



ISSN 1313 - 8820 (print)
ISSN 1314 - 412X (online)
Volume 8, Number 4
December 2016

AGRICULTURAL SCIENCE AND TECHNOLOGY

2016

An International Journal Published by Faculty of Agriculture,
Trakia University, Stara Zagora, Bulgaria

Editor-in-Chief

Georgi Petkov
Faculty of Agriculture
Trakia University, Stara Zagora
Bulgaria

Co-Editor-in-Chief

Dimitar Panayotov
Faculty of Agriculture
Trakia University, Stara Zagora
Bulgaria

Editors and Sections

Genetics and Breeding

Tsanko Yablanski (Bulgaria)
Atanas Atanasov (Bulgaria)
Nikolay Tsenov (Bulgaria)
Max Rothschild (USA)
Ihsan Soysal (Turkey)
Horia Grosu (Romania)
Bojin Bojinov (Bulgaria)
Stoicho Metodiev (Bulgaria)
Svetlana Georgieva (Bulgaria)

Nutrition and Physiology

Nikolai Todorov (Bulgaria)
Peter Surai (UK)
Zervas Georgios (Greece)
Ivan Varlyakov (Bulgaria)

Production Systems

Radoslav Slavov (Bulgaria)
Dimitar Pavlov (Bulgaria)
Bogdan Szostak (Poland)
Banko Banev (Bulgaria)
Georgy Zhelyazkov (Bulgaria)

Agriculture and Environment

Ramesh Kanwar (USA)
Martin Banov (Bulgaria)
Peter Cornish (Australia)

Product Quality and Safety

Marin Kabakchiev (Bulgaria)
Stefan Denev (Bulgaria)
Vasil Atanasov (Bulgaria)
Roumiana Tsenkova (Japan)

English Editor

Yanka Ivanova (Bulgaria)

Scope and policy of the journal

Agricultural Science and Technology /AST/ – an International Scientific Journal of Agricultural and Technology Sciences is published in English in one volume of 4 issues per year, as a printed journal and in electronic form. The policy of the journal is to publish original papers, reviews and short communications covering the aspects of agriculture related with life sciences and modern technologies. It will offer opportunities to address the global needs relating to food and environment, health, exploit the technology to provide innovative products and sustainable development. Papers will be considered in aspects of both fundamental and applied science in the areas of Genetics and Breeding, Nutrition and Physiology, Production Systems, Agriculture and Environment and Product Quality and Safety. Other categories closely related to the above topics could be considered by the editors. The detailed information of the journal is available at the website. Proceedings of scientific meetings and conference reports will be considered for special issues.

Submission of Manuscripts

All manuscripts written in English should be submitted as MS-Word file attachments via e-mail to editoffice@agriscitech.eu. Manuscripts must be prepared strictly in accordance with the detailed instructions for authors at the website www.agriscitech.eu and the instructions on the last page of the journal. For each manuscript the signatures of all authors are needed confirming their consent to publish it and to nominate an author for correspondence. They have to be presented by a submission letter signed by all authors. The form of the submission letter is available upon request from the Technical Assistance or could be downloaded from the website of the journal. Manuscripts submitted to this journal are considered if they have submitted only to it, they have not been published already, nor are they under consideration for publication in press elsewhere. All manuscripts are subject to editorial review and the editors reserve the right to improve style and return the paper

for rewriting to the authors, if necessary. The editorial board reserves rights to reject manuscripts based on priorities and space availability in the journal.

The journal is committed to respect high standards of ethics in the editing and reviewing process and malpractice statement. Commitments of authors related to authorship are also very important for a high standard of ethics and publishing. We follow closely the Committee on Publication Ethics (COPE), <http://publicationethics.org/resources/guidelines>

The articles appearing in this journal are indexed and abstracted in: DOI, EBSCO Publishing Inc. and AGRIS (FAO).

The journal is accepted to be indexed with the support of a project № BG051PO001-3.3.05-0001 "Science and business" financed by Operational Programme "Human Resources Development" of EU. The title has been suggested to be included in SCOPUS (Elsevier) and Electronic Journals Submission Form (Thomson Reuters).

Address of Editorial office:

Agricultural Science and Technology
Faculty of Agriculture, Trakia University
Student's campus, 6000 Stara Zagora
Bulgaria
Telephone.: +359 42 699330
+359 42 699446
www.agriscitech.eu

Technical Assistance:

Nely Tsvetanova
Telephone.: +359 42 699446
E-mail: editoffice@agriscitech.eu

ISSN 1313 - 8820 (print)
ISSN 1314 - 412X (online)

Volume 8, Number 4
December 2016



*AGRICULTURAL
SCIENCE AND TECHNOLOGY*

2016

An International Journal Published by Faculty of Agriculture,
Trakia University, Stara Zagora, Bulgaria

Review

Triticale – past and future

St. Dobreva*

Field Crop Institute, 6200 Chirpan, Bulgaria

(Manuscript received 17 May 2016; accepted for publication 28 October 2016)

Abstract. Two of the oldest plants that nature has provided to mankind for feeding - wheat and rye, are now combined in a totally new species. In Bulgaria, as well as all over the world, selection aims to create highly productive varieties, which are resistible to diseases. It was in the middle of the last century when people really started to work on that. The first variety of triticale in Bulgaria was obtained in 1965. The main growers of triticale are Germany, France, China, Australia, Hungary and USA, the biggest being Poland with over 1 million hectares. The main purpose of the crop worldwide is for food for the livestock. There are bread varieties of the triticale created, which are an appropriate addition to the wheat flour for the production of bread and bakery, as well as whole grains for cereals and triticale noodles. The newest usage of triticale is as a raw material for biofuels. Fertilization is critical to the yield and to the quality of production when growing triticale. In the past fertilization has been done by depositing manure, but modern agriculture provides significantly greater choice. The synthetic fertilizers are easy to store and distribute. Fertilization is mechanical, according to the needs of the plants. The use of foliar fertilizers is also completely mechanized. The study of their impact on productivity and quality of production is a subject of growing interest, taking into account the positive impact of the experiments conducted so far.

Keywords: triticale, creation, distribution, purpose, fertilizers, yields

Introduction

Triticale is a crop grown in many countries. On August 30, 1884 Carman first publishes in *Rural New Yorker* an illustration of a partial wheat-rye plant. The first constant wheat-rye hybrids were discovered by the German breeder Rimpau in 1888. To determine which are the most suitable varieties for a specific area, testing at different natural conditions is required. One of the major and most important advantages of triticale over the other cereals with fused surface is its high productive potential (Tsvetkov, 1989; Stankov, 1995). Practice shows that it can be grown in conditions which are unsuitable for the other crops or with limited farming.

In Bulgaria triticale is not where it deserves to be in the structure of the other crops, despite its proven productive possibilities and advantages (Tanchev, 2007). The main task in the selection of triticale in the country (Baychev, 1998; Tsvetkov, 1998; Vasileva et al., 2005) and in the world (Varughese, 1991) is the development of varieties, which, in addition to high productivity, should be characterized by high resistance to economically important diseases, drought and good winter resistance and suitable for cultivation on both flat and hilly areas, including poor and acidic soils.

In Bulgaria, academician Pavel Popov first started working with triticale in 1963. The first in our country primary octaploid triticale AD-SOS-3 was obtained in Agricultural University - Plovdiv in 1965 by crossing over Bezostaya 1 with the Bulgarian variety of rye C-2 (Kolev, 1967). The studies and crossovers continued in many other scientific institutes in the country. In 1967 the Institute of wheat and sunflowers "Dobrudzha" near General Toshevo created the first basic hexaploid triticale T-AD (Popov and Tsvetkov, 1970).

The purpose of this article is to introduce this crop – its development, distribution and growing in Bulgaria and abroad.

* e-mail: stefanovadobreva@gmail.com

Cultivation of triticale in some countries in the world and in Bulgaria

Today, major producers of triticale are Poland, Germany, France, China, Australia, Hungary, Czech Republic and USA (Figure 1). According to FAO, in 2005 triticale was sown on 35.2 million ha globally and 13.5 million tons of grain were produced. The largest producer is Poland (3.7 million tons) followed by Germany (2.7 million tons), France (1.8 million tons), China (1.25 million tons) and Hungary (0.57 million tons) (Figure 2).

According to FAO (<http://faostat.fao.org/>), sole leader in the world in the production of triticale is Poland with over 1 million hectares. Following it are countries such as Germany and France (over 300 000 ha), Russia and China (over 200 000 ha), Lithuania, Spain, Hungary and Australia (over 100 000 ha). In the recent years in Bulgaria the areas with triticale are growing. If in 2008 they were 4 585 ha, in 2010 they increased to 9 800 ha, and in 2013 they are already 13 700 ha (Figure 3). The average yields of grain are volatile, ranging between 2.453 t/ha in 2012 and 4.472 t/ha in 2008.

In addition to grain, triticale is attractive for use as a feedstock for biofuels because of the higher potential for grain yield, competitiveness to weeds and tolerance to drought and pests compared to their parental species (Oettler, 2005; Beres et al., 2010; Goyal et al., 2011). Triticale is considered to be tastier and highly digestible grain for feeding pigs, chickens, cattle, sheep, deer and horses, etc. (Van Barneveld, 2002). The studies with triticale in China began in 1950. The first varieties were examined in 1970 and first results were obtained in 1976 (Wenkui, 1981). The high biological production and the good adaptation of new varieties helps to increase the areas for cultivation of triticale from 10 066 ha in 1991 to 303 333 ha in 2002. The majority of the production is used for

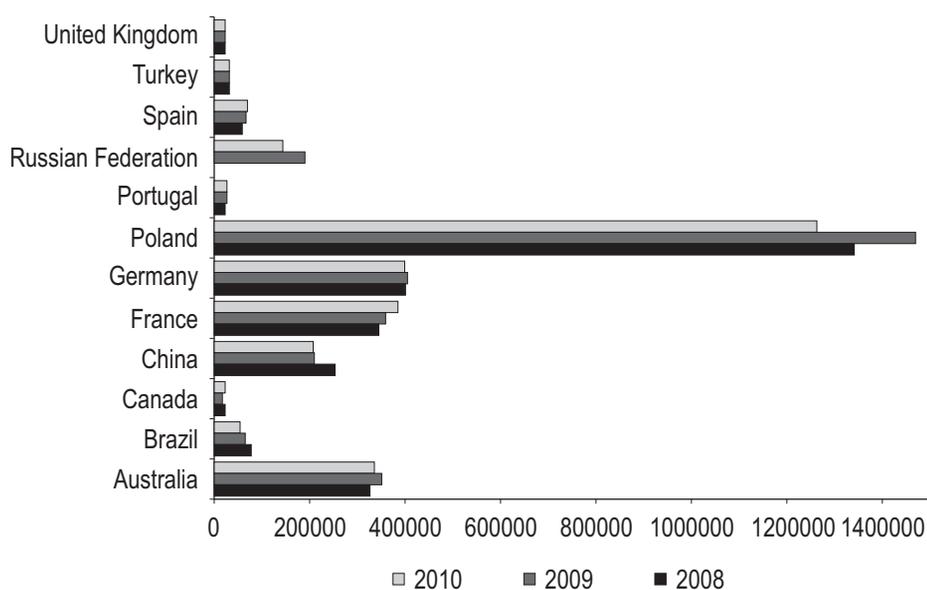


Figure 1. Areas with triticale in some countries, ha (FAOSTAT © FAO Statistics Division)

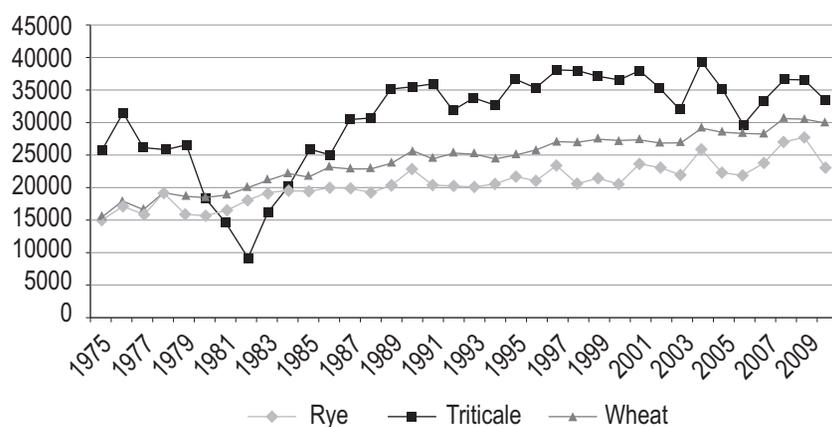


Figure 2. Yields of triticale grains compared to wheat and rye (World)

feeding animals. In France, production of triticale began before 1980. In the beginning, the areas with triticale increased consistently, and reached about 266 000 ha in 2002 (SEDIS, 2002). The production of triticale reached 4.5 million tons in 1998 (1/3 of the production worldwide) (ITCF, 2002).

In Germany, as in most European countries, triticale is used to feed pigs and poultry (Oettler, 2004). It provides a balance of aminoacids. There are no bad qualities of the rye (Boros, 1998; Boros, 2002).

In Hungary, the production of triticale starts in 1960 on areas with sandy soil in the central parts of the country. The policy of the country changed by introducing and allowing the cultivation of triticale to the landowners and the small family farms. With this rise, the areas with triticale reached 120 000 ha in 2001. Traditionally, winter varieties are grown. National Variety Field Tests and recent studies indicate that the spring triticale gives lower yields than the winter ones in the region (Bona et al., 2002). The average grain yield in poor soils varies between 3.0 and 4.5 t/ha. However, recent studies show that even in the barren, acidic and sandy soils in north-eastern Hungary triticale can produce up to 7.9 t/ha grain, if it is properly fertilized with nitrogen, phosphorus, potassium, calcium and magnesium (Kádár et al., 1999).

The study and cultivation of triticale in Poland begins in 1960,

i.e. after being developed for several years in Europe and America (Shebeski, 1980; Tarkowski, 1989). Triticale cultivation is very developed in Poland (Czembor, 1999). In 1990, the areas available for cultivation of triticale were 660 000 ha, while in 2001 they increased to 734 000 ha. Yields of winter triticale varieties in test fields for several years increased to an average of 7.0 t/ha. The problem is that the new varieties developed by seed production companies are not certified for the production of seed (Oleksiak, 2000).

Triticale is a cereal with great potential in terms of productivity (Boyadjieva, 1995; Terziev, 1996; Kolev, 2010). One of the main factors for the realization of the genetic makings of a variety (Dimitrov et al., 1987; Stankov, 1995) is the area in which triticale is grown and its specific soil and climatic conditions (Popov, 1981; Dimitrov et al., 1982; Kalinov and Tsvetkov, 1985; Lukidudis, 1986; Tanchev, 2007; Ivanova and Tsenov, 2014a,b). Up until now a significant number of varieties have been developed, part of which are introduced to agriculture (Dimitrov et al., 1987; Tsvetkov, 1998). Many of the varieties and lines have very valuable qualities, such as high productivity, resistance to biotic and abiotic stress, heavy-fed and grain high in protein and lysine, resistance to lodging and shelling, etc. (Baychev, 1998; Tsvetkov, 1998; Kiryakova and Baichev 2004; Baychev, 2004, 2005, 2006; Vassileva et al., 2005).

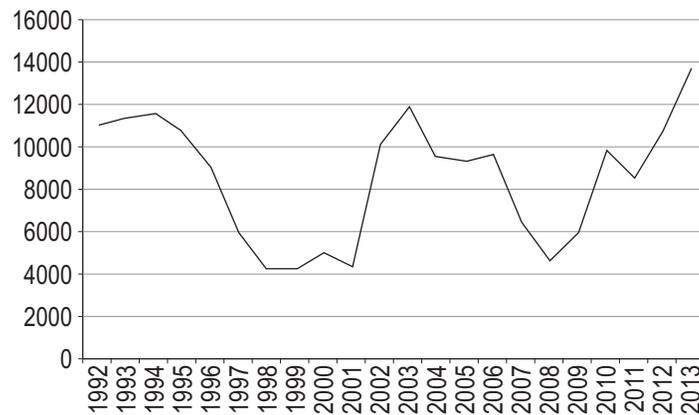


Figure 3. Areas with triticale in Bulgaria, ha

In the study of Baychev (2006) triticale variety Attila was compared with six other varieties, including the world standard Lasco and gives an average yield of 803 kg/ha. The variety Boomerang also has high yield and the average for the period tested by Baychev (2004) is 8.58 t/ha. The highest absolute yields during the test period is around 9.59 t/ha. While testing, the breeder Baychev (2006) reports that variety Colorit has the highest yield - 800 kg/ha, average for the period. In one of the years of the experiment, the same variety has realized 978 kg/ha. When testing the variety Respect with Polish varieties of triticale, including the world standard Lascaux, the Bulgarian variety showed high productive capacity - 8.33 t/ha, average for the years of testing, and in the best year of the test yield of 9.99 t/ha was reported. In a comparative study in Turkey, Central Anatolia, triticale, common wheat and durum wheat yields were obtained as follows: 5176, 5134 and 4226 kg/ha⁻¹ (Gulmezoglu et al., 2010).

Fertilization – major factor for triticale yield

With the emergence of agriculture man began to apply fertilization as a means to increase production. Fertilization is a major factor and indicator of the efficiency of agricultural production (Nogalska et al., 2012). This is one of the most powerful factors to increase yield. Fertilization experiments are conducted all over the world aiming at establishing the optimal rate for optimum production. The optimization of fertilization should be done according to the purpose of production. It was found that the conditions of the year and the level of fertilization are decisive factors for the formation of the yield in new varieties of triticale (Ivanova and Tsenov, 2014a,b). Many authors (Zolotov and Zolotov, 1980; Dimitrov et al., 1982; Kolev and Hristov, 1983; Kalinov and Tsvetkov, 1985) recommend nitrogen rates of 120 to 140 kg/ha, and on poorer soils from 180 to 240 kg/ha. The new varieties of triticale are very responsive to fertilizers and they increase their productivity with increasing the fertilizer rate (Ivanova and Tsenov, 2014a, b).

The biological value of triticale is mainly due to the high levels of protein in the grain. In this aspect mineral fertilization is crucial. In the results of a number of researchers it is indicated that the increase of protein depends on the amount of nutrients - mainly nitrogen - increasing the rate increases the content of protein (Tosheva and Stoeva, 1996). The most aminoacids are accumulated in fertilization with 120 kg/ha⁻¹ nitrogen (Kirchev and Popov, 2010).

When growing crops in modern technology the units associated with the use of growth regulators are very important (Manfredini and

Rapparini, 1987; Wach, 1989; Ivanova et al., 1999). In a study by Kolev (2010) it was found that growth stimulator "Imunotsifit" added in the phases tillering + ear formation, increases the yield of grain by 14.9 % on average for the test period compared to the untreated control. In examining the impact of the growth regulator "Agrostemin" it was found that it increases the yield by 11.2 % on average for the test period added in the stem phase (Belcheva and Kolev, 2007).

The effect of liquid fertilizers in grain cereals has been studied in a series of precise experiments conducted abroad (Petr, 2005; Wolber and Seemann, 2006) and in Bulgaria (Kolev and Hristov, 1983; Atanasova et al., 2001; Kolev and Tahsin, 2009; Kolev et al., 2011a,b; Todorov, 2012; Sevov and Delibaltova, 2013). When testing the liquid fertilizer "Amalgerol premium" Kolev (2014) found that treatment at tillering stage, the yield was increased by 11.2 % on average for the study period compared to the unfertilized control. Amalgerol Premium responded positively to the rise of the structural elements of production, such as number of spikes, number of grains and grain mass of a plant.

By testing Belgian fertilizers, Kolev et al. (2011a) have obtained the result that grain yield is increased by double treatment of triticale in the tillering stage with Azure NPK 21-21-21 + TE (micro-fertilizers) and at tillering stage with Azure NPK 16-8-34 + TE. Under this conditions, the grain yield average for the period of study, was 12.4% compared with untreated control. The tested foliar fertilizers have increased the values of the structural elements of the yield.

Conclusion

Since its establishment until today, triticale has been subject of research for many scientists. The varieties in the past and the present are different, and the aim has always been higher productivity. Modern agriculture incorporates a complex of various agricultural activities. One of the most influential factors in increasing the yield is fertilization. This requires testing of various fertilizers, both separately and in combination. Fertilization can be performed in different doses and stages. The increase of the yield can be stimulated by foliar application. This is a relatively innovative method which started to be applied in the recent past and is becoming more widespread. Foliar feeding is not intended to replace mineral fertilization but to improve the quality and quantity of grain. Many Bulgarian and foreign companies work and develop themselves in the elaboration of foliar fertilizers.

References

- Atanasova D, Valchev D and Kolev T**, 2001. Effect of biologically active substances on the growth and development of young barley plants. Jubilee session "80 years of higher agricultural education in Bulgaria." Scientific papers of the Agricultural University - Plovdiv, XLVI, 167-170.
- Baychev V**, 1998. Bugarian triticale lines with high potential for grain yield. Proceedings of the 4th International Triticale Symposium, July 26-31, 1998, Red Deer, Alberta, Canada, 2, 97-99.
- Baychev C**, 2004. Study on hybridization of F1 (6 x triticale x common wheat) with 6x-triticale and common wheat. *Field Crops Studies*, 1, 359-366.
- Baychev V**, 2005. Survey forms hybrid wheat and triticale obtained under F1 (6h- triticale / wheat-6x). Breeding and farming practices of arable crops. Balkan Scientific Conference dedicated to the 80th Anniversary of the Institute of Agriculture - Karnobat, p. 269-273.
- Baychev V**, 2006. "Kolorit" - a new variety of triticale grain. *Studies on arable crops*, III, 335-340.
- Baychev C and Petrova T**, 2011. Triticale "Respect" - a new highly productive variety with a unique cold tolerance. *Field Crops Studies*, VII, 63-70.
- Belcheva S and Kolev T**, 2007. Investigation of the growth regulator "Agrostemin" on the productivity of triticale. *Soil science, agricultural chemistry and ecology years*, XLI, 45-48.
- Boyardjieva D**, 1995. Creating new high yielding cultivars of soft winter wheat and triticale ecologically plastic and suitable for our dry country regions. *Annual Wheat Newsletter*, 4, 70-72.
- Bona I, Purnhauser L, Acs E, Beke B, Aniol A, Boros D and Cyran M**, 2002. Yield and protein content of winter versus spring triticale genotypes. In E. Arseniuk ed Proceedings of 5th Int. Triticale Symposium, Radzikow, Poland, 30 June-5 July 2002, Radzikow, Poland. Plant breeding and Acclimatization Institute, II, 433-438.
- Beres BL, Harker KN, Clayton GW, Bremer E, Blackshaw RE and Graf RJ**, 2010. Weed-Competitive Ability of Spring and Winter Cereals in the Northern Great Plains. *Weed Technology*, 24, 108-116. doi: 10.1614/WT-D-09-00036.1
- Boros D**, 1998. Nutritive value of different forms of triticale for monogastric animals. In P. Juskiw, ed. Proc. 4th Int. Triticale Simp., Red Deer, Alberta, Canada, 26-31 July 1998, p. 177-184. Interanional Triticale Associaton.
- Boros D**, 2002. Physico-chemical quality indicators suitable in selection of triticale for high nutritive value. In E. Arseniuk ed Proc. 5th Int. Triticale Simp., Radzikow, Poland, 30 June-5 July 2002, Plant breeding and Acclimatization Institute, I, 239-244.
- Czembor HJ**, 1999. Achievements in cereal breeding in Poland and varietal progress. *Pamiêtnik Pu'awski*, 114, 41-55 (Po).
- Dimitrov D, Gvozdiev K and Georgiev St**, 1982. Survey on agrotechnics of triticale. *Plant Science*, 19, 88-95.
- Dimitrov S, Dimitrov L and Todorov T**, 1987. A comparative study of some varieties of triticale. *Plant Science*, 24, 58-64.
- Goyal A, Beres BL, Randhawa HS, Nabavi A, Salmon DF and Eudes F**, 2011. Yeld stability analysis of broadly adaptive triticale germplasm in southern and central Alberta, Canada for industrial end-use suitability. *Canadian Journal of Plant Science*, 91, 125-135.
- Gulmezoglu N, Alpu O and Ozer E**, 2010. Comparative performance of triticale and wheat grains by using path analysis. *Bulgarian Journal of Agricultural Science*, 16, 443-453.
- Ivanova R, Shamov D and Kolev T**, 1999. Influence of the growth regulator GA3 on the growth and yield of the flax cultivated for oil at different cultivars. *Lucrari stiintifice*, 41, Seria agronomie, Editura "Ion Ionescu de la brad" IASI, 19-27.
- ITCF37**, 2002. Triticale, du débouché à la culture. *Perspectives Agricoles*, № 256.
- Ivanova A and Tsenov N**, 2014a. Production potencial of new triticale varieties grown in the region of Dobrudzha. *Agricultural Science and Technology*, 6, 243-246.
- Ivanova A and Tsenov N**, 2014b. Comparative evaluation of triticale cultivars grown in the region of Dobrudzha. *Agricultural Science and Technology*, 6, 387-391.
- Kádár I, Németh T and Szemes I**, 1999. Fertilizer response of triticale in long-term experiment in Nyirlugos. In Hungarian with English Summary. *Novenytermeles*, 48, 647-661.
- Kalinov I and Tsvetkov St**, 1985. In Sat: Problems of modern Bulgarian agriculture. S., Bulgarian Academy of Sciences.
- Kiryakova V and Baychev B**, 2004. Persistence of triticale lines to the agent of brown rust *Puccinia recondita* f.sp. tritici. *Field Crops Studies*, 1, 154-160.
- Kirchev H and Popov N**, 2010. Influence of nitrogen fertilization on the content of crude protein and amino acids in the grain triticale (X. Triticosecale Wittmack). *Plant Science*, 47, 441-445.
- Kolev D**, 1967. Create amfiploidi between wheat and rye. Scientific papers of VSI "V.Kolarov". Proceedings of Agronomy Faculty, XVI, 1 (Bg).
- Kolev D and Hristov St**, 1983. Impact of rising rates of fertilization on yield and grain quality in triticale varieties in Northeastern Bulgaria. *Plant Science*, 20, 55-60.
- Kolev T and Tahsin N**, 2009. Effectiveness of the multi-purpose stimulator immunocytophite on the productivity of rye (*Secale cereale* L.) *Journal of Mountain Agriculture on the Balkans*, 12, 1003-1011.
- Kolev T**, 2010. Testing of the new Bulgarian varieties of triticale grain. *Plant Science*, 47, 14-16.
- Kolev T, Todorov G and Kolev L**, 2011a. Testing of fertilizers for foliar application in triticale. *Plant Science*, 48, 495-498.
- Kolev T, Todorov Zh and Koleva L**, 2011b. Influence of the growth stimulator "Immunocitofit" on the productivity of the Durum wheat, *Priroda i selyskohozyaystvennaya deyatelnosty cheloveka – sbornik statey mezhdunarodnoy nauchno-prakticheskoy konferentsii, Irkutsk (23-27.05 2011 g.)*, II, 72-75 (Ru).
- Kolev T**, 2014. Effects of liquid fertilizer Amalgerol premium on productivity triticale. *Scientific papers of the Agricultural University*, LVIII, 219-223.
- Lukidudis S**, 1986. Survey of triticale under high fields of Bulgaria. *Plant Science*, 23, 42-46.
- Manfredini M and Rapparini G**, 1987. Come si coltiva il grano duro in Francia. *Informazione Agricoltura Verona*, 43, 79-87.
- Mitova T**, 1997. Energy evaluation of mineral fertilization in four-field rotation. *Plant Sciences*, 34, 3-4, p. 52-57.
- Nogalsa A, Czapla J and Skwierawska M**, 2012. Effect of multi-component fertilizers on spring triticale yield, the content and uptake of macronutrients. *Journal of Elementology*, 17, 95-104.
- Oettler G**, 2004. Triticale in Germany. Food and Agriculture Organization of the United Nations, Rome, Triticale Improvement and Production, 179, 115-117.
- Oetter G**, 2005. The fortune of a botanical curiosity – Triticale: past, present and future. *Journal of Agricultural Sciences*, 143, 329-346.
- Oleksiak T**, 2000. Triticale in production – practical utilization of breeding effects. Quality of planted seed and triticale yield. *Folia Universitatis Agriculturae Stetinensis* 82, 199-204 (Po).
- Petr J**, 2005. Yield potential of rye and population varieties in ecological and intensive cultivation. *Scientia Agriculturae Bohemica*,

36, 41-48.

Popov P and Tsvetkov S, 1970. Hexaploid triticale ($2n=42$) created by hybridization between *T. durum* Desv. ($2n=28$) and *S. cereale* L. ($2n=14$). Comptes rendus de l'Académie bulgare des Sciences, 23, 12.

Popov P, 1981. Results of the survey of triticale in Elena area. Plant Science, 18, 44-51.

SEDIS, 2002. Semences et Progrès, № 112.

Sevov A and Delibaltova V, 2013. Effect of Biostimulant Fertigrain on Bread wheat (*Tr. Aestivum* L.) Productivity Elements and Grain Yield. Scientific Papers, Series A, Agronomy, LVI, 353-356.

Shebeski LH, 1980. Hodowla Rooti. Aklimatizacija i nasiennictwo, 24, 279-285.

Stankov I, 1995. Analysis of some structural elements of production at new varieties and lines of hexaploid triticale. Plant Science, 32, 100-101.

Tanchev D, 2007. A comparative study of varieties of triticale grain in terms of Strandzha region. Journal of Mountain Agriculture of the Balkans, 10, 491-498.

Tarkowski C, 1989. Biology of triticale. Warszawa, PWN. p. 383 (Po).

Terziev G, 1996. Productive capabilities of newly selected triticale lines. Plant Science, 33, 33-35.

Todorov Zh, 2012. Study on growth, development and the productive capacity of the hybrid canola grown for green fodder in southern Bulgaria. Agricultural Sciences, 4, 131-134.

Tosheva E and Stoeva I, 1996. Effects of fertilization and preservation of leached vertisol the quality of triticale. Soil science, agricultural chemistry and ecology, 3, 11-13.

Tsvetkov SM, 1998. Triticale cv. Racita ($2n=6x=42$): a new original productive variety for grain in Bulgaria. Proceedings of the 4th International Triticale Symposium, July 26-31, 1998, Red Deer, Alberta, Canada, 2, 156-159.

Vasileva I, Balevska P and Baychev V, 2005. Selection of triticale in Bulgaria - Status and position. Breeding and farming practices of arable crops. Balkan scientific conference dedicated to the 80th anniversary of the Institute of Agriculture, Karnobat, p. 265-268.

Varughese G, 1991. Recognizing triticale proper place among the world's cereals. In: Second Int. Triticale Symposium, Passo Fundo, Brazil, p. 6-7.

Van Barneveld R, 2002. Triticale. A guide to the use of triticale in livestock feeds. Kingston, Australia, Grains Research and Development Corporation.

Wach M, 1989. Vliv vtuzenipudy a hnojeni dusikem na produkcii obilnin. Uroda, 37, 503-505.

Wenkui B, 1981. Octoploid triticale breeding and its management. Guiyang, China, Guizhou People Press.

Wolber D and Seemann E, 2006. Use of growth regulators in cereals. Getreide Magazin, 1, 22-29 (Ge).

Zolotov LN and Zolotov AN, 1980. Plant Agriculture of field crops in forest-steppes Povolzhya. Kuybyshev, Novosibirsk District, 7 (Ru).

Review

- Triticale – past and future** 271
St. Dobрева

Genetics and Breeding

- Productivity performance of bread winter wheat genotypes with local and foreign origin** 276
G. Raykov, P. Chamurliyski, S. Doneva, E. Penchev, N. Tsenov
- Production properties of flax (*Linum usitatissimum* L.) cultivated in Strumica region, Republic of Macedonia** 280
P. Vuckov, M. Ilievski, D. Spasova, L. Mihajlov, N. Markova-Ruzdić
- Quality of grain and flour of foreign bread wheat cultivars (*Triticum aestivum* L.) under the conditions of south Dobrudzha region** 283
P. Chamurliyski, N. Tsenov, I. Stoeva, S. Doneva, E. Penchev
- Breeding programme for developing new sweet cherry cultivars in the Fruit Growing Institute, Plovdiv, Bulgaria** 289
S. Malchev, A. Zhivondov
- Heterosis manifestations by survival and larval duration of F1 *Bombyx mori* L. hybrids** 292
R. Guncheva, M. Panayotov, P. Tsenov, Y. Dimitrova

Nutrition and Physiology

- Reproductive performance of breeding rabbits fed by graded levels of cassava (*Manihot esculenta*) leaf meal** 297
T. Ahemen, I.I. Bitto, O.I.A. Oluremi
- Clinical toxicological investigations on acute carbofuran intoxication in quails (*Coturnix coturnix*)** 302
R. Binev, I. Valchev, R. Mihaylov, Y. Nikolov

Production Systems

- Efficacy and timing of some new products against pear psylla (*Cacopsylla pyri* L.) (Hemiptera: Psyllidae): II. Spirodiclofen** 306
V. Arnaudov
- Biochemical and chemical investigations of pikeperch fingerlings (*Sander Lucioperca* L.) after wintering** 310
A. Ivanova, R. Atanasova

Effect of fluorescence on the technological characteristics of cocoons at different cooking temperatures	313
M. Panayotov	
Comparative analysis of plane geometric parameters of various types of cow milking parlors	318
D. Georgiev	
 Agriculture and Environment	
<i>Panthaleus major</i> /Duges/ of cereals in Bulgaria	323
V. Maneva, D. Atanasova	
Selectivity and stability of herbicides and their tank mixtures for the seed yield of sunflower (<i>Helianthus Annuus</i> L.)	326
G. Delchev, T. Barakova	
Effect of green manure cover crops on tomato greenhouse production	332
I. Tringovska, V. Yankova, D. Markova	
Reclamation of lands disturbed by mining activities in Bulgaria	339
I. Kirilov, M. Banov	
 Product Quality and Safety	
Fish production and meat quality traits in rainbow trout (<i>Oncorhynchus mykiss</i>) farmed in different production systems	346
St. Stoyanova, Y. Staykov, G. Zelqzkov, I. Sirakov, G. Nikolov	

Instruction for authors

Preparation of papers

Papers shall be submitted at the editorial office typed on standard typing pages (A4, 30 lines per page, 62 characters per line). The editors recommend up to 15 pages for full research paper (including abstract references, tables, figures and other appendices)

The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods, Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

Names and affiliation of authors

The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors are designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *.

Abstract should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

Keywords: Up to maximum of 5 keywords should be selected not repeating the title but giving the essence of study.

The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal?

Material and methods: The objects of research, organization of experiments, chemical analyses, statistical and other methods and conditions applied for the experiments should be described in detail. A criterion of sufficient information is to be possible for others to repeat the experiment in order to verify results.

Results are presented in understandable

tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text.

Tables should be as simple and as few as possible. Each table should have its own explanatory title and to be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

Figures should be sharp with good contrast and rendition. Graphic materials should be preferred. Photographs to be appropriate for printing. Illustrations are supplied in colour as an exception after special agreement with the editorial board and possible payment of extra costs. The figures are to be each in a single file and their location should be given within the text.

Discussion: The objective of this section is to indicate the scientific significance of the study. By comparing the results and conclusions of other scientists the contribution of the study for expanding or modifying existing knowledge is pointed out clearly and convincingly to the reader.

Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn't be numbered and no new paragraphs be used. Contributions are the core of conclusions.

References:

In the text, references should be cited as follows: single author: Sandberg (2002); two authors: Andersson and Georges (2004); more than two authors: Andersson et al. (2003). When several references are cited simultaneously, they should be ranked by chronological order e.g.: (Sandberg, 2002; Andersson et al., 2003; Andersson and Georges, 2004).

References are arranged alphabetically by the name of the first author. If an author is cited more than once, first his individual publications are given ranked by year, then come publications with one co-author, two co-authors, etc. The names of authors, article and journal titles in the Cyrillic or alphabet different from Latin, should be transliterated into Latin and article titles should be translated into English. The original language of articles and books translated into English is indicated in parenthesis after the bibliographic reference (Bulgarian = Bg, Russian = Ru, Serbian = Sr, if in the Cyrillic, Mongolian =

Mo, Greek = Gr, Georgian = Geor., Japanese = Ja, Chinese = Ch, Arabic = Ar, etc.)

The following order in the reference list is recommended:

Journal articles: Author(s) surname and initials, year. Title. Full title of the journal, volume, pages. Example:

Simm G, Lewis RM, Grundy B and Dingwall WS, 2002. Responses to selection for lean growth in sheep. *Animal Science*, 74, 39-50

Books: Author(s) surname and initials, year. Title. Edition, name of publisher, place of publication. Example:

Oldenbroek JK, 1999. Genebanks and the conservation of farm animal genetic resources, Second edition. DLO Institute for Animal Science and Health, Netherlands.

Book chapter or conference proceedings:

Author(s) surname and initials, year. Title. In: Title of the book or of the proceedings followed by the editor(s), volume, pages. Name of publisher, place of publication. Example:

Mauff G, Pulverer G, Operkuch W, Hummel K and Hidden C, 1995. C3-variants and diverse phenotypes of unconverted and converted C3. In: Provides of the Biological Fluids (ed. H. Peters), vol. 22, 143-165, Pergamon Press. Oxford, UK.

Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows. IXth International Conference on Production Diseases in Farm Animals, September 11-14, Berlin, Germany.

Thesis:

Hristova D, 2013. Investigation on genetic diversity in local sheep breeds using DNA markers. Thesis for PhD, Trakia University, Stara Zagora, Bulgaria, (Bg).

The Editorial Board of the Journal is not responsible for incorrect quotes of reference sources and the relevant violations of copyrights.

Animal welfare

Studies performed on experimental animals should be carried out according to internationally recognized guidelines for animal welfare. That should be clearly described in the respective section "Material and methods".

AGRICULTURAL SCIENCE AND TECHNOLOGY

Volume 8, Number 4
December 2016



Journal web site:
www.agriscitech.eu


Publisher:
www.alfamarket.biz