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# ANALYSIS OF THE IMPACT OF THE USE OR NON-USE OF NEONICOTINOIDS IN AGRICULTURE

PETRE IONUȚ LAURENȚIU<sup>1</sup>

**Summary:** *Neonicotinoids are a class of chemical insecticides derived from nicotine. Like nicotine, neonicotinoids act on certain types of receptors in nerve synapses. They are much more toxic to invertebrates, such as insects, than to mammals and birds. The popularity of neonicotinoids for pest control is their water solubility, which allows them to be applied to the soil and taken over by the plants. The present paper will present, analyse and evaluate the impact of the use of these insecticides in the agriculture of Romania. In the first phase of the study, we will present the overall situation of the main cultures for which these neonicotinoids are used, by qualitative and quantitative analysis of data from local, national, European and international databases. In the second phase the effect and effort of the use or non-use of these insecticides in agriculture will be estimated. Thus, the difference in production will be determined in an untreated and treated one, and we will see the value of the neonicotinoids in production, on the other hand, the less positive effects of the use of these types of insecticides, namely pollution, or what they call some "ecological disaster", but also its effect on apiculture and implicitly on bees. This study will be pertinent and objective, without favoring or disfavoring any person or institution in these two areas.*

**Key words:** neonicotinoids, effect, effort, agriculture, apiculture.

**JEL classification:** Q15, Q52, Q57

## INTRODUCTION

Neonicotinoids belong to the category of systemic pesticides, more precisely, the active substance in the insecticide is captured by the plant through the juice in the body of the pests by ingestion, and therefore each part of the plant is poisonous to the pests.

Neonicotinoids are a set of pesticides launched on the market in the 1990s as substitutes for older and more harmful pesticides. This name comes from the way it acts on insects that have ingested these products.

The European Union prohibits the use of these products for seed treatment, but also for spraying plants in vegetation. However, products containing neonicotinoids may be used in the spraying of fruit trees during vegetative rest.

In our country there are certain derogations from the European Union that allow the use of certain substances containing neonicotinoids for seed treatment during the sowing of the crops.

Crops in Romania are infested by a bunch of dangerous pests that can destroy a particular crop in a very short time. The most common problem facing farmers (predominantly in the south of the country) is the "corn grove". Unfortunately, this pest is more prevalent in us country and less in neighboring countries, in the West not representing a problem. Those who adopt and support these categories of pesticides believe that their main asset is the way they act on pests, ie it acts directly on the target, blurring the attack of the pest (target), not affecting the other insects.

Lately, the emphasis has been placed on the effects of pesticides on crops and on animals and the environment. In the foreground, pesticides containing neonicotinoids, which are believed to lead to bee death.

Bee's death due to the use of neonicotinoids can be clearly proven as follows: seeds can be treated inappropriately from the point of view of the amount of pesticides and when the seeds are sown by rubbing the seeds with each other, packaging, the seed drill gear, the substance descends from the seeds, and then carried by the wind gets in direct contact with the bees, the honey plants or the hives.

A second way of contamination of bees would be when the active substance in cellulose juice reaches the floral organs, including nectar and pollen, but in very small quantities; but this method was not 100% scientifically proven.

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The third type of contamination would be neonicotinoid treatment in the vegetation phase. It may be the most harmful for bees, although these pesticides are not approved for their use at the time of the inflorescence, some farmers do not consider treating the fruit trees when they are blooming.

Beyond the bees, one report<sup>2</sup> also states that these insecticides contribute negatively by disrupting the ability of the earthworms to soil and soil.

In this article we will highlight the situation of the surfaces treated with these pesticides, together with their degree of seizure in the total area, in order to create an overview of this situation. Bee families will also be analyzed. At the same time, the effects and efforts of the use or non-use of these insecticides, as well as the economic differences in the production and the negative effect of neonicotinoids will be analyzed.

## MATERIALS AND METHODS

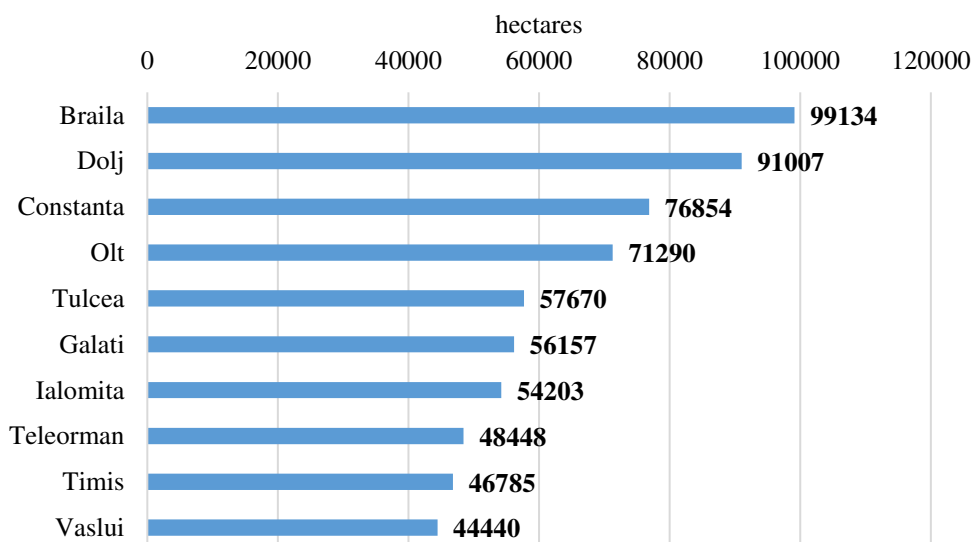
The first part of the paper will use data on total and county areas cultivated with sunflower. This culture has been established in that it is a major source of nectar for the beekeeping sector and at the same time a common culture among farmers, which is being treated with neonicotinoid. These data were taken over from the National Institute of Statistics; another reason why this culture was chosen was that its situation would be compared with the data taken from the National Phytosanitary Authority, the Office for the Control of the Marketing and Use of Plant Protection Products, which specifies the surfaces treated with neonicotinoids.

In the second part, the obtained data will be evaluated qualitatively and quantitatively, and an economic analysis will be carried out, of the main advantages and disadvantages of the use of these products.

## RESULTS AND DISCUSSIONS

In Romania, in 2016, approximately 1.04 million hectares were sown with sunflower, accounting for 63.8% of the total area of oily plants. Analyzing the areas for each county, at the same time making their ranking from the point of view of the areas cultivated with the sunflower, we can state that no county exceeds the share of 10% of the total sunflower area (at national level). The following figure shows the first 10 counties depending on the area planted with sunflower in 2016:

**Figure 1 Areas planted with sunflower in the first 10 counties in 2016**



Source: insse.ro

<sup>2</sup> Worldwide Integrated Assessment of the Impact of Systemic Pesticides on Biodiversity and Ecosystems - Volume 22, Issue 1, January 2015 ISSN: 0944-1344

As can be seen from Figure 1, in 2016, the largest area of sunflower in a county was made in Braila, 99,13 thousand hectares, justifying being in the Great Island of Braila, which exploits a significant area of land. This county has a share of 9.53% of the country's total sunflower area.

On the second place, with 91 thousand hectares (8.75% of the surface of Romania with sunflower), Dolj county, followed by Constanta (with 7.39%), Olt (with 6, 86%), Tulcea (5.5%), Galati (by 5.4%), Ialomita (by 5.21%), Teleorman (by 4.66%), Timis (by 4.5%) and Vaslui tenth with a share in the total sunflower area of 4.27%. On the opposite side, the lowest share of a county is in Covasna, where 6 hectares were grown in 2016, or 0.001% of the total country.

Following the collection of data from the National Phytosanitary Authority, with the help of the Romanian Bees Growers Association, regarding the crops and surfaces treated with neonicotinoids, only those with sunflower were extracted, resulting in the following statistics:

**Table 1 Situation of sowing areas with sunflower seed treated with ppp from the neonicotinoid group JUNE 2016**

No. crt.	County	Crop	Surface treated (Ha)	The quantity of treated seeds (Kg)	Amount of seed treated per hectare (Kg / ha)
1	Arad	Sunflower	3583,36	17205	4,80
2	Arges	Sunflower	4287,01	23383	5,45
3	Bacau	Sunflower	457,21	2760	6,04
4	Botosani	Sunflower	315,14	1080	3,43
5	Braila	Sunflower	47744,00	119349	2,50
6	Calarasi	Sunflower	14251,57	49195	3,45
7	Buzau	Sunflower	8306,01	39882	4,80
8	Bihor	Sunflower	3439,7	16510	4,80
9	Cluj	Sunflower	374,01	4805	12,85
10	Dolj	Sunflower	3774,71	19127	5,07
11	Ialomita	Sunflower	16872,78	73004,64	4,33
12	Ilfov	Sunflower	2916,71	13721,41	4,70
13	Galati	Sunflower	10052,09	35926	3,57
14	Maramures	Sunflower	67,84	339	5,00
15	Mures	Sunflower	360,41	1441,8	4,00
16	Giurgiu	Sunflower	4602,57	16021	3,48
17	Neamt	Sunflower	1993	9706	4,87
18	Prahova	Sunflower	4286,68	19127	4,46
19	Vaslui	Sunflower	17126,67	84320	4,92
20	Iasi	Sunflower	1636,21	8316	5,08
21	Olt	Sunflower	12283,63	67484,04	5,49
22	Tulcea	Sunflower	3292	17443	5,30
23	Teleorman	Sunflower	4051,73	16020	3,95
24	Timis	Sunflower	8865,34	44046	4,97
25	Suceava	Sunflower	202	920	4,55
26	Satu Mare	Sunflower	3564,39	18107,10	5,08
<b>TOTAL</b>	-	Sunflower	<b>178706,77</b>	<b>719238,99</b>	<b>4,88</b>

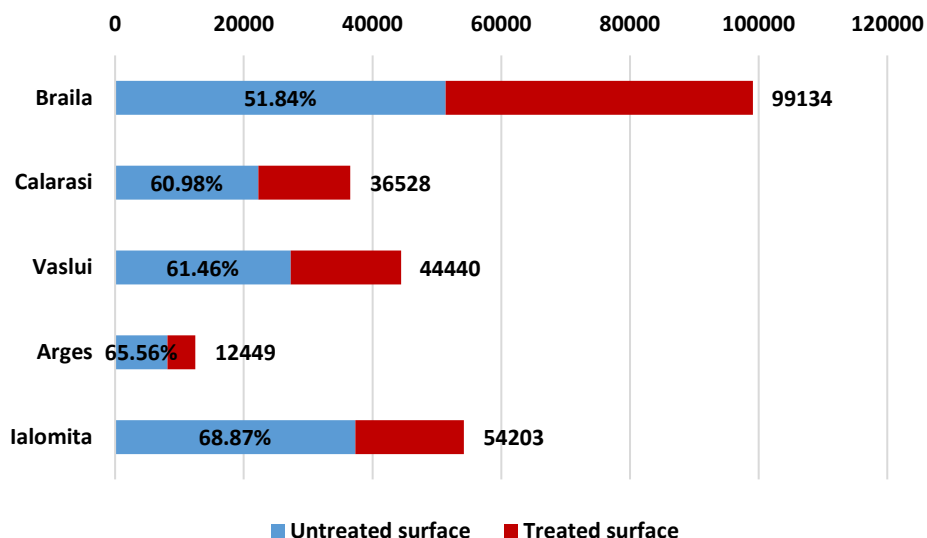
*Source: Romanian Bees Growers Association*

Table 1 summarizes the areas and quantities of hectares and sunflower seeds that were treated in 2016, so it can be seen that at national level, the area treated with neonicotinoids is 178 thousand hectares. This total area was sown with treated seeds with a total weight of 719.24 tons, which means a sowing rate of 4.88 kilograms of seed per hectare.

Among the counties that have the largest areas with sunflower treated, there are: Braila (47.7 thousand hectares), Vaslui (17.13 thousand hectares), Ialomita (16.87 thousand hectares), Călărași (14.25 thousand ha) and Olt (with 12.28 thousand ha); of these 5 counties, four are also found in the top ten counties that cultivate the sunflower at national level, of which Calarasi County is an

exception, having a total sunflower area of 36.5 thousand hectares, therefore the super-surface treated in this county is 39%.

**Figure 2. The first 5 counties depending on the weight of the treated area**

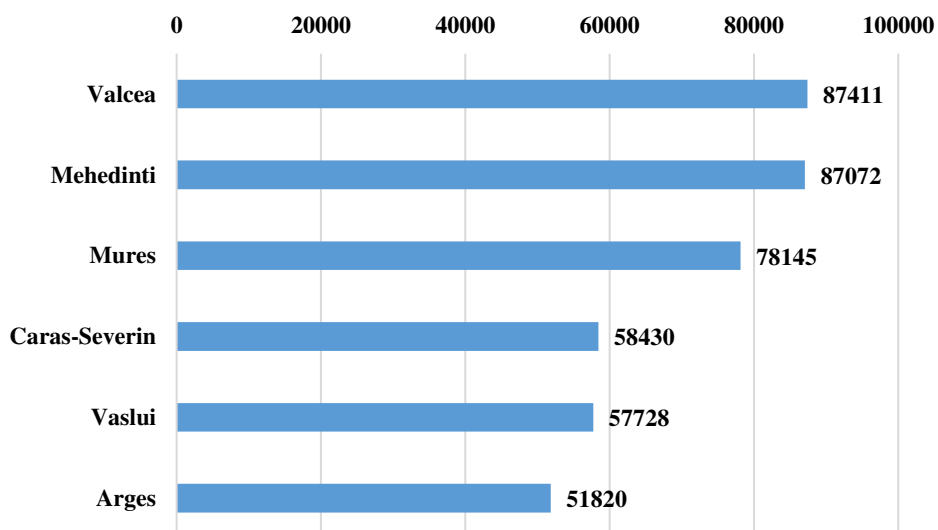


*Source: own calculations*

At national level, the treated sunflower area is present in a share of 17.19% of the total area. Figure 2 shows the first 5 surfaces where the treated surface is present at a high level. Therefore, out of the 99.134 thousand hectares of sunflower in Braila in 2016, 48.16% of them (44.74 thousand hectares) were treated. Calarasi County, although it does not have a total area with very large sunflowers (36.5 thousand ha), ranks second in terms of the share of the treated area in total, ie 39.02% (representing about 14.25 thousand ha.). With 38.54% (17.13 thousand hectares), the area treated with neonicotinoids, out of the total sunflower area, in the county, is ranked third in the county of Vaslui. The county of Argeş, with a share of the area planted with sunflower, in the national total of only 1.2% (12.5 thousand ha), holds a total area of sunflower treated with pesticides of 34.44% (respectively 4.3 thousand ha.). Fifth place, according to the weight of the treated area, is Ialomita County, which has such a surface area of 31.13% (16.8 thousand hectares).

As far as the bee population is concerned, according to data from the National Institute of Statistics, in 2016 there were almost 1.44 million bee families; referring to the total sunflower area, reporting these series of data, the number of bees families per each hectare of sunflower, namely 1.38 hives / ha of sunflower. Referring to the counties of Romania, in Figure 3, the first 6 counties were presented, depending on the number of bee families.

**Figure 3. Effects of bee families in the first counties (2016)**



*Source: insse.ro*

The top of the ranking, 87.4 thousand bee families rank Vâlcea county, representing 6.08% of the national bee population. On the second place, at a very small distance of only 340 bee families, lies Mehedinti County, which has a share in Romania's population of 6.06%. Mureş County occupies the third position in this ranking, with 78.15 thousand bee families, with a share of 5.44%. With 4.06% of Romania's total hives, Caraş-Severin County, is ranked fourth. The following two counties (Vaslui and Argeş) occupy the fifth and sixth places in this ranking, respectively with a percentage of 4.02% and 3.61% of the bee population, but these two counties occupy 3rd and 4th place in the top of the counties most of the treated areas.

The other three counties in the ranking of the weight of the treated surface (fig. 2), Brăila, Călăraşi, Ialomiţa are found in the last 10 counties according to the number of bee families, so we can assume that one reason would be the treatment of quite large areas these pesticides (neonicotinoids). For example, Braila County, which ranks first among the counties with the largest areas of sunflower, occupies the before last place among the counties with the most bee families, followed by Ilfov (which is reduced from the point of view of the physical dimension) and Covasna County where there are only 6 hectares of sunflower, so it is understandable why there are no bees there.

In order to better describe this situation, the information on the areas under sunflower, the treated ones, the weight of the latter and the number of bee families are summarized in Table 2:

**Table 2 Centralization**

County	Sunflower Surface (ha)	The sunflower surface treated (Ha)	Share (%)	Effective bee families (No)
Braila	99134	47744	48.16%	14142
Calarasi	36528	14252	39.02%	21934
Vaslui	44440	17127	38.54%	57728
Arges	12449	4287	34.44%	51820
Ialomita	54203	16873	31.13%	20224
<b>National Level</b>	<b>1039823</b>	<b>178707</b>	<b>17.19%</b>	<b>1437394</b>

Source: *insse.ro, aca.org.ro*

As mentioned above, at the national level, the proportion of sunflower treated areas with neonicotinoids in total sunflower areas was 17.19% in 2016, so we can say that the bee population is affected of these substances in the same percentage on average; so that of almost 1.44 million families will suffer 247 thousand.

If we refer to the counties, we can see that almost half of the sunflower fields in Braila were treated in 2016, which means that about 6810 bee families will be at risk. In the counties of Vaslui and Argeş, the situation is even worse, given the large share of the treated areas and the large number of bee families, thus reaching the risk of 22,25 thousand families in Vaslui and about 17, 85,000 families in Arges. Of all the counties in Table 2, in Ialomita the situation is not so difficult because the number of bee families is quite low, thus in this county about 6300 hives.

By referring to the economic aspects and effects, we can analyze, in terms of effect and effort, in order to determine the amount of loss or gain, depends on the situation, data referring to outputs, prices acquisition environments and differences in production.

**Table 3 Value of losses in case of non-use of neonicotinoids**

County	Sunflower production (t)	Share of treated areas in production (t)	Production due to the non-use of neonicotinoids	Loss / Difference (35%) (t)	Average purchase price (lei / kg)	Loss Value (thousand lei)
Braila	225249	108482	70514	37969	1.48	56194
Calarasi	97921	38204	24833	13372	1.61	21528
Vaslui	54159	20872	13567	7305	1.37	10008
Arges	17226	5932	3856	2076	1.61	3343
Ialomita	135316	42122	27380	14743	1.61	23736
<b>National Level</b>	<b>2032340</b>	<b>349283</b>	<b>227034</b>	<b>122249</b>	<b>1.51</b>	<b>184596</b>

Source: *own calculations based on data insse.ro*

In Romania, in the year 2016, 2 million tons of sunflower were harvested, of which 349 thousand tons were harvested from the areas under the treatment of pesticides (respecting the weight

of the surface treated). After a study<sup>3</sup>, on average, losses on sunflower production, in the case of non-use of neonicotinoids, are about 35 percent. Thus, in the present case, the loss at national level, expressed in physical units, was 122.25 thousand tons, this being considered at the national average purchase price of 1.51 lei per kilogram of sunflower, a loss of 184.5 million lei would have been recorded in the case of the abandonment of the use of insecticides.

As expected, if pesticides were to be abandoned, farmers in Braila would suffer the most, registering a loss of 56.2 million lei. On the opposite side, the lowest loss registered in Arges County, worth 3.3 million lei.

**Table 4 Amount of earnings for non-use of neonicotinoids**

County	Production of honey (t)	Possible production (t)	Difference (t)	Average purchase price (lei / kg)	Win value (thousand lei)
Braila	210	311	101	14.17	1433
Calarasi	322	448	126	12.49	1569
Vaslui	826	1144	318	14.33	4562
Arges	674	906	232	12.49	2899
Ialomita	296	388	92	12.49	1151
<b>National Level</b>	<b>21202</b>	<b>24846</b>	<b>3644</b>	<b>15.11</b>	<b>55058</b>

*Source: own calculations based on data insse.ro*

At the national level in 2016, 21.2 thousand tons of honey were extracted; by abstract, if the share of the surfaces would affect the bee mortality in the same way, and therefore a lower level of production, it would be assumed that there may be favorable proportions directly proportional. Thus, if the level of production would increase, the same percentage would have obtained in 2016, an amount of extracted honey of 24.85 thousand tons. Compared to the real situation, this would be higher by 3644 tons of honey, valued at the average purchase price of 15,11 lei per kilogram of grocer's last year, there would be a national gain of 55 million lei.

Referring to the counties, it can be seen, as expected and expected, that the first county according to the value of the extra gain is Vaslui, where the largest number of bee families are registered among these five counties in Table 4; this would have been 4.5 million lei. The lowest gain in the five counties analyzed was 1.15 million lei, resulting in Ialomita.

## CONCLUSIONS

Comparing the two situations, namely the value of the losses (Table 3) and the value of the gains (Table 4), it can be noticed that the withdrawal of the pesticides from the sunflower production technology affects the sphere of the agricultural producers more strongly than the beekeepers, to production. Thus, in the present case, the value of losses is greater than that of earnings of about 3.35 times.

By comparing the five counties analyzed, significant differences can be observed in most areas, so in the county of Braila, where the largest area of sunflower is present, and among the fewest bee families (a reason may be the fact that this area is treated in a weighting of 48%), there were deviations between the value of the losses and 39 times the winnings in favor of the first category.

In Calarasi County, the difference between the value of the losses due to the non-use of pesticides and the gain obtained as a result of the increase in honey production was 13.7 times, in the county of Vaslui 2.2 times in the Ialomita County of 20 times. Thus, all the counties analyzed would record higher losses in the farmers 'sphere than beekeepers' profits; but in Argeş County these values are the closest and can be compared directly, so as a result of the dropout of toxic products, farmers' losses would amount to 3.34 million lei, instead the increases obtained by the bee breeders the increase in production would be 2.9 million lei, so a difference of only 15%.

<sup>3</sup> <http://www.descopera.ro/stiinta/12950929-sa-fie-neonicotinoidele-cel-mai-mare-dezastru-ecologic-contemporan>

Concluding, taking into account only their productions and their values, it can be stated that the withdrawal of neonicotinoids from the technological sheet of the sunflower crop is not profitable; but if we consider the beehives lost, as a result of intoxication with these substances, together with the value of each family, we could say that the economic differences would not be so great. Taking into account the national share of the treated areas of 17.19% as a decrease in the number of bee families, it would result that 247 thousand families would be lost. Thus, adding this cost to the value of the gain, it would amount to 154 million lei, 16.6% lower than the losses of the agricultural holdings. All these can be added to the value of the gain, the outsourced expenses, representing the other negative effects of pesticides such as pollution (air, soil, water), the death of other creatures or their imbalances, and so on, thus pushing the balance into the other camp can talk about a profitability of the ban on neonicotinoids in agriculture.

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