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).*

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

COMITÉ AGRONOMIQUE
1 Avenue Franklin D. Roosevelt, Paris 8e

JOINT TECHNICAL AND AGRICULTURAL MEETING

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

1 9 5 6

PA/147

Subject : 3

SUPERPHOSPHATE AS A MANGANESE CARRIER,

by A. Fruhstorfer

(Verein Deutscher Dünger-Fabrikanten, Hamburg, Germany)

In Germany a lack of Mn is quite often noticed in light humic sandy soil and acid in typically humic soil. The latter includes particularly alkaline low moorland and sour high moorland. The lack of Mn nearly always shows itself in alkaline moorland; on the other hand, it is rarer in the case of high moorland and only appears there as a result of incautious liming. Since formerly the complete elimination of humic acid was thought necessary, it was not rare to find at the beginning of this century in moor areas of the Netherlands a manganese deficiency, called in consequence "moorland disease".

In the meantime, it was also recognized for sandy soils that the appearance of Mn deficiency depended on the soil reaction. Today it has been established that in a light sandy soil no deficiency in Mn occurs at a pH under 6.o, but only from a pH of 6.4 in principle. Thus, uncertainty only exists for this relatively reduced range. From this one can see that Mn deficiency can be lessened or even eliminated by lowering pH of this area through an appropriate application of fertilisers. In composing the corresponding basal dressing, superphosphate naturally has a particular importance.

One other fact characterizes Mn, that is its quick fixation in the soil. In general, it is a question not of an absolute lack of this element but its fixation by certain humic matter which brings about this deficiency. It has been found quite useless to create a reserve of this element through applying substances containing Mn, because a total fixation is produced. Sulphate of manganese must not be applied all at once at the beginning of the spring, but - if possible - at sowing time, in order that the plants can still profit from it. Due to the strong fixation, one should apply much greater quantities than can actually be absorbed and for this reason fertiliser with a Mn base is the one which has by far the weakest coefficient of utilization.

All these comments are equally relevant, at least to some extent, to superphosphate. The water-soluble P_2O_5 of superphosphate is also fixed in the soil and consequently not fully utilized. A late application allows a better utilization than one too early. The granulation of superphosphate is a barrier to fixation and it is band placement that is the one most recommended as a means of avoiding it.

From this it is obvious that a combination of sulphate of manganese and superphosphate should have a favourable effect, especially combined with granulation and band placement. The formation of small acid islands round the granules helps to render Mn soluble and keep it soluble.

In 1954, at our request, some fertilising experiments were carried out at the Agricultural Experimental Station at Oldenburg, for the purpose of examining the effect of physiologically acid fertiliser in general and the action on the yield of a superphosphate containing Mn. A similar series of experiments was also organized at Annen-Hof, unfortunately without success, because the soil - which was poor in Mn in 1953 - no longer showed this deficiency when put in pots.

From the experiments at the Oldenburg Station we can give the following information: During the course of several experiments on oats, it was established that a physiologically acid fertiliser, with a sulphate of ammonia, superphosphate and potassium sulphate base, could, on its own - through lowering the pH value - clearly limit, if not eliminate, the inconveniences of a Mn deficiency. The relative figures, concerning two experiments on oats, are below:

	1st trial	2nd trial
1. NPK alkaline	1oo	1oo
2. NPK + 25 kg/ha Mn ploughed-in	16o	158
3. NPK + 3 " " "	1o6	121
4. NPK + 3 " " sprayed	149	15o
5. NPK acid, before sowing	119	118
6. NPK " , top-dressed	111	119

The Oldenburg Station carried out two other experiments on potatoes, using the following products:

1. NPK
2. NPK + 25 kg/ha Mn ploughed-in
3. NPK + 3 " " "
4. NPK + 3 " " sprayed
5. NPK with acid effect, applied before sowing, P in the form of super containing Mn, corresponding to 6 kg/ha of Mn
6. NPK with acid effect, top-dressed, P as above

Super containing Mn is a homogenous mixture of superphosphate and 5% sulphate of manganese in granulated form. The ratio of the latter to Mn is 4 : 1. Together with 8o kg/ha of P_2O_5 consequently one applies 24 kg/ha of sulphate of manganese, which corresponds to 6 kg/ha of Mn. Yields in dry matter and relative yields were as follows:

	1st trial		2nd trial	
plot 1	39.46	1oo	46.39	1oo
" 2	7o.3o	178	61.97	134
" 3	42.48	1o8	5o.6o	1o9
" 4	61.o8	155	59.35	128
" 5	67.95	172	58.72	127
" 6	72.1o	183	55.73	12o

From these results one can make the following conclusions:

1. With a physiologically acid fertiliser and by using superphosphate as phosphatic fertiliser, manganese deficiency in light soils can be considerably limited.

2. By means of a fertiliser with a superphosphate base + sulphate of manganese at 5% the same effects can be obtained as with much greater quantities of sulphate of manganese not combined with superphosphate.

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No. 2

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JOINT TECHNICAL AND AGRICULTURAL MEETING

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1 9 5 6

PA/148 ✓ Subject : 3

INFLUENCE OF SULPHUR CONTAINED IN SUPERPHOSPHATE ON PLANT GROWTH .

by A. Fruhstorfer

(Verein Deutscher Dünger-Fabrikanten, Hamburg, Germany)

1. Sulphur as a plant nutrient

It is well known that S is a nutrient element necessary for the plants, which take up approximately the same amount of S as of P_2O_5, cereals absorbing a little more of the latter, whereas legumes more of the former. S is assimilated as SO_4 ions, any other compound of that element being usually toxic for plant growth. Oxidation and reduction take place in the soil, especially thanks to S-bacteria contained in the sewage. Their action changes the smell and the colour of their substratum, this fact being mainly noticed in composts.

2. Sulphur sources

The agricultural literature mentions very little the S content of soils. Following sources are to be considered as to the origin of soil sulphur:

a) The parent-rock.- The mineral sulphur-compounds from the parent-rock seem to play a very small part, especially on light soils and in wet regions.

b) Organic matter. - The soil organic matter makes the most important reserve of soil sulphur and albumin in particular. Sulphur is put into the cycle by decomposition. In principle, a humiferous soil can be regarded as sulphur deficient chiefly if humus is present in a not too easily decomposable form.

c) The air. - Burning gases increase the sulphur dioxide content of the air and the rain gives back this acid to the soil where it is transformed into a sulphate by oxidation. In the neighbourhood of industrial areas the sulphur dioxide content can be very high.

d) Through sulphates, especially sulphate of ammonia, sulphate of potash and superphosphate. Thanks to the regular application of such fertilisers, S deficiency can hardly happen.

3. Sulphur losses

Losses of S from a soil derive chiefly from leaching in the form of calcium sulphate, since draining- and spring-water have a high sulphate content. As sulphate ions are as uneasily retained as nitrate ions, an improvement of the sulphur content of the soil owing to a fertiliser does not seem possible. It is only by increasing the organic matter of the soil that sulphur reserves can be created.

4. Sulphur efficiency

S has a very marked action as a plant nutrient, i.e. small amounts of S are already sufficient to reach a maximum yield. S deficiency will then not appear, provided the soil is regularly supplied with farmyard manure and fertilisers containing sulphates, or if sulphur is given by the air. However, in stopping such applications, even for a short while, rise can be given to a sudden sulphur deficiency.

5. Experiments

We analysed the S-content of several arable soils near our Experimental Station and carried out a fertilising experiment in the soil having the lowest content in that element, i.e. 0.028%. First of all - in 1954 - mustard was grown on that soil, followed by spring rape and spinach, care being taken not to allow fertilisers nor sprayed wate[r] to supply sulphates.

In 1955, an experiment was carried out on mustard followed by a mixture of peas and maize.

Table (see next page)

It appears from the table that the first mustard crops have already shown in 1955 a clear effect due to sulphur, since the soil has not been supplied with this element for one year. This action is quite significant at the second crop on which the applicatio[n] of phosphatic fertilisers without sulphur proved no more efficient. It was only after a gypsum supply that a satisfactory yield could be reached. Results of the third crop were similar.

This experiment suggests to draw more attention to the sulphur content of the soil and to be careful to make regular applications of that element on soils with a low humus content.

Engrais appliqués - Fertilisers applied

Fumure de fond par vase (Basal manuring per pot): 1 g N (nitrate de Ca)
1,2 g K_2O (chlorure de K)

Parcelles d'essais - Experimental plots

1) NK sans P_2O_5 (without)
2) NK + SO_4Ca equivalent à (to) (4)
3) NK + SO_4Ca " " " (5)
4) NK + 0,3 g P_2O_5 (super)
5) NK + 0,6 g P_2O_5 (")
6) NK + 0,3 g P_2O_5 Mélange de sels purs conforme à la composition du super utilisé (mixture of pure salts in accordance to the composition of super used)

Sans SO_4Ca (without)

7) NK + 0,6 g P_2O_5 comme (like) (6)
8) NK + 0,3 g P_2O_5 " " " + SO_4Ca équivalent à (to) (4)
9) NK + 0,6 g P_2O_5 " " " + SO_4Ca " " " (5)

RESULTATS DE LA RECOLTE - RESULTS OF THE HARVEST

Essai nº Trial "	Matière sèche - Dry matter 1. Moutarde (mustard) abs. g	rel. %	2. Moutarde (mustard) abs. g	rel. %	Mélange (mixture) abs. g	rel. %	Total abs. g	rel. %	Absorption de P_2O_5 (uptake) 1. Moutarde (mustard) %	2. Moutarde (mustard) %	Mélange (mixture) %	Tot %
1	16,6 ± 0,2	78	9,3 ± 0,2	49	4,2 ± 0,3	56	30,1 ± 0,7	63	-	-	-	-
2	17,9 ± 0,2	84	16,2 ± 0,2	86	5,5 ± 0,5	73	39,6 ± 0,5	83	-	-	-	-
3	19,4 ± 1,0	91	17,0 ± 0,4	90	5,7 ± 0,6	76	42,1 ± 1,1	88	-	-	-	-
4	21,4 ± 0,9	100	18,8 ± 0,3	100	7,5 ± 0,2	100	47,6 ± 1,2	100	16	12	4	33
5	22,9 ± 0,5	107	20,3 ± 0,3	108	7,2 ± 0,6	96	50,4 ± 1,1	106	11	8	2	21
6	20,9 ± 0,3	98	9,8 ± 0,2	52	3,8 ± 0,7	51	34,5 ± 1,0	72	13	3	0	17
7	21,8 ± 0,5	102	9,3 ± 0,1	49	5,0 ± 0,7	67	36,1 ± 1,0	76	9	3	1	13
8	22,9 ± 0,3	107	17,6 ± 1,2	94	7,5 ± 0,6	100	48,0 ± 1,8	101	17	9	3	30
9	23,9 ± 0,4	112	20,0 ± 0,7	106	8,9 ± 0,9	119	52,7 ± 1,6	111	7	8	3	18

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