Online Version ISSN: 1314-412X
Volume 5, Number 1
March 2013

AGRICULTURAL SCIENCE AND TECHNOLOGY

2013

An International Journal Published by Faculty of Agriculture,
Trakia University, Stara Zagora, 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 manuscript written in English should be submitted as MS-Word file attachments via e-mail to ascitech@uni-sz.bg. Manuscripts must be prepared strictly in accordance with the detailed instructions for authors at the website http://www.uni-sz.bg/ascitech/index.html 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 on 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 from request from the Technical Assistance or could be downloaded from the website of the journal. 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.

Internet Access

This journal is included in the Trakia University Journals online Service which can be found at www.uni-sz.bg.

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
http://www.uni-sz.bg/ascitech/index.html

Technical Assistance:
Nely Tsvetanova
Telephone.: +359 42 699446
E-mail: ascitech@uni-sz.bg

Online Version ISSN: 1314-412X

Volume 5, Number 1
March 2013

AGRICULTURAL SCIENCE AND TECHNOLOGY

2013

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

AGRICULTURAL SCIENCE AND TECHNOLOGY, VOL. 5, No 1, pp 25 - 27, 2013

Grain yield of winter feed barley varieties

B. Dyulgerova*, D. Dimova, D. Valcheva, D. Vulchev, T. Popova, M. Gocheva

Institute of Agriculture, 8400 Karnobat, Bulgaria

Abstract. *Five winter feed barley varieties were tested at the experimental field of the Institute of Agriculture – Karnobat over a six-year period to assess their yield potential and stability. Varieties Bozhin and Iz Bori are new varieties and Vesletc, Izgrev and Aheloj 2 are widely grown feed barley varieties in Bulgaria. Stability parameters were estimated by the model of Lin and Binns (1988) and GGE biplot methodology was used for graphical display of yield data. According to the results, genotype x environment interactions for grain yield was highly significant indicating genetic variability between genotypes by changing enviroment. Average grain yield of varieties in six-year trail ranged from 5.13 t/ha (Vesletc) to 5.78 t/ha (Bozhin). High yield combined with high stability was demonstrated by new varieties Bozhin end Iz Bori.*

Keywords: barley, varieties, genetic variability, stability, grain yield

Abbreviations: G – genotype, GEI – genotype by environment interaction, AEC – average environment coordination

Introduction

Increasing grain yield without sacrificing yield stability is a major challenge for barley breeding, especially for regions characterized by large variation in weather and soil conditions. Several traits that are useful for better adaptation to unfavorable conditions can be counter productive, while other traits that can increase yielding potential can reduce adaptation to stress conditions. Calderini and Slafer (1999) found a general decrease in yield stability (assessed in absolute terms) with genetic gains in yield potential. Breeding for yield stability has always been important, but will be increasingly so, as predicted climate changes will probably bring more weather variations from one year to another.

The objectives of this study were to evaluate the grain yield of winter feed barey cultivars, tested in diverse weather conditions in Southeastern Bulgaria and to determinate their stability.

Material and methods

Five feed winter barley varieties were gown during six years 2006–2011 in the experimental field of the Institute of Agriculture, Karnobat. Bozhin and Iz Bori are new varieties and Vesletc, Izgrev and Aheloj 2 are widely grown feed barley varieties in Bulgaria. All tested varieties have been developed at the Institute of Agriculture, Karnobat. The experiment was carried out in four replications on 10 m^2 plots. The plot yield was converted to t/ha. The experimental area is located in Southeastern Bulgaria**.** The climate is transitional continental, with long and relatively cool spring, dry and hot summer, long and wet autumn, and little snow in winter, with large variations of temperature. Average temperature and precipitation during the experimental period is shown on Figures 1 and 2. The soil of the experimental field is leached chernozem-smolniza, slightly acid (pH is 6.2).

Analyses of variance were computed for the grain yield data within and across the six years Stability parameters were estimated by the model of Lin and Binns (1988) and GGE biplot methodology (i.e., G = genotype and GE = genotype by environment, interaction) was used for graphical display of yield data.

* e-mail:bdyulgerova@abv.bg

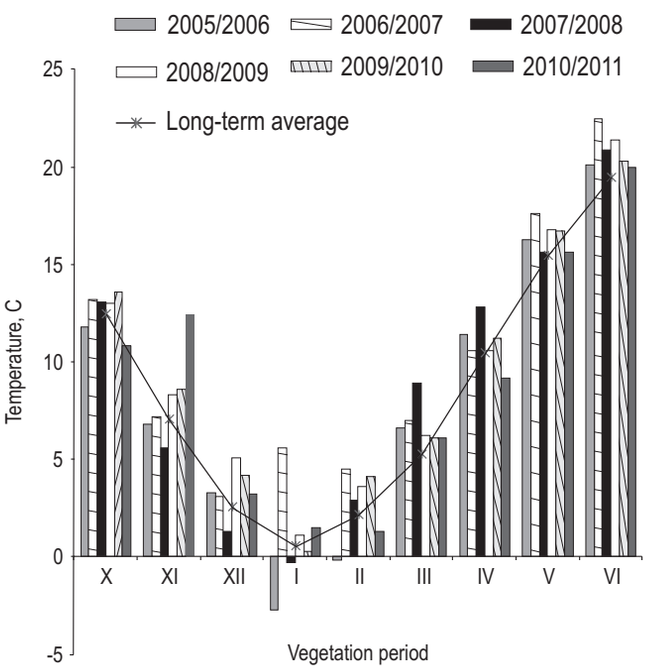

Figure 1. Temperature dates, °C of 2005–2011 years and long-term average in Karnobat

The Lin and Binns' (1988) model uses the P_i parameters obtained by the expression to assess the superiority of the cultivar,

$$P_i = \sum_{j=1}^{n} (X_{ij} - M_j)^2 / 2n$$

where P_i is superiority index of the i-th cultivar, X_{ij} is yield of the i-th cultivar in the j-th environment, M_j is maximum response obtained among all the cultivars in the j-th environment, and n is number of

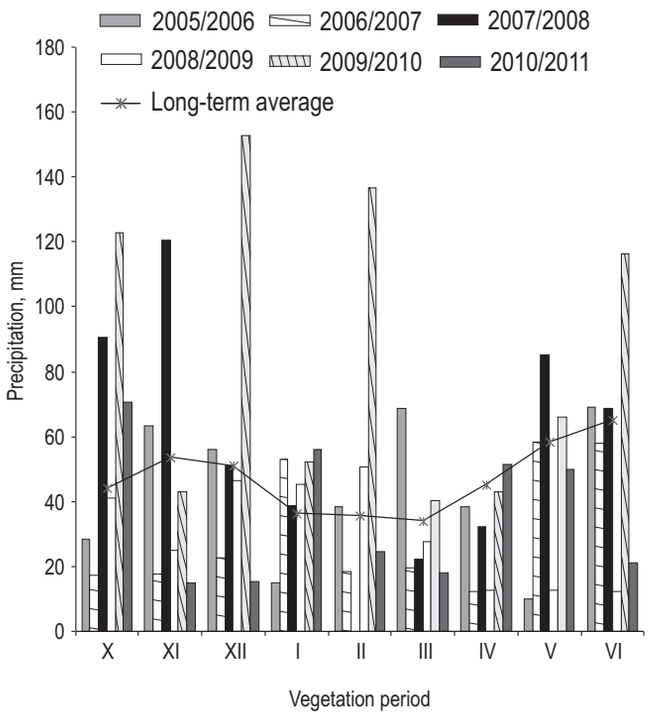

Figure 2. Precipitation dates, mm of 2005-2011 years and long-term average in Karnobat

environments.

GGE-biplot methodology, which is composed of 2 concepts, the biplot concept (Gabriel, 1971) and the GGE concept (Yan et al., 2000), was used to visually analyze. This methodology uses a biplot to show the factors (G and GE) that are important in genotype evaluation and that are also the sources of variation in GEI analysis (Yan et al., 2000, 2001). The GGE-biplot shows the first 2 principal components (PC1 and PC2, also referred to as primary and secondary effects, respectively) derived from subjecting environment-centered yield data (yield variation due to GGE) to singular value decomposition (Yan et al., 2000).

Results and discussion

The combined ANOVA showed that barley grain yields were significantly affected by E, which explained 85% of the total (G + E + GEI) variation, whereas G and GEI, which were significant ($P < 0.0001$), accounted for 4% and 11%, respectively (Table 1).

The diversity of conditions included in the study is reflected by the large variation of yields of the 5 cultivars in the six years (Table 2), which varied from 3.21 t/ha (Vesletc) to 7.35 t/ha (Bozhin). Grain yield of the studied varieties averaged across the 6 environments varying from 5.13 to 5.78 t/ha, with highest yields obtained in new cultivars and the lowest yield in Vesletc.

Table 1. Analysis of variance for barley grain yield

Source of variation	df	SS	MS	SS(%)[1]
Total	119	195.56		
Genotype (G)	4	8.48	2.12***	4.44
Environment (E)	5	161.36	32.27***	84.51
G* E	20	21.10	1.06***	11.05
Error	90	4.62	0.05	

*** significant
[1]Total sum of squares of G, E and GEI

Yield performance and stability of genotypes were evaluated by an average environment coordination (AEC) method (Yan and Hunt, 2002; Yan, 2002). In this method, an average environment is defined by the average PC1 and PC2 scores of all environments, represented by a small circle (Figure 3). A line is then drawn to pass through this average environment and the biplot origin. This line is called the average environment axis and serves as the abscissa of the AEC. The ordinate of the AEC is the line that passes through the origin and is perpendicular to the AEC abscissa (Figure 3). Unlike the AEC abscissa, which has one direction, with the arrow pointing to greater genotype main effect, the AEC ordinate is indicated by double arrows, and either direction away from the biplot origin indicates greater GEI effect and reduced stability. The AEC ordinate separates genotypes with below-average means from those with above-average means. In our study varietes with above-average means were Bozhin, Iz Bori and Aheloj 2, while genotypes below-average means were Vesletc and Izgrev.

The length of the average environment vector (the distance from biplot origin and the average environment marker), relative to the biplot size, is a measure of the relative importance of the genotype main effect vs. GEI. The longer it is, the more important is the genotype main effect, and the more meaningful the selection based on mean performance. For this study, the length of the average environment vector was sufficient to select genotypes based on yield mean performances.

A longer projection to the AEC ordinate, regardless of the direction, represents a greater tendency of the GEI of a genotype, which means it is more variable and less stable across environments or vice versa. For instance, variety Iz Bori was the most stable and varieties Aheloj 2 and Vesletc were more variable.

Table 2. Grain yield (t/ha) of investigated barley varieties during the six-year period

Variety	Years						Mean yield
	2006	2007	2008	2009	2010	2011	
Vesletc	4.53	4.63	6.46	6.36	3.21	5.60	5.13
Izgrev	3.91	5.08	6.65	6.78	3.63	6.05	5.35
Aheloj 2	3.91	4.49	7.23	7.04	4.04	5.33	5.34
Bozhin	4.28	4.29	6.78	6.89	5.08	7.35	5.78
Iz Bori	4.18	4.88	6.40	7.09	4.10	6.95	5.60
LSD 0.05%	0.31	0.30	0.39	0.31	0.40	0.33	0.17

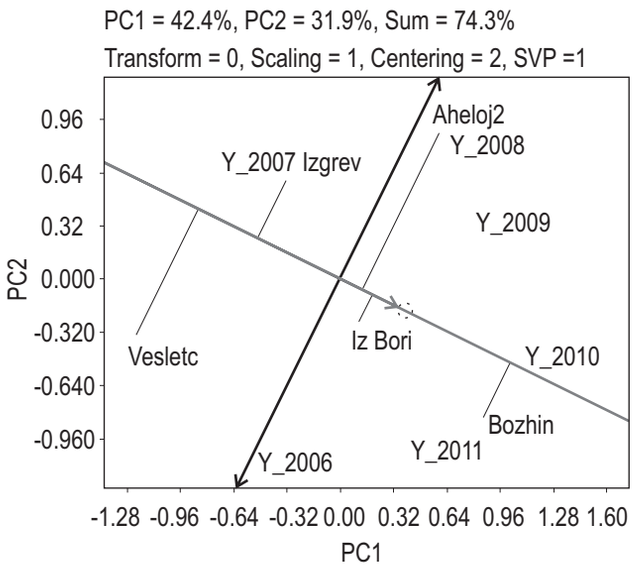

Figure 3. Average environment coordination (AEC) views of the GGE-biplot for the means performance and stability of genotypes

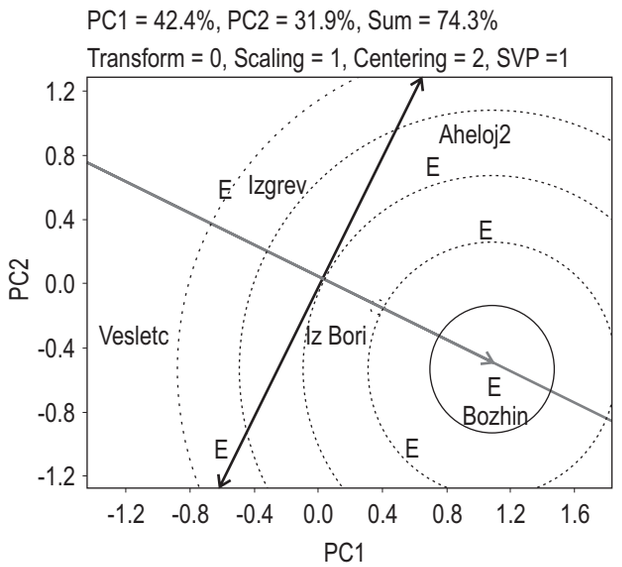

Figure 4. GGE-biplot for comparison the genotypes with the ideal genotype

An ideal genotype should have the highest mean performance and be absolutely stable (i.e. perform the best in all environments). Such an ideal genotype is defined by having the greatest vector length of the high-yielding genotypes and with zero GEI, as represented by an arrow pointing to it (Figure 4). Although such an ideal genotype may not exist in reality, it can be used as a reference for genotype evaluation. A genotype is more desirable if it is located closer to the ideal genotype. Thus, using the ideal genotype as the center, concentric circles were drawn to help visualize the distance between each genotype and the ideal genotype. Because the units of both PC1 and PC2 for the genotypes are the original unit of yield in the genotype-focused scaling (Figure 4), the units of the AEC abscissa (mean yield) and ordinate (stability) should also be the original unit of yield. The unit of the distance between genotypes and the ideal genotype, in turn, is the original unit of yield as well. Figure 4 revealed that Bozhin, which fell into the center of concentric circles, was an ideal genotype in terms of higher yielding ability and stability, compared with the rest of the varieties.

Regarding the method proposed by Lin and Binns (1988) it was observed that Bozhin showed lowest value of *Pi* measure and is considered as a most desirable genotype (Table 3). Similar results were obtained by Pavlov et al.,2011 finding that the highest yielding genotype had the lowest *Pi* value.

Table 3. Superiority index (Pi) for investigated varieties

Variety	Pi	Rank
Vesletc	0.784	5
Izgrev	0.461	3
Aheloj 2	0.591	4
Bozhin	0.093	1
Iz Bori	0.195	2

Conclusion

According to the results, genotype x environment interactions for grain yield was highly significant indicating genetic variability between genotypes by changing enviroment. Average grain yield of varieties in six-year trail ranged from 5.13 t/ha (Vesletc) to 5.78 t/ha (Bozhin). High yield combined with high stability was demonstrated by new varieties Bozhin end Iz Bori.

References

Calderini DF and Slafer GA, 1999. Has yield stability changed with genetic improvement of wheat yield? Euphytica, 107, 1, 51-59.

Gabriel KR, 1971. The biplot graphic display of matrices with application to principal component analysis. Biometrika, 58, 453-467.

Lin CS and Binns MR, 1988. A superiority measure of cultivar performance for cultivar x location data. Canadian Journal of Plant Sciences, 68, 193-198.

Pavlov J, Delić N, Stevanović M, Čamdžija Z, Grčić N and Crevar M, 2011. Grain yield of ZP maize hybrids in the maize growing areas in Serbia Proceedings. 46th Croatian and 6th International Symposium on Agriculture. Opatija. Croatia, 395-398.

Yan W and Hunt LA, 2001. Interpretation of genotype x environment interaction for winter wheat yield in Ontario. Crop Science, 41, 19-25.

Yan W, Hunt LA, Sheng Q and Szlavnics Z, 2000. Cultivar evaluation and mega-environment investigation based on the GGE biplot. Crop Science, 40, 597-605.

Yan W, 2002. Singular-value partitioning in biplot analysis of multienvironment trial data. Agronomy Journal, 94, 990-996.

CONTENTS **1 / 3**

CONTENTS **2 / 3**

CONTENTS **3 / 3**

Product Quality and Safety

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, Sept.11 – 14, Berlin, Germany, p. 302 (Abstr.).

Thesis:

Penkov D, 2008. Estimation of metabolic energy and true digestibility of amino acids of some feeds in experiments with muscus duck (Carina moshata, L). Thesis for DSc. Agrarian University, Plovdiv, 314 pp.

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

AGRICULTURAL SCIENCE AND TECHNOLOGY

Volume 5, Number 1
March 2013

Journal web site:
www.uni-sz.bg/ascitech/index.html

Publisher:
www.alfamarket.biz