# THE CORRELATION BETWEEN THE FERTILIZATION SYSTEM AND YIELD FOR THE SUNFLOWER CROP

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***Abstract:*** *The aim of the studies and research on which the present paper is based was to assess the level of interdependency between the fertilization system and the yield for the sunflower crop in view of establishing some fertilization variants for different crop systems. The sunflower crop, together with maize and winter wheat, are grown on large areas in Banat plain, where the agricultural systems practiced are mostly vegetal, with simple rotations, often monoculture. Under the current social and economic conditions, with a major influence brought about by the financial crisis, the vegetal cultures in the area under research are intensive crop systems to various degrees. From the point of view of fertilization, as an element of technology, we can find different situations, from a total lack of fertilizers, to various doses of fertilizers, which in some cases can vary from one year to the other according to the economic power and the opportunities that may appear. We observed the interdependence between the mineral fertilization system and the amount of the yield. The fertilization schemes were made on PK combinations (where we had four variants: 0, 50, 100 and 150 kg/ha active substance) to which we added nitrogen in five variants (0, 50, 100, 150 and 200 kg active substance./ha). There are three types of fertilization systems that can be emphasized :"low fertilizer system", for $P_0K_0$ and nitrogen variations from 0 to 200 kg/ha; this system is frequently met with in subsistence farms or in family farms where the budget for the entire technology is generally low, and fertilization is occasional and made with nitrogen-based fertilizers. The second type is "medium fertilizer or budget fertilizer system" for $P_{50}K_{50}$ and nitrogen variations from 0 to 200 kg/ha. Phosphorus and potassium-based fertilization, even if used within low limits, amplifies the effect of nitrogen-based fertilizers by up to 1.26 times when compared to the unilateral nitrogen fertilization. The third type is "high fertilizer system" for $P_{100}K_{100}$ and $P_{150}K_{150}$ and nitrogen variations from 0 to 200 kg/ha. Here we find the fertilization variants which generate the highest yields, because they amplify the effect of nitrogen fertilizers by 1.47-1.61 times when compared to the control variant. A balanced NPK fertilization brings the highest yields, with significant increase when compared to the control variant.*

***Key words:*** *soil fertility, mineral fertilizers, fertilizer systems, sunflower crop production, correlation,*

## INTRODUCTION

Rational use of fertilizers plays an essential role in improving the quantity and quality of the yield; this means that it has great impact upon our food supplies, STEER et col. 1984, DUMITRU 2002, HERA 2002, RUSU 2002. However, the use of fertilizers is possible only when we are familiar with the following: the characteristics of the soil as nutrition environment for plants, crop requirements in terms of nutrition and fertilizer-soil-plant relations, SALA 2008, MARINCA et coll. 2009.

It often happens that farmers apply fertilizers without taking into consideration the soil or what the plants need. Thus we can often find situations where the doses are limited or inadequate from the point of view of the combination of fertilizers and the conditions in which the crop will grow. At present the effect of the financial crisis is added to all the other causes, so supporting the crop through fertilization is even harder to do, and crop technologies are in many cases short.

Our research consisted in assessing the correlation between the mineral fertilization system (combinations of fertilizers and dosage) and yield for the sunflower crop (*Heliantus anuus L.)*, *Rumbasol OR* hybrid, under the soil and climatic conditions specific to Banat Plain.

Based on the results of our research, we can draw practical recommendations for ensuring a certain level of fertilization in relation to the estimated yield, the soil supply of nutritious elements and also in connection with the financial resources for the entire technology and for fertilization in particular.

## MATERIAL AND METHOD

For the purpose of our research we tested the influence of different types of simple mineral fertilizers with basic macroelements (N, P, K), administered in various combinations and dosage.

The experiences were bifactorial 4x5 in subdivided lots:

Factor A: fertilization with phosphorus and potassium:
- $a_1 – P_0K_0$ – control
- $a_2 – P_{50}K_{50}$
- $a_3 – P_{100}K_{100}$
- $a_4 – P_{150}K_{150}$

Factor B: nitrogen fertilization
- $b_1 – N_0$
- $b_2 – N_{50}$
- $b_3 – N_{100}$
- $b_4 – N_{150}$
- $b_5 – N_{200}$

The experience was made for sunflower crop (*Helianthus anuus L.*), *Rumbasol OR* hybrid, which displays high qualitative and quantitative potential and can be found in the west of our country.

The natural conditions for our experiment are specific to Banat Plain: the soil is cambic faeoziom (cambic chernozem), weakly gleyed, with neutral reaction (*p*H = 6.7-6.8), good supply of humus (H = 3.2), nitrogen index IN = 3.09, high base saturation level (over 85-87%), poor supply of mobile phosphorus ($P_{AL}$ = 17.4 ppm) and average supply of potassium (K = 128 ppm).

The climatic conditions are characterized by average multiannual values of 603.3 mm precipitations and temperatures of 10.9°C. In the period when our research was carried out, the level of rainfall was within the multiannual average, but displayed lack of uniformity over years and decades. As for the temperature, the values we recorded were higher than the multiannual average; by association with droughty periods, in certain decades they resulted in periods of time that were not auspicious for crops.

The research was organized on plot A 363, Timişoara Didactic Station, with the following topographic coordinates: N 45° 28` 30.9``, E 21° 7` 9.8``, from 2007 to 2009.

## RESULTS AND DISCUSSION

In the experimental conditions presented above, the fertilizers applied in the fertilization variants led to different yields, as shown in Table 1 and Picture 1.

The experimental variant $P_{150}K_{150}N_{150}$ gave the highest yield, namely 3120 kg/ha. It also proved to be one of the most costly variants.

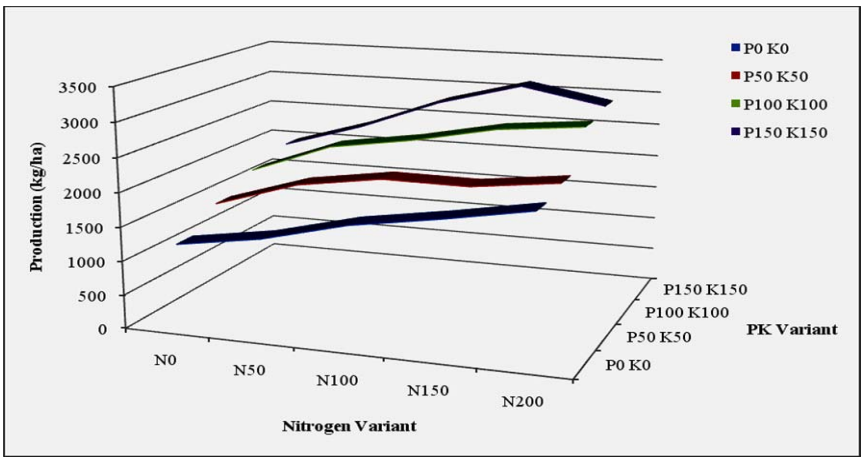
High yields were also obtained from variants $P_{150}K_{150}N_{200}$ – 2887.50 kg/ha, $P_{150}K_{150}N_{100}$ – 2793.75 kg/ha, $P_{100}K_{100}N_{150}$ – 2671.25 kg/ha and $P_{100}K_{100}N_{200}$ – 2787.50 kg/ha.

Four experimental variants gave yields within the limits of 2500-3000 kg/ha, and seven variants gave yields of 2000-2500 ka/ha. Productions of 1500-2000 kg/ha were the result of six variants, and other 2 variants, one of which being the control, unfertilized variant, led to productions under 1500 kg/ha.

*Table 1*

Yield of sunflower Rumbasol OR, obtained under the influence of the mineral fertilization system in the conditions of Timişoara Didactic Station, 2006-2009 (average values)

| Fertilization variants | | Yield (kg/ha) | Relative values (%) | Differences | Significance |
|---|---|---|---|---|---|
| $P_0$ $K_0$ | $N_0$ | 1212.50 | 100.00 | - | |
| | $N_{50}$ | 1403.75 | 115.77 | 191.25 | |
| | $N_{100}$ | 1711.25 | 141.13 | 498.75 | * |
| | $N_{150}$ | 1905.00 | 157.11 | 692.50 | ** |
| | $N_{200}$ | 2123.75 | 175.15 | 911.25 | *** |
| $P_{50}$ $K_{50}$ | $N_0$ | 1526.25 | 125.88 | 313.75 | |
| | $N_{50}$ | 1911.25 | 157.63 | 698.75 | ** |
| | $N_{100}$ | 2093.75 | 172.68 | 881.25 | *** |
| | $N_{150}$ | 2081.25 | 171.65 | 868.75 | *** |
| | $N_{200}$ | 2228.75 | 183.81 | 1016.25 | *** |
| $P_{100}$ $K_{100}$ | $N_0$ | 1783.00 | 147.05 | 570.50 | ** |
| | $N_{50}$ | 2238.75 | 184.64 | 1026.25 | *** |
| | $N_{100}$ | 2425.00 | 200.00 | 1212.50 | *** |
| | $N_{150}$ | 2671.25 | 220.31 | 1458.75 | *** |
| | $N_{200}$ | 2787.50 | 229.90 | 1575.00 | *** |
| $P_{150}$ $K_{150}$ | $N_0$ | 1960.00 | 161.65 | 747.50 | *** |
| | $N_{50}$ | 2330.00 | 192.16 | 1117.50 | *** |
| | $N_{100}$ | 2793.75 | 230.41 | 1581.25 | *** |
| | $N_{150}$ | 3120.00 | 257.32 | 1907.50 | *** |
| | $N_{200}$ | 2887.50 | 238.14 | 1675.00 | *** |



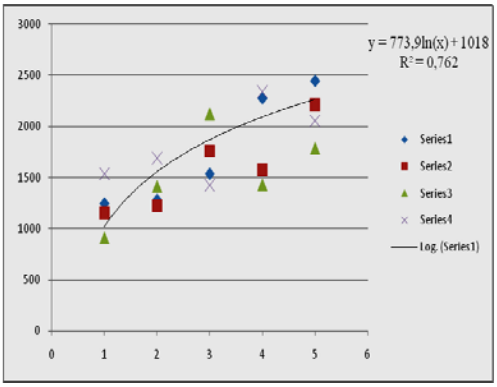

Picture 1. Graphic representation of the yield given by the sunflower crop, *Rumbasol OR* hybrid, under the influence of the mineral fertilization variants, Timişoara Didactic Station, period 2006-2009.

If the results are analyzed according to groups of combinations (PK and N), in each group we can identify fertilization variants which ensure the highest production, and also

variants with the closest correlation between fertilization and yield, and therefore high probability for obtaining such results in similar conditions.

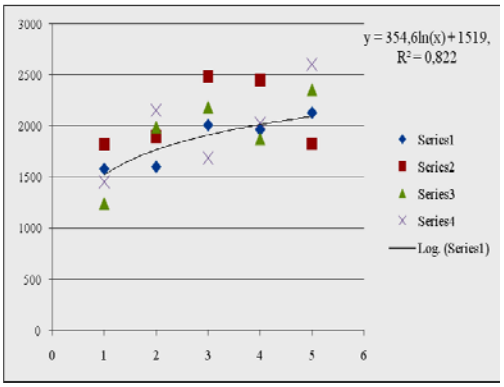
For the combination $P_0K_0$ and nitrogen variations between 0 and 200 kg/ha, the highest yield was obtained for variant $P_0K_0N_{200}$. The correlation between the two variables (the independent variable – fertilizer doses and the dependent variable – yield) was determined based on the logarithmic equation, with the correlation $R^2$=0.762, Picture 2.

The variations of the doses of nitrogen fertilizers within the same limits 0-200 kg/ha on $P_{50}K_{50}$ ensure the highest production for the combination $P_{50}K_{50}N_{200}$ and the degree correlation between the variables, determined through the logarithmic equation and expressed by the correlation coefficient, is high ($R^2$ = 0.822), Picture 3.




$P_0K_0$ $N_{0-200}$

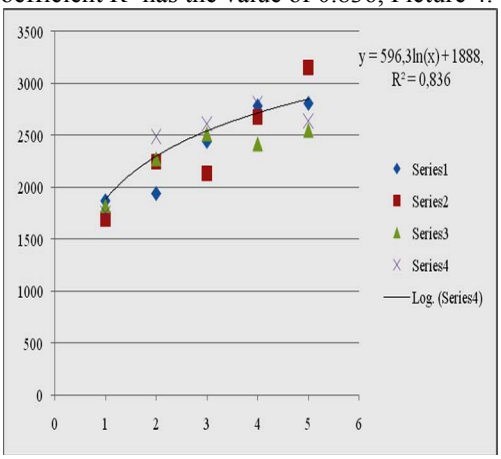
Picture 2. Logarithmic curve representing the correlation between the doses of fertilizers and yield (combinations $P_0K_0$ $N_{0-200}$)



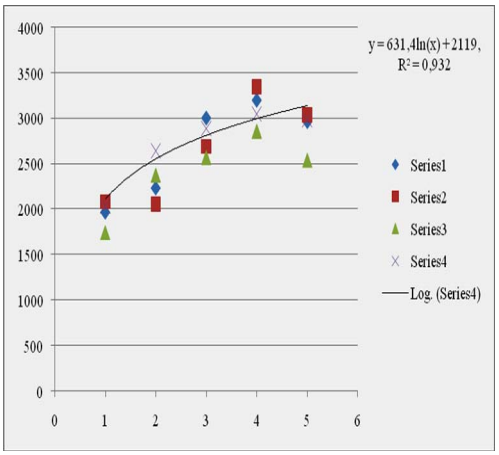

$P_{50}K_{50}$ $N_{0-200}$

Picture 3. Logarithmic curve representing the correlation between the doses of fertilizers and yield (combinations $P_{50}K_{50}$ $N_{0-200}$)

For combination $P_{100}K_{100}$ and nitrogen variations from 0 to 200 kg/ha, the highest production was obtained from combination $P_{100}K_{100}N_{200}$, and the correlation level between the two variables (fertilizer dosage and yield) with the logarithmic equation and correlation coefficient $R^2$ has the value of 0.836, Picture 4.




Picture 4. Logarithmic curve representing the correlation between the doses of fertilizers and yield (combinations $P_{100}K_{100}$ $N_{0-200}$)




Picture 5. Logarithmic curve representing the correlation between the doses of fertilizers and yield (combinations $P_{150}K_{150}$ $N_{0-200}$)

For combination $P_{150}K_{150}$ and nitrogen variations from 0 to 200 kg/ha, the highest production was obtained from combination $P_{150}K_{150}N_{150}$, and the correlation level between the two variables is high, the value of the correlation coefficient $R^2$ being 0.932 Picture 5.

The most balanced fertilization, expressed both by the yields obtained and by the correlation coefficient between the two variables (dose of fertilizer and yield) is obtained from combinations $P_{100}K_{100}$ and $P_{150}K_{150}$ with nitrogen variations between 100 and 150 kg/ha.

## CONCLUSIONS

The research outlined the differentiated influence of the fertilizers and doses used in various combinations for fertilizing the sunflower crop in the soil and climatic conditions at Timisoara Didactic Station.

**We can notice 3 types of fertilization:**

- "low fertilizer ", in the case of $P_0K_0$ and nitrogen variations from 0 to 200 kg/ha; frequently met with in subsistence farms or family farms where the budget for the entire technology is low, and fertilization is occasional and based on nitrogen fertilizers. The role of this type of fertilization in obtaining yields is determined by nitrogen-based fertilizers and the nutritious elements in the soil. The yields recorded are from 1212.5 kg/ha for the control variant to 2123.75 kg/ha for $N_{200}$.
- "medium fertilizer or budget fertilizer" in the case of $P_{50}K_{50}$ and nitrogen variations between 0 and 200 kg/ha. It ensures productions from 1526 kg/ha to 2228.75 kg/ha. Fertilization with phosphorus and potassium, although within low limits, amplify the effect of nitrogen fertilizers up to 1.26 times as compared to the unilateral nitrogen fertilization.
- "high fertilizer" in the case of $P_{100}K_{100}$ and $P_{150}K_{150}$ and nitrogen variations from 50 to 200 kg/ha. This category includes the fertilization variants which generate the highest yields, phosphorus and potassium amplifying the effect of nitrogen fertilizers by 1.47 – 1.61 as compared to the control variant.

Balanced NPK fertilization brings about much higher yields, with significant increase as compared to the control variant.

When the results of the yields generated by the fertilization variants are analyzed with logarithmic equations and correlation coefficient, multiple fertilization solutions appear, in relation to the type of agricultural exploitation and the financial resources available for technology as a whole and for fertilization in particular.

This makes it possible to establish combinations and doses of fertilizers and to harmonize fertilization systems in relation to the existing technical and economic conditions.

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