Varietal and fertilizer investigations with short-aged (3 & 3½ months) rice in cultivators' fields in the Irranavillu Coastal Drainage and Reclamation Scheme — results of yala 1973 and yala 1974

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SUMMARY

The Irranavillu Drainage and Reclamation Scheme is situated in the Semi-Wet Intermediate Zone. It is designed to increase rice production by improving the drainage, reducing flood risk , minimizing salt water injury, reclaiming abandoned land and introducing double rice cropping where traditionally a single long-aged crop was grown.

The varietal investigations carried out in *Yala* 1973 and *Yala* 1974 showed that the improved short/intermediate statured, short-aged varieties recommended by the Department of Agriculture were superior to the village variety *Kalu Heenati*. With Bg 34-8, Bg 94-1 and Bg 34-6 the potential for achieving the target yield for the elevations +1′—+2′ MSL and +2′—+3′ MSL was revealed. Successful *Yala* Cropping is possible provided adequate, irrigation water is available.

A fertilizer invtigation, on Gleyic Alluvial Soil, with the improved short aged variety Bg 34-8 showed a highly significant yield response with the use of the fertilizer recommendation of the Department of Agriculture over the unfertilized control. Furthermore highly significant yield increases were obtained over the departmental recommendation by increasing the nitrogen applied at planting from 4.5 lb. to 10 lb. N/ac and fertilizer phosphorus from 29 lb. P_2O_5/ac as rock hosphate to 47 lb. P_2O_5/ ac/as concentrated superphosphate.

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On soils which were strongly acidic (pH 4.5) and low in available phosphorus, rice plants showed a yellowish—orange discolouration of varying intensity. This condition appeared to be phosphorus deficiency combined with iron toxicity.

INTRODUCTION

The Irranavillu Drainage and Reclamation Scheme is situated at Madampe approximately 8 miles South of Chilaw (West coast), in the Semi-wet Intermediate Zone (Low country). The scheme covers an extent of approximately 1,800 acres of frequently flooded, poorly drained, lowlying lands ranging in elevation from below Mean Sea Level (MSL) to +5′ above MSL. Of this extent 1,000 acres are between +1′—+5′ MSL, 650 acres between +1′—0 MSL and 150 acres below mean sea level. Lands below +1.5′ MSL are subject to coastal salinity injury during dry weather. Rice is extensively cultivated in the area but yields are low, risk of crop damage due to flooding is high and considerable extents of land are abandoned, particularly below +1′ MSL. In this area only a single rice crop is planted in the period mid July to end of August. Tall, lodging suceptible village varieties are extensively cultivated. The most popular variety was the tall, photoperiod-sensitive, 5½ –6½ months village variety " *Mawee* ".

With the objective of increasing rice production in the area the Irrigation Department commenced construction work in 1967, in order to reduce the flood hazards, improve and control the drainage and minimize coastal salinity injury to the rice crop. Subsequently, in 1970, this scheme was included as one of the six non-contiguous and independent Coastal Drainage and Reclamation Schemes in the International Development Agency (World Bank) assisted *Southern and Western Sectors Drainage and Reclamation Project* (Drainage Project I). Under this project a further means of increasing rice production was the introduction of double rice cropping on lands above +1′ MSL. This project does not take responsibility for increasing rice production on lands below +1′ MSL, mainly due to the high flood risk. The construction work is expected to be completed in 1976.

GENERAL PROBLEMS OF RICE CULTIVATION IN THE IRRANAVILLU SCHEME

The Lunu Oya traverses the scheme and carries the drainage water from the rice fields and the discharge from the Kadupitiya Oya and the Old Dutch Canal. The sea outfall of the Lunu Oya is at the Chilaw lagoon and it has in addition, within the scheme area, a flood outfall at Thoduwawe (Madampe). During periods of low water discharge in the Lunu Oya the flood outfall is blocked by a sandbar. Consequently, during periods of heavy rainfall the discharge from the Lunu Oya heads up behind the sandbar at Thoduwawe causing flooding of the lowlying rice fields. Depending on the height of the sandbar, flooding of the lowlying rice fields occurs up to an elevation of +3′—+4 MSL. In this "Lagoon-type" flood system the height of the flood water in the rice fields depends on the height of the sandbar and the elevation of the fields, while the duration of flooding is largely governed by the time taken for the water in the lagoon to rise sufficiently to breach the sandbar.

Durng periods of low water discharge in the Lunu Oya tidal movements at the sea outfall (Chilaw lagoon) results in saline water intrusions into lowlying rice fields, particularly below +1′ MSL. Even at the elevation +1′—+2′ MSL salnity can cause considerable damage, particularly during dry weather, to the rise crop at the seedling stage.

During drought periods, owing to inadequate irrigation water, farmers are often compelled to use for irrigation purposes the water in field channels which frequently has a high saline content. This is a hazardous undertaking when carried out on a 3-4 week old broadcast crop as serious damage could result when the salt content in the water is excessively high.

The cumulative effects of the production constraints have been unstable yields with wide yield fluctuations between years, low usage of fertilizers pesticides and weedicides and average yields of 15–20 bu/ac below +2′ MSL and 30–35 bu/ac above +2′ MSL.

The Mahawewa, Thinipitiyawewa and the Kudawewa, with rated capacities of 1,250 acre feet, 500 acre feet and 64 acre feet respectively, are the tanks (reservoirs) which provide irrigation water to this area. The Thinipitiyawewa is fed from an anicut on the Kadupitiya Oya but in *Yala*, owing to the low water level in the stream, replenishment is uncertain. Furthermore, owing to the very considerable siltation of these tanks the present irrigation capacities are well below the rated capacities. For a *Yala* crop the water requirement in this area for tank irrigation is approximately 4 acre feet/acre at the sluice. Therefore, even at the full rated capacities of the tanks, the irrigable extent in *Yala* is approximately 450 acres out of a total extent of 1,000 acres between +1′MSL and +5′MSL. In *Yala* 1973, 80 acres were cultivated while in *Yala* 1974 the acreage shrank to 12 acres owing to inadequate water and a delay in harvesting the previous *maha* 1973/74 crop.

In this area, traditionally, the sowing of a long aged, photoperiod-sensitive rice variety commenced from mid July and extended up to the end of August. The crop was planted and sustained with rainfall within the area supplemented with irrigation water from the three small local reservoirs. However since *yala* 1973 considerable dislocation has occured in the traditional cultivation of long aged varieties in the high flood risk areas below +1′MSL. This is due to the introduction of double rice cropping and consequent reserving of available irrigation water for the *Yala* crop.

BENEFITS FROM THE DRAINAGE AND RECLAMATION PROJECT

The construction work at Irranavillu is designed to improve the drainage, reduce flood hazards—mainly above +2'MSL, minimize salt water injury to the rice crop and reclaim abandoned land for rice cultivation. In addition, double rice cropping is to be introduced to lands above +1'MSL. (Oudshoorn and De Glopper, 1969.). These objectives are to be achieved by the following methods :—

(i) Construction of two groynes at the Lunu Oya flood outfall at Thoduwawe, in order to prevent the formation of the sandbar. This outlet would also shorten the drainage path, thereby reducing the flood risk.

(ii) Effecting improvements to the internal drainage of the fields by reconditioning and extending the channel system.

(iii) Construction of flood regulators.

(iv) Construction of salt water exclusion bunds and regulators.

The flood control and salt water exclusion regulators will also help to regulate the ground water level and prevent over drainage.

The expected benefits and increased yields, weighted for flood damage, are as follows (refer Appendix 1A & 1B) :—

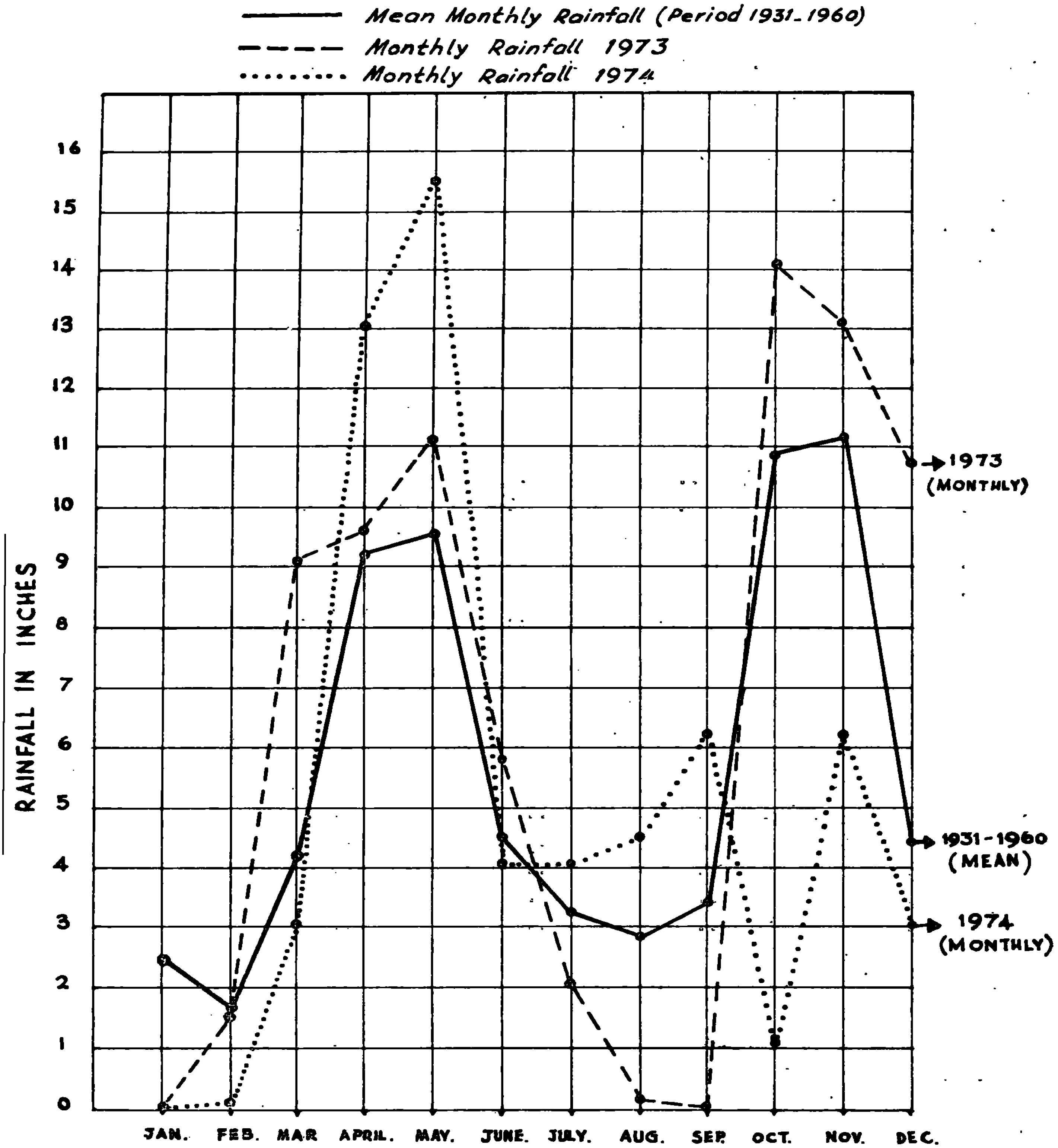
(*a*) +1'—+2'MSL — Double cropping. Risk of flood damage remains unchanged. (i.e. 4 of 10). Yield per acre, per year increased from 18 bu/ac. to 42 bu./ac. (i.e. 120% increase).

(*b*) +2'—+ 3'MSL — Double cropping. Risk of flood damage reduced to 1 in 20. Yield per acre, per year, increased from 42 bu./ac. to 152 bu.→ac. (i.e. 261% increase).

(*c*) Above +3'MSL — Double cropping. Risk of flood damage reduced to 1 in 20. Yield per acre per year, increased from 72 bu./ac. to 152 bu./ac. (i.e. 111% increase).

CLIMATE

The scheme is located in the Semi-Wet Intermediate Zone (Low country) and receives an annual rainfall of 60"–80". There are two distinct high rainfall periods, in the months of April and May (*Yala* season) and from October to December (*Maha* season) and the rest of the months have conspicuously lower rainfall (Fig. 1). During the peak rainfall periods flooding of the lowlying lands is a common occurance. Droughts frequently occur in the period August–September, when the *Maha* crop is in the seedling or early vegetative stage, and irrigation water is required to ensure the survival of the crop. The dry weather in January–February provides favourable conditions for ripening and harvesting of the *Maha* crop. Flooding in the period April–June and low rainfall in the period July–August were unfavourable for a *Yala* crop. Therefore, traditionally a *Yala* crop was not planted in the area.



A photoperiod-sensitive 5½–6½ months village variety was sown with supplementary irrigation, in July for the *Maha* season. This was to ensure, prior to flooding, an undisturbed and well established plant population and that plants attain a sufficient height before the uncontrolable rise in the water level in fields. Heading occurs at the end of December, ripening and harvesting coincides with dry weather in January–February.

With the prevailing rainfall pattern purely rainfed rice cultivation carried a substantially high risk. For stable double cropping, or even single cropping, adequate supplimentary irrgation is required.

SOILS AND CROPPING PATTERN

According to De Alwis and Panabokke (1972) these soils occupy Map Unit No. 14. Dimantha (1971) mapped and classified the soils within the Irranavillu Scheme as low humic, Gleyic Alluvial soils derived from alluvium. Approximately 85% of the area is fine textured, Gleyic Alluvial soils, while the balance 15% is equally divided between medium and coarse texture.

Table 1

Soil Characteristics in Cultivators' Fields

		Range	*Mean*
1.	Organic matter %	1·9 – 6·3	4·5
2.	pH	4·5 – 5·1	4·5
3.	Conductivity (mill. mhos./cm., 1 : 5 Sol)	0·010 – 0·154	0·063
4.	Total Nitrogen %	0·09 – 0·24	0·21
5.	Available P_2O_5 lb./ac. (Olsen's)	00 – 60	23·5
6.	Exc. Potassium (me/100g. soil)	0·15 – 0·60	0·37

Table 2

Frequency Distribution of Available Phosphorus in Rice Soils of the Irranavillu Scheme

	Rating	*Available P_2O_2 (lb./ac.)*	*Percentage*
1.	Very High	>–60·0	Nil
2.	High	45·1–60·0	28
3.	Medium	30·1–45·0	11
4.	Low	5·0–30·0	28
5.	Very Low	<–5·0	33

In cultivated fields the soils were low in organic matter (4.5%), strongly acidic (pH 4.5) and had a low electrical conductivity (0.063 mill. mhos/cm.). Dimantha (1971) reported that these soils were low in available phosphorus and exchangable potassum. In fields where experiments were conducted exchangable potassium was high (0.37 m.e./100 gm., Average). Table 1 shows that the range of available phosphorus was zero to 60 lb. P_2O_5/ac., with an average of 23.5 lb. P_2O_5/ac. The frequency distribution of available phosphorus in Table 2 shows that in these rice soils available phosphorus was "Very Low" in 33% and "Low" in 28% of the sites (i.e. Less than 30 lb. P_2O_5/ac., in 61% of the sites). Available phosphorus was "High" in 28% of the sites, probably reflecting the use of phosphorus fertilizer by some farmers. Therefore, while the available phosphorus status of these soils have a considerably wide range of variation, the major part of the rice soils is low in available phosphorus.

Dimantha (1971) in his soil map of the Irranavillu Scheme has shown that approximately 85% of the scheme area is affected by salinity. However, Table 1 shows that electrical conductivity was low in soil samples taken prior to planting from cultivated fields, above mean sea level. The low conductivity could be due to heavy leaching of the salt during flooding. With the salt water exclusion measures envisaged, the salinity problem on land above †2′ MSL is likely to be insignificant, while between † 1′—† 2′ MSL it could be mild. However, on land below mean sea level, despite the preventive measures, salinity could be a problem in dry weather owing to salt water seepage through the coastal dune. The varying intensity of salinity in the different land elevations would have to be taken into consideration when making varietal and management recommendations.

The workability of the soil is good, sufficiently firm for the use of buffaloes, two wheel tractors and even small four wheel tractors. With the benefits from the Drainage and Reclamation Scheme and use of the right type of variety and improved management there are good prospects for increasing rice production on these soils.

FIELD EXPERIMENTATION IN CULTIVATORS' FIELDS

At the end of 1972, although construction work in the scheme was not complete, the Irrigation Department felt that sufficient improvements had been made to the Mahawelyaya and Uliyanpangu tracts to justify an intensification of efforts by the Department of Agriculture to increase rice production. In 1973 the Field Trials Division of the Department of Agriculture established a Field Experiments Unit at Irranavillu for carrying out investigations on rice in cultivators' fields.

In *Yala* 1973, for the first time in this scheme, a *Yala* crop was planted using village varieties and improved short aged varieties. (i.e. 3 & 3½ Months). Cultivation was done in the Mahawelyaya and Uliyanpangu tracts and covered an extent of approximately 80 acres. Irrigation water was provided from the Tinipitwewa. Experimental sites were to be located above +1′ MSL, but owing to difficulties in obtaining land, selection of suitable cultivators and in determining field elevations, several sites were planted below +1′MSL. Since farmers expected flooding in the period mid April—mid May, sowing of fields and experiments commenced from the end of May. However, this season flooding occured in the first week of June causing damage, by way of disturbed plant stand, to some experimental sites. The damaged sites were mainly below +1′ MSL. (Ref. Fig. 1 and Tables 7 & 8).

In *Yala* 1974 the acreage cultivated was only 12 acres. This was due to late harvesting of the previous *Maha* 1973/74 crop, insufficient irrigation water and a substantial degree of disagreement among double cropping and single cropping farmers regarding irrigation water supplies in the period late *Yala*/ early *Maha*. Planting of short aged varieties commenced in late June. This decision being partly influenced by the experience from the previous *Yala* 1973 season when flooding occured in early June. Further, unlike in the previous season, there was adequate water owing to the restricted acreage planted and favourable rainfall in the period June to September (Fig. 1). Consequently, in *Yala* 1974 yields were higher than in *Yala* 1973.

(I) VARIETAL INVESTIGATIONS

Materials and methods

With the objective of selecting varieties for *Yala* cultivation improved varieties of 3 & 3½ Months duration were tested using the short aged village variety *Kalu Heenati* as the control. The experiments were conducted at the recommended fertilizer level of 56 lb. N/ac. as Urea, 29 lb. P_2O_5/ac. as Rock Phosphate and 38 lb. K_2O/ac. as Muriate of Potash.

In *Yala* 1973 the experimental sites were in Mahawelyaya and Uliyanpangu tracts while in *Yala* 1974 they were confined to the reclaimed areas of the Mahawelyaya tract. The soils were fine textured, low humic, Gleyic Alluvial soils.

A complete randomized block design was used. Each site was taken as a replicate for the purpose of statistical analysis of the yield data. The gross plot size was 16½′×26¼′ (i.e. 433 sq. ft.)—approximately 1/100 acre. Each plot was surrounded by a perimeter bund and had a separate irrigation water inlet and outlet. All plots were broadcast sown using sprouted seed, as this is the usual method of crop establishment in the area. The seed rate was the standard 2 bushels per acre. The nett harvested area of each plot, after eliminating a 12 inch border, was 14½′×24¼′ (i.e. 352 sq. ft.). Management practices were those recommended by the Department of Agriculture for weed, pest and water control.

In 1973 and 1974 farmers commenced *Yala* season planting at the end of May and late June respectively, the experiments too were planted at the same time. The yield data are given in Tables 3 & 4

Table 3

Varietal Investigation—Yala 1973 (Yield in Bu./ac.)

Age Group	Variety	Elevations <+1′MSL	†1′–+2′MSL
3 Months	Bg 34–8	75·0	71·3
,,	Bg 33–2	60·0	57·5
,,	62–355	65·0	57·5
,,	"*Kalu Heenati*"	55·0	40·0
3½ Months	Bg 34–6	55·0	60·0
,,	A9–48	40·0	41·3
L. S. D. 5%		—	6·9*
L. S. D. 1%		—	9·7*
L. S. D. 5%		—	7·7†
L. S. D. 1%		—	10·7†
C. V.		—	8·5%
No. of Sites		1	4
Flood damage		3	1

N.B.—*For comparing treatment means other than *Kalu Heenati*.

† For comparing *Kalu Heenati* with other varieties.

Table 4

Varietal Investigation—Yala 1974 (Yield in Bu./ac)

Age Group	Variety	Elevation +2′—+3′MSL
3 Months	Bg 34–8	96·7
,,	Bg 33–2	90·0
,,	62–355	86·5
	"*Kalu Heenati*"	75
3½ Months	Bg 94–1	111·5
,,	Bg 34–6	106·5
,,	A 16–14	91·5
L. S. D. 5%		15·0
L. S. D. 1%		20·8
C. V.		8·8%
No. of Sites		4
Flood Damage		Nil

Note.—No. flood damage in Yala 1974.

RESULTS AND DISCUSSION

The results of the varietal investigations are as follows :—

(i) All recommended improved varieties significantly outyielded the traditional village variety *Kalu Heenati*, an exception being the 3½ months variety A9-48. The latter vairety being longer in duration than *Kalu Heenati* was adversely affected by water stress in Yala 1973.

(ii) Among the 3 months varieties, Bg 34-8 was consistantly superior in yield to Bg 33-2 and 62-355.

(iii) In *Yala* 1973, 3½ months varieties were significantly outyielded (1%) by the 3 months variety Bg 34-8. This appears to have been largely due to water stress at the tail end of the season which effected the yields of the 3½ months varieties more than that of 3 months varieties. However, in *Yala* 1974, when water was not a limiting factor the new improved 3½ months varieties Bg 94-1, and Bg 34-6 gave the highest yields and outyielded Bg 34-8, although the yield differences were not statistically significant. When *Yala* planting is done in June, a 3 months variety would probably be more appropriate as a safeguard against tail end water stress often experienced by 3½ months varieties.

(iv) Despite the higher yield potential of the short/medium statured, improved plant type varieties eg. Bg 34-8, several farmers continue to grow the taller, lodging susceptible, traditional plant type varieties eg. 62-355, and *Kalu Heenati*. The main reason for this appears to be that the tall stature and drooping leaves of the older varieties ensure better weed competitive ability than the short/medium stature, erect leaves and compact tillering of improved varieties. Another significant reason is that both 62-355 and *Kalu Heenati* have grain with a red pericarp colour which appears to be prefered by farmers in th area over grain with white pericarp colour.

62-353 and *Kalu Heenati* both had the ability to elongate faster at the early seedling stage than the improved varieties. This reduced the flood risk and also increased the ability to compete with weeds such as the sedges eg. *Fimbristylis miliacea* Vahl, *Cyperus iria* L., *Cyperus haspen* L.

(v) All varieties of improved plant type had better lodging resistance than the taller varieties 62-355 and *Kalu Heenati*. The short/medium statured Bg 34-8, Bg 33-2, Bg 94-1 and even the taller Bg 34-6 were all non-lodging. A 16-14 had moderate lodging resistance and grain with red pericarp colour.

(vi) Typical "Bronzing" symptoms, where the older leaves turn purplish-brown or reddish-brown in colour from the leaf tip downwards, were rare even on a "Bronzing" susceptible variety like Bg 34-8. Nevertheless, a condition often observed was an abnormal pale orange discolouration of leaves, which in some instances was followed by rolling and drying of the leaf tips. These symptoms appeared 4-5 weeks after sowing and at some sites persisted up to harvest. All varities showed these symptoms to varying degrees. On the improved varities, however, the intensity was more than on the village variety *Kalu Heenati*. The cause of this condition is not yet clearly identified. With the low pH and a scum of iron compounds observed in standing water, the symptoms could be that of "Yellow Bronzing" (Ota and Yamada, 1962), or considering the low available phosphorus status of the soils, these symptoms could be due to phosphorus deficiency where the typical bluish-green colour of the leaves is diluted by a yellowish colouration owing to associated nitrogen deficiency (IRRI Rep. Vol. 6, No. 5). However, these symptoms were very probably phosphours deficiency combined with iron toxicity.

(vii) The target yield for the elevation +1′ – +2′MSL (ie. 35 bu/ac) was exceeded with the improved varieties Bg 34-8 and Bg 34-6 by 100% and 70% respectively. (Table 5). Similarly, the target for +2′ – +3′ MSL (ie. 80 bu/ac) was exceeded by 94-1, Bg 34-6 and Bg 34-8 by40%, 33% and 21% respectively. (Table 5).

(viii) In *Yala* 1973, despite tail end water stress and adjusting the yield for crop failure, the estimated yield per acre per season at +1′ – +2′MSL was 57 bu/ac. and 48 bu/ac. with Bg 34–8 and Bg 34–6 respectively, while the project target for this elevation was 21 bu./ac. per season. With *Kalu Heenati* the adjusted yield was 32 bu./ac. (Table 5).

In *Yala* 1974, with no water stress or flooding, the yield per acre per season at the elevation +2′—+3′ MSL was 111·5 bu./ac., 106·5 bu./ac. and 96·7 bu./ac. for Bg 94–1, Bg 34–6 and Bg 34–8 respectively and with *Kalu Heenati* 75 bu./ac. which was less than the project target per acre yield of 80 bu./ac. for this elevation.

These data indicate the higher potential of the new improved varieties for increasing rice production when compared with the village variety *Kalu Heenati*.

(ix) The varietal investigations suggested a strong possiblity of double cropping in tracts traditionally confined to a single crop. In *Yala*, with adequate fertilizer, good management and irrigation, the possibility of achieving the project target yields estimated for the land elevations +1′—+2′ MSL and +2′—+3′ MLS with improved 3 and 3½ months varieties was revealed.

(x) The Irranavillu Scheme and other areas with similar production constraints require for elevations above +2′ MSL varieties with adequate tolerance to low available soil phosphorous, iron toxicity, flooding. poor drainage conditions and drought. Varieties grown below +2′ MSL should, in addition, combine tolerance to salinity. A high weed competitive ability is an important attribute for these largely rainfed, high risk areas.

Table 5

Estimated Production Potential in Yala 1973 and Yala 1974

Season	*Land Elevation*	*Variety*	*Yield (bu./ac.)*		*Crop Failure*	*Yield/ac.season (Adjusted for crop failure)*
			Target	*Actual*		
Yala '73 ..	+1′—+2′MSL ..	Bg 34–8* ..	35 bu. ..	*71.3*bu. ..	2 of 10 sites ..	71·3 × *0.8* = *57*bu
,, ,, ..	,, ..	Bg 34–6† ..	,, ..	*60.0*bu. ..	2 of 10 sites ..	60·0 × *0.8* = *48*bu.
,, ,, ..	,, ..	*Kalu Heenati** ..	,, ..	*40.0* bu. ..	2 of 10 sites ..	40·0 × *0.8* = *32*bu.
Yala '74 ..	+2′—+3′MSL ..	Bg 94–1† ..	80 bu. ..	*111·5* bu.	Nil ..	*111·5* bu.
,, ,, ..	,, ..	Bg 34–6† ..	,,	*106·5* bu. ..	Nil ..	*106·5* bu.
,, ,, ..	,, ..	Bg 34–8* ..	,, ..	*96·7* bu. ..	Nil ..	*96·7* bu.
,, ,, ..	,, ..	*Kalu Heenati**	,, ..	*75·0* bu. ..	Nil ..	*75·0* bu.

* = 3 Months variety.
† = 3½ Months variety.

(II) FERTILIZER INVESTIGATION—YALA 1973

Materials and methods

This investigation was carried out with the following objectives :—

(*a*) To evaluate and where necessary modify the Department of Agriculture fertilizer recommendation (1971) for short aged varieties in the Pitigal Korale North and South.

(*b*) Achieve the target yields for the different land elevations as set out in the project estimates (Appendix 1A & 1B).

(*c*) Obtain information on the nutritional requirements of rice specific to the local environment.

The trial sites were in reclaimed areas of the Mahawelyaya tract on low humic, fine textured, Gleyic Alluvial soils, subject to occasional sudden flooding. A complete randomized block design was used and for the purpose of statistical analysis each site was taken as a replicate. The test variety was the improved 3 months variety Bg 34–8. All sites were broadcast sown with sprouted seed at the standard seed rate of 2 bushels per acre. The gross plot size was $16\frac{1}{2}' \times 26\frac{1}{4}'$ (i.e. 433 sq. ft.). Each plot was surrounded by a perimeter bund and had a separate irrigation water inlet and outlet. After eliminating a 12 inch border around each plot, the nett area harvested for yield determination was $14\frac{1}{2}' \times 24\frac{1}{4}'$ (i.e. 352 sq. ft.). Management was according to the recommendations of the Department of Agriculture for improved varieties. Planting was done in June 1973 along with the rest of the tract.

Owing to difficulties in determining field elevations, 10 trial sites were planted below +1′ MSL and 2 sites between +1′—+2′ MSL. Of the former sites one was abandoned owing to uneven plant stand caused by flooding. The yield data from 9 sites below +1′ MSL are presented in Table 6 along with the data from two sites between +1′—+2′ MSL.

Table 6

Fertilizer Investigation with Bg 34-8—Yala 1973

	Weights of Nutrients (lb/ac)						Grain Yield (bu/ac)	
	Nutrient Content	At Planting	Top Dressings				Elevations	
Treatments	$N—P_2O_5—K_2O$	$N—P_2O_5—K_2O$	2 wks.	5 wks	6 wks.	7 wks.	<1′MSL	+1′—+2′ MSL
T_1—No. Fertilizer (Control)	00—00—00	— — —	—	—	—	—	45.5	47.5
T_2—*Fertilizer Recommendation of the Department of Agriculture (Higher Level)	56—29—38	4.5—29—21	13N	—	$38.5N+17_2K0$	—	66.9	62.9
T_3—Fertilizer Recommendation of the Department of Agriculture (Increased nitrogen at planting)	56—29—38	10—29—21	16N	—	$30N+17K_20$	—	85.4	75.0
T_4—Fertilizer Recommendation of the Department of Agriculture with increased phosphorus (Conc. Super phosphate)	56—47—38	4.5—47—21	13N	—	$38.5N+17K_20$	—	93.9	77.5
T_5—Increased NPK wih no nitrogen at planting	80—80—80	00—80—80	20N	40N	—	$20N+40K_20$	89.9	95.0
T_6—Increased NPK with nitrogen at planting	80—80—80	10—80—40	10N	20N	—	$40N+40K_20$	91.4	110.0
T_7 Treatment 4 with higher level of nitrogen	80—47—38	10—47—21	10N	20N	—	$40N+17K_20$	85.4	120.5
						L.S.D. 5%	10.8	—
						L.S.D. 1%	14.4	—
						C.V.	14.3%	—
						No. of Sites	9	2

N.B.—*Nitrogen as Urea
Phosphorus as Rock Phosphate
Potassium as Muriate of Potash

RESULTS AND DISCUSSION

The results of the investigation are as follows :—

(i) *Response to NPK Fertilizer.*—Below +1′ MSL all NPK fertilizer treatments gave a highly significant (1%) yield increase over the "No Fertilizer" Control. At the elevations +1′—+2′ MSL too a similar trend was observed (Table 6). Therefore these data show a highly beneficial effect of applying NPK fertilizer, in reclaimed areas, to the 3 months variety Bg 34-8 in the *Yala* season.

It was also observed that when unfertilized plots were subject to flooding soon after sowing the plant population was low and recovery of the seedlings poor when compared with the NPK fertilized plots. This tends to indicate that application of NPK fertilizer is beneficial for increasing resistance to flood damage by producing healthy, vigorous seedlings.

(ii) *Yield Response to the Department of Agriculture Fertilizer Recommendation.*—The yield response in reclaimed areas below +1′ MSL to the Department of Agriculture fertilizer recommendation (T_2) over the unfertilized control (T_1) was 21.4 bu./ac. and significant at the 1% level of probability. (i.e.,32% increase). At the elevation +1′—+2′ MSL too a very substantial increase of 15.4 bu./ac. was obtained with the use of the Departmental fertilizer recommendation (i.e., 24% increase) (Table 6). These data indicate the potential for increasing rice production in this area with the use of the Department of Agriculture fertilizer recommendation.

The yields obtained with treatments T_3, T_4, and T_6 (Table 6) show that by modifying the current Departmental fertilizer recommendation even a higher yield response to NPK fertilizer may be expected with Bg 34–8 in the *Yala* season.

(iii) *Yield Response to Increased Nitrogen at Planting.*—Thenabadu *et. al.* (1974) reported a highly significant response in the Irranavillu Scheme when the nitrogen applied at planting was increased from 4.5 lb. N/ac. to 10 lb. N/ac.with the improved, photoperiod-sensitive long aged variety Bg 3–5.

Comparison of treatments T_3 and T_2 (Table 6) shows that, below +1′ MSL, increasing the quantity of nitrogen applied at planting from 4.5 N/ac. as recommended by the Department of Agriculture to 10 lb. N/ac. along with increasing the nitrogen at 2 weeks after sowing, gave a highly significant (1%) yield increase over the current Departmental fertilizer recommendation. (i.e., increase of 18.5 bu./ac. or 22%). At the elevation +1′—+2′ MSL too, increasing the nitrogen at planting from 4.5 lb. N/ac. to 10 lb. N/ac. gave higher yields. These data indicate the beneficial effect of increasing the quantity of nitrogen applied in the early vegetative stage of the short aged variety Bg 34–8 when broadcast sown. Further, in these lowlying areas where flooding can occur soon after sowing, increasing the quantity of nitrogen applied at planting on short aged varieties can counteract setbacks likely to be caused by a delay in applying the first top dressing of nitrogen at 2 weeks after sowing.

(iv) *Response to Increased Phosphorus.*—The soil analysis from cultivators fields (Table 1 & 2) indicates that available soil phosphorous is low. The increase in yield of treatment T_4 over T_2 (Table 6) shows a highly significant (1%) yield response to increasing the level of phosphorous from 29 lb. P_2O_5/ac. as rock phosphate to 47 lb. P_2O_5/ac. as concentrated superphosphate (i.e. +27 bu./ac.) This indicated that the high tillering, improved plant type, short aged variety Bg 34–8 can benefit from a higher level of phosphorus than that currently recommended for this area.

Although treatment T_4 (47 lb. P_2O_5/ac.) significantly outyielded T_2 (29 lb. P_2O_5/ac.) it failed to be superior to T_3 (29 lb. P_2O_5/ac.) (Table 6). Both T_2 and T_3 had the same quantity of NPK nutrient (56–29–38), but in the case of T_3 an increased quantity of nitrogen was applied at planting and two weeks after planting and less at 6 weeks after planting. Therefore, it appears that the response to the higher level of phosphorus was related to the quantities of nitrogen applied at the different times. This suggests an interaction between the quantity of nitrogen applied at different times and the response to increased phosphorus, viz., with a higher early application of nitrogen a lower phosphorus fertilizer requirement.

(v) Below +1′ MSL both treatments T_5 and T_6 (80–80–80), although containing higher levels of NPK nutrients than T_3 (56–29–38) failed to give significantly higher yields over T_3. However, between +1′—+2′ MSL, both T_5 and T_6 gave very substantial yield increases over T_3. This tends to indicate a relationship between response to fertilizer and the elevation, which is probably dependent on drainage conditions.

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Table 7

FLOOD DAMAGE—Varietal Investigation—Yala 1973

Elevation	*No. of Sites Planted*	*No. of Sites Damaged*
>+1′ MSL	3	2
+1′—+2′ MSL	5	1

Table 8

FLOOD DAMAGE—Fertilizer Investigation—Yala 1963

Elevation	*No. of Sites Planted*	*No. of Sites Damaged*
>+1′ MSL	10	1
+1′—+2′ MSL	2	Nil

Appendix 1A

Yield Estimate Before the Project, in Bushels per Acre (Gleyic Alluvial Soil)

Land Elevations	*Cropping pattern (No. of crops)*	*Chance of crop failure*	*Yield per acre*	*Yield per acre per season (adjusted for crop failure)*	*Yield per acre, per year (adjusted for crop failure)*
+1′—+2′ MSL ..	Single ..	4 of 10 ..	30 Bu. ..	30×0·6=18 Bu. ..	18 Bu.
+2′—+3′ MSL ..	Double ..	4 of 10 ..	35 Bu. ..	35×0·6=21 Bu. ..	42 Bu.
above +3′ MSL ..	Double ..	1 of 10 ..	40 Bu. ..	40×0·9=36 Bu. ..	72 Bu.

Appendix 1B

Yield Estimate After the Project, in Bushels per Acre (Gleyic Alluvial Soil)

Land Elevations	*Cropping pattern (No. of crops)*	*Chance of crop failure*	*Yield per acre*	*Yield per acre per season (adjusted for crop failure)*	*Yield per acre, per year (adjusted for crop failure)*
+1′—+2′ MSL ..	Double ..	4 of 10 ..	35 Bu. ..	30×0·6=21 Bu. ..	42 Bu.
+2′—+3′ MSL ..	Double ..	1 of 20 ..	80 Bu. ..	80×0·95=76 Bu. ..	152 Bu.
above +3′ MSL ..	Double ..	1 of 20 ..	80 Bu. ..	80×0·95=76 Bu. ..	152 Bu.

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