4). Judged for many aspects TMV 9 among bunch, TMV 6 among semi-spreading and TMV 3 among spreading possess all desirable features leading to increased yielding potentiality. Yield is thus governed by a complex interaction where by flower production is governed by percentage of fertilization and efficiency in pod development.

REFERENCES

ENYI, B. A. C. 1973. Effect of Plant population on growth and yield of soybeans *(Glycine Max) J. agric. Sci*, 81, 131-138

FORTANIER, 1957. De beinvoloeding vande block van *Arachis hypogaea* L. Thesis. Wagenigen

JAYAMOHAN RAO, V., VIDYASAGAR RAO, K. and HARNARAYAN G. 1975 Sub-Specific variation for pod and seed characters in groundnut. *Indian J. Genet.* 35 399-402

MUHAMMAD, S. V., and DORAIRAJ, M. S. 1969. Flowering pattern and reproductive efficiency in bunch varieties of *Arachis hypogaea* I. *Madras agric. J. 56*: 239-243

RAMANATHAN, T., BALASUBRAMANIAN, V. and RAMACHANDRAN, M. 1970. TMV 7-A new bunch groundnut strain. *Madras agric J. 57*: 234-238

SMITH, B. W. 1950. *Arachis hypogaea*-Aerial flowering and subterranean fruit *Amer. J. Bot. 37*: 802-815

UMEN D. P. 1976. Biology of peanut flowering part II. Amerin Publ. New Delhi.

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EFFECT OF PYRITES AND FERTILIZER ON YIELD OF RICE IN A CALCAREOUS ALKALI SOIL*

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An experiment was conducted on Tirhut Agricultural College Farm, Dholi [Muzaffarpur], Bihar during *kharif* seasons of 1974 and 1975 to find out the effect of pyrites and fertilizers on growth and yield of rice. The treatments consisted of five levels of pyrits [0, 1.5, 3.0, 4.5 and 6.0 tonnes/ha] alloted to main plots treatments and five levels of fertilizers [0, 25, 50, 75 and 100 per cent of the recommended dose of NPK] in the sub-plots. The test varieties were IR 20 during 1974 and Sita in 1975. The maximum grain yield and net return was obtained with the application of 1.5 t/ha of pyrites during 1974 and 1975. Grain yield and net return was maximum with 100 per cent recommended dose [100 N, 60 P_2O_5 and K_2O kg/ha] of fertilizers. Interaction was not significant.

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The calcareous alkali soils in Uttar Pradesh and Bihar account for more than 1.3 million hectares. Normally sulphur and gypsum are used for reclaiming these soils. But Mc George and Greene (1935) reported that though shlphur can be used with advantage to reclaim these lands, it is oxidised so slowly that it is considered relatively ineffective. More over, sulphur is costly and not easily available in the country. Similarly the rate of reaction of gypsum is limited by its extremely low solubility. On the other-hand pyrites has the advantage of liberating large volume of carbondioxide in the soil (Kelly, 1951). This lowers the pH value and through mobilizing native calcium helps in the reclamation process. Hence pyrites (a by product of M/s Pyrites, Phosphates and Chemicals Limited, Amjhore, Dehri-on-Sone, Rohtas district) which is available in abundance in Bihar at a comparatively cheaper rate can be used for reclaiming calcareous alkali soils. Bhumbla and Abrol (1972) reported that the yield of rice was increased by 35 per cent due to pyrites application. Apart from a few laboratory studies, there was no field study at Dholi-Pusa (Bihar) to evaluate the agronomic usefulness of the pyrites. Having this in view, the investigation was carriedout to findout the effect of pyrites and fertilizers on the yield of rice.

MATERIALS AND METHODS

Field experiments were conducted during *kharif* 1974 and 1975 on the Tirhut Agricultural College Farm, Dholi (Muzaffarpur), Bihar. The soil of the experimental field was calcareous alkali (32 2% free $CaCO_3$) with pH 9.58, EC 0.495 m mhos/cm at 25°C, organic carbon 0.23%, available N 560 kg/ha, available P_2O_5 11.2 kg/ha and water soluble sodium 5.6 me/litre. The test variety was IR 20 in 1974 while in 1975 Sita, a variety released by Rajendra Agricultural University and reported to be resistant to blast was used. The spacing adopted was 15x 15 cm in both the years. The treatments consisted of five levels of pyrites (0, 1.5, 3.0, 4.5 and 6.0 tonnes/ha) and five levels (0, 25, 50, 75 and 100 per cent) of the recommended dose of fertiliser which is 100 kg N, 60 kg P_2O_5 and 40 kg K_2O / ha. The levels of pyrites were alloted to main plot and fertiliser dose to sub-plots. The experiment was laid out in split plot design replicated four times. Pyrites application was done one month before transplanting the crop. The composition of the pyrites used in the experiment is given in Table 1. Pyrites was thoroughly mixed in the top 10 cm of the soil as per the treatmental schedules and then irrigation was given to allow leaching. Nitrogen was given in three equal splits i.e. at transplanting, maximum tillering (30 days after transplanting) and at panicle initiation stages.

RESULTS AND DISCUSSION

1. Yield

Effect of pyrites application

In 1974 a higher grain yield of 17.3 q/ha was obtained with the

application of 3.0 tonnes/ha of pyrites which was 20.14 per cent more than in no pyrites application. In 1975 an yield of 16.2 q/ha was obtained with 1.5 tonnes/ha which was 11.34 per cent more than in no pyrites. The straw yield due to pyrites treatments did not differ significantly. The differences in the effect of pyrites during 1974 and 1975 may be due to the differential rate of oxidation of sulphur contained in pyrites to sulphuric acid which is influenced by several factors like temperature, moisture content and oxygen availability etc. (Anonymous, 1981). Singh *et al.* (1978) reported under controlled laboratory conditions that as the soil water content decreased, the drop in soil pH was correspondingly less which had an influence on the rate of oxidation. A rainfall of 1565 mm in 1974 and 897.7 mm in 1975 was received during the period from mixing pyrites in the soil to the harvest of the crop. The heavy and continuous rainfall during 1974 might have caused more favourable conditions for reaction of pyrites with salts which may be responsible for a higher level of response in 1974 compared to 1975. The yield attributes were not influenced by application of pyrites.

Table 1 Composition of pyrites

Nutrient		Nutrient	
Total S	15 to 20%	Alumina	8 to 12%
Total Fe	17 to 23%	Arsenic	Traces
Carbon	1.7 to 3%	Mg	0.5%
Silica	35 to 42%	Zn	80 ppm
pH of acquous Extract (1 : 2.5)	2.8	Mn	60 ppm

EFFECT OF FERTILIZATION

Maximum grain yield of 20.70 q/ha and 17.83 q/ha was obtained with the 100 per cent recommended dose of fertilizers during 1974 and 1975 respectively and it was significantly superior to the rest of the doses. The full dose of fertilizers also gave higher straw yields of 39 45 q/ha and 35 83 q/ha in 1974 and 1975 respectively. The yield attributes were not influenced by fertilizer doses. Rejput (1979) based on experiments at Kanpur and Indore, showed that typical sodic soils under reclamation gave increased yields of paddy and wheat with increased levels of fertilizer nitrogen in the soil. Verma and Abrol (1980) concluded from the field

experiments conducted at Karnal (Haryana) that application of pyrites and fertilizers increased the yield of paddy and wheat. The results obtained from this present study is in confirmity with the results reported by Rajput (1979) and Verma and Abrol (1980).

The interaction was not significant in its effect on yield of rice during both the years of experimentation.

Table 2 Chemical characteristics of soil before and after mixing pyrites in soil

Soil characteristics	Before mixing pyrites	At harvest (After mixing pyrites in soil)
pH	9.58	9.16
E. C. (m mhos/cm)	0.50	0.25
Organic carbon (%)	0.23	0.38
Available P_2O_5 (kg/ha)	11.20	18.59

2. Chemical characteristics of soil

The initial chemical analysis of soil sample collected before mixing pyrites showed that the pH was 9.58, electrical conductivity 0.50 m mhos/cm at 25°C, organic carbon 0.23% and available P_2O_5 11 20 kg/ha. However, the analysis at harvest showed that pH and EC of the soil had undergone change. There was reduction in pH and EC and increase in available P_2O_5 which indicated that application of pyrites had a role in bringing about favourable changes in soil conditions for better crop production and fertilizer use efficiency.

3. Economics

The average cost of fertilizer doses was included uniformly for calculating the economics due to pyrites application. Similarly the average cost of pyrites doses was included uniformly for calculating economics due to fertilizer doses.

The economics was not favourable when pyrites alone was considered for a single crop. It is known that the pyrites application will have residual effect on the succeeding crop and in that situation it will give a favourable return.

It may be noted that slightly negative return was obtained under no fertilizer which is due to the fact that the average cost of pyrites doses was included in cost of cultivation for calculating economics. Pyrite application together with ferti-

Table 3 Yield and profit as influenced by pyrites and fertiliser doses

Treatments	Grain yield (q/ha)			Straw yield (q/ha)			Net return (Rs./ha)*		
	1974	1975	Mean	1674	1975	Mean	1974	1975	Mean
Pyrites doses (tonnes / ha)									
0 (Control)	14.40	14.55	14.48	26.30	29.70	28.00	983	1047	1015
1.5	15.80	16.20	16.00	29.95	24.57	27.26	1060	1086	1073
3.0	17.30	13 80	15.55	31.95	27.10	29.53	1154	405	780
4.5	14.70	13.08	13.89	27.70	26.78	27.24	350	17	184
6.0	14.00	12.13	13.07	27.00	28.03	27.52	-22	-386	-204
C. D. 5%	1.97	1.36	—	NS	NS	—	—	—	—
Fertiliser doses (% recommended dose)									
0 (Control)	9.70	9.93	9.82	19.05	16.35	17.70	-30	-11	-21
25	12.30	12.83	12.57	24.90	23.90	24.40	299	395	347
50	15.60	13.80	14.70	28.10	27.23	27.67	765	396	581
75	17.90	15.58	16.74	31.40	32.88	32.14	1008	559	784
100	20.70	17.83	19.27	39.45	35.83	37.64	1423	812	1118
C. D. (5%)	1.18	1.15	—	2.20	3.06	—	—	—	—
Interaction [PxF]	NS	NS	—	NS	NS	—	—	—	—

* Rounded off to nearest rupee.

Cost of paddy grain Rs. 2.00/kg
Cost of wheat grain Rs. 2.50/kg
Cost of straw [Paddy] Rs. 0.10/kg
Cost of Pyrites Rs. 0.15/kg
Cost of N Rs. 4.90/unit
Cost of P_2O_5 Rs. 5.50/ ,,
Cost of K_2O Rs. 2.10/ ,,

lizer application at all doses gave a consistant increase in net return.

From these results it is evident that for the calcareous alkali soils of North Bihar, application of pyrites at the rate of 1.5 tonnes/ha together with full (100 N, 60 $P_2 0_5$, 40 $K_2 0$ kg/ha) recommended dose of fertilizers was most beneficial for the rice crop.

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REFERENCES

ANONYMOUS 1981. Pyrites in the reclamation of alkali soils. Pyrites, Phosphates & Chemicals Ltd., Dehri-Onsone, Rohtas. Bihar.

BHUMBLA, D. R. and ABROL, I. P. 1971-72. Saline and alkali soils in India, their occurence and management. World Soil Resources, FAO Rept No. 41 : 41-51.

KELLY, W. P. 1951. Alkali soils, New York. p. 135.

Mc GEORGE, W.T. and GREENE, R. A. 1935. Oxidation of sulphur in Arizona soils and its effect on soil properties. Ariz. Agr. Expt. Stat. Tech. Bull. 59. [C. f. Thorne, D. W. and Peterson, H. B. 1954. Irrigated soils and their fertility and Management. 2nd edition. Tata Mc Graw Hill Publishing Company Ltd.]

RAJPUT, R. K. 1979. Research on water management and soil salinity. ICAR Progress report 1977-79.

SINGH, N. T., HIRA, G. S. and SINGH, R. 1978. Proc. Seminar, FAI-PPCL, Lucknow.

VERMA, K. S. and ABROL, I. P. 1980. Int. Symp. Salt affected soils, Karnal : 330.