Phytosanitary status of oats in organic and conventional farming

Dina Atanasova*, Vasilina Maneva
Institute of agriculture, Karnobat
E-mail: *dinadadar@gmail.com*

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Abstract
The study was conducted in 2013 – 2016 at the experimental fields in the Institute of Agriculture - Karnobat with wintering oats cultivars Kaloyan and Kehlibar. Observations have been made on the phytosanitary status of crops in organic and conventional agriculture. The level of weed infestation on winter oats in fields depends on the weather conditions of the year and genotypes of crops - in both conventional and organic farming, the lowest number of weeds per m^2 was reported for cultivar Kehlibar as compared to cultivar Kaloyan. In conventional farming over the studied years, on both cultivars was observed infliction with *Puccinia coronate* var. *avenae*, and on cultivar Kaloyan the infestation was over 25%, whereas on cultivar Kehlibar it was under 25%. In organic farming on both oats cultivars were reported plants slightly inflicted with *Ustilago avenae*, which was due to the lack of decontamination of the seeds. The type of farming had a great impact on the disease infestation on winter oats. In organic and conventional farming of oats, the most widely spread type of aphid was *Sitobion avenae L.*. *Schizaphis graminum Rond.* was only observed in conventional farming on cultivar Kaloyan. With organically grown oats the aphid population number was lower, probably due to the presence of natural entomophagy, which developed there owing to the existence of more flowering weed vegetation and non-treatment with insecticides.

Keywords: wintering oats; phytosanitary status; organic and conventional farming

INTRODUCTION

Cereals have an important role in world agriculture. Compared to other cereals, oats are a important crop. It is mainly used for animal feed and also as food and supplements for humans. Oat protein has good protein concentration and has excellent balance of amino acids (Robbins et al., 1971). Oats are one of the healthiest grains on our planet. It does not contain gluten and is replete with important vitamins, minerals, fiber and antioxidants. Studies show that oats and oatmeal (porridge from oats) have a large number of useful properties. These include weight loss, lower blood sugar and a reduced risk of cardiovascular disease. Of great interest is oats growing in organic farming - without the use of pesticides and mineral fertilizers (Batalova, 2004; Savova et al., 2005; foodismedicine.ru).

Comparing organic and conventional cereal crop fields, it is established that organic fields have five times more diverse plant species and about twenty times more diverse pollinants compared to conventional farming fields. The abundance of pollinants was more than a hundred times higher in organic fields. On the contrary, the abundance of cereal aphids was five times lower in the organic fields, whereas the abundance of pests was three times higher, and the predator-prey ratio was twenty times higher in the organic fields, which shows significantly greater potential for biological pest control in organic fields (Krauss et al., 2011). In other research, when organic and conventional fields are compared, the number of weeds shows greater percentage of broadleaf weed spread on the organic fields and three times more species when herbicides are not applied (Moreby et al., 1994; Jastrebska et

al., 2013). In Northern France, the weed diversity and density are significantly higher on the organic fields than on the conventional ones (Gosme et al., 2012). Organic farming oftentimes has positive effect on the species diversity and density but its effects differ among groups of organisms and landscapes (Bengtsson et al., 2005). But competition from weeds can reduce grain yields in both conventional and organic systems (Mason et al., 2007b). One of the methods of weed regulation in organic farming system is a choice of crop and varieties with bigger competitive ability against weeds. Competitive ability of the crop showed to be important in weed regulation. Peas, a weak competitor, had significantly higher weed biomass at harvest compared with oats and winter wheat (Lundkvist et al., 2008). Plant height, tillering, and elevated photosynthetically active radiation interception are some of the traits thought to help confer competitive ability in cereal grains (Mason et al., 2007a). Szewszyk (2013) was report, that the number and dry matter of weeds were less differentiated because of the variety, and much more because of the years due to different weather conditions.

The aim of this study was to compare the phytosanitary condition of the cultivars of oats grown in two types of farming systems – organic and conventional.

MATERIAL AND METHODS

This study was carried out in the period of 2013-2016 on *Eutric Vertisols* (Ninov, 2005) at the Institute of Agriculture in Karnobat, Bulgaria, on the certified field for organic farming and the experimental field for conventional farming. The conventional field, we investigated, were treated with agrochemicals like herbicides, fungicidies and inorganic fertilisers. By contrast the organic field were cultivated under the Council Regulation (EC) 834/2007, 889/2008 and Regulation (BG) 5/2018 based on a prohibition of inorganic fertilisers and pesticide application. The experiment tested two cultivars of wintering oats - Kehlibar and Kaloyan, sowing with 450 germinated seeds/m^2. The predecessor was peas-sunflower mixture. In conventional farming were applied nitrogen fertilizers (N_6) in February and during at vegetation - zeta-cipermetrina against *Oulema melanopa* (L.). Phytosanitary monitoring was carried out. The insects were reported by means of direct monitoring of the crop pests. The reporting of weeds included species composition and density of weed infestation measured by the quantity-weight method (weeds/m^2; g/ m^2), at the end of tillering stage. The disease infestation was determined by visual inspection of the plots during crop vegetation, by route monitoring and by inspection of plants.

RESULTS AND DISCUSSION

In Southeastern Bulgaria, the climate is transitional continental with average annual rainfall of 549 mm. Winter is comparatively warm, spring is short and cool, summer is hot and dry, autumn is long and warm. The studied period was marked by excessive rainfall and in the first year it was 8% more than the multi-annual values, in the second – by 40%, in the third – by 30% more. Rainfall was unevenly distributed by months, but provided humidity during the specific periods and the conditions for growing cereal crops were favourable (Figure 1).

The lowest level of weed infestation in both organic and conventional farming of winter oats was observed in 2013/2014 vegetation year – 17-18 weeds.m^2 on the conventional field, and 32-37 weeds.m^2 on the organic field (Figure 2). The weed infestation was significant – the weed density was twice higher in the organic than in the conventional field. This can be explained with the weather conditions. The following years were significantly more humid and with better development conditions for both weeds and crop (Figures 3 and 4). In 2014/2015 the difference in the level of weed infestation was insignificant – 33-41 weeds/m^2 and 37-48 weeds/m^2 in conventional and organic farming, respectively. In the last year of the study, the weed infestation was lower than in 2015/2016 and higher than in the first year of the study. This results can be explained with the weather conditions. In both conventional and organic farming, the lowest number of weeds per m^2 was reported for cultivar Kehlibar as compared to cultivar Kaloyan. This tendency is find out of the many autors (Barberi, 2002; Szewszyk, 2013 and others).

When phytosanitary monitoring for diseases was conducted on oats grown in organic farming, both cultivars reported plants inflicted with *Usti-*

lago avenae, which was probably due to the lack of decontamination of the seeds. In conventional farming over the studied years, on both cultivars was observed infliction with *Puccinia coronata* var. *avenae*, and on cultivar Kaloyan the infestation was over 25%, whereas on cultivar Kehlibar it was under 25%. Probably nitrogen fertilization in conventional farming affected the cell walls of the plants – they became thinner and therefore more susceptible. Out of the conducted observations we can draw the conclusion that the type of farming had a great effect on disease infestation (Table 1).

In organic and conventional farming of oats, the most widely spread type of aphid was *Sitobion*

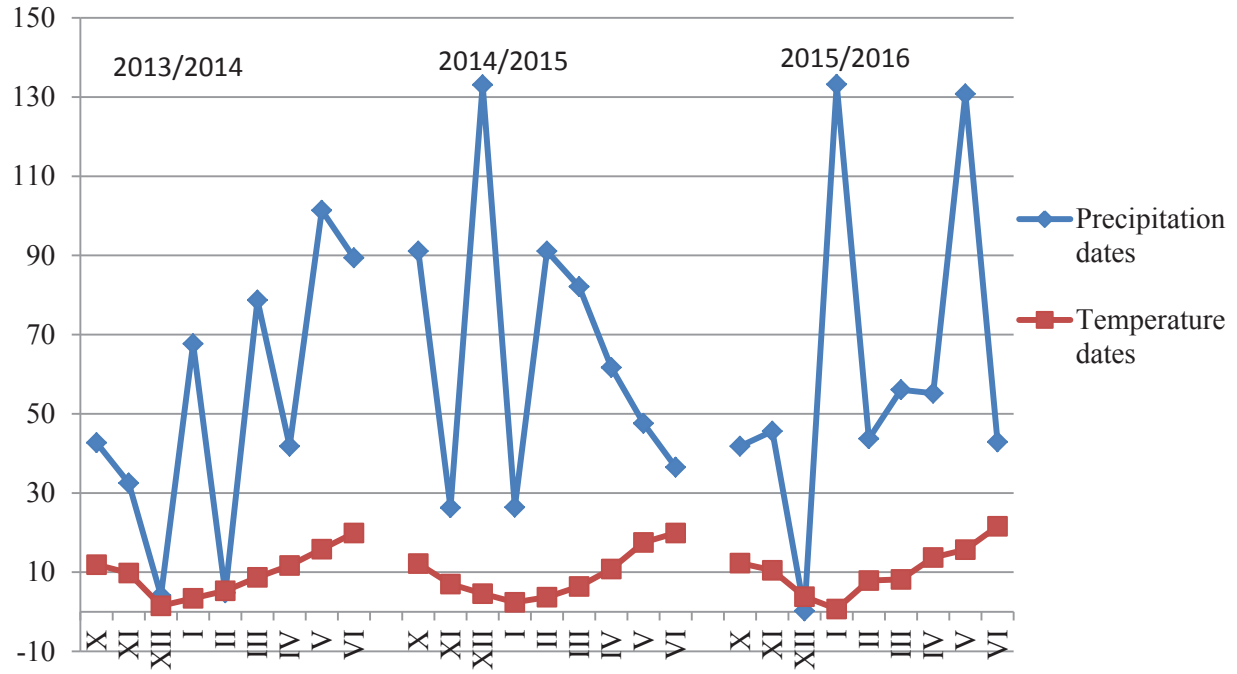

Figure 1. Temperature (^{0}C) and precipitation (mm) dates in Karnobat

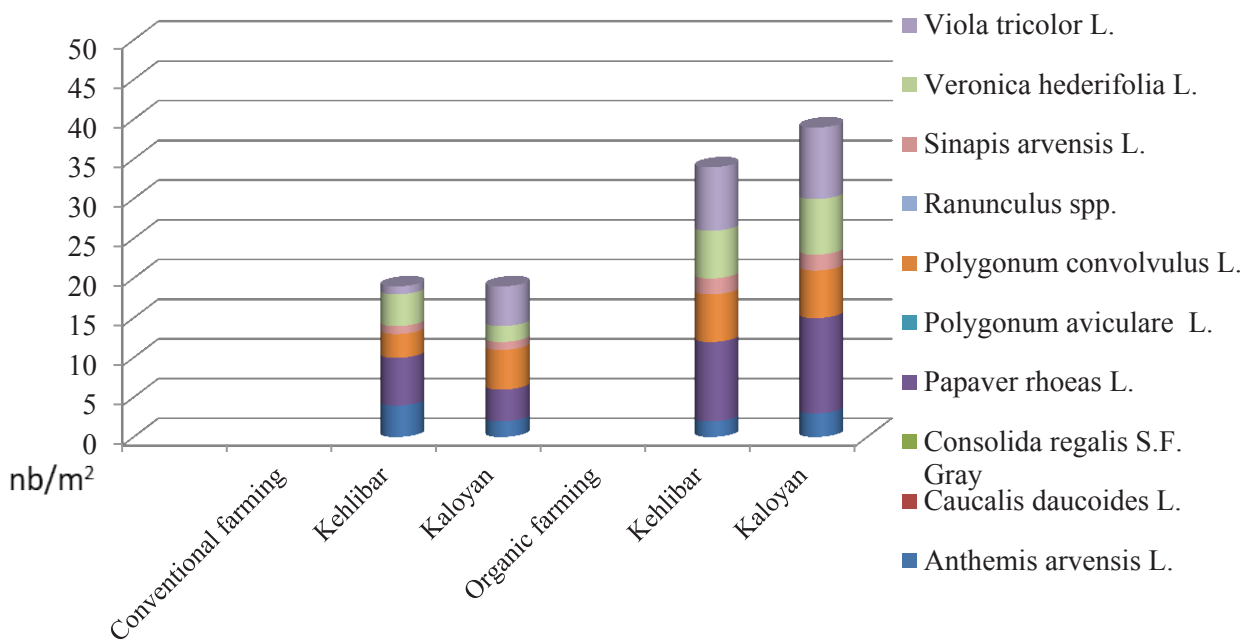

Figure 2. Weed infestation in organic and conventional farming oats, 2014

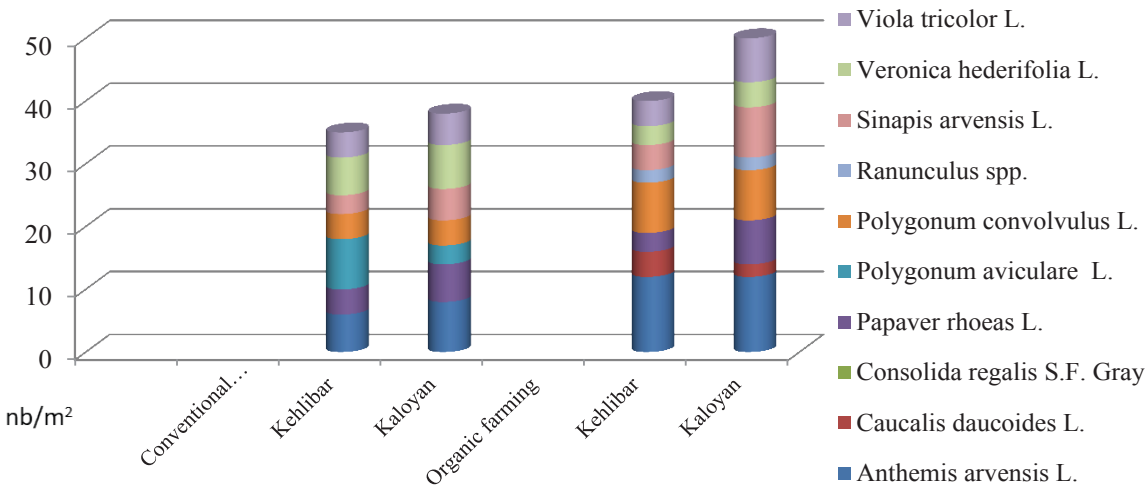

Figure 3. Weed infestation in organic and conventional farming oats, 2015

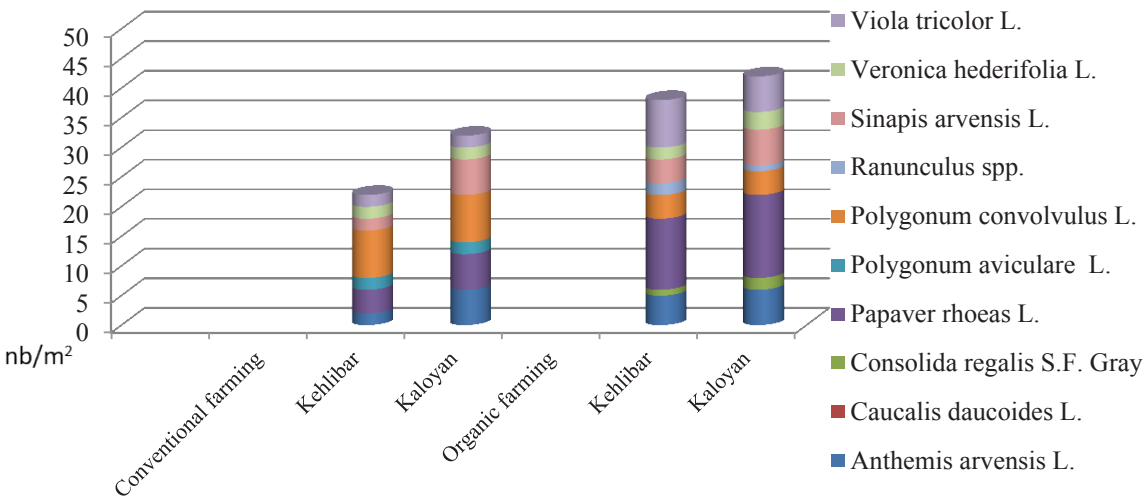

Figure 4. Weed infestation in organic and conventional farming oats, 2016

Table 1. Oats Diseases in Organic and Conventional farming (average 2013 - 2016)

Diseases	Oats cultivars			
	Kaloyan		Kehlibar	
	Organic	Conventional	Organic	Conventional
Ustilago avenae	+	-	+	-
Puccinia coronata var. *avenae*	-	+++	-	++

+ low attack rate - up to 10%; ++ average attack rate - 10 to 25%; +++ high fall - more than 25%.

Table 2. Species composition of aphids in organic and conventional farming (average 2013 - 2016)

Aphids	Oats cultivars			
	Kaloyan		Kehlibar	
	Organic	Conventional	Organic	Conventional
Sitobion avenae L.	+	+	+	+
Schizaphis graminum R o n d .	-	+	-	-

+ presence of aphids; - absence of aphids

avenae L.. *Schizaphis graminum* Rond. was only observed in conventional farming on cultivar Kaloyan (Table 2).

The population dynamics of aphids by years varied in dependence of the weather conditions. The abundant rainfall in the spring of 2015/16 severely reduced their population. With oats in conventional farming, the aphid population was higher in the three years, which was probably due to the nitrogen fertilization applied in this type of farming. In two out of the three studied years the density of aphids was higher for cultivar Kaloyan. With organically grown oats the aphid population number was lower, probably due to the presence of natural entomophagy, which developed there owing to the existence of more flowering weed vegetation and non-treatment with insecticides. In this type of farming, over the three years, aphid density was higher than on cultivar Kaloyan (Figure 5 and 6).

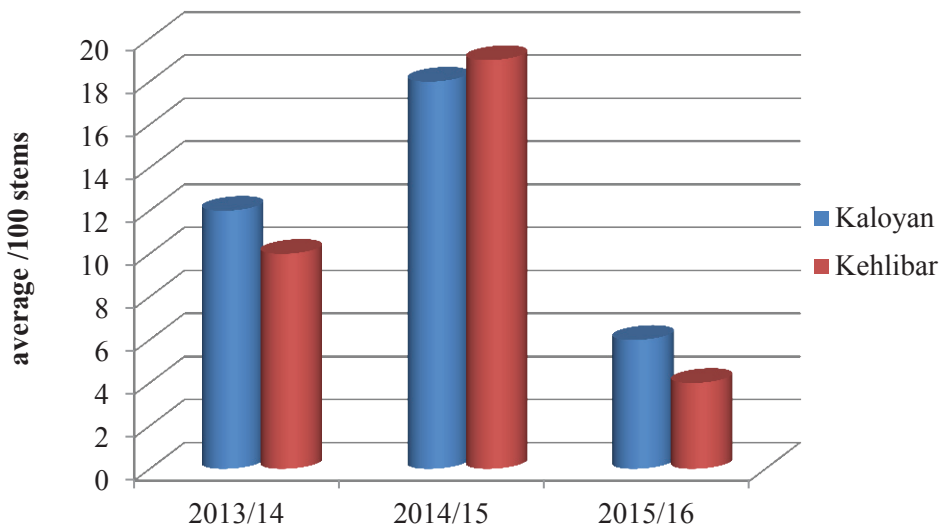

Figure 5. Population dynamics of aphids by years on oats in conventional farming, 2013-2016

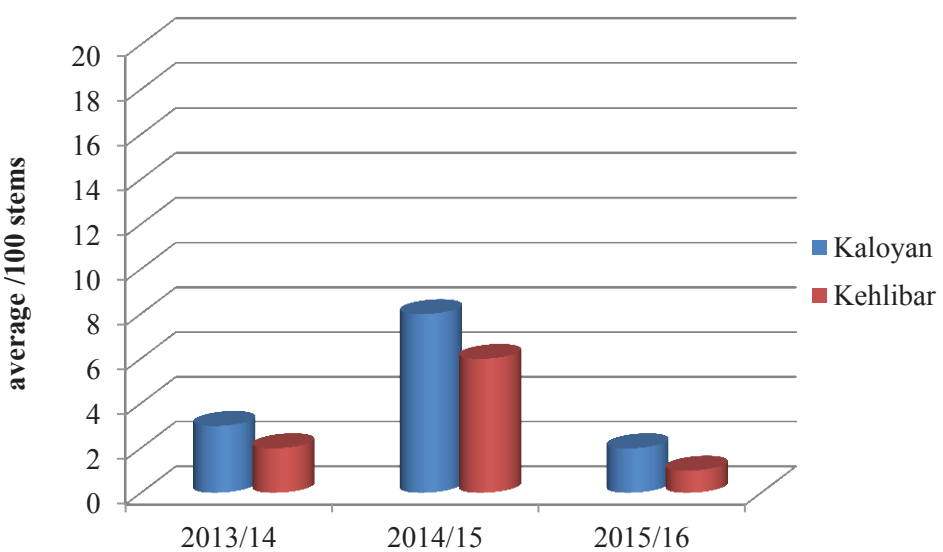

Figure 6. Population dynamics of aphids by years on oats in organic farming, 2013-2016

CONCLUSION

The level of weed infestation on winter oats in fields depends on the weather conditions of the year and genotypes of crops - in both conventional and organic farming, the lowest number of weeds per m^2 was reported for cultivar Kehlibar as compared to cultivar Kaloyan.

In conventional farming over the studied years, on both cultivars was observed infliction with *Puccinia coronate* var. *avenae*, and on cultivar Kaloyan the infestation was over 25%, whereas on cultivar Kehlibar it was under 25%. In organic farming on both oats cultivars were reported plants slightly inflicted with *Ustilago avenae*, which was due to the lack of decontamination of the seeds. The type of farming had a great impact on the disease infestation on winter oats.

In organic and conventional farming of oats, the most widely spread type of aphid was *Sitobion avenae L.. Schizaphis graminum Rond.* was only observed in conventional farming on cultivar Kaloyan. With organically grown oats the aphid population number was lower, probably due to the presence of natural entomophagy, which developed there owing to the existence of more flowering weed vegetation and non-treatment with insecticides.

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