International Fertilizer Industry Association

ISMA* Joint Technical and Agricultural Meeting

Lausanne, Switzerland
24-27 September 1956

*In 1982, the name of the International Superphosphate Manufacturers' Associations (ISMA) was changed to International Fertilizer Industry Association (IFA).

International Fertilizer Industry Association - Secretariat: 28 rue Marbeuf - 75008 Paris - France
Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

ASSOCIATION INTERNATIONALE
DES FABRICANTS DE SUPERPHOSPHATE (I.S.M.A.)

COMITÉ AGRONOMIQUE

1 AVENUE FRANKLIN D. ROOSEVELT, PARIS 8e

(2)

JOINT TECHNICAL AND AGRICULTURAL MEETING

LAUSANNE (Switzerland) - Monday 24th - Thursday 27th SEPTEMBER, 1956.

PA/155

Subject 3

THE RELATIONSHIP BETWEEN PHOSPHATE AND MANGANESE

by Sigurd LARSEN,

(Levington Research Station, Fisons Ltd., United Kingdom)

In a paper presented to the I.S.M.A. Conference in Helsinki (1955), FRUHSTORFER discussed the influence of superphosphate on the availability of manganese in soils. When the superphosphate was applied in granular form, he concluded that the effect of superphosphate on manganese availability could be explained by an increased acidity in the soil immediately surrounding the granules.

The purpose of this paper is to report the results of experiments carried out by the author with a bearing on this same subject. In pot experiments with two different soils which were given heavy applications of phosphate (as monocalcium phosphate) it was found that there was a very striking effect of phosphate on the severity of the symptoms of manganese deficiency in barley plants. The two soils, called here Soil A and Soil B, had very similar contents of labile phosphate, but Soil A was poor in available manganese. Soil A was a soil with a relatively high content of organic matter while Soil B was a loamy soil. Analytical particulars are as follows :

Soil	pH in water	Inorg. P m.mol PO_4 per kg	Inorg. P m.mol PO_4 per pot	Labile P per kg	Labile P per pot	Soil Dry Matter kg/pot	Organic Matter %
A	6.1	7.6	103	3.6	50.2	14.0	14.4
B	7.1	4.7	94	2.9	57.1	20.0	2.5

The experimental crop was barley and each pot was given a basic fertiliser treatment of 10 gm potassium nitrate, 1gm copper sulphate and 1gm manganese sulphate. Monocalcium phosphate was added at three rates : 20, 40 and 80 m.mols PO_4 per pot. The crop was harvested at two dates (1) after 9 weeks and (2) at maturity. Yield data for the two harvest dates are given in figures 1 and 2.

It will be noted that the 20 m. mol per pot treatment gave a slight increase in yield for soil B, which was not manganese deficient, but that there was a slight decrease for soil A at the mid-season harvest. Higher levels of phosphate did not significantly increase the yield for soil B, but had a very substantial effect

on soil A - in fact the yield was increased to the same level as for soil B with the heaviest rate of PO_4 application.

During the growing period symptoms of manganese deficiency were observed in the barley growing on soil A and the following notes were made during the season :

SOIL A.

6/6 Marked manganese deficiency symptoms in treatments 1 and 2.

9/6 Deficiency symptoms appeared also in treatment 3

13/6 Very marked deficiency in treatment 1, 2 and 3, but only faint symptoms in treatment 4.

25/6 Plants in treatments 3 and 4 have recovered from manganese deficiency.

21/8 Plants in treatments 1, 2 and 3 are ripening in two stages.
Straw still green but grain fully ripe.

These observations indicate that manganese deficiency was serious in treatments 1 and 2 and also affected, to a lesser degree, treatment 3, while treatment 4 showed only very slight symptoms of deficiency.

It can be concluded that heavy applications of phosphate counteracted the manganese deficiency and produced a very large increase in the final yield. It is very probable that the yield increase was mainly due to increased manganese availability and not to normal phosphate response.

Mrs E. BOKEN, of the Royal Agricultural and Veterinary College Copenhagen, observed a similar effect of heavy phosphate dressings under field conditions in the relatively dry year 1947. On soils similar in type to soil A and with oats as the experimental crop she obtained the results given in Table 1 in a series of pot experiments carried out in 1952.

TABLE 1

Soil	P.H.		H.N.	
Treatment	Grain gm/pot	Straw gm/pot	Grain gm/pot	Straw gm/pot
Basic treatment	3.3	31.8	0	4.7
10 gm. super/pot	0.6	34.6	0	11.0
20 gm. super/pot	1.7	43.5	0	13.2
40 gm. super/pot	10.5	62.9	0	19.4

In the case of soil P.H., phosphate first depressed the yield of grain and at the heaviest rate substantially increased it. The degree of manganese deficiency in soil H.N. was so great that no yield of grain was obtained even with the heaviest

phosphate application although there was a marked effect on the straw. It will be noted that these results are in good agreement with the author's results for soil A.

In the experiments reported above, the phosphate fertiliser was applied as powder and intimately mixed with the soil. No change in soil pH could be measured which is in agreement with previous findings on the effect of monocalcium phosphate on soil acidity. It seems unlikely, therefore, that the effect of phosphate on the availability of soil manganese can be attributed to increased acidity in the soil. The slight decrease in the availability of manganese where comparatively small amounts of phosphate were added, suggests that phosphate may have a rather complicated influence on manganese availability. A possible explanation is that phosphate first forms an insoluble compound with manganese and that with larger applications of phosphate there are produced more soluble complexes between phosphate and manganese ions.

When comparing the conditions in pot experiments with those in the field it has to be remembered that the amounts of phosphate applied to the pots correspond, approximately, to 1,000, 2,000 and 4,000 kg. superphosphate per ha. By using granulated superphosphate at lower rates, local concentrations of similar high magnitude may occur around the granules sufficient to give a local increase in the availability of soil manganese.

The experiments reported here confirm FRUHSTORFER's findings that superphosphate has a favourable influence on the availability of soil manganese, but the author considers that this effect is not due to increase in acidity, but to a direct effect of phosphate on the solubility or availability of manganese compounds in the soil.

PFA/155

g/pot
g/vase

Yield data at maturity
Chiffres de rendement à maturité

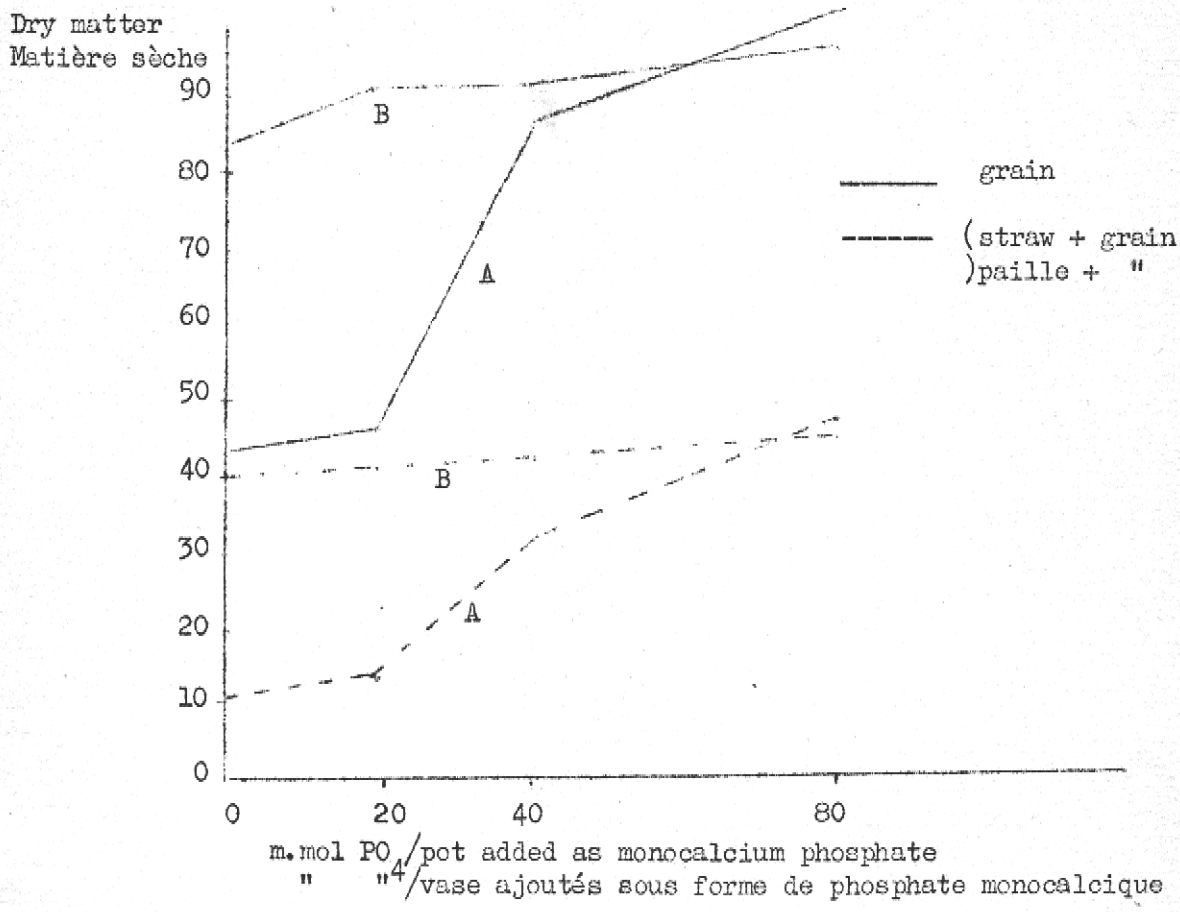

Fig. 1

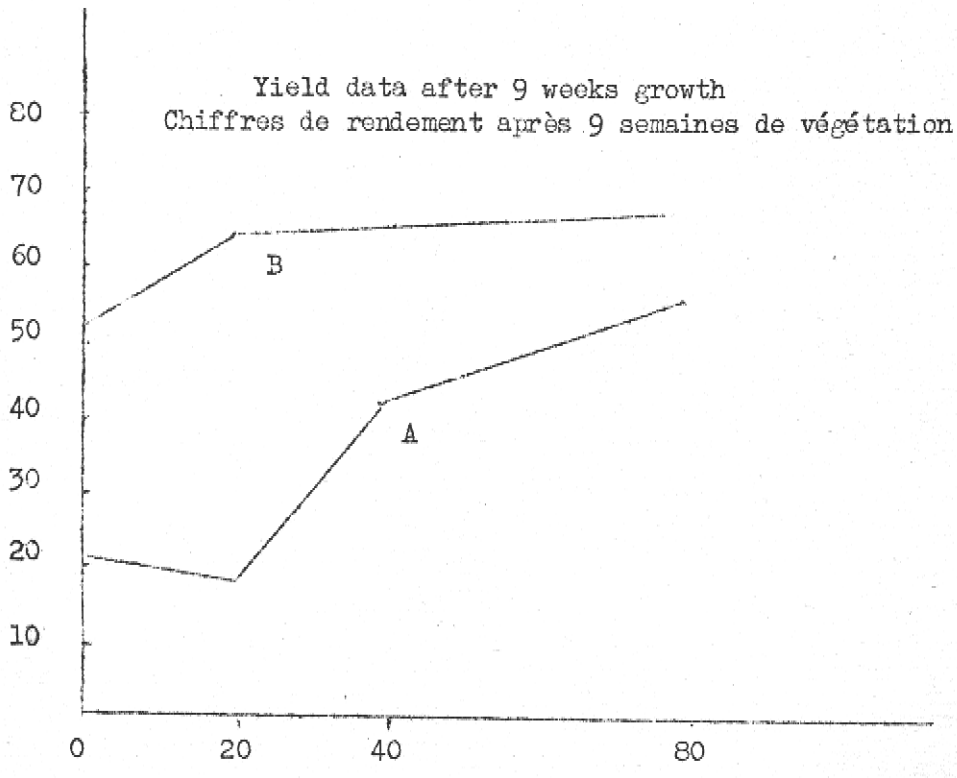

Fig. 2