10.7251/AGSY1303424A

THE EFFECT OF AIR ‑ASSISTED ON DIFFERENT DOSE APPLICATIONS AGAINST SUNN PEST (*EURYGASTER* SPP. HEMIPTERA: SCUTELLERIDAE) CONTROL

Arzu AYDAR*,Yasemin SABAHOĞLU, İbrahim ÇILINGIR, Ergin DURSUN, Mehmet TÜRKOĞLU, İbrahim ERGÜL

Plant Protection Central Research Institute, Ankara, Turkey
*(Corresponding author: arzu_erman@zmmae.gov.tr)

Abstract

During chemical applications against plant diseases and pests while some of the pesticide is drifted to non-target area by wind or suspended in the air, the other part drops into non-target sources of water and the ground. As a result of this, negative impacts such as low biological efficiency, high cost and enviromental pollution are occured.

In Türkiye between 2000-2012 which are the years epidemies occured chemical applications were made against sunn pest at area of approximately 11-18 million da. sunn pest control was conducted by both aerial and ground sprayers until 2002. Since then these applications have been turned into only ground applications gradually. This situtation has accelerated national studies that works on increasing the spraying efficiency by reducing spray losses.

The objective of this study was to develope an air-assisted sprayer that is domestic production and suitable for purchasing power of Turkish farmer. This sprayer was evaluated in terms of biological efficiency and distribution uniformity at a domestic wheat variety. The tests were carried out in two stages. Spraying characteristics were determined in the first step. Trials of biolocigal efficiency in which was used Alphacypermethrin EC (100 g/l) at dose of 15.0, 12.5 and 10.0 ml/da against the sunn pest were conducted in the second step (Babaroğlu et al. 2013). Thus, efficiency of the air-assisted against sunn pest was brought up to compare with the convantional application and reduction of pesticide use with lower dose application was evaluated. As a result of the study, high biological efficieny was achieved at low doses with air-asisted sprayer.

Key words: Air-assisted, sprayer, sunn pest, dose.

Introduction

Cereals which are mainly produced in the world are basic food in human and animal nutrition. Besides it is transported and stored easily and also turned into bread and pasta with simple procedures. In Turkey, wheat and barley have the largest production share of the cereals with the planting area of 13.030.000 ha and production of 25.700.000 tons. Cereals that is the most important food material for Turkey are used not only domestic consumption but also exported (Anonymous, 2012/1).

Agricultural production varies from year to year with the effect of various factors. Plant diseases and pests that is one of the most important of these factors cause damage of 15 % in annual agricultural income in agricultural products (Kansu, 1994). Therefore, plant protection against these harmful agents which cause the loss of agricultural product is very important. Both in the world and in our country chemical application is the most widely used control of plant diseases and pests and pesticides are applied with sprayers in this method. However,

during applications all pesticide can not reach the target plant surfaces. while some of them is drifted by wind or suspended in the air, the other part falls into non-target sources of water and the ground. As a result of this, negative impacts such as low biological efficiency, high cost and enviromental pollution are occured. Studies show that 20-25 % of applied pesticide reaches to the target area.

Sunn pest (*Eurygaster* spp.) is one of the major pest which largely causes crop loss in Türkiye. If necessary measures are not provided against the sunn pest, damage may occur up to 100 %. Negative impact of this damage effects yield and quality. Chemical control against the sunn pest has been made in the area of 1 billion hectars per year in Türkiye and insecticide of 150.000 liters has been consumed. This situation has caused a heavy load in the country's economy (Anonymous, 2012/2).

Reducing losses of pesticide, increasing the penetration in both sides of the leaves and protecting enviroment during applications are necessary for a optimum spraying. However, according to the wind speed and direction uniformity of spray deposition deteriorates, pesticide is collected upper part of plant and doesn't reach under the leaves in applications with conventional sprayers. Thus expected success is not achieved and both enviromental pollution and the cost of spraying increase with repeated the applications. It is necessary to use new application techniques for higher biological efficiency by placing pesticide on the the target area and lower spraying costs. One of the application techniques of these is the air-assisted application. The basic aim is to increase spray droplet velocity and modify their trajectory. Air-assisted sprayer appears as the ideal tools to improve the application quality (smaller droplet, in higher number), increase productivity (lower volumes and replenishments, higher displacement speed and extended spraying times), reduce the drift (wind speed of sprayer is greater than the atmospheric wind) and exposure to the products. Result from some studies have shown the potential of air-assisted spraying in providing better covarage and reducing drift by approximately 50 % (Mollrooney at all 1997, Pieche at all 2000).

Air-assisted ground sprayers are not being manufactured in Turkiye. Only a few farmers have imported from other countries and used them. Taking into account all the advantages of these sprayers , an air-assisted sprayer which is suitable for country conditions and purchasing power of farmers was manufactured. Efficiency trials against sunn pest were completed including some low dose applications with Alphacypermethrin.

Materials and methods

The main material of the study consisted of an air-assisted sprayer and wheat field. Trials carried out in two stages. In the first stage, trials were conducted with tracer to determine spraying characteristics in Aksaray-Türkiye. The experimental design was completely randomized plot with three replications. Tartrazine which is a water-soluble food dye was used as tracer and its application rate was 220 g/ha. The cone nozzles which has the plate of 1.2 mm was used at the pressure of 4 bar. Total nozzle flow rate was 16 l/min and application rate was 110 l/ha. Forward speed was 7.8 km/h. Two different air speeds (30 and 20 m/s) were adjusted for the air-assisted appplications in the experiments. Filter papers were used as the target surface and placed to the wooden sticks along the plant. Cholorometric method was used to measure the concentration of the tracer. During the applications, average temperature and humidity were measured 26 ^{o}C, 33.5 % respectively. Average wind speed was measured 1.6 m/s, 2.6 m/s and 2.5 m/s in the air-assisted applications of 30 m/s and 20 m/s and conventional application respectively.

In the second stage, trials of biolocigal efficiency in which was used Alphacypermethrin EC (100 g/l) at dose of 15.0, 12.5 and 10.0 ml/da against the sunn pest were conducted in Konya-Türkiye. The experimental design was completelly randomized block with four replications. Wheat variety of Gerek 79 have the plant height of 40 cm and plant density of 410 number/m^2. The plot size was about 16x60 m. The number of 12 counting was made with frames of 1 m^2 in every plot on the day before spraying and the first and the third days of after spraying (Babaroğlu et al. 2013).

Results and discussion

The air-assisted sprayer was manufactured by Teknik 20 Mechanical and Electrical Industry and Trade Co. Mean spray deposit of tracer collected on wheat plants **(**average of the three levels of the plant) for both conventional and air-assisted applications are given in Table 1 and Figure 1.

Table 1. Mean spray deposit of tracer collected on wheat plants

Type of sprayer	Spray deposits of tracer (µg/cm^2)
Conventional field sprayer	0.00271±0.00034 **b**
Air-assisted field sprayer (20 m/s)	0.00318±0.00040 **a**
Air-assisted field sprayer (30 m/s)	0.00325±0.00040 **a**

$p<0.05$

Spray deposits of tracer were higher for the air-assisted applications. Air-assisted application with an air speed of 20 m/s has increased the spray deposits at rate of 17,36 % and with an air speed of 30 m/s at rate of 20,06 % compared to the conventional application ($p = 0.014$).

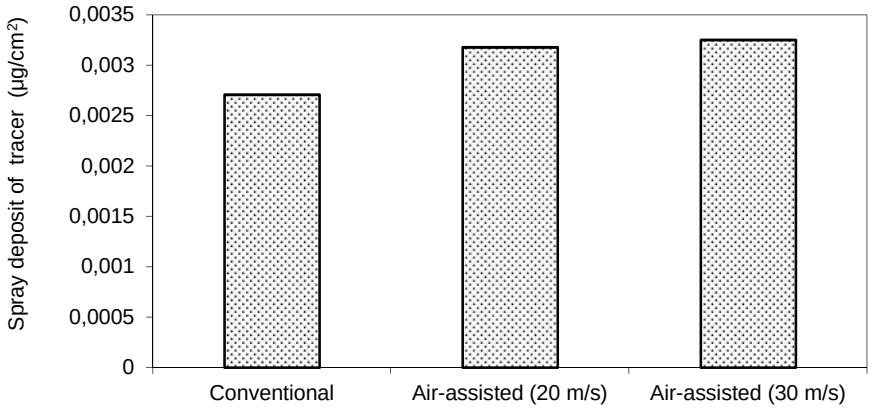

Figure 1. Mean spray deposit of tracer collected on wheat plants

Mean spray deposit of tracer collected on the ground for conventional and two different air-assisted applications were given Table 2.

Table 2. Spray deposit of tracer collected on the ground

Type of Sprayer	Spray deposit of tracer (µg/cm^2)
Conventional Field Sprayer	0.00109 ± 0.00009 a
Air-assisted Field Sprayer (20 m/s)	0.00078 ± 0.00010 b
Air-assisted Field Sprayer (30 m/s)	0.00082 ± 0.00005 b

$p<0.05$

As can be seen in Table 2, spray deposits of tracer collected on the ground in conventional application were measured higher than in air-assisted applications (p=0.043). While average of spray deposits of tracer on the ground in conventional application was found 0.001094 µg/cm^2, in air-assisted applications with air speed of 20 and 30 m/s were found 0.000780 and 0.000823 µg/cm^2, respectively. Spray deposits of tracer collected on the ground in conventional application was higher than air-assisted applications at rate of 40.26 % and 32.93 % respectively (with the air speed of 20 m/s and 30 m/s). In the other words, air-assistance caused reduction of spray deposits of tracer collected on the ground. Spray deposits of tracer collected on the ground increased with raise of air speed from 20 m/s to 30 m/s. Increasing of kinetic energy imparted to droplets with increased air flow velocity caused this situtation. Thus the droplets can not hold on to the plant and flow to the ground.

Countings were made to determine nymphs density of Sunn pest (mainly the third and fourth period nymphs) in trials of the biological efficiency on 17/06/2004. Results were given in Table 3.

Table 3. Nymph density of Sunn pest in wheat field in Konya (Babaroğlu et al. 2013)

Date	Replication	Control	Density of Sunn pest (number/m²)			
			Conventional Field Sprayer	Air-Assisted Field Sprayer (30 m/s)		
			15.0 ml/da	10.0 ml/da	12.5 ml/da	15.0 ml/da
17/06/04	1	16	20	20	23	20
	2	27	37	26	18	26
	3	13	12	27	11	27
	4	21	24	16	21	16
18/06/04	1	22	1	0	0	0
	2	19	2	0	0	0
	3	19	0	0	0	0
	4	24	0	0	0	0
20/06/04	1	18	0	0	0	0
	2	32	0	0	0	0
	3	20	0	0	0	0
	4	26	0	0	0	0

Table 4. Biological efficiencies of the sprayers at first and third days in different doses (Babaroğlu et al. 2013)

Type of Sprayer	Dose (ml/da)	Efficiency (%) (Mean)	
		First day	Third day
Conventional Field Sprayer	15.00	97.18	100.00
Air-Assisted Field Sprayer (30 m/s)	15.00	100.00	100.00
	12.50	100.00	100.00
	10.00	100.00	100.00

Biological efficiencies of the sprayers in different doses are shown in Table 4. There were no significant differences between the conventional and air-assisted field sprayers in insecticide applications at full dose of 15 ml/da (0.282 %). Altough the dose was reduced at rate of 17 % and 33 % according to the full dose, the effect of 100 % was achieved in spraying with air-assisted field sprayer. Trials of low dose were carried out previously with the conventional field sprayer in a different location and values of biological efficieny remained below of 90 % (84 % and 82 %). Therefore, lower doses were not applied at the trials in the different location due to the small plots. Advantage of the air-assisted application against the conventional application was clear in the spraying conditions which had high wind speeds.

Conclusion

In our country, the air-assisted spraying technique has been used in orchards for a long time. But for the field plants air-assisted applications are relatively new and especially in the last 10 years the usage of field sprayers has increased. However compared to conventional systems its higher costs impose restrictions on both usage by farmer and manufacturing by firms. On the other hand the increasing in pesticide assembly on target surfaces and higher biological effect with low dose applications can not be excluded. A reduction at a rate of 1/3 of insecticide used against Sunnpest can be provided by this system and it will be extremely important in terms of economy of the country and the safety of environment.

References

Anonymous, 2012(1). T.C. Çevre ve Şehircilik Bakanlığı, Türkiye'nin Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi'ne İlişkin İkinci Ulusal Bildirimi, Türkiye'de İklim Değişikliğinin Tarım ve Gıda Güvencesine Etkileri. (Ministry of Enviroment and Urbanization, Second National Communication of the United Nations Framework Convention on Climate Change, Implications of Climate Change on Agriculture and Food Assurance in Turkey).

Kansu, İ.A., 1994. Genel Entomoloji (General Entomology). Kıvanç Basımevi 426 s.

Anonymous, 2012(2). T.C. Gıda Tarım ve Hayvancılık Bakanlığı Gıda Kontrol Genel Müdürlüğü, 2013 Yılı Bitki Sağlığı ve Karantina Program ve Prensipleri. (Ministry of

Food, Agriculture and Livestock General Directorate of Food Control, Program and Principles of Plant Health and Quarantine in 2013).

Babaroğlu, N., Çilingir, İ., Gökdoğan, A., Özkan, M., Koçak, E., Aydar, A., Sabahoğlu, Y., Dursun E., Yılmaz, A., Kan, M., Türkoğlu, M., Ergül, İ., 2013. Süne [*Eurygaster* spp. (Heteroptera: Scutelleridae)] Mücadelesinde Yardımcı Hava Akımlı Tarla Pülverizatörünün Etkinliğinin Araştırılması. 1. Bitki Koruma Ürünleri ve Makineleri Kongresi, Antalya.(Investigation of Efficiency of Air-Assisted Field Sprayer against Sunn pest [*Eurygaster* spp. (Heteroptera: Scutelleridae)]. Congress of Plant Protection Products and Machinery).

Mollrooney, J.E. and L. Skjoldager, 1997. Evaluation of an air-assisted ground sprayer for control of Boll Weevil (*Anthonomus grandis*, Coleoptera: Curculionidiae) and Beet Armyworm (*Spodoptera* exiqua, Lepidoptera: Noctuidae). Southwestern Entomologi: 2222(3): 315-322.

Piché, M., Panetton, B. And R. Thériault, 2000. Field evaluation of air-assisted boom spraying on broccoli and potato. Transactions of the ASAE, 43(4):793-799.