

## EFFECT OF FERTILIZER FRITS ON WHEAT

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Fertilizer frits, prepared in PCSIR Laboratories, Karachi, were tried on Paven and Sonnah varieties of wheat. In the presence of frits, wheat seeds plated in petridishes, germinated earlier and grew faster than those without it. On application of 200 mg. of frits/pot, the plants matured one week earlier than control and a 30% increase in yield was also observed. Application of large quantities of frits did not show any corresponding increase in yield.

*Key words:* Wheat, Frits, Micronutrient.

### INTRODUCTION

Wheat is the staple food of Pakistani's and plays an important role in country's economy. Introduction of modern varieties and innovation of improved practices have made Pakistan self sufficient in wheat production. However, due to ever increasing population, the need to have higher yields has become a continuous process. A judicious and balanced use of major and minor nutrients is essential to sustain productivity. This becomes still more important as soils [1,2] in Pakistan possess limitations in storing and supplying nutrient to crops. The present study deals with evaluation on a composition of micronutrients, badly needed by crop plants. These were prepared in the form of frits [3] and salts of zinc, iron, cobalt, manganese, copper, magnesium, boron, calcium, sodium and potassium were used in appropriate amounts. The study was divided in two parts. The first, being a preliminary investigation, was conducted in pots and the data thus obtained is presented here. The second part deals with field investigations and will be published separately.

### MATERIAL AND METHODS

Wheat seeds were grown on a sterilized cotton layer in petridishes and distilled water was used throughout the experiments. Two sets of petridishes (in triplicate) were arranged: one set contained 6.0 mg. of fertilizer frits; the other kept as control. Cotton layer was soaked with 100ml. distilled water at the time of sowing. Distilled water was added to petridishes as and when needed to keep the cotton moist. Fifteen seeds were plated in each petridish. After 20 days, the germinated seedlings were removed from petridishes and tillers (above ground plant parts) were

collected and analysed quantitatively using atomic absorption for  $\text{Cu}^{++}$ ,  $\text{Fe}^{++}$ ,  $\text{Zn}^{++}$  and  $\text{Mn}^{++}$ , colorimeter for  $\text{Co}^{++}$ , EDTA for  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$  and flame photometer for  $\text{Na}^+$  and  $\text{K}^+$ .

Sandy loam was used in pot experiments. Twenty-two pots, eleven each for Paven and Sonnah varieties were used. Varying quantities of frits (100 mg to 5000 mg) were separately added to 10 pots of each variety with 2 pots each were left as control. Four g. of nitrophos (23 - 23 - 0) and 100 g. of cow dung manure were added to each pot (both treated and control) at the time of sowing and another four g. of nitrophos was given to each pot at the time of seedling. Minute quantities of frit were thoroughly mixed with sand and spread on to the soil in pots numbered as T1 - T10. The control pots were numbered as C. The frits were added to the pots in the following proportions.

Frits (mg)	Control	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>	T <sub>7</sub>	T <sub>8</sub>
	(nil)	100	200	300	400	500	1000	2000	3000
		T <sub>9</sub>	T <sub>10</sub>						
		4000	5000						

Frits were applied to the treated pots at the time of sowing. Twenty seeds of each variety were separately sown in pots and watered. The pots were subsequently irrigated after four days and from then on weekly. Data on sowing, germination, maturity of the crop, average length of the plants, number and fresh weight of the plants, number and weight of seeds per spike were recorded.

### RESULTS

In treated petridishes (with frits), germination started after 24 hr and 90% seeds germinated within 48 hr, whereas



in controls (without frits) germination started after 48 hr and 80% seeds germinated after 90 hr. After 20 days, treated plants attained a height of 18.5cm. while that of control of 15.5cm.

In pot experiments there were significant differences in crop yield in controls as to treated plants (Table 1). The highest average increase in yield was recorded in plants where micronutrients were provided in proportions of 200mg. Plants with 100mg of frits show little increase in yield, though more than controls. Further increase in micronutrient supply to plants did not have any effect on the yield of plants. Significant differences were found in controls and treated plants with regard to growth rate. Treated plants grew faster than control and the differences begin to manifest themselves from germination till the maturity of the plant (Table 2). The maximum average height of plants for Paven and Sonnah, recorded after 49 days, was 53.3 and 42.4 cm. respectively. The average maximum height of the spike was 9.1 and 7.9 cm. in the treated and control plants respectively. Analysis of ash of wheat tillers show that ash from treated plants contain metals in a little more quantity than controls (Table 3).

#### DISCUSSION

The importance of micronutrients in agriculture is well known [2,4,5]. It is known that majority of the nutrients present in the soil are not readily and adequately taken up by the plant and their availability is restricted by soil, pH, and irrigation practices [6,7] etc. In the case of high yielding crops, the deficiency of micronutrients becomes

a limiting factor. Visual deficiency symptoms could well be distinguishable in green house experiments rather than in the fields. Soil analysis is of limited value in determining the nutrient requirements of a crop but the analysis of plant tissue could help and identify the nutrient requirements. This method has now been applied in many countries of the world including Hawaii, Mauritius and Australia [8].

Seeds of wheat, barley and oats etc. from plants grown with metal salts like boron, copper, iron, magnesium, manganese etc. gave a higher percentage of germination than the seeds from plants grown without micronutrients and seedlings produced from the later are more than half developed [4].

Petridish experiments do indicate the absorption of metals by plants, the absorption, though not so significant, was higher in treated plants. This low rate of absorption may be due to a short growing period of only twenty days. According to Patterson [9], the plant receives all essential elements from the seed itself till it develops roots and green leaves. On exhaustion of this source, the growth of the plant begins to slow down and ultimately stop. This, however, was not the case with treated plants where an additional supply of trace elements was available from fertilizer frits and hence better growth.

In pot experiments, the seeds germinated earlier in the treated pots than control (Table 1). The effect of metal absorption becomes more significant with the passage of time and treated plants grew faster than control (Table 3). These results are in conformity with those of Mokricuich and Vlasyuk *et al.* [10-11] on wheat, corn, sugar beet, peas, potatoes, etc, where the growth of above mentioned

Table 1. Effect of fertilizer frits on the average number and weight of grains per spike on Sonnah and Pavan varieties of wheat.

Experiment No.	Variety	Control					Treated					
		C	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>	T <sub>7</sub>	T <sub>8</sub>	T <sub>9</sub>	T <sub>10</sub>
Average number of grain/spike	Sonnah	38	46	48	48	47	48	48	47	48	47	47
	Pavan	38	46	47	46	42	47	42	44	42	44	46
Average weight of grain/spike (g).	Sonnah	1.7	2.21	2.24	2.20	2.30	2.3	2.26	2.22	2.28	2.21	2.21
	Pavan	1.7	2.2	2.21	2.24	2.24	2.2	2.19	2.3	2.26	2.22	2.22
Percent increase of yield over control	Sonnah	—	30.0	31.3	29.4	35.2	35.2	32.9	30.5	32.9	30.5	30.5
	Pavan	—	29.4	30.0	31.29	31.29	29.4	28.8	35.2	32.9	30.5	30.5



Table 2. Height of the plants in relation to time in control and treated plants.

Experiment No.	Maximum height of the plant after sowing (cm.)					
	10 days	17 days	24 days	31 days	38 days	49 days
(Var. Sonnah)						
C	8.9	15.24	20.32	21.6	29.2	31.10
T <sub>1</sub>	12.7	21.0	23.5	29.2	33.0	34.8
T <sub>2</sub>	15.2	21.0	29.2	35.0	39.4	42.4
T <sub>3</sub>	15.3	20.3	27.9	33.0	39.1	40.6
T <sub>4</sub>	13.9	20.3	25.4	26.7	30.5	31.8
T <sub>5</sub>	15.2	21.0	27.9	35.6	40.6	42.4
T <sub>6</sub>	12.7	16.5	25.4	33.0	34.3	36.1
T <sub>7</sub>	14.0	21.0	25.4	30.5	34.2	34.8
T <sub>8</sub>	11.4	21.0	14.1	25.4	30.7	35.0
T <sub>9</sub>	15.2	20.3	26.0	31.8	39.4	41.1
T <sub>10</sub>	12.7	21.0	25.4	33.0	39.6	42.2
(Var Pavan)						
C	8.6	12.7	26.8	31.0	36.8	51.0
T <sub>1</sub>	9.1	14.5	30.7	36.0	43.3	50.8
T <sub>2</sub>	9.7	18.3	33.0	37.3	44.4	53.3
T <sub>3</sub>	9.6	15.7	31.7	37.2	44.2	52.3
T <sub>4</sub>	9.5	15.5	32.2	37.1	44.2	52.1
T <sub>5</sub>	9.9	18.2	33.0	37.2	44.3	53.3
T <sub>6</sub>	9.9	15.4	31.8	36.8	44.2	52.07
T <sub>7</sub>	9.1	15.6	31.8	36.0	44.2	52.07
T <sub>8</sub>	9.4	15.7	32.3	36.7	44.2	52.07
T <sub>9</sub>	9.1	15.7	32.8	36.8	44.2	53.0
T <sub>10</sub>	9.4	15.7	32.5	36.9	44.2	53.3

Table 3. Ash analysis of wheat tillers (control and treated) showing percentage of various metals.

Element	Control	Treated	
		Sannah	Paven
Cu <sup>++</sup>	0.035	.037	.038
Zn <sup>++</sup>	0.16	0.17	0.171
Mn <sup>++</sup>	0.11	0.15	0.142
Fe <sup>++</sup>	0.41	0.42	0.42
Co <sup>++</sup>	NIL	NIL	NIL
Mg <sup>++</sup>	0.0062	0.0064	0.0078
Ca <sup>++</sup>	0.0021	0.0062	0.0047

plants increased with the uptake of nutritive substances, and especially of those which had been treated with mineral salts.

In the present investigation, it was observed that the yield of treated plants percentage wise was more significant as compared to controls due to the supply of fertilizer frits which contain B, Cu, Zn, Fe, Mn, and Mg, needed by the plants for growth and development. Many workers [5,9] have reported the function of each element, the main criterion being the absorption of metals by plants. Fertilizer frits used in present investigation contain the above minerals and slowly release them for easy assimilation. The metals so liberated are easily absorbed by the plant and help in increased growth and better yield.

The present study indicates that plants of both wheat varieties absorbed metals equally well from fertilizer frits and no adverse effects were noted from germination till harvesting on increasing quantities of fertilizer frit. This may possibly be due to the low solubility of frits in water and hence limited supply of metals. Experiments show that frits, when applied in the field, release metals at a rate of 3-8 ppm at each watering which is fairly safe for plant growth. Further investigations are in progress and results will be reported elsewhere.

#### REFERENCES

1. M. Yousuf Choudhary, *Progr. Farming*, 4, 4 (1984).
2. M. Saleem Saif, *Micronutrient Problem in Pakistan*, Pakistan Agr. (Nov. 1979).
3. M.A.A. Beg and M.S. Siddiqui, *A Process for the Production of Fertilizer Frits*, Pakistan Pat. Filed 24. 4. 1986.
4. Walter Stiles, *Trace Element in Plants* (Cambridge at University Press, 1961).
5. Tzo-Chaun Juang, Ming-Muh Kao and Chin-Hua Chang, Paper presented at ISSCT meeting Brazil (1977).
6. Arnon, *Crop Production in Dry Region*, (Leonard Hill Books, London, 1971), Vol. 1.
7. H.O. Buckman, and N.C. Brady, *The Nature and Properties of Soil* (McMillan Co. New York, 1969).
8. R.P. Humbert. *The Growing of Sugarcane*, (Elsevier, Amsterdam, 1968).
9. P.F. Peterson, *Wheat* (Interscience Publishers Inc., New York, 1965).
10. G.L. Mokricuich and G.M. Ignatinich *et al.*, *Root Nutrition of Plants and the Use of Frits as Fertilizers*, Chem. Abst., 10777h, 55(1961).

11. P.A. Vlasyuk, M.S. Darmanko and L.P. Khalabuda, *Effect of Fritted Trace Elements on the Yield of*

*Agricultural Plants*, Chem. Abst., 2726, 56, (1962); Chem Abst., 11592a, 57 (1962).

During the experiment, the following fertilizers were used: 1) 100% of the fertilizer was applied in the form of granules; 2) 100% of the fertilizer was applied in the form of frits; 3) 100% of the fertilizer was applied in the form of granules and frits; 4) 100% of the fertilizer was applied in the form of granules and frits with the addition of a trace element.

The results of the experiment show that the use of fritted fertilizers leads to a significant increase in the yield of wheat. The increase in yield is most pronounced when the fertilizer is applied in the form of frits. The addition of a trace element to the fertilizer also leads to an increase in yield. The results of the experiment are given in the following table.

MATERIALS AND METHODS

The experiment was conducted in a field near the village of ... The soil was ... The fertilizer was applied in the form of granules, frits, and a combination of granules and frits. The results of the experiment are given in the following table.

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