https://doi.org/10.29321/MAJ.10.A03488

Sources and Levels of N with P and K as Factors Influencing the Yield of Ragi *(Eleusine Coracana Gaerten)*

by

S. SUBRAMANIAN[1], Dr. Y. B. MORACHAN[2] and R. KALIAPPA[3]

Introduction: The cereal crops in India has responded very well to the application of major nutrients. The works attempted on the fertilisation of *ragi*, which occupies 2.35 million hectares in India including 0 32 million hectares in Tamil Nadu, are very few. Positive responses for N on *ragi* had been recorded by Ranganathan (1962), and Kolandaiswamy (1964), upto 100 kg N/ha. Govindarajan and Venkat Rao (1952) and Raniperumal *et al* (1969) had observed P to increase grain yield of *ragi*. The interaction effects of N with P and K, especially at higher levels, had been attempted by very few on *ragi*. To augment the meagre agronomic data that are already available and to exploit the full potentiality of the strain CO 7, *ragi*, the present study was taken up.

Materials and Methods: The experiment was laid out with CO 7 *ragi*, in the Central Farm, Agricultural College and Research Institute, Coimbatore, during June–October 1968. The soil was deep, black and fine textured with a pH of 8.00. In a split plot design, three sources of N *viz.* ammonium sulphate, calcium ammonium nitrate and urea each at three levels (60, 120 and 180 kg N/ha), besides the control were allotted to the sub plots, while the three levels of P (0, 35 and 70 kg P_2O_5/ha) and two levels of K (0 and 35 kg K_2O/ha) were combined and allotted to the main plots.

Two thirds of the N, full dose of P as super phosphate and K as muriate of potash were applied as basal dressing. The remaining one third of the N was top dressed thirty days after transplanting. Uniform application of compost at 12.5 tonnes/ha was applied 15 days before transplanting.

Results and Discussion: (a) *Yield of grain:* 1. *Effect of N:* The results (Table 1) reveal that the applied N favourably influenced the grain yield of *ragi*. Eventhough the increase in yield was maintained upto the 180 kg N level, the favourable effect was not impressive after the first incremental dose of N. All the levels except the zero were on par. The response per kg of added N was 4.25 kg of grain at the first incremental dose (N_0 to N_{60}), whereas it dwindled to 0.45 kg in the range 120 to 180 kg N/ha.

---

* Forms part of M.Sc.(Ag.) thesis submitted to the University of Madras.

1. District Agricultural Officer (Minor Irrigation) 2. Professor of Agronomy and 3. Former Reader in Agronomy, Agrl. College and Res. Instt., Coimbatore.

TABLE 1. *Effect of nitrogen and phosphorus on grain yield (Plot yield in kg)*

Levels of Nitrogen kg/ha	Levels of P205 kg/ha				S.E.D.	C.D.
	0	35	70	Mean		
0	3.400	3.282	3.436	3.372	0.062	0.123
60	3.427	3.574	3.907	3.636		
120	3.529	3.677	3.778	3.662	0.044	0.087
180	3.484	3.695	3.887	3.688		
Mean	3.460	3.557	3.752			
S E.D.		0.050				
C.D.		0.0998				

Conclusion:

Nitrogen N180, N120, N60, N0 *Phosphorus* P70, P35, P0

	S.E.D.	C.D.
Comparing 'P' at any one level of 'N'	0.1105	0.2331
Comparing 'N' at any one level of 'P'	0.1075	0.2134

Levels of 'P'	Levels of 'N'	Levels of 'N'	Levels of 'P'
0	N120, N180, N60, N0	0	P70, P0, P35
35	N180, N120, N60, N0	60	P70, P35, P0
70	N60, N180, N120, N0	120	P70, P35, P0
		180	P70, P35, P0

Thus, these findings corroborate those of the earlier investigators on *ragi* (Narasimhamoorthy 1952, Miller 1958, Chavan and Shendge 1955, Karunakara Shetty 1961, Ranganathan 1962, Kolandaiswamy 1964 and Ananthapadmanabhan *et al* 1967). Mariakulandai and Morachan (1966) reported a similar trend in millets for N application. Similarly, the favourable influence of N has been reported by several workers on other millets (Gingrich and Smith 1953, on wheat; Kraniz and Chandler 1954, on Corn; Pande *et al* 1954, on sorghum; and Wabersick 1967, on rye and other arable crops). Herron *et al* 1963, observed that the largest increase in N application on sorghum with the first incremental dose of N.

ii) *Effect of sources of nitrogen:* Ammonium sulphate and calcium ammonium nitrate recorded marginal increases over urea which were not statistically significant (Table 2). This is in agreement with the work of Chinnasami *et al.*, (1967) at Coimbatore and Griffith and Mills (1958) in South Africa, who observed no significant differences from the application of different sources of N on *ragi*. Similar were the observations of Stanberry *et al.* (1963), on Corn and Balasubramaniam *et al.* (1957), on rice. However,

ABLE 2. *Effect of sources of nitrogen on grain yield (Plot yield in kg.)*

Sources of 'N'	Mean Yield	S.E.D.	C.D.
Am. Sulphate	3.677	—	—
C A N	3.675	0.310	—
Urea	3.633	—	—

the findings of Sharma *et al.* (1968), are in contrast to this in that, he found ammonium sulphate to be superior to urea on corn. Devine and Holmes (1963), observed that soil factors play some role on the effect of sources of N, and this perhaps explains the variable results.

iii) *Effect of phosphorus*: Phosphorus is found to influence the yield, favourably and significantly (Table 1). Govindarajan and Venkatrao (1952) and Mustafa and Durairaj (1967) on *ragi*, and Panikar (1958) on *sorghum*, recorded a positive linear response with P application. Analysing the results of 2000 field experiments on arable crops, Gericks (1967) observed a 20% increase in yield of cereals due to phosphate application. In contrast to the above, Ramakrishnan Nair (1963) and Ananthapadmanabhan *et al.* (1967), both on *ragi*, did not secure any response for P application.

The response observed in this study is in line with the findings of most workers.

Besides the main effect of P, significant interaction between P and N was observed. Added N at all levels interacted with both levels of added P, significantly increasing grain yield over the control. The combination N60 P70 recorded the maximum grain yield and was followed closely by N180 P70 (Table 1); however, the difference between the two combinations was not significant. This clearly brings out the existance of interaction between the two nutrients and is in accordance with the views of Russel (1961), who held that the yield boosting ability of P is enhanced when combined with N. Such an interaction is presumably due to better utilisation of applied P in protein synthesis brought about by the P added.

iv) *Effect of Potassium*: The applied K as muriate of potash had not influenced the grain yield.

While Ananthapadmanabhan *et al.* (1967) reported no response to P applied to *ragi*, Michaelraj *et al.* (1965) reported K favourably influencing the yield.

Bray (1956), as cited by Thompson (1957), found good correlation between the amount of exchangeable K in the soil and response to K fertilisation. He reported that only one out of seven soils responded to K fertilisation where the soil contained over 175 pounds exchangeable K per acre. Thompson

(loc. cit.) reported that in calcareous soils where there is naturally a high base saturation with ca^{++} and mg^{++}, one would expect a rapid release of K^{+} from primary and secondary minerals. He concluded that the calcareous soils of the sub humid, semi-arid and arid regions rarely respond to K fertilisation.

The absence of response to added K in this study is resolved, when viewed in the light of the high K status of the calcareous soil under the experiment and the 37.5 kg per ha of K supplied through the compost.

Interaction of K with N and P was also absent. (Fig.)

Response curve for grain yield: Since the grain yield responded significantly for added N and P, response curves were fitted for estimating the response of grain yield for the same. As linear trend of response existed for applied P a linear response was fitted for P.

$$\hat{Y} = 3347 + 4.743x$$

Where $\hat{Y}$ is the estimated yield per ha and x is the unit of added P.

The same linearity was not maintained in the case of N. As such a cubic formula was fitted. In fitting the polymonial of the third degree, the orthogonal polymonial given by Fisher and as enumerated by Goulden (1959) was made use of in finding the value of the coefficients, b, c and d of the x, x^2 and x^3 terms respectively. The final formula runs as indicated below.:

$$\hat{Y} = 3261 + 7.428x - 0.03208x^2 + 0.0001774x^3$$

Where $\hat{Y}$ is the estimated yield per ha and x is the unit of added N.

b) *Straw yield:* The three levels of added N favourably influenced the yield of straw when compared to the control. However, there was no difference between the levels of added N (Table 3).

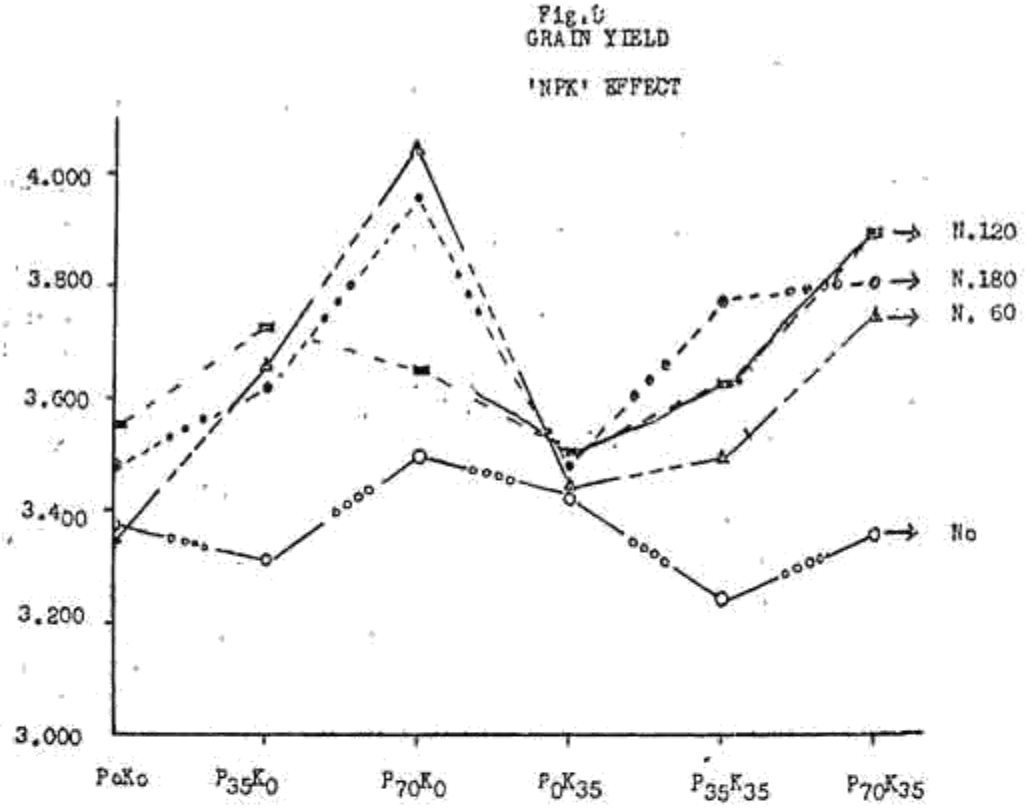
TABLE 3. *Effect of nitrogen on straw yield. (Plot yield in kg)*

Levels of N	Yield	S.E.	C.D.
N0	13.277	0.597	1.779
N60	16.440		
N120	17.041		
N180	17.141		

Conclusion: $\overline{\text{N180, N120, N60}}$, N0

The present finding parallels the observations of Karunakara Shetty (1961) and Ranganathan (1962).

Neither P nor K influenced the straw yield. Interaction of any kind was absent.



Summary and Conclusions: An experiment was laid out on a calcareous black soil in Fd. No. N.A. 4 of the Central Farm, Coimbatore, during July–October, 1968, to study the effect of three sources of N each at three levels, besides the control, three levels of P, and two levels of K on CO 7 *ragi*. From the study the following conclusions were recorded.

The grain and straw yield were favourably influenced by the applied N in a curvilinear way; the grain yield was increased both by the main effect of P and its interactions with N; the maximum yield being recorded with N60 P70 combination. The K has not influenced the grain or straw yield.

REFERENCES

Ananthapadmanabhan, C. D., R. Appadurai and K. A. Seshu. 1967. Optimum dose of fertiliser for *ragi* in the Lower Bhavani Project. *Madras agric. J.*, 54 : (12)

Balasubramaniam, B., T. Kalyanikutty, V. Srinivasan, K. M. Palaniswamy and G. Purushothaman. 1967. Calcium ammonium nitrate - A fertilizer to Paddy. *Madras agric. J.*, 54 : 127-30.

Chavan, V. M. and P. Y. Shendge. 1955. Intensive cultivation of *Nagli* in Bombay State. 1. *bid*, 46 : 180-82.

Chinnasami, K. N., S. Kannan and Rajarathinam. 1967. Response of ragi to calcium ammonium nitrate. *Fert. News*, 12 (9) : 31.

Devine, J. R. and Holmes. 1963. Field experiments comparing ammonium nitrate, ammonium sulphate, calcium nitrate and urea combine drilled with spring barley. *J. agric. Sci.*, 61 : 381-90.

*Gericke, S. 1967. Results of phosphate fertiliser trial. *Phosphorsaure*, 27 : 47-78. (*Soils and fert*, 31 (1) 559.

Gingrich, J. C. and F. W. Smith. 1953. Investigation of small grain response of N P K on several kansas soils. *Soil Sci. Soc. Am. Proc*, 17383-386.

Govindarajan, S. V and B. V. Venkatrao. 1952. Manures and fertilisers their efficient and effective use for increasing crop production. *Mysore agric. J.*, 51 : 214-19.

*Griffith, G. A. P. and W. R. Mills. 1958. Department of Agriculture record of investigation No. 2 1949-50, 25 (*Emp. J. Expt. agric.*, 26 : 373-78).

Herron, Grines and Musick. 1963. Response of corn to nitrogenous fertiliser. *Agron. J*, 55.

Karunakara Shetty, B. 1961. Studies on the effect of graded doses of nitrogen on the yield potentials of popular *ragi* strains of the Madras State. M. Sc. (Ag.) dissertation Univ. Madras (Unpub.)

Kolandaiswamy, S. 1964. Effect of spacing and split doses of nitrogen on CO 7 *ragi* M. Sc. (Ag.) dissertation Univ. Madras (Unpub.)

Mariakulandai, A. and Morachan, Y. B. 1966. Results of manurial trial in Madras State on millets. Part II *ragi, samai* and *panivaragu*. *Madras agric. J.*, 53 : 207-12.

Michael Raj, S., K. Mahudeswaran and A. Shanmugasundaram. 1965. Response of *ragi* crop to potash fertilizers. *Madras agric. J.*, 52 : 465-66.

Miller, G. D., C. W. Deyo, T. L. Walter and F. W. Smith. 1964. Varieties in protein levels in Kansas Sorghum grain. *Agron. J.*, 56 : 302-4.

Mustaffa, S. P. and D. J. Durairaj. 1968. Effect of phosphate carriers and doses on yield of CO 7, *ragi* in major soil groups of India. *Madras agric. J*, 55 : 569-74.

Narasimhamoorthy, K. 1952. Economic dose of groundnut cake (as manure) for enhancing yields of irrigated ragi. *Madras agric. J*, 34 : 183-4.

Pande, P. S. *et al.* 1954. Brief note on research work done in jowar in Bombay State. *Poona Agri. Coll. Mag.* 45

Panikar, M. R. 1958. Co-ordination of Agricultural Research in India. *Chemistry and Soil Sci.*, 4. ICAR., *New Delhi.*

Ramakrishnan Nair, K. 1963. Response of CO 7 *ragi* to phosphate and potash. Dissertation Univ. Madras.

Ranganathan, A. K. 1962. Influence of spacing and manuring on the yield of irrigated *ragi*. M. Sc. (Ag) dissertation Univ. Madras (Unpub.)

Raniperumal, L. Mohamed Gouse, and R. Soundararajan, 1969. Effects of continuous application of fertilizers and manure on yield and composition of certain crops. 1. Effect on *ragi*. *Madras agric. J.*, 56 : 58-63.

Russel, E. J. 1961. Soil conditions and plant growth Longmans XI edd.

Sharma, K. C., N. C. Saxena, S. C. Modgal and K. L. Arora. 1958. Response of Ganga Hybrid maize to different sources of nitrogen in Tarai. *Fert. News*, 13 : (4).

Thompson, L. M. 1957. *Soils and Soil Fertility*. Mc Graw Hill Book Company Inc., New York.

Miller, C. E. 1958. *Soil Fertility*. John Willy and Sons Inc., New York.

Krantz, B. A. and W. V. Chandler. 1954. Advances in Agronomy, 8 : 362.

Wabersick, R. 1967. Long term fertiliser trial at Bernburg Soils and Fertiliser, 31 (1).

Stanberry, C. O., H. A. Schreiber, M. Lowrey and C. L. Jenson. 1963. Sweet corn as moisture and nitrogen variable. *Agron. J.*, 55 : 159-61.