Experiments with Granular-Compound-Fertilizers on Rice in the Wet-Zone of Ceylon

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INTRODUCTION

INORGANIC fertilizers may be classified as (i) "simple" or "straight" if they are individual products which contain one or more plant nutrients, and (ii) "compound" or "complex" if they are mechanically prepared mixtures which contain two or more plant nutrients.

Granular-compound-fertilizers have several advantages over straight fertilizers. Granulation or pelletization, which is a significant technological development in the fertilizer industry, improves the storage and handling qualities of fertilizer mixtures. Due to the high nutrient content of these fertilizers (in comparison to the straight fertilizers currently recommended for the wet-zone) there may be savings in the cost of transport, storage and labour. Granular fertilizers are usually non-hydroscopic and easy to apply and they enable the uniform and simultaneous application of balanced amounts of several plant nutrients.

The wet-zone of Ceylon which receives an annual rainfall between 100 to 200 inches has many factors that limit maximum rice production. Large tracts of rice fields in the wet-zone are ill-drained and boggy and present problems for fertilizer application in the usual manner. In these tracts solid granular fertilizers could conveniently be broadcast from the bunds if the individual fields (liyaddes) are not large. These fertilizers are especially suitable for boggy fields where they would sink in the soil and run no risk of being carried away by surface drainage. In other areas of the wet-zone water-soluble fertilizers tend to be leached out due to excessive rainfall and the relatively low cation exchange capacity of the soils. Losses due to leaching could be reduced if nutrients are released slowly throughout the season and granulation is claimed to be effective in retarding the rate of solubilization of fertilizers. Further there may be no need

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for split applications as with straight fertilizers if these granular fertilizers would " meter out " plant nutrients to satisfy crop demands throughout the period of growth.

This paper reports briefly the results and conclusions on the performance of granular-compound-fertilizers in the wet-zone of Ceylon. It includes the results of experiments of the first two seasons, Maha 1966/67 and Yala 1967, with two fertilizers (15—15—15— and 15—15—6—4, Sunfoska Grades A and B), which were presented earlier (3), and those of subsequent field investigations with other types of granular-compound-fertilizers.

EXPERIMENTAL

The components and composition of the granular-compound-fertilizers used were as follows :

Fertilizers	*Components*	*Composition*			
		N%	*P_2O_5%*	*K_2O%*	*MgO%*
1. Sunfoska A	$(NH_4)_2HPO_4$ .. $(NH_4)_2SO_4$ Urea KCl	15	15	15	—
2. Sunfoska B	$(NH_4)_2HPO_4$ .. $(NH_4)_2SO_4$ .. NH_4Cl KCl $Mg(OH)_2$ H_3PO_4	15	15	6	4
3. Ammonium Phosphate Type	$(NH_4)_2HPO_4$ .. Conc. Superphosphate KCl	5	15	15	—
4. I. B. Compound.	Isobutylidene diurea Urea Conc. Superphosphate Fused Magnesium phosphate KCl	10	10	10	1
5. Ammonium Chloride Type	NH_4Cl .. $(NH_4)_2HPO_4$ KCl	14	14	14	—

Field experiments were conducted at School Farms Karapincha and Wagolla, Government Farm Labuduwa, Rice Research Station, Bombuwela, and in cultivators' fields of the Ratnapura and Matara Districts and at Geli-oya.

(A). 15—15—15 ; N : P_2O_5 : (Sunfoska Grade A)

The fertilizer 15—15—15 ; N : P_2O_5 : K_2O (Sunfoska Grade A) was compared at the School Farm, Karapincha and in cultivators' field in the Ratnapura district with the equivalent quantities of nutrients supplied as straight fertilizers and with straight fertilizers according to recommendations of the Department of Agriculture (1) during Maha 1966/67. The treatments were as follows :

(1) No fertilizers.

(2) Straight fertilizers applied according to recommendations of Department of Agriculture.

(3) Granular-compound-fertilizer (15—15—15) at 300 lbs., per acre applied at planting.

(4) Straight fertilizers to supply 45 lbs. each of N, P_2O_5 and K_2O per acre applied at planting.

(5) Straight fertilizers to supply 45 lbs., each of N, P_2O_5 and K_2O per acre applied at times recommended by the Department of Agriculture.

(6) Granular-compound-fertilizer (15—15—15) at 300 lbs. per acre applied one week after planting or four weeks after sowing.

(7) Straight fertilizers to supply 45 lbs. each of N, P_2O_5 and K_2O per acre applied one week after planting or four weeks after sowing.

In the straight fertilizer treatments nitrogen, phosphorus and potassium were applied as urea, saphos-phosphate and muriate of potash (50 per cent. grade) respectively.

At Karapincha the experiment was a randomized block with 7 plots replicated 4 times. In the cultivators' fields randomized blocks of 7 plots were replicated at 7 locations ; viz., Galagama, Weligepola, Hunuwela, Panamure, Millawitiya, Kolonne and Muttettuwegama. The first three locations had ill-drained fields while the rest were relatively better drained. The variety of rice H—4 was row planted at Karapincha and in cultivators' fields except at Kolonne and Panamure where it was row sown.

(B) . 15—15—15 ; N : P_2O_5 : K_2O (Sunfoska Grade A) and 15—15—6—4 ; N : P_2O_5 : K_2O : MgO (Sunsoska Grade B)

The efficiencies of Sunfoska Grade A—15—15—15 ; N : P_2O_5 : K_2O and Sunfoska Grade B—15—15—6—4 ; N : P_2O_5 : K_2O : MgO were

evaluated and compared with straight fertilizers as recommended by the Department of Agriculture (1) at 7 locations in the Matara district and the Rice Research Station, Bombuwela, during Yala 1967 and at the School Farm, Labuduwa (Narawala) during Maha 1967-68. The treatments were as follows :

(1) No Fertilizers.

(2) Straight fertilizers applied according to recommendations of the Department of Agriculture.

(3) Granular-compound-fertilizer (15—15—15) at 300 lbs. per acre applied at planting.

(4) Granular-compound-fertilizer (15—15—15) at 300 lbs. per acre applied one week after planting or four weeks after sowing.

(5) Granular-compound-fertilizer (15—15—6—4) at 300 lbs. per acre applied at planting.

(6) Granular-compound-fertilizer (15—15—6—4) at 300 lbs. per acre applied one week after planting or four weeks after sowing.

At Bombuwela the experiment was a randomized block with 6 plots replicated 4 times. In the Matara district randomized blocks of 6 plots were replicated at 7 locations. At Labuduwa the 6 plots were replicated 3 times. The variety of rice H—4 was row planted at Bombuwela and Labuduwa and row sown at 6 locations in the Matara district and row planted at 1 location.

(C) OTHER COMPOUND FERTILIZERS

Three other types of granular-compound-fertilizers were tried during Maha 1967/68 to compare their efficiencies with the recommendations of the Department of Agriculture (using straight fertilizers) (1) and the two compound fertilizers 15—15—15 and 15—15—6—4 (Sunfoska Grades A and B). Randomized block experiments were laid down at School Farm Karapincha, Rice Research Station Bombuwela, School Farm Wagolla, and in a cultivator's field at Geli-Oya. The variety H—4 was planted at Karapincha, Bombuwela and Geli-Oya and Ptb—16 was planted at Wagolla. The treatments were as follows :

(1) Straight fertilizers applied according to recommendations of the Department of Agriculture.

(2) Granular-compound-fertilizer 15—15—15 (Sunfoska Grade A) at 300 lbs. per acre applied at planting.

(3) Granular-compound-fertilizer 15—15—6—4 (Sunfoska Grade B) at 300 lbs., per acre applied at planting.

(4) Granular-compound-fertilizer 5—15—15 at 300 lbs. per acre applied at planting and 30 lbs. nitrogen per acre as straight fertilizer (Urea) applied at pollen-mother-cell stage.

(5) Granular-compound-fertilizer 10—10—10 (I. B. Compound) at 450 lbs. per acre applied at planting.

(6) Granular-compound-fertilizer 14—14—14 (Ammonium Chloride Type) at 320 lbs. per acre applied at planting.

RESULTS AND DISCUSSION

(A). Performance of Granular-Compound-Fertilizer 15—15—15; N : P_2O_5 ; K_2O (Sunfoska Grade A)

The results of trials with granular-compound-fertilizer 15—15—15 N : P_2O_5 : K_2O and straight fertilizrs in the Ratnapura district during Maha 1966-67 together with some characteristics of the soils from the experimental locations are presented in table 1.

(i) *School Farm, Karapincha*

Plants in plots receiving granular-compound-fertilizers exhibited luxuriant growth from the beginning of the experiments in comparison to those receiving straight fertilizers. This may most probably be due to differences in the constituents of the fertilizers. The effect of treatment on the yield of paddy was significant at the 0.1 per cent. level probability.

The yield data shows that granular-compound-fertilizer (15—15—15) applied at planting or one week after was superior to straight fertilizers supplying the equivalent quantities of N, P_2O_5 and K_2O applied at planting or one week after planting or applied according to times specified in the recommendations of the Department of Agriculture. Compound fertilizer treatments were also superior to the recommendations of the Department of Agriculture. Three hundred pounds per acre of compound fertilizer (15—15—15) applied one week after planting out-yielded the equivalent quantity of the same fertilizer applied as a basal dressing at planting by 5 bushels per acre. This difference however was not significant.

Treatments receiving straight fertilizers at the rate of 45 lbs. each of N, P_2O_5 and K_2O were not significantly different from each other or

from the recommendations of the Department of Agriculture. The best yield with straight fertilizers (supplying 45 lbs. each of N, P_2O_5 and K_2O) was obtained when these were applied at times recommended by the Department of Agriculture. Application of straight fertilizers one week after planting and at planting gave second and third highest yields respectively among treatments receiving straight fertilizers. This order of performance is most probably due to loss of nutrients by leaching, runoff, immobilization through chemical reactions with organic matter, fixation by clay minerals ; and in the case of nitrogenous fertilizers losses may be due to denitrification through biological and chemical mechanisms and volatilization of ammonia. Earlier applications of fertilizers cause greater losses of nutrients than later applications.

Among the straight fertilizer treatments, applications according to recommendations of the Department of Agriculture yielded the lowest. This is most probably because these plots received less of N and K_2O (6 and 3 lbs. per acre respectively) than other treatments with straight fertilizers.

(ii) *Cultivators' Fields in Ratnapura District*

Plants in plots receiving granular-compound-fertilizers exhibited luxuriant growth in comparison to those in other treatments. Plots receiving compound fertilizers yielded the highest on an average and an application at planting generally out-yielded an application one week after planting. The superiority of granular-compound-fertilizers did not prevail at all locations. At Weligepola, for instance, straight fertilizers applied according to recommendations of the Department of Agriculture was the best and straight fertilizers (45 lbs. per acre each of N, P_2O_5 and K_2O) applied at times recommended by the Department (treatment 5) or applied one week after planting (treatment 7) out-yielded the granular-compound-fertilizer treatments. This was an ill-drained location where loss of nutrients due to leaching would be expected to be low. The fertility of the soil is exceptionally low, so are the cation exchange capacity and organic matter status.

(B) Performance of Granular-Compound-Fertilizers 15-15-15, N : P_2O_5 : K_2O (Sunfoska Grade A) and 15-15-6-4 ; N : P_2O_5 : K_2O ; MgO (Sunfoska Grade B)

The results of trials with 15-15-15 : N : P_2O_5 : K_2O and 15-15-6-4 N : P_2O_5 : K_2O : MgO in the Matara District and at Bombuwela

and Labuduwa together with some characteristics of the soils from the locations are presented in table 2.

(i) *Cultivators' Field in Matara District*

Generally, plants from plots treated with granular-compound-fertilizers (15—15—15 and 15—15—6—4) exhibited better growth and a darker green colour than those receiving straight fertilizers.

The effect of fertilizer treatments on the yield of rice at Matara district is shown in table 2. Granular-compound-fertilizer 15—15—15 applied either as a basal dressing at planting or one week after planting out-yielded the control by approximately 26 bushels per acre and was significantly better than the fertilizer 15—15—6—4 applied at the same times or straight fertilizers applied according to recommendations of the Department of Agriculture. The yields obtained in the latter treatment (No. 2) was not different from those in treatments receiving the compound fertilizer 15—15—6—4.

In four locations a basal application at planting of 15—15—15 was better than a dressing one week after planting while in two locations the late application was better than one at planting. The data from plots receiving the two grades of granular-compound-fertilizer indicates the need for adequate potassum fertilization for maximum yields on these soils. Comparison of treatments 4 and 6 shows that an average yield increase of 10.5 bushels per acre is obtained for the difference of 27 lbs. K_2O per acre. The quantity of K_2O recommended by the Department of Agriculture for soils at five locations amounts to 42 lbs. per acre, 28 lbs. of which is applied before planting and the balance two weeks before heading. Evidently this K_2O is not used efficiently by the crop and it is probable that much of the muriate of potash which is applied before planting is lost through leaching and runoff from these moderately fine textured, strongly acid soils with medium cation exchange capacity.

The results do not indicate a response to magnesium (in treatments 5 and 6). This is probably due to the inadequate supply of potassium in these treatments. The indications are that larger amounts of potassium are required on these soils for optimum yield.

(ii) *Research Station, Bombuwela*

Plants in plots treated with granular-compound-fertilizers exhibited better growth than those in plots treated with straight fertilizers as judged by their darker green colour and better tillering.

The results of the experiment are shown in table 2. The differences among treatments were significant. The compound fertilizer 15-15-15 applied either at planting or one week later was better than 15-15-6-4 applied at the same times. A basal application at planting of the former was found to be better than a late application. Straight fertilizers applied according to recommendations of the Department of Agriculture were not significantly different to the fertilizer 15-15-15, although a basal application of the latter out-yielded the straight fertilizers by approximately 8 bushels per acre.

(iii) *School Farm, Labuduwa*

The results in table 2 show that straight fertilizer applied according to the recommendation of the Department of Agriculture are inferior to both granular-compound-fertilizers 15-15-15 and 15-15-6-4. The relatively poor yield in the control treatment indicates the low fertility status of the soils.

(C) Performance of 15-15-15 (Sunfoska Grade A) ; 15-15-6-4 (Sunfoska Grade B) ; 5-15-15 ; 10-10-10 (I. B. Compound) and 14-14-14 (Ammonium Chloride Type)

The results of trials conducted during Maha 1967/68 with the above fertilizers together with soil characteristics of the locations are presented in table 3.

(i) *School Farm, Karapincha*

The highest yield was obtained in plots where 5-15-15 was applied at planting with top-dressings of nitrogen. This yield however was not significantly different from that obtained with 15-15-15 and 15-15-6-4 applied at planting. The fertilizers 10-10-10 and 14-14-14 were inferior to the fertilizer 5-15-15 plus top-dressing of nitrogen. The straight fertilizer treatment according to the recommendations of the Department of Agriculture yielded the lowest, but was not different in performance from the fertilizers 10-10-10 and 14-14-14.

(ii) *Research Station, Bombuwela*

At Bombuwela the yields were generally lower than at any of the other three locations. The straight fertilizer treatment was significantly lower than all other treatments. The two Sunfoska fertilizers 15-15-15 and 15-15-6-4 were not significantly different from each other although the magnesium containing 15-15-6-4 out yielded the other by approximately 5 bushels per acre. It should be noted that 15-15-15

performed better than 15-15-6-4 in the previous season at this station. The fertilizers 15-15-6-4, 5-15-15, 10-10-10 and 14-14-14 performed equally well at this location.

(iii) *School Farm, Wagolla*

All granular-compound-fertilizers tested gave significantly better yields than straight fertilizers applied according to recommendations of the Department of Agriculture. Among the compound fertilizers 300 lbs. per acre of 5-15-15 with 30 lbs. nitrogen per acre as a straight fertilizer applied at pollen-mother-cell stage yielded the highest.

(iv) *Geli-oya*

At this location yields were generally higher than at the others. The straight fertilizer treatment according to recommendations of the Department of Agriculture yielded the lowest but this was not significantly different from the 15-15-15 and 5-15-15 treatments. The magnesium containing 15-15-6-4 and the 10-10-10 (I. B. Compound) gave the highest yields but were not significantly different from those obtained with the fertilizers 15-15-15 and 14-14-14.

The results with these fertilizers confirm the earlier data that granular-compound-fertilizers perform better than straight fertilizers in the wet-zone. The performance of the individual fertilizers do not fall into a pattern that lends to any generalizations. The currently popular compound fertilizer 5-15-15 (with top-dressing of nitrogen) was found to give the highest yield at Karapincha and Wagolla, and came very close to the highest yielding treatment at Bombuwela. At Geli-Oya it was not significantly different from the straight fertilizer treatment.

ECONOMICS OF FERTILIZER USE

The economics of the use of granular-compound-fertilizers in the wet-zone are presented in Tables 4, 5 and 6. Total net income is taken to be the difference between value of paddy and cost of fertilizers added. The price of paddy is taken at Rs. 14 per bushel and that of fertilizers is calculated from the following C. I. F. values furnished by the Ceylon Fertilizer Corporation.

Urea at Rs. 450/– per ton
Saphos – phosphate at Rs. 173¼–per ton
Muriate of potash (50% grade) at Rs. 245¼–per ton
Granular–Compound–Firtilisers
15–15–15, 15–15–6–4 & 5–15–15 at £ 30/– per ton

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Nett return is the difference between the value of yield increase due to fertilizer application and the cost of fertilizer applied. It will be noted that in tables 4 and 5 the yield increase is calculated in relation to the no fertilizer control plot while in table 6 this is done in relation to the straight fertilizer treatment.

The profit from the use of granular-compound-fertilizer 15-15-15 applied as a top dressing over the equivalent quantity of nutrients supplied as straight fertilizers at times recommended by the Department of Agriculture at Karapincha Farm is approximately Rs. 200 per acre (Table 4). However in the cultivators' fields of the Ratnapura district there appears to be no economic advantage from the use of granular-compound-fertilizers as indicated by these results. In cultivators' fields of the Matara district the net return from the use of granular-compound-fertilizer 15-15-15 over straight fertilizers applied according to the recommendations of the Department of Agriculture is approximately Rs. 137 per acre and at Labuduwa the net profit is approximately Rs. 330 per acre (Table 5). At Bombuwela the profit from the use of granular-compound-fertilizer 15-15-15 at planting over the straight fertilizers applied according to the recommendations of the Department of Agriculture is Rs. 80 per acre, but application of this granular-compound-fertilizer one week after planting is not profitable compared to the use of straight fertilizers (Table 5).

Data in table 6 indicates that among the different fertilizers tested at Karapincha, Bombuwela and Wagolla the granular-compound-fertilizer 5-15-15 plus nitrogen at pollen-mother-cell stage was most profitable. At Geli-Oya however the granular-compound-fertilizer 15-15-6-4 gave the highest returns.

CONCLUSIONS

From the investigations carried out so far the indications are that granular-compound-fertilizers are a better source of nitrients for rice in the wet zone than straight fertilizers. These fertilizers offer the possibility of obtaining more profits from fewer acres although the profits in general may not always be as high as in the examples cited.

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TABLE 1.—FERTILIZER TREATMENTS, YIELD OF PADDY AND SOIL CHARACTERISTIC FROM EIGHT LOCATIONS IN RATNAPURA DISTRICT—MAHA, 1966/1967

Paddy Yields — Bushels Per Acre

No.	*Fertilizer Treatments*	*Locations*								
		Karapincha Farm 1	*Galagama 2*	*Weligepola 3*	*Hunuwela 4*	*Panamure 5*	*Millawitiya 6*	*Kollonna 7*	*Muttetuwegama 8*	*Average of Locations 2–8*
1.	No fertilizers	47·3a*	62·8	66·0	59·3	39·4	37·6	53·6	52·6	53·0a*
2.	Straight fertilizers applied according to recommendations of Department of Agriculture	66·9b	71·9	89·0	60·4	43·2	46·7	73·6	74·8	65·7 bc
3.	Granular compound fertilizer (15 : 15 : 15) at 300 lbs./acre applied at planting	86·5 c	77·3	80·5	90·9	60·3	55·1	78·4	82·6	75·0 d
4.	Straight Fertilizer to supply 45 lbs. each of N, P_2O_5, and K_2O per acre applied at planting	68·1 b	73·5	73·9	55·3	48·1	56·9	68·0	73·7	64·2 b
5.	Straight fertilizer to supply 45 lbs. each of N, P_2O_5, and K_2O per acre applied at times recommended by the Department of Agriculture	75·1 b	72·6	86·0	67·1	61·9	58·7	73.1	74·1	70·5 bcd
6.	Granular-compound-fertilizer (15 : 15 : 15) at 300 lbs./acre applied one week after planting or 4 weeks after sowing	91·5 c	85·0	78·7	77·8	51·4	53·8	77·1	84·4	72·6 cd
7.	Straight fertilizers to supply 45 lbs. each of N, P_2O_5, and K_2O per acre applied one week after planting or 4 weeks after sowing	70·1 b	83·3	84·8	62·4	67·5	47·3	74·7	68·6	69·8 bcd
	Coefficient of Variation	10·1 %								10·5 %

*Significant at 5% level using Duncan's multiple range test (2). Means not followed by same letter within a coloumn are significantly different from each other.

†Departmental Recommendations :—Locations 1, 2, 3, 4, 6 and 8 received 39 lbs. N, 47 lbs. P_2O_5, and 42 lbs. K_2O as urea, saphos Phosphate, and muriate of potash respectively. Locations 5 & 7 received 47 lbs. N, 31 lbs. P_2O_5 and 28 lbs. as ammonium sulphate, saphos phosphate and muriate of potash respectively.

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Soil Data

No.	*Location*	*Texture*	*pH*	*C.E.C. m.e/100g.*	*Organic matter%*	*Total N%*	*Available P_2O_5 (Olsen's) lbs./acre*	*Exchangeable catrons m.e./100 gms*		
								K+	*Ca+*	*Mg+*
1.	Karapincha Farm ..	.. Sandy Clay Loam.	.. 5·2	.. 17·6	.. 4·6	.. 0·24	.. 12·5	.. 0·10	.. 8·68	.. 0·65
2.	Galagama	.. Clay Loam	.. 5·9	.. 17·2	.. 3·3	.. 0·29	.. 29·6	.. 0·16	.. 3·04	.. 1·95
3.	Weligepola ..	.. Clay Loam	.. 5·6	.. 6·0	.. 1·6	.. 0·11	.. 14·8	.. 0·12	.. 3·04	.. 0·87
4.	Hunuwella ..	.. Clay Loam	.. 5·4	.. 8·0	.. 2·5	.. 0·09	.. 18·2	.. 0·08	.. 3·76	.. 0·75
5.	Panamure ..	.. Clay Loam	.. 5·5	.. 10·0	.. 2·7	.. 0·14	.. 22·8	.. 0·12	.. 2·60	.. 1·09
6.	Millawitiya ..	.. Clay Loam	.. 4·7	.. 16·8	.. 7·2	.. 0·32	.. 23·9	.. 0·40	.. 1·95	.. 0·87
7.	Kolonna ..	.. Sandy Clay Loam	.. 5·2	.. 10·8	.. 2.7	.. 0·15	.. 22·8	.. 0·08	.. 2·17	.. 0·22
8.	Muttetuwegama ..	.. Sandy Clay Loam	.. 5·2	.. 6·3	.. 2·3	.. 0·13	.. 23·9	.. 0·08	.. 3·12	.. 0·97

TABLE 2.—FERTILIZER TREATMENTS, YIELDS OF PADDY AND SOIL CHARACTERISTICS FROM SEVEN LOCATIONS IN MATARA DISTRICT, BOMBUWELA AND LABUDUWA

Paddy Yield — Bushels Per Acre

No.	Fertilizer Treatments	*Matara District*									
		Talalla 1	*Dampella* 2	*Lalpe* 3	*Hathamune* 4	*Mapalana* 5	*Karagoda Uyangoda* 6	*Pallegama* 7	*Average of locations* 1–7	*Bombuwela*	*Labuduwa*
1.	No fertilizers	43·7	56·6	50·4	42·8	46·9	52·6	40·4	47·6a*	58·0a*	12·9a
2.	Straight fertilizer spplied according to recommendations of the Department of Agriculture	59·5	69·4	63·7	58·9	64·6	67·1	53·1	62·3b	66·0ab	23·6b
3.	Granular-compound-fertilizer (15-15-15) at 300 lbs./acre applied at planting	52·2	80·4	80·1	79·6	70·5	87·8	68·2	74·1c	74·1b	49·6cd
4.	Granular-compound-fertilizer (15-15-15) at 300 lbs./acre applied one week after planting or four weeks after sowing	53·6	91·1	76·6	77·6	72·1	84·8	61·9	74·0c	66·7ab	52·7 d
5.	Granular-compound-fertilizer (15-15-6-4) at 300 lbs./acre applied at planting	56·6	68·9	66·2	68·9	67·7	87·1	55·3	67·2b	65·0a	44·9c
6.	Granular-compound-fertilizer (15-15-6-4) at 300 lbs./acre applied one week after planting or 4 weeks after sowing	48·1	72·1	67·1	67·7	68·9	69·3	51·5	63·5	64·0a	53·2 d
	Coefficient of Variation								8·2%	8·4%	9·75%

*Significant at 5% level using Duncan's multiple range test (2). Means not followed by the same letter within a column are significantly different from each other.

†Departmental Recommendation, Locations ; 1 & 2 received 26 lbs. N, 48 lbs, P_2O_5 and 28 lbs. K_2O as urea, saphos phosphate, and muriate of potash respectively. Locations 3, 4, 5, 6 & 7 received 39 lbs. of N, 48 lbs. P_2O_5 and 42 lbs. K_2O as urea, saphos phosphate and muriate of potash r espectively.

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Soil Data

No.	Location	Texture	pH	C.E.C. m.e/100 g.	Organic matter%	Total N%	Available P_2O_5 (Olsen's) lbs/acre	Exchangeable cations m.e/100gms.		
								K+	Ca++	Mg.++
1.	Talalla	Sandy Clay Loam	5·0	8·5	2·0	0·10	22·8	0·04	1·95	0·87
2.	Dampella	Sandy Clay Loam	4·7	12·0	6·0	0·30	26·2	0·16	2·17	0·65
3.	Lalpe	Sandy Clay Loam	5·3	22·2	4·3	0·25	63·8	0·26	9·77	5·86
4.	Hathamune	Clay Loam	4·8	16·8	6·4	0·37	9·1	0·26	4·12	1·95
5.	Mapalana	Clay Loam	5·0	10·8	3·8	0·21	43·3	0·08	3.04	0·65
6.	Karagoda-Uyangoda	Clay Loam	5·1	16·8	8·2	0·49	33·1	0·10	7·60	1·09
7.	Pallegama	Clay Loam	5·1	12·0	6·0	0·33	65·0	0·12	1·74	0·65
8.	Bombuwela (Humic)	Silty Clay	5·1	21·0	14·8	0·66	56·0	0·21	3·29	0·69
9.	Labuduwa (Narawala)	Loam	5·2	35·1	11·2	0·88	36·5	0·10	1·95	0·90

TABLE 3.—FERTILLIZER TREATMENTS, YIELDS OF PADDY AND SOIL CHARACTERISTICS FROM KARAPINCHA, BOMBUWELA, WAGOLLA AND GELI-OYA—MAHA, 1967/68

Paddy Yields — Bushels Per Acre

No.	*Fertilizer Treatments*	*Locations*			
		Karapincha 1	*Bombuwela* 2	*Wagolla* 3	*Geli-oya* 4
1.	Straight fertilizers applied according to recommendations of the Department of Agriculture	64·4a*	39·8a	48·57a	71·0a
2.	Granular-compound-fertilizer 15-15-15 (Sunfosca Grade A) at 300 lbs per acre applied at planting	73·8bc	48·4b	64·42bc	86·2ab
3.	Granular-compound-fertilizer 15-15-6-4 (Sunfosca Grade B) at 300 lbs. per acre applied at planting	72·3bc	53·4bc	61·55bc	102·1b
4.	Granular-compound-fertilizer 15-15-15 at 300 lbs. per acre applied at planting and 30 lbs. N per acre as straight fertilizer applied at pollen-mother-cell stage	77·3cd	54·8c	66·22c	74·9a
5.	Granular-compound-fertilizer 10-10-10 (I.B. Compound) at 450 lbs. per acre applied at planting	67·1ab	55·3c	56·87b	102·5b
6.	Granular-compound-fertilizer 14-14-14 (Ammonium chloride type) at 320 lbs. per acre applied at planting	69·6ab	52·5bc	61·20bc	93.7b
	Ceofficient of Variation	6 05	7·62	8·44	11·43

*Significant at 5% level using Duncan's multiple range test (2). Means not followed by the same letter within a column are significantly different from each other.

†Departmental Recommendation, Locations 1 & 2 as in Tables 1 & 2 Location 3 and 4 received 52 lbs. N, 31 lbs P_2O_5 and 42 lbs. K_2O per acre.

Soil Data

No.	*Location*	*Texture*	*pH*	*C.E.C. m.e./100 gms.*	*Organic matter%*	*Total N%*	*Available P_2O_5 (Olsen's) lbs./acre*	*Exchangeable cations m.e./100 gms.*		
								K+	*Ca++*	*Mg.++*
1.	Karapincha	Sandy Clay Loam	5·2	17·6	4·6	0·24	12·5	0·10	3·68	0·65
2.	Bombuwela (Humic)	Silty Clay	5·1	21·0	14·8	0·66	56·0	0·21	3·29	0·69
3.	Wagolla	Sandy Clay Loam	5·3	27·0	2·5	0·19	23·9	0·08	1·98	3·13
4.	Geli-Oya	Fine Sandy Clay Loam,	5·9	9·5	2·3	0·17	35·7	0·15	3·06	2·71

TABLE 4.—ECONOMICS OF THE USE OF 15-15-15 FERTILIZER IN THE RATNAPURA DISTRICT

Treat No.	*Treatments*	*Karapincha Farm*			*Ratnapura District Average of 7 Locations*		
		Yield increase Bu./acre	*Total nett income Rs. c.*	*Net Return Rs. c.*	*Yield increase Bu./acre*	*Total net income Rs. c.*	*Net Return Rs. c.*
1.	No Fertilizers	—	662 20	—	—	742 0	—
2.	Straight fertilizers applied according to Departmental recommendations	19.6	898 18	235 98	12.7	881 38	139 38
3.	Granular-compound-fertilizer (15-15-15) at 300 lbs. per/ac. applied at planting	39.2	1,146 35	484 45	22.0	985 65	243 65
4.	Straight fertizers 45 N, 45 P_2O_5 and 45 K_2O lbs. per acre applied at planting	20.8	913 40	251 20	11.2	858 80	116 80
5.	Straight fertililizers 45 N, 45 P_2O_5 and 45 K_2O lbs. per acre applied according to Departmental recommendations ..	27.8	1,011 40	349 20	17.5	947 00	205 00
6.	Granular-Compound-Fertilizer 15-15-15 at 300 lbs. per acre applied as top dressing	44.2	1,216 65	554 45	19.6	952 05	210 05
7.	Straight fertilizers, 45N, 45 P_2O_5 and 45 K_2O lbs. per acre applied as top dressing	22.8	941 40	279 20	16.8	937 20	195 20

TABLE 5.—ECONOMICS OF THE USE OF 15–15–15 and 15–15–6–4 ERTILIZERS IN MATARA DISTRICT, LABUDUWA AND BOMBUWELA

Treat No.	*Treatments*	*Matara District Average of seven locations*			*Labuduwa*			*Bombuwela*		
		Yield increase	*Total Net income*	*Nett return*	*Yield increase*	*Total net income*	*Nett return*	*Yield increase*	*Total net income*	*Nett return*
		Bu./ac.	*Rs. c.*	*Rs. c.*	*Bu./ac.*	*Rs. c.*	*Rs. c.*	*Rs. c.*	*Rs. c.*	*Rs. c.*
1.	No Fertilizer	—	666 40	—	—	180 60	—	—	812 0	—
2.	Straight fertilizer applied according to Departmental recommendations	14.7	833 78	167 38	10.7	295 70	115 10	8.0	894 96	82 96
3.	Granular-Compound-Fertilizer (15-15-15) at 300 lbs. per acre applied at planting ..	26.5	973 05	306 65	36.7	630 05	449 45	16 1	973 05	161 05
4.	Granular-Compound-Fertilizer (15 : 15 : 15) at 300 lbs. per acre applied one week after planting or 4 weeks after sowing	26.4	971 65	305 25	39 8	673 45	492 80	8.7	869 45	57 45
5.	Granular-Compound-Fertilizer (15 : 15 : 6 : 4) at 300 lbs. per acre applied at planting ..	19.6	876 35	210 05	32.0	564 25	383 65	7.0	845 65	33 65
6.	Granular-Compound-Fertilizer (15 : 15 : 15) at 300 lbs. per acre applied one week after planting or 4 weeks after sowing	15.9	824 65	158 25	40.3	680 45	499 45	6.0	831 65	19 65

TABLE 6.—ECONOMICS OF THE USE OF 15-15-15, 15-15-6-4 AND 5-15-15 FERTILIZERS AT KARAPINCHA, BOMBUWELA, WAGOLLA AND GELI-OYA

Treat No.	Treatments / Locations	Karapincha			Bombuwela			Wagoila			Geli-Oya		
		Yield increase Bu/ac	Total net income Rs. c.	Net return Rs. c.	Yield increase Bu/ac	Total net income Rs c.	Net return Rs. c.	Yield increase Bu/ac	Total net income Rs. c.	Net return Rs. c.	Yield increase Bu./ac.	Total nett income Rs. c.	Net return Rs. c.
1.	Straight fertilizers applied according to recommendations of the Department of Agriculture	—	863 18	—	—	528 16	—	—	640 07	—	—	953 67	—
2.	Granular-compound-fertilizer (15-15-15) at 300 lbs. per acre applied at planting ..	9.4	968 85	67 25	8.6	613 25	56 05	15.8	837 25	156 85	15.2	1,142 45	148 45
3.	Granular-compound-fertilizer (15-15-6-4) at 300 lbs. per acre applied at planting ..	7.9	947 85	46 25	13.6	683 25	126 05	13.0	798 05	117 65	31.1	1,365 05	371 05
4.	Granular-compound-fertilizer (5-15-15) at 300 lb. per acre applied at planting and 30 lbs. Nitrogen per acre as a straight fertilizer applied at Pollen-Mother-Cell Stage	12.9	1,004 75	103 15	15.0	689 75	132 55	17.6	849 35	168 95	3.9	971 15	—