Informatics System for Planning the Pastoral Beekeeping in Romania

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Abstract

The paper presents the basic ideas for the conceptualization and the development of an informatics system for planning the pastoral beekeeping in Romania, whit a study case at level of Ilfov County. This informatics system for planning the pastoral beekeeping integrates administrative and geographic information database, surfaces and melliferous potential of the main melliferous plants in Romania (acacia - *Robinia pseudocacia* L., lime - *Tilia tomentosa* Moench.; *Tilia cordata* Mill.; *Tilia platyphyllos* Scop., rapeseed - *Brassica napus* L. ssp. *oleifera* Metzg., and sunflower - *Helianthus annuus* L.), the average multiannual climatic data, as well as a database concerning the number of beekeepers and beehives and their territorial repartition in each homogenous zone.

The informatics system for planning the pastoral beekeeping is thought as a tool to be used by decision makers at national and regional level for planning the pastoral activity of the beekeepers in Romania. In the same time, this informatics system is thought as a useful tool to be used by beekeepers in view to get information about the repartition and places of the melliferous forests and crops, as well as about their melliferous potential according to the climatic conditions of the year.

Keywords: *pastoral beekeeping, acacia, lime, rapeseed, sunflower.*

INTRODUCTION

Development of beekeeping and increasing the apiculture production (honey, pollen, and other beehive products) are closely related to the richness and diversity of melliferous plants, which are providing food (nectar and pollen) for honeybees assuring their growth and maintenance, but also assuring the honey production for the beekeeper.

According to the national legislation, the beekeepers in Romania are allowed to benefit free of charge of the state forestry and agricultural melliferous resources. Thus, the beekeepers can move in pastoral all over the country with their beehives to the melliferous forests and crops. Unfortunately, the pastoral activity is not organised and planned at national or regional level [2]. As a consequence, it often happens to have too much beehives for a forest or some melliferous crops in a certain zone, which leads to a reduced efficiency of the melliferous pastoral activity and an increased risk of sanitary problems for the bees. Also, it very often happens that some melliferous forests and crops to be less or even not at all valorised.

An informatics system for planning the pastoral beekeeping can be used by decision makers at national and regional level for planning the pastoral activity of the beekeepers in view to put into value the melliferous resources of each area and to make efficient the pastoral activity of the beekeepers.

In the same time, such informatics system can be used by the beekeepers in view to get useful information about the melliferous potential of different forests (acacia and lime forests) and crops (rapeseed and sunflower) according to the climatic conditions of the year.

MATERIAL AND METHOD

The informatics system for planning the pastoral beekeeping in Romania is thought as an useful tool for providing information about: locations of acacia and lime forests; main zones for growing rapeseed and sunflower in Romania; melliferous potential of acacia, lime, rapeseed and sunflower according to the climatic conditions of the year, respectively the forecasting of beginning and duration of the flowering process and the potential honey production function of potential nectar secretion and its sugar concentration, and potential number of flowers. The four species taken into account represent the most important melliferous resources in Romania, more than three quarters of Romanian honey marketed production coming from these species. The informatics system is thought to be developed gradually at county and then at national level.

In the present paper, there is presented the development of the informatics system at Ilfov County level (region all around Bucharest city). Ilfov County was chosen because of its diversity concerning the melliferous flora.

First activity was that to establish the features that characterize the melliferous resources of the county. In view to calculate the melliferous balance at county level (total production of potential honey in the Ilfov County), there were took into consideration the surfaces occupied by each melliferous species [1].

Data on areas cultivated with rapeseed and sunflower were provided by Ilfov County Agricultural Department and data on areas occupied by acacia and lime have been supplied by the Forest Research Institute Ştefăneşti. This represents the first stage in the development of the informatics system for planning the pastoral beekeeping, and this is compiled with the administrative and geographic information concerning acacia and lime forests, as well as concerning the sunflower and rapeseed crops.

It the second stage of the informatics system development, the average multiannual climatic data for each acacia and tile forest, as well as for each homogenous zone with melliferous crops (rapeseed and sunflower) has to be gathered.

In the third stage, for each acacia and tile forest, as well as for each homogenous zone with rapeseed and sunflower crops the melliferous potential has to be calculated and the maximum load of beehives has to be established.

Then, in the fourth stage, a database containing the number of beekeepers and beehives in the county has to be built.

Finally, in the fifth stage, all the data and information has to be compiled into an informatics system.

RESULTS AND DISCUSSION

The melliferous potential expressed through the potential honey yield/ha is calculating using the following formula:

$$M = [(Sn \times Cn \times D \times Nf \times Np)/100{,}000{,}000] \times 1.25 \quad (1)$$

where: M = potential honey yield (kg/ha);
Sn = nectar secretion (mg nectar/flower/day);
Cn = nectar content in sugar (%);
D = flowering duration for a flower (days);

Nf = number of flowers /plant;
Np = number of plants/ha;
1.25 = coefficient of sugar transformation in honey.

All the parameters from the above formula are taken as average values for normal forests and crops in normal climatic years.

The melliferous potential is determined by the biological factor (species and variety) but this is significantly influenced by the climatic conditions, especially by water (rainfall) and temperature [4]. That is why the melliferous potential calculated has to be corrected function of climatic conditions of the year, respectively corrections has to be made in the rainy and cold years and dry and hot years.

The calculated melliferous potential is used for the establishment of the maximum load of beehives on the surface unit, but also for the information of the beekeepers which are moving in pastoral with their beehives (table no 1 and table no 2).

In view to provide correct estimation about the melliferous capacity of each melliferous plant (acacia, lime, rapeseed and sunflower) by using the informatics system, for each forest and agricultural homogenous area where the melliferous crops are grown (rapeseed and sunflower), the average multiannual maximum and minimum daily temperatures and average multiannual monthly rainfall were gathered. The climatic data were gathered from the most closed meteorological station and when this was not possible, these data were obtained through the interpolation calculation of the climatic data existing in the neighbourhood. The climatic data are necessary because they are influencing the melliferous potential but also the period of flowering [5]. For instance, mainly because of temperatures, in South Romania there are three periods of flowering for acacia, respectively: the acacia along the Danube River is flowering first, then acacia in the middle of Romania Plain is flowering and lastly the acacia in the hilly regions nearby Carpathians is flowering. The beekeepers know this different flowering periods of acacia and some of them are moving with their beehives three times in a year only for acacia.

Also, in view to provide useful information about the melliferous characteristics of the main melliferous plants (acacia, lime, rapeseed and sunflower), it is also very important to calculate the date of starting and duration of flowering process [3]. In this respect, there is already well-known the fact that the plant development is determined by an important number of complex factors and their complex interrelations. This makes the calculation task to be a so-called “poor-structured problem”. However, a simple method that can be used to estimate the plant development is based on “thermal time” measured in “growing degree-days” (GDD). This method starts from the fact that each plant requires a specific amount of heat (a specific sum of GDD) to develop from one point to another in their life-cycle and development occurs only if the air temperature exceeds a minimum limit, named “base temperature” (Tb), which has values according to the species (7^oC for sunflower and 0^oC for rapeseed, acacia and lime).

The following model of the GDD calculation is implemented:

$$GDD = [(T_{max} + T_{min})/2] - T_b \qquad (2)$$

if: $(T_{max} + T_{min})/2 \leq T_b$ then GDD = 0

where: T_{max} = maximum air temperature;
T_{min} = minimum air temperature;
T_b = base temperature;
GDD = growing degree-days.

The sum of GDD is calculated for each crop, i.e. acacia and tile, and regarding the sunflower and rapeseed for each hybrid maturity class.

In view to calculate the using rate of the melliferous resources in each area and the number of beehives that could be moved in each area in view to have an efficient valorisation of the melliferous resources and to avoid the situations of too much or too less beehives on the surface unit of melliferous crops and forests, there are necessary to create a database containing the number of beekeepers and the number of beehives in each area (at villages level in and county).

Table no 1

Potential number of honeybee families according to the melliferous potential and surface cultivated with rapeseed and sunflower in Ilfov County

No	*Villages in Ilfov County*	***Rapeseed*** *Brassica napus* L. ssp. *oleifera* Metzg.			***Sunflower*** *Helianthus annuus* L.			***Total Number of Potential Honeybee Families (rapeseed + sunflower)***
		Surface* (ha)	***Melliferous Potential (kg honey)***	***Potential Number of Honeybee Families*****	***Surface* (ha)***	***Melliferous Potential (kg honey)***	***Potential Number of Honeybee Families*****	
1.	Brăne□ti	782	180,642	6,021	409	16,769	671	6,692
2.	Pope□ti Leordeni	725	167,475	5,583	307	12,587	503	6,086
3.	Găneasa	558	128,898	4,297	699	28,659	1,146	5,443
4.	Afuma□i	447	103,257	3,442	1,009	41,369	1,655	5,097
5.	Tunari	471	108,801	3,627	468	19,188	767	4,394
6.	Cernica	405	93,555	3,119	678	27,798	1,112	4,231
7.	Dascălu	458	105,798	3527	387	15,867	635	4,162
8.	Grădi□tea	428	98,868	3296	401	16,441	658	3,954
9.	Vidra	370	85,470	2,849	257	10,537	422	3,271
10.	Petrechioaia	317	73,227	2,441	254	10,414	416	2,857
11.	□tefane□ti	255	58,905	1,964	163	6,683	267	2,231
12.	Otopeni	243	56,133	1,871	143	5,863	234	2,105
13.	Moara Vlăsiei	153	35,343	1,178	554	22,714	908	2,086
14.	Nuci	150	34,650	1,155	312	12,792	512	1,667
15.	Glina	72	16,632	554	179	7,339	293	847
16.	Chitila	70	16,170	539	173	7,093	283	822
17.	Snagov	62	14,322	477	173	7,093	283	760
18.	1 Decembrie	90	20,790	693	0	0	0	693
19.	Buftea	85	19,635	655	0	0	0	655
20.	Jilava	55	12,705	424	50	2,050	82	506
21.	Ciorogârla	27	6,237	208	130	5,330	213	421
22.	Domne□ti	0	0	0	135	5,535	221	221
23.	Gruiu	25	5,775	193	0	0	0	193
24.	Mogo□oaia	0	0	0	100	4,100	164	164
25.	Pantelimon	0	0	0	82	3,362	134	134
26.	Ciolpani	0	0	0	30	1,230	49	49
TOTAL		**6,248**	**1,443,288**	**48,110**	**7,093**	**290,813**	**11,628**	**59,738**

** Date supplied by Ilfov County Agricultural Department*

***Number of honeybee families according to the melliferous potential and surface of the main melliferous cultivated crops: rapeseed and sunflower*

Table no 2

Potential number of honeybee families according to the melliferous potential and surface with acacia and lime in Ilfov County

No	*Forestry in Ilfov County*	*Production units in the forestry*	*Acacia* *Robinia pseudocacia* L.			*Lime* *Tilia tomentosa* Moench. *Tilia cordata* Mill. *Tilia platyphyllos* Scop.		
			Surface* (ha)	***Melliferous Potential (kg honey)***	***Potential Number of Honeybee Families*****	***Surface* (ha)***	***Melliferous Potential (kg honey)***	***Potential Number of Honeybee Families*****
1.	Brăne□ti	II	376.0	125,960	4,063	52.9	31,052	1,242
2.		V	25.9	8,677	280	361.2	212,024	8,480
3.		VI	125.9	42,177	1,360	407.2	239,085	9,563
Total Brăne□ti Forestry			**527.8**	**176,814**	**5,703**	**821.3**	**482,161**	**19,285**
4.	Bucure□ti	II	26.8	8,978	281	134.5	78,951	7,158
5.		III	195.9	65,626	2,051	123.8	72,670	2,906
6.		IV	289.7	97,049	3,033	66.0	38,742	1,549
7.		V	323.1	108,238	3,382	96.1	56,352	2,254
8.		VI	677.8	227,063	,7096	19.7	11,563	462,556
Total Bucure□ti Forestry			**2,025.7**	**506,954**	**15,842**	**440.1**	**258,278**	**476,423**
9.	Snagov	V	18.2	6,097	191	174.0	102,138	4,085
10.		VI	19.9	6,666	208	350.2	205,567	8,222
Total Snagov Forestry			**38.1**	**12,763**	**399**	**524.2**	**307,705**	**12,307**
TOTAL			**2,591.6**	**696,531**	**21,944**	**1,756.1**	**1,048,144**	**508,015**

** Date supplied by Forest Research Institute Ştefăneşti*

*** Number of honeybee families according to the melliferous potential and surface of the acacia and lime forests*

Once there are all the necessary databases and information, these will be compiled into an informatics system. Firstly, there should be designed the logical structure of the system and the working interface (format, graphics and so on). Then, the functionality of the informatics system should be verified and validated.

The informatics system is to be implemented and used at a county level firstly, and after different test and validations, this will be developed at South Romania level and then at national level. This informatics system will be used by decision makers at national and regional level for planning the pastoral activity of the beekeepers. But also, this is providing useful information for beekeepers about the repartition and places of the melliferous forests and crops, as well as about the melliferous potential of different forests and crops according to the climatic conditions of the year.

CONCLUSIONS

1. The risk of moving beehives at random to the melliferous forests and crops, without knowing their melliferous potential and without knowing the already present beehives in the area impose the necessity for the development of an informatics system for planning the pastoral beekeeping.
2. An informatics system for planning the pastoral beekeeping could be used by decision makers at national and regional level as a useful tool for planning the pastoral activity of the beekeepers.
3. An informatics system for planning the pastoral beekeeping could be used by beekeepers as a useful tool in view to get information about the repartition and the melliferous characteristics of the main melliferous plants (acacia, lime, rapeseed and sunflower).

4. Such an informatics system for planning the beekeeping in Romania integrates different kinds of information and databases, such as: administrative and geographic information database, surfaces and melliferous potential of the main melliferous plants in Romania (acacia, lime, rapeseed and sunflower), the average multiannual climatic data, as well as a database concerning the number of beekeepers and beehives and their territorial repartition in each homogenous zone.

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