Phytosanitary status of barley crops in two types farming

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

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Abstract

One of the major issues in the organic farming of cereals is the increase in weed, disease and pest infestation compared to conventional farming. The aim of this study was to compare the phytosanitary condition of the cultivars of barley grown in two types of farming systems – organic and conventional. This study was conducted in the period of 2013-2016 on medium strong, sandy-clay to light clay leached vertisols at the Institute of Agriculture in Karnobat, Bulgaria, on the certified field for organic farming and the experimental field for conventional farming. In the experiment were tested winter multi-row barley cultivars - Aheloy 2, Veslets, IZ Bory and Bozhin. Phytosanitary monitoring was carried out. In conventional farming of winter multi-row barley, no varietal difference was reported in the level of weed infestation. In organic farming, the varietal difference was well-expressed. The lowest level of weed infestation was observed with cultivar Veslets, and the highest – with the cultivar IZ Bory. In organic farming, for all the varieties of multi-row barley was reported the occurrence of Ustilago nuda, and the degree of infestation was under 10%. In conventional farming was observed higher degree of infestation of leaf diseases (Pyrenophora teres and Rhynchosporium secalis), than in organic. In conventional farming, higher density of aphids was reported for the cultivars IZ Bory and Bozhin. The lowest degree of infestation was reported for cultivar Veslets, followed by Aheloy. In organic farming, the tendency remains the same, and the degree of infestation over the years was much lower than in conventional farming.

Keywords: winter barley; phytosanitary status; organic and conventional farming

INTRODUCTION

One of the major issues in the organic farming of cereals is the increase in weed, disease and pest infestation compared to conventional farming. Chemical pest control just like in conventional farming is not allowed in organic farming. Numerous studies are being carried out to compare the density of pests, diseases and weed infestation on cereals in organic and conventional farming fields. Romero et.al. (2008) compared the impact of the farming system on weed diversity, structure and composition. They found that organic farming led to increase in the number of weeds and the diversity of species. Other studies showed that the increase in weeds is insignificant – 2 weeds more in the organic fields than in conventional ones (Hyvonen et al., 2003). A study by Albrecht (2005) showed that cultivated organic crops were beneficial to the weed diversity. In the studies of Moreby et al. (1994) in UK with winter wheat the number of weeds was higher in the organic fields than in the conventional ones, with three times more species when herbicides were not used. Herbicides diminished weed species richness in approximately 47 % and changed the species composition (Armengot et al., 2013). In South Germany, organic fields had five times higher plant species richness and about twenty times higher pollinator species richness compared to conventional fields. Abundance of pollinators was even more than one-hundred times higher on organic fields. The abundance of cereal aphids was five times lower in organic fields, while predator abundances were three times higher and predator-prey ratios twenty times

higher in organic fields, indicating a significantly higher potential for biological pest control in organic fields. (Krauss et al., 2011). Significantly, higher densities of nematoceran and acalypteran Diptera, Hemiptera (especially aphids), aphid-specific predators, parasitic Hymenoptera and cryptophagid and cantharid Coleoptera were found in conventionally grown fields (Moreby et al., 1994).

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

MATERIAL AND METHODS

This study was conducted in the period of 2013-2016 on medium strong, sandy-clay to light clay leached vertisols 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 was 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. In the experiment were tested winter multi-row barley cultivars - Aheloy 2, Veslets, IZ Bory and Bozhin, sowing by 450 germinated seeds/m^2. In conventional and organic farming the predecessor was peas-sunflower mixture. In conventional farming – barley`s seeds were treatment with triticonazole + prochloraz. During the vegetation were applied spiroxamin + tebuconazole + triadimenol. Nitrogen fertilizers (N_{10}) were applied in February. 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 method (weeds/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 favorable (Figure 1).

The lowest level of weed infestation in both organic and conventional farming of barley was in 2013/2014 vegetation year (Figure 2). This can be explained with the weather conditions.

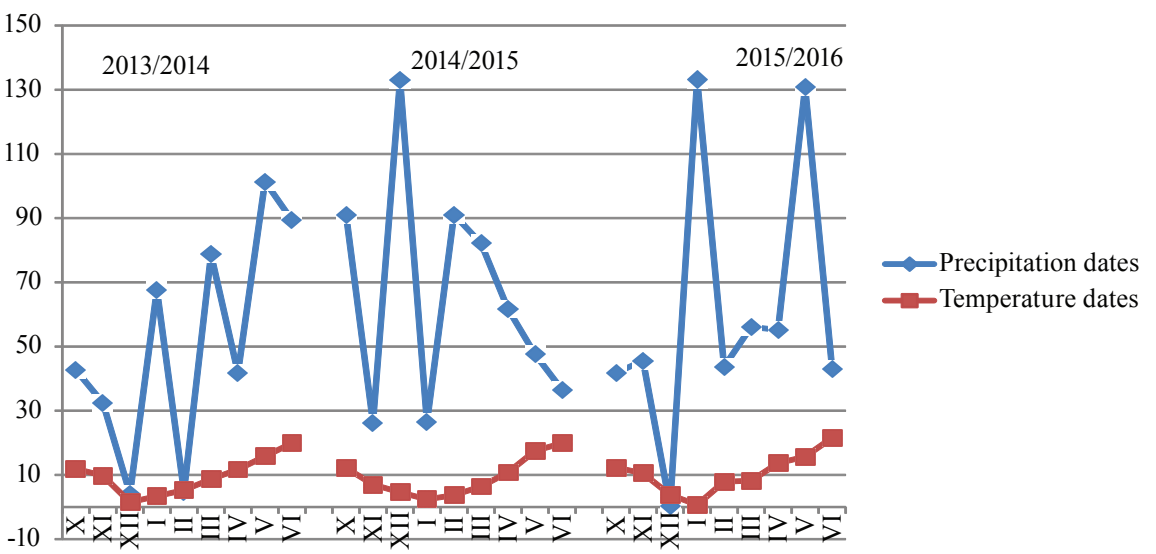

Figure 1. Average daily temperature (^{0}C) and precipitation (mm) dates in Karnobat

The following years were comparatively more humid and had better conditions for occurrence of weeds (Figures 3 and 4). In conventional farming, the lowest number of weeds per m^2 were reported for cultivars Veslets and Aheloy 2. In organic farming it was cultivar Veslets (17 weeds/m^2), and the

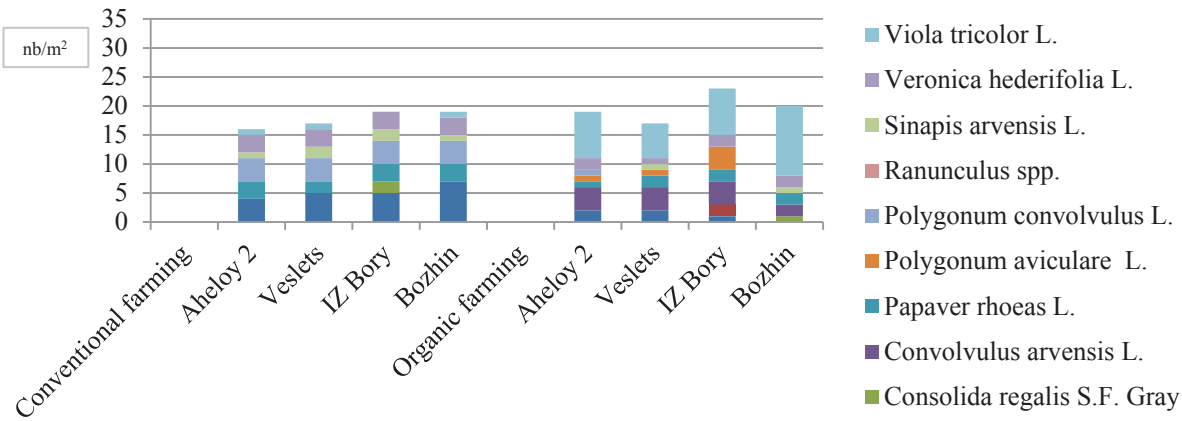

Figure 2. Weed infestation in two types farming barley, 2014 (nb/m^2)

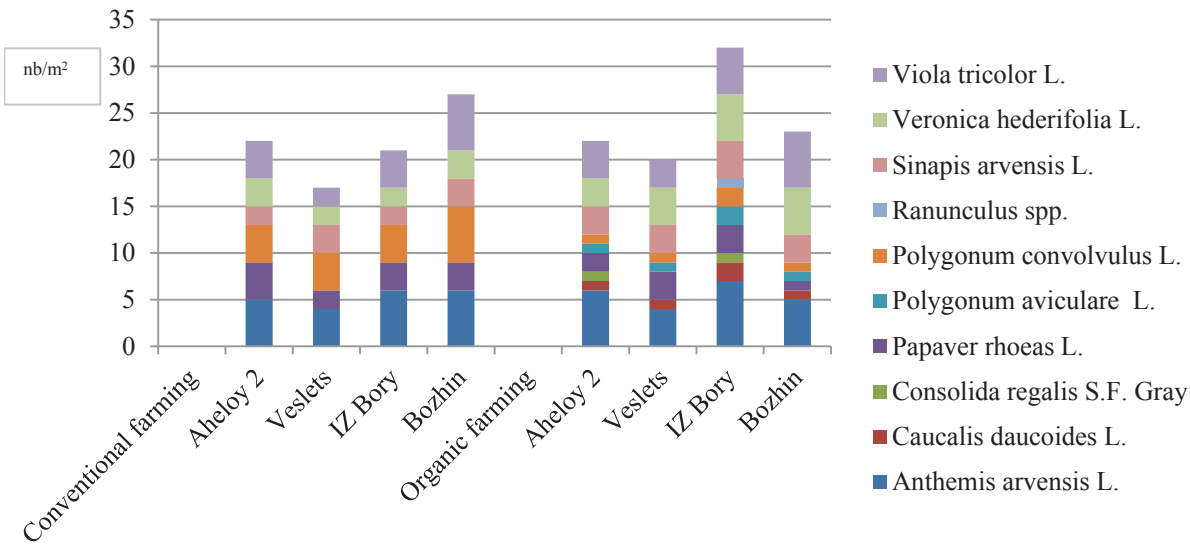

Figure 3. Weed infestation in two types farming barley, 2015 (nb/m^2)

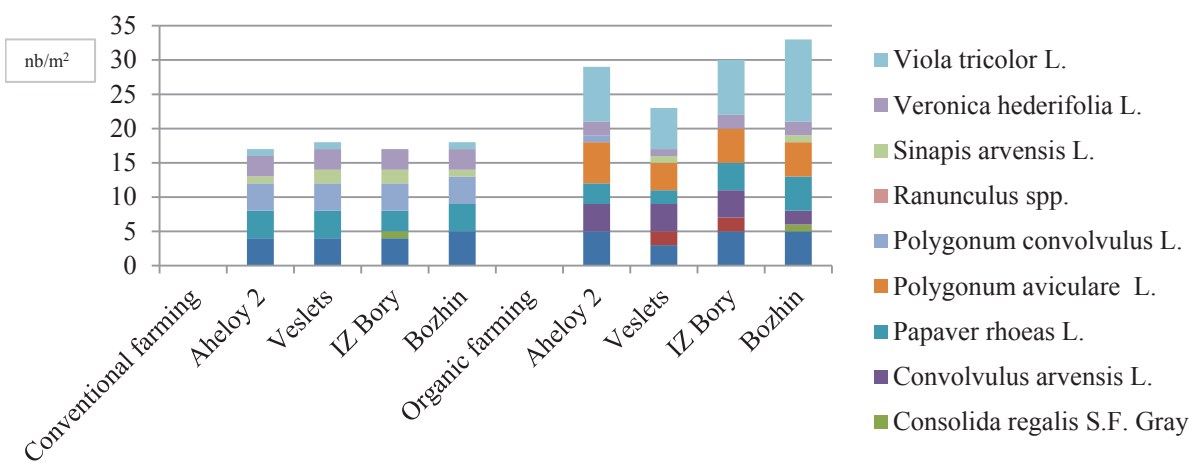

Figure 4. Weed infestation in two types farming barley, 2016 (nb/m^2)

highest number of weeds was reported for IZ Bory and Bozhin (up to 33 weeds/m^2). In the conventional farming of these barley cultivars, no difference in the level of weed infestation was reported. In organic farming, the varietal differences were clearly outlined. The lowest level of weed infestation was expressed by cultivar Veslets, and the highest by cultivar IZ Bory. This is due to the relationships between the morphological features of cereals varieties and their competitive ability against weeds (Cosser et al., 1997; Szewczyk, 2013).

In all cultivars of multi-row barley, in organic farming, was reported *Ustilago nuda*. This is probably due to the lack of seed decontamination in this farming system. The degree of infestation was under 10%. *Puccinia hordei* with density of under 10% was reported in organic farming only on cultivar IZ Bory, whereas with cultivar Bozhin the degree of infestation ranged from 10 to 25%. In conventional farming, the disease was found on all four cultivars, and it was under 10% with cultivars Veslets and Aheloy, with IZ Bory the degree of infestation was up to 25%, and with cultivar Bozhin – over 25%. *Pyrenophora teres* in organic farming of barley attacked cultivars Veslets and Aheloy at under 10%, and IZ Bory and Bozhin up to 25%. In conventional farming under 25% attacked cultivar Veslets, whereas the others had over 25% infestation. *Rhynchosporium secalis* was only observed in conventional farming, and the infestation on all cultivars was under 10%. The higher degree of infestation in conventional farming was probably due to the fact that the plants were grown with nitrogen fertilization, which is a precondition for a more severe disease infestation. Another factor was the better developed dense crops which created suitable microclimate for the development of some diseases (Table 1).

Aphids are some of the main, economically significant pests on barley. In organic farming, three species of aphids were mainly found attacking the barley cultivars. *Sitobion avenae L.* was the most widely distributed species and was observed with all the cultivars. *Rhopalosiphum maydis Fitch.* was

Table 1. Barley diseases in two types farming (average 2013 - 2016)

Diseases	Barley cultuvars							
	Veslets		Aheloy 2		IZ Bory		Bozhin	
	1*	2*	1	2	1	2	1	2
Ustilago nuda	+	-	+	-	+	-	+	-
Puccinia hordei	-	+	-	+	+	++	++	+++
Pyrenophora teres	+	++	+	+++	++	+++	++	+++
Rhynchosporium secalis	-	+	-	+	-	+	-	+

+ low attack rate - up to 10%; ++ average attack rate - 10 to 25%; +++ high fall - more than 25%.
*1- organic farming, 2-conventional farming

Table 2. Species composition of aphids in two types farming (average 2013 - 2016)

Species of aphids	Barley cultivars							
	Veslets		Aheloy 2		IZ Bory		Bozhin	
	1*	2*	1	2	1	2	1	2
Sitobion avenae L.	+	+	+	+	+	+	+	+
Schizaphis graminum Rond.	-	+	-	-	-	-	-	-
Rhopalosiphum maydis Fitch.	+	+	+	-	-	+	+	+
Rhopalosiphum padi L.	-	+	-	-	+	+	+	+

+ presence of aphids, - absence of aphids *1- organic farming, 2-conventional farming

reported for cultivar Veslets, Aheloy 2 and Bozhin. *Rhopalosiphum padi L.* was only observed on cultivars IZ Bory and Bozhin. In the conventional farming system, *Sitobion avenae L.* was again the most widely distributed species and was reported for four cultivars. *Schizaphis graminum R o n d*. E was only found on cultivar Veslets. *Rhopalosiphum maydis Fitch.* and *Rhopalosiphum padi L.* were reported on cultivars Veslets, IZ Bory and Bozhin (Table 2).

The population dynamics of aphids was reported and in conventional farming, higher density was observed with the cultivars IZ Bory and Bozhin. Cultivar Veslets was most weakly infested followed by Aheloy 2. This conclusion is corroborated by previous studies on the variety preferences of the aphids (Maneva, 2010; Maneva et al., 2018). In organic farming the tendency remained the same, and the degree of infestation over the years was much lower than in conventional farming. This is probably due to the occurrence of flowering weed vegetation in the organic field which is habitat for part of the beneficial entomofauna which regulates their density. Another factor which should probably be taken under consideration is the poorer unfertilized soil, where plants get tough earlier and are unsuitable for food for aphids. The difference in aphid density by years were due to the various weather conditions. The low density in 2015/2016 in both types of farming was due to the abundant rainfall in spring, which washed away a great part of the aphids (Figure 5 and 6).

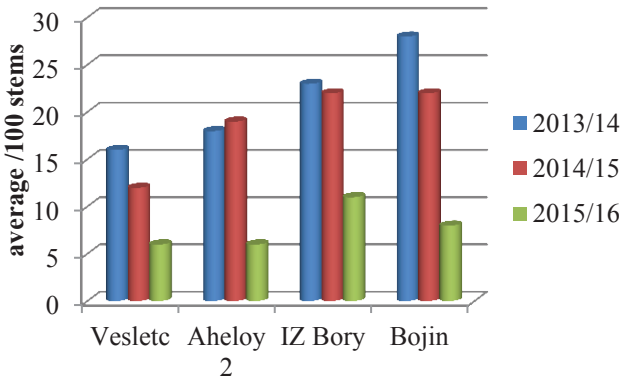

Figure 5. Population dynamics of aphids by years on multi-row barley grown in conventional farming

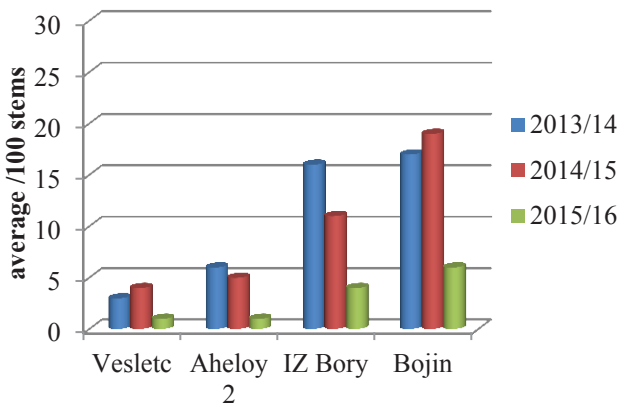

Figure 6. Population dynamics of aphids by years on multi-row barley grown in organic farming

CONCLUSION

In conventional farming of winter multi-row barley, no varietal difference was reported in the level of weed infestation. In organic farming, the varietal difference was well-expressed. The lowest level of weed infestation was observed with the cultivar Veslets, and the highest – with the cultivar IZ Bory.

In organic farming, for all the varieties of multi-row barley was reported the occurrence of *Ustilago nuda,* and the degree of infestation was under 10%. In conventional farming was observed higher degree of infestation of leaf diseases (*Pyrenophora teres* and *Rhynchosporium secalis*), than in organic. This is probably due to fact that the plants were grown with sufficient nitrogen fertilization and they developed good, dense crops which provided suitable microclimate for the development of some diseases.

In conventional farming, higher density of aphids was reported for the cultivars IZ Bory and Bozhin. The lowest degree of infestation was reported for cultivar Veslets, followed by Aheloy. In organic farming the tendency remains the same, and the degree of infestation over the years was much lower than in conventional farming.

REFERENCES

Armengot, L., José-María, L., Chamorro, L., & Sans, F. X. (2013). Weed harrowing in organically grown cereal crops avoids yield losses without reducing weed diversity. *Agronomy for sustainable development*, *33*(2), 405-411.

Albrecht, H. (2005). Development of arable weed seedbanks during the 6 years after the change from conventional to organic farming. *Weed Research*, *45*(5), 339-350.

Cosser, N. D., Gooding, M. J., Thompson, A. J., & Froud-William, R. J. (1997). Competitive ability and tolerance of organically grown wheat cultivars to natural weed infestations. *Annals of Applied Biology*, *130*(3), 523-535.

Council Regulation (EC) 834/2007 - http://data.europa.eu/eli/reg/2007/834/oj

Council Regulation (EC) 889/2008 - http://data.europa.eu/eli/reg/2008/889/oj

Hyvönen, T., Ketoja, E., Salonen, J., Jalli, H., & Tiainen, J. (2003). Weed species diversity and community composition in organic and conventional cropping of spring cereals. *Agriculture, Ecosystems & Environment*, *97*(1-3), 131-149.

Krauss, J., Gallenberger, I., & Steffan-Dewenter, I. (2011). Decreased functional diversity and biological pest control in conventional compared to organic crop fields. *PloS one*, *6*(5), e19502.

Maneva, V. (2010). Aphids (*Aphididae; Hemiptera*) on barley and possibilities for their control. PhD Thesis. Plovdiv.

Maneva, V., Dimova, D., & Atanasova. D. (2018). Screening of barley varieties for resistance to Sitobion avenae (F.) and Rhopalosiphum padi (L.) *Field Crops Studies*, *11*(2), 251-260.

Moreby, S. J., Aebischer, N. J., Southway, S. E., & Sotherton, N. W. (1994). A comparison of the flora and arthropod fauna of organically and conventionally grown winter wheat in southern England. *Annals of applied Biology*, *125*(1), 13-27.

Regulation (BG) 5/2018 - https://biocertification.eu/wp-content/uploads/2018/%D0%9D%D0%B0%D1%80%D0%B5%D0%B4%D0%B1%D0%B0%20%E2%84%96%205%20%D0%BE%D1%82%2003.09.2018.pdf

Romero, A., Chamorro, L., & Sans, F. X. (2008). Weed diversity in crop edges and inner fields of organic and conventional dryland winter cereal crops in NE Spain. *Agriculture, Ecosystems & Environment*, *124*(1-2), 97-104.

Szewczyk, B. F. (2013). The influence of morphological features of spelt wheat (Triticum aestivum ssp spelta) and common wheat (Triticum aestivum ssp vulgare) varieties on the competitiveness against weeds in organic farming system. *J Food Agric Environ*, *11*, 416-421.