# SUNN PEST MANAGEMENT IN ROMANIA

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## ABSTRACT

***Eurygaster integriceps* is one of the most important pests of wheat in Romania. In damage area of sunn pest, security of wheat harvest quality is inconceivable without some energetic protection measures. Investigations covering a great number of years tried to underline the contribution of some elements in outlining the integrated control concept for sunn pest. Thus, the following elements have been examined: ratio between species and their distribution areas in Romania, size and space distribution of sunn pest populations, study of annual peculiarities of their life cycle, relationships between pest and oophagous parasites and the economic damage thresholds and the means for their control. The share of various elements has been established, and namely: prevalence of *Eurygaster integriceps*, this pest covering a damage area of about 1,000,000 ha of wheat crops in 24 districts; contribution of oophagous parasites (*Telenomus chloropus* and *Trissolcus grandis*), and the economic damage thresholds, as calculated differentially in accordance with crop vegetation stage and harvest destination. Forecast and warnings are of permanent concern in the whole country, and they are based on a methodology developed by A.R.D.I. Fundulea, and applied across the country by the District Inspectorates for Plant Protection and Phytosanitary Quarantine. Chemical control of sunn pest in Romania is supported by Government.**

**Key words**: *Eurygaster integriceps*, sunn pest, life-cycle, damage areas, diapause, oophagous parasites, economic damage threshold (EDT), forecast and warning, chemical control.

## INTRODUCTION

*Eurygaster integriceps* Put. is one of the most important pests of wheat in Romania (Barbulescu, 1971; Paulian and Barbulescu, 1970; Paulian and Popov,1980; Popov, 1972; 1974; 1991; Popov et al., 1988; 1992; 1996; 1998; 2003). In damage area of *Eurygaster integriceps*, security of wheat harvest quality is inconceivable without some energetic protection measures (Barbulescu and Popov, 1975; Barbulescu et al., 2003; Popov, 1977 a; Popov et al., 1997 a,b; 1999).

Investigations covering a great number of years tried to underline the contribution of some elements in outlining the integrated control concept for sunn pest. The following elements have been examined: ratio between species and their distribution areas in Romania, size and space distribution of sunn pest populations, study of annual peculiarities of their life cycle, relationships between pest and oophagous parasites, the economic damage thresholds and the means for their control. Forecast and warnings are of permanent concern in the whole country, and they are based on a methodology developed by A.R.D.I. Fundulea, and applied across the country by the District Inspectorates for Plant Protection and Phytosanitary Quarantine. Chemical control of sunn pest in Romania is supported by Government, according to the Main Undertakings Regarding Organization and Development of Nationwide Campaign of Sunn Pest Control in Romania (Popov et al., 1982; 1983; 1989; 2003, Appendix 1).

## MATERIAL AND METHODS

Investigations extended to the whole country for a great number of years aimed at various aspects playing a role in dynamics of sunn pest populations. Ratio between *Eurygaster* species as established in the recent decades on about 15,000 specimens annually, has been compared to data published by Montandon (1907) and Radulescu and Gruita (1942). Based on data of distribution and population level it is possible to limit the damage area and zones with favourable degree for an explosive reproduction of this pest, at the levels of the 41 districts of Romania (Figure 1). In the damage area of sunn pest in Romania, the following surfaces are included: 230,200 ha of oak forests (575 forests), favourable to adult diapause, and 30% of the whole wheat area from the total of 737,000-1,184,000 ha annually cultivated with wheat (Table 1).

In autumn, in October, all 575 forests are inspected, and density of overwintering adult dia-

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pause insects is established. The average number of insects/sq.m. of forest, district, zone and whole area, as well as the total number of insects, are calculated.

*Appendix 1.* Main undertakings regarding organization and development of the national campaign for sunn pest control in Romania

| No | Performed actions | Execution term | Coordination |
|---|---|---|---|
| 1 | Establishing the Programme for sunn pests control in Romania, based on wheat cultivated surfaces in the damage areas and on diapausing sunn pest population levels | January | MAFRD - CLPQ; ARDI |
| 2 | Development of methods to pursue the sunn pest life-cycle in representative areas within the districts included in the damage area | January | MAFRD - CLPQ; ARDI |
| 3 | Estimation of pesticide amount and means of application needed, depending on the size of forecasted action to be performed | February | MAFRD - CLPQ; ARDI |
| 4 | Centralized training (of the whole personnel which will participate in the control action of sunn pests in the damage area | March | MAFRD - CLPQ; IPPPQ; ARDI |
| 5 | Providing necessary insecticides (according to estimated areas) and funds assigned by subsidies | March-April | MAFRD - CLPQ; DIPPPQ |
| 6 | Recording biological reserve of sunn pests at the end of overwintering by spring samplings in diapausing sites in forests | April, 5$^{th}$ - 20$^{th}$ | DIPPPQ |
| 7 | Designing the surfaces having to be treated against the overwintering adults, according to percentage of mortality during diapause of sunn pest populations | April, 20$^{th}$-25$^{th}$ | MAFRD - CLPQ; ARDI |
| 8 | Providing terrestrial and aerial means for applying treatments against the sunn pests | April | DIPPPQ; Service aircraft; Agricultural producers |
| 9 | Checking, identification and homologation of airfields for airplanes and helicopters participating in the control activities, having in view their efficient use. | April | MAFRD - DIPPPQ; Specialised units |
| 10 | Recording migration of overwintering adults from forests to crops (in representative areas of every district) according to the method established, in view of releasing warnings | April - May | DIPPPQ |
| 11 | Recording densities of overwintering adults in wheat crops; designation of wheat plots where chemical treatment is imposed | May, 1$^{st}$. - 5$^{th.}$ | DIPPPQ; Agricultural producers |
| 12 | Release of warning bulletins for applying treatments against the overwintering adults | Depending on migratory evolution | CLPQ; DIPPPQ |
| 13 | Performance of treatments against the overwintering adults | Warned period | DIPPPQ; Agricultural producers |
| 14 | Assessment of the treatment efficacy and operative report | After two days | CLPQ; DIPPPQ |
| 15 | Observation of pest life-cycle in representative zones of every district, in order to warn treatments against nymphs according to the recommended method | May - June | MAFRD - CLPQ; IPPPQ; ARDI |
| 16 | Estimation of parasitical level of sunn pest eggs by oophagous parasitoids, collecting and preservation of biological material in order to identify the species | June | DIPPPQ; ARDI |
| 17 | Estimation of surfaces to be treated against the nymphs, depending on adults fecundity, parasitical and climate factor evolution | June | DIPPPQ |
| 18 | Release of warning bulletins for applying treatments against nymphs | Depending on pest evolution | MAFRD - CLPQ ; IPPPQ |
| 19 | Finishing-off the nymph control programme by establishing wheat plots to be treated, according to crop destination (food or seed) and pest density (economic damage threshold) | June | DIPPPQ |
| 20 | Performing treatments against nymphs | Warned period | DIPPPQ; Agricultural producers |
| 21 | Assessment of treatment efficacy and operative report | After two days | MAFRD - CLPQ; IPPPQ; ARDI |
| 22 | Recording the new sunn pests adult populations level in crops before harvest: the action represents a first step of forecast for the next year | Prior to harvest | DIPPPQ; ARDI |
| 23 | Harvesting wheat in the damage area as rapidly as possible, before the end of complete feeding of adults, as a technological measure to diminish sunn pest populations | July | Agricultural producers |
| 24 | Evaluation of pricked grain percentage in wheat harvest in the damage area | July - August | MAFRD - CLPQ; DIPPPQ |
| 25 | Performing autumn samplings to establish the biological reserve of sunn pests in diapausing sites | October | DIPPPQ |
| 26 | Presentation of the Report regarding the way of achievement of sunn pests control programme by districts | December | DIPPPQ |
| 27 | Evaluation of sunn pest population affecting wheat crops in the next year, based on overwintering adults density/m² | December | MAFRD - CLPQ; ARDI |
| 28 | Establishment of the Programme for sunn pests control in Romania, based on wheat surfaces in the damage areas and on sunn pest diapausing population levels | January | MAFRD - CLPQ; ARDI |

MAFRD – Ministry of Agriculture, Forests and Rural Development
CLPQ – Central Laboratory for Phytosanitary Quarantine
DIPPPQ – District Inspectorate of Plant Protection, and Phytosanitary Quarantine
ARDI – Agricultural Research and Development Institute - Fundulea

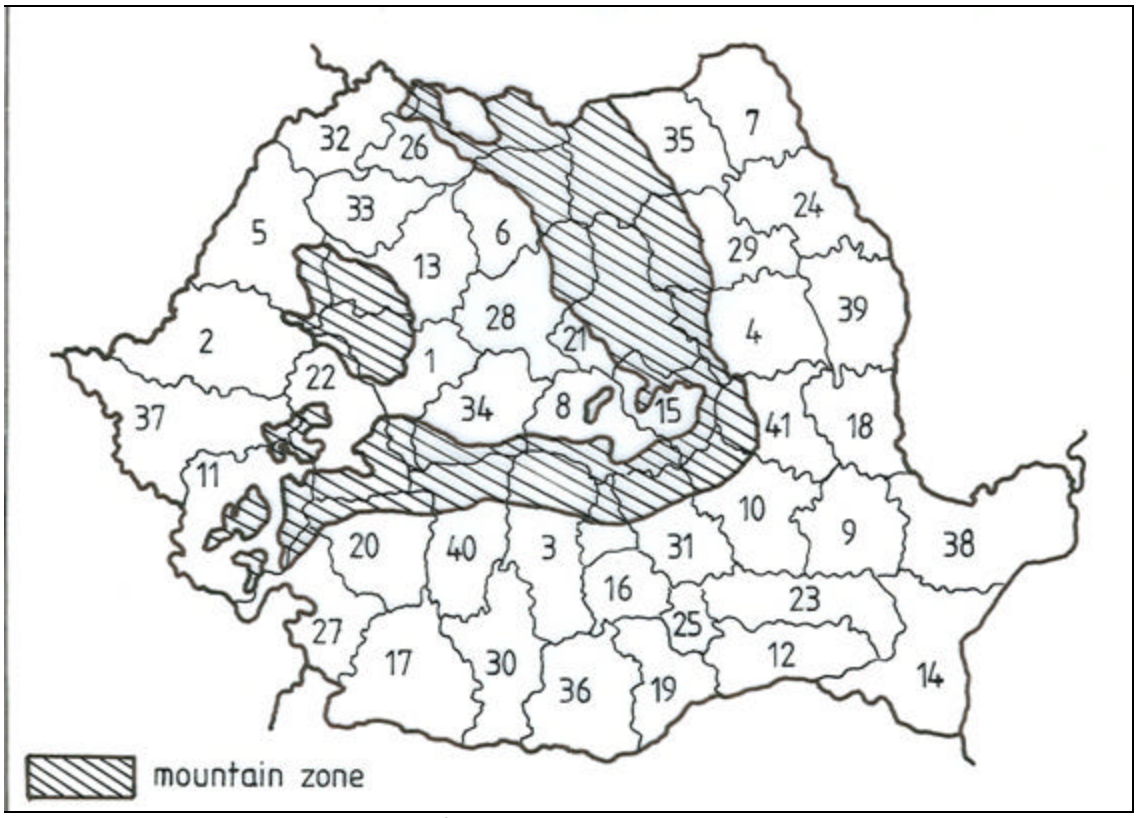


*Figure 1.* Area of sunn pest in Romania (district cod number)

*Favourable zone I* (Muntenia: 9, 12, 19, 23, 25, 36; Oltenia: 17, 27, 30; Dobrudja: 14, 38; Moldavia: 7, 18, 24, 39)
*Favourable zone II* (Muntenia: 3, 10, 16, 31, 40; Moldavia: 4, 29, 35, 41),
*Unfavourable zone* (West Plain: 2, 5, 11, 26, 32, 37; Oltenia: 20; Transylvania: 1, 6, 8, 13, 15, 21, 22, 28, 33, 34)

The insect density is estimated at the end of control campaign (before leaving crops towards forests), and also the attack level is analysed (by establishing the percentage of stung kernels), these representing an early step in evaluation of insect population level which will infest wheat crops in the next year (Barbulescu, 1971; Paulian and Barbulescu, 1970; Popov and Barbulescu, 2000; Popov, 1972; 1975; 1977 b; 1979; 1984 a; Popov and Rosca, 1991; Popov et al., 1982;1983; 1999; 2003).

## RESULTS AND DISCUSSION

### Relationship between species, damage areas

*Eurygaster* Lap. and *Aelia* L. genera exist throughout the country in various ratios (Table 2). Two *Eurygaster* species, *E. maura* and *E. austriaca* had been known since the beginning of the past century, as shown in fauna lists by Montandon (1907). Early records for these species as pests belong to Radulescu, starting from 1929 (Radulescu,1937, in Radulescu and Gruita,1942). From 1938-1939 three harmful species have been reported: *E. maura*, *E. austriaca* and E. *integriceps* - the last one being recorded for the first time by Radulescu and Gruita (1942). *E. testudinaria*, mentioned by Popov (1972; 1977 a) is devoid of economical significance. Now, the genus *Eurygaster* exists throughout the country, practically in all area cropped with cereals and primarily wheat (Popov, 1975; Popov et al., 1996; 1998). However, the damage area is confined to South and East of the country, in the extra-Carpathian zones, i.e. in Dobrudja, Muntenia, Oltenia and Moldavia (Barbulescu and Popov, 1975; Paulian and Popov, 1980; Popov, 1974; 1975; Popov et al,, 1982; 1983; 1988; 1999).

*Table 1*. Distribution of wheat areas and oak forests,in damage areas, in Romania

| Zone/District cod number | Oak forests (ha) | Wheat area (ha) | |
|---|---|---|---|
| | | Total | Affected |
| AREA | 230,200 | 1,363,000-1,945,000 | 737,000-1,184,000 |
| *Favourable zone I* | 189,600 | 1,134,000-1,577,000 | 685-1,084,000 |
| Botosani, 7 | 53,000 | 45,000-85,000 | 35,000-60,000 |
| Braila, 9 | 3,600 | 65,000-90,000 | 50,000-70,000 |
| Calarasi, 12 | 15,200 | 125,000-180,000 | 75,000-125,000 |
| Constanta, 14 | 8,000 | 100,000-130,000 | 75,000-100,000 |
| Dolj, 17 | 12,000 | 145,000-190,000 | 75,000-120,000 |
| Galati, 18 | 6,200 | 65,000-90,000 | 35,000-65,000 |
| Giurgiu, 19 | 7,100 | 54,000-80,000 | 45,000-65,000 |
| Ialomita, 23 | 14,900 | 75,000-100,000 | 60,000-80,000 |
| Iasi, 24 | 18,700 | 40,000-75,000 | 10,000-25,000 |
| Ilfov, 25 | 4,000 | 20,000-32,000 | 15,000-24,000 |
| Mehedinti, 27 | 10,500 | 55,000-65,000 | 20,000-35,000 |
| Olt, 30 | 10,100 | 115,000-145,000 | 60,000-95,000 |
| Teleorman, 36 | 16,000 | 130,000-160,000 | 70,000-120,000 |
| Tulcea, 38 | 3,300 | 50,000-80,000 | 40,000-65,000 |
| Vaslui, 39 | 7,000 | 50,000-75,000 | 20,000-35,000 |
| *Favourable zone II* | 40,600 | 229,000-368,000 | 52,000-100,000 |
| Arges, 3 | 1,000 | 38,000-54,000 | 10,000-15,000 |
| Bacau, 4 | 16,400 | 15,000-45,000 | 5,000-15,000 |
| Buzau, 10 | 3,900 | 40,000-70,000 | 8,000-13,000 |
| Dâmbovita, 16 | 2,000 | 30,000-42,000 | 5,000-11,000 |
| Neamt, 29 | 1,400 | 25,000-35,000 | 4,000-7,000 |
| Prahova, 31 | 4,100 | 30,000-40,000 | 7,000-13,000 |
| Suceava, 35 | 5,200 | 17,000-25,000 | 3,000-6,000 |
| Vâlcea, 40 | 1,000 | 10,000-22,000 | 5,000-8,000 |
| Vrancea, 41 | 6,000 | 24,000-35,000 | 5,000-12,000 |

*Table 2*. Ratio between *Eurygaster* Lap and *Aelia* L. species in Romania in 1907-2004 period

| Zones | Period: | | | |
|---|---|---|---|---|
| | 1907* | 1939** | 1970 | 2004 |
| AREA | 41 districts | | | |
| *Favourable zone I* | 15 districts | | | |
| DOBRUDJA | Y/Y | 86/14 | 97/3 | 98/2 |
| MUNTENIA | Y/Y | 80/20 | 93/7 | 98/2 |
| OLTENIA | Y/Y | 80/20 | 93/7 | 98/2 |
| MOLDAVIA | Y/Y | 75/25 | 80/20 | 87/2 |
| Favourabe zone II | 9 districts | | | |
| MUNTENIA | Y/Y | 75/25 | 85/15 | 97/3 |
| MOLDAVIA | Y/Y | 70/30 | 75/25 | 95/5 |
| *Unfavourable zone* | 17 districts | | | |
| WEST PLAIN | Y/Y | 75/25 | 80/20 | 80/20 |
| TRANSYLVANIA | Y/Y | 65/35 | 70/30 | 77/23 |

NOTE: * Montandon, 1907 (Y-only mention)
** Radulescu and Gruita, 1942
No - percent: *Eurygaster* spp./*Aelia* spp.

As shown in table 3, at present, in this area *E. integriceps* is prevailing over *E. maura* and *E. austriaca* to an overwhelming extent, accounting for more than 95%. Moreover, evolution in time of the species ratio showed that this dominance was stabilized during the last three decades. Extension of *E. integriceps* started in the 2nd and 3rd decades of the last century, by successive migrations from the Russian steppe, through the North of Black Sea, going on towards West and South in Bulgaria, Serbia and European part of Turkey (Popov, 1975, 1991; Popov et al., 1989, 1992, 1996). An illustration of this phenomenon is well expressed by its area in Oltenia, where *E. integriceps* did not exist during 1938-1939, reached 16-50 percentages in 1970 and finally, being strongly prevalent (96-98%) at present (Popov, 1984 a b; 1991). Table 4 presents the situation in the unfavourable zone for *E. integriceps*.

This damage area appeared since 1965 and expanded progressively, covering at present 24 districts. Climate conditions and surfaces cropped with wheat (for multiplication and development) and oak forests (for diapause), differentiate the

damage area in a very favourable zone (15 districts), where the ensemble of factors are steadily optimal, and a

*Table 3*. Ratio between *Eurygaster* species in favourable zone (1907-2004)

| Zone/District cod number | Period | | | |
|---|---|---|---|---|
| | 1907* | 1939** | 1970 | 2004 |
| AREA | 41 districts | | | |
| *Favourable zone I* | 15 districts | | | |
| Botosani, 7 | - | 0/66/34 | 47/33/20 | 96/2/2 |
| Braila, 9 | - | - | 88/7/5 | 98/1/1 |
| Calarasi, 12 | 0/Y/Y | - | 94/3/3 | 98/1/1 |
| Constanta, 14 | 0/Y/Y | 75/11/14 | 94/4/2 | 98/1/1 |
| Dolj, 17 | 0/Y/Y | 0/86/14 | 36/25/39 | 97/2/1 |
| Galati, 18 | 0/Y/Y | 45/33/22 | 85/9/6 | 98/1/1 |
| Giurgiu, 19 | - | - | 73/18/9 | 98/1/1 |
| Ialomita, 23 | - | 35/20/45 | 95/3/2 | 98/1/1 |
| Iasi, 24 | - | 0/67/33 | 41/40/19 | 97/2/1 |
| Ilfov, 25 | - | 31/28/41 | 94/3/3 | 98/1/1 |
| Mehedinti, 27 | - | - | 16/36/58 | 96/2/2 |
| Olt, 30 | - | 0/65/35 | 50/26/24 | 98/1/1 |
| Teleorman, 36 | 0/Y/Y | - | 66/21/13 | 98/1/1 |
| Tulcea, 38 | - | 87/5/8 | 94/4/2 | 98/1/1 |
| Vaslui, 39 | - | 21/52/27 | 57/28/15 | 97/2/1 |
| *Favourable zone II* | 9 districts | | | |
| Arges, 3 | 0/Y/Y | - | 26/54/20 | 96/2/2 |
| Bacau, 4 | - | 0/54/46 | 45/9/46 | 97/2/1 |
| Buzau, 10 | - | - | 32/47/21 | 95/3/2 |
| Dâmbovita, 16 | | - | 27/52/21 | 94/3/3 |
| Neamt, 29 | - | - | 42/20/38 | 90/4/6 |
| Prahova, 31 | - | 15/42/43 | 28/52/20 | 96/2/2 |
| Suceava, 35 | - | 0/94/6 | 0/54/46 | 90/6/4 |
| Vâlcea, 40 | - | - | 25/53/22 | 93/4/3 |
| Vrancea, 41 | - | - | 27/40/33 | 91/5/4 |

NOTE: 0 - absent; Y - mentioned;
No. - percent (*Eurygaster integriceps/Eurygaster maura /Eurygaster austriaca)*

less suitable area (9 districts), where the optimal conditions intermittently occur. In the favourable zone I the largest surfaces are cropped with wheat, while oak tree forests represent more than 80% of the area.

Inspections performed at the beginning of diapause in all oak forests revealed variable average densities from a zone to another and from a year to another (Tables 5, 6). Multiannual analyses outlined the fact that the highest density has been reached only in the districts included in the favourable zone I. In these biotopes, pest densities are variable from year to year, their number fluctuating from a few specimens per sq.m. reaching sometimes more than 50 (Paulian and Barbulescu, 1970; Popov et al., 1989, 1992, 1997). Based on records in autumn samplings (October, $15^{th}$ - $30^{th}$) and in spring samplings (April, $1^{st}$-$15^{th}$), the total number for every forest, district and total area can be estimated, this estimation being the basis of drafting forecast apparition of sunn pests every year (Table 7), (Popov, 1977 a; 1991; Popov et al., 1982, 1983, 1992, 1997 a). These areas can be considered as a stable and maximum area for zones in Dobrudja, Muntenia, Oltenia and Moldavia, where *E. integriceps* finds favourable conditions to develop numerous populations, obviously varying from year to year (Popov et al., 1996, 1997 a, b).

*Table 4*. Ratio between *Eurygaster* species in unfavourable zone (1907-2004)

| Zone/District cod number | Period: | | | |
|---|---|---|---|---|
| | 1907* | 1939** | 1970 | 2004 |
| AREA | 41 districts | | | |
| *Unfavourable zone* | 17 districts | | | |
| Alba, 1 | - | 0/83/17 | 0/85/15 | 0/80/20 |
| Arad, 2 | - | - | 0/43/57 | 1/44/55 |
| Bihor, 5 | 0/Y/Y | 0/77/23 | 1/41/58 | 1/43/56 |
| Bistrita-Nasaud, 06 | - | - | 0/73/27 | 0/60/40 |
| Brasov, 8 | | - | 0/65/35 | 0/63/37 |
| Caras-Severin, 11 | - | - | 0/46/54 | 0/50/50 |
| Cluj, 13 | 0/Y/Y | 0/89/11 | 0/80/20 | 0/75/25 |
| Covasna, 15 | - | - | 0/50/50 | 0/53/47 |
| Gorj, 20 | - | - | 7/41/52 | 33/35/32 |
| Harghita, 21 | - | - | 0/50/50 | 0/57/43 |
| Hunedoara, 22 | - | 0/66/34 | 0/87/13 | 0/81/19 |
| Maramures, 26 | - | - | - | 0/50/50 |
| Mures, 28 | - | 0/40/60 | 0/62/38 | 0/63/37 |
| Satu Mare, 32 | - | 0/79/21 | 0/58/42 | 0/64/36 |
| Salaj, 33 | - | - | 0/61/39 | 0/59/41 |
| Sibiu, 34 | - | - | 0/58/42 | 0/56/44 |
| Timis, 37 | - | 0/72/28 | 3/36/58 | 1/49/50 |

NOTE: 0 - absent; Y - mention;
No. - percent (*Eurygaster integriceps/Eurygaster maura /Eurygaster austriaca)*

*Table 5*. Sunn pest diapausing populations in oak forests, in damage area (densit./sq.m.), during the recent years

| Zone/District cod number | 1987 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| AREA | 14.4 | 2.9 | 3.4 | 6.0 | 4.4 |
| *Favourable zone I* | 20.8 | 4.4 | 5.3 | 10.1 | 7.0 |
| Botosani, 7 | 5.3 | 0.3 | 0.3 | 0.4 | 0.6 |
| Braila, 9 | 43.8 | 8.9 | 12.9 | 24.0 | 9.1 |
| Calarasi, 12 | 61.8 | 5.6 | 12.3 | 24.4 | 7.7 |
| Constanta, 14 | 29.4 | 8.7 | 6.4 | 16.4 | 5.1 |
| Dolj, 17 | 19.3 | 3.4 | 4.2 | 5.8 | 3.4 |
| Galati, 18 | 24.3 | 3.5 | 3.4 | 7.9 | 5.4 |
| Giurgiu, 19 | 23.4 | 4.5 | 4.9 | 4.7 | 8.2 |
| Ialomita, 23 | 40.5 | 3.1 | 3.1 | 14.6 | 7.5 |
| Iasi, 24 | 2.8 | 0.8 | 0.8 | 1.2 | 1.1 |
| Ilfov, 25 | 24.1 | 0.5 | 0.5 | 2.2 | 2.1 |
| Mehedinti, 27 | 1.6 | 0.8 | 1.2 | 1.4 | 2.6 |
| Olt, 30 | 25.1 | 1.8 | 3 | 4.6 | 4.4 |
| Teleorman, 36 | 35.7 | 4.1 | 8.4 | 14.4 | 12.7 |
| Tulcea, 38 | 6.4 | 10.4 | 13.6 | 22.5 | 24.2 |
| Vaslui, 39 | 14.7 | 1.5 | 1.6 | 1.8 | 1.3 |
| *Favourable zone II* | 8.1 | 1.4 | 1.4 | 1.9 | 1.9 |
| Arges, 3 | 12.4 | 4.7 | 4.8 | 5.2 | 5.2 |
| Bacau, 4 | 7.2 | 2.3 | 2.8 | 3.0 | 2.8 |
| Buzau, 10 | 11.7 | 1.4 | 1.2 | 1.1 | 0.8 |
| Dâmbovita, 16 | 29.3 | 1.4 | 1.3 | 2.8 | 2.9 |
| Neamt, 29 | 0.4 | 1.7 | 0.5 | 2.3 | 2.1 |
| Prahova, 31 | 10.5 | 0.3 | 0.8 | 2.0 | 1.8 |
| Suceava, 35 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Vâlcea, 40 | 1.5 | 1.1 | 1.1 | 0.8 | 1.2 |
| Vrancea, 41 | 5.2 | 0.3 | 0.4 | 0.3 | 0.3 |

*Table 6*. Maximum density (individuals/sq.m.), recorded at the level of a representative forest in each district

| Zone/District cod number | Years | | | | Maximum density in 1969-2003 period |
|---|---|---|---|---|---|
| | 1969 | 1978 | 1987 | 2003 | |
| AREA | 142.8 | 107.9 | 185.2 | 66.2 | 185.2/1987 |
| *Favourable zone I* | 142.8 | 107.9 | 185.2 | 66.2 | 185.2/1987 |
| Botosani, 7 | - | - | 41.4 | 8.8 | 49.3/1988 |
| Braila, 9 | 7.4 | 36.0 | 71.5 | 22.0 | 85.5/1977 |
| Calarasi, 12 | 27.0 | 80.5 | 185.2 | 28.0 | 185.2/1987 |
| Constanta, 14 | 50.9 | 85.0 | 74.0 | 66.2 | 118.7/1982 |
| Dolj, 17 | 3.7 | 107.9 | 114.6 | 12.4 | 114.6/1987 |
| Galati, 18 | 7.7 | 24.6 | 44.9 | 3.7 | 69.4/1982 |
| Giurgiu, 19 | 11.0 | 14.6 | 67.9 | 11.5 | 67.9/1987 |
| Ialomita, 23 | 27.5 | 74.8 | 65.7 | 22.9 | 80.5/1979 |
| Iasi, 24 | - | - | 10.0 | 2.7 | 10.0/1987 |
| Ilfov, 25 | - | 12.9 | 76.5 | 11.0 | 76.5/1987 |
| Mehedinti, 27 | 0.4 | 74.5 | 67.3 | 2.6 | 74.5/1978 |
| Olt, 30 | 1.8 | 92.2 | 85.0 | 12.7 | 132.1/1985 |
| Teleorman, 36 | 13.3 | 102.2 | 139.9 | 29.8 | 139.9/1987 |
| Tulcea, 38 | 142.8 | 31.9 | 26.0 | 21.3 | 142.8/1969 |
| Vaslui, 39 | - | - | 44.5 | 2.5 | 97.0/1982 |
| *Favourable zone II* | - | 65.6 | 73.8 | 23.5 | 73.8/1987 |
| Arges, 3 | - | 65.6 | 24.8 | 4.8 | 65.6/1978 |
| Bacau, 4 | - | - | 23.9 | 23.5 | 23.9/1987 |
| Buzau, 10 | - | - | 19.8 | 1.3 | 19.8/1987 |

| | | | | | |
|---|---|---|---|---|---|
| Dâmbovita, 16 | - | 40.5 | 64.8 | 5.5 | 70.0/1988 |
| Neamt, 29 | - | - | - | 2.7 | 2.7/1998 |
| Prahova, 31 | - | - | 73.8 | 3.6 | 73.8/1987 |
| Suceava, 35 | - | - | - | 4.1 | 4.1/1998 |
| Vâlcea, 40 | - | - | 5.7 | 2.0 | 6.9/1993 |
| Vrancea, 41 | - | - | 19.7 | 1.1 | 41.0/1982 |

*Table 7.* Sunn pest diapausing populations(,000,000 overwintering adults), in oak forest, in damage area, during the recent years

| Zone/District cod number | 1995/ 1996 | 1996/ 1997 | 2001/ 2002 | 2002/ 2003 |
|---|---|---|---|---|
| AREA | 29844 | 5120 | 6372 | 17409 |
| *Favourable zone I* | 26567 | 4506 | 6101 | 17080 |
| Botosani, 7 | 2852 | 96 | 121 | 1899 |
| Braila, 9 | 303 | 96 | 471 | 3728 |
| Calarasi, 12 | 2629 | 442 | 877 | 1726 |
| Constanta, 14 | 3616 | 1124 | 834 | 2138 |
| Dolj, 17 | 2154 | 368 | 429 | 695 |
| Galati, 18 | 1328 | 184 | 183 | 422 |
| Giurgiu, 19 | 1803 | 317 | 347 | 335 |
| Ialomita, 23 | 913 | 463 | 464 | 2184 |
| Iasi, 24 | 37 | 158 | 157 | 221 |
| Ilfov, 25 | 729 | 25 | 23 | 217 |
| Mehedinti, 27 | 117 | 88 | 108 | 149 |
| Olt, 30 | 1347 | 187 | 305 | 462 |
| Teleorman, 36 | 7205 | 610 | 1336 | 2187 |
| Tulcea, 38 | 215 | 323 | 421 | 697 |
| Vaslui, 39 | 1318 | 25 | 22 | 20 |
| *Favourable zone II* | 896 | 948 | 608 | 741 |
| Arges, 3 | 87 | 40 | 41 | 44 |
| Bacau, 4 | 364 | 431 | 93 | 102 |
| Buzau, 10 | 173 | 61 | 42 | 49 |
| Dâmbovita, 16 | 1434 | 27 | 26 | 12 |
| Neamt, 29 | 1 | 16 | 4 | 19 |
| Prahova, 31 | 855 | 12 | 32 | 84 |
| Suceava, 35 | 1 | 1 | 1 | 1 |
| Vâlcea, 40 | 87 | 40 | 41 | 44 |
| Vrancea, 41 | 354 | 18 | 28 | 13 |

Monitoring sunn pest populations by evaluating the total number of insects in a generation, in diapausing sites, expressed high share of favourable zone I of the total sunn pest populations in the damage area in Romania. Zonal and periodical fluctuations of population level outlined the fact that both in years less favourable to sunn pest (1997, 1998), and in those particularly favourable to its development (1995, 2003), the most numerous populations were recorded in the favourable zone I.

Analysis of mortality of diapausing pest is an other significant element for monitoring; multiannual data revealed in Romania 15-30 % mortality, with broad variations between zones and years (Table 8).

As a rule the overwintering adults can be found in spring in the crops at densities of a few individual/sq.m., and more rarely at densities between 15 and 20 individuals/sq.m.

*Table 8*. Average adults mortality (%) recorded in diapause period during the recent years

| Zone/District cod number | 1997/ 1998 | 1998/ 1999 | 1999/ 2000 | 2000/ 2001 | 2001/ 2002 | 2002/ 2003 |
|---|---|---|---|---|---|---|
| AREA | 28.5 | 17.0 | 29.8 | 12.6 | 10.7 | 15.6 |
| *Favourable zone I* | 21.9 | 15.8 | 18.7 | 8.8 | 9.7 | 9.3 |
| Botosani, 7 | 28.6 | 17 | 24.2 | 17.7 | 8.8 | 18.2 |
| Braila, 9 | 55 | 23.1 | 20 | 4.4 | 11.5 | 7.5 |
| Calarasi, 12 | 62 | 58 | 31.6 | 5.3 | 32.3 | 16.2 |
| Constanta, 14 | 9.7 | 11.8 | 12.6 | 4.6 | 21.8 | 12.6 |
| Dolj, 17 | 14.3 | 12.4 | 10.4 | 7.7 | 5.1 | 10.7 |
| Galati, 18 | 38 | 52 | 27 | 5.5 | 2.2 | 3.4 |
| Giurgiu, 19 | 10 | 14.8 | 17.8 | 8.9 | 5.6 | 6.6 |
| Ialomita, 23 | 39 | 53 | 30.5 | 7.6 | 10.4 | 7.3 |
| Iasi, 24 | 28.6 | 10 | 32.6 | 3.7 | 4.8 | 12.4 |
| Ilfov, 25 | 7.3 | 11 | 12.6 | 6.7 | 2.1 | 2.3 |
| Mehedinti, 27 | 8.7 | 8.9 | 12 | 13.1 | 6.3 | 5.7 |
| Olt, 30 | 53 | 12 | 28.8 | 5.7 | 5.2 | 4.2 |
| Teleorman, 36 | 14.1 | 12 | 15 | 20 | 6.1 | 11.7 |
| Tulcea, 38 | 3.8 | 3 | 4.8 | 7.4 | 8.2 | 5.2 |
| Vaslui, 39 | 10.6 | 20 | 30.8 | 7.5 | 5.8 | 3.3 |
| *Favourable zone II* | 35.2 | 18.3 | 40.8 | 16.3 | 11.7 | 21.8 |
| Arges, 3 | 4.8 | 8 | 15.5 | 8.4 | 3.3 | 3.3 |
| Bacau, 4 | 2.8 | 12 | 25 | 7.9 | 7.9 | 13.1 |
| Buzau, 10 | 19.4 | 21 | 20 | 24.2 | 25.2 | 30.3 |
| Dâmbovita,16 | 13.4 | 16.7 | 24 | 7.5 | 3.7 | 4.6 |
| Neamt, 29 | 6.8 | 7.3 | 46.9 | 9.6 | 11.8 | 46.5 |
| Prahova, 31 | 78 | 56 | 58.9 | 35.7 | 14.1 | 14.7 |
| Suceava, 35 | 10.7 | 4.5 | 46.5 | 12.3 | 3.3 | 6.3 |
| Vâlcea, 40 | 93.4 | 33 | 97.6 | 27 | 10.7 | 56.7 |
| Vrancea, 41 | 77.3 | 9 | 24.7 | 15.3 | 23.5 | 10.6 |

The new generation (nymphs and young adults) recorded higher densities, usually 15-20 specimens/sq.m., or during the years with particularly favourable climatic conditions, 70-94 specimens/sq.m. as happened in 1996. In 2003 year, 145 spc./sq.m. were recorded (Table 9).

## Life-cycle - annual peculiarities

The supervision of life-cycle evolution in direct relationship with annual ecological peculiarities is of major interest, due to insect ability to develop more or less numerous populations, according to climatic conditions and phenology of host-plant, and to pass or not the whole life-cycle under optimal conditions (Barbulescu, 1970; Paulian and Popov, 1980; Popov and Rosca, 1991; Popov et al., 1989; 1996; 1997 a).

*Table 9*. Sunn pest population densities in wheat fields (nr./sq.m.), in damage area, in Romania

| Zone/District cod number | Favourable year | | Normal year | |
|---|---|---|---|---|
| | Overwintering adults | Nymphs | Overwintering adults | Nymphs |
| AREA | 1-22 | 10-145 | 1-12 | 2-51 |
| *Favourable zone I* | 2-22 | 28-145 | 1-12 | 7-51 |
| Botosani, 7 | 2 | 28 | 2 | 12 |
| Braila, 9 | 13 | 62 | 1 | 37 |
| Calarasi, 12 | 4 | 125 | 3 | 20 |
| Constanta, 14 | 10 | 140 | 7 | 46 |
| Dolj, 17 | 22 | 120 | 2 | 25 |
| Galati, 18 | 14 | 95 | 3 | 20 |
| Giurgiu, 19 | 12 | 85 | 1 | 34 |
| Ialomita, 23 | 5 | 90 | 7 | 51 |
| Iasi, 24 | 7 | 30 | 1 | 8 |
| Ilfov, 25 | 14 | 63 | 1 | 15 |
| Mehedinti, 27 | 6 | 40 | 3 | 7 |
| Olt, 30 | 21 | 76 | 3 | 18 |
| Teleorman, 36 | 7 | 145 | 2 | 35 |
| Tulcea, 38 | 12 | 118 | 12 | 38 |
| Vaslui, 39 | 5 | 52 | 1 | 14 |
| *Favourable zone II* | 1-9 | 10-45 | 1-7 | 2-20 |
| Arges, 3 | 4 | 38 | 3 | 12 |
| Bacau, 4 | 2 | 25 | 2 | 10 |
| Buzau, 10 | 9 | 45 | 6 | 20 |
| Dâmbovita, 16 | 2 | 25 | 5 | 10 |
| Neamt, 29 | 1 | 20 | 1 | 5 |
| Prahova, 31 | 4 | 27 | 7 | 12 |
| Suceava, 35 | 1 | 10 | 1 | 2 |
| Vâlcea, 40 | 9 | 12 | 1 | 3 |
| Vrancea, 41 | 1 | 18 | 1 | 4 |

In this respect, the particularly favourable climatic conditions to this pest in 2003 could be mentioned which induced hastening life-cycle by 2-3 weeks, and increased its reproductive potential with about 25-35 % than usually. In 1997 and 2003 years, field pest evolution took place under normal ecological conditions (Tables 10 and 11).

The physiological preparation factor expressed by the fat-body, is particularly important for population fluctuation, being aside the

Table 10: First overwintering *Eurygaster integriceps* adults migrated to the wheat crops in 1997 and 2003

| Zone/District cod number | 1997 | | 2003 | |
|---|---|---|---|---|
| | Date | S t C° | Date | S t C° |
| AREA | 30.03-02.05 | 25.7 | 10-30.04 | 18.0 |
| *Favourable zone I* | 30.03-28.04 | 23.6 | 10-28.04 | 19.9 |
| Botosani, 07 | 25.04 | 21.7 | 26.04 | 21.2 |
| Braila, 09 | 9.04 | 33.9 | 16.04 | 11.7 |
| Calarasi, 12 | 8.04 | 15.2 | 24.04 | 16.4 |
| Constanta, 14 | 12.04 | 28.2 | 20.04 | 11.9 |
| Dolj, 17 | 30.03 | 11.7 | 17.04 | 15.3 |
| Galati, 18 | 06.04 | 17.2 | 18.04 | 10.9 |
| Giurgiu, 19 | 15.04 | 19.4 | 24.04 | 12.8 |
| Ialomita, 23 | 17.04 | 32.1 | 22.04 | 16.8 |
| Iasi, 24 | 28.04 | 31.2 | 28.04 | 31.2 |
| Ilfov, 25 | 10.04 | 27.7 | 22.04 | 2,5 |
| Mehedinti, 27 | 15.04 | 24.2 | 10.04 | 20.5 |
| Olt, 30 | 18.04 | 16.8 | 13.04 | 16.6 |
| Teleorman, 36 | 08.04 | 24.9 | 15.04 | 10.5 |
| Tulcea, 38 | 17.04 | 11.3 | 23.04 | 11.9 |
| Vaslui, 39 | 14.04 | 35.1 | 28.04 | 37.5 |
| *Favourable zone II* | 09.04-02.05 | 27.9 | 23-30.04 | 16.1 |
| Arges, 03 | 10.04 | 32.7 | 25.04 | 15.9 |
| Bacau, 04 | 27.04 | 18.4 | 30.04 | 15.1 |

| | | | | |
|---|---|---|---|---|
| Buzau, 10 | 17.04 | 28.8 | 30.04 | 22.1 |
| Dâmbovita, 16 | 21.04 | 36.4 | 24.04 | 6.2 |
| Neamt, 29 | 30.04 | 33.9 | 23.04 | 17.2 |
| Prahova, 31 | 09.4 | 22.8 | 23.04 | 16.1 |
| Suceava, 35 | 02.05 | 28.3 | 28.04 | 16.7 |
| Vâlcea, 40 | 09.04 | 20.8 | 27.04 | 18.8 |
| Vrancea, 41 | 14.04 | 30.2 | 29.04 | 16.8 |

climate, one of the main factors affecting pest numerical levels (Popov, 1972, 1977 a,b; 1978, 1979, 2002; Popov et al., 1996, 2003).

**Pests - parasites relationship**

The parasitical level is important and of concern for the control technology. From Table 12 it could be noted that generally, the average parasitical level fluctuates between 30 and 50 %, with certain higher values in a few districts. At present, protection of natural parasitic fauna is achieved mainly by framing treatments within the optimal time (Popov, 1977 c; 1980; 1991; 1999; Popov and Paulian, 1971; Popov et al., 1985; 1987 a;). Composition of oophagous parasitic species occurring in Romania revealed a high share for *Telenomus chloropus* and *Trissolcus grandis* (70-80 %), among the total of 8 recorded species (Popov et al., 1985; 1987 a; 2003).

*Table 11*. First appearance of nymphs (stage III) and new adults in wheat crops, in 1997 and 2003

| Zone/District cod number | Nymphs stage III | | New adults | |
|---|---|---|---|---|
| | 1997 | 2003 | 1997 | 2003 |
| AREA | 02 - 30.06 | 22.05 - 9.06 | 20.06 - 2.08 | 11.06 - 1.07 |
| *Favourable zone I* | 02 - 16.06 | 22.05 - 9.06 | 20.06 - 9.07 | 11 - 27.06 |
| Botosani, 7 | 06.06 | 06.06 | 03.07 | 27-06 |
| Braila, 9 | 02.06 | 26.05 | 26.06 | 17.06 |
| Calarasi, 12 | 09.06 | 29.05 | 27.06 | 21.06 |
| Constanta, 14 | 12.06 | 26.05 | 30.06 | 11.06 |
| Dolj, 17 | 06.06 | 23.05 | 05.07 | 16.06 |
| Galati, 18 | 03.06 | 27.05 | 30.06 | 14.06 |
| Giurgiu, 19 | 03.06 | 27.05 | 25.06 | 22.06 |
| Ialomita, 23 | 02.06 | 22.05 | 26.06 | 19.06 |
| Iasi, 24 | 16.06 | 28.05 | 09.07 | 20.06 |
| Ilfov, 25 | 05.06 | 29.05 | 21.06 | 14.06 |
| Mehedinti, 27 | 10.06 | 09.06 | 20.06 | 27.06 |
| Olt, 30 | 08.06 | 28.05 | 25.06 | 20.06 |
| Teleorman, 36 | 02.06 | 07.06 | 24.06 | 26.06 |
| Tulcea, 38 | 05.06 | 31.05 | 27.06 | 20.06 |
| Vaslui, 39 | 08.06 | 29.05 | 30.06 | 27.06 |
| *Favourable zone II* | 02 - 30.06 | 26.05 - 1.06 | 25.06 - 2.08 | 20.06 - 1.07 |
| Arges, 3 | 06.06 | 02.06 | 28.06 | 23.06 |
| Bacau, 4 | 28.06 | 11.06 | 06.07 | 01.07 |
| Buzau, 10 | 02.06 | 06.06 | 25.06 | 28.06 |
| Dâmbovita, 16 | 10.06 | 26.05 | 05.07 | 20.06 |
| Neamt, 29 | 27.06 | 06.06 | 25.07 | 02.07 |
| Prahova, 31 | 03.06 | 11.06 | 08.07 | 13.07 |
| Suceava, 35 | 30.06 | 10.06 | 02.08 | 21.07 |
| Vâlcea, 40 | 12.06 | 03.06 | 29.06 | 25.06 |
| Vrancea, 41 | 05.06 | 27.05 | 09.07 | 25.06 |

**Economic damage threshold (EDT) and control measures**

Overwintering adults control is applied only in wheat plots, where bugs density exceeds the EDT, established as follows:

- 7 specimens/sq.m. - in plots with normal plant density and vegetation, when spring is humid and cool;

- 5 sp./sq.m. - in plots with normal plant density and vegetation, in spring with high temperatures;

- 3 sp./sq.m. - in plots with reduced plant densities, with poor overwintering, humid and warm spring;

- 1-2 sp./sq.m. - under unfavourable complex conditions to crops; late emergence of plants in autumn - winter; prolonged winter with persistent snow layer; late spring with excessively dry weather.

Establishing plots to be treated for larval control: Chemical application is performed only in wheat plots where pest density overpasses the EDT, thus:

- 5 nymphs/sq.m. - for plots designed for bread-making;

- 3 nymphs/sq.m. - for plots designed for seed multiplication.

*Table 12*. Parasitical level (%) of sunn pest eggs by oophagous parasites, during the recent years

| Zone/District cod number | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|
| AREA | 31.3 | 35.2 | 34.1 | 38.2 |
| *Favourable zone I* | 39.9 | 37.0 | 39.2 | 37.5 |
| Botosani, 7 | 40 | 35 | 30 | 45 |
| Braila, 9 | 17 | 18 | 21 | 32 |
| Calarasi, 12 | 15 | 41 | 30 | 44 |
| Constanta, 14 | 30 | 20 | 31 | 35 |
| Dolj, 17 | 57 | 68 | 66 | 60 |

| | | | | |
|---|---|---|---|---|
| Galati, 18 | 20 | 10 | 6 | 37 |
| Giurgiu, 19 | 22 | 38 | 26 | 31 |
| Ialomita, 23 | 60 | 38 | 12 | 15 |
| Iasi, 24 | 40 | 30 | 35 | 40 |
| Ilfov, 25 | 12 | 12 | 6 | 6 |
| Mehedinti, 27 | 48 | 49 | 48 | 42 |
| Olt, 30 | 35 | 25 | 35 | 34 |
| Teleorman, 36 | 60 | 31 | 28 | 48 |
| Tulcea, 38 | 36 | 32 | 57 | 21 |
| Vaslui, 39 | 47 | 33 | 46 | 30 |
| *Favourable zone II* | 22.8 | 33.5 | 29.0 | 38.9 |
| Arges, 3 | 22 | 40 | 30 | 28 |
| Bacau, 4 | 49 | 31 | 33 | 40 |
| Buzau, 10 | 25 | 14 | 26 | 46 |
| Dâmbovita, 16 | 35 | 7 | 25 | 12 |
| Neamt, 29 | 48 | 46 | 45 | 45 |
| Prahova, 31 | 50 | 66 | 53 | 49 |
| Suceava, 35 | 38 | 40 | 25 | 46 |
| Vâlcea, 40 | 76 | 50 | 60 | 69 |
| Vrancea, 41 | 28 | 25 | 22 | 15 |

Chemical control is the unique practical method of intervention in order to diminish harvest damage (Barbulescu, 1970; Popov, 1977 a; 1991; Popov and Enica, 1991; Popov et al., 1983, 1987 b, 1996, 1997 a,b; 2003). The registered insecticides assortment includes both organophosphorus and synthetic pyrethroid compounds. The main share in sunn pest control in the past has been detained by organophosphorus compounds based on trichlorfon and dimethoate (100% in 1970-1975, 96% in 1985, 89% in 1993 compared with 2% in 1997). After 1985 other insecticides, mainly pyrethroids have been registered. The expansion in practice of these pesticides has been slow but steady (in 1993 they represented 10% of the treated areas against the sunn pest). However after 1998 they represented over 95% of the total treated surface in Romania, especially cypermetrin (Popov et al., 1996, 1997 a,b, 1998, 2001, 2003). All data of the complex monitoring action allow to forecast the annual sunn pest attack, in view of the correct treatment application.

Chemical control (integrally subsidized by the Ministry of Agriculture, Forest, and Rural Development) is applied only in areas and plots where the economic damage threshold (EDT) is overpassed. The treated wheat surfaces vary from one year to another (Table 13).

*Table 13.* Chemical treatment level (ha) of wheat crops against sunn pest, applied in Romania in recent years

| Zone/District cod number | 1996 | 2001 | 2002 | 2003 |
|---|---|---|---|---|
| AREA | 749,811 | 513,362 | 449,607 | 398,433 |
| *Favourable zone I* | 663,195 | 470,703 | 404,423 | 336,017 |
| Botosani, 07 | 8,734 | 2,860 | 1,860 | 0 |
| Braila, 09 | 43,080 | 36,779 | 41,320 | 33,536 |
| Calarasi, 12 | 62,106 | 59,320 | 64,800 | 59,547 |
| Constanta, 14 | 87,697 | 71,963 | 42,464 | 14,830 |
| Dolj, 17 | 113,662 | 31,281 | 25,950 | 36,382 |
| Galati, 18 | 37,180 | 36,947 | 29,670 | 14,214 |
| Giurgiu, 19 | 39,362 | 12,599 | 18,150 | 16,705 |
| Ialomita, 23 | 55,767 | 50,290 | 36,880 | 21,350 |
| Iasi, 24 | 11,280 | 5,230 | 4,030 | 3,800 |
| Ilfov, 25 | 12,801 | 7,520 | 5,329 | 10,037 |
| Mehedinti, 27 | 10,670 | 2,200 | 2,640 | 3,850 |
| Olt, 30 | 66,157 | 47,573 | 34,630 | 29,586 |
| Teleorman, 36 | 54,668 | 40,518 | 43,445 | 49,143 |
| Tulcea, 38 | 41,700 | 41,000 | 23,000 | 26,230 |
| Vaslui, 39 | 18,331 | 24,623 | 30,255 | 16,807 |
| *Favourable zone II* | 86,616 | 42,659 | 45,184 | 62,416 |
| Arges, 03 | 15,077 | 14,333 | 17,310 | 26,209 |
| Bacau, 04 | 9,742 | 5,600 | 6,220 | 7,690 |
| Buzau, 10 | 8,626 | 3,766 | 5,302 | 6,309 |
| Dâmbovita, 16 | 14,973 | 7,800 | 3,250 | 4,850 |
| Neamt, 29 | 20,571 | 0 | 4,486 | 6,892 |
| Prahova, 31 | 500 | 400 | 0 | 0 |
| Suceava, 35 | 7,385 | 960 | 890 | 1,265 |
| Vâlcea, 40 | 4,000 | 5,200 | 2,860 | 3,312 |

Harvest quality analysis, as established by the percentage of damage grains (Table 14) (practically performed to all grain production in the damage area) reveals the excellent results of a complex activity for protection of wheat crops in Romania against the particularly harmful outbreak by sunn pest.

*Table 14.* Percentage of damaged grains in recent years

| Year | Total grain tons analysed | Wheat yield, % | | | |
|---|---|---|---|---|---|
| | | Without attack | Attack level, % | | |
| | | | 0.1-2.0 | 2.1-5.0 | over 5.1 |
| 1994 | 2,146.3 | 22.5 | 55.2 | 16.7 | 5.6 |
| 1995 | 2,229.6 | 14.5 | 51.7 | 25.1 | 8.7 |

| | | | | | |
|---|---|---|---|---|---|
| 1996 | 800.5 | 12.6 | 73.7 | 13.0 | 0.7 |
| 1997 | 2,308.7 | 28.4 | 68.2 | 3.3 | 0.1 |
| 1998 | 1,663.9 | 29.0 | 68.0 | 3.0 | - |
| 1999 | 2,310.0 | 18.6 | 77.2 | 4.1 | 0.1 |
| 2000 | 1,484.3 | 23.6 | 70.2 | 5.6 | 0.6 |
| 2001 | 2,429.3 | 20.9 | 72.9 | 6.2 | - |
| 2002 | 1,142.9 | 6.7 | 70.7 | 18.2 | 4.4 |
| 2003 | 302.7 | 6.4 | 51.3 | 29.7 | 12.6 |

## CONCLUSIONS

Monitoring the sunn pest population in Romania should be carried out annually in all districts, based on the following elements:

– *density in diapausing sites, by*:

– average insect number/sq.m. in each forest, at diapausing start and end;

– adults mortality during diapause;

total insect population at forest, district, zone, area level.

– *density under field conditions, by*:

– infestation level by overwintering adults;

– establishment of the features of life-cycle (migration, oviposition, nymphal development, adults formation);

– share of natural parasitism;

– infestation level by nymphs for each plot in the damage area.

Centralization and interpretation of these data lead to setting up average and short-term forecasts for the whole area, in order to release application warnings for chemical control undertakings, by zones and districts.

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Table 1

Average yield of experiments with winter wheat cultivars, under irrigation and dry-land in six localities from the South of Romania (2002)

| Locality | Average yield under: | | Yield percentage diminution |
|---|---|---|---|
| | irrigation (kg/ha) | dry-land (kg/ha) | |
| Caracal | 8560 | 5601 | 34.6 |
| Marculesti | 4716 | 3075 | 34.8 |
| Teleorman | 5963 | 3594 | 39.8 |
| V. Traian | 6941 | 3794 | 45.3 |
| Fundulea | 4858 | 1918 | 60.5 |

| | | | |
|---|---|---|---|
| Simnic | (8560) | 380 | 95.6 |

*Table 2*

Percentage diminution of some plant features under water stress conditions as compared to irrigation

| Locality | Plant number | Plant height | Grain filling period | Spike number | Grain/ear | TKW | Test weight |
|---|---|---|---|---|---|---|---|
| Caracal | 0 | 14,9 | 15,0 | 7,9 | 10,2 | 14,1 | 0,9 |
| Teleorman | 0 | 10,0 | 19,2 | 12,0 | 12,0 | 11,9 | 1,0 |
| V.Traian | 34,9 | 21,0 | 16,9 | 42,5 | 12,2 | 2,9 | 8,1 |
| Fundulea | 4,9 | 28,8 | 24,9 | 6,9 | 28,9 | 29,5 | 3,9 |
| Simnic | 27,6 | 61,7 | 30,0 | 65,0 | 64,5 | 53,1 | 10,7 |
| Media | 13,5 | 27,3 | 21,2 | 26,9 | 25,6 | 22,3 | 4,9 |

*Table 3*

Minimum, maximum and average yields registered at Fundulea in 2002 in international trials WWEERYT with genotypes grouped depending on the originating country

| Source | Average yield of the tested genotypes (kg/ha) | Maximum yield of the tested genotypes (kg/ha) | Minimum yield of the tested genotypes (kg/ha) |
|---|---|---|---|
| Romania | 2368 | 2953 | 2073 |
| Russia | 2327 | 2453 | 1980 |
| Ukraina-Odessa | 2224 | 3013 | 1287 |
| Hungary | 2181 | 2780 | 1320 |
| Ukraina-Mironovka | 2108 | 2753 | 1500 |

| | | | |
|---|---|---|---|
| Moldova | 1927 | 2560 | 1293 |
| Bulgaria | 1898 | 2873 | 1313 |
| Turkey | 1893 | 2420 | 1487 |
| Azerbaidjan | 1460 | 1553 | 1367 |
| Kazahstan | 1422 | 1833 | 853 |
| LSD 5% | 243 | 275 | |

***Table 4***

Correlations between yield under water stress conditions and different traits

| Locality | Average yield diminution because of water stress (%) | Correlation coefficients between yield under water stress conditions and: | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | yield under irrigation | plant height under stress conditions | plant height under irrigation | heading time | spike/ m² | grain/ear | TKW |
| Caracal | 34,6 | **0,48** | 0,29 | -0,31 | -0,12 | 0,20 | 0,11 | -0,30 |
| Teleorman | 39,8 | **0,80** | 0,35 | 0,31 | **-0,85** | **0,58** | - | - |
| Valu Traian | 45,3 | 0,04 | 0,33 | 0,20 | **-0,40** | **0,42** | **0,40** | 0,22 |
| Fundulea | 60,5 | 0,00 | **0,46** | -0,31 | **-0,46** | **0,52** | 0,30 | -0,17 |
| Simnic | 95,6 | -0,01 | **0,41** | **-0,62** | -0,04 | **0,40** | **0,50** | 0,15 |

The bold characters are significant at the probability level of 0.05

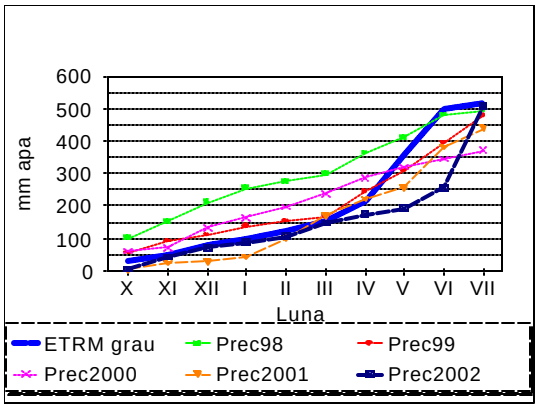


Figure 1. Average evapotranspiration and rainfall during 1999-2002 at Fundulea (mm water; month; wheat evapotranspiration; rainfall)

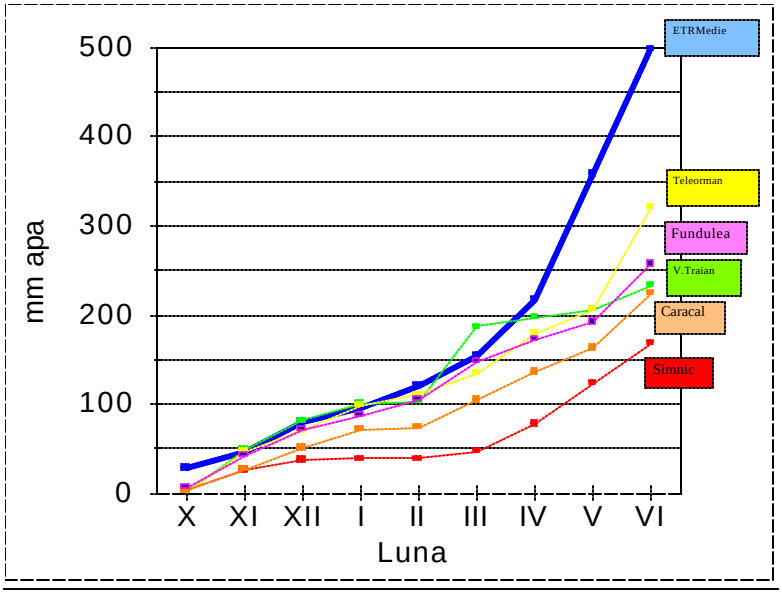


Figure 2. Average evapotranspiration and rainfall during the vegetation period in six locations of Southern of Romania in 2001-2002 year (mm water; month).

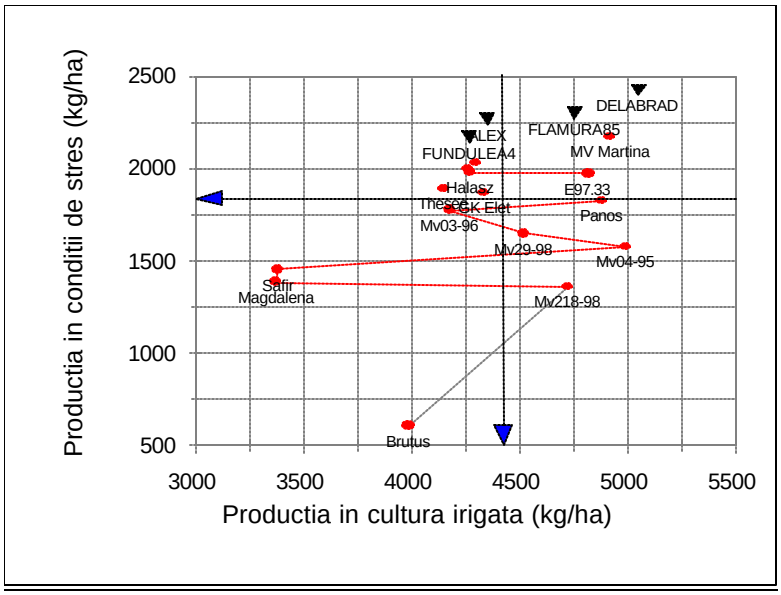


Figure 3. Yield obtained by some Romanian and foreign cultivars under irrigation and non-irrigation, in 2002 at Fundulea (arrows indicate the experiments average yield)(Yield under stress conditions; yield under irrigation).

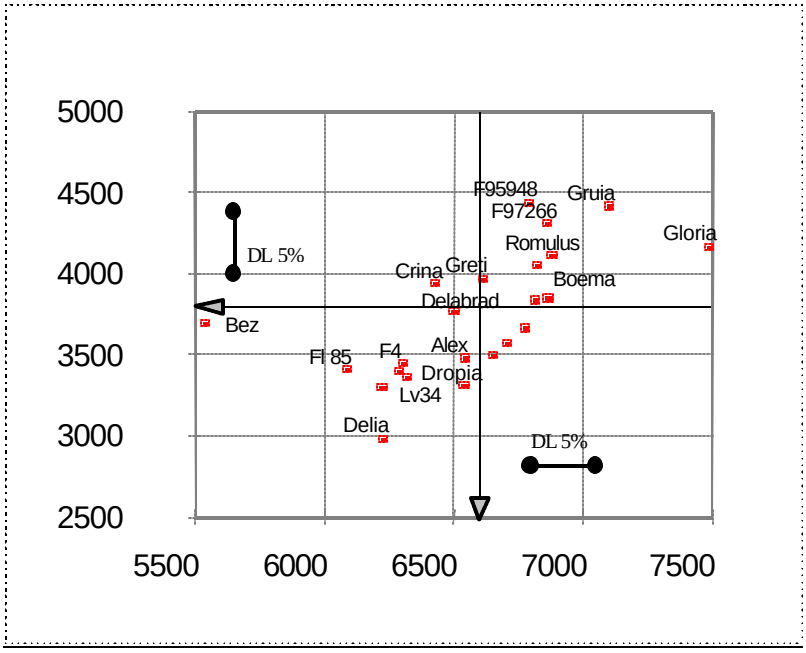


Figure 4. Average yields in four locations, obtained in 2002 by Romanian new lines and cultivars under irrigation and non-irrigation (arrows indicate experiments average yield)(Yield under non-irrigation; Yield under irrigation; LSD).