Basic Fertilization with Mineral Fertilizers in Soybean Crop

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Abstract. Rich in high nutritional value protein, likely to the protein of animal origin, soybean is considered to be “a golden plant” or “wonder plant”, aimed to resolve global protein deficiency (insuring in present 60% of humanity’s protein requirements). The mature seeds are used in human nutrition. The most important role which soybean has is related to its capacity to fix atmospheric nitrogen without any efforts from farmers. The symbiosis which results from the relation between plant and Bradyrhizobium japonicum ensures 50% of the nitrogen needed for plants growth and development and after harvest remain in soil between 80 and 120 kg N. ONIX variety is made on S.C.D.A. Turda and registered in the year 2002. This variety is highly resistant to falling, shaking and specific diseases. It’s an early variety which is included in maturity group 00, with a vegetation period of 123 days. Having a high protein content of 40,1%, and 21% fats this variety is superior under this aspect to the others varieties created on S.C.D.A. Turda. The research were undertaken on S.C.D.A. Turda on the period 2009 - 2011, on a polifactorial experience of 3x5x5 type, installed after the subdivided parcels method. The experience has as factors: the year (2009-2011), the fertilization with phosphorus (P0, P40, P80, P120, P160) and the fertilization with nitrogen (N0, N25, N50, N75, N100). The highest soybean yields were registered taking into account the specific of this crop related to the presence of nitrogen fixation bacteria. Soybean production levels confirm the framing of central area of Romania as a very favorable area for this crop and in conclusion it is recommended to expand the cultivated areas.

Keywords: soybean, nitrogen, phosphor, potassium, fertilizer, Bradyrhizobium japonicum

INTRODUCTION

Soybean is an “oil-protein plant”, cultivated in many countries, from which we use all biomass quantity. Its seeds are rich in protein substances (27,0 – 50,0%), non-nitrogenous extractive (23 – 30 %), fats (18 – 22 %), vitamin complex (B₁, B₆, B₁₂) and mineral salts.

Rich in high nutritional value protein, likely to the protein of animal origin, soybean is considered to be “a golden plant” or “wonder plant”, aimed to resolve global protein deficiency (insuring in present 60% of the protein requirements). The mature seeds are used in human nutrition. Soybean oil occupies the first place in global production of vegetable fats, is used in human nutrition, on the manufacture of plastics, in obtaining colors for painting and the cakes and oilcakes obtained after its extraction are used as animal feed. The most important role which soybean has is related to its capacity to fix atmospheric nitrogen without any efforts from farmers. The symbiosis which results from the relation between plant and Bradyrhizobium japonicum ensures 50% of the nitrogen needed for plants growth and development and after harvest remain in soil between 80 and 120 kg N.

Due to the high quantity of nitrogen left in soil, soybean is considered to be a good pre-emergent plant for most of no leguminous species having also a positive influence on the physical conditions of the soil. As pre-emergent plant soybean prefers cereal grains (wheat, barley, fodder and some weeding plants such as sugar beet, unfertilized maize and potato).
is not recommended that soybean plants precedes the annual or perennial legumes. Also
sunflower and rape with common diseases (Sclerotinia sclerotiorum) are not used as pre-
emergent plant.

Soybean yield has increased over time in response to improved genetics and
agronomic practices (De Bruin and Pedersen, 2008). The fertilization on soybean is made
according to soil’s content in nutritive elements and the desired production. Due to its high
protein content soybean is included between the biggest nutritional elements consumer’s
plants, especially nitrogen, phosphorus and potassium. For achieving 1000 kg beans, plus
secondary production, soybean requires: 93 – 104 kg N, 22 – 26 kg P₂O₅ and 29 – 44 kg K₂O
(Diaconescu, 1971, cited by Salontai, 1982). In which concerns the consume in nitrogen, on
the beginning of the vegetation period soybean consumes 50% of the required nitrogen from
soil, and after the installation of symbiosis mechanism between plant roots and nitrogen
fixation bacteria (Bradyrhizobium japonicum), most of the nitrogen is achieved from
atmosphere. In which concerns phosphorus, soybean has high requirements immediately after
rising and from flowering to mature.

The development of nitrogen fixation bacteria is favored by the presence of phosphorus which also has a positive influence by increasing the number of nodules,
according to climatic conditions and cultivated variety. Phosphorus has a direct influence on
symbiosis installation and on the plant strengthening.

Nodules have a double content in phosphorus than the root. Phosphorus insufficiency
is manifested by slowing plant growth, leaf spotting brown after flowering and seed
germination capacity decrease. Excess phosphorus produces toxicity phenomenon, the edges
of the leaf necrosis, it reduced plant growth and productivity. The maximum amount of
potassium is absorbed rapidly during vegetative growth, reduces as the starting seed
formation. Potassium plays an important role in the fats synthesis and their storage in seeds.
Potassium promotes increased soybean resistance to disease, promotes the formation of
nodules and symbiotic nitrogen fixation.

MATERIAL AND METHOD

We aimed by this paper to evaluate the influence of mineral fertilization on soybean
culture. The research was conducted during 2009 - 2011 growing seasons, in S.C.D.A. Turda,
located in Transylvania region, Cluj County. From climatic conditions point of view these
region registered a constant annual temperature average, between 9,4°C (2011) and 10,3°C
(2009). The total precipitations meet important differences among the 3 experimental years,
so that from 739 mm which was the average for the year 2010, on 2011 the average of
precipitation decreased up to 433 mm (Fig. 1).

The experimental field was installed after the subdivided parcels method, on the
period between 20 April and 1 May on a black earth soil type. The biological material used
was ONIX variety, created on S.C.D.A. Turda and registered in the year 2002. It is a variety
with a height average of 121 cm, a range of variation between 99 cm and 133 cm. The port of
the plant is erect and increase semi determinate.

Flowers are violet, the bean is spherical and yellow with dark brown hilum. 1000 grain weight
is an average of 150 grams. This variety is highly resistant to falling, shaking and specific diseases. It’s an early
variety which is included in maturity group 00, with a vegetation period of 123 days. Having
a high protein content of 40.1%, and 21% fats this variety is superior under this aspect to others varieties created on S.C.D.A. Turda.

Fig. 1. Evolution of climatic parameters (temperature and precipitation average) during experimental period (2009 – 2011)

Sowing was made using 115 kg/ha ONIX seeds, with 45 cm distance between roads and on 4-5 cm deepness.

In order to achieve the proposed objectives a polifactorial experience of 3x5x5 type was installed. The experimental factors are:

A = year, with graduation: a1 = 2009, a2 = 2010, a3 = 2011;
B = phosphorus fertilizers, with the graduations: b1 = P0, b2 = P40, b3 = P80, b4 = P120, b5 = P160;
C = nitrogen fertilizers, with the graduations: c1 = N0, c2 = N25, c3 = N50, c4 = N75, c5 = N100.

Harvesting was performed mechanical, at the technical maturity of soybean plants.

RESULTS AND DISCUSSIONS

The results on soybean productivity, obtained among the three experimental years, showed that the year has the highest influence. From the point of view of favorability level of soybean production is highlighted the year 2010 when the production was with 71% and 97% higher than in 2009 or 2011 (Tab. 1).

The results obtained are subscribing to those obtained by other authors, showing once more that soybean yield responses can vary in specific combinations of environment, cultivar maturity and seeding date (Lee et al., 2008).
Tab. 1

The influence of the factor “year” on soybean production in Turda, between the years 2009 – 2011

<table>
<thead>
<tr>
<th>Factor A (year)</th>
<th>Production</th>
<th>Differences to a1 - 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>a1 = 2009</td>
<td>23.62</td>
<td>100.0 Mt. -</td>
</tr>
<tr>
<td>a2 = 2010</td>
<td>40.40</td>
<td>171.0 +16.78 xxx</td>
</tr>
<tr>
<td>a3 = 2011</td>
<td>20.47</td>
<td>86.7 - 3.15 0</td>
</tr>
</tbody>
</table>

DL 5% 2.29
DL 1% 3.79
DL 0.1% 7.09

On the second place stands phosphorus fertilizers. The highest production increases (ensured very significant, from statistical point of view) were registered on the variant fertilized with 160 kg/ha phosphor. Important production increases were achieved also on the variants fertilized with 80 and 120 kg/ha phosphor (Tab. 2).

Tab. 2

The influence of phosphorus fertilizers on soybean production/yields in Turda, during 2009 – 2011

<table>
<thead>
<tr>
<th>Factor B (phosphor)</th>
<th>Production</th>
<th>Difference to b1 – P0</th>
</tr>
</thead>
<tbody>
<tr>
<td>b1 = P0</td>
<td>26.07</td>
<td>100.0 Mt. -</td>
</tr>
<tr>
<td>b2 = P40</td>
<td>27.90</td>
<td>107.0 +1.83 -</td>
</tr>
<tr>
<td>b3 = P80</td>
<td>28.26</td>
<td>108.4 +2.18 X</td>
</tr>
<tr>
<td>b4 = P120</td>
<td>27.73</td>
<td>110.2 +2.65 Xx</td>
</tr>
<tr>
<td>b5 = P160</td>
<td>29.85</td>
<td>114.5 +3.77 XXX</td>
</tr>
</tbody>
</table>

DL 5% 1.84
DL 1% 2.50
DL 0.1% 3.35

In which concerns the influence of nitrogen fertilizers on soybean yields an insignificant growth is observed on the agro fond N100 (Tab. 3).

Tab. 3

The influence of nitrogen fertilizers on soybean production/yields in Turda, during 2009 – 2011

<table>
<thead>
<tr>
<th>Factor C (nitrogen)</th>
<th>Production</th>
<th>Difference to c1 – N0</th>
</tr>
</thead>
<tbody>
<tr>
<td>c1 = N0</td>
<td>27.33</td>
<td>100.0 Mt. -</td>
</tr>
<tr>
<td>c2 = N25</td>
<td>27.96</td>
<td>102.3 +0.63 -</td>
</tr>
<tr>
<td>c3 = N50</td>
<td>28.12</td>
<td>102.9 +0.79 -</td>
</tr>
<tr>
<td>c4 = N75</td>
<td>27.81</td>
<td>101.8 +0.48 -</td>
</tr>
<tr>
<td>c5 = N100</td>
<td>29.57</td>
<td>108.2 +2.24 xxx</td>
</tr>
</tbody>
</table>

DL 5% 1.18
DL 1% 1.56
DL 0.1% 2.00

The highest soybean yields were registered taking into account the specific of this crop related to the presence of nitrogen fixation bacteria. The nitrogen fixation bacteria have a
better development on soils with a good storage in phosphor, potassium, sulfur, calcium and magnesium and in condition of moderate humidity and temperature

CONCLUSION

In order to prevent destruction of nitrogen-fixing bacteria of soybean it is recommended not to treat the seeds with fungicides. The use of herbicides in large quantities leads to a reduce formation of nodules of *Bradyrhizobium japonicum* on the roots. Soybean average yield recorded throughout the period 2009-2011 was on an average of 2816 kg / ha.

Soybean production levels confirm the framing of central area of Romania as a very favorable area for this crop and in conclusion it is recommended to expand the cultivated areas.

REFERENCES


