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The composition of the Ragi grain and straw as affected by the application of farm yard manure and Superphosphate Fertilizer[*]

by

U. S. SREE RAMULU[1] and A. MARIAKULANDAI[2]

Synopsis: The influence of Phosphorus as present in Farm yard manure and in superphosphate on the composition of *ragi* crop was studied in a field experiment at Coimbatore and the results are discussed in this paper.

Introduction: While increasing the yields of the crops, attempts should be made to maintain the nutritive value or the quality of its grain and straw. Manuring has been known to have an influence on the composition of grain and straw. Since phosphatic fertilising has been known to influence the nutritive value of the grain, this study was taken up to find out the influence of farm yard manure and superphosphate on equal phosphorus basis on the quality of the *ragi* Crop.

Review of Literature: Blair and Prince (1939) reported that the percentage of phosphorus in the Alfalfa leaf showed a tendency to increase with increased amounts of phosphorus application and there was a variation in the potash content of the plant but this variation was not regular. Further, they reported that there was no variation in the nitrogen and calcium contents of the plant and also no increase in the yield. Smirnov and Pleskov (1955) reported higher increased uptake of phosphorus by potatoes when superphosphate alone was applied than in combination of superphosphate and compost. Srivatsava, Biswas and Das (1955) reported significant increase in the total uptake of phosphorus in treatments receiving superphosphate or combination of superphosphate and farm yard manure, but indicated that organic manure had no appreciable effect on the total phosphorus content of wheat grain. Mariakulandai and Soundararajan (1958) working on the composition of *sorghum* grain in the long term manurial plots of Coimbatore, found an increase in the total phosphorus content of the grain in the phosphorus treated plots. Sree Ramulu, Daniel and Mariakulandai (1959) in addition to reporting similar results in paddy had reported that increasing the dosage of phosphorus did not have any influence on the nitrogen or lime content of the grain but resulted only in an increased yield. Takahashe, Yanagiswa *et al* (1955) reported only slight increases in the phosphorus content of the plant in spite of heavy applications of superphosphate. Weinmann (1953) found little effect on the composition of maize grain due to fertilizer application.

On the influence of phosphorus on the absorption of other nutrients, Sen and Sircar (1943) reported that supply of phosphorus controlled the absorption of nitrogen and greatest absorption of nitrogen occurred at the highest levels of

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1. Assistant Lecturer in Chemistry, A. C. & R I., Coimbatore. (Now doing Ph. D. in U. S. A.). 2. Professor of Agronomy and Associate Dean, A. C. & R. I., Coimbatore.

phosphorus in wheat. Chaves Sanchez and Gonzalez Gracia (1956) found that the increasing of phosphorus level decreased the nitrogen content but rapidly increased the potash and phosphorus in wheat grain. Gupta and Das (1954) reported a depression in protein content with phosphorus treatments and slight increase in in the calcium content of the grain but no significant correlation between anyone in the wheat crop. Lewis Nielson (1956) reported a decrease in the absorption of calcium and magnesium with increase in potash in corn. Venkata Rao and Govindarajan (1956) recorded a depressing effect on the phosphorus and nitrogen content of straw in ragi and a favourable influence on the grain formation as against purely vegetative growth with increased application of phosphorus. They observed an inter-relationship between the nitrogen content and phosphorus availability.

Regarding the variation in the nutrient contents of a crop during growth, Acharya (1931) reported that the phosphorus content of *sorghum* crop reached the maximum at the seedling stage corresponding to the root development and at the grain formation stage. In view of the absence of any data on the above aspects of the crop, this work was taken up with two sources of phosphorus viz. superphosphate and farmyard manure, on *ragi* crop.

Materials and Methods: Two strains of *ragi* (Co. 1, long duration and Co. 7, short duration) were used in a field experiment that was conducted at Coimbatore, with the following treatments:

Treatment	1	Control–No manure.
Treatments	2 to 5	Farm yard manure to supply 10, 20, 30 & 40 lb. P_2O_5 per acre respectively.
Treatments	6 to 9	Superphosphate to supply 10, 20, 30 & 40 lb. P_2O_5 per acre respectively.
Treatments	10 to 15	Combination of farm yard manure and superphosphate to supply 20, 30 & 40 lb. P_2O_5 per acre.

Treatment No.	Farm yard manure to supply		Superphosphate to supply	
10.	10 lb. P_2O_5	per acre	+ 10 lb. P_2O_5	per acre
11.	10	,,	+ 20	,,
12.	10	,,	+ 30	,,
13.	20	,,	+ 10	,,
14.	20	,,	+ 20	,,
15.	30	,,	+ 10	,,

Plot size: 20' × 6' Split plot design.

Net Plot: 18' × 5' Number of replications: 3

The crop was sown in the nursery on 10—3—1959 and was transplanted on 1—4—1959 and 2—4—1959 in the field. The effect of the treatments on the yields of grain and straw and on the soil have been reported in an earlier paper by the authors in 1963.

For chemical analysis of plant material during the growth period, five plants were drawn at random from each treatment between 6 and 10 a. m. every time. Sampling was done at an interval of one month from the date of sowing to the date of harvest. All the plant material samples were analysed by the A. O. A. C. methods.

Results: *Composition of grain and straw:* The results of chemical analysis of plant material are furnished in tables I and II. In all the treatments the phosphorus content of the straw was more at the time of harvest than at the flowering stage and maximum was reached in plots receiving 30 lb. P_2O_5 per acre. The phosphorus content of straw was more in plants from the superphosphate plots than the farm yard manured plots. In most cases, the phosphorus content of the straw in the farm yard manured plots was either less or equal to that of the control. The straw from the plots receiving both the forms of phosphorus had higher phosphorus content than the straw from the plots receiving farm yard manure alone on equal phosphorus basis. Among the final straw samples, the straw from the plots receiving low proportion of farm yard manure with high proportion of superphosphate had either equal or slightly less phosphorus content than those from the plots receiving higher amounts of farm yard manure and low proportion of superphosphate.

The phosphorus content of the grain from the farm yard manured plots increased upto 20 lb. P_2O_5 per acre level and then decreased at higher levels. The phosphorus content of the grain from the super phosphate treated plots increased with increasing doses of superphosphate application to the soil, the increase being more marked at 20 lb. P_2O_5 per acre level. In general, the phosphorus content of grain was more than the control in all the manured plots. The phosphorus content of the grain from the plots receiving low amounts of farm yard manure with high amounts of superphosphate had higher phosphorus content than the grain from the plots receiving high amounts of farm yard manure with low amounts of superphosphate, possibly due to the higher availability of phosphorus during the complete growth of the crop in the former case. (Sree Ramulu and Mariakulandai, 1962). So, the results of this experiment is in accord with those of Srivatsava, Biswas and Das (1955), and Mariakulandai (1959).

Potash content: The Potash content of the straw was the lowest at the time of harvest than at the end of the first month or at the flowering stage. At the harvest time the straw from the superphosphate treated plots had more potash content than that from the farm yard manured plots. There was no regular variation in the potash content of the straw.

TABLE I.

Variation in the Composition of Ragi Straw (at different periods of Growth) and Ragi Grain due to Manuring. Co. 1. Ragi.

S. No.	Amount of phosphorus (P_2O_5) supplied as		Ragi straw												Ragi grain				
			Moisture %			Phosphorus (P_2O_5) %			Potassium (K_2O) %			Calcium (CaO) %							
	Farm yard manure	Superphosphate	20—4—'59	20—5—'59	Harvest	20—4—'59	20—5—'59	Harvest	20—4—'59	20—5—'59	Harvest	20—4—'59	20—5—'59	Harvest	Moisture %	N %	P_2O_5 %	K_2O %	CaO %
1.	Control		7·7	8·1	9·7	0·67	0·51	0·71	2·98	3·30	2·45	3·16	1·65	1·15	10·9	1·13	0·57	1·27	0·85
2.	10 lbs.+...		5·6	5·7	12·5	0·65	0·53	0·78	2·51	3·34	2·42	2·66	2·34	2·13	11·6	1·22	0·68	1·57	0·77
3.	20 lbs.+...		8·4	7·8	12·3	0·66	0·67	0·69	2·68	2·43	2·32	2·50	1·90	1·62	10·3	1·10	0·78	1·59	0·57
4.	30 lbs.+...		8·6	6·1	9·6	0·68	0·68	0·65	2·60	3·62	1·99	2·52	2·16	1·92	11·0	1·40	0·75	1·67	0·58
5.	40 lbs.+...		5·4	6·3	12·9	0·73	0·73	0·66	2·05	3·86	2·68	2·80	2·29	1·81	11·0	1·25	0·65	1·73	0·81
6.	...	+10 lbs.	4·9	8·9	9·7	0·68	0·73	0·80	2·81	3·42	2·54	2·63	2·47	1·57	11·5	1·34	0·60	1·46	0·83
7.	...	+20 lbs.	3·9	7·4	6·5	0·78	0·68	0·99	2·83	2·91	2·99	2·08	1·86	1·75	8·8	1·33	0·71	1·81	0·85
8.	...	+30 lbs.	8·2	10·7	10·1	0·93	0·72	0·76	3·92	3·18	2·35	2·72	1·95	1·50	11·4	1·25	0·73	1·81	0·75
9.	...	+40 lbs.	6·0	5·6	12·9	0·96	0·89	0·78	3·60	2·74	2·55	2·96	1·67	1·41	11·3	1·35	0·74	1·50	0·72
10.	10 lbs.+10 lbs.		7·1	10·7	11·9	1·01	0·80	0·73	4·60	3·31	2·30	3·54	2·29	1·20	11·4	1·30	0·69	1·95	0·76
11.	10 lbs.+20 lbs.		10·4	11·1	9·1	0·87	0·61	0·78	4·05	3·68	2·62	3·39	2·03	1·44	10·5	1·22	0·73	1·84	0·62
12.	10 lbs.+30 lbs.		3·0	7·4	6·2	0·84	0·82	0·82	3·83	2·53	2·19	2·50	1·93	1·57	8·7	1·15	0·75	1·37	0·56
13.	20 lbs.+10 lbs.		9·9	9·5	11·6	0·71	0·89	0·77	2·15	2·64	2·41	2·38	2·18	1·43	11·8	1·52	0·71	1·74	0·74
14.	20 lbs.+20 lbs.		8·0	3·3	13·2	0·78	0·7	0·74	2·48	2·75	2·30	2·92	2·66	1·71	9·9	1·49	0·65	1·59	0·61
15.	30 lbs.+10 lbs.		6·3	5·1	9·9	0·68	0·75	0·81	1·75	2·79	2·44	2·52	1·78	1·63	9·6	1·16	0·64	1·60	0 68

TABLE II

Variation in the Composition of Ragi Straw (at different periods of Growth) and Ragi Grain due to Manuring. Co. 7. Ragi.

S. No.	Amount of phosphorous (P_2O_5) supplied as		Ragi straw												Ragi grain				
			Moisture %			Phosphorus (P_2O_5) %			Potassium (K_2O) %			Calcium (CaO) %							
	Farm yard manure	Superphosphate	20—4—'59	20—5—'59	Harvest	20—4—'59	20—5—'59	Harvest	20—4—'59	20—5—'59	Harvest	20—4—'59	20—5—'59	Harvest	Moisture %	N %	P_2O_5 %	K_2O %	CaO %
1.	Control		7·4	4·8	11·7	0·54	0·73	0·92	2·68	3·47	2·40	2·64	1·99	2·12	12·6	1·21	0·68	1·25	0·75
2.	10 lbs.+...		7·7	6·4	11·2	0·57	0·81	0·83	2·79	3·52	2·38	2·93	2·03	2·14	11·8	1·45	0·68	1·29	8·57
3.	20 lbs.+...		9·4	4·9	11·4	0·92	0·52	0·81	3·30	3·39	2·34	2·17	1·62	2·03	10·5	1·23	0·75	1·34	0·87
4.	30 lbs.+...		6·9	8·5	10·9	0·93	0·51	0·89	4·65	2·22	2·30	3·15	2·18	2·28	11·3	1·29	0·72	1·40	0·82
5.	40 lbs.+...		11·2	8·7	11·0	0·80	0·71	0·84	4·84	2·85	2·19	2·02	1·85	1·97	10·6	1·29	0·69	1·36	0·77
6.	...	+10 lbs.	7·1	6·7	11·6	0·55	0·58	0·96	3·11	2·68	2·57	2·73	2·11	2·53	11·4	1·31	0·68	1·35	0·68
7.	...	+20 lbs.	11·6	8·2	7·1	0·66	0 61	0·98	3·48	2·74	1·55	2·94	1·78	1·86	8·7	1·16	0·73	1·32	0·75
8.	...	+30 lbs.	8·2	9·9	11·1	0·76	0·73	1·05	3·50	2·63	1·34	2·29	2·03	2·14	10·7	1·29	0·77	1·31	0·78
9.	...	+40 lbs.	6·9	11·5	10·7	1·04	0·67	0·98	3·26	3·42	2·21	2·49	1·64	2·19	11·2	1·55	0·89	1·51	0·83
10.	10 lbs.+10 lbs.		7·5	9·4	12·6	0·67	0·61	0.85	2·80	4·26	1·88	2·46	2·07	2·09	11·4	1·62	0-79	1·55	0·94
11.	10 lbs.+20 lbs.		7·4	9·3	10·1	0·57	0·79	0·91	3·82	3·10	1·88	2·42	1·90	2·08	9·7	1·45	0·88	1·63	0·79
12.	10 lbs.+30 lbs.		7·8	11·1	6·9	0·56	0·93	0·71	3·14	3·05	1·37	2·46	1·82	1·93	10·3	1·40	0·89	1·43	0·79
13.	20 lbs.+10 lbs.		11·3	9·8	8·8	0 78	0·78	0·87	2·31	2·81	2·65	2·42	1·65	1·41	11·5	1·37	0·70	1·74	0·93
14.	20 lbs.+20 lbs.		10·2	10·5	11·0	0·62	0·80	1·05	2·25	2·74	2·75	2·72	1·70	1·76	11·3	1·32	0 70	1·47	0·99
15.	30 lbs.+10 lbs.		8·2	10·0	8·3	0 58	0·49	1·02	3·76	3·23	2·79	2·13	1·85	1·90	9·1	1·21	0·70	1·52	0·95

The potash content of the grain was increased by manuring but this increase was not in regular sequence. The increase was more in treatments receiving both the forms than in individual applications.

Calcium content: In the short duration *ragi*, there was a gradual decrease in the calcium content of the straw up to the flowering time and again an increase in the calcium content at the harvest time. But in the case of long duration *ragi*, there was a gradual decrease of the calcium content of the straw from the first month to the harvest time. In general, at the harvest time the *ragi* straw from superphosphate treated plots was less than those from farm yard manure plots. Similarly in most of the treatments receiving both forms of phosphorus, the straw had lesser amounts of calcium than the straw from the farm yard manure plots. Higher calcium content of straw was observed in the plots receiving high amounts of farm yard manure and low amounts of superphosphate in the case of short duration crop. There was very little difference between the two in the case of long duration crop.

The calcium content of Co. 1 grain was depressed due to manuring. In Co. 7 *ragi* grain, the calcium content was depressed only in a few cases. The result of this experiment is in accord with the views of Gupta and Das (1954) and Lewis Nielsen (1956).

Nitrogen content of grain: The Nitrogen content of grain was increased in all cases due to manuring. The variation was not regular in the case of Co. 1 grain, but still the treatments receiving both forms of phosphorus had higher content of nitrogen than those receiving only one form. Among the combinations, the grain from plots receiving low amounts of farm yard manure with high amounts of superphosphate had higher nitrogen content than those with high amounts of farm yard manure and low amounts of superphosphate. The results achieved in this experiment show an increase in nitrogen content due to the application of fertilizers or manures, while many workers have reported a decrease of the same due to phosphate fertilisation. However results obtained in this experiment showed that from the point of view of composition of grain and straw, the combinations with low amounts of farm yard manure and high amounts of superphosphate seem to be preferable to all other combinations and also to individual application of farm yard manure or superphosphate at the same phosphorus level.

Summary: The influence of phosphorus as present in farm yard manure and in superphosphate on the composition of *ragi* crop was studied. They were applied individually and also in combination of both, at equal P_2O_5 levels. Superphosphate was more effective in raising the phosphorus content of the grain and straw, than the farm yard manure on equal phosphorus basis. Increasing the amounts of farm yard manure had a depressing effect of the phosphorus content of the straw. Application of phosphatic manures increased the potash and nitrogen content but depressed the calcium content of the grain. The potash content of the plants exhibited a certain antagonism to the calcium

content of the plant. Maximum calcium content was found at the end of one month and subsequently reached a minimum and again increased slightly up to the harvest time. From the above facts, it is seen that the phosphorus when applied as a combination of superphosphate and farm yard manure, the latter being in low amounts, (i. e. 10 lb. P_2O_5 per acre or approximately 4 to 5 tons per acre of farm yard manure contain 0·1% P_2O_5) was better than applying them separately. Between superphosphate and farm yard manure, superphosphate was better than farm yard manure considering the composition of grain and straw of the *ragi* crop.

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REFERENCES

Acharya, C. N.	1931	Relation between growth and uptake of nutrients in *cholam*. Madras agric. J. **19** : 157–68.
Blair, A. W. and A. L. Prince	1933	Influence of organic matter on crop yield and C : N ratio : Soil Sci. **52** : 63–81.
Chaves-Sanchez M. and Gonzalez gracia	1956	Influence of fertilizers on yield and composition VI Cong. Inst. Sci. Soil Rapp. D. 231–38.
Gupta, Y. P. and N. B. Das	1954	Quality of wheat as affected by manure, J. Indian Soc. Soil Sci. **12** : 121–26.
Lewis Nielsen	1956	*Mineral nutrition of corn*. Adv. in Agron. Academy Press, New York.
Mariakulandai, A. and R. Soundararajan	1958	Phyt in phosphorus content of grain. Madras agric. J. **48** : 185–88.
Official methods of A. O. A. C.	1955	Published by A. O. A. C. Washington.
Smirnov, P. M. and B. P. Pleshkov	1955	Effect of N, K and organic matter on phosphorus content. Doks. Akad. Nawk. **102** : 673.
Sree Ramulu, U. S., F. L. Daniel and A. Mariakulandai	1959	Effect of manuring on the composition of paddy grain, Madras Agric. J. **46** : 17–18.
Sree Ramulu, U. S. and A. Mariakulandai	1962	Assessment of available phosphorus status of soils. Madras agric. J. **49** : 247–53.
Sree Ramulu, U. S. and A. Mariakulandai	1963	Influence of phosphate manuring on the available nitrogen, pH and organic carbon of the soil Madras agric. J. **50** : 455–62.
Srivatsava, B. N., J. D. Biswas and N. E. Das	1955	Influence of manure and fertilizer on wheat. J. Indian Soc. Soil Sci. **3** : 33–40.
Takashi, Yanagisawa, Kono *et al.*	1955	Studies on nutrients absorption by crops. Bull. Nat. Instt. Agri. Sci. Tokyo B. **11** : 36–39.
Venkata Rao, V. and S. V. Govindarajan	1956	Influence of phosphate on *ragi* Mysore Agric. J. **31** : 214–19.
Weinmann	1956	Chemical composition and nutrient uptake of maize. Rhod. Agri. J, **53** : 168–81.