

METHOD FOR DETERMINING THE ECONOMICALLY OPTIMAL RATE OF PHOSPHORUS FERTILIZER APPLICATION

Second DRAFT

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Description

Today the excessive use of chemical fertilizers is one of the most frequent causes of environmental pollution. The reduction of P losses in soil and water may be achieved by using a scientific P fertilization systems based on P_{AL} content from soil, soil contribution of efficient phosphorus and expected yields [1, 2].

Rationale, mechanism of action

When the P status of a soil is medium to high, the P mineral fertilizers are recommended to be used according to the economically optimal rates (EOR).

The main principles of this system are:

- utilization of available natural, partially renewable P sources (like as soil and organic fertilizers)
- application of chemical P fertilizers in completion or in supplement of natural resources, in economically rates to maximize of net profit per hectare.

In order to establish the total optimal amount of P from mineral fertilizers a mathematical model is used. This model derives from the following regression equations:

$$Cf = a + b/EY$$

$$Ps = A(1 - 10^{-c \cdot P_{AL}}) + d \cdot EY$$

$$EOR \text{ of P} = \frac{\log(2,3 \cdot Cf \cdot EY \cdot UPY/UPPF) - Ps}{Cf}$$

in which:

Cf- phosphorus action coefficient considered to depend on the expected yield;

EY-expected yield (t/ha);

a, b- coefficients of regression established between Cf and level of the EY;

Ps-the soil contribution of efficient phosphorus to plant yield, which depends of the P-AL content in soil and EY (kg P_2O_5 /ha);

A, c-coefficients of regression established between Ps, P-AL and EY;

d- coefficient of the ecological favorable conditions for yield;

UPY/UPPF-ratio between the unitary price of the yield and the unitary price of P fertilizer;

EOR of P - economically optimal rates of P fertilizer (kg P_2O_5 /ha.year).

Applicability

This measure is applied on medium to high P soils (P_{AL} values more than 45 ppm).

Effectiveness, including certainty

EOR is an efficient method to establish the need of chemical P fertilizers for field crops.

Time frame

A decrease of mobile P content in soil may occur in time, because the economically optimal rates of P fertilizer can compensate only: 0.25-0.75 parts of P uptake by plants, 0.25-0.75 parts of P consumptions with naturally entropic processes in soil and 0-0.5 parts of initial P_{AL} in soil.

Environmental side-effects / pollution swapping

EOR system corresponds at a large measure with the environmentally protective exactingness against degradation caused by chemical pollution and represents a best agricultural practice.

Relevance, potential for targeting, administrative handling, control

This practice is obligatory (by Action Plans) in the Nitrate Vulnerable Zones, where the farmer must fill out the fertilization plan with data referring to P chemical fertilizers.

Costs: investment, labor

The cost of analyses and P recommendation is quite difficult to be supported by the farmers.

References

- [1] Code of Good Agricultural Practices (Order of the Minister of Agriculture, Food and Forests and of the Minister of Waters and Environmental Protection no.1182/1270/2005, MO no. 224/13.03.2006), <http://www.icpa.ro>.
- [2] Code Good Agricultural and Environmental Condition (Order of the Minister of Agriculture, Food and Forests and of the Minister of Waters and Environmental Protection no. 446/737/2006, MO no. 635/24.07.2006), <http://www.icpa.ro>.