

## Shifting from Aerial to Ground Spraying for Sunn Pest Control: Farmers' Perceptions and Problems

Aykut Gul<sup>1</sup>, Aden Aw-Hassan<sup>2</sup>, Halil Kutuk<sup>3</sup>, Ramazan Canhilal<sup>3</sup>, Ahmed Mazid<sup>2</sup>, Majid Hasani Moghaddam<sup>4</sup>, Hamoud Haj Hamoud<sup>5</sup> and Mustapha El Bouhssini<sup>2</sup>

<sup>1</sup>University of Cukurova, Adana, Turkey;

<sup>2</sup>International Center For Agricultural Research in the Dry Areas, P.O. Box 5466, Aleppo, Syria;

<sup>3</sup>Plant Protection Research Institute, Adana, Turkey;

<sup>4</sup>Syrian Ministry of Agriculture, Damascus, Syria;

<sup>5</sup>Iran Plant Protection Research Institute, Tehran, Iran.

### Abstract

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Turkish government has been changing Sunn Pest control policy by shifting from aerial to ground spraying. The Thrace Region is a major cereal growing area and in 2002 and 2003 no aerial spraying for Sunn Pest was done. Our objective was to investigate the impact of this policy change in the region in terms of wheat production, grain quality and what farmers' perceptions of this change were. To achieve this a survey with farmers was done and the results evaluated. The new Sunn Pest management policy received a favorable perception from farmers and government officials in the Thrace region. As a result of two years experience, the adoption of ground spraying became easier than expected although there were some problems like lack of equipment for spraying, tractor crushing of wheat while spraying and inadequate training of personnel.

Keywords: Control methods, *Eurygaster integriceps*, policy, socioeconomics, Sunn Pest, Thrace Region.

### Introduction

Wheat and barley are very important food crops in the Near East, Middle East, and South-western Asian countries. They are attacked by several species of bugs including Sunn Pest, which is a major threat to wheat and to a lesser extent, barley production. Over 15 million hectares can be affected annually and during outbreaks, infestations may result in 100% crop loss. Damage commonly results in yield losses of 20-30% in barley and 50-90% in wheat. Sunn Pest also injects chemicals into the grain that destroys the gluten and reduces the baking quality of the flour (8, 12).

Presently, chemical control is the main method of protection against Sunn Pest. Within the entire region affected by Sunn Pest about 8 million hectares of wheat are infested annually, of which more than 2 million hectares are treated with insecticides at an

estimated cost of 42 million dollars (U.S.). There has been an over-use of insecticides over the past and the shortcomings of pesticide usage in Sunn Pest control and its effect on the environment (particularly reductions of the beneficial entomofauna) have now become evident. Chemical treatment is costly, hazardous to human health and environmental safety, and has a negative impact on agricultural sustainability (2).

Moreover, even without these shortcomings, opportunities for chemical control are likely to become more restricted as costs increase and pesticide subsidies are reduced. The development of new, sustainable and more environmentally benign alternatives is a major priority (12). Sunn Pest populations have increased the last decade and the number of research activities on Sunn Pest has increased in Turkey and most neighboring countries (1, 5, 10, 9, 11, 14).

Wheat and barley are strategic crops for Turkey and many other countries. Total cultivated area in Turkey is 26.4 million ha and 69% of it is cultivated field area (18.2 million ha) (11). Wheat is grown on approximately 9.4 million ha in Turkey. Total production of wheat is 19 million tons and the average annual yield is 2,021 kg/ha. Barley is also an important crop for animal feed. The average cultivated area of barley is 3.45 million ha and the total production is 8 million tons (7).

Sunn Pest is one of the most important pests of wheat and barley in Turkey. There are three economically important Sunn Pest species, *Eurygaster integriceps* Puton, *E. maura* L., and *E. austriaca* Schrank (6, 15). Sunn Pest first reached economically damaging levels in South and Southeast Anatolia in 1927, in Thrace in 1982 and in Central Anatolia in 1988. The population density of the pest increased again in South and Southeast Anatolia in 1977 and at present, about 75% of the wheat and barley areas in Turkey are threatened by Sunn Pest (15). In 2002 -1,492,122 ha of wheat were sprayed against Sunn Pest using both aerial and ground equipment. This sprayed area was increased to 1,882,493 ha in 2003. The purpose of spraying was to prevent damage and to keep populations under the economic threshold, without causing damage to natural enemies.

Organization of Sunn Pest control has been implemented by the Ministry of Agriculture and Rural Affairs (MARA) and all requirements (planes, insecticides) have been met by the Government in Turkey. Pest surveys, egg parasitization and nymphal populations) have been carried out by Sunn Pest experts of MARA (13).

The mission of the government is Sunn Pest management by performing the proper control methods at the right time, and conserving the natural balance to support farmers by preventing damage (3). The government has conducted Sunn Pest management, mainly based on chemical control since 1927. Neither farmers nor

technical consultants have been satisfied with their programs.

The area sprayed for Sunn Pest management is given in Table 1. This area has almost doubled from 1997 to 2003. The use of ground equipment as opposed to aerial application has increased rapidly from 8% in 1997 to 56% in 2003.

Sunn Pest spraying methods in Turkey can be seen in Figure 1. According to 2002 data, 39% of the total sprayed area is sprayed with ground equipment. The Thrace Region was important because no aerial spraying was done in 2002. In 2003, spraying by ground increased beyond the government's target (the target was 35% ground spray for 2003) and it was 56% including activities in the Central Anatolia Region.

One goal of the government is to transfer their Sunn Pest management programs to farmers by providing technical information and equipment. Ultimately farmers will conduct Sunn Pest management programs without any help. MARA, Ministry of Finance, State Planning Organizations, Treasury and Office for Field Crops are the main public institutions dealing with Sunn Pest management in Turkey.

These institutions have advantages in Sunn Pest management such as: experience, strong organization, powerful management, good impact on farmers, technology use, and adaptation to plant protection standards in the world. Insufficiency in research & development and experts are the weak sides of the system. There are also some opportunities like supporting the establishment of farmers' unions and assigning sufficient budget. There are also a lot of weaknesses in the system. These are as follows (2):

- Lack of coordination among public institutions;
- Farmers are irrelevant to Sunn Pest management;
- Climatic and geographical structure;
- Farmers' Unions couldn't be established;

- Unconscious intervention of politicians, farmers' associations, large land owners and local administrators;
- Sunn Pest is a big threat in neighboring countries.

The Turkish government has been changing Sunn Pest control policies by shifting from aerial spraying to ground spraying.

The Thrace Region was firstly discussed in Integrated Sunn Pest Management in the West Asia Workshop held in Tehran, Iran in October, 2002. A decision was made to conduct a study in the region to determine how much farmers accepted spraying against Sunn Pest by using ground equipment and how successful they were. The purpose of this study is to investigate the impact of this policy change in the region in terms of wheat production and grain quality and farmers' perception of the change. To achieve this goal a survey with farmers was done and results were evaluated.

## Materials and Methods

The region of Thrace in the Marmara region, has 3,310 sq mi (8,575 sq km), and is southeast of Europe. It occupies the southeastern tip of the Balkan Peninsula and is northeast of Greece, and south of Bulgaria and European Turkey. Its boundaries have varied in different periods. It is bordered by the Black Sea in the northeast and by the Sea of Marmara and the Aegean Sea in the south (4).

In Thrace Region, three major wheat producing provinces were selected Edirne, Tekirdag and Kırklareli for study. Then 141 farmers were randomly selected; 77 from Edirne, 22 from Kırklareli and 42 from Tekirdag. Questionnaires were prepared and completed with face-to-face interviews. The survey was conducted from 13-19 July, 2003. For some of the tables' the Likert scale was used to calculate the points. Besides the survey with farmers, some interviews were done with the technical staff at the Research Institute of

Thrace and the Extension Services of MARA. Secondary data related to Sunn Pest were obtained from various units of MARA.

## Results and Discussion

Views and Opinions Gathered from Technical Staff at the Research Institute of Thrace and the Extension Services of MARA

From 1983-2001 farmers and technical staff working for MARA noticed that spraying against Sunn Pest with airplanes was not successful. As a result of this, authorities of MARA decided that spraying against Sunn Pest must be performed with ground equipment by the farmers in the Thrace Region. MARA personnel in the agreed and they persuaded and educated farmers to make this change.

One of the reasons that the farmers accepted spraying with ground equipment, instead of airplane, was kernel damage. In areas sprayed by air kernel damage was high. In the Thrace Region a lot of farmers' wheat was sold through a Commodity Exchange and the higher the quality the greater the price of the wheat. First year spraying with ground equipment, some farmers did not spray against Sunn Pest and they had difficulty selling their wheat. The following year they realized that spraying was necessary. In the second year (2003) almost all farmers sprayed against Sunn Pest with ground equipment. Another reason that the farmers accepted spraying with ground equipment was that it was more effective than spraying with an airplane. Farmers realized this situation while selling their wheat.

There are some difficulties in spraying with ground equipment and many advantages. The most important difficulty is the crushing of wheat by the tractor while spraying. But farmers know very well how much Sunn Pest cause kernel damage when they do not spray. Because of that farmers say they will spray even though crushing damage occurs. Farmers are looking for measures to reduce **crushing**

damage. For this they use narrower wheels on their tractors, they leave gaps in the fields for their tractors and they increase the capacity of their equipment. Farmers complain about the prices of narrower wheels and as a result they sow their seed by drilling which leaves gaps in the field for their tractors. However, in some villages one or two farmers bought narrower wheels and sprayed all the fields in the area. Crushing damage was reduced. Almost all of the farmers in the region accepted the sowing procedure. They believe that leaving some gaps reduces crushing damage and fungal diseases.

In the Thrace Region, MARA technicians have been working there many years and they know the region very well and have a good relationship with the farmers. They are not appointed frequently to other provinces. Thus, they are more effective on changing the habits of the farmers.

Another important point is that farmers have enough ground equipment to spray against Sunn Pest and adhere to changes. However some farmers in some villages of Edirne Province are still opposing ground applications because tractors damage the wheat and they insist on the use of aerial application. Some farmers complained about not receiving pesticides on time.

Most of the farmers do not know about the safety measures for spraying Sunn Pest and number of extension staff is not enough to give the necessary training.

Survey staff of MARA must be very careful about surveys of Sunn Pest to decide on spraying. Because we had some complaints from some villagers saying that officials told them there was no need for spraying against Sunn Pest but after harvest they got wheat with very high percentage of Sunn Pest damage. As a result MARA has lost some of its credibility. As a result of this some farmers obtained their pesticides from the free market and sprayed even though it was not needed. They decided to spray because the price of pesticide was low and they didn't want to take the risk of severe Sunn Pest damage.

Eventually this causes the deterioration of the environment because of overuse of pesticides. Thus the government must be more careful about losing its reliability/credibility.

### Results of Farmers' Survey

The average age of the farmers is **48.1** years, share of agricultural income is **86.1%** and the ratio of membership to an agricultural organization is **80.1%**. Of the investigated farmers, **80.4%** graduated from primary school and the remaining from high school or higher education.

Chamber of Agriculture, Agricultural Credit Cooperative, Agricultural Sale Cooperative of Thrace, Irrigation Union, Commodity Exchange and Leader Farmers' Union are the major agricultural organizations that the investigated farmers have membership.

Average farm size was **17.2** ha and **12%** of land was irrigated; **50.3%** of farmers cultivated land was used for wheat production (**8.7** ha).

**95.0%** of the farmers observed worms and bugs in their fields; **82.3%** of farms had weeds and **22.7%** had fungi; **97.2%** of the farmers were able to recognize Sunn Pest; **82.3%** recognized adult Sunn Pest while **61.7%** could identify Sunn Pest eggs and **64.5%** the nymphal stage. Farmers expressed that they have had Sunn Pest problems for an average of **8.3** years.

In Table 2 data related to farmers' evaluation of Sunn Pest are given. Farmers have good knowledge about Sunn Pest damage (**66%**). But farmers have very little knowledge of parasitic wasps (**22%**). Farmers do not feel they have enough information about Sunn Pest (**47%**).

Farmers (**47%**) responded that they do not have enough knowledge about the negative effects of aerial spraying on the environment and human health.

Farmers see Sunn Pest in the field for the first time in mid-April. For the question "in your opinion, should Sunn Pest be sprayed as soon as it appears in the field?" **30.5%** of the

respondents answered yes. 76.6% of the respondents said that they informed extension service when they see **Sunn** Pest in the field. Most of the respondents (78.0%) said that they considered some other kind of Sunn Pest control except chemical. Among these they considered biological control (**54.5%**), parasitic wasps (36.4%) and resistant varieties (9.1%) as other control methods. A large proportion of the respondents (80.1%) want to get training on Sunn Pest.

74.4% of the respondents have difficulties in marketing their wheat. **Sunn**

Pest damage was the number one wheat marketing problem (70.9%). Structural marketing problems were second (4.3%).

When the farmers were asked about the timing of aerial spraying in previous years, only 33.3% said spraying (aerial) was done on time. Farmers' evaluation about the timing of ground spraying for the last 2-3 years was a good indicator for the success of ground spraying. 83.0% of the farmers noted that spraying (ground equipment) was done on time. The farmers were in favor of ground spraying (Table 2, last row).

Table 1. Sunn Pest sprayed area by regions in Turkey (ha).

| Region                | Methods | Years  |          |          |        |          |          |          |
|-----------------------|---------|--------|----------|----------|--------|----------|----------|----------|
|                       |         | 1997   | 1998     | 1999     | 2000   | 2001     | 2002     | 2003     |
| Southeastern Anatolia | Aerial  | 563.86 | 941.01   | 922.63   | 579.10 | 529.62   | 574.36   | 770.27   |
|                       | Ground  | 17.29  | 20.99    | 21.70    | 13.73  | 26.77    | 43.87    | 88.10    |
| Southern Anatolia     | Aerial  | 82.56  | 213.43   | 26.67    | 47.37  | 71.73    | 80.10    | 41.11    |
|                       | Ground  | 178.00 | 1.14     | 400.00   | 3.22   | 14.80    | 25.17    | 40.24    |
| Central Anatolia      | Aerial  | 87.25  | 5.77     | 39.31    | 77.43  | 285.09   | 254.18   | 31.69    |
|                       | Ground  | 5.13   | 160.00   | 787.00   | 1.61   | 17.63    | 35.82    | 205.60   |
| Aegean                | Aerial  | 500.00 | 22.17    | 89.86    |        |          |          |          |
|                       | Ground  |        | 2.45     | 3.36     | 25.20  | 60.26    | 100.53   | 184.47   |
| Thrace                | Aerial  | 178.71 | 361.42   | 212.44   | 7.57   | 42.95    |          |          |
|                       | Ground  | 48.60  | 56.78    | 49.62    | 16.240 | 39.26    | 357.30   | 487.71   |
| Marmara               | Aerial  |        |          | 8.53     |        |          |          |          |
|                       | Ground  | 3.40   |          | 1.50     | 9.70   | 24.03    | 19.90    | 33.15    |
| Total                 |         | 973.18 | 1,625.31 | 1,375.79 | 803.06 | 1,112.13 | 1,492.12 | 1,882.49 |

Table 2. Farmers' evaluation on Sunn Pest and its control.

| Evaluation                                                                                       | Likert scale* |
|--------------------------------------------------------------------------------------------------|---------------|
| Farmers' knowledge about damages caused by Sunn Pest                                             | 2,63          |
| Farmers' knowledge about parasitic wasps**                                                       | 0,87          |
| Sufficiency of farmers' information about <b>Sunn</b> Pest                                       | 1,87          |
| Farmers' satisfaction with Sunn Pest spray conducted by MARA                                     | 2,60          |
| Farmers' knowledge about the negative effects of aerial spraying on environment and human health | 1,89          |
| Farmers' opinion about the continuation of the current policy (ground spraying)                  | 2,85          |

\* Questions were asked to indicate on a 5-point Likert scale to which the statements indicate sufficiency of the criteria. Likert scale: 4=very sufficient.. 0=definitely insufficient.

\*\* 30% of the respondents gave reasonable answers for parasitic wasps

In ground spraying, availability of equipment is very important for success: 78.7% of the farmers said that they have enough equipment for spraying Sunn Pest with ground equipment. Some of the farmers also told that the extension services provided equipment for Sunn Pest control (2.1%). Some also expressed that the availability of tractors with narrow wheels was necessary.

90.8% of the respondents said that government officials gave them pesticides on time. The remaining had problems obtaining pesticides from the government. Some farmers (5.0%) expressed that using ground equipment harmed wheat production so they tended to use the pesticide given to them for other crops. But it is not a common practice.

A significant proportion of the farmers (55.3%) expressed that they noticed some positive environmental change (like increasing number of snakes, rabbits, turtles etc.) after ground spraying started.

In general 65% of farmers are satisfied with Sunn Pest control conducted by **MARA**. Some farmers were not satisfied with it and gave reasons why. Insufficient pesticide dose, no spraying, late spraying, ineffectiveness of pesticides and lack of agricultural extension are the major reasons in sequence.

Another important key point was the effectiveness of ground and aerial spraying according to farmers' opinion. Ground spraying was expressed as more effective by 68.1% of the respondents while aerial spraying by 27.7%. That is a good indicator for new policy acceptance and success by the farmers. Aerial spraying was found more effective because (1) no crop lost because of spraying, (2) more effective and (3) the whole and wider area is sprayed. The reasons for ground spraying effectiveness are expressed as (1) more effective (spraying lower elevation, only target crop is effected), (2) better timing, (3) much care on own field and (4) less environmental damage. Farmers' negative opinions for ground spraying can be listed in order of importance: (1) High crop damage,

(2) lack of equipment, (3) negative effect on human health and (4) higher cost.

### Changes in Spraying Cost as a Result of Different Spraying Methods

The cost which is calculated in this section refers to the additional cost that farmers should bear as a result of shifting from aerial to ground spraying. Average cost of ground spraying was calculated 14,780,000 TL/ha (10.56 USD/ha). Labor, fuel, machinery and equipment are the major cost items. Besides this cost, there is another important one called opportunity cost, which is the crop lost due to ground spraying. In this case three scenarios should be considered:

- 1) For the current situation nearly all the farmers do not leave unplanted space for tractor tires. If normal tractor tires are used, the crop lost will be 5%.
- 2) It will be 2 percent if narrow tractor wheels are used.
- 3) Very few farmers leave lines for tractor to work, in this case there will be no crop lost.

The average wheat yield is 3000 kg/ha in the region and the average wheat price is 330,000 TL/kg according to the Edime Commodity Exchange. Using these data, additional opportunity cost can be calculated for each of the three scenarios (49.500.000 TL/ha -35.36 USD/ha-, 19.800.000 TL/ha - 14.14 USD/ha- and no cost). If we add the machinery related cost given at the beginning that means 45.92, 24.70 and 10.56 USD in scenario order.

According to **MARA**, average airplane hiring cost is 344.000 TL/da/airplane (2.46 USD/ha/airplane) for ULV and 625.000 TL/da/airplane (4.46 USD/ha/airplane) for conventional (plus V.A.T.). This is the government saving as a result of no aerial spraying.

## Conclusions

Spraying with ground equipment is essential in terms of social, environmental, cost and health aspects. Therefore, the policy the current government and the previous one is following is correct. Another important factor is that this policy has become a national policy rather than a political matter. Current government's policy is the continuation of the previous one and this is a new progress in that respect because the SUM Pest control issue has always been a way of pleasing voters.

The major finding of this study is that the new SUM Pest management policy gives good results in terms of farmers' perception and government officials in Thrace Region of Turkey. As a result of two years experience, the adoption of ground spraying has become easier than expected although there were some problems such as the lack of equipment for spraying, tractor crushing while spraying and training.

The educational level of the farmers in the region is higher than other parts of the country. Also, most of the farmers are willing to get training on SUM Pest control. Therefore, extension services should work harder and be well-organized in the region. The farmers in the region are aware of how Sunn Pest damage is important to get good quality wheat yield. Even there were unexpected problems (organization, providing equipment and pesticide on time and etc.) at the beginning stage of policy change; the farmers were in favor of ground spraying.

Shifting from aerial spraying to spraying with ground equipment causes some problems because farmers and technical staff are not trained and lack of equipment forces farmers to make new organizations to control Sunn Pest.

Aerial spaying must be ended unless there is an obligation in terms of technical,

economical and geographical reasons. Field surveys must be done correctly and in time. Staff dealing with SUM Pest business should be trained and paid for their extra work.

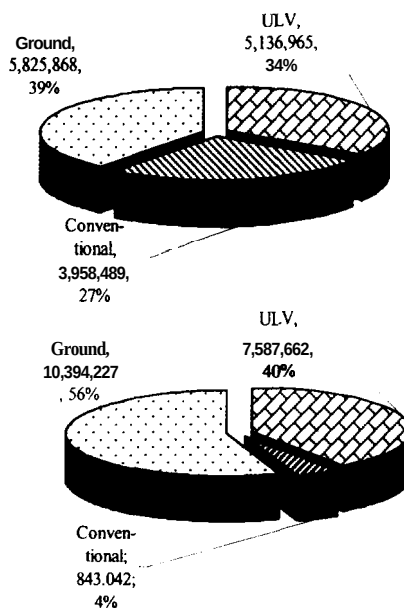


Figure 1. Sunn Pest spraying methods in Turkey in 2002 and 2003.

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### الملخص

غول، أيكوت، آدن أو-حسن، خليل كنتك، رمضان جانهلال، أحمد مزيد، مجيد حسني مقدم، حمود حاج حمود ومصطفى البوحسيني. 2007. التحول من الرش الجوي إلى الرش الأرضي لمكافحة حشرة السونة: إدراك الزراعة ومشاكلهم. الصفحات 331-339.

غيرت الحكومة التركية سياسة مكافحة حشرة السونة بالتحول من الرش الجوي إلى الرش الأرضي. تعد منطقة ثراس (Thrace) في إقليم مرمرا من أهم مناطق زراعة الحبوب، في عامي 2002 و 2003 لم يطبق للرش الجوي لمكافحة حشرة السونة. هدف هذا البحث إلى تقصي أثر هذا التغيير في سياسة المنطقة من حيث إنتاج القمح، نوعية الحبوب وكيف كان إدراك الزراعة لهذا التغيير. لتحقيق ذلك أجري مسح للزراعة وتم تقييم النتائج. تم تلقي السياسة الجديدة لإدارة حشرة السونة بإدراك إيجابي من قبل الزراعة وموظفي الحكومة في منطقة ثراس. وبمحصلة نتائج خبرة عامين، وجد بأن تبني الرش الأرضي أصبح أسهل من المتوقع رغم وجود بعض المشاكل كنقص معدات الرش، سحق الجرارات للقمح خلال الرش، والتدريب غير الكافي للموظفين.

كلمات مفتاحية: طرائق مكافحة، *Eurygaster integriceps*، سياسة، اجتماعي اقتصادي، حشرة السونة، منطقة Thras.

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