Зборник Матице српске за природне науке / Proc. Nat. Sci, Matica Srpska Novi Sad, № 110, 187—194, 2006

UDC 633.63:632.5(497.11)"1961/2004"

Dušan S. Čamprag[1], *Radosav R. Sekulić*[2], *Tatjana B. Kereši*[1]

[1] Faculty of Agriculture, Trg D. Obradovića 8
Novi Sad, Serbia and Montenegro
[2] Institute of Field and Vegetable Crops
Maksima Gorkog 30, Novi Sad, Serbia and Montenegro

FORECASTING OF MAJOR SUGAR BEET PEST OCCURRENCE IN SERBIA DURING THE PERIOD 1961—2004*

ABSTRACT: In Serbia, sugar beet is grown in the province of Vojvodina mostly. The increase in areas sown to this crop in the province from 30,000 hectares in 1931—1939 to over 70,000 in 1951—2000 provided a large boost to the reproduction of sugar beet pests in this part of the country. More than 15 species are considered major pests of sugar beet. The Department of Plant and Environmental Protection of the Faculty of Agriculture in Novi Sad and the Institute of Field and Vegetable Crops in Novi Sad have been making forecasts of the occurrence of major sugar beet pests since 1961. Over the last 30 years (1975—2004), the following average pest numbers per meter square at the end of the growing season have been recorded: *Bothynoderes punctiventris* (3.3), *Elateridae* (3.6), *Melolonthidae* (1.0), *Scotia* spp. (0.4), *Mamestra* spp. (1.5) and *Scrobipalpa ocellatella* (14.8). In addition to these, population dynamics of the following pest species are also monitored: *Lixus scabricollis*, *Chaetocnema tibialis*, *Cassida* spp., *Aphis fabae*, *Pemphigus fuscicornis*, *Autographa gamma* and *Loxostege sticticalis*.

KEY WORDS: sugar beet, pests, population dynamics, forecasts of occurrence

INTRODUCTION

Sugar beet is important crop in Serbia, mainly grown in the province of Vojvodina (northern part of the country). Areas sown to sugar beet in the province varied over the years as follows: 30.000 ha (1930—1939), 43.000 ha (1947—1960), 45.000 ha (1961—1970), 68.000 (1971—1980) and 86.000 ha (1981—1990). At the end of the 20th century, the acreage under this crop significantly decreased.

* The paper was presented at the first scientific meeting IV INTERNATIONAL SYMPOSIUM ON SUGAR BEET Protection held from 26—28 september 2005 in Novi Sad.

The acreage in sugar beet increased greatly in the second half of the 20th century compared with the first and sugar beet growing became concentrated in large agricultural estates. This promoted the multiplying of numerous pest species and enhanced their agricultural importance. There are over 15 pest species or pest groups that are considered major pests of sugar beet (Čamprag, 1992). These include *Bothynoderes punctiventris* Germ., *Tanymecus dilaticollis* Gyll., *Chaetocnema tibialis* Illig., *Elateridae* (*Agriotes* spp.), *Melolonthidae, Euxoa temera* Hb., *Scotia segetum* Schiff., *S. ipsilon* Hufn., *Mamestra brassicae* L., *Scrobipalpa ocellatella* Boyd., *Loxostege sticticalis* L., *Aphis fabae* Scop., *Pemphigus fuscicornis* Koch., *Heterodera schachtii* Schmidt., *Microtus arvalis* Pall. and *Cricetus cricetus* L.

MATERIALS AND METHODS

In 1961, the research began in Vojvodina on the long- and short-term predictions of the severity of occurrence of major sugar beet pests in the province in order to reduce losses caused by them, make the crop protection more economical and reduce agroecosystem and environmental pollution by pesticides. This effort, headed by the Department for Plant and Environmental Protection of the Faculty of Agriculture in Novi Sad has been ongoing for the past 45 years and is carried out in collaboration with 13 regional agricultural organizations (institutes, departments and stations) and several major agricultural cooperations. It produces exact long-term predictions for *B. punctiventris, Elateridae*, and *Melolonthidae* and more approximate long-term predictions for *S. segetum, M. brassicae* and *S. ocellatella*. Data for these prognoses are collected during September/October by examining soil sown to sugar beet as well as that on which wheat, the most common preceding crop in sugar beet production was previously grown. In the last 45 years, on average, around 75 fields sown to sugar beet and around 100 of those on which wheat was the last crop have been examined annually. The samples have been collected using probes 0.25 m^2 in size (50 x 50 cm and up to 50 cm deep).

The dynamics of *S. ocellatella* incidence was determined by examining the total of 100 sugar beets in late September (10 locations were inspected overall and 10 plants were taken from each). The same method was also used during the growing season to monitor population dynamics and frequency of occurrence of most of other major sugar beet pests in order to make short-term predictions of their incidence.

RESULTS AND DISCUSSION

Table 1. shows population dynamics by year of six pest species or pest groups (of the families *Coleoptera* and *Lepidoptera*) during 1975—2004. In that period, it often happened that in years in which the incidence of the species *B. punctiventris* and *S. ocellatella* was high, that of the species of the *Ma-*

mestra genus was low and vice versa. The former two species are xerothermophilous, while the latter are hygrophilous and do not like high temperatures.

Table 1. Population dynamics of major pests of sugar beet in Vojvodina during 1975—2004.

Year	Pest density (No. per 1 m^2)					
	Bothynoderes punctiventris	*Elateridae*	*Melolonthidae*	*Scotia* spp.	*Mamestra* spp.	*Scrobipalpa ocellatella*
1975	0.0	5.5	0.6	0.60	7.8	0.0
1976	1.6	2.6	0.6	1.10	2.6	2.4
1977	0.0	3.9	0.8	0.30	0.4	1.6
1978	0.1	4.6	0.5	0.30	14.0	1.6
1979	0.0	5.0	0.4	0.70	4.0	4.0
1980	1.1	3.9	0.3	0.20	3.5	6.4
1981	3.6	7.1	0.7	0.48	0.4	3.2
1982	8.0	8.2	1.5	0.63	1.7	4.0
1983	9.8	6.8	0.9	0.50	0.3	40.0
1984	15.5	3.2	0.9	0.25	1.0	21.6
1985	6.3	5.2	1.0	0.39	4.1	8.8
1986	1.9	4.6	1.3	0.17	0.3	35.2
1987	2.1	3.7	1.0	1.20	1.0	26.4
1988	5.2	2.1	0.5	0.13	0.3	74.4
1989	2.1	4.2	1.2	0.94	0.4	4.8
1990	1.8	1.3	0.4	0.19	1.4	9.6
1991	5.7	1.8	1.0	1.00	1.3	6.4
1992	3.6	1.0	2.9	0.38	0.1	38.4
1993	5.3	0.7	1.4	0.05	0.0	12.8
1994	7.5	3.5	2.5	0.03	0.1	22.4
1995	2.4	1.2	0.6	0.23	0.5	4.0
1996	1.1	3.6	1.0	0.28	0.2	2.4
1997	0.7	2.1	0.3	0.16	2.6	0.8
1998	0.6	4.0	0.9	0.61	0.1	4.0
1999	2.1	4.3	0.8	0.64	0.4	0.0
2000	1.0	1.7	1.2	0.04	0.0	25.6
2001	2.9	3.6	1.4	0.13	0.0	3.2
2002	1.3	4.9	2.9	0.22	0.2	10.4
2003	3.9	2.0	1.0	0.13	0.0	36.8
2004	1.0	3.1	0.4	0.13	0.2	?
Average	3.3	3.6	1.0	0.39	1.5	14.8

Shown in Table 2. are data on the percentage contributions of different levels of infestation by *B. punctiventris, Mamestra* spp. and *Elateridae* on fields in years with high and low incidences of these pests. In years with low abundance of the overwintering individuals of these species, a prediction was made in the autumn that their incidence would be low the following spring,

which made it possible to make major savings in the area of chemical crop protection.

Bothynoderes punctiventris Germ. This species is the most important pest of sugar beet in Vojvodina. Over the last 60 years, it has destroyed more than 250,000 hectares of young sugar beets in total and has caused crops to be resown. Between 1961 and 2003, 3.1 individuals were recorded per meter square on average (Čamprag, Sekulić et al., 2004). By the end of the decade, the average varied as follows: 3.5 (1961—1970), 0.6 (1971—1980), 5.6 (1981—1990) and 3.0 (1991—2000).

The abundance of *B. punctiventris* in the last 30 years is shown in Table 1. It varied from 0 to 15.5 m^2 depending on the year. Mass reproduction of the insect is favored by higher temperatures and drought during the growing season, especially when there are two to three such years in succession. Based on the number of overwintering individuals, a long-term prognosis is made in autumn in order to estimate the level of danger from this pest for the following year. The level of risk in 1979 was much lower than that in 1984 (Table 2).

Table 2. Different possibilities for making savings in sugar beet pest control by forecasting

Number per m^2	Percentage contribution of fields with different pests density			
	Bothynoderes punctiventris		*Mamestra* spp.	
	1979	1984	1963	1965
0	**81**	1	**57**	1
0.1—1	19	5	**34**	5
1.1—5	0	35	9	17
5.1—10	0	**22**	0	**22**
10.1—20	0	**12**	0	**29**
> 20	0	**25**	0	**26**
Total	100%	100%	100%	100%
Average density/m^2	**0.1**	**15.5**	**0.3**	**18.6**

Elateridae. After the cultivation of wheat, which is most often followed by sugar beet, around 20 click beetle species were found in the Vojvodina province. The dominant pests are the larvae of *Agriotes ustulatus* Schall., followed by *A. sputator* L. and other species. *Agriotes* genus accounts for 79% of all click beetle individuals found in the province and for 76% of those found in Ukraine (Fedorenko, 1998). Over a 30-year period, the average number of the larvae recorded per meter square was 3.6, ranging from 0.7 to 8.2/m^2 depending on the year (Table 1). During the 1961—2003 period, the average number was 3.3/m^2.

Chemical control of click beetle larvae should be performed when their incidence exceeds the economic damage threshold of one individual per meter square. Many sugar beet growers incorporate insecticides into the soil preventatively without inspecting the field for larval abundance beforehand and thus unnecessarily increase their production costs. The larval abundance per meter square varies widely from field to field and from year to year, as illustrated by

Table 2. Larger savings could have been made on the chemical control of click beetle larvae in 1993 than in 1982.

Melolonthidae. The soil on fields sown to sugar beet is dominated by the larvae of the following three species: *Anisoplia austriaca* H r b s t., *Rhizotrogus aequinoctialis* H r b s t. and *Amphimallon solstitialis* L. Population dynamics of the entire family during 1975—2004 are presented in Table 1. The annual incidence ranged from 0.3 to 2.9 m^2, averaging 1.0. The best conditions for the reproduction of *A. austriaca* in Vojvodina existed during the 1992—1994 period, when the average abundance of the species was 2.3/m^2. Larvae of *A. austriaca* account for 65% of all *Melolonthidae* larvae present in Vojvodina and for 58% of those reported in neighbouring Hungary (M a n n i n g e r, 1955).

Scotia spp. In Vojvodina, *S. segetum* S c h i f f. species is highly dominant, while *S. ipsilon* H u f n. is second in importance. The abundance of the second generation caterpillars ranged between 0.03 and 1.2/m^2 during 1975—2004 (Table 1). On average, 0.4 larvae per meter square were recorded. The same average was recorded in Hungary between 1955 and 1964.

In the last six decades, there were three massive outbreaks of *S. segetum* in Hungary, in 1948—1950, 1962 and 1968 (M é s z á r o s, 1993). Such outbreaks were recorded in the same years in Vojvodina as well. In the past 36 years, however, there was no major, widespread outbreak of this pest in the province.

Euxoa temera H b. This species is a dangerous polyphagous pest that causes major damage to sugar beet crops from time to time. The last huge outbreak of this insect in the region was recorded back in 1946—1950 in Serbia, Bulgaria and Hungary. In 1948 in Bulgaria, the pest completely destroyed about 7,200 hectares of young sugar beet, which represented one third of the total acreage sown to this crop in the country that year.

For over half a century, there has been no mass reproduction of *E. temera* in the above countries. The last mass outbreak of huge proportions mentioned above was caused by drought and high temperatures that lasted several years. In the 20th century, the average growing season temperature in Belgrade was 18.5°C. The hottest five-year stretch during that 100-year period was the time between 1946 and 1950, when the average temperature during the growing season was 19.9°C and frequent droughts occurred, causing the afore-mentioned massive outbreak of *E. temera.* There has been no repeat of such conditions since 1951. Short-term predictions of *E. temera* occurrence in Serbia are made by monitoring the flight dynamics of the butterflies during August/September using light traps.

Mamestra spp. There are two *Mamestra* species that are important for Serbian sugar beet production, namely *M. brassicae* and *M. oleracea*. The former species is of particular importance, because it accounts for 80% of all individuals of this genus found in the country, while the remaining 20% belong to the latter species. The same ratio is found in neighbouring Hungary (M é s z á r o s, 1993). A single caterpillar of the cabbage moth consumes a total of 169 cm^2, or 5.8 g of sugar beet leaves in the course of its life (S e k u l i ć, 1972).

During 1961—2003, an average of 2.8 individuals per meter square was recorded in the country for the second generation (Čamprag, Sekulić et al., 2004). Depending on the decade, this average varied as follows: 5.9 (1960s), 6.5 (1970s), 1.1 (1980s) and 0.5 (1990s). Table 1 shows cabbage moth abundance by years over the last 30 years. Between 1961 and 2004, the incidence of this pest ranged from 0 to 18.6/m^2 and was the highest in 1965.

Mass reproduction of the cabbage moth is favored by wetter growing season conditions (i.e. wetter microclimate of sugar beet crop) with no high temperatures. This insect was not on the list of sugar beet pests in Croatia in 1930s, when average yields of around 20 t/ha were obtained (Kovačević, 1931). It became major sugar beet pest in Serbia and Croatia because of intensified production (use of higher-yielding varieties, higher nitrogen fertilizer rates and irrigation) and the development of luxuriant sugar beet plants as well as of the use of dense and complete stands in sugar beet production. The insect is found in fields that produce high yields and is absent from those where the crops are in poor condition. For example:

1930—1939 = 19 t/ha on average (no major presence of the pest)

1961—1980 = 38 t/ha on average (mass reproduction of the pest)

Rough long-term predictions for the cabbage moth are made based on the abundance of the insect overwintering pupae. Very different levels of infestation were predicted in the autumn of 1963 and 1965 for the first generation in the following year (Table 2).

In our country, the flight dynamics of cabbage moth butterflies are monitored using light traps. The butterfly abundance determines the level of infestation by the catterpillars and the extent of the need for crop protection. In Vojvodina, 345—393 butterflies were caught for three consecutive years (1978—1980) and 13,000 hectares of sugar beet were treated on average. In the following year, 1981, 105 butterflies were caught and 2,950 hectares were treated.

Scrobipalpa ocellatella Boyd. This species reproduces on a mass scale occasionally, when there is dry and warm weather during the growing season. Weather conditions, especially during July and August, play the dominant role in the population dynamics of this pest (Stanković, 1954). In Vojvodina, mass outbreaks were recorded in 1949—1950, 1962—1964 and in several years during the 1983—1994 period.

Between 1975 and 2003, about 15 catterpillars per meter square were recorded at the end of the growing season on average, ranging from 0 in 1999 to 74 in 1988 (Table 1). In 1988, the year with peak incidence of the pest, the population dynamics were as follows: June 7—10% of the fields infested (1% of sugar beet plants attacked), June 23—70% (4%), July 13—90% (14%), July 28—100% (26%), August 8—100% (65%) and September 29—100% (92%).

For prediction-making purposes, the abundance and frequency of occurrence of the following sugar beet pests is monitored: *Lixus scabricollis* Boh., *Chaetocnema tibialis* Illig., *Cassida* spp., *Aphis fabae* Scop., *Pemphigus fuscicornis* Koch. and so on.

The long- and short-term predictions of the occurrence of sugar beet pests are presented to the public in various ways (at crop protection seminars and

consultations, at consultation meetings of agronomists, by publication in the journal Plant Doctor or in agricultural magazines such as the Farmer and others).

The economic damage thresholds for some of the sugar beet pest species are as follows: *Elateridae* (over 1 individual per meter square), *Amphimallon* and *Rhizotrogus* spp. (2—3 ind./m^2), *Bothynoderes punctiventris* (0.1—0.3 ind./m^2 for seedlings*), Euxoa temera* (0.3—1 ind./m^2), *Scotia ipsilon* (1—2 ind./m^2), *S. segetum* (2—3 ind./m^2), and *Mamestra* spp. (8—10 ind./m^2).

ACKNOWLEDGEMENT

The authors wish to express their deep gratitude to plant protection experts from a number of agricultural service organizations (agricultural institutes, departments and stations in Sombor, Vrbas, Bačka Topola, Senta, Subotica and Novi Sad) and several major agricultural companies (*PIK Bečej* from Bečej, *PD A. Šantić* and others) for their long-standing collaboration on the collection of materials on major pests of sugar beet.

REFERENCES

Čamprag, D. (1992): *Štetočine šećerne repe i integralna zaštita bilja*, VANU, akademske besede, knj. 29, Novi Sad, 133 str.

Čamprag, D., Sekulić, R., Kereši, T. (2004): *Razprave IV razreda SAZU*, XLV-1, Ljubljana, 37—48.

Fedorenko, V. P. (1998): *Entomokompleks na cukrovih burjakah*, Agrarna nauka, Kiev, 463 str.

Kovačević, Ž. (1931): *Kultura šećerne repe u Slavoniji i njeni neprijatelji*, Osijek, 20 str.

Manninger, G. A. edit. (1955): *A cukorrépakártevők előrejelzése Magyarságon*, Mezögazdásagi Kiadó, Budapest.

Mészáros, Z. (1993): 637—643, In: Jermy, T., Balázs, K., *A növényvédelmi állattan kézikönyve*, 4/B, Akademiai Kiadó, Budapest.

Sekulić, R. (1972): *Fitofarmakološka vrednost savremenih insekticida za Mamestra brassicae L., sa osvrtom na proučavanje ishrane gusenica*, Magistarski rad, Poljoprivredni fakultet, Novi Sad.

Stanković, A. (1954): *Repin moljac (Phthorimaea ocellatella Boyd.)*, Institut za zaštitu bilja, posebna izdanja 1, Beograd, 102 str.

ПРОГНОЗИРАЊЕ ПОЈАВЕ ШТЕТОЧИНА ШЕЋЕРНЕ РЕПЕ У СРБИЈИ У ПЕРИОДУ 1961—2004. ГОДИНА

Душан С. Чампраг[1], Радосав Р. Секулић[2], Татјана Б. Кереши[1]
[1] Пољопривредни факултет, Трг Д. Обрадовића 8,
Нови Сад, Србија и Црна Гора
[2] Научни институт за ратарство и повртарство,
Максима Горког 30, Нови Сад, Србија и Црна Гора

Резиме

Шећерна репа се у Србији углавном гаји у покрајини Војводини. Повећање површина у Војводини са 30.000 хектара (1931—1939) на преко 70.000 (1951—2000), веома је погодовало повећању размножавања штеточина шећерне репе. Томе је допринела и концентрација производње на крупним газдинствима. У важније штеточине ове културе убраја се преко 15 врста. Департман за заштиту биља и животне средине (Пољопривредног факултета у Новом Саду) и Научни институт за ратарство и повртарство од 1961. баве се прогнозирањем појаве важнијих штеточина шећерне репе. То се обавља у сарадњи са 13 регионалних установа пољопривредне службе и са неколико пољопривредних комбината. Током 30 година (1975—2004) установљена је крајем вегетације просечна бројност по m^2 следећих штеточина: *Bothynoderes punctiventris* (3,3), *Elateridae* (3,6), *Melolonthidae* (1,0), *Scotia* spp. (0,4), *Mamestra* spp. (1,5) и *Scrobipalpa ocellatella* (14,8). У годинама када је бројност репине пипе и репиног мољца висока, понајчешће бројност купусне совице буде ниска, као и обратно. Поред наведених штеточина, прати се кретање бројности и учесталости сретања *Lixus scabricollis*, *Chaetocnema tibialis*, *Cassida* spp., *Aphis fabae*, *Pemphigus fuscicornis*, *Autographa gamma* и *Loxostege sticticalis*.