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.

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 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. 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

Editor-in-Chief
Tsanko Yablanski
Faculty of Agriculture
Trakia University, Stara Zagora
Bulgaria

Co-Editor-in-Chief
Dimitar Panaiotov
Faculty of Agriculture
Trakia University, Stara Zagora
Bulgaria

Editors and Sections
Genetics and Breeding
Atanas Atanasov (Bulgaria)
Nikolay Tsenov (Bulgaria)
Max Rothschild (USA)
Ihsan Soysal (Turkey)
Horia Grosu (Romania)
Bojin Bojinov (Bulgaria)
Stoicho Metodiev (Bulgaria)

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

Production Systems
Radoslav Slavov (Bulgaria)
Dimiter Pavlov (Bulgaria)
Bogdan Szostak (Poland)
Banko Banev (Bulgaria)
Georgy Zhelyazkov (Bulgaria)

Agriculture and Environment
Georgi Petkov (Bulgaria)
Ramesh Kanwar (USA)
Martin Banov (Bulgaria)

Product Quality and Safety
Marin Kabakchiev (Bulgaria)
Stefan Denev (Bulgaria)
Vasil Atanasov (Bulgaria)

English Editor
Yanka Ivanova (Bulgaria)
Influence of the dimensions of lifting brushes on the losses at direct harvesting of standing vine dry bean

I. Iliev*, G. Milev

Department of Agrotechniks, Dobrudzha Agricultural Institute, 9520 General Toshevo, Bulgaria

(Manuscript received 11 June 2015; accepted for publication 30 November 2015)

Abstract. The influence of the dimensions of lifting brushes, mounted on the cutting bar of a small combine, on the losses at direct harvesting of standing vine dry edible bean, was studied. The form of the brushes was cylindrical and they were mounted on the cutter-bar along the direction of travel of the machine. The diameter and the longitude of the brushes were studied as well as the distance between them on the cutter-bar. Losses at cutting were evaluated. The limits of space position of the pods by height of two new cultivars of standing vine dry bean were determined. It was established that application of the brushes could decrease the losses at direct harvesting under 12%. A brushes diameter of Ø38, a longitude, equal to the longitude of the fingers of the cutter-bar, and a distance of 76.2 mm between brushes were found as optimal.

Keywords: cereal beans, upright beans, direct harvesting, lifting brushes

Introduction

Dry bean, Phaseolus vulgaris L., appeared as very popular agricultural crop last years. Its price went up 2 – 4 times and any way on the market had not domestic production of dry edible bean. The crop is very proper for agro-ecological crop rotation, which brings new 350 BGN subsidy per ha. Except of this the dry bean is perfect predecessor of winter cereals, leaves on time the plots for cereal sowing and enriches the soil by fixed from the atmosphere nitrogen.

The cultivars, spread nowadays in the country, are basically semi-climbing type. They have to be harvested in two phases, which complicates and elongates the harvesting. The losses at first stage, mowing, reached 5%, from the staying on the field and threshing at optimum working speed – 5.7%, and the indirect losses reached 17% (Georgiev, 1988; Bogatsevska et al., 2003). The tendency in breeding and production of dry edible bean last years was to turn to standing vine cultivars heaving simultaneous maturing of the pods and proper for direct harvesting, without preliminary mowing or uprooting (Papworth et al. 2004).

Direct cutting advantages are decreased dependency from the meteorological conditions, lower costs of the harvesting devices, gathered cleaner and healthy grains etc. Disadvantage are the increased losses at cutting over the soil surface, where often high percentage of the plant pods were disposed (Zyla et al., 2002; Borisov, 2005). The losses at direct harvesting of semi-climbing type cultivars dry bean at Dobrudzha agricultural institute reached 13.5 – 4.9%, but at harvesting standing vine cultivars losses of 10.6 – 13.2% were evaluated (Georgiev, 1988). Since then neither new upright cultivars were developed nor investigations on direct harvesting of such crops were processed in our region.

The aim of the study was to find out the influence of lifting brushes dimensions and the distance between them along the cutter-bar of a combine on the losses at direct harvesting of standing vine dry edible bean, developed in Bulgaria.

Material and methods

Crops data

Two new standing vine dry bean cultivars were studied, developed by breeders of Dobrudzha Agricultural Institute, General Toshevo, Bulgaria. Later in the year they would be accepted by State Cultivar Agency and named, but for the study they will be Cultivar 1 and Cultivar 2. In an agro-technical trial the cultivars were grown at five densities – 30, 35, 40, 45 and 50 plants per square meter. The phosphorus fertilizing was P80 (80 kg ha⁻¹ P₂O₅) at four levels of nitrogen fertilization N00 (Control), N40, N80, and N120. The diameters of the stems, 40 mm from the soil were red, as well as the height of lowest end of the first pod along the stem h₁ and the height of its catch to the stem h₄.

Equipment design and laboratory evaluation

Preliminary laboratory trials were led to study characteristics of the plants and the lifting brushes, aiming the number of studied parameters decrease. Especially constructed hand operated carriage has been used. Individual bean plants were fixed on the floor under the carriage and different models of brushes and their position were visually evaluated until defining of study parameters and their levels of variation.

Field evaluation

Field evaluation was led by small combine heaving working width of 1.5 m. Cylindrical form brushes, like bottle washing one, whose dimensions and distance between them are shown in Table 1, were mounted on the cutter-bar along the direction of travel as can be seen on Figure 1. The length of the brushes has been chosen to be half of the length of the fingers of the cutter-bar and equal to it. The distance between brushes was multiple to the step of the knife.

Rear discharge collection system was mounted on the combine to prevent threshing losses to compromise direct-cut losses.
Optimal reel and header height were fixed in preliminary trials and then used for field evaluation. The reel index was chosen to be 1.5. The direct cut by lifting brushes field trial was conducted on a 0.2 ha crop of the new Cultivar 2 in a technology estimating agro-technical trial. Pre-harvest losses were estimated by gathering of shattered seeds from six areas of 0.25m². The seeds then were dried and the moisture content was adjusted at 16% moisture content wet basis (Smith, 2010). Later the whole plants of the same sample areas were collected and threshed to estimate the yield. Field testing began when approximately 80% of the pods were mature and was completed over a period of two days. The crop was free of weeds and had a yield of 2320 kg/ha.

The cutting losses were observed by tossing randomly 0.25m² measuring frame after the cutter-bar has passed. Seeds on the ground in the frame then were collected and separated to shutter, stalk and stubble losses. Pod moisture content was estimated to be 13.4% with a standard deviation of 1.7%.

**Experimental design**

A completely randomized split-plot design has been used with 2x2 main plot factors of brush diameter and length and 3x2 sub-plot factors of travel speed and distance between brushes. The trial was conducted in three replications. The factors, their levels and values are presented in Table 1. Four loss samples of 0.25m² were collected from each replication.

**Results and discussion**

**Crop susceptibility to direct cutting**

The two new cultivars were 2A type, heaving standing vine and fruit bud on the top (CIAT, 1986). The pods are disposed in upper 4/5 of the stem height. The mass of 1000 seeds was 305 – 328 g. A cutting height of 40 mm is considered a typical minimum for a direct-cut harvester, especially equipped by flex draper headers (Folmes, 2011).

During 2014 year the middle diameter of the stem near the zone of cutting was 6.02 mm (SD=0.72 mm) for Cultivar 1 and 5.92 mm (SD=0.62 mm) for Cultivar 2. Along with the increase of the crop density the zone of first pod displacement slightly went higher (Figure 2). Similar results indicated Papworth et al. (2004) and they concluded that the climatic and crop conditions had more to do then

### Table 1. Test parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Levels</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush diameter d, mm</td>
<td>2</td>
<td>38; 60</td>
</tr>
<tr>
<td>Brush length l, mm</td>
<td>2</td>
<td>75; 150</td>
</tr>
<tr>
<td>Distance between brushes L, mm</td>
<td>2</td>
<td>76.2; 152.4</td>
</tr>
<tr>
<td>Travel speed v, km/h⁻¹</td>
<td>3</td>
<td>2; 3; 4</td>
</tr>
</tbody>
</table>

**Figure 1.** Disposition of the lifting brushes, d=60 mm, l=150 mm, L=76.2 mm

**Figure 2.** Influence of the crop density on the lowest pod disposition; \( h_1 \) – height of lowest pod end; \( h_2 \) – height of lowest pod attachment to stem.

**Figure 3.** Influence of the fertilizing on the lowest pod disposition. \( h_1 \) – height of lowest pod end; \( h_2 \) – height of the lowest pod attachment to stem.
header attachments alone. The middle height of the lowest end of the first pod along the stem for the two new cultivars varied in the limits 42.5 – 45.1 mm. The nitrogen fertilizing obviously influenced this parameter. At N80 its values stabilized in the limits 27 – 32 mm, especially at first two densities (Figure 3). The first pod attachment to the stem was at height 138 – 148 mm (SD=18.5 mm), obviously at the first pod along the stem for the two new cultivars varied in the breeding perfect susceptibility for direct harvesting at lower losses was reached (Figures 2 and 3). This height assured possibility for the lifting brushes to incline the first pod away from the cutting zone of the stem.

### Table 2. Analysis of variance for test parameters

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Sum of squares</th>
<th>Computed F</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush diameter (BD)</td>
<td>1</td>
<td>196</td>
<td>0.28</td>
<td>0.6496</td>
</tr>
<tr>
<td>Brush length (BL)</td>
<td>1</td>
<td>1926</td>
<td>5.46*</td>
<td>0.2481</td>
</tr>
<tr>
<td>BD x BL</td>
<td>1</td>
<td>182</td>
<td>0.24</td>
<td>0.7428</td>
</tr>
<tr>
<td>Error (M)</td>
<td>8</td>
<td>2130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance between brushes (DB)</td>
<td>1</td>
<td>1128</td>
<td>4.26*</td>
<td>0.0765</td>
</tr>
<tr>
<td>Travel speed (TS)</td>
<td>2</td>
<td>196</td>
<td>1.78</td>
<td>1.6842</td>
</tr>
<tr>
<td>DB x TS</td>
<td>2</td>
<td>219</td>
<td>1.96</td>
<td>1.9457</td>
</tr>
<tr>
<td>M x S</td>
<td>15</td>
<td>764</td>
<td>0.88</td>
<td>1.0456</td>
</tr>
<tr>
<td>Error (S)</td>
<td>40</td>
<td>2103</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* – M, S – main plots and subplots; * – significant at 5% probability level

![Figure 4](image4.png)  
**Figure 4.** Total losses at direct cutting of standing vine dry edible bean, brushes longitude l=150 mm, distance between brushes L76.2 mm and L152.4 mm, %

![Figure 4](image5.png)  
**Figure 5.** Total losses at direct cutting of standing vine dry edible bean, l=75 mm of the brushes, distance between brushes L76.2 mm and L152.4 mm, %
Field tests

The analysis of variance displayed that the brush diameter increase have not proven influence on the losses at direct cut of the standing vine dry bean crop (Table 2). In this case we suggest the little diameter because of durability and technological considerations. The increase of the distance between brushes along the cutter-bar led to proven losses increase, especially shutter and stubble losses (Figures 4 and 5). It is due to cut pods which stayed not lifted near the stem in the zone of cutting, and stems, inclined by the brushes and by the fingers which later were cut at higher height.

The increase of brushes longevity led to proven decrease of the losses, especially the shutter losses (Figures 4 and 5). The shortest brushes inclined the lowest pods away of the cutting zone, but in the moment the pod reached the end of the brushes the reel bat pushed them on the knife and shutter losses increased. Gathering losses for the lifting brushes heaving d = 38 mm and I = 150 mm varied from 11.4 – 23.2% with a mean of 17% (SD = 5.5%). Gathering losses for the lifting brushes heaving d=60 mm and l=75 mm varied from 15.3 – 26.3% with a mean of 21.4% (SD = 4.8%) (Figures 4 and 5). Shattered losses were the major part of gathering losses, comprising 65 – 80% of them. We can´t find difference between stalk and stubble losses, so the total of losses is analyzed then. Never mind the analysis of variance revealed that there is not difference in losses according to working speed, the least losses can be observed at 2 km/h – under 12% (Figure 4, a and b). The optimum brushes dimensions and distance between them one could determine according to the minimum of total losses, so it can be seen on Figure 4a at 2 km/h working speed and a distance of 76.2 mm between brushes.

Conclusion

During 2014 year the middle diameter of the stem near the zone of cutting was 6.02 mm (SD = 0.72 mm) for Cultivar 1 and 5.92 mm (SD = 0.62 mm) for Cultivar 2. The middle height of the lowest end of the first pod along the stem for the two new cultivars varied in the limits 42.5 – 45.1 mm. It was established that application of the described brushes could decrease the losses at direct harvesting under 12%. A brushes diameter of Ø38, a longitude equal to the longitude of the fingers of the cutter-bar and a distance of 76.2 mm between brushes were found as optimal and we do suggest these dimensions to the producers at harvesting in the practice.

References

Georgiev D, 1988. Study on Some Biological and Mechanical Qualities of the Field Bean, Methods and Devices of its Mechanized Harvesting. Thesis for PhD, Dobrudzha Agricultural Institute, General Toshevo (Bg).
CONTENTS

Review

Classical and modern concepts of inbreeding and effects of inbreeding depression in animals
S. Tanchev  3

Genetics and Breeding

Genotype by environment interaction in mutant lines of winter barley for grain yield
B. Dyulgerova, N. Dyulgerov  14

Genotype-environment interaction and stability analysis for grain yield of winter barley in the conditions of North-East and South Bulgaria
M. Dimitrova-Doneva, D. Valcheva, G. Mihova, B. Dyulgerova  19

Production Systems

Effect of predecessors on the productivity and phytosanitary condition of hull-less oats in organic farming
D. Atanasova, V. Maneva, T. Nedelcheva  24

Partial factor productivity of nitrogen fertilizer on grain and grain protein yield of durum wheat cultivars
G. Panayotova, S. Kostadinova  28

Influence of the dimensions of lifting brushes on the losses at direct harvesting of standing vine dry bean
I. Iliev, G. Milev  37

Energy productivity, fertilization rate and profitability of wheat production after various predecessors
II. Profitability of wheat production
Z. Uhr, E. Vasileva  41

Selectivity and stability of new herbicides and herbicide combinations for the seed yields of some field crops I. Effect at coriander (Coriandrum Sativum L.)
G. Delchev  46

Determination of some macro and micro elements in grain of winter barley genotypes

Agriculture and Environment

Effects of irrigation and fertilization on soil microorganisms
T. Dinev, I. Gospodinov, A. Stoyanova, G. Beev, D. Dermendzhieva, D. Pavlov  58
Investigation on some biotic factors in carp fish ponds  
D. Terziyski, H. Kalcheva, A. Ivanova, R. Kalchev 62

Investigation of some energy characteristics of pig farm  
P. Kostov, K. Atanasov, I. Ivanov, K. Peychev, R. Georgiev 70

Variability in the resistance to bacterial spot causal agents Xanthomonas euvesicatoria P and Xanthomonas vesicatoria PT2 among Bulgarian and introduced pepper varieties  
T. Vancheva, S. Masheva, D. Ganeva, N. Bogatzevska 75

Comparative analysis for macro and trace elements content in goji berries between varieties from China and R. Macedonia  
B. Balabanova, I. Karov, S. Mitrev 79

Product Quality and Safety

Extraction and characterization of anthocyanin colorants from plant sources  
S. Dyankova, M. Doneva 85

Heavy metal content in the meat of common carp (Cyprinus carpio L.) and rainbow trout (Oncorhynchus mykiss W.), cultivated under different technologies  
St. Stoyanova, I. Sirakov, K. Velichkova, Y. Staykov 90
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, IX 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".