

## INFLUENCE OF N-LEVELS ON THE YIELD AND UPTAKE BY CERTAIN CROPS AND THEIR IMPACT ON N-EFFICIENCY AND RECOVERY

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Comparative efficiency of different levels of nitrogen application and their impact on yield, uptake, N-use efficiency and N-recovery were studied with rice-Bhavani (Soil-Typic Haplustalf), ragi-Co 11, Groundnut-Pol. 2 (Soil Typic Ustorthent), and Cotton-MCU 5 (Soil Typic Chromustert). Nitrogen fertilizer incorporation exhibited a general increase in the yield and uptake of nitrogen by crops, which was more prominent and significant by the addition of 100 kg N/ha for rice, 45 kg N/ha for ragi, 10 kg N/ha for groundnut and 60 kg N/ha for Cotton. Beyond these levels, the yield increases were not apparent. Added fertilizer N and its positive effect in enhancing the N use efficiency/recovery and economy were well manifested at the lower N-levels. The lower efficiency and recovery of fertilizer N at higher N-application rates could be due to higher N-losses associated with larger dressings.

Judicious use of fertilizers forms one of the most important means of stepping up agricultural production. For efficient fertiliser use, it is necessary to have information on the optimum doses and combinations of fertilizers based on soil testing, under different soil climatic conditions. Use of fertilizers may be given due regard and it should not be used as mumbo-jumbo, used to reduce farmers into the purchase of unwanted fertilizer. This paper aims to find out the effect of liberal use of N-fertilizers on the yield and uptake of certain crops-rice, ragi, groundnut and cotton and its impact of N-efficiency, recovery and economy.

### MATERIALS AND METHODS

The crops-rice, ragi, cotton and groundnut raised under All India Co-ordinated Soil Test-Crop Response

Correlation Project, Coimbatore, representing the major soil groups-alluvial, Noyyal series (Typic Haplustalf), red Irugur series (Typic Ustorthent) and mixed black (Perianaickenpalayam series, Typic Chromustert), have been used in this investigation for calculating the parameters such as N-recovery, N-efficiency and economy with their respective yield, uptake and soil test values for nitrogen. Fertilizer-N was applied in three splits for cotton and rice, and in two splits for groundnut and ragi.

The percent efficiency of contribution from N-fertilizer (CFN) is calculated from the total uptake of nutrients, soil test value of treated plot, average soil efficiency (CS) and fertilizer N-dose as follows:

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$$\text{GFN \%} = \frac{\text{Total uptake of N in treated pkt} \left\{ \begin{array}{l} \text{Soil test value} \\ \text{in treated plot} \end{array} \right. \times \frac{\text{AV}}{\text{CS}}}{\text{Fertilizer N dose}} \times 100$$

The per cent N recovery, (NR) is calculated based on Bartholomew and Clark (1965) as given below.

$$\text{NR\%} = \frac{\text{N uptake from ferti - N uptake from lizer treated Plot - control plot}}{\text{Fertilizer N dose}} \times 100$$

## RESULTS AND DISCUSSION

The yield, uptake, N recovery, efficiency and economy along with the range of soil test values for N have been tabulated for the crops rice, ragi, groundnut and cotton (Tables 1-5 and Fig. 1-5).

### Rice

The yield and uptake of N by rice - Bhavani showed that a considerable increase in these two parameters was observed upto 150 kg/ha of N incorporation (Table 1), whereas such an influence was not indicated as regards N recovery and N efficiency. Recovery of N increased from 35.4 to 45.2 per cent, when N fertilizer level was enhanced from 50 kg to 100 kg/ha. This condition was similar in N efficiency, a marked difference in the tempo of efficiency could be noticed when the N dose was increased from 50 kg to 100 kg/ha. Chen Rong-Ye and Zhu-Wang (1932) stated that N efficiency was 30.5% for 100 kg N/ha when it was applied in two splits for rice. Mangal Prasad and Rajendra Prasad (1982) reported in rice that the apparent recovery of applied N was reduced when the dose of N was increased from 100

kg to 200 kg N/ha. The lower recovery of applied N at higher rate of application was due to higher N losses associated with larger dressings. The available N had a significant negative influence on the N use efficiency ( $r = -0.89^{**}$ ), while N uptake and yield had a significant positive effect on the fertilizer N efficiency (N uptake  $r = 0.64^{**}$ ; yield  $r = 0.59^{**}$ ). The return per rupee invested on N fertilizer, as a criterion of economy showed a distinct effect up to 100 kg per ha of N dose. The highest return of Rs. 5.60/ rupee on fertilizer, was also observed up to 100 kg/ha of N level only. The increased dosage of N, viz. 150 and 200 kg/ha had recorded lower returns.

### Ragi

Nitrogenous fertilizer addition showed a general increase in yield of ragi grain over the control ( $N_0$ ), which was much more marked with 45 kg N/ha (Table 2). Mishra *et al* (1973) observed the economic optimum level of N to range between 79-93 kg/ha for ragi. Kadrekør and Bhosala (1981) found that 50 and 100 kg N/ha gave more yield than control but was on par for

Table 1 : Efficacy of added N on Rice.

Nomenclature	Typic Haplustalf	Year	: 1978
Series/Order	Noyyal/Alfisol	Season	: Rabi
Group	Alluvial	Variety	: Bhavani

N levels (kg/ha)	Grain yield (kg/ha)	Total uptake (kg/ha)	KMnO <sub>4</sub> (mean) PS (kg/ha)	N Recovery (%)	N efficiency (%)	Return (Rs/Re)
0	2029	43.0	263	—	—	—
50	3213	60.7	257	35.4	19.1	3.69
100	4530	88.1	243	45.1	30.9	5.60
150	4465	92.7	278	33.4	15.9	4.26
200	4349	94.8	263	25.9	9.1	3.33

N = 1 kg @ Rs. 5.00

PS : Pre-sowing

Cost of paddy grain Rs. 2.00/kg

Rs/Re : Return in Rs/Ruppee invested on N fertiliser

Table 2 : Efficacy of added N on Ragi

Nomenclature	: Typic Ustorthent	Year	: 1981
Series/Order	: Irugur/Entisol	Season	: Rabi
Group	: Red	Variety	: Co. 11

N levels (kg/ha)	Grain yield (kg/ha)	Total uptake (kg/ha)	KMnO <sub>4</sub> N (mean) PS (kg/ha)	N Recovery (%)	N efficiency (%)	Return (Rs/Re)
0	1945	42.1	277	—	—	—
45	3050	64.8	273	50.5	36.2	3.20
90	2700	65.5	280	27.2	10.5	1.50
135	2600	70.4	266	28.2	7.2	1.00

Cost of Ragi grain : Rs 1.70/kg

Cost of N : Rs. 5.00/kg

Rs/Re : Return in Rs/Ruppee invested on N fertiliser

PS : Pre-sowing

ragi crop. This situation was in marked contrast to N uptake where N application of 45 kg to 135 kg/ha effected an uniform increase of uptake from 64.8 to 70.4 kg/ha respectively with N levels. The recovery due

to added N varied from 27.2 to 50.5 per cent respectively. The highest recovery of N was registered by 45 kg N/ha. N efficiency also presented a similar trend. It ranged from 7.2 to 36.2 per cent. The lowest efficiency of

N was recorded by the highest application of N dose (135kg/ha). The added N had beneficial influences on yield/uptake that were wide and varied but the influence is limited by lack of statistical significance. The lower dose of N 45 kg/ha to ragi had a marked influence on the economy too. The highest return of Rs 3.20 was noticeable for 45 kg N/ha while a lowest return of Rupee one was observed for highest N application (135 kg N/ha).

### Groundnut

The N fertilisation had facilitated N uptake/yield of groundnut but this is restricted to 10 kg N/ha. A significant positive correlation was registered between yield and N fertiliser efficiency ( $r = 0.52^{**}$ ). The N uptake with fertiliser efficiency also registered a high significant correlation ( $r = 0.72^{**}$ ). This is of interest again, where higher N application of 20 kg/30 kg/ha was accompanied by decrease in yield/up-

take of N. Ramanathan *et al.*, (1982) reported that the application of N at higher levels did not influence the groundnut pod yield. The lower level of N addition and its impact on higher N recovery was well exhibited by recording highest recovery of 130 per cent. Fertiliser application of 10kg N/ha for groundnut crop recorded higher order of efficiency (84 per cent) while only 36 and 26 per cent respectively were produced with 20 and 30kg N/ha. Pande *et al.*, (1971) studied the response of groundnut varieties to the varying levels of soil fertility and reported groundnut being a leguminous crop, its N requirement is considerably low and therefore the effect of N at higher levels had little influence on pod yield. The parallelism obtained in efficiency and recovery was also perceptible in returns (5.66 for 10 kg N/ha; 1.72 for 20kg N/ha; 0.60 for 30 kg N/ha).

Table 3 : Efficacy of added N on Groundnut

Nomenclature : Typic Ustorthent  
 Series/Order : Irugur/Entisol  
 Group : Red  
 Year : 1978  
 Season : Rabi  
 Variety : POL 1

N levels (kg/ha)	Pod yield (kg/ha)	Total uptake (kg/ha)	KMnO <sub>4</sub> N (mean) (kg/ha)	N Recovery (%)	N Efficiency (%)	Return (Rs/ha)
0	1150	77.5	204	—	—	—
10	1520	91.5	192	130.0	84.0	5.66
20	1288	84.5	184	33.0	36.0	1.72
30	1211	91.0	192	45.0	26.0	0.60

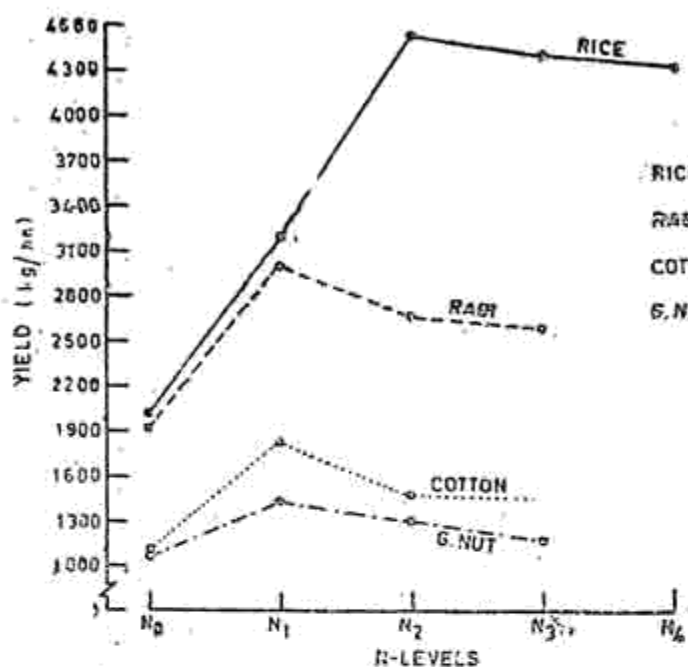
Cost of Pod : Rs. 4.50/kg

Cost of N : Rs. 5.00/kg

Rs/Re : Return in Rs/Rupee invested on fertiliser

9

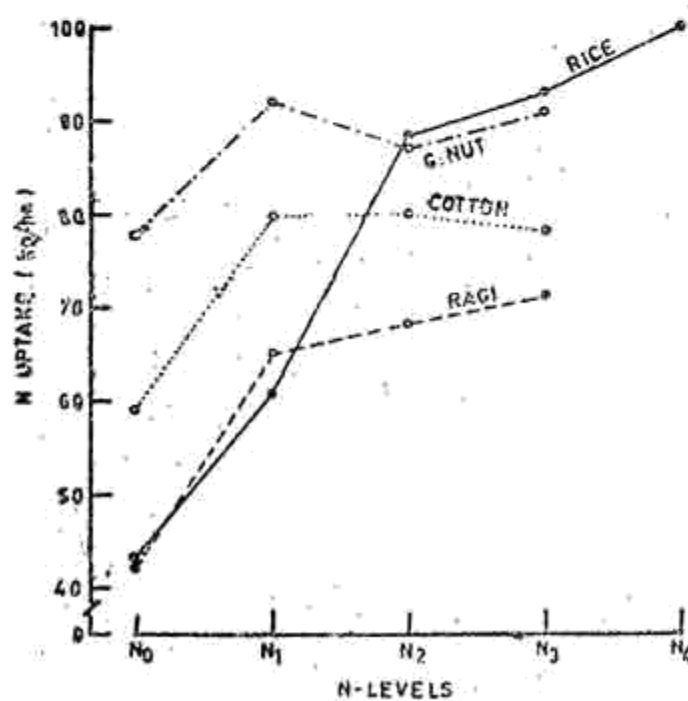
FIG.1 N-LEVELS Vs YIELD



RICE N 100 - 4520 kg/ha  
 RAGI N 45 - 3050 "  
 COTTON N 60 - 1873 "  
 G.NUT N 10 - 1520 "

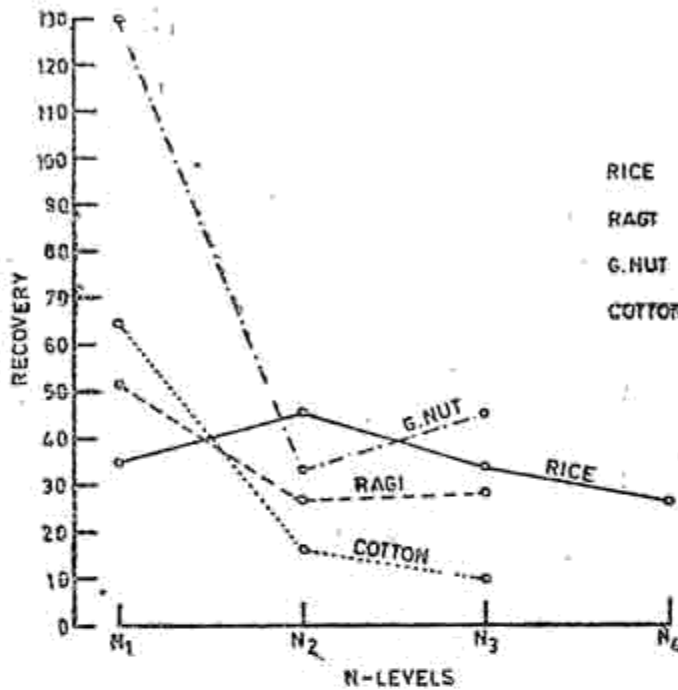
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FIG.2 N-LEVELS Vs UPTAKE



RICE N 200 - 94.0 kg/ha  
 RAGI N 135 - 70.4 "  
 G.NUT N 10 - 91.5 "  
 COTTON N 60 - 80.4 "

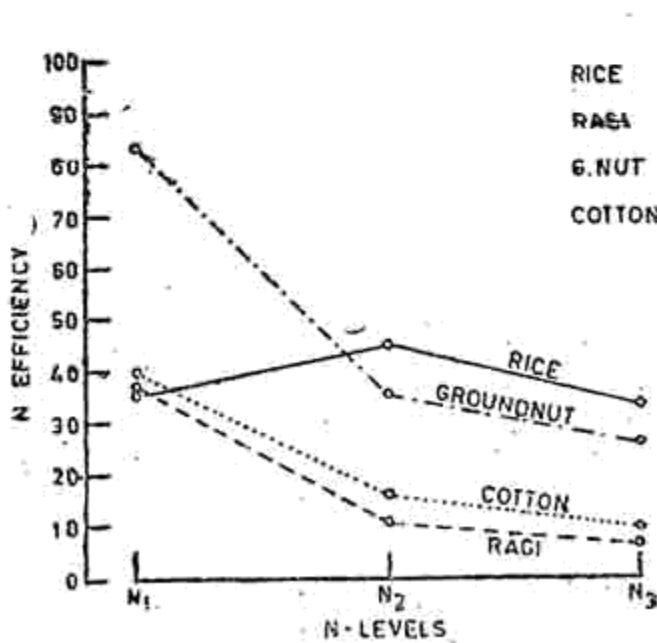
FIG. 3 N-LEVELS Vs RECOVERY



RICE N 100 - 45.1 %  
 RAGI N 45 - 50.5 %  
 G.NUT N 10 - 130 %  
 COTTON N 60 - 65 %



FIG. 4 N-LEVELS Vs EFFICIENCY



RICE N 100 - 30.9 %  
 RAGI N 45 - 36.2 %  
 G. NUT N 10 - 84.0 %  
 COTTON N 60 - 30.0 %

### Cotton

The yield of cotton kapas, as the most important economic end product was markedly enhanced from 1142 kg/ha to 1873 kg/ha by the addition of 60 kg N/ha. They reported that the optimum dose of N for cotton NHH-1 was 60 kg N/ha. Kapas yield was positively correlated with N fertiliser efficiency ( $r = 0.49^*$ ). Addition of higher doses of N 120 kg and while this decrease was steep and easily manifested in N recovery and it was equally apparent in N efficiency.

N fertilisation of 60 kg/ha had a distinct efficacy judged by the marked increase in N recovery (65 per cent), N efficiency (38.9 per cent) and also higher return (Rs. 14.62/Re invested on fertiliser). N recovery steeply decreased from 65.0 to 16.3 per cent when the N dose was increased from 60kg to 120kg N/ha. Similar trend was observed when the addition of N was enhanced to 180 kg/ha, the recovery was still reduced to 9.5 per cent only. The soil available N varied from 188 to 206 kg/ha and it exhibited a negative influence on the efficiency of added N ( $r =$

0.60\*). The mean values of N efficiency ranged from 9.5 per cent for 180 kg N/ha to 38.9 per cent for 60 kg N/ha of N additions. The influence of higher doses of N incorporation was not so impressive in enhancing the efficiency. In the presence of higher doses of N, the difference in returns per rupee spent on fertiliser was evened out and 60 kg N/ha effected the highest return per rupee (14.62).

Thus it can be concluded that N fertilisation showed a general increase in the yield/uptake of crops, which was much more prominent by the addition of 100 kg N/ha for rice, 45 kg N/ha for ragi, 10 kg N/ha for groundnut and 60 kg N/ha for cotton. Increasing the N levels beyond these levels, the differences in yield were not apparent. Added N and its positive effect in enhancing the N fertiliser use are well manifested at the lower N levels. The lower efficiency of fertiliser N and N recovery at higher N application could be due to higher N losses associated with larger dressings.

Table 4 : Efficacy of added N on Cotton

N levels (kg/ha)	Kapas yield (kg/ha)	Total uptake (kg/ha)	KMnO <sub>4</sub> N (mean) (kg/ha)	N Recovery (%)	N efficiency (%)	Return (Rs/Re)
0	1142	59.2	192	—	—	—
60	1873	80.4	188	65.0	38.9	14.62
120	1589	79.8	202	16.3	16.3	4.47
180	1673	76.6	206	9.5	9.5	3.08

Nomenclature : Typic Chromustert  
 Series/Order : Perianaickenpalayam/vertisol  
 Group : Mixed black  
 Year : 1978  
 Season : Rabi  
 Variety : MCU 5

Cost of kapas : Rs. 6.00/kg  
 Cost of N : Rs. 5.00/kg  
 Rs/Re : Return in Rs/Rupee Invested on fertilizer

FIG.5 N-LEVELS Vs RETURN (Rs/Re)

10

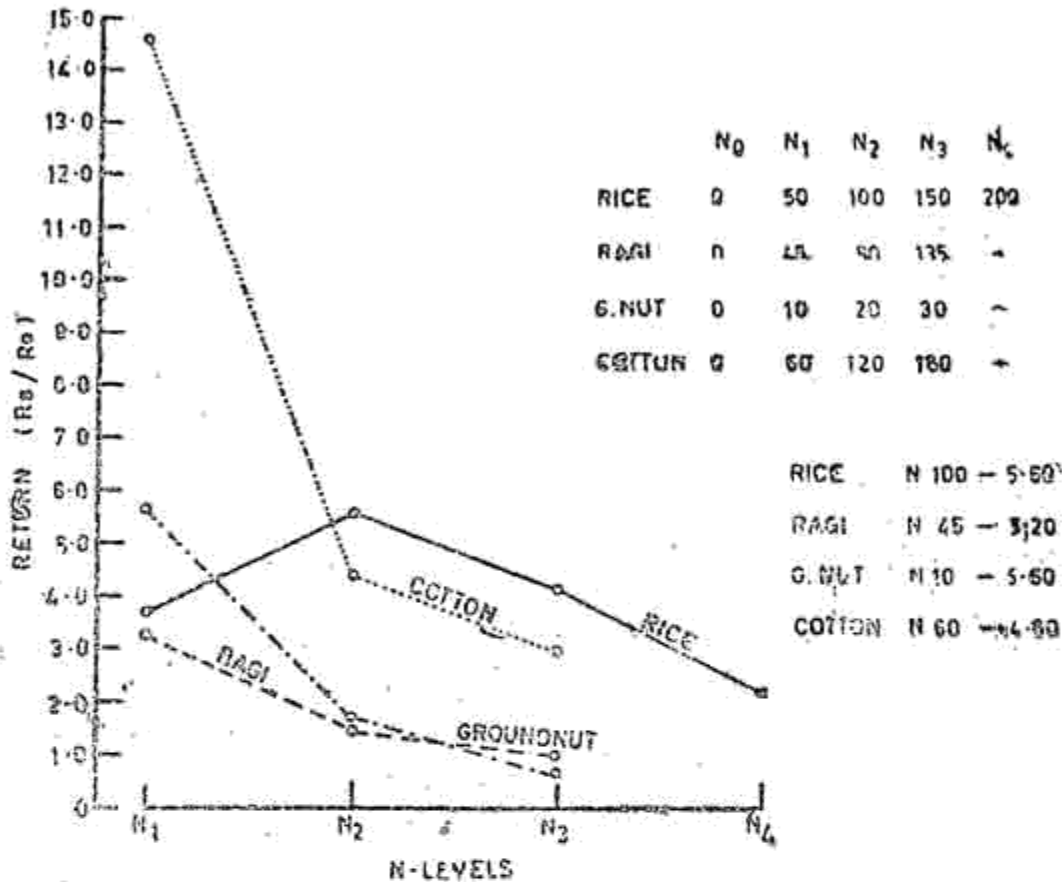


Table 5. Results of Statistical Analysis for Correlation (r) (Number of pairs 20)

Relation between		Rice	Ragi	Groundnut	Cotton
X	Y				
N Efficiency	Yield	0.57**	0.44 NS	0.52**	0.49*
N Efficiency	Uptake	0.64**	0.13 NS	0.72**	0.20 NS
Efficiency	Soil Test values	-0.89**	-0.02 NS	-0.08 NS	-0.70*

\*\* Significant at 1% level

\* Significant at 5% level NS - Not Significant

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