RICE IN NEW ZEALAND

J.C. GERLACH AND T.F. SOUTHON
FIELD RESEARCH SECTION, RESEARCH DIVISION,
NEW ZEALAND DEPARTMENT OF AGRICULTURE

SUMMARY

Research work started in 1958 with rice varieties introduced from a number of countries led to the establishment of commercial plantations in the Bay of Plenty in 1965 using the short-grain Japanese variety Shin setsu. Pure line selection produced a cultivar, Te Puke Gold, of improved qualities adapted to this region. In Northland some early Italian long-grain varieties may be successful, while trials conducted at the Winchmore Irrigation Research Station showed that the night temperatures on the Canterbury Plains are too low for rice.

INTRODUCTION

Rice (Oryza sativa L.) is one of the oldest food crops and at present it is the staple food of more than half of the world population. More than a hundred countries grow rice, and a total of 307 million tons was produced from 135 million ha. in 1970.

Although rice originated in the tropics of South Asia highest yields are now obtained in temperate countries with a warm summer and where cultivation methods are superior. Average yields for 1970 were Australia - 6,220 kg/ha; Japan - 5,640 kg/ha and the U.S.A. 5,120 kg/ha. Lately new high yielding and disease resistant varieties developed at the International Rice Research Station in the Phillipines have improved yields considerably in several tropical countries. Most rice crops are grown as "wet-land rice", that is, in flooded fields divided into levelled bays bordered by narrow stopbanks or levees. "Dry-land rice" grown without irrigation usually yields less than paddy rice and is more liable to failure.

In New Zealand imports of rice and rice products follow an upward trend, averaging in the past five years some 3,775 metric tons per year at a value of $660,000 with a maximum of 4,900 metric tons valued at $876,000.

RESEARCH

General

In research work started in 1958 by the Tropical Section at the Rukuhia Soil Research Station the following basic problems were considered:-

1. Which group of the more than 12,000 registered rice varieties would have the best chance under our conditions?

2. How could the rice crop be fitted into the existing farming system and what cultural techniques should be applied?

After initial research at the Rukuhia Station had shown some promising results in cage trials, the four best varieties were tested on a larger scale in the Kaituna Valley near Te Puke on a peaty loam. In 1963 a small cage trial was also established near Waiharara in the Kaitaia district. The results from these trials were satisfactory and were described in detail by Gerlach and Weeda (1965).

Based on these favourable trial results a company, Rice Growers of New Zealand Ltd, was formed in 1965 and started operations with a commercial planting of 5 ha. Techniques and results of the commercial plantations have been described by Southon (1967).

In a trial with 28 varieties laid down on the shore of Lake Waikere near Te Kauwhata in 1968 results showed that the climate in this area would allow early long-grain varieties to ripen.

In 1967 rice research in Northland was started again under the supervision of Mr G. Gould, Field Research Section, Research Division, New Zealand Department of Agriculture, Whangarei with long and short-grain varieties.

Trials with the earliest and most cold tolerant rice varieties were conducted at the Winchmore Irrigation Research Station in the South Island. Despite several measures employed to obtain the most favourable growth conditions for the crop, e.g., a warming bay for the water, soaking and pre-germinating the seed, etc., it appeared that low temperatures of soil and water during the night prevented normal development of the rice plant and none of the varieties produced grain. After two attempts the work was discontinued after 1970.

Dry-land rice lacks the advantage of weed drowning and weedicide trials were important with this crop. So far weed control by use of weedicides has not been fully satisfactory.

Varieties

Of the two types, Indica (originating from India, China and Java) and Japonica (from Japan) it was decided to try first early to medium late varieties of the Japonica type which are more tolerant to low temperatures. In later trials with early varieties of the Indica type from Fiji, Malaya, Taiwan and Cambodia produced grain.

The first varieties received from New South Wales, Australia were tested in a small scale trial at the Rukuhia Research Station as wet-land rice. Only one, the Hungarian No. 1, a vigorous medium long-grain variety proved to be early enough for Waikato conditions.

In the following year with assistance from the Food and Agriculture Organisation and the International Rice Commission a number of long and short-grain varieties were obtained from respectively the Rice Research Station at Vercelli, Italy and the Sapporo Rice Research Station, Hokkaido, Japan, for testing. This brought the total number of tested varieties to about 40 in 1963. Several of these varieties showed some promise in the trial at Rukuhia producing yields of 2500 to 3100 kg/ha. Further introductions from the same three sources and later from France, the U.S.A. and the International Rice Research Institute in the Philippines swelled the total number of varieties tested to well over one hundred. The varieties received from the I.R.R.I. included several newly developed cultivars, and also nine cultivars suitable for dry-land rice. The results will be discussed later.

Cultural Practices

Levelling and bonding of the bays followed by fertilising and seed bed preparation has been done on dry land. The seed has been drilled in the period mid-October to early November when the soil temperatures and moisture are usually adequate in the Te Puke area for germination and first growth. Flooding followed when the rice seedlings were 5-10 cm. high after application of the weedicide Propanil. Inundation helped to drown the weeds, and as necessary the water level was raised for this purpose to a depth of 15-20 cm. following the growth of the rice plants. In the commercial plantations near Te Puke the water has been led through a shallow warming bay before it enters the rice bays. On sunny days this has produced an increase in water temperature of up to 6°C.

A water flow of about 1.3 litres/second per ha. maintains a gentle continuous flow of water 5-10 cm. deep over all the bays till February. This improves the availability of nutrients, the supply of oxygen to the plants, reduces weed growth and provides for a more equable micro-climate around the plants. The

water is drained after the grain has filled, and the crop is usually ripe and ready for harvest with a rice header harvester by mid-March to early April.

Rice should be harvested at 20-25 per cent moisture content and dried slowly to 13-14 per cent before milling. If dried too quickly or left in the field below 18 per cent, stress cracking of the grain may occur producing more broken grains during processing.

When soil conditions are too wet for drilling, the seed can be sown by air on to shallowly inundated fields, using pre-germinated seed, soaked for 24 hours in water of 37-43°C., drained and kept under cover for a further 24 hours. Aerial sown seeds which penetrate only shallowly in the mud are, in the first week, easily torn from their anchorage by windy weather and drift away. Also they are more easily pulled out by ducks than drilled seed. Drilling usually produces a stand of sturdier plants.

Weed Control

If the moist seed bed is well rolled after sowing, the two main weeds in the Te Puke area, barnyard grass (Echinochloa crus - galli) and willow weed (Polygonum persicaria), emerge before the rice. Paraquat 0.28 - 0.43 kg. a.i./ha applied just before the rice seedlings emerge will remove these weeds and give the rice a clean start. A further treatment with Propanil 3.3 - 5.6 kg a.i./ha may be required at the seedling stage just prior to flooding to remove further seedling establishment of barnyard grass and other weeds. In wet areas where the soft jointed rush (Juncus acuminatus) is a problem MCPA 0.8 - 1.1 kg a.i./ha is effective at the 4-5 leaf stage.

Seed Improvement Programme

Following degeneration of the commercial variety Shin setsu which lead to lower yields, a seed purification programme was started in 1967 by application of a mass selection technique to produce a number of improved pure lines. Selection within the variety Shin setsu has produced a cultivar, now called Te Puke Gold, which shows improvement in early vigour, seed size, yield and grain quality. The 1000 grains weight increased by 5 per cent to 30.95 g and the new selection threshes more easily yielding 7150kg/ha in 1970 compared with the usual yield of 5000 kg/ha of Shin setsu.

Trial Results

In the Bay of Plenty a range up to 15 - 20 varieties were tested every season in the vicinity of Te Puke and Papamoa. Almost without exception the short grain Japanese varieties proved the most reliable producers confirming that the potential yield of that type in this area, when sown on properly drained land, is around the 5000 kg/ha paddy rice. A few early long-grain varieties ripen here in favourable seasons, but otherwise

fail to produce high yield of grain. The only exception is the medium long-grain variety Hungarian No. 1 which has given yields up to 7000 kg/ha, but this variety sheds its grain too easily to be of commercial use. Attempts are now being made to select lines having better seed retention.

As can be seen from trial results over the past two years given in the Appendix a number of other short-grain varieties including Oirase, Fuku yuki, Sasa ho nami and Eiko have given very high grain yields of over 10,000 kg/ha occasionally, but to date the Shin setsu proved to be the best all round variety for this area.

Research is continuing in the Kaitaia district where the Italian varieties Allorio, Azibarotto, Maratelli showed some promise last season. Trials near Dargaville have given variable results dependent on seasonal conditions. Other areas worthy of further work are the Whakatane district, the northern half of the Waikato and the Auckland area.

Other experiments conducted in the Bay of Plenty included fertiliser trials, comparison of seeding rates and grain quality.

Fertiliser Trials

The Pongakawa peaty loam in the rice area near Te Puke has a pH of 5. - 5.4, Ca 3-5, K 3-5 and P 1-2. Lime applied at 1100 - 2200 kg/ha gave only slight, non-significant responses. There was a good response to phosphate applied as superphosphate 250 kg/ha, while an additional quantity 250 kg gave a much smaller yield increase. Nitrogen which according to Grist (1955), Matsui (1961), Adair (1966), Anon. (1966), Anon. (1967) and Southon (1967) the main fertiliser used on rice has given no response and produced a depression in unfavourable seasons. Foliar analyses in one of the trials where three rates of nitrogen were applied showed that the existing level of nitrogen was high at 4 per cent of the dry matter or more, so that no response could be expected (see Appendix).

No response was obtained from potash or magnesium.

Seeding Rate

In a rates of seeding trial in which seed 90 - 180 kg/ha was sown a clear indication was found that the rate usually applied of 110-130 kg/ha was most suitable for the area.

Quality Considerations

Samples of milled rice of different varieties including the commercial Shin setsu (Te Puke Gold) were sent for testing to rice merchants and also to the International Rice Research Institute. The comments received on the appearance and cooking quality of the commercial variety were favourable. This was confirmed by the ready acceptance by the New Zealand public of both polished and unpolished (brown) rice.

CONCLUSIONS

1. There is no doubt that rice can be grown profitably in New Zealand as wet-land rice.

2. Short grain varieties have proved to be highest yielding at Te Puke while long-grain varieties showed some promise in Northland. South Island areas have so far proved unsuitable for rice.

3. Since the bulk of the demand is for long grain rice research work on these varieties in the warmer parts of New Zealand should be continued.

4. The promising seed selection programme should be continued.

5. The production of dry-land rice, though lower in yield, but easier to produce seems worth investigating.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the co-operation received from Mr G. Goold, Field Research Officer, Whangarei and his staff, Messrs L.J. Matthews and B. Burney of the Weed Section, and Messrs E. Vercoe of Te Puke and W. Thomas of Papamoa for makingpart of their farm available for trial work.

REFERENCES

Adair, C.R. (1966) - Rice in the United States : Varieties and Production. U.S.D.A. Agricultural Handbook No. 289.

Anon. (1966) Agriculture Asia - Development of Paddy Rice Culture Techniques in Japan. Association of Agricultural Relation in Asia. Publ. No. 4.

Anon. (1967) - F.A.O. Symposium on Problems in developmen and ripening of Rice Grain, held at 11th Pacific Science Cong. (1966). Special issue of the Internati Rice Commission Newsletter.

Anon. (1966) International Rice Research Institute (1966) - The Mineral Nutrition of the Rice Plant. Proc. of Symposium at the I.R.R.I.

F.A.O. - Production Year Book 1969.

Gerlach, J.C. and Weeda, W.C. (1965) - Rice can be grown in New Zealand. N.Z. J. Agric. 110, 293.

Gerlach, J.C. and Southon, T.F. (1970) - Pure line rice selection. N.Z. J. Agric. 121, 64.

Grist, D.H. (1955) - Rice

Matsui, Takane (1961) - Rice culture in Japan.

Southon, T.F. (1967) - Five hundred acres set aside for Rice. N.Z. J. Agric. 114, 41.

APPENDIX

TRIAL RESULTS WITH RICE

Variety Trials:

Te Puke 1968/69

Variety	Yield kg/ha dry dressed paddy rice	
	Canaan Block	Company Block
Shiro Yuki	1659	4417
Fuku Yuki	2914	6390
Sasa ho nami	1423	very poor
Hiroi	2107	-
Norin 34	594	-
Oirase	-	5650
Shin setsu	not harvested	6838

Te Puke 1969/70

Variety	Yield kg/ha dry dressed paddy rice	
	Canaan Block	Company Block
Shin setsu	9675	8813
Oirase	7567	7646
Sasa ho nami	11278	5301
Hiroi	9104	-
Eiko	7983	9777
Shiro yuki	5942	7646
*Hungarian No. 1	5639	11323
Fuku yuki	10539	7511
Shio Kari	8196	7825
* Ital Patna	late	-
*Arborio	late	-
Norin 34	-	7746
Norin 20	-	10965
F. Roncarollo	no germination	-

*Long grain varieties.

TE PUKE 1968/69

Foliar analysis of rice crop fertilised before sowing with 0, 188 kg and 376 kg/ha sulphate of ammonia and 0, 251 kg and 502 kg/ha superphosphate.

	N	P	Mg	Ca	Na	K
						23.1.69
P_0N_0	4.20	.151	.07	.30	.08	1.98
P_0N_{188}	4.70	.208	.08	.30	.10	2.15
P_0N_{376}	4.65	.180	.10	.15	.10	2.23
$P_{251}N_0$	4.20	.239	.11	.15	.09	2.18
$P_{251}N_{188}$	4.15	.252	.11	.16	.08	2.15
$P_{251}N_{376}$	4.00	.260	.10	.19	.09	2.43
$P_{502}N_0$	4.32	.263	.10	.20	.08	2.20
$P_{502}N_{188}$	4.13	.295	.10	.17	.08	2.08
$P_{502}N_{376}$	4.00	.236	.06	.30	.12	2.48
						18.3.69
P_0N_0	5.18	.157	.09	.77	.01	1.95
$P_{502}N_0$	4.30	.221	.09	.94	.02	1.81
$P_{502}N_{188}$	4.60	.236	.08	1.00	.05	1.84
$P_{502}N_{376}$	4.76	.224	.09	1.00	.05	1.84
$P_{251}N_{376}$	4.76	.220	.08	1.02	.04	1.90
P_0N_{376}	5.40	.179	.09	.80	.04	2.05