www.incda-fundulea.ro; doi.org/10.59665/rar4136 First Online: February, 2024. DII 2067-5720 RAR 2024-72

Study of the Influence of Cultivar and Biological Seed Category on Winter Wheat Production

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ABSTRACT

Wheat is one of the most cultivated agricultural species alongside corn and rice. In this study, we tested the influence of cultivars and seed biological class on yield in winter wheat. As a comparison, we used two Romanian varieties, Dropia and Faur, and two foreign varieties, Apache and Bercy in field-testing under normal agronomical practices. Data obtained in field trails was statistically processed by Duncan test for multiple comparisons between tested variants. Results indicate that yield decreases according to the seed biological class. Furthermore, the analysis of the distribution of significance differences in production, it resulted that both the cultivar and the biological category of the seeds act individually and combined on the average yields of winter wheat. Since the assortment of varieties in winter wheat is one that is renewed every year, and as a result of the fact that farmers have the option of multiplying the seed of autogamous varieties for their own use, we believe that the obtained results can be useful in evaluating the productive potential of winter wheat crops sown with seed from certified generations C1 and C2 or from subsequent generations of multiplication, which are not subject to the official certification process.

Keywords: certified seed, non-certified seed, seed production, winter wheat.

INTRODUCTION

Due to its agricultural and economic importance (Byrne, 2020), its suitability for autumn sowing in temperate climates, wheat is the most cultivated agricultural species (Venske et al., 2019; Erenstein et al., 2022).

According to the annual statistics for the period 2018-2022 of the European Seed Certification Agencies Association (ESCAA), Romania ranks seventh out of ten among EU countries in terms of areas cultivated with seed lots, after France, Italy, Spain, Germany, Poland and Denmark. In the EU as a whole, common wheat (*Triticum aestivum* L., ssp. *vulgare*) is the species that competes for first place in terms of area cultivated with seed lots with the complex group of fodder and lawn species (escaa.org). With the exception of 2019, in the period 2018-2022, Romania was the leader of the ranking in the quantities of certified seeds in EU, the average of the years 2018-2022 being 336,282 tons (escaa.org).

Most of the research related to the impact of some technological or environmental factors in the field of wheat seed production reported in Romania were carried out at National Research and Development Institute for Agriculture (NARDI) Fundulea (Păcurar et al., 2007), on some cultivars that are only partially current.

More recent researches on the contribution of the biological category of the seeds in achieving the yield potential of some winter wheat cultivars (Egesel et al., 2012; Szabo, 2015; Guţă and Marin, 2020), demonstrated that, compared to the biological category Basic (B) and under optimal technology conditions, production decreases at the lower biological categories are very significant in all varieties, with proportions between 6% in the Certified I and 13.2% in the Certified II categories.

Although it is recognized that the productivity and stability of a cultivar largely depends on the correct and constant application of conservative selection in the

Received 30 November 2023; accepted 19 February 2024.

seed lots (Haș, 2006; Zaman et al., 2007), often farmers do not know closely the genetic structure of the cultivars they it multiplies them, which can lead to negative effects on production.

By not knowing the information about the genetic structure of the wheat cultivars, as well as by growing them in environmental conditions different from those in which they were improved and tested, disturbing factors can be activated in a relatively short time, of only a few years of genetic balance such as natural selection, cultural selection or delayed segregations (Haș, 2006; Cordea, 2008). Edwards (2017), after a study during the years 2003-2005 in multiple locations, found that the seeds multiplied by farmers for their own use and that no longer go through the certification process can lead to reductions in wheat grain yield of about 15 %, especially in those situations where the conditioning of the seeds was either absent or was performed improperly. Studies on the same topic mention decreases in wheat seed production between 10.3% in Kazakhstan (Baglan et al., 2020) and 19.6% in Turkey (Tanrivermis et al., 2007).

In addition to productivity, the biological purity of a cultivar can be affected to a high extent, in the absence of appropriate measures to avoid mechanical mixing of seeds from different varieties harvested in the same season on a farm.

MATERIAL AND METHODS

The biological material tested was represented by four cultivars of winter wheat. Two varieties, Dropia and Faur are indigenous, the Apache is a variety from France and Bercy of Dutch origin. For each cultivar, five biological categories of seed were tested, namely two generations of certified seed (C1 and C2) and three successive generations resulting from repeated propagation (C3, C4 and C5).

The testing was carried out in a farm of the SC Interagroaliment SRL company, Bacău County, during 2010-2011, according to the method of subdivided plots, in three repetitions. The sown surface of the experimental plot was 6.3 sqm, and the harvestable surface resulting from lateral removals was 5 sqm. Fertilization and maintenance work were carried out as in the production crop. The production data were statistically processed through variance analysis, and the multiple comparisons test (Duncan's test) was used to determine the significance of the production differences between the experimental variants.

RESULTS AND DISCUSSION

The two experimental factors caused a diverse range of differences in wheat production, both through the separate action of each factor and due to their interaction (Table 1).

Table 1. Influence of cultivar and seed biological class on yield in winter wheat (t/ha)

Experimental factors	B (Biological category of seed)					
A (Cultivar)	Certified C_1 (b_1)	Certified C_2 (b_2)	Uncertified C_3 (b_3)	Uncertified C_4 (b_4)	Uncertified C_5 (b_5)	Average factor A
Dropia (a_1)	$5,617^{de}$	$5,633^{d}$	$5,650^{d}$	$5,633^{d}$	$5,400^{hi}$	$5,587^{B}$
Faur (a_2)	$5,577^{defg}$	$5,570^{defg}$	$5,483^{fgh}$	$5,427^{hi}$	$5,320^{i}$	$5,475^{C}$
Apache (a_3)	$5,893^{bc}$	$5,860^{c}$	$5,600^{def}$	$5,593^{defg}$	$5,383^{hi}$	$5,666^{A}$
Bercy (a_4)	$6,067^{a}$	$5,980^{ab}$	$5,497^{efgh}$	$5,473^{gh}$	$5,383^{hi}$	$5,680^{A}$
Average factor B	$5,788^{M}$	$5,761^{M}$	$5,558^{N}$	$5,532^{N}$	$5,372^{O}$	-

DS 5% for two cultivar mean values = 0,030-0,032 t/ha;
DS 5% for two average values of the seed biological category = 0,054-0,058 t/ha;
DS 5% for two mean values of the interaction cultivar x biological category of seed = 0,107-0,129 t/ha.

The influence of the cultivar on the production was manifested by significant differences between the varieties tested. The highest production, of 5.68 t/ha, was obtained in the Bercy variety (Figure 1), closely followed by the Apache variety, with a non-significant difference between the two cultivars. The local cultivars Faur and Dropia recorded significant differences in production, both among themselves and compared to the two foreign cultivars.

Regarding the influence of the biological category of seed on the production, the highest value, of 5.79 t/ha (Figure 2), resulted in the case of the first category of certified seed (C1).

Between the close biological categories C1 and C2, as well as between the biological categories C3 and C4, the differences in production were non-significant. The fifth generation of multiplication (C5) stands out for significant production decreases compared to the other two groups (C1-C2 and C3-C4). Overall, it turned out that between the biological categories separated by more than one generation and with the increase in the number of multiplication generations, yields drop significantly.

The analysis of the interaction between the cultivar and the biological category of the seed (Figure 3) revealed significant differences in production that can be distributed in three significantly different groups from each other. Thus, in the Dropia and Faur varieties, two significantly different groups resulted (group C1-C4 and group C5), in the Apache variety three significantly different groups resulted (group C1-C2, group C3-C4 and group C5), and in the case of the Bercy variety, two significantly different groups resulted (group C1-C2 and group C3-C5).

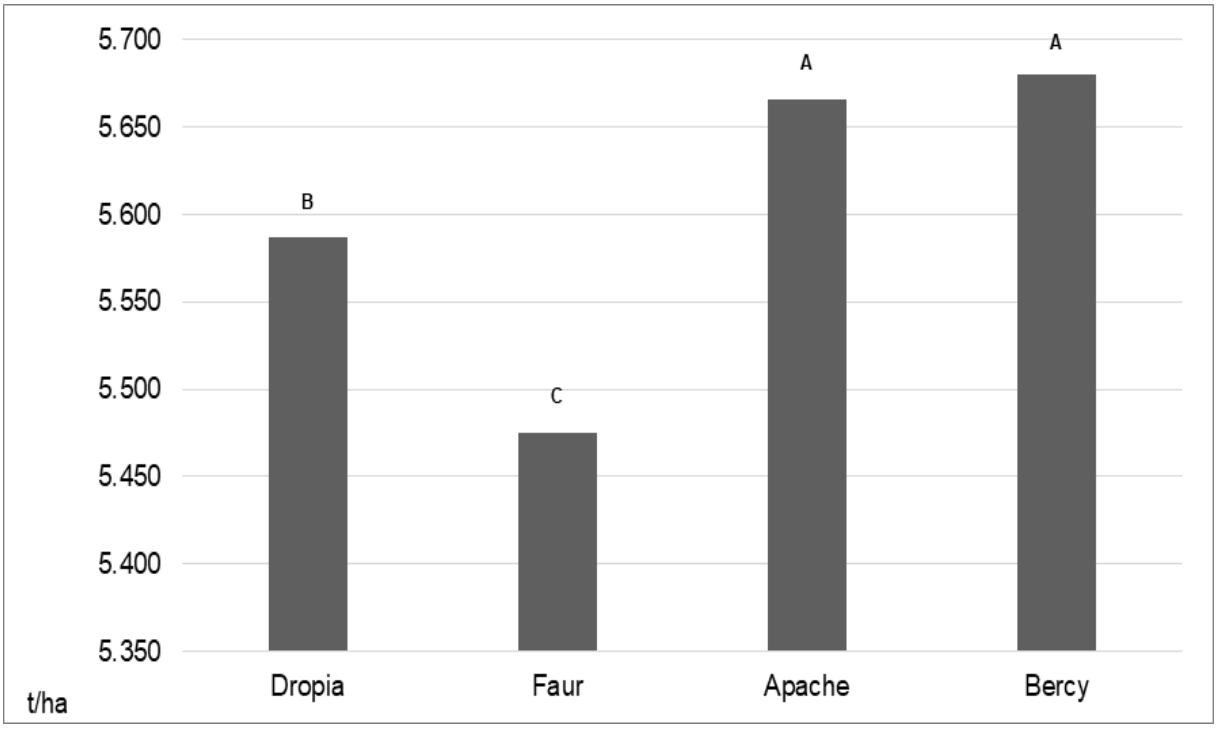

Figure 1. The cultivar influence on yield of winter wheat. Significance between genotypes was determined by Duncan's Multiple Range Test (DMRT). Similar alphabets (A,B,C) denotes no significance at $P<0.05$. Each value represents Mean ±SE of three biological replicates (n=3).

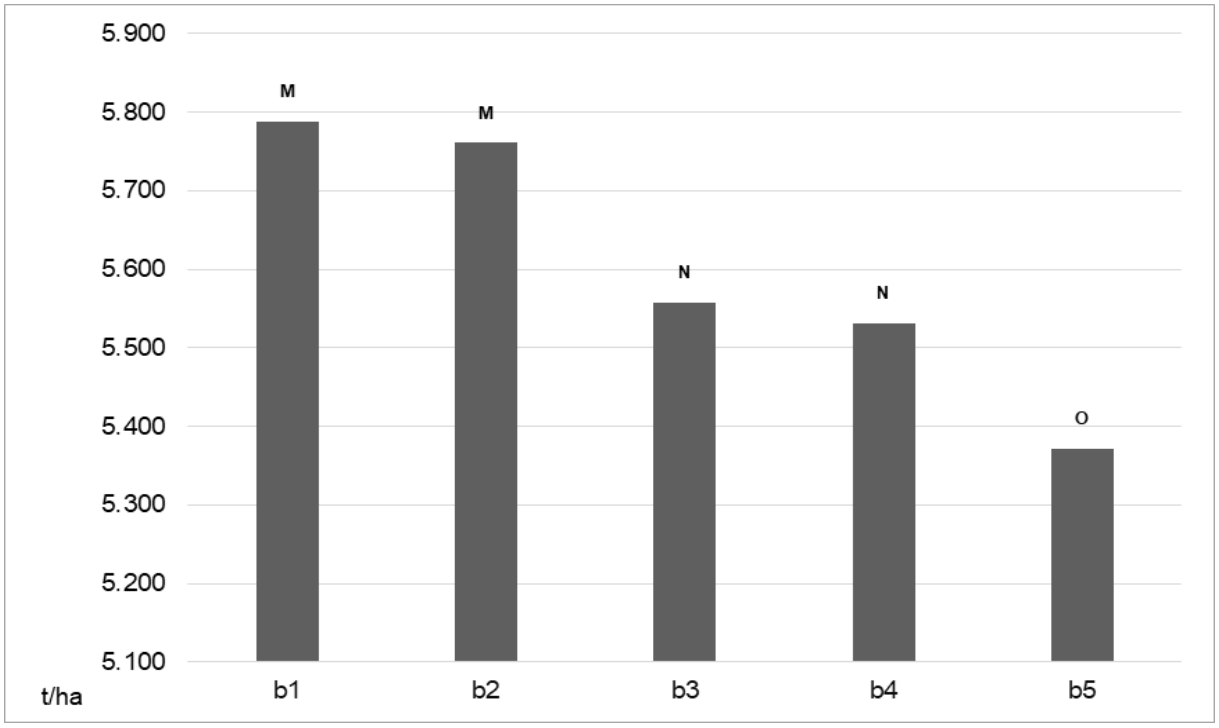

Figure 2. The influence of biological categories of seeds on yield of winter wheat. Significance between biological categories was determined by Duncan's Multiple Range Test (DMRT). Similar alphabets (M,N,O) denotes no significance at P<0.05. Each value represents Mean ±SE of three biological replicates (n=3).

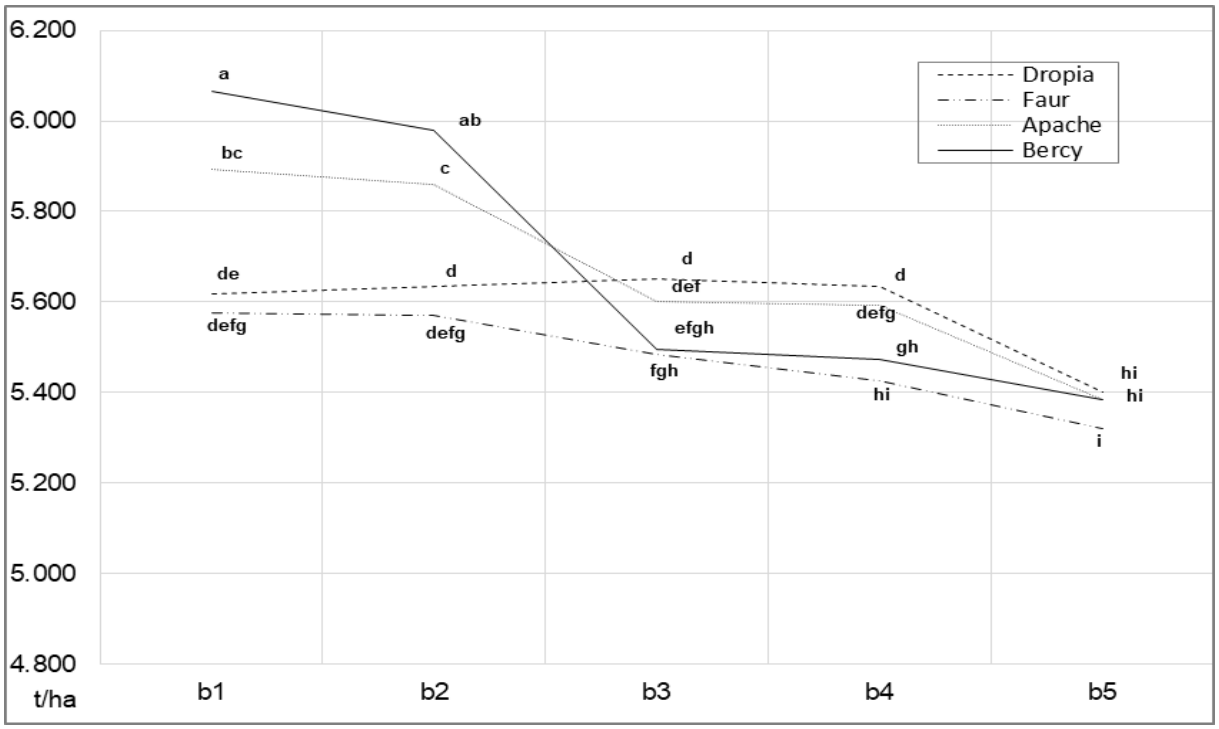

Figure 3. The influence of the interaction between the cultivar and the biological category of the seed on the yield of winter wheat. Significance between different variants of the interactions genotype x biological category of seed was determined by Duncan's Multiple Range Test (DMRT). Similar alphabets (a,b,c,d,e,f,g,h,i) denotes no significance at P<0.05. Each value represents Mean ±SE of three biological replicates (n=3).

CONCLUSIONS

The influence of the cultivar on grain production was evident, highlighted by significant differences between the varieties tested, between 79 kg/ha and 205 kg/ha.

The biological category of the seeds (or the multiplication generation) allowed a

grouping of the related variants in three groups: C1-C2, with the highest productions, C3-C4, with lower productions by about 200 kg/ha and C5, where the differences of production compared to the second group were about 160-180 kg/ha. The difference in production between categories C1 and C5, of 416 kg/ha, and that of 389 kg/ha between C2 and C5, clearly demonstrates the importance of using certified seeds, from generations C1 and C2, to ensure the highest yields in winter wheat, regardless of cultivar.

The interaction between the cultivar and the biological category of the seeds highlights the Apache variety, the only one that resulted in three significantly different groups in relation to the biological category of the seeds, and the Bercy variety, where the productions obtained in the C3-C5 variants did not differ significantly. In three of the cultivars (Dropia, Faur and Apache), the seed biological category C5 was associated with significant negative differences from the previous biological categories (C1-C4).

Of course, only the cost and profit analysis of a crop intended for consumption can help the farmer to opt for the use of certified seeds or not, but in order to obtain the highest productions, it would be ideal for the seeds to be obtained and conditioned by technologies as close as possible to those used in the process of producing certified seed.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge SC Interagroaliment SRL, who has provided experimental station facilities, and technicians, i.e. Ms. Mihaela Perju, who has helped in plant preparation and yield processing.

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