yield of rice than improved phosphate fertilizers such as fused magnesium phosphate even on the acid lateritic and ill-drained boggy soils. Although discussions were centered to nitrogen application in this meeting because of its higher efficiency in rice production I hope in the near future this symposium will pick up the phosphorus problem and phosphate fertilizers. There may be some items such as difference between indica and japonica in their suscesptibility to phosphorus in connection with the different breeding bases, besides method of fertilization.

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