The Use of Acid Resins Supplied by the Oil Industry in the Chemical Amelioration of Alkali Soils

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In Hungary salt-affected soils occupy more than 10 per cent, i.e. about 1 million hectares, of the total area under agricultural use. Agricultural productivity of these soils can only be increased through extensive labor and financial investments.

Methods and techniques of amelioration of salt-affected soils greatly depend on their properties. The task of amelioration is the following:

1. Lowering the pH of the soil;
2. Leaching the harmful salts;
3. Exchange of exchangeable sodium with calcium.

In Hungary the amelioration of solonetz soils is very important. Chemical amelioration is carried out by the application of materials containing calcium. If the surface layers of the soil contain lime or have an alkaline reaction, gypsum or other materials capable of acidic hydrolysis are applied. Improvement of the fertility of non-calcareous solonetz soils is achieved by the application of calcareous substances, for instance limestone dust, sugar beet factory liming slime, etc.

At present, 10—30 tons of amendment per hectare is usually used for the improvement of these soils. The very high investment in amelioration, is returned only after a few years. One of the important reasons for this is that limestone dust is only slightly soluble in the soil and an organic-mineral coating forms on the surface of the limestone particles decreasing further their solubility. A considerable part of the amendment applied remains ineffective in the soil. Therefore, the efficiency of the chemical amelioration of these soils depends to a great extent on the solubility of the ameliorant.

The simplest and quickest way of increasing the solubility of limestone dust is to add acidic materials to it. Industrial wastes and by-products offer a cheap source of acidic materials. Petroleum resins, obtained as a by-product during the sulphuric acid refining of coal petroleum is a promising product. The petroleum resins consists of large molecule organic substances as well as, depending upon refining procedure, 10 – 40 per cent sulphuric acid. After considerably long storage at low temperatures it polymerises into solid material. Petroleum resins for soil improvement, may be applied with the same success for the amelioration of either strongly alkaline calcareous salt-affected soils, or non-calcareous neutral or slightly acidic ones. The difference in the role of petroleum resins in the improvement of these two soils, lies in the fact

that with calcareous soils it releases native calcium and with non-calcareous soils limestone dust, mixed with petroleum resins, serves as a source of calcium.

The results of laboratory analysis and long-term field experiments, which have been carried out since 1965 at the Research Institute of Soil Tillage in Karcag, demonstrate, that petroleum resins considerably increase the solubility of limestone dust. Due to the application of petroleum resins, changes take place in the soil, which greatly influence the yield of crops under cultivation.

As evidence supporting the above statement I would like to report on the results of one field experiment in which tillage and fertilizer applications were uniform. The effect of applications of various doses of petroleum resins and limestone dust on the fertility of "meadow solonetz turning into steppe formation" was studied.

Some of the analytical data of this soil were as follows:

The texture of the investigated soil was clay loam. The pH-value in water of the 20 cm plow layer was 6.1. The humus content, determined by the Turin method, was 3.8 per cent. Exchangeable sodium and potassium was 11.5 m.e., or 26.8 per cent of the total exchange capacity.

The B-horizon of this soil had features characteristic of typical solonetzes: pH-value in water was 8.0. Exchangeable sodium plus potassium was 16.3 m.e., 37.5 per cent of the total exchange capacity.

Calcium-carbonate occurred at a depth of 50 cm. The depth of the ground water table was 3 to 5 m, thus it did not influence the surface layers of the soil to a significant extent.

Petroleum resins, due to their sulphuric acid content, are quite injurious to the human body and should be used with great care. Thus, the liquid petroleum resins were soaked up with solid materials such as sawdust, peatdust and so on. This gave a solid mixture which could be easily handled.

The following treatments alone and in combination were applied in the autumn of 1966:

Limestone dust

1. Control
2. 6 tons of limestone dust per hectare
3. 12 tons of limestone dust per hectare
4. 24 tons limestone dust per hectare
5. 48 tons of limestone dust per hectare

Petroleum resin

1. Control
2. 2.5 tons of petroleum resin per hectare
3. 5 tons of petroleum resin per hectare
4. 10 tons of petroleum resin per hectare
5. 20 tons of petroleum resin per hectare
6. 40 tons of petroleum resin per hectare.

Sunflowers were grown in the first year after amelioration and in the second, sorghum. In the case of sunflowers the grain yield, and of sorghum for silage, greenmass yield harvested at the milk stage were measured.

Figures 1 *a)*–*e)* show the yield increases from ameliorants expressed as percents of the two year average control plot yields.

Figure 1*a)* clearly demonstrates the considerable difference between the effects of the ameliorants of yield. According to our present knowledge, the non-calcareous solonetz soils, which have so far been reclaimed by the application of limestone dust in Hungary, may be improved by the application

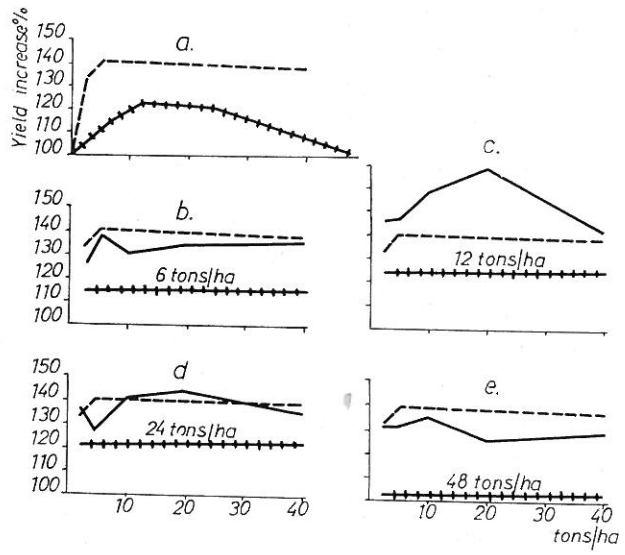

Fig. 1

The effect of the limestone dust and acid resin on increasing the productivity of solonetz soils. Percent yield increase,, average of the two years. (Karcag, 1967—1968) Line marked by crosses: Limestone dust. — — — Acid resin. ——— Limestone dust + Acid resin

of strongly acidic materials. The largest yield increases were obtained by the application of 2 tons of limestone dust or 5 tons of petroleum resin per hectare. The effect of the petroleum resin was double that of limestone dust.

Figure 1*b)* shows the effect of the joint application of 6 tons of limestone dust with different rates of petroleum resin. The effect of the joint application of various rates of petroleum resin with 6 tons of limestone dust per hectare did not exceed the effect of the petroleum resin applied alone. Changing the rate of limestone dust to 24 and 48 tons per hectare did not change these results (Figs. 1*d*–*e)*. The best joint application of limestone dust and petroleum resin (Fig. 1*c*) was with 12 tons of limestone dust per hectare. In our experiment, the joint application of 12 tons of limestone dust and 20 tons of petroleum resin per hectare was the most effective treatment. The limestone dust alone increased the two-year average yield by 23 per cent, and the petroleum resin by 40 per cent, but the joint application of the two ameliorative materials increased the yield by as much as 70 per cent.