N.T. Agarkova, USSR

INFLUENCE OF PROLONGED APPLICATION OF FERTILIZERS ON AGROCHEMICAL PROPERTIES OF SOIL IN SUNFLOWER CROP ROTATION

Studies of the effect of systematic fertilizer application on the agrochemical properties of soil were made in a stationary experiment involving crop rotation with the following crops: winter wheat, sunflower, winter wheat, castor oil plant, winter wheat, sugar beet, winter wheat, maize-soya mixture for silo.

The plot's soil was leached, super deep, little humus and heavy loamy chernozem.

The main objects of the experiment were soil and plant samples.

Soil samples were selected according to four experimental variants. In the variant without a fertilization $N_{40}P_{10}$ were applied for winter wheat and $N_{40-50}P_{40-60}$ for clean-cultivated crops. Increased NP dosages were applied in another variant: $N_{100}P_{70}$ for winter wheat and $N_{60-70}P_{100-120}$ for clean-cultivated crops. In the variant with complete mineral fertilization the nitrogen and phosphorus dosages were the same as in the previous variant. Potassium was annually applied in the proportion of 60 kg/ha of acting substance.

Twice a year, in spring and after crop harvesting soil samples were selected at the depth of 60 cm in 20 cm layers. A mixed specimen was made from 12 individual samples.

Soil nitrogen regime studies were made for all crops in the rotation.

The studies showed that annual fertilizer application, especially in increased dosages, enriched soil with mobile forms of nitrogen.

Azotates are known not to be fixed by soil and can be washed together with precipi-

tation on vertical profile at a considerable depth. In our conditions the quantity of rainfall is nearly 350 mm on average in autumn, winter and early spring and soil has thick humus horizon; azotates are therefore washed at the 160-240 cm depth. But when fertilizers are applied annually in increased dosages azotates noticeably increase throughout the whole third metre of the soil by the end of the first crop rotation.

The crops in the rotation do not follow the same pattern in using azotates by the end of vegetation. It was proved that maize-soya mixture, sunflower and winter wheat use azotates in the depth of 150-160 cm, 2.0-2.5 m and 2.5-3.0 m, respectively.

Regular application of mineral fertilizers did not substantially influence total nitrogen and humus in the soil.

Studies were also made of the fertilizer system influence on the soil phosphate regime.

The results of analyses showed an increase in phosphorus total reserves, its mobile form content, and the soil mobile phosphates rate (Table 1).

Total phosphorus reserves increased by 90-150 kg/ha in the 40 cm layer by the end of crop rotation. Its small increase was also observed in the 40-60 cm layer.

Mobile phosphates enrich soil gradually, in direct dependence upon the rate of fertilizer application.

In the first three years a small increase in mobile phosphates only occurred in the upper layer but after fertilization during five years they reached the depth of 60 cm. By the end of the first crop rotation mobile phosphorus content increased, as against the check, by 11.2% at average fertilizer dosages and by 20.9 - 29.1% in the variants with increased fertilizer dosages.

A small increase of mobile phosphorus (by 1.5 - 5.8%) was also observed in deeper

Table 1

Influence of Systematic Fertilizer Application on the Soil Phosphate Regime in the 0-40 cm Layer

Variant	mg P_2O_5 per 100 g of soil		mg P_2O_5 per 1 litre
	general	mobile	
Without fertilizer	178	18.2	0.070
NP in average doses	190	20.4	0.112
NP in increased doses	192	22.0	0.200
NPK in increased doses	188	23.5	0.169

layers (40-60 cm). This apparently results from the motion of a proportion of it together with plant roots.

The maximum phosphate mobility was observed in the variants with increased dosages of mineral fertilizers. During crop rotation the mobile phosphate rate in these variants increased 140-190% and on plots with average doses by 60% as against the non-fertilized plots.

The positive fertilizer effect on the phosphate mobility rate was preserved to the end of vegetation in all the years concerned.

Some physico-chemical properties of soil are cited in Table 2.

Data on hydrolytic acidity show its increase on fertilized plots. When fertilizer app-

lication increases hydrolytic acidity raises by 14.2-23.7%, while in the 40-60 cm layer it remains practically the same.

In most cases the absorbed bases total in fertilization variants is lower than the check.

In cases with increased dosages of mineral fertilizers the rate of soil saturation with bases decreased by 2.2-3.0% by the end of the crop rotation period.

Thus soil analysis proved that systematic fertilizer application positively influences its fertility; this improves plant nourishment, increases growth and accumulation of organic mass, and facilitates a more active supply of nutrients and their output from the soil.

Table 2

Change in the Physico-Chemical Soil Properties under Fertilization in the 0-40 cm Layer

Variant	mg per 100 g of soil		V, %
	Hr	S	
Without fertilizer	4.22	31.4	88.4
NP in average doses	4.58	30.8	86.9
NP in increased doses	4.82	30.7	86.2
NPK in increased doses	5.22	29.9	85.4

Thus in fertilization variants sunflower puts out 29-31% more nitrogen, 10-18% more phosphorus and 6-27% more potassium than in cases without fertilization.

On caster-oil plants the respective increase was 21-23%, 18-31% and 10-24%, on winter

wheat - 46-68%, 22-46% and 56-81% and on maize-soya mixture for silo - 25-50%, 16-40% and 21-30%.

Balances and co-efficients of using the basic nutrients have been calculated on the basis of analysis data (Table 3).

Table 3

Coefficients of Using Nutrients and Fertilizers, %

Variant	N	P_2O_5	K_2O
Without fertilizer	-	-	-
NP in average doses	60.0	17.5	-
NP in increased doses	58.3	12.4	-
NPK in increased doses	55.2	16.1	102.1

During crop rotation as a whole, the balance was positive only for phosphorus in cases with increased fertilizeration dosages. With the average annual dosage of P_{30} the coefficient was 17.5% for rotation. In the variant with increased fertilization dosages it decreased to 12.4-16.1%.

The nitrogen and potassium balance is negative in all fertilization variants. The nitrogen fertilizer consumption coefficient was from 55 to 60%.