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STUDIES REGARDING THE DENSITY DYNAMICS OF *AVENA FATUA* WEED SPECIES ON WHEAT CULTIVATED IN MONOCULTURE (2 AND 3 YEARS) AND IN THE WHEAT–RAPE CROP ROTATION ON BURNAS PLATFORM (ALEXANDRIA)

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Abstract

Until 1995, the Avena fatua (odos) wasn't even known as a weed in Burnas Plain wheat crop. Starting with the beginning of the first decade of the millennium, also fostered by the climate change process, Avena fatua has been slowly, but surely, installed in the area. By 2010 it reached almost 50 plants/m^2 on wheat after wheat and about 90 plants/m^2 in 3 years wheat monoculture. Over the past three years, the specie's density has logarithmically increased up to 600 plants/m^2 on wheat after wheat and to almost 900 plants/m^2 in 3 years wheat monoculture. The surfaces identified by us have exceeded 1500 ha, while the yield losses reach up to 100%. In these conditions, the rape-wheat simple crop rotation reduces weed infestation and keeps it slightly variable between 5-10 plants/m^2, well below the economic threshold of tolerance. At the same time, substantive amendments in weed's biology and ecology were observed, it becoming therophytes - hemitherophytes due to climate change. Can talk about a weed infestation of the crop with biannual and annual forms. Between all the chemical methods used so far, very good results were obtained with the Pallas 75 WG product, at a dose of 150 g/ha, even without safener.

Key words**:** *Avena fatua, Burnas Plaini, control, density, weed infestation*

INTRODUCTION

The registered increase of *A. fatua* species in the Romanian territory occured in several stages. It was brought from the Central and Northern parts of the country once with the migration process – of combines, as well as of seeds. In the middle of Transylvania the studied weed lies there for more than 50 years, its number and mass easily competing plants like wheat, barley etc. Depending on the soil and climate conditions, but also on the crop, the competition index ranges between 0.35-0.45, being 1.8 times more competing than *Apera spica-venti*, with whom practically shares the same attack area [5][6].

In the South part of the country, in terms of very long dry autumns, followed by mild winters, the weed finds the best conditions for growth and multiplication. Such a situation was registered in the agricultural year 2012-2013, but also in 2010-2011.

Some studies previously performed on soils from the center of Transylvania show that, in normal years, to weed infestation with *A. fatua* in 4 years wheat monoculture are found 430 plants/m^2 [4][7]. A simple crop rotation of 2 years (wheat – maize) has reduced the weed infestation by 55%, a triple one (wheat – maize – soya) by 80%, and a 4 year crop rotation (wheat – maize – soya – sunflower) by 95%, placing it significantly below the pest threshold.

According to our estimations, as well as of those made with Corlaus and Nagy (1980) [8], the economic damage threshold of *A. fatua* varies, for wheat, between 8-18 plants/m^2.

Researches regarding the *A. fatua* weed biology of, but also of its effects, were conducted at the Tg. Mures, Turda, Suceava, and Livada experimental stations [8][7]. Each time the results proved to be different from one zone to another. The results were published in different editions of the INCDA Fundulea Annals.

In the LXXV Volume, anniversary volume, Alexandrina Popescu [1] makes a synthesis regarding the *A. fatua* control, indicating as main efficient herbicides the mixtures of Icedin Forte with Avadex BW, with Tolkan S., Avenge, Suffix BW, Mataven and Illoxan, with yield increases of 440-840 kg/ha, but only for densities of *Avena* species that haven't exceeded 280-380 plants/m^2.

Returning to the biology and ecology of the species, we emphasize that from an ecological point of view it is "xeromesophyll – mesophyll, eurythermophilic, low acidic - neutrophil" [3]. The Weed Atlas, published in 2002 [3], doesn't finds the species in the Alexandria region other than sporadic and most often as ruderal plant. In the biology of the species happened events that have changed both its biology and its ecology.

The seed movement and the species multiplication facility are favored by a pappus of piliferous, particularly placed at the base of the seed, while in some thermophilic ecological forms they extend over the entire surface of the seed (Fig. 1).

Fig. 1. Different seeds of *Avena fatua*, originated from different ecological zones in The United States territory (Source: USDA) [9]

MATERIALS AND METHODS

Object of research: analyzing ecological explosion of *Avena fatua* species in Burnas Plain – causes, damage and protection measures for cereal crops (wheat, in particular).

Aim of the research: the establishment of new biological and ecological parameters encountered by *Avena fatua* in Burnas Plain and the design of some researches on avoiding damages.

The research work was done directly in the sowing field, where plots were demarcated in 4 repetitions for each variant.

The following versions were used:

1. Wheat after rape (W.R.);
2. Wheat after wheat (W.W.), 2 years monoculture;
3. Wheat after wheat, after wheat (W.W.W.), 3 years monoculture.

Weed density determinations were carried out from 5 to 5 years, from 1995 to 2010, after which they were performed annually due to the increased intensity of their density. The result was a number of measurements of 7 * 4 * 3 = 84.

The main tracked parameters were:

a) Number of weeds/m^2 (density);
b) Changes in biological and ecological characteristics of the species;
c) Possibilities of weed combat using agrotechnical and chemical methods.

Data collected have been interpreted using the statistical calculation of dispersional analysis, the "student" distribution version, as well as model calculations of correlation analysis in 2D and 3D.

The results are presented in the form of graphs and tables.

RESULTS AND DISCUSSIONS

Although the studies continues, we are able to specify that the weed has particularly changed its ecological characteristics and, potentially, some of the biological ones.

Biological form of *Avena fatua* is therophytes [3]. That means that it is a spring annual plant, which multiplies by seed. Otherwise, this should also be the form of hibernation. Normally, it can't pass the winter in the form of a plant, as it happens with most of the winter crops.

From our observations we noticed that, especially in years with long autumns and mild winters, such as 2010-2011 and 2012-2013, the plant becomes hemitherophyte or therophyte – hemitherophyte. It is an ecological modification that, at least in the

recent years, transformed the plant from an annual to a biannual one. Long and sometimes wet autumns (toward winter) forces *Avena fatua* to germinate from autumn (Ist year) and, because of warm winters, to bear well this period of time, entering into the 2nd year of life, when it completes the cycle and throws its seeds.

The species transformation into a one even potentially hemitherophyte explaines, in fact, its great capacity for multiplication. Vigorous growth in autumn, which is completed with spring emergence, forms a chain of annual and biannual plants that completely stops the wheat growth (Fig. 2). The thermic conditions are more favorable than those in Central Transylvania and the acido-neutral soil helps to the favorable ecological characteristics completion [2][7].

Fig. 2. Wheat field compromised by *Avena fatua* (author's photo, Alexandria – 09.05.2013)

1st variant. The density dynamics of *Avena fatua* on wheat in R.G. rotation demonstrates that in the early years (1995) on wheat after rape *Avena fatua* was very difficult to find, in 2000 we see that it reached to over 2 plants/m^2, in the next five years it has doubled, reaching nearly 5 plants/m^2, so that for the period 2010-2013 to have a logarithmic growth, but on small areas (under 12 plants/m^2) – Fig. 3.

The calculated dynamics, although it is a complicated function, it is accompanied by a correlation ratio of less than 0.5, ie the possibility of repeating this equation is less than 50%. The density game being carried out under 12 plants/m^2, it is found in the technical-economic non-damage limits and, in conclusion, wheat after rape doens't require treatments.

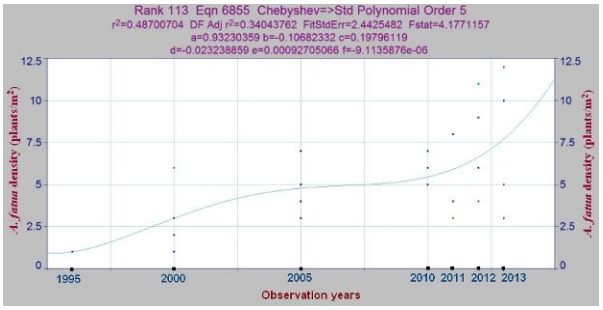

Fig. 3. The *Avena fatua* density dynamics on wheat after rape – W.R. system (1995-2013) in Alexandria

2nd variant. Wheat is cultivated after wheat (Fig. 4). The density dynamics shows that in the first 10 years of observations the *A. fatua* density remained in the tolerance thresholds, but then, in the years 2005-2013, has grown exponentially, in 2013 reaching to 600 plants/m^2. In this case wheat was muffled and 100% compromised (also see Fig. 5).

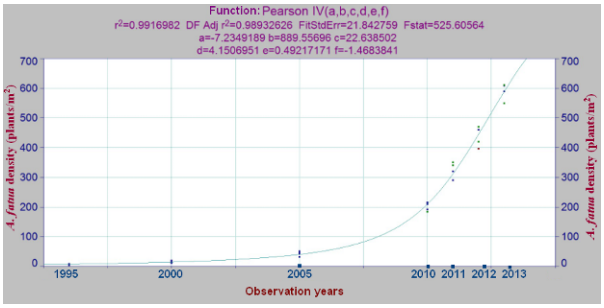

Fig. 4. The *Avena fatua* density dynamics on wheat after wheat - W.W. system (1995-2013) in Alexandria

Fig. 5. Lower density of *Avena fatua* (460 plants/m^2), but very dangerous (author's photo, Alexandria 2013)

3rd variant. Wheat is cultivated three years in a row, in monoculture (Fig. 6).
In the first 10 years the graphical form of the function is similar to the one from Variant 2, with the specification that the density values are somewhat higher.

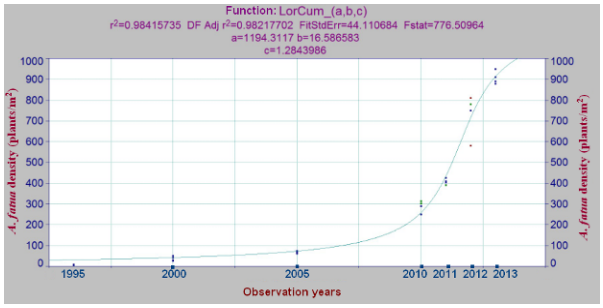

Fig. 6. The *Avena fatua* density dynamics on wheat after wheat, after wheat – W.W.W. system (1995-2013) in Alexandria

However, starting from 2010 the increase is explosive, easily reaching over 900 plants/m^2 (Fig. 7).

Fig. 7. Untreated field, with 870 plants/m^2 (author's photo, Alexandria 2013)

Fig. 8. Atrium wheat field treated with Pallas WG in autumn 2012 ⇒ 98% combat (Alexandria 2013)

It is obvious that, without chemical intervention in these conditions no crop is no longer possible. By doing the treatment with Pallas WG 150 g/ha it was obtained wheat like the one in Fig. 8.
In Fig. 9 is presented the model in 3D of the *Avena fatua* density dynamics according to the 3 working variants.

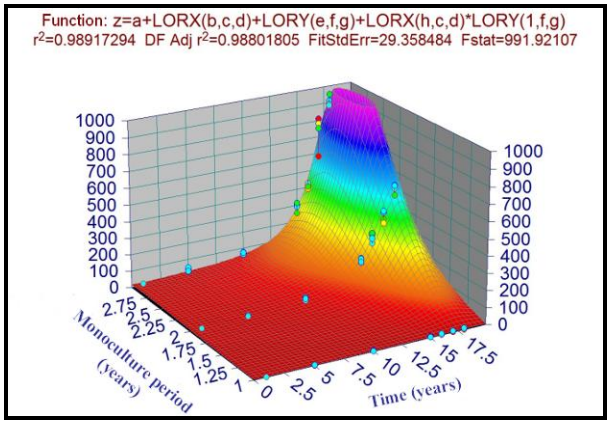

Fig. 9. The density dynamics (1995-2013) of *Avena fatua* plants depending on the length of wheat monoculture
x = time, in years
y = monoculture length
z = *Avena fatua* plant density

z = f (x * y), LOR type function

The model indicates a low agitation of the density during the first 10 years of observations, but a very agitated one afterwards. In the first 5-10 years of observation the density rarely exceeded the economic pest threshold, but thereafter the 3 years monoculture it produced a 50% higher density, leaving no chance to the wheat yield.
In Fig. 10 it can be observed that in the W.W.W. untreated system rarely appears a wheat plant.

Fig. 10. High density of *Avena fatua*, compromised field (original, Alexandria 2013)

Chemical treatments

For wheat monoculture chemical control it has been chosen the product Pallas 75 WG (Dow Agrosciences), that contains 7,5% pyroxsulam and 7,5% a cloquintocet-methyl safener (adjuvant).

In contrast to other research and taking into account the previously facts, the treatments were carried out in autumn, after the rains from the end of October, at a dose of 150 g/ha + adjuvant.

No other treatments were done in the spring.

The results concerning the reduction degree in weed infestation are presented in Table 1.

Table 1. The combat degree of the *Avena fatua* species with the product Pallas 75 WG in 2012-2013, on wheat crop in Alexandria (Astardo variety, chernozem soil with 34% clay, autumn treatment)

	2 years monoculture density		**3 years monoculture density**		**Crop rotation rape/wheat density**	
	No.	%	No.	%	No.	%
Untreated	550	100	890	100	5	100
Treated	5	0,9	7	0,8	0,5	10

In Fig. 11 are presented, in comparison, a plot treated with Pallas 75 WG (left) and an untreated plot (right).

Fig. 11. The difference between the untreated control version (right) and treated with Pallas 75 WG (left) (original photo, Alexandria 2013)

It follows that the wheat had no chance against this high density, doubled by the extremely vigorous bio-ecological form of the weed (Fig. 12).

Fig. 12. Bio-ecological form highly vigorous photosynthetic and mesophilic (a, b) of *Avena fatua* in 2013 (original, Alexandria 2013)

CONCLUSIONS

In the past 3-4 years in the Plain Burnas has appeared an extremely vigorous form of *Avena fatua*, this having a hemitherophyte and partial therophyte biological form. The biannually form of this new biological construction gives to the weed an increased force of competition, both as density, as well as like vigour.

The registered densities have been of 600 plants/m^2 on wheat after wheat, of 900 plants/m^2 on wheat – wheat – wheat system and of only 5 plants/m^2 on wheat after rape. At least 60% of the hemitherophyte fructified at W.W., while at W.W.W. this percentage was of 50%.

As a previous plant, rape has an excellent ability to control the weed without any other investment in synthesis chemistry.

The Pallas 75 WG herbicide at a dose of 150 g/ha + safener had an efficiency of about 99% in weed control, that if the treatment was carried out in autumn, in the middle of weed's vegetative growth.

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