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Chapter 13

THE IMPACT OF CLIMATE CHANGE ON DISEASES AND PESTS OF SMALL GRAINS AND SUNFLOWERS IN THE VOJVODINA REGION (SERBIA)

***R. Jevtić*[1,*], *S. Maširević*[2] and *D. Vajgand*[3]**
[1]Small Grains Department, Institute of Field and Vegetable Crops, Novi Sad, Serbia
[2]Department for Phytomedicine and Environmental Protection, Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia
[3]Agroprotekt, Sombor, Serbia

ABSTRACT

The risk of disease and pest damage to agricultural crops has increased significantly as a result of climatic changes. The climatic change has resulted in the dominance of pathogens that require higher temperatures for their development or are better able to adapt to drought conditions. This is the reason why the fungal diseases of the genus *Fusarium* and *Septoria* spp. that affect small grains have played a dominant role in causing significant damage and why the causal agents of sunflower spots develop very well and rapidly at high temperatures. The diseased plants may suffer from complete defoliation and premature ripening. Fungi of the genus *Alternaria* are favored by high temperatures accompanied by a short period of wet weather. The parasite develops best and most rapidly at temperatures between 20 and 30 °C.

During the 2009 - 2010 growing season, there was a significant *Fusarium* infestation on wheat, barley and triticale in the Vojvodina region (Serbia). In the locality of Rimski Šančevi near Novi Sad, the percentage of *Fusarium*-damaged kernels in some commercial fields (the spring-planted variety Natasha) reached up to 33.3 % per m^2. In the same growing season and locality, the levels of deoxynivalenol (DON) in cereal samples were very high.

The effectiveness of the *Pm* resistance genes is correlated with the air temperature conditions. During the 1990 - 2009 period, numerous genotypes had the V7, V6 and V8

* Corresponding author: E-mail address: radivoje.jevtic@ifvcns.ns.ac.rs; Phone: +381 21 489 8207. Fax: +381 21 489 8222.

virulence alleles. The most efficient among the sexual populations of the parasite was the gene combination Pm5+6 from the variety Coker 983. Compared with the previous period, the rust (*Puccinia* spp.) pathogens have recently formed fewer generations and have transitioned quickly from the uredo to the teleuto stage, which is a direct result of the climate change impact.

Orobanche cumana is a serious problem in sunflowers. Since the 1990s, broomrape has caused significant damage to the susceptible hybrids in Serbia. In the north of the Bačka region alone, 15 000 ha have been endangered. The yield losses depend on the intensity of the attack and can range from 5 to 100 %.

Besides having a great impact on pathogens, the climate change also influences pests. Moths are insects and thus do not have a constant body temperature. The speed of their development is directly correlated to the air temperature. Increasing temperature leads to changes in the cycle of development and the diversity of the individual species. A species that we can safely say has become dominant due to the increase in air temperature is the cotton bollworm (*Helicoverpa armigera*). In years with mass outbreaks of the cotton bollworm in the north of Vojvodina, 60 to 100 % of maize ears and sunflower heads and 20 to 94 % of string bean pods were reportedly damaged.

1. INTRODUCTION

Climate change not only influences cultivated plants, but it can also cause changes in the development of parasitic organisms. Climate change also influences the resistance of the plant hosts and leads to the modification of host-pathogen interactions. The most frequent effects are changes to the geographic distribution of the pest organisms, namely the appearance of thermophilic species in moderate climate zones, which could endanger efficient control of the pests. In the absence of barriers, it may be possible for a species or for communities to migrate in response to the changing conditions. Vegetation zones may move towards higher latitudes or higher altitudes following shifts in mean air temperatures. The movements will be more pronounced at higher latitudes, where the temperatures further from the equator are expected to increase. In the mid-latitude regions (45 to 60°), the present temperature zones could shift by 150 - 550 km [1]. There will be a northward expansion of warmer-season seed crops (e.g., soybean and sunflower) [2]. On the other hand, the yield of spring crops, most importantly sunflowers, will prospectively decrease in Central and South Europe [3]. The pathogens that are normally less aggressive in natural plant communities could devastate the crop monocultures that grow in close proximity [4]. The occurrence of new diseases, pests and weeds is a direct consequence of the climate changes in Austria, Italy, Greece, Poland, Russia and Serbia [5]. In the Vojvodina region (Serbia), the climatic changes have increased the incidence of small-grain pathogens and influenced their prevalence, adaptability and development cycle. The pathogen control principles used so far have shown weaknesses in certain areas, indicating a need for new research methods under the new set of circumstances.

The keystone factor in determining the rate of physiological development in sunflowers is the accumulated air temperature (mean daily air temperature over 6 °C). The projections from the UKCIP02-United Kingdom Climate Impact Programme [6] data indicate that the area suitable for sunflower production will increase to approximately 79 % of the land in England by 2050. There will be a substantial increase in the number of varieties that will be suitable for use in the United Kingdom. Rainfall levels will decrease, but these conditions will favor the drought-tolerant sunflower [6]. The climate change implicates the shifts in sunflower