ÚSTAV ZEMĚDĚLSKÝCH A POTRAVINÁŘSKÝCH INFORMACÍ

ZEMĚDĚLSKÁ TECHNIKA

AGRICULTURAL ENGINEERING

1

ČNÍK 40 (LXVII)
HA 1994
ISSN 0044-3883

ČESKÁ AKADEMIE ZEMĚDĚLSKÝCH VĚD
SLOVENSKÁ AKADÉMIA PÔDOHOSPODÁRSKYCH VIED

ZEMEDELSKA TECHNIKA

AGRICULTURAL ENGINEERING

VOLUME 40 (1994)

Čtvrtletník pro publikaci původních vědeckých prací z oboru zemědělské techniky, zemědělských technologií a zpracování zemědělských produktů. Příspěvky jsou publikovány v češtině, slovenštině a angličtině. - A quarterly for publication of the original scientific works from the branches of agricultural engineering, agricultural technologies and processing the agricultural products. The articles will be published in Czech, Slovak and English.

SAPAM '93

SAPAM '93 is an abbreviation of an English name „Seminar on Agronomical Properties of Agricultural Materials as Related to Machine Design 1993". This is the name of scientific seminar held on October 11 - 13, 1993 at the Faculty of Mechanization of the University of Agriculture in Nitra, prepared by the staff of the Department of Machinery and Manufacturing Systems and the Department of Physics. 24 foreign participants and 62 domestic specialists were present in the scientific seminar.

Debates of the seminar proceeded in the plenum, i. e. in a single section. The subject of the scientific seminar were the following thematic issues:

- agrophysical properties of cereals, potatoes, sugar beet, and other agricultural materials and products,
- physical properties of soil and fertilizers,
- the use of agrophysical properties in the design of machines, in agricultural technologies and in agricultural power engineering.

19 papers and 12 posters were given at the seminar. The part of the scientific seminar SAPAM '93 was a special excursion into agricultural and processing enterprises and some social activities. Discussions in smaller groups concerning the cooperation and exchange of experience were held too. In common social activities new personal contacts were made and the participants exchanged their experience and opinions.

The scientific seminar was a culmination of presenting the results of research project, solved in the years 1990 to 1993, achieved at the above-mentioned workplaces of the Faculty of mechanization under the name „The Connection between Biological Material with Components of Farm Machinery."

For the years 1993 to 1996 the team of the staff of the Department of machinery and Manufacturing Systems proposed a new research project „Machines and their Working Mechanisms Affecting the Technological Systems of Potato, Root Vegetables and Sugar Beet Cultivation under the Conditions of Sustainable Agriculture."

The proceedings of the annotations of papers and posters given at the scientific seminar SAPAM '93 were published only. For this reason, we much appreciate that the Editorial Board of the journal Zemědělská Technika has enabled to publish some of the papers. We suppose that the published original scientific studies will meet with a good response in readers.

The list of given papers and posters is presented in the section of this issue.

Ad revidendum at SAPAM '96.

Prof. Ing. Ján J e c h , CSc.

SAPAM '93 is an abbreviation of an English name „Seminar on Agrophysical Properties of Agricultural Materials as Related to Machine Design 1993". This is the name of scientific seminar held on October 11 - 13, 1993 at the Faculty of Mechanization of the University of Agriculture in Nitra, prepared by the staff of the Department of Machinery and Manufacturing Systems and the Department of Physics. 24 foreign participants and 62 domestic specialists were present in the scientific seminar.

Debates of the seminar proceeded in the plenum, i. e. in a single section. The subject of the scientific seminar were the following thematic issues:

- agrophysical properties of cereals, potatoes, sugar beet, and other agricultural materials and products,
- physical properties of soil and fertilizers,
- the use of agrophysical properties in the design of machines, in agricultural technologies and in agricultural power engineering.

19 papers and 12 posters were given at the seminar. The part of the scientific seminar SAPAM '93 was a special excursion into agricultural and processing enterprises and some social activities. Discussions in smaller groups concerning the cooperation and exchange of experience were held too. In common social activities new personal contacts were made and the participants exchanged their experience and opinions.

The scientific seminar was a culmination of presenting the results of research project, solved in the years 1990 to 1993, achieved at the above-mentioned workplaces of the Faculty of mechanization under the name „The Connection between Biological Material with Components of Farm Machinery."

For the years 1993 to 1996 the team of the staff of the Department of machinery and Manufacturing Systems proposed a new research project „Machines and their Working Mechanisms Affecting the Technological Systems of Potato, Root Vegetables and Sugar Beet Cultivation under the Conditions of Sustainable Agriculture."

The proceedings of the annotations of papers and posters given at the scientific seminar SAPAM '93 were published only. For this reason, we much appreciate that the Editorial Board of the journal Zemědělská Technika has enabled to publish some of the papers. We suppose that the published original scientific studies will meet with a good response in readers.

The list of given papers and posters is presented in the section of this issue.

Ad revidendum at SAPAM '96.

Prof. Ing. Ján Jech, CSc.

STRESS CRACKS DURING SEED CORN DRYING

V. Náplava, H. Weingartman

Universität für Bodenkultur, Wien

The artificial drying of the fresh-harvested cobs is performed by flows of hot air. Changes in the volume due to loss of water, during this process, lead to tensions inside the kernel. This is due to endosperm cracks, wich are called stress cracks. Kernels with damaged endosperm have a smaller consistence. This is a reason for secondary damage during conditioning. The aim of this project is to investigate the damage to corn caused by the process of drying. The research was done in three parts:

1. The investigation of the level of temperature at which stress cracks develop.

2. The investigation of the influence of the number of stress cracks on the corn stability.

3. The investigation of stress cracks with electrical conductivity.

Kernels without any external damage were tested and categorized as no, single, double and multiple stress cracks. The stress cracks analysis and compression testing gave the following results:

- If the initial drying temperature is higher than 45 °C, the number of stress cracks will be greater.

- Large round kernels have a higher number of stress cracks.

- The compression force decrease with the number of stress cracks.

- There was no difference in conductivity rest between undamaged kernels and kernels with stress cracks identified.

- Drying air temperature and sensibility of hybrid have been recognized as the major reasons affecting the stress cracks and therefore the quality of corn.

corn drying; stress craks; damage; compression

In Europe the corn seed harvest is carried out at a grain moisture of 30 to 40 %, the so-called Corn picker (Bourgoin-GX 306, 406). To obtain the damage as low as possible during post-harvest processing and in particular loss-free storage, the kernels have to be dried to a moisture of 12 to 13 %. Drying of corn seed cobs is done in two- or three-phase hot-air box driers. Heat transport and water withdrawal are done via air flow (350 to 400 m^3/m^3 per hour). Changes in the volume of kernels during the loss (evaporation) of water causes a tension inside the kernels due to which soft (fine) cracks in endosperm develop, called stress cracks (maximum size of 58 + 14 μm). These cracks, so-called primary damage, are a cause of secondary damage, cracks of kernels into two or more parts during further post-harvest processing and transportation.

Stress cracks according to their number are classified into:

none-stress cracks	NSC
single-stress crack	SSC
double-stress cracks	DSC
multiple-stress cracks	MSC

Mechanization of operational process during harvest, drying and post-harvest processing of corn seed increases the percentage of damage to kernels, and thus reduces the seed quality. Aim of my study was to find the type of intensity and determination of critical places of mechanical damage to corn seed during drying and post-harvest processing.

MATERIAL AND METHODS

Two hybrids Dea (3839) and Helga (3902) were tested:

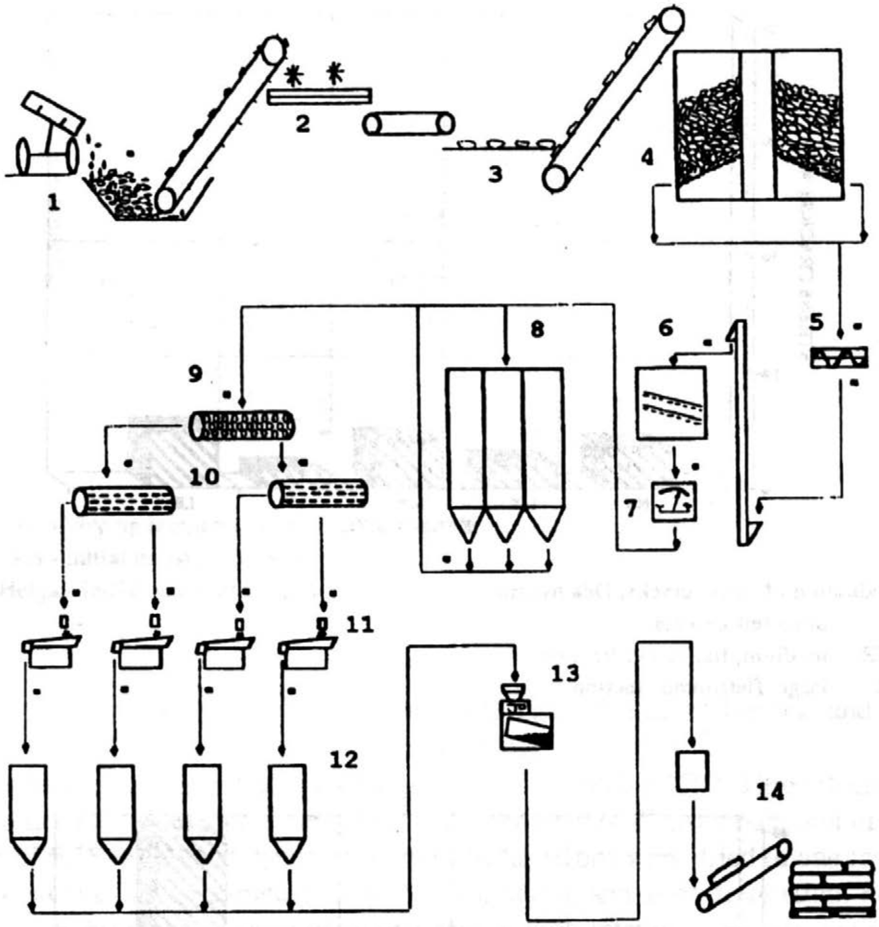
- Dea, medium-early single hybrid, FA 290, flint character,
- Helga, medium-early single hybrid, FA 290, dent character.

Two various parts of each hybrid were tested. Samples were taken during both the seasons in the PIONEER Company, Parndorf. Cobs were torn off manually after drying, all samples were stored in the plastic boxes at BOKU Vienna.

Drying and post-harvest processing of two hybrids (Dea and Helga) of corn seed supplied by the firm PIONEER Saaten GmbH, Parndorf, Austria (Fig. 1) supplemented by experimental tests at BOKU Vienna and Bundesanstalt für Pflanzenbau Wien.

For the reasons of accurate determination of frequency and development of mechanical damage and its effect on the biological value of the seed, the following tests were accomplished:

- DYE TEST 0.1 % Naphthol Blue Black solution to dip for 30 sec
  to wash out the seed under the flowing water
- ISTA WARMTEST +25 °C, 90 - 95 % of relative humidity lighting 8h/day, 6 days
- ISTA COLDTEST +10 °C, 85 % relative humidity, 7 days
  +25 °C, 90 - 95 % of relative humidity, 6 days
- ELECTRIC CONDUCTIVITY (ASAC-1000, HI 8733)
  Measurement of electric conductivity in solution; seed dipped in distilled or deionized water.
- STRESS CRACKS ANALYSIS
  Kernels without any external damage placed by a shoot downside on non-transparent glassy plate. White light of 100 W intensity penetrates the opening in plate (about 2.5 mm) and kernel. The number of stress cracks is a selection criterion.



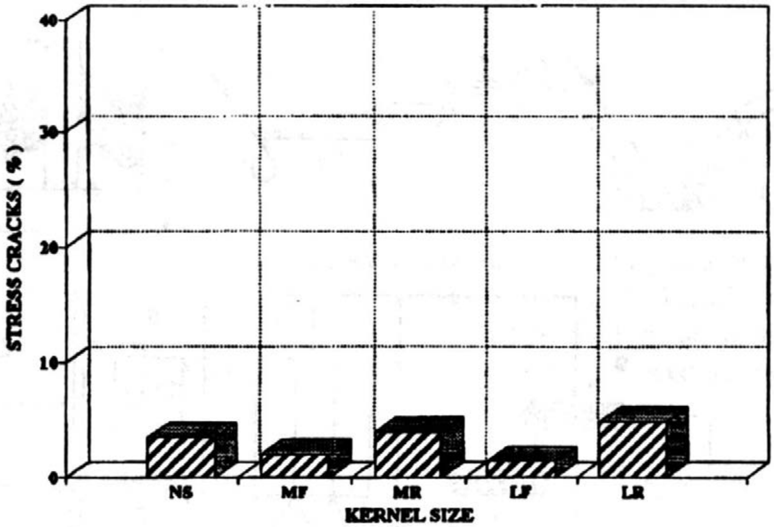
1. Diagram of operational process

1. Uptake of cobs
2. Defoliation
3. Manual sorting
4. Drying boxes
5. Corn sheller
6. Pre-treatment
7. Automated weighing
8. Force (pre-treated seed)
9. Calibrating (round hole screens)
10. Calibrating (slot screens)
11. Pneumatic air-operated
12. Inter-tanks of sorted seed
13. Treatment
14. Bagging, marking, palletization

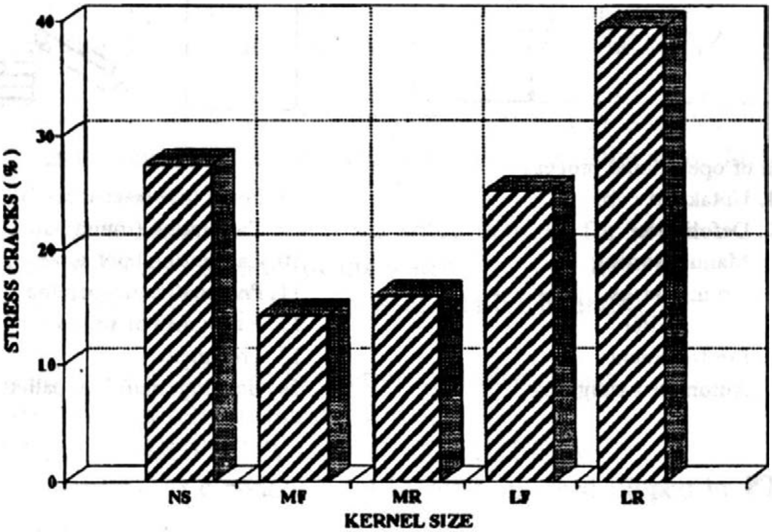
RESULTS

Finding the initial temperature of corn seed drying at which stress cracks appear

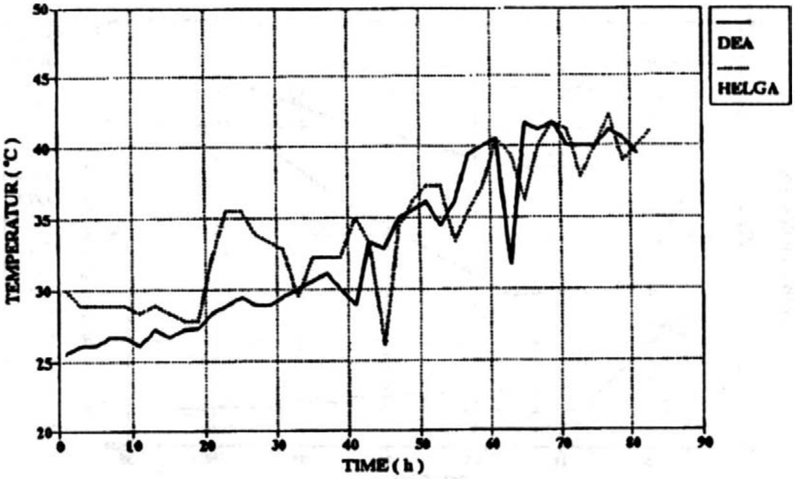
Following the DYE test and subsequent analysis for stress cracks it was sound that the Helga hybrid has much higher number of stress cracks compared to the Dea hybrid (Figs. 2a, b) yet after drying, though the drying temperatures were almost identical (Fig. 3).



2a. Evaluation of stress cracks, Dea hybrid
NS - unsorted kernels
MF/MR - medium, flat/round fraction
LF/LR - large, flat/round fraction



2b. Evaluation of stress cracks, Helga hybrid
NS - unsorted kernels
MF/MR - medium, flat/round fraction
LF/LR - large, flat/round fraction



3. Course of drying temperatures of the Dea and Helga hybrids in Parndorf
—— Dea - initial moisture 33.8 %
- - - - Helga - initial moisture 33.2 %

For this reason a part of my research was concentrated on the rise and development of stress cracks during corn seed drying.

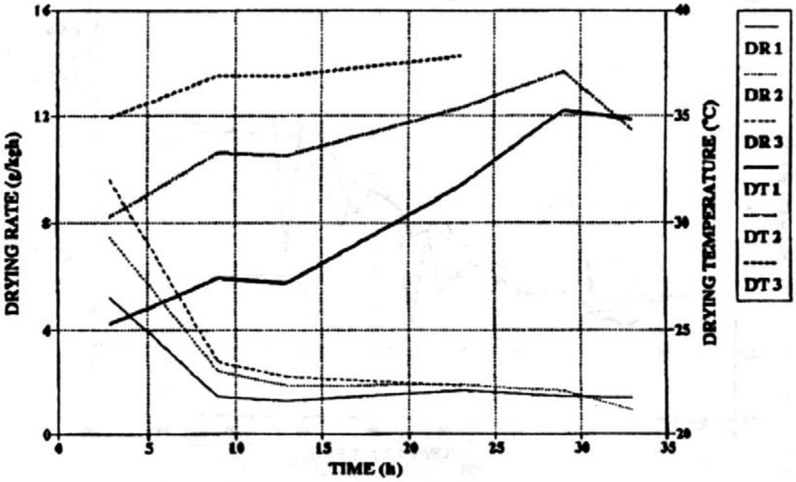
Tests were accomplished in the harvest season of 1992 to 1993. Three electrically heated drying devices were designed for measurements. Constant amount of air of a rate of 0.18 m/sec was supplied by built-in fan. Cobs were dried in one layer on drying sieves (air temperature 25 to 50 °C), before and after defoliation. For the reasons of the determination of drying rate in time intervals measurements were performed together with the determination of kernel moisture (Dickey John, Wile 35-Humic OY).

The following values were measured graphically during drying by personal computer:

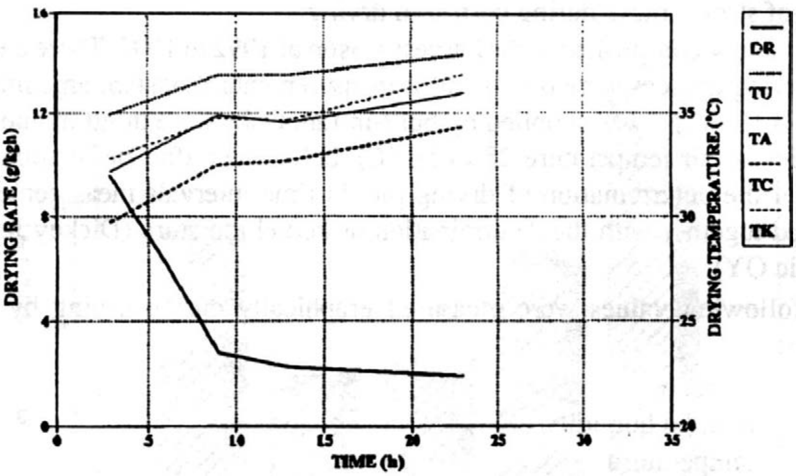
a) input air pressure
relative humidity
temperature

b) in each device temperature below drying sieve
temperature above drying sieve
kernel temperature
rachis temperature

Diagram of the course of temperatures show Figs. 4, 5. After drying the cobs were manually torn off, ISTA Warm, Kalttest, and DYE tests were executed. The analysis for stress cracks was carried out in kernels without any external damage.



4. Laboratory drying, Helga, 28. 9. 1992
DR1, DR2, DR3 - rate of drying in the first, second, third drying devices
DT1, DT2, DT3 - temperatures below the sieve in the first, second, and third drying device



5. Laboratory drying, Helga, 28. 9. 1992, third drying device
DR - rate of drying
TU - temperature below drying sieve
TA - temperature above drying sieve
TC- rachis temperature
TK - kernel temperature

I. Laboratory drying, BOKU Wien - DEA

Date	T_i (°C)	M_i (%)	M_f (%)	T_d (h)	WT (%)	CT (%)	Stress cracks (%)		
							S[1]	D[2]	M[3]
29. 9. 1992	25.4*	23.9	13.0	29	97	99	0.5	0.0	0.0
	29.8*	23.9	11.9	29	98	97	0.5	0.0	0.0
	33.7*	23.9	12.0	25	97	93	1.0	0.0	0.0
1. 10. 1992	34.1	24.2	11.9	27	96	95	1.0	0.0	0.0
	37.3	24.2	11.9	21	94	99	1.5	0.5	0.0
	40.7	24.2	10.9	21	96	98	5.0	0.0	0.0
2. 10. 1992	32.6*	23.9	12.0	27	96	96	0.5	0.0	0.0
	35.4*	23.9	11.8	21	98	93	2.0	0.0	0.0
	38.5*	23.9	11.3	21	96	96	2.5	0.0	0.0
5. 10. 1992	30.4*	24.2	12.6	27	94	95	0.5	0.0	0.0
	35.5*	24.2	12.4	27	94	93	3.0	0.0	0.0
	39.4*	24.2	11.4	25	94	91	5.0	0.0	0.0
6. 10. 1992	30.6*	23.4	12.6	25	94	98	1.5	0.0	0.0
	33.4*	23.4	12.4	21	96	96	2.5	0.0	0.0
	40.0*	23.4	11.9	19	96	97	4.5	0.0	0.0
7. 10. 1992	30.5*	23.7	12.5	23	95	95	1.0	0.0	0.0
	33.6*	23.7	12.0	23	95	94	7.5	0.5	0.0
	41.5	23.7	11.6	19	96	95	8.5	0.0	0.5
9. 10. 1992	37.0	23.8	12.8	23	97	96	6.5	0.0	0.0

T_i - initial drying temperature
M_i - initial kernel moisture
M_f - final kernel moisture
T_d - time of drying

(*) - increase in drying temperature
(–) - falling of drying temperature
( ) - constant drying temperature
WT, CT - Warm-, Kalttest

[1]single stress cracks; [2]double stress cracks; [3]multiple stress cracks

It follows from the results of measurements:

- higher initial temperature of drying in the Dea hybrid results only in a slight increase in number of stress cracks, seed germination, too, is not markedly reduced (Tab. I),
- higher initial temperature of drying in the Helga hybrid results in higher number of stress cracks, what had adverse effects in the seed germination (in particular ISTA Kalttest) (Tab. II).

II. Laboratory drying, BOKU Wien - HELGA

Date	T_i (°C)	M_i (%)	M_f (%)	T_d (h)	WT (%)	CT (%)	Stress cracks (%)		
							S[1]	D[2]	M[3]
	29.1*	26.3	13.6	43	97	82	1.5	0.5	0.5
14. 9. 1992	44.3-	26.3	12.5	41	94	79	10.5	6.0	0.0
	46.6	26.3	13.8	20	90	58	44.0	14.0	1.5
	29.2*	26.4	12.0	51	97	78	7.0	2.5	1.0
17. 9. 1992	37.9*	26.4	11.5	49	95	78	18.0	4.5	0.5
	47.2	26.4	11.4	37	93	72	26.0	7.0	1.0
	28.3*	26.1	13.8	53	95	81	4.0	0.5	0.5
20. 9. 1992	33.3*	26.1	13.0	53	94	81	5.0	1.0	0.0
	36.7*	26.1	10.5	53	93	79	9.0	1.0	0.5
	26.5*	24.5	13.5	35	96	83	3.0	1.0	0.0
23. 9. 1992	30.5*	24.5	12.4	33	93	77	5.0	1.0	0.0
	34.3*	24.5	11.7	27	95	71	9.0	3.5	0.0
	25.7*	23.4	12.8	39	97	78	1.5	1.0	0.0
24. 9. 1992	30.2*	23.4	12.3	39	96	83	3.5	0.0	0.0
	34.9*	23.4	12.4	29	93	74	9.5	2.0	0.0
	25.4*	24.1	13.6	33	97	93	1.0	0.0	0.0
28. 9. 1992	30.2*	24.1	13.0	31	98	78	2.5	1.0	0.0
	34.9*	24.1	12.4	23	98	81	5.0	0.0	0.0
9. 10. 1992	37.1	23.4	13.0	23	96	75	4.0	1.0	0.0
	42.0	23.4	11.9	23	92	58	9.5	1.0	0.0

T_i - initial drying temperature
M_i - initial kernel moisture
M_f - final kernel moisture
T_d - time of drying

(*) - increase in drying temperature
(–) - falling of drying temperature
( ) - constant drying temperature
WT, CT - Warm-, Kalttest

[1]single stress cracks; [2]double stress cracks; [3]multiple stress cracks

Finding the effect of the number of stress cracks on the kernel stability

The seed of the season 1991 to 1992 was used in this part of the experiment. The seed was taken after drying in Parndorf. The kernels from manually torn off cobs was sieved in such a way to obtain the same fractions as in the actual operational process. The LR (large round, 8 to 10 mm kernel width) fraction was subjected to tests, as it had the highest number of stress cracks in both harvest seasons. The measuring device Instron was used for testing the quasi-static compression. The kernels were placed by a shoot downside between two parallel plates, constant deformation rate of the upper plate was 5 mm/min. 100 kernels were tested in each group. The results were recorded and assessed by personal computer.

It follows from the results of measurements:

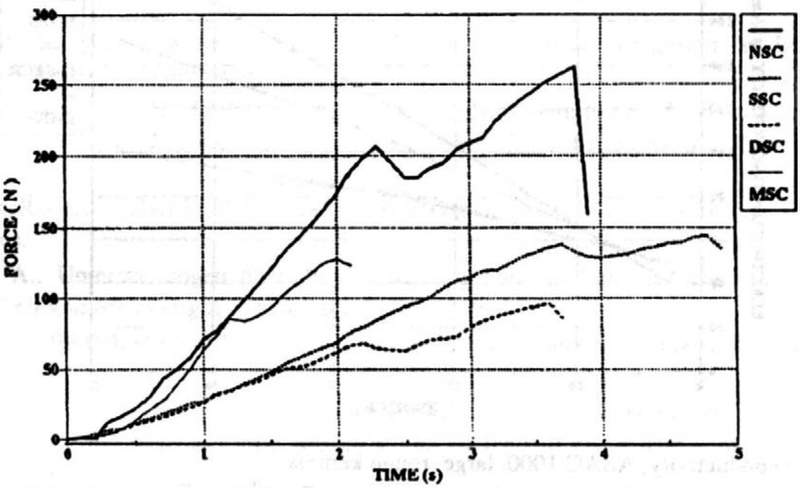
- kernels with stress cracks do not display bio-yield point (Fig. 6),
- presence of stress cracks reduces the size of compression force needed for crack of kernel (rupture point) (Fig. 7).

Finding stress cracks by electric conductivity

Electric conductivity was measured by the device ASAC-1000 (kernels were measured individually) at Bundesanstalt für Pflanzenbau in Vienna. The same seed of the Dea and Helga hybrids was used.

It follows from the results of measurement (Fig. 8):

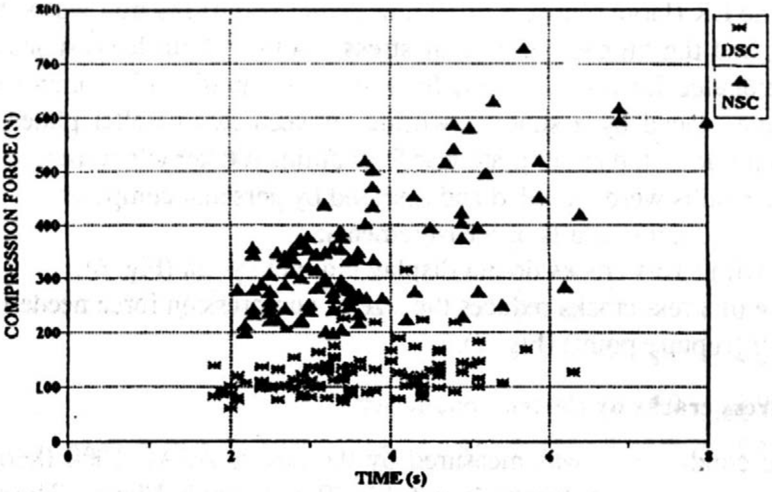
- differences between undamaged kernels and kernels with stress cracks were not found out by measurements in the Dea hybrid,
- significant differences were found out by measurements not earlier than after 24 hours of measurements, what means that this method is not suitable for analysis of stress cracks. (Higher values of electric conductivity in the Helga hybrid were measured in all kinds of damage to pericarp.)



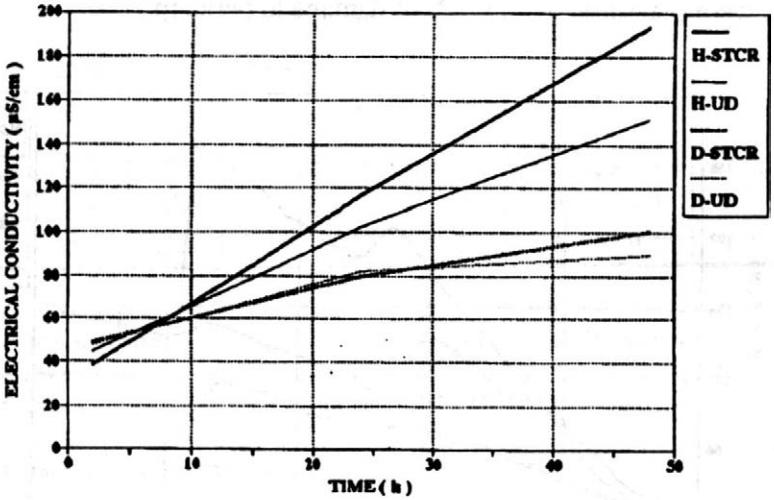
6. Deformation curves, Helga hybrid, large, round kernels, deformation rate 5 mm/min

NSC - none stress cracks **DSC - double stress cracks**

SSC - single stress cracks **MSC - multiple stress cracks**



7. Compression force vs. time of cracking, Helga, large, round kernels, deformation rate 5mm/min
DSC - double stress cracks
NSC - none stress cracks



8. Electric conductivity, ASAC 1000, large, round kernels

H - STCR - Helga hybrid - stress cracks
H - UD - Helga hybrid - none stress cracks
D - STRC - Dea hybrid - stress cracks
D - UD -Dea hybrid - none stress cracks

CONCLUSION

Major factors affecting the development of stress cracks are as follows:
Sensibility of hybrid - Significant differences between the Dea and Helga hybrids were found out during tests.
Initial drying temperature in dependence on kernel moisture - Higher initial drying temperature in the Helga hybrid resulted in higher number of stress cracks.
Kernel size - The highest number of stress cracks was always found in large round fraction in both hybrids.

References

BALASTREIRE, L. A. - HERUM, F. L. - STEVENS, K. K. -BLAISDELL, J. L.: Fracture of corn endosperm in Bending, Part I.Fracture Parameters. Trans. ASAE, *25*, 1982 (4).

GUNASEKARAN, S. - COOPER, T. M. - BERLAGE, A. G. - KRISHNAN, P.: Image processing for Stress Cracks in corn kernels. Trans. ASAE, *30*, 1987 (1).

GUNASEKARAN, S. - DESHPANDE, S. S. - PAULSEN, M. R. - SHOVE, G. C.: Size characterization of Stress Cracks in corn kernels. Trans. ASAE, *28*, 1985 (5).

GUNASEKARAN,S. - PAUSELN, M. R.:Breakage resistance of corn as a function of drying rates. Trans. ASAE, *28*, 1985 (6).

GUNASEKARAN, S. - PAUSELN, M. R. - SHOVE, G. C.: A laser optical method for detecting corn kernels defects. Trans. ASAE, *29*, 1986 (1).

HUSS, W.: Die Struktur des Maiskorns nach Trocknung unter verschiedenen Bedingungen. Mais 3/76, 1976.

KUSTERMANN, M.: Beanspruchung realer Körper durch Stoß - dargestelt am Beispiel des Schlages gegen ein Maiskorn. [Dissertation.] 1986.

KUSTERMANN, M. - KUTZBACH, H. D.: Der Einfluß thermischer Vorbehandlung auf die statische Festigkeit von Maiskörner. Grundl. Landtechn., *31*, 1981 (5); Grundl. Landtechn., *32*, 1982 (1).

SCHERER, R. - KUTZBACH, H. D.: Das Festigkeitsverhalten des Maiskorns. Grundl. Landtechn., *28*, 1978 (6).

SPITTEL, A.: Untersuchungen über die Auswirkung dynamischer Beanspruchungen auf die Keimfähigkeit von Maissaatgut. [Dissertation.] Bonn, 1984.

SPITTEL, A. - BRINKMANN, W.: Zur Qualitätbeeinflussung bei der Saatmaisaufbereitung. Mais 3/85, 1985.

WELLER, C. L. - PAULSEN, M. R. - STEINBERG, M. P.: Stress cracking and breakage susceptibility as affected by moisture content at harvest for four yelow dent corn hybrids. Trans. ASAE, *33*, 1990 (3).

Received for publication December 9, 1993

Náplava, V. - Weingartman, H. (Pôdohospodárska univerzita, Viedeň):

Napäťové lomy počas sušenia osivovej kukurice.

Zeměd. Techn., *40*, 1994 (1): 3-14.

Umelé sušenie čerstvo pozberaných šúľkov kukurice sa zabezpečuje vháňaním ohriateho vzduchu. Objemové zmeny v dôsledku straty vody počas tohto procesu vedú k vzniku napätia vo vnútri zŕn. Toto je príčinou praskania endospermu. Pre tento jav možno použiť výraz „napäťové lomy". Zrno s poškodeným endospermom má menšiu hustotu. Pri pozberovom spracovaní vznikajú ďalej druhotné poškodenia. Cieľom tohto príspevku je skúmanie poškodenie zrna, ktoré vzniká v procese sušenia. Skúmanie problému bolo realizované v troch etapách:

1. skúmanie úrovne teploty, pri ktorej napäťové lomy vznikajú,
2. výskum vplyvu počtu napäťových lomov na stabilitu zrna,
3. výskum vplyvu napäťových lomov zrna na elektrickú vodivosť.

Zrná bez akéhokoľvek vonkajšieho poškodenia boli testované a zaradené do skupín: bez lomu, jeden lom, dva lomy a viac napäťových lomov.

Analýza napäťových lomov a stláčacie testy umožnili získať nasledovné výsledky:

- v prípade, že počiatočná sušiaca teplota je vyššia ako 45 °C, počet napäťových lomov je vyšší,
- vo veľkých okrúhlych zrnách dochádza k väčšiemu počtu napäťových lomov,
- stláčacia sila sa znižuje s počtom napäťových lomov,
- neboli zistené rozdiely v testoch vodivosti medzi nepoškodenými zrnami a zrnami identifikovanými s napäťovými lomami,
- teplotu sušiaceho vzduchu a citlivosť hybridov možno považovať za hlavnú príčinu ovplyvňujúcu napäťové lomy a z toho dôvodu aj kvalitu zrna.

sušenie zrna; napäťové lomy; poškodenie; stláčanie

Contact Address:

Dipl.-Ing. Vladimír N á p l a v a , Universität für Bodenkultur, Peter Jordan-Strasse 82, A-1190 Wien, Österreich

---

IDENTIFICATION OF MECHANICAL DAMAGE TO SEEDS BY PHYSICAL METHODS

J. Pecen

University of Agriculture, Prague

Seed damage, its identification and classification and its quantitative evaluation, are still a vivid problem. There are many ways and methods how to accomplish it. In the time, when the quality of materials and products is required and emphasized more and more, the damage is to be detected and evaluated more carefully, as some kinds of damage affect the qualitative properties of seeds. An attention here is paid only to mechanical damage to grain, internal and external, in view of possibilities how to detect it. The external damage to seeds was detected by the method of image analysis. The internal mechanical damage to seeds was detected by the X-ray method in particular. Other methods for determination of damage, e.g. colorimetric and conductomertic methods, are discussed briefly. Grains of wheat, barley, and molt were used for experiments. The results obtained were not linked with biological damage to seeds in any case.

image analysis; roentgenogram; mechanical damage; internal damage; stress cracks; cracks; seeds

Damage to grain, its identification, classification and quantitative evaluation, are the problem still very topical. They are many methods and ways how to accomplish it. In the time when quality is emphasized and required more and more, the damage is to be detected and evaluate as well as some kinds of garin damage affect its qualitative properties. For this reason, there is a tendency to offer objective results based on simple and reliable in detection of grain damage. An attention here is paid only to mechanical damage to grain (out of many kinds of damage), external and internal, in particular in view of possibilities of its detection. General reasons for this orientation of the study are referred to by P e c e n et al. (1992). Though the presented work concerns mainly with the wheat grain damage, most of the presented reasons are of more general application.

SURVEY OF PRESENT SITUATION

Direct visual observations and evaluation of the damage is very difficult without using any, though simple aids. They are limited by distinguishing capacity of a human observer. In spite of it, as reported by M b u v i et al. (1989), the damage can be rather well determined using the different properties of the sample under study, though it is not exclusively mechanical damage. External grain damage can be detected either directly visually or better, using some of the colouring methods. For the above reason, image analysis method seems to be suitable, as reported K i m et al. (1990). Results of the study, based on this method, compared with the results obtained by human observers are reported by C h u r c h i l (1990). The results presented confirm the suitability of the use of the image analysis method. This method is used e.g. for morphological evaluation and characteristics of individual wheat cultivars, as presented by K e e f e and D r a p e r (1986). A similar problem was solved by B e r l a g e et al. (1988) and N e u m a n et al. (1987).

Conductometric and colorimetric methods are used for determination of internal damage. Their comparison is reported by G r u n d a s et al. (1989). Both the methods, in case of their use, manifest completely identical results in dependence on the size of mechanical damage. The use of X-ray apparatus for identification of internal damage of grain is reported by P e c e n (1993). The procedure as described by N i e w c z a s (1991) can be used to evaluate the roentgenogram, and thus also to quantify internal damage. T o l l n e r and M u r p h y (1991) are concerned with the absorption of X-ray radiation in passing through biological materials and soil.

The method of image analysis and roentgenographic method are used most frequently out of many other ways of external and internal grain damage detection. S a r w a r and K u n z e (1989) are dealing with some of the causes of grain mechanical damage.

METHODS USED DETERMINATION OF GRAIN DAMAGE

Direct visual observations

To detect external damage to grain, simple aids, such as magnifying glass, or colouring agent, are enough. The results obtained may be subjective to a high degree. Internal damage to grain is usually associated with its mechanical strength. This can be used for the standard test determining the susceptibility of grain to breaking. This fact may be associated with a degree of mechanical damage to grain.

Colouring methods

They use e.g. tetrazolium solution colouring live cells into red. The modifications of this method are used to achieve better and faster penetration of the colouring agent into the grain. Simultaneously with it, the solution Fast Green is used for these targets. This method was successfully used also for wheat to test susceptibility of individual wheat cultivars to damage. To make visible the external grain damage, practically any suitable organic colouring agent, which can adhere to damaged parts, may be applied.

Colorimetric method

The solution Fast Green is applied like in colouring methods, though with a difference that the colouring agent, adhered mainly to bare parts of damaged endosperm of grain, is washed out of the sample by soda lye and an area of absorbance and transmittance of this solution is measured. If the times of different working phases of the test are preserved sufficiently accurately, there is a good reproducibility. This procedure can detect internal damage to seeds as a mean value of small sample, not of individual grains.

Conductometric method

The method is based upon knowledge that the grains dipped into distilled water form gradually conductive solution from water - electrolyte whose conductivity is proportional to concentration. A high value of conductivity can be used as an indicator of bad membrane and this can be linked with the grain damage. This method, modified in such a way that individual grains are measured, has good results e.g. in examination of germination capacity.

Direct optical methods

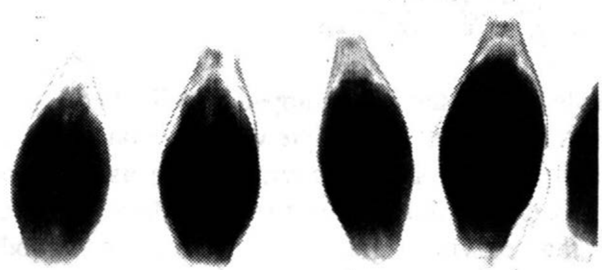
They are used as non-destructive methodologies to identify the stress cracks in kernels. For example the use of laser for identification of internal cracks is not suitable, but on the contrary very good for the detection of external damage. Ultrasound was of low efficiency for the detection of internal damage. The visible light applied form marked differences in intensity on fracture surfaces or stress cracks of grain endosperm.

Method of delayed luminescence

This method is accurate enough, though demanding for equipment and operation. Various degrees of damage can be detected by it, and to distinguish different cultivars from each other. Disadvantage consists in great time dependence of emitted and recorded electro-magnetic radiation. The method is suitable to be used in laboratory conditions.

X-ray method

The method is based upon absorption of soft X-ray radiation during passage through the sample under review. The roentgenogram obtained on a flat film records rather good the situation inside the grain. „Wet“ process of film development and long-exposure times prevent the practical and available use of this method, together with manual processing of roentgenogram obtained particularly. Otherwise, this method provides the most information regarding the actual state of the „grain inside“ (Fig. 1, 2). The latter disadvantage should be removed by using the method of image analysis by which each roentgenogram should be processed very quickly. This should result e.g. in certain value expressing the degree and danger of grain damage, as proposed by e.g. N i e w c z a s (1991).

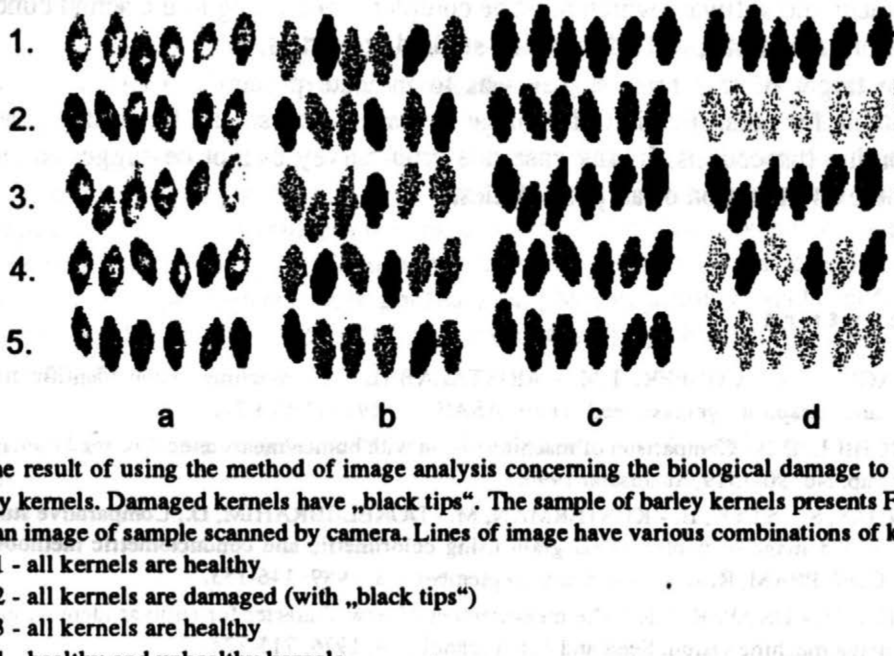


1. Roentgenogram of endosperm of spring barley kernels. The cracks in endosperm of kernels are light lines, as the image is negative. Cracks are spread the most frequently in normal cross section (referred to long axis of kernel)

2. Endosperm of molt kernels. Longitudinal cracks are visible, besides many normal crack. All crack are mechanical ones as a result of extremely high humidity and temperature during drying process

Method of image analysis

This is very perfect tool with huge possibilities. The sample is scanned by camera (vidicon camera or CCD camera), and an image obtained is digitalized and stored in binary form in the computer memory. The binary file, stored in such a way and representing the image scanned, can serve for different mathematic operations. Following the modifications, the result is again displayed on the screen of monitor in the usual form. The time needed for modifications depends on the quantity of samples, kind (complexity) and speed of computer and may be practically negligible in some cases, i.e. the computer works in real time. In dependence on technical equipment and particular software such information can be obtained which should be achieved with difficulties in other way. Using this method to analyze the samples of cereals, information on grain damage (in combination with X-ray apparatus on internal grain damage), information on morphology of individual grains in sample, their physical dimensions, biological damage, etc. (Fig. 3). This method seems to



3. The result of using the method of image analysis concerning the biological damage to spring barley kernels. Damaged kernels have „black tips". The sample of barley kernels presents Fig. 3a. It is an image of sample scanned by camera. Lines of image have various combinations of kernels
line 1 - all kernels are healthy
line 2 - all kernels are damaged (with „black tips")
line 3 - all kernels are healthy
line 4 - healthy and unhealthy kernels
line 5 - all kernels with „black tips"
Lines in Figs. 3b, 3c represent the lines on Fig. 3a. Various shades of black colour of single barley kernels in Figs. 3b and 3c represent the different values of setting up the accuracy to distinguish healthy and unhealthy kernels. This corresponds to the significance of this phase in the total image processing. Fig. 3d represents the result of the whole processing and corresponds exactly to the image sample in Fig. 3a. Healthy kernels in Fig. 3d are of dark black colour and unhealthy kernels are of light colour

be promising in the future, not all its faculties are utilized now. Potentially it represents a practical tool for routine and sufficiently profound inspection of grain damage (mechanical and biological).

DISCUSSION AND CONCLUSION

It follows from comparison of possibilities offering by different methods for detection of the size and kind of damage to grains that the most effective seems to be the method of image analysis and in combination with Y-ray method for identification of internal damage to grain. Furthermore, a greater attention and more studies should be given to colorimetric method for its simplicity, though it submits „mean“ results. The method of image analysis seems to be good also for identification of „biological“ damage to grain, not only mechanical. As reported by Churchill (1990), the results obtained by the above-mentioned methods are more reliable than those obtained by a human being. Simultaneously with it, processing of data is immediate. Some disadvantage consists in higher expenses for the whole equipment and software which must be completed according to the actual concrete conditions (kind of specified material, studied properties, etc.).

The target of this brief survey was to indicate properties of some methods acceptable for quantification of damage to grain which should be used in practice for routine inspections. In any case this brief survey cannot be suggested as the complete enumeration of all possibilities.

Literature

BERLAGE, A.G. - COOPER, T.M. - ARISTAZABAL, J.F.: Machine vision identification of diploid and tetraploid ryegrass seed. Trans. ASAE, *31*, 1988 (1): 24-27.

CHURCHILL, D.B.: Comparison of machine vision with human measurement of seed dimension. ASAE Pap. No. 90-7519, St. Joseph 1990.

GRUNDAS, S. - STYK, B. - KUSTERMAN, M. - DOREL-IBRAHIM, D.: Comparative study of mechanical damage to winter wheat grain using colorimetric and conductometric methods. 4th Intern. Conf. PPAM, Rostock, Germany, September 4-8, 1989: 146-153.

KEEFE, P.D. - DRAPER, S.R.: The measurement of new character for cultivar identification in wheat using machine vision. Seed and Sci. Technol., *14*, 1976: 715-724.

KIM, CH. - RIED, J.F. - PAULSEN, M.R.: Evalution of machine vision system for corn stress-crack detection. ASAE Pap. No. 90-7051, St. Joseph 1990.

MBUVI, S.W. - LICHTFIELD, J.B. - SINCLAIR, J.B.: Physical properties of soybean seeds damaged by fungi and virus. Trans. ASAE, *32*, 1989 (6): 2093-2096.

NEUMAN, M. - SAPIRSTEIN H.D. - SHWEDYK, E. - BUSHUK, W.: Discrimination of wheat class and variety by digital image analysis of whole grain samples. J. Cereal Sci., 1987 (6): 125-132.

NIEWCZAS, J.: The method of determination of the index of mechanical damage of a single kernel by means of X-ray detection. In: Zesz. probl. Post. Nauk rol., 1991 (398): 89-95. Instytut Agrofyziky PAN, Lublin, Poland.

PECEN, J.: Internal damage identification of seeds. 5th Int. Conf. PPAM, Bonn, Germany, September 6-8, 1993, Pap. No. 93-1135.

PECEN, J. - GRUNDAS, S. - VELIKANOV, L.: On the need for studies on mechanical damage to wheat grain. In: Proc. int. Conf. - Trends in agricultural engineering, Prague, Sept. 15-18, 1992: 398-403.

SARWAR, G. - KUNZE, O.R.: Relative humidity increases that cause stress-cracks in corn. Trans. ASAE, *32*, 1989 (5): 1737-1743.

TOLLNER E.W. - MURPHY, C.: Factors affecting soil X-ray absorption coefficients with computer tomography. Trans. ASAE, *34*, 1991 (3): 1047-1053.

Received for publication December 9, 1993

PECEN, J. (Vysoká škola zemědělská, Praha):

Fyzikální metody identifikace mechanického poškození semen.

Zeměd. Techn., *40*, 1994 (1): 15-21.

Jsou uvedeny různé metody pro detekci mechanického poškození semen (pro vnitřní a vnější poškození semen). Pro charakteristiku semen a jejich vnějšího poškození je použita hlavně metoda analýzy obrazu. Pro srovnání jsou uvedeny různé způsoby a varianty této metody včetně vlastních výsledků. Vnitřní poškození semen bylo detekováno především za použití rentgenu. Obrázek semen (jejich endosperm) může být zpracován touto metodou (analýzy obrazu) a tím zároveň můžeme kvantifikovat poškození semen. Jsou uvedeny i další metody pro určení poškození, např. colorimetrická, vodivostní. V experimentech byla použita zrna pšenice, ječmene, sladu, čočky atd. Získané výsledky nebyly v žádném případě spojovány s jakýmkoli biologickým poškozením semen.

analýza obrazu; rentgenogram; mechanické poškození; vnitřní poškození; trhliny; semena

---

Contact Address:

Doc. ing. Josef P e c e n , CSc., Vysoká škola zemědělská, 165 21 Praha 6-Suchdol

---

MECHANICAL DAMAGE TO PEA GRAINS BY IMPACT

J. Jech, J. Artim, R. Kichi

University of Agriculture, Nitra

The effect of a mechanical impact loading on pea grain damage and germination were investigated. Grain pea variety Belinda were used with the grain moisture content 7,2-12,5 %. Seed quality were studied in relation to the height of the free fall of the grain, incline angle of the plate, material of the plate and grain moisture content. Height of 4 m is considered as critical height of free fall. Neverthelles, even minimal height falling have caused a grain damage and decreasing of grain germination. Effect of the falling angle of the grain is favourite when this angle is 60 degreas. The rubber is considered as a most suitable material, while steel plate is most unsuitable. The effect of the grain moisture content is very significant. Overdried pea grains (grain moisture content less than 9 %) are sensitive to damage when mechanicaly loaded. Manipulation of such pea grains causes high damage and decreasing of pea seed germination.

seed; pea; impact; damage; germination

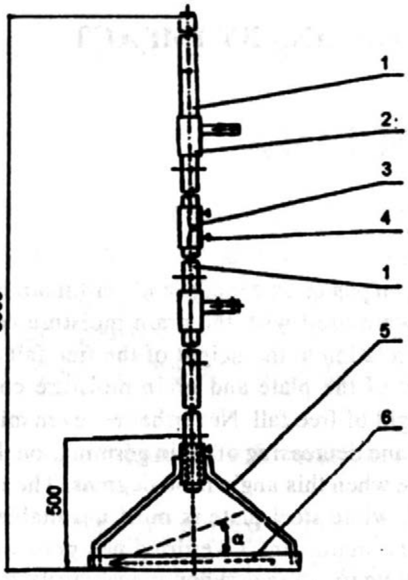
In the process of post-harvest grain treatment by purification and sorting, individual grains are exposed to dynamic stress resulting in their mechanical damage. The dynamic stress appears on transport mechanisms and during free fall and impact of grains against working surface of the cleaners. The damage arisen in such a way (macro-, microdamage, and loss of germinating capacity) reduces the viability of grains, seeding quality and the market value as well. Damaged and dead grains lose their nutritive value during long-term storage.

The transportation by free fall and self-fall is used frequently in post-harvest lines, whereby grains in the process of purification and sorting impact multiplicatively on metallic working pads or metallic working surfaces from different heights. For these reasons, our study was aimed at investigation of the effect of fall height on the damage and germinating capacity of grains in impact on the pad, the effect of angle of impact area and the effect of the kind of material of this area.

MATERIAL AND METHOD

Characteristics of the grain material applied

Pea *(Pisum sativum)*, cv. Belinda, manually collected at a moisture of 9.3 per cent, was used in the experiments. Grains were also manually released from pods. The pea (after manual collection) was classified as follows:



1. Diagram of device intending for study of the effect of height of free fall on the pea grain damage and germinating capacity during impact on solid pad: 1 - polyvinyl chloride tube, 2 - clamp, 3 - connector, 4 - screw, 5 - stand, 6 - exchangeable solid pad, alpha - angle of pad

- pea damaged prior to collection (natural damage),
- undamaged pea.

Following dynamic stress pea grains were classified as follows:

1. micro-damaged grains:
   a) whole grains with damage visible by free sight,
   b) halves of grains,
   c) broken pieces of grains;
2. micro-damaged grains:
   a) damaged seedcase,
   b) damaged germ,
   c) damaged seedcase and germ;
3. undamaged grains.

Microdamage to grains was studied by means of colouring by ozine in ultrasound tank for 4 minutes. Evalution was carried by magnifying glass in 6-multiplied magnification.

Healthy and undamaged grains exclusively were used in experimental measurements. In evaluating the germinating capacity grains were divided into germinating and anomalies of seedlings according to CSN standard 46 0311.

Characteristics of studied parameters

The effect of height of free fall on the damage and germinating capacity of pea grains, cv. Belinda during the impact on the pad was followed. Pea grain damage at the impact by free fall on the pad was studied on the device constructed in the Department of Machinery and Production System, University of Agriculture, Nitra (Fig. 1)

Using this device we studied the following:

a) the effect of angle (0.15°, 30°, 45°, 60°, 75°) of the pad (steel sheet) on the pea grain damage and germinating capacity during free fall from a height of 8 m,
b) the effect of material of pad (steel, concrete, wood, polyvinyl chloride, pea grains) on the pea grain damage and germinating capacity during free fall from a height of 1, 2, 4, 6, and 8 m,
c) the effect of grain moisture (7.2 to 12.5 %) on the grain damage during free fall from a height of 0, 1, 2, 4, 6, and 8 m.

300 grains was tested for each change in the above parameters. Experimental measurements were conducted in the years 1991 and 1992 in the Department of Machinery and Production Systems, University of Agriculture in Nitra.

The evalution of experimental measurements was carried out by routine statistic-mathematical methods on the computer.

RESULTS

The effect of an angle of pad on the pea grain damage and germinating capacity during free fall

The angle of pad, on witch individual grains were impacted, was selected to be 0°, 15°, 30°, 45°, 60°, and 75°. The height of fall was contact 8 m. Grain moisture during measurements was 9,03 %. 300 grains were tested for each change in angle. The pad used - steel sheet. Figs. 2 and 3 present the results of measurements. The equation of approximation and correlation index is evident from Tab. I.

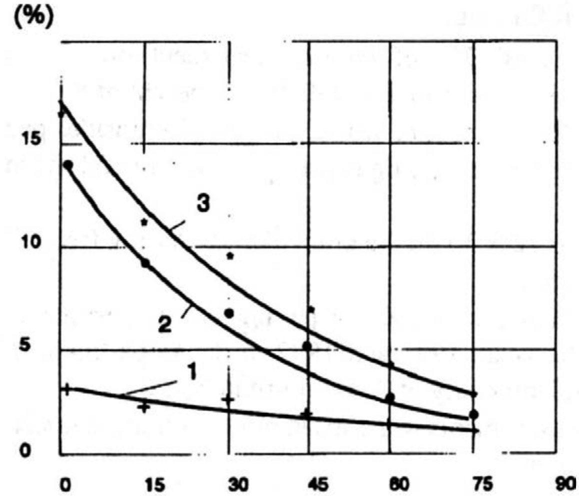
The angle of pad of impact area has a marked influence on the damage, in particular on macrodamage to grains. Almost the same can be applied to germinating capacity (Fig. 3). Enlargement of the angle of impact area has a good influence on the reduction of grain damage and on the increase in germinating capacity during impact of grains on the pad.

The effect of pad material and height of free fall of grains on their damage and germinating capacity

The steel sheet, concrete, wood, polyvinyl chloride and a layer of pea grains were used as materials of impact pad. Pea grains fell on the above pads from a height of 0, 1, 2, 4, 6, and 8 m. Grain moisture was 9.3 %. 300 grains were used for each height. Figs. 4 to 10 present the results of measurements for different pads. Equations of approximation and indices of correlation are presented in Tab. I.

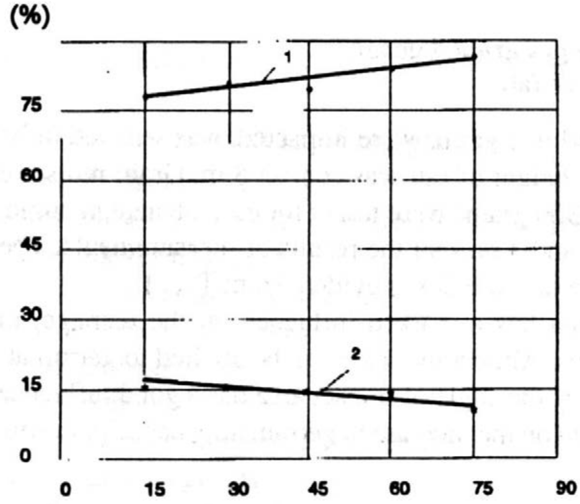
DISCUSSION

In studying the effect of angle of steel pad, we found out that the damage to free-falling grain declines with enlargement of angle of the pad (Fig. 2).



2. The effect of angle of the pad (steel sheet) on the pea grain damage, cv. Belinda, during free fall from a height of 8 m. Grain moisture of 9.3 %, where: 1 - microdamage, 2 - macrodamage, 3 - total damage to grains

angle of gradient, damage



3. The effect of angle of the pad (steel sheet) on the germinating capacity and anomalies of seedlings of pea grains, cv. Belinda, during free fall from a height of 8 m. Grain moisture of 9.3 %, where: 1 - germinating grains, 2 - anomalies of seedlings of grains

angle of gradient, germinating capacity

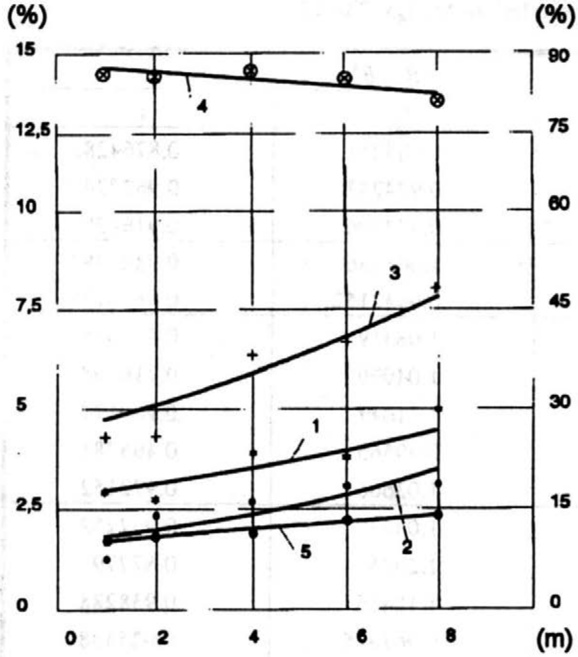
Intensity of decline in damage is faster in macrodamage compared with the microdamage. For comparison - macrodamage to grains at angle of the pad 0 was 11.4 %, and at angle of 75 only 2.01 %, the total decline of 9.39 %, but the microdamage in total dropped by 1.68 %.

The total damage representing arithmetic summation of macro and microdamages is of markedly falling tendency in the area of angle of the pad from 0 to 45 (Fig. 2). For example, between angles 0 and 15 we measured the decline in damage of 5 %, on the contrary, at angles 60 and 75 only 1.2 %.

The best germinating capacity (Fig. 3) had pea grains falling to the pad of angle 75. Anomalies of seedlings had the highest value at angle of 15 - 15.82 %. It follows

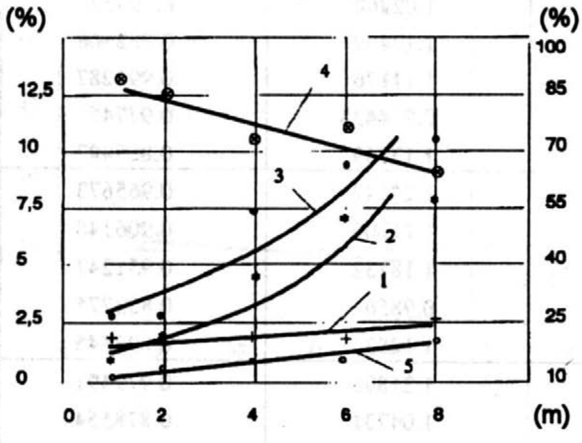
I. Approximation constant and indices of correlations to Figs. 2 to 12

Number of Fig.		$y = B_0 . B^x$		
		B_0	B_1	i
2.	1	3.77324	0.984241	0.876428.
	2	15.2648	0.974247	0.962724
	3	21.607	0.972506	0.916438
3.	1	76.27036	1.001656	0.9323484
	2	18.54435	0.9942152	0.8698158
4.	1	2.15019	1.08319	0.811055
	2	2.0103	1.04079	0.716398
	3	3.17636	1.11017	0.969177
	4	85.1826	0.99565	0.465781
	5	10.6108	1.03666	0.972152
5.	1	1.97912	1.0363	0.932252
	2	1.32609	1.2935	0.87779
	3	3.18101	1.18455	0.938288
	4	91.3097	0.967785	0.925458
	5	9.96364	1.11889	0.944795
6.	1	2.17888	1.02962	0.99953
	2	1.66054	1.17499	0.982508
	3	3.75643	1.11176	0.991287
	4	90.9902	0.974438	0.97745
	5	6.82569	1.13569	0.865497
7.	1	0.590888	1.27647	0.965673
	2	1.32033	1.11706	0.906148
	3	1.85665	1.18732	0.951242
	4	87.0677	0.9856	0.853775
	5	9.08936	1.1083	0.893345
8.	1	1.0492	1.21893	0.979491
	2	1.8196	1.04731	0.878554
	3	2.78832	1.13366	0.978229
	4	93.603	0.991155	0.957327
	5	6.16245	1.06601	0.884247
11.	1	4.18363	1.16644	0.991605
	2	2.594	1.20232	0.969226
	3	1.4534	1.14304	0.979182
12.	1	96.8098	0.990292	0.891599
	2	97.7762	0.99316	0.817662
	3	98.5106	0.993791	0.958511



4. The effect of the material of pad (wood) and heights of free fall of grains on their damage and germinating capacity at impact, where: 1 - microdamage, 2 - macrodamage, 3 - total damage to grains, 4 - grain germinating capacity, 5 - anomalies of seedlings. Pea, cv. Belinda, grain moisture of 9.3 %

height of fall, damage, germinating capacity



5. The effect of the material of pad steel (sheet) and heights of free fall of grains on their damage and germinating capacity at impact, where: 1 - microdamage, 2 - macrodamage, 3 - total damage to grains, 4 - grain germinating capacity, 5 - anomalies of seedlings. Pea, cv. Belinda, grain moisture of 9.3 %

height of fall, damage, germinating capacity

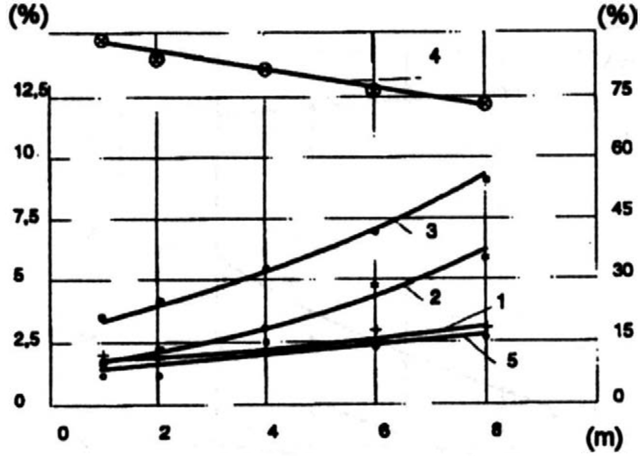
follows from the above that an increase in angle of the pad has a significant influence on the preserving the germinating capacity or intensity of reduction in seedlings, resp.

Greater angle exhibited lower damage and higher germinating capacity. It can be explained by the fact that at direct impact of bodies kinematic energy transforms into only deformation energy, subsequently reducing the germinating capacity and increases the damage to pea grains.

The effect of a material of pad and height of free fall on the damage and germinating capacity of pea grains is significant (Figs. 4 to 10). It is evident from

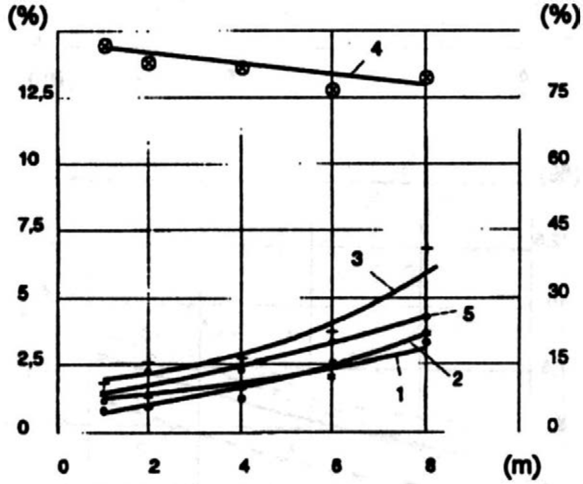
6. **The effect of the material of pad (concrete) and heights of free fall of grains on their damage and germinating capacity at impact, where: 1 - microdamage, 2 - macrodamage, 3 - total damage to grains, 4 - grain germinating capacity, 5 - anomalies of seedlings. Pea, cv. Belinda, grain moisture of 9.3 %**

height of fall, damage, germinating capacity



7. **The effect of the material of pad (polyvinyl chloride) and heights of free fall of grains on their damage and germinating capacity at impact, where: 1 - microdamage, 2 - macrodamage, 3 - total damage to grains, 4 - grain germinating capacity, 5 - anomalies of seedlings. Pea, cv. Belinda, grain moisture of 9.3 %**

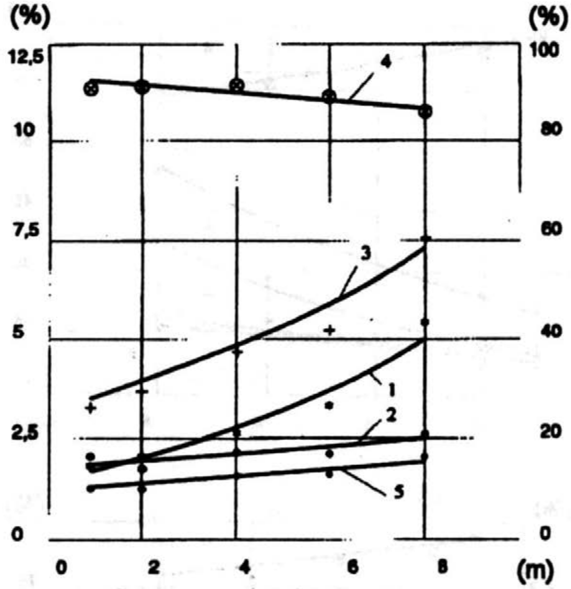
height of fall, damage, germinating capacity



the given figures that pea grain damage is increasing and germinating capacity is reducing with the greater height of fall. These conclusions are identical with those of Pugačev (1976). This is caused by the fact that grain falling from greater height has a higher velocity and thus, also kinematic energy, whereby the collision of grains will be significantly greater and the destruction of grains will be greater as well. The limit at which the height of fall has no influence on the damage is given by critical rate of the rise of pea grains in air flow, from which the limit value of height of free fall can be calculated.

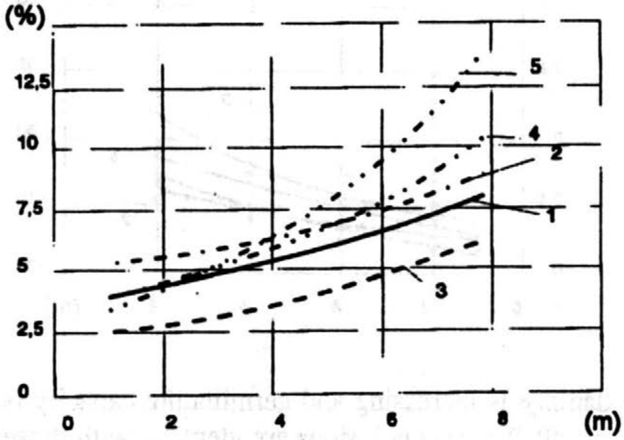
As it is evident from Fig. 9, the greatest damage was measured with the steel sheet and concrete, the lowest on polyvinyl chloride pad and on the layer of pea grains.

The total damage is expressed by arithmetic sum of macro and microdamages. The effect of different materials on the pea grain damage and germinating capacity during free fall and impact on solid pad is evident from Fig. 9.



8. The effect of the material of pad (layer of pea grains) and heights of free fall of grains on their damage and germinating capacity at impact, where: 1 - microdamage, 2 - macrodamage, 3 - total damage to grains, 4 - grain germinating capacity, 5 - anomalies of seedlings. Pea, cv. Belinda, grain moisture of 9.3 %

height of fall, damage, germinating capacity

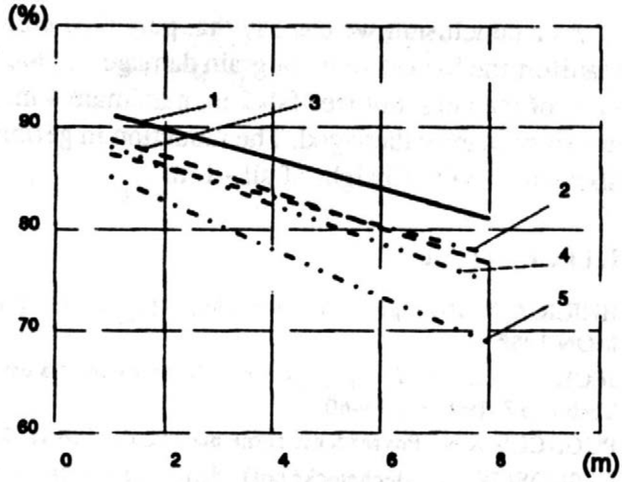


9. The effect of pad materials and height of free fall of grains on their damage at impact - comparison of different pads from Figs. 4 to 8, where: 1 - pea layer, 2 - wood, 3 - polyvinyl chloride, 4 - concrete, 5 - steel sheet

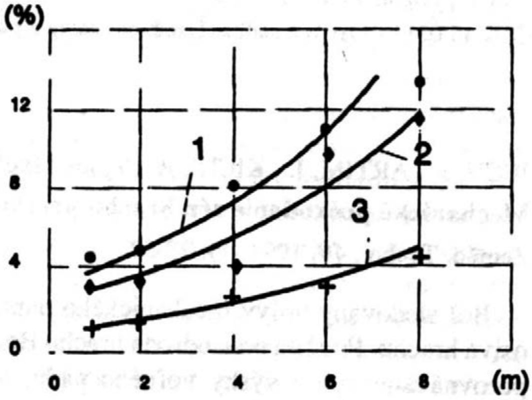
height of fall, damage

Measurements confirmed convictions of Thér (1979) that the grain has a certain resistance to mechanical damage, but this resistance is falling during collection and post-harvest treatment (Figs. 4 to 12). The knowledge that the grains partially damaged during harvest are subject to much more faster damage in further processing follows from it. The impact of grains on metallic materials, as reported by Hnilica (1988), Pugačev (1976), Sosnowski (1989), Jech and Artim (1991), and other, has an adverse effect. This fact has to be fully considered in the proposal of technology and in the selection of working surfaces of machines and equipment.

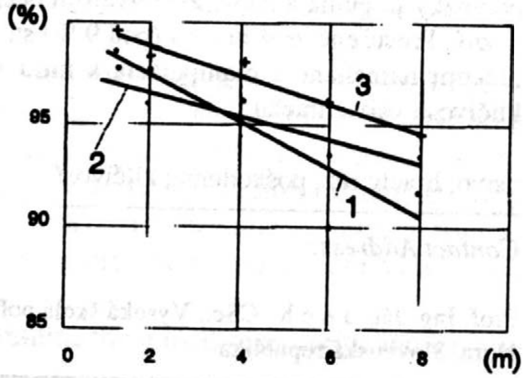
10. **The effect of pad materials and height of free fall of grains on their germinating capacity at impact - comparison of different pads from Figs. 4 to 8, where: 1 - pea layer, 2 - wood, 3 - polyvinyl chloride, 4 - concrete, 5 - steel sheet**



11. **The effect of grain moisture and height of free fall on their damage at impact, where: 1 - grain moisture of 7.2 %, 2 - grain moisture of 9.3 %, 3 - grain moisture of 12.5 %. Pad is of steel sheet, pea of cv. Belinda**



12. **The effect of grain moisture and height of free fall on their germinating capacity at impact, where: 1 - grain moisture of 7.2 %, 2 - grain moisture of 9.3 %, 3 - grain moisture of 12.5 %. Pad is of steel sheet, pea of cv. Belinda**



As a conclusion we can say that polyvinyl chloride and pea layer used as a pad manifest the lowest value of grain damage and the highest germinating capacity. In view of the height of free fall 2 m, maximum 4 m, are the limit below which grains are significantly damaged. The reduction in germinating capacity is noticeable yet above the limit of height of all - 1 m.

Literature

HNILICA, P.: Reologie zrna v technologických procesech a manipulaci. [Monografie.] Praha, VN MON 1988.

JECH, J. - ARTIM, J.: Vplyv pozberového spracovania osiva hrachu na kvalitu produktu. Zeměd. Techn., *37*, 1991 (1): 49-60.

PUGAČEV,A.N.: Povreždenie zerna mašinami. Moskva, Kolos 1976, s. 318.

SOSNOWSKI, S.: Mechanické poškodenie sóje vznikajúce pri pozberovom spracovaní. Mechaniz. Poľnohosp. *18*, 1989 (7).

THÉR, M.: Změny pevnosti zrna pšenice při opakovaném mechanickém namáhání. [Výzkumná zpráva.] Praha, VÚZT 1979, 55 s.

ČSN 46 0311 - Osivo a sadba. Uznávaní osiva a sadby. Praha 1986.

Received for publication December 9, 1993

JECH, J. - ARTIM, J. - KICHI, R. (Vysoká škola poľnohospodárska, Nitra):

Mechanické poškodenie zŕn hrachu pri ráze.

Zeměd. Techn., *40*, 1994 (1): 23-32.

Bol sledovaný vplyv mechanického namáhania pri ráze na poškodenie a klíčivosť osiva hrachu. Použitá bola odroda hrachu Belinda v rozsahu vlhkosti 7,2 až 12,5 %. Bol porovnávaný vplyv výšky voľného pádu, uhlu sklonu a materiálu podložky ako aj vlhkosti zrna na výslednú kvalitu osiva. Kritickou výškou pri voľnom páde zŕn hrachu je hodnota 4 m, pričom aj minimálné výškové prepady už spôsobujú poškodenie a zníženie klíčivosti zŕn. Uhol dopadu zŕn (60°) na podložku ma priaznivý vplyv na znižovanie ich poškodenia a zachovanie klíčivosti, pričom najvhodnejším materiálom podložky je guma a najnepriaznivejším oceľový plech. Vplyv vlhkosti je veľmi preukazný. Presušené zrná hrachu (pod 9 %) sú veľmi náchylné na poškodenie pri mechanickom namáhaní a manipulácia s nimi spôsobuje vysoké poškodenie a zníženie klíčivosti osiva hrachu.

osivo; hrach; ráz; poškodenie; klíčivosť

Contact Address:

Prof. Ing. Ján J e c h , CSc., Vysoká škola poľnohospodárska, Tr. A. Hlinku 2, 949 01 Nitra, Slovenská republika

THE EFFECT OF MATURITY AND HARVEST DATE ON FIRMNESS OF STRAWBERRY FRUIT

C. Puchalski, J. Gorzelany, Z. Goracy

Agricultural Academy in Kraków
Faculty of Production Technology, Rzeszów

Several factors limit the quality of strawberry fruit, including loss of firmness and darkening. The lack of information on proper harvesting and handling procedures has limited further development of fresh strawberry marketing. The purpose of this study was to determine the effects of maturity and harvest date on the quality of strawberry fruits, on the base of their firmness measurement. Four harvests form a 3-year-old planting of Senga, Dukat and Kama were made in 1993. Fruits were separated visually into four stages of horticultural maturity. A 20-fruit sample was used per date for each stage of maturity. Firmness was measured with a mechanical force gauge with cylindrical tip of 5 mm, at three penetration speeds. These results demonstrate that stage of maturity has a major effect on the quality of strawberry. For factors such as force to rupture and at the end of penetration force quality decreased with increasing maturity. The optimum stage of maturity of tested fruits will depend on the relative importance of each of these factors. Harvest date also may affect the optimum stage of maturity. Deformation and force decreased with harvest date at all stages of fruit maturity. This decrease in force was greater than in deformation. Harvest date effects, which previously have not been recognised as an important determinant of quality, must be considered in all handling procedures of fruits.

strawberry; firmness; measurement; harvest

Several factors limit the quality of strawberry fruit, including loss of firmness and darkening. Harvesting at an optimum stage of horticultural maturity has been recommended for extending the storage life of strawberry fruit. Current recommendations for fresh-market storage are to use fruit that are firm rather than „very ripe" (T o p p i n g , 1973; F i e d l e r , 1987). The textural quality of fruit is influenced by flesh firmness measured by puncture tests penetrometer (B o u r n e , 1980).

The purpose of this study was to determine the effects of maturity and harvest date on the firmness of strawberry fruit.

MATERIAL AND METHODS

Four harvests from a 3-year-old planting of Kama, Dukat and Senga were made in 1993. Fruits free of rot or other visible defects were selected at each harvest date from three random locations in the planting. Fruits were separated visually into four stages of horticultural maturity (W a t a d a et al., 1984) : GR (green) - whole fruit surface was green, IN (inception) - red color present but 25 to 75 % of the fruit surface still green, RR (red ripe) - 100 % of the fruit surface yellowish-red to red without purplish-red hues visible, PR (processing ripe) - 100 % of the fruit surface red to purplish-red without being overripe. A 20-fruit sample was used per date for each combination of replication, stage of maturity. Samples were weighed, so as to constitute a uniform testing material. Fruits were harvested and allowed to equilibrate at room temperature (293 K).

Firmness was measured with a mechanical force gauge with cylindrical tip of 5 mm at three penetration speeds of 0.08, 0.16 and $0.33.10^{-2}$ m/s. The following parameters predicting the fruit firmness by puncture test were measured : force to rupture, deformation to rupture and force at the end of penetration (at depth of 5 mm).

RESULTS

Main effects. Harvest date main effects were detected for all factors of three cultivars (Tabs. I - III). However, harvest date main effects for force to rupture, deformation and force at end of penetrometer were affected by interactions with stage of maturity. Force to rupture and at the end of penetrometer of all cultivars, and deformation of Ducat and Senga, decreased between the first and third harvest and than increased on fourth date. Both linear and nonlinear effects were detected (Tab. I - III). On the contrary, deformation to rupture of Kama increased between the first and last harvest and both linear and nonlinear effects were detected (Tab. I). Variation of force during the season (in harvest period) was higher in comparison with deformation, variation coefficients averaged 27 % and 15 %, respectively (Tabs. I - III).

Stage of maturity main effects were detected for all factors (Tabs. I - III). Force to rupture and at the end of penetration, and deformation of all cultivars decreased with increasing maturity by as much as 75 % and 26 %, respectively. Both linear and nonlinear effects were detected. Variation of force between various stages of maturity was higher in comparison with the deformation for tested cultivars.

Interactive effect. Harvest date by stage of maturity interactions were detected for all factors except force at the end of penetration at speed of $0.16 \cdot 10^{-2}$ m/s for Senga. These interactions were due to differences among stages of maturity in the regression against harvest date (Figs. 1 - 3). Because early analysis showed that

I. Main effects of harvest date and stage maturity on force to rupture, deformation and force at the end of penetration of Kama

Treatment	Force to rupture (N)				Deformation to rupture (10^{-3} m)				Force at the end of penetration (N)			
	Speed (10^{-2} m/s)			Average C. V. (%)	Speed (10^{-2} m/s)			Average C. V. (%)	Speed (10^{-2} m/s)			Average C. V. (%)
	0.08	0.16	0.33		0.08	0.16	0.33		0.08	0.16	0.33	
Harvest date H												
6 June	2.33 a	2.88 a	3.32 a	58	1.95 a	2.36 a	2.68 a	20	1.05 a	1.45 a	1.69 a	55
9 June	2.30 a	2.71 a	3.37 a	67	2.17 b	2.80 b	3.07 b	29	1.05 a	1.36 b	1.54 b	51
12 June	1.86 b	2.47 b	2.75 b	51	1.83 c	2.23 c	2.38 c	17	0.82 b	1.07 c	1.22 c	43
15 June	2.28 a	2.56 c	3.56 c	60	2.40 d	2.77 d	2.72 d	24	1.0 a	1.33 d	1.51 b	69
Stage of maturity M												
Green	4.01 a	4.75 a	5.74 a	33	2.54 a	2.92 a	3.16 a	17	1.72 a	2.24 a	2.60 a	37
Inception	2.12 b	2.72 b	3.38 b	24	2.05 b	2.57 b	2.73 b	18	0.92 b	1.34 b	1.51 b	23
Red ripe	1.64 c	2.02 c	2.36 b	23	1.89 c	2.32 c	2.41 c	14	0.75 c	0.94 c	1.07 c	22
Processing ripe	0.98 d	1.14 d	1.54 c	30	1.86 c	2.34 c	2.55 d	30	0.54 d	0.69 d	0.78 d	25
Significance												
H linear	NS	***	NS		***	***	**		NS	***	***	
H parabolic	**	NS	***		***	NS	NS		*	***	***	
H cubic	***	NS	***		***	***	***		***	***	***	
M	***	***	***		***	***	***		***	***	***	
H * M	***	***	***		***	***	***		***	***	***	

Mean separation within a column by Duncan's multiple range test, 5 % level,
NS. **. ***. Insignificant or significant at the 1 % or 0.1 % levels, respectively, by *F*-test

II. Main effects of harvest date and stage of maturity on force to rupture, deformation and force at the end of penetration of Dukat

Treatment	Force to rupture (N)				Deformation to rupture (10^{-3} m)				Force at the end of penetration (N)			
	Speed (10^{-2} m/s)			Average C. V. (%)	Speed (10^{-2} m/s)			Average C. V. (%)	Speed (10^{-2} m/s)			Average C. V. (%)
	0.08	0.16	0.33		0.08	0.16	0.33		0.08	0.16	0.33	
Harvest date H												
14 June	3.08 a	3.43 a	4.41 a	50	3.21 a	3.47 a	4.02 a	19	1.29 a	1.55 a	3.04 a	53
17 June	2.46 b	3.04 b	3.39 b	47	3.17 b	3.29 b	3.83 b	15	1.29 a	1.53 a	2.43 b	54
20 June	2.28 c	2.84 c	3.22 c	46	2.85 c	3.03 c	3.39 c	16	0.97 b	1.25 c	1.72 c	44
23 June	2.66 d	3.14 b	3.47 d	49	3.12 d	3.34 d	3.74 d	16	1.14 c	1.47 a	2.05 d	51
Stage of maturity M												
Green	4.25 a	5.20 a	5.99 a	26	3.40 a	3.72 a	4.25 a	14	1.87 a	2.29 a	3.52 a	36
Inception	2.80 b	3.31 b	3.77 b	20	3.25 b	3.34 b	3.86 b	13	1.28 b	1.56 b	2.62 b	35
Red ripe	2.11 c	2.52 c	2.94 c	21	3.05 c	3.24 b	3.73 b	13	0.91 c	1.19 c	2.03 c	33
Processing ripe	1.32 d	1.42 d	1.78 d	29	2.66 d	2.84 c	3.16 c	18	0.62 d	0.77 d	1.07 d	26
Significance												
H linear	***	***	***		***	***	***		***	***	***	
H parabolic	***	***	***		***	***	***		**	**	***	
H cubic	NS	NS	NS		***	***	***		***	***	***	
M	***	***	***		***	***	***		***	***	***	
H * M	***	*	*		**	***	**		***	***	***	

Mean separation within a column by Duncan's multiple range test, 5 % level,
NS. **. ***. Insignificant or significant at the 1 % or 0.1 % levels, respectively, by *F*-test

III. Main effects of harvest date and stage of maturity on force to rupture, deformation and force at the end of penetration of Senga

Treatment	Force to rupture (N)				Deformation to rupture (10^{-3} m)				Force at the end of penetration (N)			
	Speed (10^{-2} m/s)			Average C. V. (%)	Speed (10^{-2} m/s)			Average C. V. (%)	Speed (10^{-2} m/s)			Average C. V. (%)
	0.08	0.16	0.33		0.08	0.16	0.33		0.08	0.16	0.33	
Harvest date H												
16 June	2.25 a	2.72 a	3.33 a	52	2.83 a	3.09 a	3.42 a	20	0.99 a	1.36 a	1.69 a	46
19 June	2.13 a	2.74 a	3.43 a	60	2.91 a	2.91 a	3.31 b	19	1.13 a	1.43 a	1.83 a	46
22 June	1.73 b	2.10 b	2.49 b	40	2.39 b	2.71 c	2.75 c	15	0.81 c	0.99 b	1.21 b	30
26 June	2.12 c	2.63 a	3.11 c	53	2.46 b	2.84 d	3.28 d	19	1.01 a	1.57 a	1.70 a	47
Stage of maturity M												
Green	3.41 a	4.25 a	5.13 a	36	2.83 a	3.10 a	3.52 a	16	1.54 a	2.20 a	2.47 a	38
Inception	2.11 b	2.70 b	3.14 b	22	2.61 b	3.05 a	3.11 b	16	1.09 b	1.43 b	1.57 b	28
Red ripe	1.66 c	1.97 c	2.41 c	22	2.68 b	2.80 b	3.11 b	18	0.86 c	0.96 c	1.29 c	20
Processing ripe	1.06 d	1.26 d	1.67 d	30	2.48 c	2.59 c	3.02 b	27	0.65 d	0.76 d	1.09 d	23
Significance												
H linear	***	***	***		***	***	***		***	NS	**	
H parabolic	***	***	**		***	***	***		***	*	***	
H cubic	***	***	***		***	NS	***		***	***	***	
M	***	***	***		***	***	***		***	***	***	
H * M	***	***	***		***	**	***		***	NS	***	

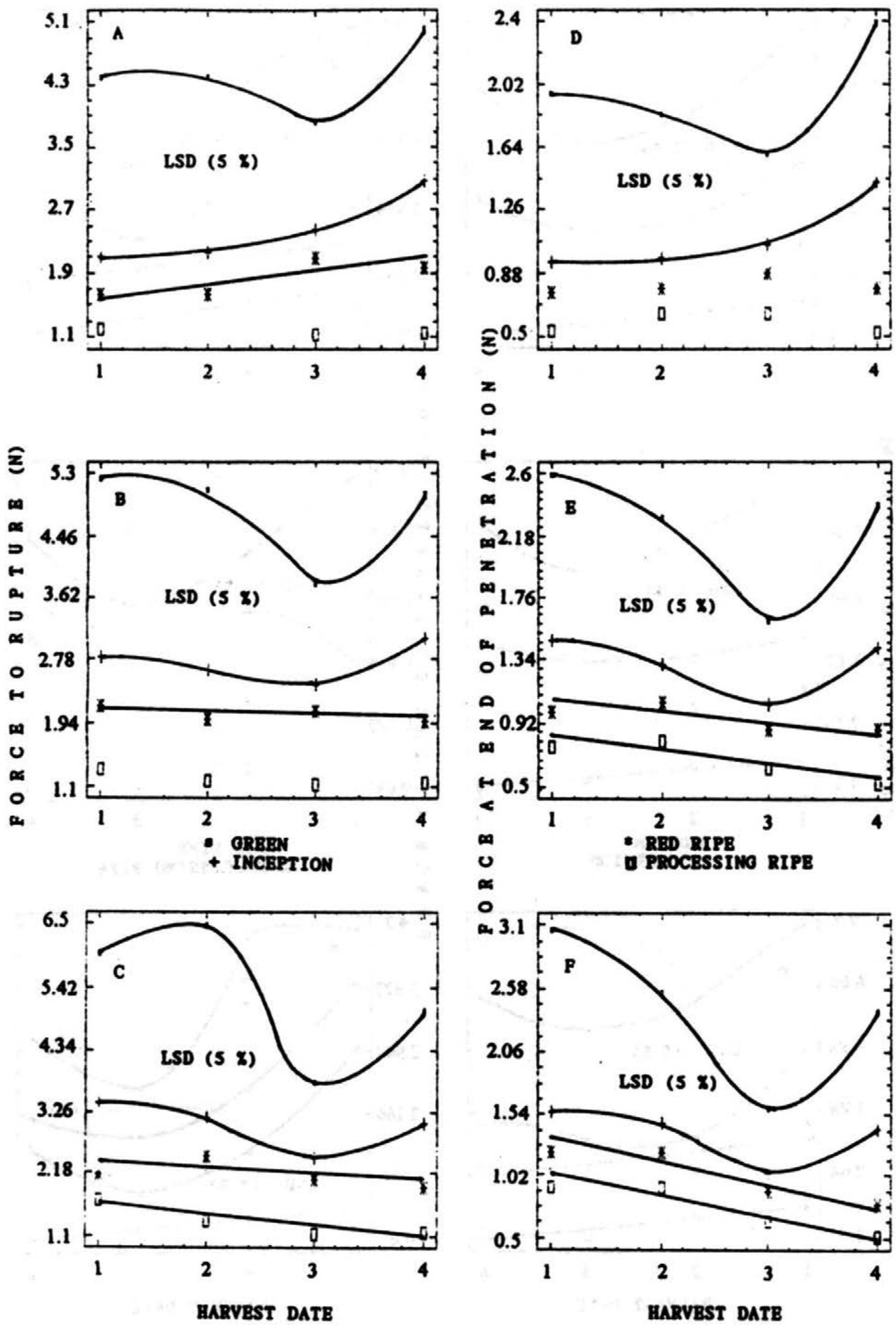
Mean separation within a column by Duncan's multiple range test, 5 % level,
NS. **. ***. Insignificant or significant at the 1 % or 0.1 % levels, respectively, by *F*-test

penetration force had higher variation in the harvest period than deformation, force should be a more accurate measure of changes in fruit firmness. Force to rupture at speed of 0.08 . 10^{-2} m/s in RR of Kama and Senga, and in PR of Dukat did not change significantly during the season, but increased and decreased (respective to variety) nonlinearly and linearly in the remaining stages of maturity (Figs. 1A, 2A, 3A). Force to rupture at speed of 0.16 . 10^{-2} m/s in PR of Dukat and Senga, and in RR of Kama did not change significantly in the harvest period, but decreased nonlinearly and linearly in the remaining stages of maturity (Figs. 1B, 2B, 3B). Force to rupture at speed of 0.33 . 10^{-2} m/s changed significantly during the season in all stages of fruit maturity and decreased nonlinearly in GR and IN, and linearly in PR and RR fruit. Force at the end of penetration at speed of 0.08 . 10^{-2} m/s did not change significantly in either PR or RR fruit of Kama during the season. For other varieties in all stages of maturity these changes were significant (Figs. 1D, 2D, 3D). For all varieties at speed of 0.33 . 10^{-2} m/s significant differences existed in mean force at the end of penetration values in all stages of fruit maturity, except in RR fruit of Senga (Figs. 1F, 2F, 3F).

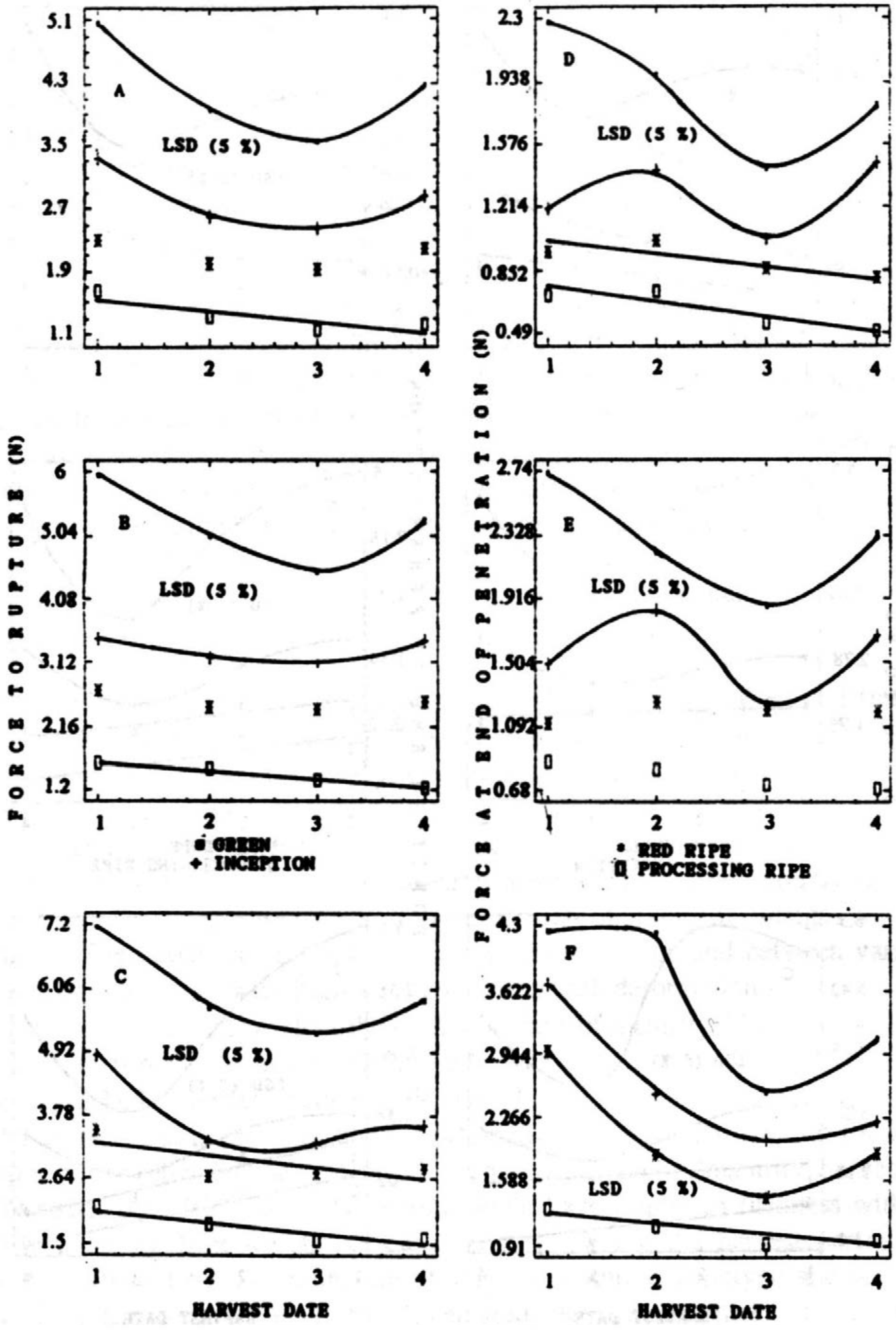
DISCUSSION

These results demonstrate that stage of maturity has a major effect on firmness of strawberry fruit. For some factors, such as force to rupture and at the end of penetration fruit quality decreased with increasing maturity. For other factors such as deformation to rupture, quality improved with increasing maturity. The optimum stage of maturity for strawberry fruit will depend on the relative importance of these factors as well as on others, not measured here, such as color preference and appearance. Force appeared to be a more accurate measure of changes in fruit firmness. The variations in force during the harvest period and between various stage of fruit maturity were higher in comparison with deformation.

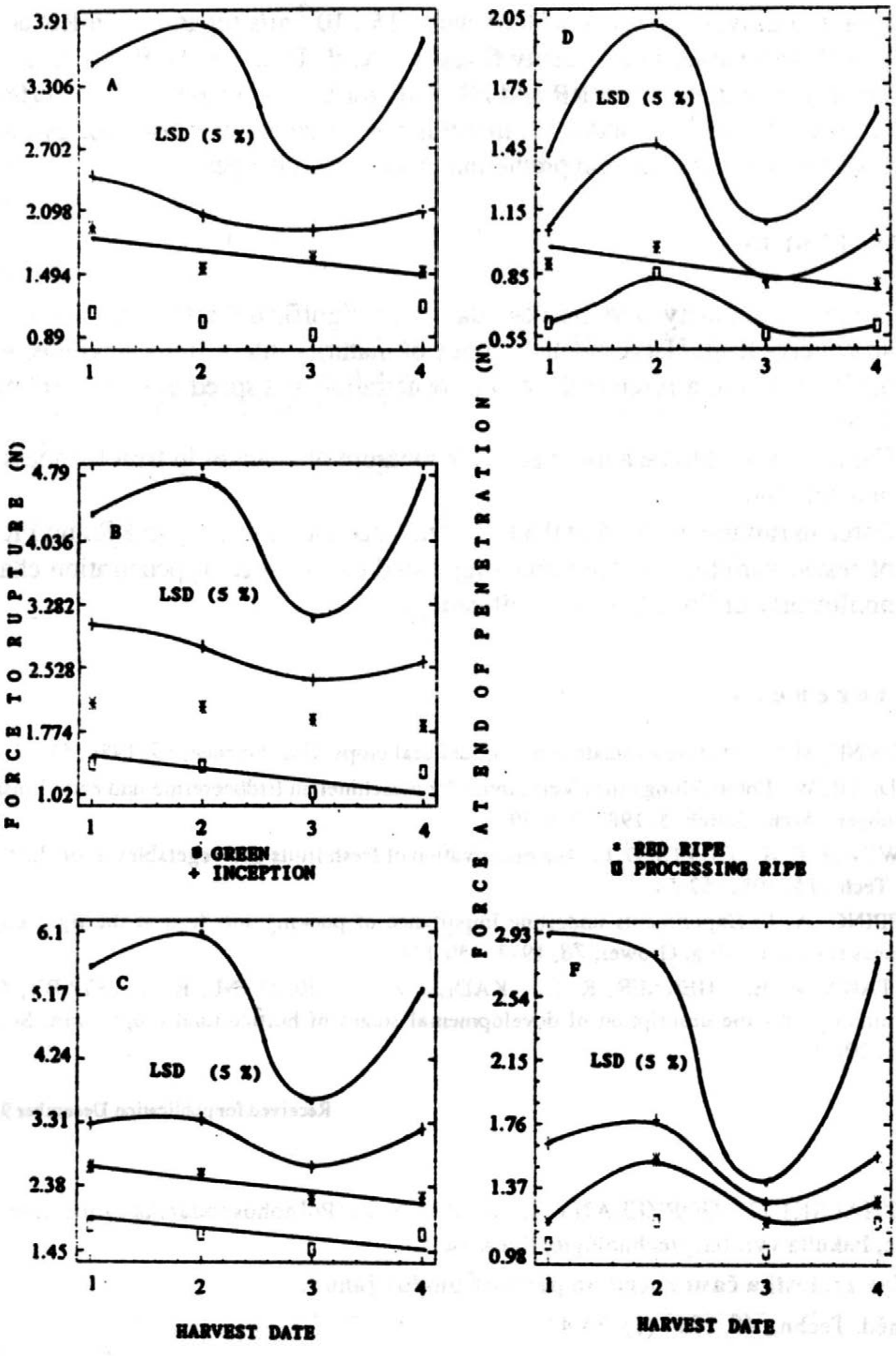
Harvest date also may affect the optimum stage of maturity. The percentage of decrease in force with increasing maturity was not constant during the season (Figs. 1, 2, 3). Differences between GR and IN fruits were higher at the beginning of the season than at the third harvest, while those between IN, RR and PR were smaller. Since force declined during the season in all stages of maturity, harvesting at IN rather than RR late in the season would have improved firmness without greatly reducing fruit weight. Changes in force during the harvest period are probably affected by a combination of stage of maturity, genotype and weather conditions (L o w i n g s et al., 1982). Our study demonstrates that stage of maturity interacts with harvest date and variety in relation to force and depend on speed of testing. Dukat and Kama had higher resistance to penetration force, which corresponds to firmness, than Senga (Figs. 1, 2, 3). We observed no change in force to rupture and in that at the end of penetration during the harvest period with the



1. Interactive effects of harvest date and stage of maturity on force to rupture at speed of 0.08 (A), 0.16 (B), 0.33 . 10^{-2} m/s (C), and force at the end of penetration at speed of 0.08 (D), 0.16 (E), 0.33 . 10^{-2} m/s (F) of Kama. Harvest dates: 6 June (1), 9 June (2), 12 June (3), 15 June (4)



2. Interactive effects of harvest date and stage of maturity on force to rupture at speed of 0.08 (A), 0.16 (B), 0.33 . 10^{-2} m/s (C), and force at the end of penetration at speed of 0.08 (D), 0.16 (E), 0.33 . 10^{-2} m/s (F) of Dukat. Harvest dates: 14 June (1), 17 June (2), 20 June (3), 23 June (4)



3. Interactive effects of harvest date and stage of maturity on force to rupture at speed of 0.08 (A), 0.16 (B), 0.33 . 10^{-2} m/s (C), and force at the end of penetration at speed of 0.08 (D), 0.33 . 10^{-2} m/s (F) of Senga. Harvest dates: 16 June (1), 19 June (2), 22 June (3), 25 June (4)

strawberry cultivars, at speed of 0.08 and 0.16 . 10^{-2} m/s separately in RR and PR or in both these stages of maturity (Figs. 1 - A, B, D, 2 - A, B, E, 3 - A, B). The presence of linear effects in RR and PR fruits for harvest date interactive effects at speed of 0.33 . 10^{-2} m/s indicates that this parameter may be used for evaluation among stages of maturity and prediction of firmness changes.

CONCLUSIONS

1. Stage of maturity and harvest date had significant effect on firmness of strawberry fruit. Harvest date by stage of maturity interactions was detected for all factors except force at the end of penetration at a speed of 0.16 . 10^{-2} m/s of Senga.
2. Force appeared to be a more accurate measure of changes in fruit firmness than deformation.
3. Force to rupture at speed of 0.33 . 10^{-2} m/s decreased linearly in RR and PR fruit of tested varieties. At the remaining tested cases, force of penetration changes nonlinearly or linearly or insignificantly.

References

BOURNE, M. C.: Texture evaluation of horticultural crops. Hort Science, *15*, 1980: 51-57.

FIEDLER, W.: Entwicklung eines Verfahrens der maschinellen Erdbeerernte und erste Einsatzerfahrungen. Arch. Garteb, *8*, 1987: 379-391.

LOWINGS, P. H. - CUTTS, D. F.: The preservation of fresh fruits and vegetables. Proc. Inst. Food Sci. Tech., *15*, 1982: 52-54.

TOPPING, A. J.: Experiments underline importance of pocking soft fruit at the right stage of ripeness for pre-cooling. Grower, *78*, 1973: 130-131.

WATADA, A. E. - HERNER, R. C. - KADER, A. A. - ROMANL, R. J. - STABY, G. L.: Terminology for the description of developmental stages of horticultural crops. Hort. Sci., *19*, 1984: 20-21.

Received for publication December 9, 1993

PUCHALSKI, C. - GORZELANY, J. - GORACY, Z. (Poľnohospodárska akadémia v Krakove, Fakulta výrobnej technológie, Rzeszów):

Vplyv zrelosti a času zberu na pevnosť plodov jahôd.

Zeměd. Techn., *40*, 1994 (1): 33-43.

Niektoré faktory obmedzujú kvalitu plodov jahôd, vrátane straty pevnosti a stmavnutia. Nedostatok poznatkov o spôsoboch zberu a manipulácie obmedzujú ďalší vývoj predaja čerstvých jahôd.

Cieľom predloženého príspevku bolo určiť vplyv zrelosti a času zberu na plody jahôd, a to na základe merania ich pevnosti. Pre merania boli použité plody odrôd SENGA, DUKÁT a KAMA, zberané v r. 1993. Porast jahôd bol tri roky starý. Plody boli podľa zrelosti rozdelené do štyroch skupín. V každej vzorke bolo 20 plodov s rovnakou zrelosťou. Pevnosť bola meraná prostredníctvom mechanického silového snímača s valcovým hrotom o hrúbke 5 mm. Použité boli tri rýchlosti vtláčania hrotu.

Výsledky meraní potvrdzujú, že stav zrelosti má hlavný vplyv na kvalitu jahôd. V dôsledku pôsobenia takých faktorov, ako je deformácia a sila, dochádza pri zvyšovaní zrelosti ku znižovaniu kvality. Optimálna úroveň zrelosti testovaných plodov bude závisieť na relatívnej dôležitosti každého z týchto faktorov. Deformácia a sila sa znižovala s predlžovaním času zberu pre všetky stavy zrelosti plodov. Takéto zmenšenie sily bolo väčšie ako úbytok deformácie. Pôsobenia faktora času zberu je značné, čo zatiaľ nebolo zohľadňované ako dôležitý faktor kvality. Tento faktor musí byť zohľadnený počas pozberového spracovania plodov.

jahody; pevnosť; merania; zber

Contact Address:

Dr. Czeslaw P u c h a l s k i , Agricultural Academy, Faculty of Production Technology, Cwiklinskiej 2, 35-959 Rzeszów, Poland

INSTITUTE OF AGRICULTURAL AND FOOD INFORMATION
Slezská 7 CS 120 56 Praha 2 Czech Republic
Fax: (00422) 25 70 90

In this institute scientific journals dealing with the problems of agriculture and related sciences are published on behalf of the Academy of Agricultural Sciences. The periodicals are published in the Czech or Slovak languages with long summaries in English or in English language with summaries in Czech or Slovak.
Subscription to these journals should be sent to the above-mentioned address.

Periodical	Number of issues per year	Number of pages
Rostlinná výroba (Plant Production)	12	96
Veterinární medicína (Veterinary Medicine)	12	64
Živočišná výroba (Animal Production)	12	96
Zemědělská ekonomika (Agricultural Economics)	12	96
Lesnictví (Forestry)	12	96
Zemědělská technika (Agricultural Engineering)	4	80
Ochrana rostlin (Plant Protection)	4	80
Genetika a šlechtění (Genetics and Plant Breeding)	4	80
Zahradnictví (Horticultural Science)	4	80
Potravinářské vědy (Food Sciencies)	6	80

THE EFFECT OF THE PHYSICAL PROPERTIES OF RAPE AND OF THE WORKING PARAMETERS OF THE COMBINE ON THE EXTENT OF RAPESEED LOSSES

B. Szot[1], M. Szpryngiel[2], M. Grochowicz[1], J. Tys[1], T. Rudko[1]

[1]*Institute of Agrophysics, Polish Academy of Sciences, Lublin*
[2]*University of Agriculture, Lublin*

The cause of rape seed losses during ripening and harvest have been determined using an original and unconvetional method. Also, the variability of the strength parameters of siliques was characterized with relation to the variety features, ripeness stage, moisture and agrotechnical practices applied. As a result of comprehensive studies it was found out that minimization of seed losses can only be achieved through an appropriate adaptation of the combine and adjustment of its assemblies for the existing physical condition of the field, the ripeness stage and harvest time, and the vulnerability of particular rape varieties to silique cracking and seed breaking. Such a comprehensive approach to the problem allows the seed losses limitation oven down to the level of 3 % of the crop - a considerable achievement when compared to the harvesting technology commonly used.

rape; physical properties; harvest; losses

Studies conducted for a number of years on the strength properties of rape siliques showed that the latest rape varieties are two- or even three-fold more vulnerable to cracking as compared to the high-erucic. On the basis of such experience in the Institute of Agrophysics the methods of rape siliques strength properties determination were developed (Report, 1986). Preliminary implementation tests conducted by the Institute of Agrophysics at numerous production plantations confirmed the possibility of a considerable reduction in rapeseed losses. Laboratory studies and field experiments showed that the variety features and the agrotechnical conditions in the broad sense of the term constitute the most important factors determining the amount of seeds shattered during harvest (S z p r y n g i e l et al., 1991; S z o t et al., 1991). Determination and analysis of these factors may lead to considerable reduction of losses, thus yielding measurable economic benefits.

METHODS

The study, the objective of which was to determine the extent of rapeseed losses and their causes, was aimed at obtaining knowledge on the strength properties of rape siliques and on those factors which had a direct effect on such properties. The study was conducted according to the method developed earlier (Report, 1986) which allowed to determine the coefficient of silique resistance to cracking (R) by means of which siliques of particular rape varieties were characterized from the viewpoint of their vulnerability to cracking.

Also, an assessment was made for the operation of those combine subassemblies which determine the extent of seed losses in the course of harvesting. The method developed for the purpose allows the accurate determination of rapeseed losses under field conditions. It consists in collecting shattered seeds from predetermined areas, after the passage of the combine.

During field experiments the rapeseed losses were determined by the following manners:

1. By collecting straw and chaff onto a tarpaulin set at the back of the combine. Such losses will be further referred to as the „thresher losses". These allow the assessment of the operation of the thresher, cleaner, and separator assemblies.

2. In the central part of the swath - „centre belt". This allows for the assessment of the operation of the screw-pin feeder whose high energy operation causes silique cracking and seed scattering, especially in the central part of the swath, where the highest concentration of the cut rape mass occurs. The cause of such losses lies in the too short floor plate of the harvesting assembly of the combine.

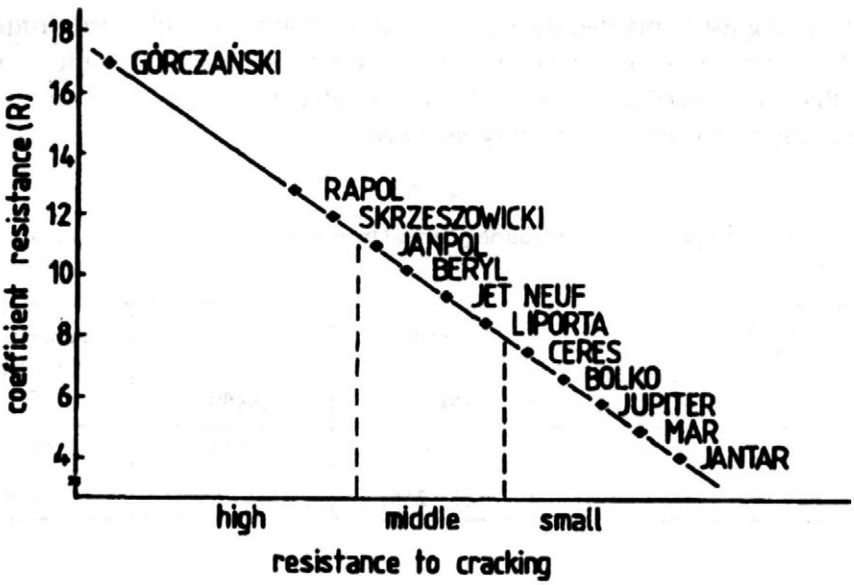
3. On the rims of the swath - „swath rim". Samples collected from the swath rims allow to assess the operation of the harvesting assembly rake and canopy divider.

RESULTS

The multi-year studies on the strength properties of rape siliques showed a considerable variability among varieties and allowed the classification of the cultivars under study according to the values of their strength properties (Fig. 1). This can be used as a basis for the forecasting of the level of seed losses of particular varieties at the end of the process of ripening and harvest. The latest double-zero cultivars show a considerably higher vulnerability to cracking as compared to the high-erucic varieties, e.g. the Górczański variety. For the double-zero varieties, therefore, a special technological regime must be used in order to restrict considerably the level of seed losses.

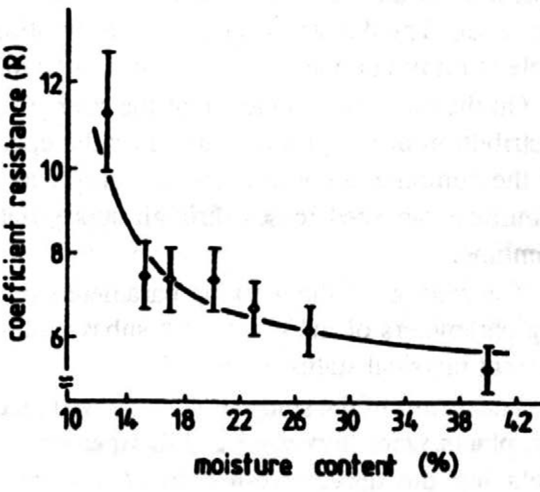
One of the most important factors affecting the strength is their moisture content (Fig. 2). An increase in silique moisture results in a decrease in silique strength. This phenomenon is especially observable at moisture increase from 12 to 14 %.

The results of fundamental studies describing the variability of the strength properties of rape siliques were used for the determination of the main causes of occurrence of seed losses in the course of combine harvest of rape.



1. The resistance of winter rape varieties to silique cracking and seed shattering

2. The effect of the moisture content of rape siliques on their strength properties



Multi-year field studies showed that the distribution of seed losses on the working width of the combine was not uniform. The highest losses were observed in the central part of the swath (beneath the straw) and within the zone of operation of the canopy divider, seed losses on the remaining areas of the stubble field being considerably lower (Tab. I). In the central part of the working width of the combine (central belt) seed losses were from 198 to 484 kg/ha. Lower losses were observed in the outer rims of the swath - from 124 to 253 kg/ha. Losses related to the operation

of the threshing assembly and the cleaner and separator assembly were from 63 to 153 kg/ha. These results, together with the observations made, prompted the conclusion that the operation of some of the assemblies of the Bizon combine was improper, which caused considerably seed losses.

I. Rapeseed losses in a production field during harvest by means of a typical cereal combine (mean for 10 years)

Header losses		Thresher	Mean	Percentage of crop
Swath rim (kg/ha)	Central belt (kg/ha)	(kg/ha)	(kg/ha)	(%)
199.9	302.7	124.3	357.8	13.6
(124 - 253)	(198 - 484)	(63 - 256)	(244 - 592)	(8.6 - 28.1)

It was shown that the highest contribution to the overall seed losses was that of the harvesting assembly. This resulted from the fact that rape responds to the operation of the working elements of the assembly in a different manner than cereal plants do. The design of the typical harvesting assembly makes it virtually impossible to eliminate the seed losses attributed to its operation.

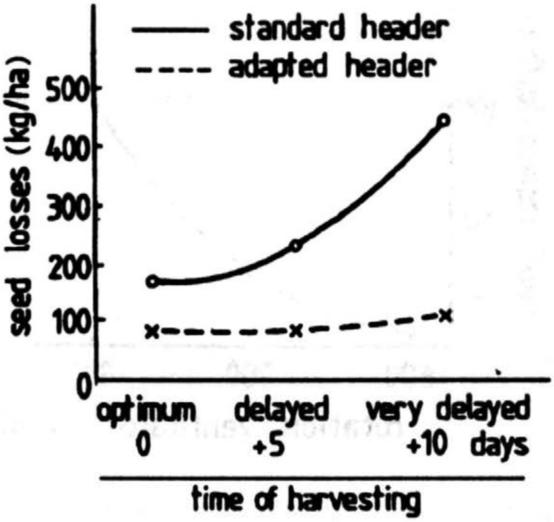
On the basis of knowledge of the strength properties of rape siliques, and of the distribution of seed losses caused by the operation of the particular subassemblies of the combine, a comprehensive study was made, the objective of which was to minimize rapeseed losses through appropriate adjustments and adaptation of the combine.

The settings of the working parameters of the thresher assembly and the operating parameters of the grain table subassemblies were changed with relation to the current physical status of the field.

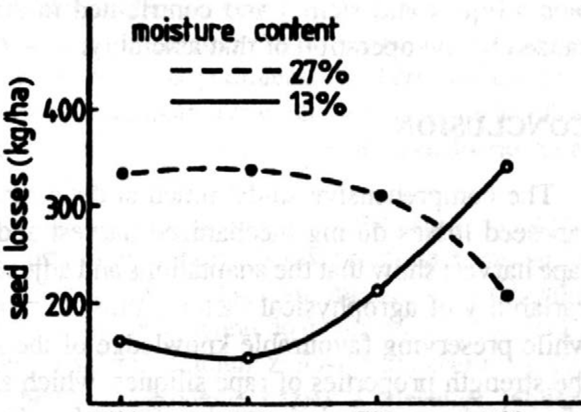
The results of the study (Fig. 3) showed that the lowest seed losses occurred when the plants were harvested at full ripeness - about 150 kg/ha (optimum harvest). Delaying the harvest results in an unavoidable increase in seed losses caused especially by the operation of the standard harvester assembly. In the case of harvest ten days after optimum ripeness the losses were over 400 kg/ha. The application of extended floor plate of the thresher assembly clearly lowers rapeseed losses, stabilizing them at a low level irrespective of the time of harvesting. The beneficial effect of the extended floor plate is especially notable in the case of delayed harvest, when the siliques are more vulnerable to cracking and seed shattering.

Minimization of rapessed losses occurring in the course of combine harvest is possible if the combine adaptation is accompanied by a comprehensive tuning

3. The influence of the time of harvesting and the header type on the rapeseed losses

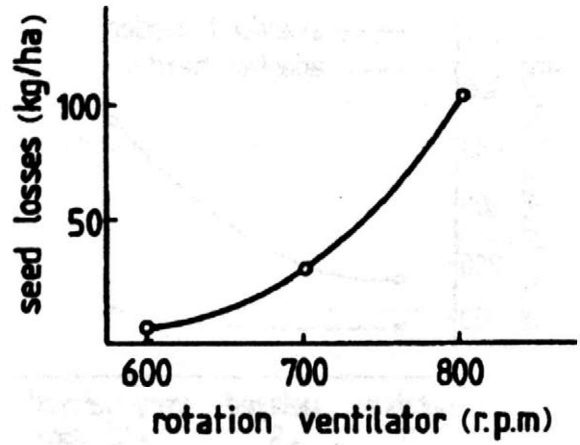


4. The effect of rape silique moisture and of threshing drum speed on the level of rapeseed losses



(adjustment) of the operation of its individual assemblies. This especially concerns the operation of the thresher assembly which is very important for the minimization of seed losses in the harvesting of rape of varied silique moisture. It was found out that at the optimum harvest time, at low silique moisture, the lowest seed losses occur at threshing drum speeds of 500 - 600 r. p. m. (Fig. 4), while for moist rape (silique moisture at about 27 %) minimum seed losses occur at threshing drum speeds of 700 - 800 r. p. m.

Seed losses limitation is also related to the proper setting of the blower speed (Fig. 5). An increase in blower r. p. m. increased the losses considerably irrespective of the type of grain table screens. The application of a prototype ear screen provided



5. The effect of blower speed on the level of rapeseed losses

a considerably relief for the grain table from the secondary mass flow load (crumbled siliques and stems) and contributed to significant limitation of seed losses caused by the operation of that assembly.

CONCLUSION

The comprehensive study aimed at determination of the causes and sources of rapeseed losses during mechanized harvest and at optimization of the process of rape harvest show that the adaptations and adjustments used, taking into account the variability of agrophysical factors, allow to minimize quantitative losses of seeds while preserving favourable knowledge of the subject was the characterization of the strength properties of rape siliques, which allowed forecasting of the response of particular rape varieties to the effect of various external factors occurring in the course of ripening and harvest, and for their incorporation in the plant-machine system. Such a comprehensive approach to the problem allows the minimization of seed losses, even down to 2.9 % of the crop, which compared to the commonly used harvest technology with the related levels of seed losses (8.4 to 28.1 %), provides measurable economic benefits in the form of an additional grain mass from the same rape plantation.

References

SZPRYNGIEL, M. - GROCHOWICZ, M. - KRÓLIKOWSKI, M. - SZOT, B. - TYS, J.: The design and application of extended floor plate of the harvester assembly of a combine for rape harvest (in Polish). V Sympozjum, Politechnika Warszawska, Plock, 1991.

SZOT, B. - SZPRYNGIEL, M. - GROCHOWICZ, M. - TYS, J.: The application of active canopy dividers for rape harvest (in Polish). V Sympozjum, Politechnika Warszawska, Płock, 1991.

SZOT, B. - SZPRYNGIEL, M. - GROCHOWICZ, M. - TYS, J.: The adaptation of a combine grain table for rape harvest (in Polish). V Sympozjum, Politechnika Warszawska, Plock, 1991.

REPORT, 1976 - 1990, on the realization of the Branch Research and Development program No. 05. 3. „Study of the technological parameters affecting the level of rapeseed losses during harvest" (in Polish). Instytut Agrofizyki PAN Lublin.

Received for publication December 9, 1993

SZOT, B. - SZPRYNGIEL, M. - GROCHOWICZ, M. - TYS, J. (Poľská akadémia vied, Lublin; Vysoká škola poľnohospodárska, Lublin):

Vplyv fyzikálnych vlastností repky a pracovných parametrov kombajnu na veľkosť strát semien.

Zeměd. Techn., *40*, 1994 (1): 45-51.

Príčiny strát semena repky počas dozrievania a zberu boli určované prostredníctvom originálnej a nekonvenčnej metódy. Premenlivosť pevnostných parametrov bola charakterizovaná vo vzťahu k charakteristickým znakom odrody. Bolo zistené, že v prípade použitia štandardného obilného kombajnu pri zbere repky straty semien sa nachádzali v rozmedzí od 9,4 do 28,1 %, a to v závislosti na podmienkach zberu. Konštrukcia kombajnu nezodpovedá špecifickým charakteristikám danej plodiny, ktorej nažky ľahko praskajú. Spôsobujú tak nezvratné straty, a to jednak v záverečnej fáze dozrievania, jednak pri styku s pracovnými prvkami zberového stroja.

Výsledkom rozsiahleho výskumu bolo zistenie, že straty semena repky môžu byť minimalizované iba prostredníctvom príslušnej úpravy zberového stroja a správnym nastavením jeho pracovných orgánov (otáčok mláťacieho bubna, medzery medzi košom a bubnom, otáčok ventilátora a p.). Je potrebné pritom brať do úvahy reálne podmienky na poli (sklon pozemku, vlhkosť semien a nažiek), štádium zrelosti a čas zberu. Vplýva tiež náchylnosť niektorých odrôd repky na poškodenie nažiek a trieštenie semien. Úpravy tiež vyžaduje žací stôl ako aj separačno čistiaci mechanizmus. Komplexný prístup k uvedeným problémom umožňuje obmedziť straty semena, a to až na hranicu 3 %, čo možno považovať za značný úspech v porovnaní s technológiou bežne v praxi používanou.

repka; fyzikálne vlastnosti; zber; straty

Contact Address:

Prof. dr. Boguslaw S z o t , Polish Academy of Sciences, Doswiadczalna 4, 20-236 Lublin, Poland

---

THRESHING OF BEAN BY ADJUSTED THRESHING MECHANISM OF HARVESTER

J. Poničan

University of Agriculture, Nitra

Kinematic and constructional parameters of threshing mechanism of harvester thresher affect the quality of bean seed threshing in a high degree. The contribution analyses the effect of circumferential velocity of threshing cylinder (7.85 to 11.77 m/s) and threshing gap (20/13, 20/15, 25/20, and 30/25 mm) on the damage to bean seeds and their subconcave separation. The measurements were accomplished on the model of adjusted threshing mechanism under laboratory conditions. The adjustment of threshing mechanism consisted in rubberizing of drum sledge by molecular rubber UNIREP 33 and threshing concave was formed by transversal bars, on which plastic cups were put on. It follows from the values measured and assessed that the damage to been seeds in the Ultima variety ranged from 6.4 to 21.5 % and from 16.7 to 32.3 % in the Kreola variety. Higher separation capability below the concave was recorded in the Kreola variety (52.0 %) compared to the Ultima variety (51.7 %).

bean; adjusted threshing concave; rubberized threshing units; damage to seeds; separation

The scientific studies of a number of authors confirm the fact that the use of harvesters with unadjusted threshing mechanism causes disproportionate damages and losses of legume seeds. The unsuitability of a technical solution of threshing mechanism is markedly manifested especially in the bean threshing where damages are often exceeding 50 % (J e c h et al., 1985).

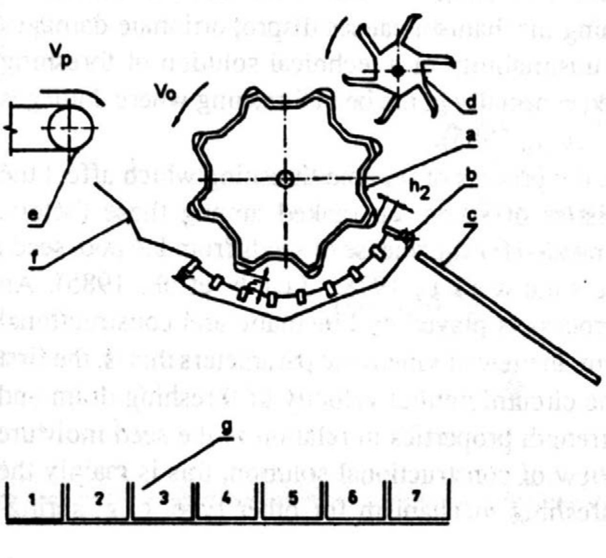
There is a number of factors in the process of legume threshing which affect the sees quality. The size characteristics of seeds are ranked among these factors, together with their weight, power needed for the release of seeds from the pod, seeds strength, their moisture, etc. (S o s n o w s k i , 1978; J e c h et al., 1985). An important role in the threshing process is played by kinematic and constructional parameters of threshing mechanism. In view of kinematic parameters this is, the first of all, the case of harmonizing the circumferential velocity of threshing drum and the size of threshing gap witch strength properties in relation to the seed moisture and their varietal properties. In view of constructional solution, this is mainly the case of substitution of sledge threshing mechanism for other type, e. g. spring-loaded fingers on the drum and the concave (B l a g o j e v i č , R a d o j č i č , 1983; B a j k i n , 1985), rubberizing of sledges or of the whole threshing drum (J e c h et al., 1980). All these studies are aimed at searching for such a solution, either in the design or technological process of threshing which could contribute significantly to the reduction of damage to bean seeds during threshing.

The aim of the study was to find out the values characterizing bean seed threshing in laboratory conditions on the model of adjusted threshing mechanism of the harvester. This is mainly the case of damage to seeds and subconcave separation in dependence on the circumferential velocity of threshing drum and on the change in the size of a threshing gap.

MATERIAL AND METHOD

The measurements proper of the effect of the circumferential velocity of the threshing drum and of the threshing gap on the damage to bean seeds and subconcave separation of seeds were performed on the model of sledge threshing mechanism (Fig. 1). The threshing mechanism was adjusted for measurements in the following way: sledges of a threshing drum were rubberized by molecular rubber UNIREP 33 and the threshing concave was formed by cross bars to which plastic rotary cups were put on (Fig. 2a, b). Measurements were carried out at the circumferential velocity ranging from 250 to 375 l/min, what corresponds to the circumferential velocity from 7.85 to 11.77 m/s.

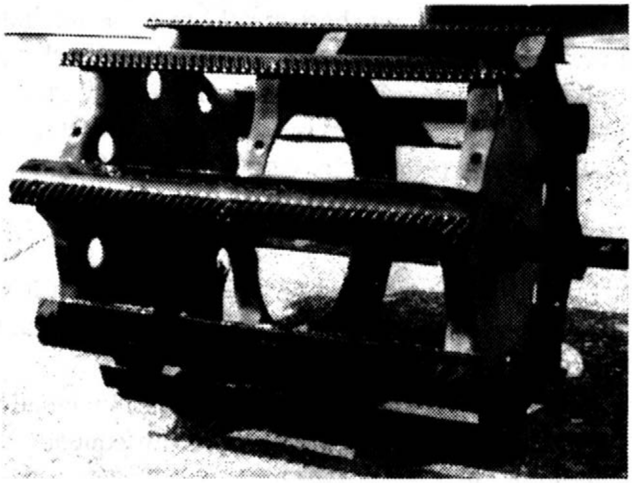
The threshing gap was set to the value of 20/13, 20/15, 25/20 and 30/25 mm/mm. The seed moisture during threshing was 12.4 to 13.4 % and of straw 16.4 to 16.8 %. The weight passage of a threshing drum was constant - 1.66 kg/s.



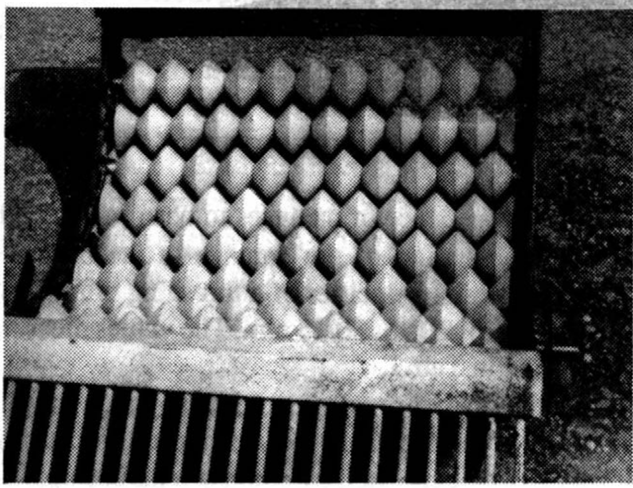
1. Principal diagram of threshing model for threshing of bean seeds

a - threshing drum, b - threshing concave, c - gravity plate, d - releasing drum, e - loading conveyer, f - receiving hopper, g - collectors

2. **Adjustment of threshing mechanism**



a) rubberized bars of threshing drum



b) new threshing concave

The stand of seed bean of the Ultima and Kreola varieties was used for threshing. The bean intended for threshing was manually pulled up in the field, placed in the row and after drying up transported to the laboratory. The threshing drum is driven by electric motor with continuous possibility of the change in revolutions and their recording. There are sheet-metal boxes for retaining the subconcave separation of threshing in the lower part of the threshing mechanism. In the direction of discharge of threshed material to shaking units is placed the oblique sheet-metal and trapping bag. The dosing of the mass into the threshing mechanism is done by means of conveyer belt (e) and charging hopper (f) (Fig. 1).

Procedure during measurement

– Plant mass was placed on the conveyer belt in a dose which provided the rated weight passage of threshing mechanism (kg/s) at the constant velocity of loading conveyer.
– After setting to the constructional and kinematic values of the threshing mechanism, this was put to operation and subsequently the dosing conveyer was put into operation too.
– The overflow of threshed material below the concave, which is characterized as subconcave separation, was trapped into sheet-metal boxes (Fig. 1g, 1 - 7), the straw with the rest of seeds was trapped behind the threshing mechanism into a bag.
– After threshing of each sample the overflow from individual collectors below the concave and behind the threshing mechanism was weighed and recorded into tables.
– Separation capacity of the concave and the damage to seeds was calculated into percentage (%) from weight fractions.

RESULTS OF MEASUREMENTS

The dependence of damages to bean seeds for the Ultima and Kreola varieties:

The evaluation of the damage to the bean seeds was carried out at various circumferential velocities of a threshing drum (7.85 - 11.77 m/s) and the threshing gap of 20/13, 20/15, 30/25 mm. The values measured for bean seed damage (%) are presented in Tab. I.

The course of the damage to bean seeds for different varieties is in Fig. 3. The dependence of the damage of bean seeds on circumferential velocity of the threshing drum can be expressed by empiric relationship:

$$p = a + bx + cx^2 \qquad (\%)$$

Statistical values of experimental dependences are presented in Tab. II. It follows from the values measured that with the rising circumferential velocity of the threshing drum in the selected range from 7.85 to 11.77 m/s the damage to bean seeds is growing. This damage in the Ultima variety is from 6.4 to 6.5 % at the lowest circumferential velocity of 7.85 m/s, and it is ranging from 13.8 to 21.5 % at the highest circumferential velocity of 11.77 m/s. This coincidence can be stated in the similar way also with the Kreola variety where the damage is 16.7 to 20.2 % at

I. Damage to bean seeds (%) for the Ultima and Kreola varieties

Circumferential velocity of threshing drum (m/s)	Ultima		Kreola		
	threshing gap		threshing gap		
	20/13 mm	20/15 mm	20/15 mm	25/20 mm	30/25 mm
7.85	6.4	6.5	19.5	20.2	16.7
8.63	16.0	9.3	22.5	22.0	18.6
9.42	17.1	12.4	26.4	22.9	20.0
10.20	18.5	13.2	26.6	23.4	23.4
10.99	18.9	13.3	26.7	24.0	23.8
11.77	21.5	13.8	32.3	24.1	23.9

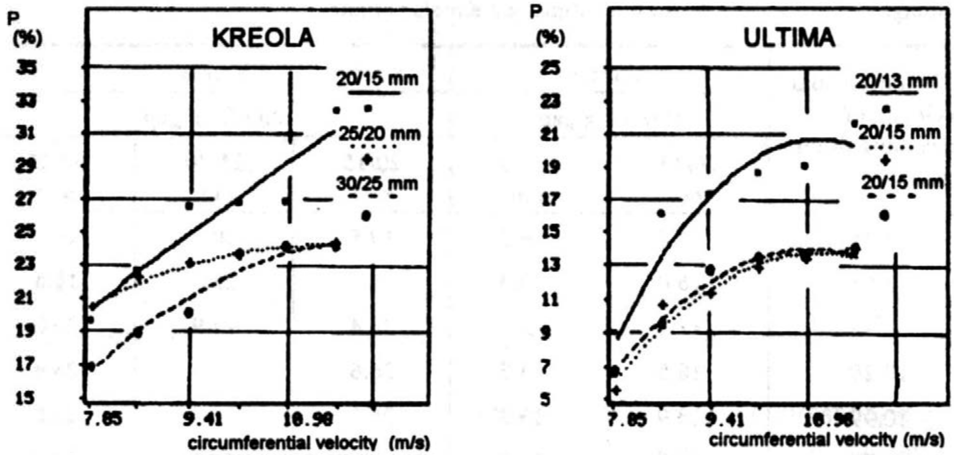
the lowest circumferential velocity and at the highest circumferential velocity - 23.9 to 32.3 %.

When comparing selected working gaps we can say that with growing gap the damage to seeds is falling. This change is insignificant in the Ultima variety and at the lower circumferential velocity of the threshing drum (7.85 m/s), but the damage fell from 21.5 % to 13.8 % at the highest chosen velocity of 11.7 m/s. The damage in the Kreola variety can be assessed alike.

In evaluation of chosen varieties in view of threshed material we can say that the Ultima variety is more suitable for threshing where in selected range of circumferential velocities is a lower damage to seeds ranging from 6.5 to 13.8 % compared to the Kreola variety where the damage is from 16.7 to 23.9 %.

II. Statistical values of experimental dependences

Varieties	Threshing gap (mm)	Coefficients			
		a	*b*	*c*	V_k
Kreola	20/15	- 8.09	4.09	- 0.65	0.94
	25/20	- 11.49	6.14	- 0.26	0.99
	30/25	- 34.30	9.40	- 0.37	0.97
Ultima	20/13	- 119.57	25.01	- 1.11	0.94
	20/15	- 71.29	15.20	- 0.68	0.96
	20/15 U	- 70.98	15.25	- 0.68	0.99



3. The damage to bean seeds in dependence on the circumferential velocity of threshing drum

Separation capability of seed overflow through the openings of the threshing concave

The comparison of the results of the damage to bean seeds and its separation below the threshing concave can be considered to a certain extent as the criteria of quality of threshed material, eventually as evaluations of a new constructional solution of threshing mechanism. The values measured from subconcave separation of bean seeds (%) are presented in Tab. III.

Figs. 4 and 5 gives the course of subconcave separation of seeds for the Ultima and Kreola varieties in dependence on the circumferential velocity of the threshing drum (7.85 to 11.77 m/s). It follows from the values measured that the separation capability of the concave is increasing with its length and the overflow of seeds is falling in different zones of overflow.

When comparing the effect of circumferential velocity of the threshing drum on the total separation of bean seeds below the concave, it can be said that the Ultima variety with increasing circumferential velocity at the gap of 20/13 mm the separation rose by 20 % and at the gap of 20/15 the decrease of 15.7 % appears. In the Kreola variety the separation of the concave in dependence on increasing circumferential velocity of threshing drum (7.85 to 11.77 m/s) grows by 3.6 to 11.3 %.

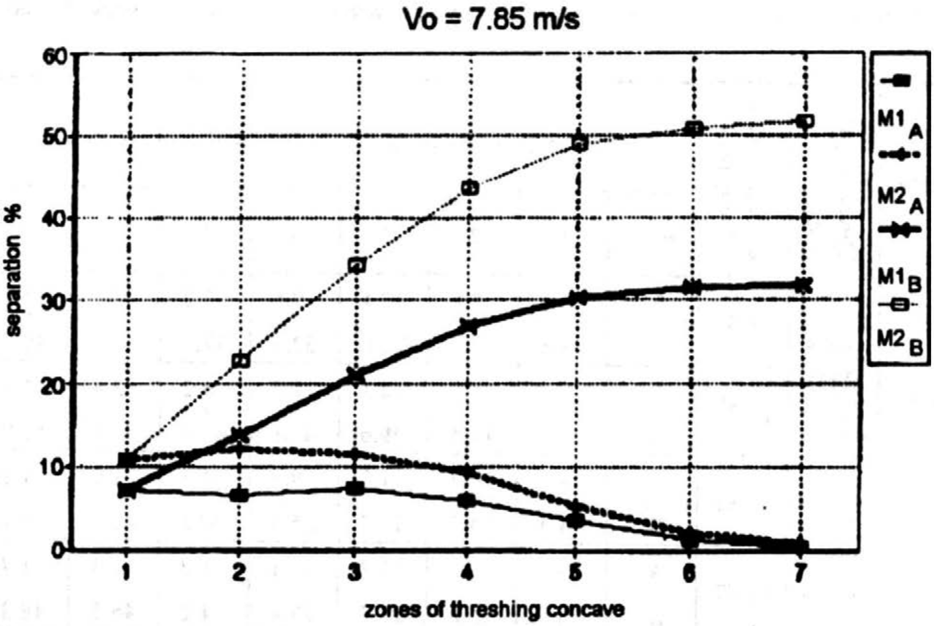
When comparing the effect of selected threshing gap on the separation capability of concave, we can say that the separation grew from 40.7 to 43.2 % in the Kreola variety with increasing threshing gap at the circumferential velocity of the threshing drum 7.85 m/s and fell from 52.0 to 45.4 % at the velocity of 11.77 m/s. In the Ultima variety with growing threshing gap the separation capability of the concave grows (31.7 - 51.6 %) at the circumferential velocity of the threshing drum (Fig. 1a) 85 m/s and falls (51.7 to 35.9 %) at a velocity of 11.77 m/s.

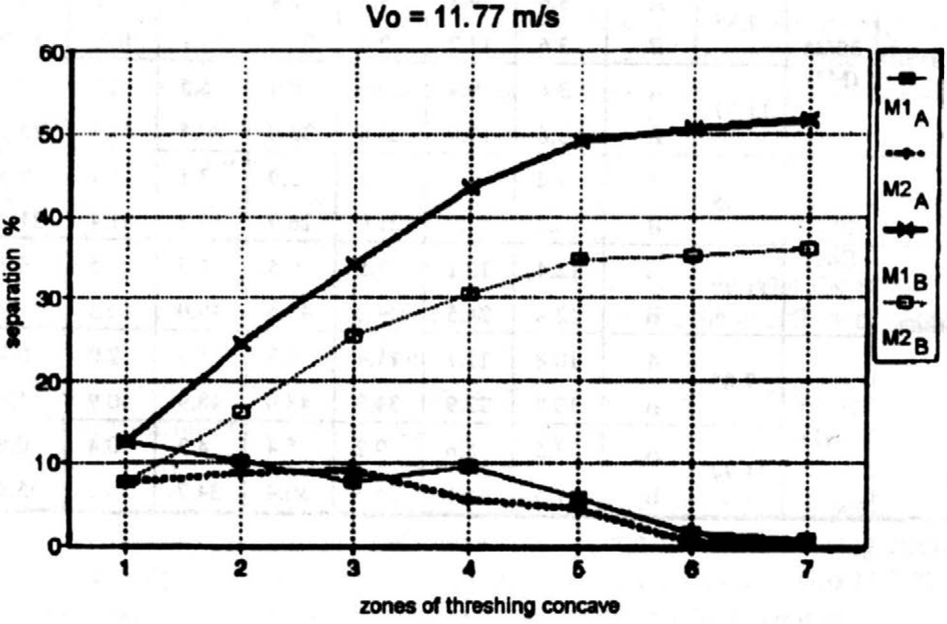
III. Separation of bean seeds below threshing concave (%) according to different zones (A) and in total (B)

Variety	Threshing gap (mm)	Circumferential velocity (m/s)	Grain separation alongside the lenght of concave in %							
			zone	1	2	3	4	5	6	7
Kreola	20/15 (M1)	7.85	A	3.8	8.8	10.4	9.6	5.0	2.0	1.1
			B	3.8	12.6	23.0	32.6	37.6	39.6	40.7
		11.77	A	6.0	11.5	12.1	11.5	6.2	2.8	1.9
			B	6.0	17.5	29.6	41.1	47.3	50.1	52.0
	25/20 (M2)	7.85	A	4.5	10.2	11.0	9.8	4.7	1.9	1.1
			B	4.5	14.7	25.7	35.5	40.2	42.1	43.2
		11.77	A	5.0	10.6	11.7	11.1	5.8	2.3	1.7
			B	5.0	15.6	27.3	38.4	44.2	46.5	48.2
	30/25 (M3)	7.85	A	3.6	9.1	9.8	9.4	7.2	1.5	0.8
			B	3.6	12.7	22.5	31.9	39.1	40.6	41.8
		11.77	A	3.6	9.4	10.6	9.4	6.5	3.9	2.1
			B	3.6	13.0	23.6	33.0	39.4	43.3	45.4
Ultima	20/13 (M1)	7.85	A	7.2	6.5	7.3	5.9	3.4	1.1	0.3
			B	7.2	13.7	21.0	26.9	30.3	31.4	31.7
		11.77	A	12.4	10.1	7.5	9.5	5.5	1.5	0.7
			B	12.4	24.5	34.0	43.5	49.0	50.5	51.7
	20/15 (M2)	7.85	A	10.8	12.1	11.4	9.3	5.3	2.0	0.7
			B	10.8	22.9	34.3	43.6	48.9	50.9	51.6
		11.77	A	7.5	8.6	9.2	5.4	4.3	0.4	0.8
			B	7.5	16.1	25.3	30.4	34.7	35.1	35.9

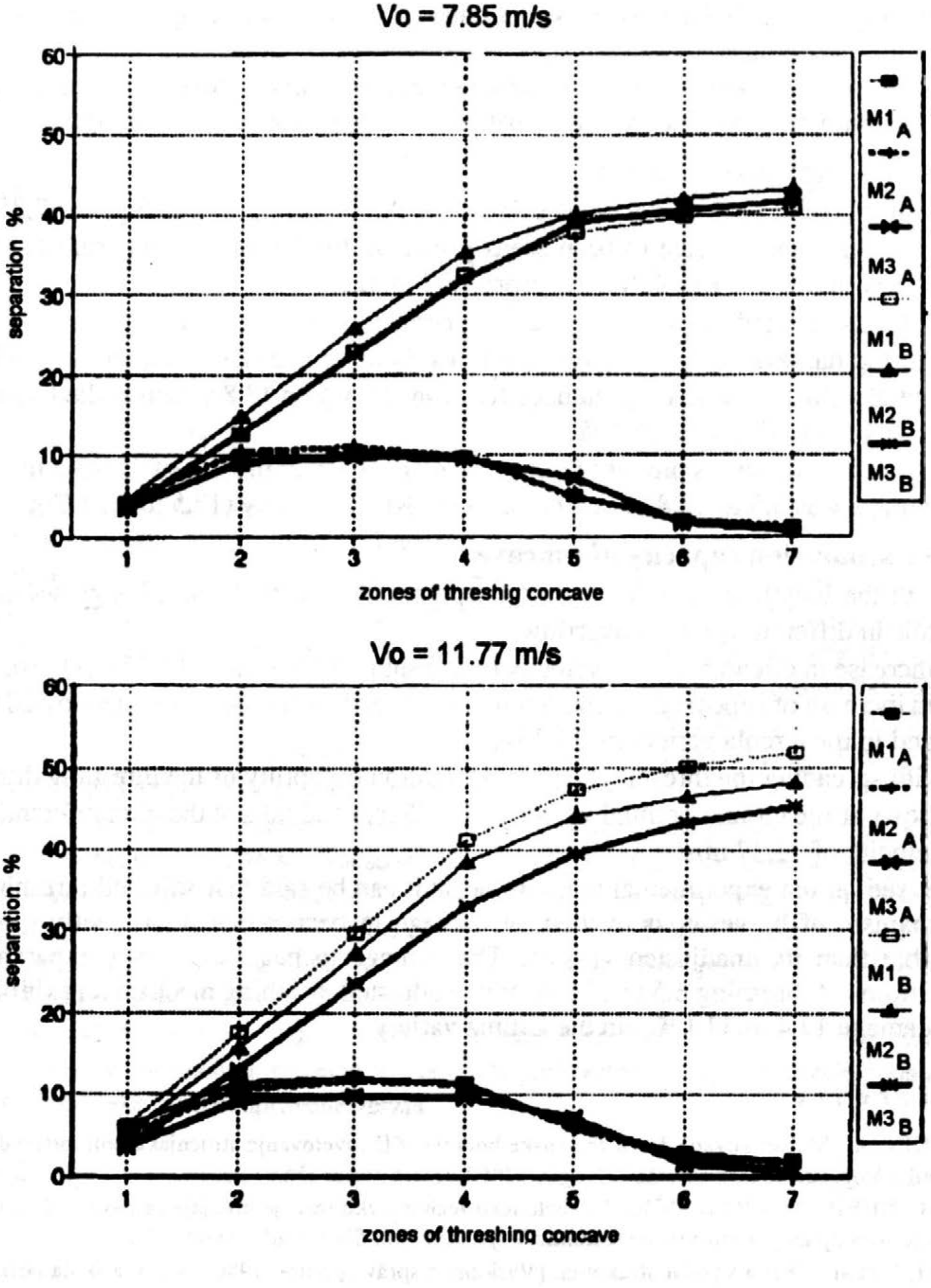
CONCLUSION

The constructional execution of operating mechanisms of harvesters can together with the properties of the harvesting material affect to a large extent the total quality of the resulting product. For this reason it is necessary to harmonize kinematic parameters of harvesting machines with biological properties of harvested crops,





4. Subconcave separation of bean seeds for the Ultima variety
M1 - threshing gap 20/13 mm
M2 - threshing gap 20/15 mm
A - separation in individual zones of overflow
B - total separation



5. Subconcave separation of bean seeds for the Kreola variety
M1 - threshing gap 20/15 mm
M2 - threshing gap 25/20 mm
M3 - threshing gap 30/25 mm
A - separation in individual zones of overflow
B - total separation

eventually to search for new constructional solutions of working mechanisms of harvesting machines.

It follows from experimentally measured and evaluated values on the model of adjusted threshing mechanism of the harvester thresher for bean threshing:

a) for damage to bean seeds

- with increasing circumferential velocity of the threshing drum (Fig. 1a, 7.85 - 11.77 m/s) the damage to bean seeds grows, in the Ultima variety from 6.4 to 21.5 % and in the Kreola variety from 16.7 to 32.3 %,
- as far as selected threshing gaps are concerned, we can say that with increasing gap the damage falls while this difference is more marked at higher circumferential velocities where the damage fell from 21.5 % to 13.8 % and in the Kreola variety from 32.3 % to 23.9 %,
- the Ultima variety is more resistant to damage when at the gap of 20/15 mm the damage was 6.5 to 13.8 % compared to the Kreola variety (19.5 to 32.3 %);

b) for separation capacity of concave

- with the length of concave the total separation capacity of concave grows and falls in different zones of overflow,
- increase in circumferential velocity of threshing drum (7.85 - 11.77 m/s) results in increase of subconcave separation of bean seeds in the Ultima variety by 20 % and in the Kreola variety by 11.3 %,
- with spreading the threshing gap the separation capability of the threshing drum grows at the circumferential velocity of 7.85 m/s and falls at the circumferential velocity of 11.37 m/s.

Based on the experimental measurements it can be said that adjusted threshing mechanism of harvester is in view of damage to bean seeds significantly more suitable than its unadjusted version. The damage to bean seeds in comparable conditions of threshing 6.5 to 13.5 % and unadjusted threshing mechanism exhibits the damage 17.4 to 37.1 % - in the Ultima variety.

References

BAJKIN, A.: Mehanizovana žetva semenske boranje. XII savetovanje stručnjaka poljoprivredne technike Vojvodine. In: Sbor. Rad. Trogir, 1985.

BLAGOJEVIČ, M. - RADOJČIČ, I.: Techničko-technoložko rešenje uredjaja za pasulj. X. savetovanje stručnjaka poljoprivredne technike Vojvodine. In.: Sbor. Rad. Cavtat., 1983.

JECH, J. et al.: Zber a výmlat strukovín. [Výskumná správa.] Nitra, 1980 - Vysoká škola poľnohospodárska.

JECH, J. et al.: Vlastnosti strukovín z hľadiska zberu. [Výskumná správa.] Nitra, 1985 - Vysoká škola poľnohospodárska.

SOSNOWSKI, S.: Sledovanie kvality výmlatu strukovín. [Kandidátska dizertačná práca.] Nitra, 1978 - Vysoká škola poľnohospodárska.

Received for publication December 9, 1993

PONIČAN, J.: (Vysoká škola poľnohospodárska, Nitra):

Výmlat fazule upraveným mláťacím mechanizmom obilného kombajnu.

Zeměd. Techn., *40*, 1994 (1): 53-63.

Kvalita výmlatu je ovplyvňovaná kinematickými a konštrukčnými parametrami mláťacieho mechanizmu. V práci je rozobraný vplyv obvodovej rýchlosti mláťacieho bubna (7,85 - 11,77 M/s) a mláťacej medzery (20/13, 20/15, 25/20 a 30/25 mm) na poškodzovanie semien fazule (%) a podkošovú separáciu. Meranie sa uskutočnilo na modeli upraveného mláťacieho mechanizmu v laboratórnych podmienkach (obr. 1). Úprava mlaťacieho mechanizmu spočívala v pogumovaní mlatiek mláťacieho bubna molekulárnou gumou UNIREP 33 a vložením nového mláťacieho koša. Kôš je konštrukčne riešený tak, že priečky koša sú oceľové tyče, na ktoré sú nasunuté tvarované poháriky z umelej hmoty (obr. 2).

Z nameraných a vyhodnotených hodnôt vyplýva, že poškodzovanie semien fazule v závislosti na obvodovej rýchlosti mláťacieho bubna bolo pri odrode Ultima od 6,4 do 21,5 % a pri odrode Kreola od 16,7 do 32,3 % (obr. 3).

Separačná schopnosť mláťacieho mechanizmu bola hodnotená prepadom semien pod košom (obr. 4 a 5). Môžeme konštatovať, že separačná schopnosť s dĺžkou koša narastá, ale v jednotlivých zónach prepadu postupne klesá. Vyššiu separačnú schopnosť vykazuje odroda Kreola (52,0 %) ako Ultima (51,7 %). Tiež je možné konštatovať, že pri odrode Ultima so zvyšovaním obvodovej rýchlosti mláťacieho bubna (7,85 - 11,77 m/s) sa separácia semien pod košom pri mláťacej medzere 20/13 mm zvyšuje o 20 % a pri medzere 20/15 dochádza k poklesu o 15,7 %.

Vplyv zvolených pracovných medzier na separačnú schopnosť koša pri odrode Kreola sa prejavil tak, že so zväčšovaním mláťacej medzery a pri obvodovej rýchlosti 7.85 m/s sa separácia zvýšila (40,7 - 43,2 %) a pri obvodovej rýchlosti 11,77 m/s sa separácia znížila (52,0 - 45,4 %). Pri odrode Ultima so zväčšovaním mláťacej medzery separačná schopnosť koša stúpa (31,7 - 51,6 %) pri obvodovej rýchlosti 7,85 m/s a klesá (51,7 - 35,9 %) pri rýchlosti 11,77 m/s.

Na základe experimentálnych meraní je možné konštatovať, že upravený mláťací mechanizmus obilného kombajnu je z pohľadu poškodzovania semien fazule podstatne výhodnejší ako jeho neupravená verzia.

fazuľa; upravený mláťací kôš; pogumované mlatky; poškodenie semien; separácia

Contact Address:

Doc. Ing. Juraj P o n i č a n , CSc., Vysoká škola poľnohospodárska, Tr. A. Hlinku 2, 949 01 Nitra, Slovenská republika

Ústav zemědělských a potravinářských informací
Slezská 7 , 120 56 Praha 2

UPOZORNĚNÍ PRO ODBĚRATELE

VĚDECKÝCH ČASOPISŮ ČAZV A SAPV

Od roku 1994 zajišťuje distribuci vědeckých časopisů vydavatel - Ústav zemědělských a potravinářských informací Praha.

Věříme, že i v dalších letech zůstanete odběrateli našeho vědeckého časopisu, a proto Vás žádáme, abyste nám

co nejdříve zaslali objednávku
na předplatné časopisu,
který budete v roce 1994 odebírat.

	Periodicita	Rozsah	Předplatné
Rostlinná výroba	12	96 s.	420,-
Živočišná výroba	12	96 s.	420,-
Veterinární medicína	12	64 s.	360,-
Zemědělská ekonomika	12	96 s.	420,-
Lesnictví	12	48 s.	420,-
Potravinářské vědy	6	80 s.	192,-
Zemědělská technika	4	80 s.	128,-
Ochrana rostlin	4	80 s.	128,-
Genetika a šlechtění	4	80 s.	128,-
Zahradnictví	4	80 s.	128,-

Objednávky zasílejte na adresu:

Ústav zemědělských a potravinářských informací
referát odbytu - pí Tejčková
Slezská 7
120 56 Praha 2

THE EFFECT OF CHANGES OF PHYSICO-MECHANICAL SOIL PROPERTIES ON THE SUGAR BEET STAND PROPERTIES

J. Páltik, J. Šabík, K. Kecskemétiová

University of Agriculture, Nitra

The contribution deals with the problem of tram lines loosening within the so-called tram line system of sugar beet cultivation. The aim was to adjust lines in mechanical way after wheel traffic in the spring in order to minimize their negative impacts on sugar beet stand. The contribution presents the impacts of wheel traffic on the changes of some physico-mechanical properties of soil, followed by analysis of the effect of two systems of looseners on changes of some properties of a grown stand. The use of proposed looseners had a positive impact, particularly on field emergence rate in adjacent lines, reduced representation of celeriac roots, and some other properties of grown stand.

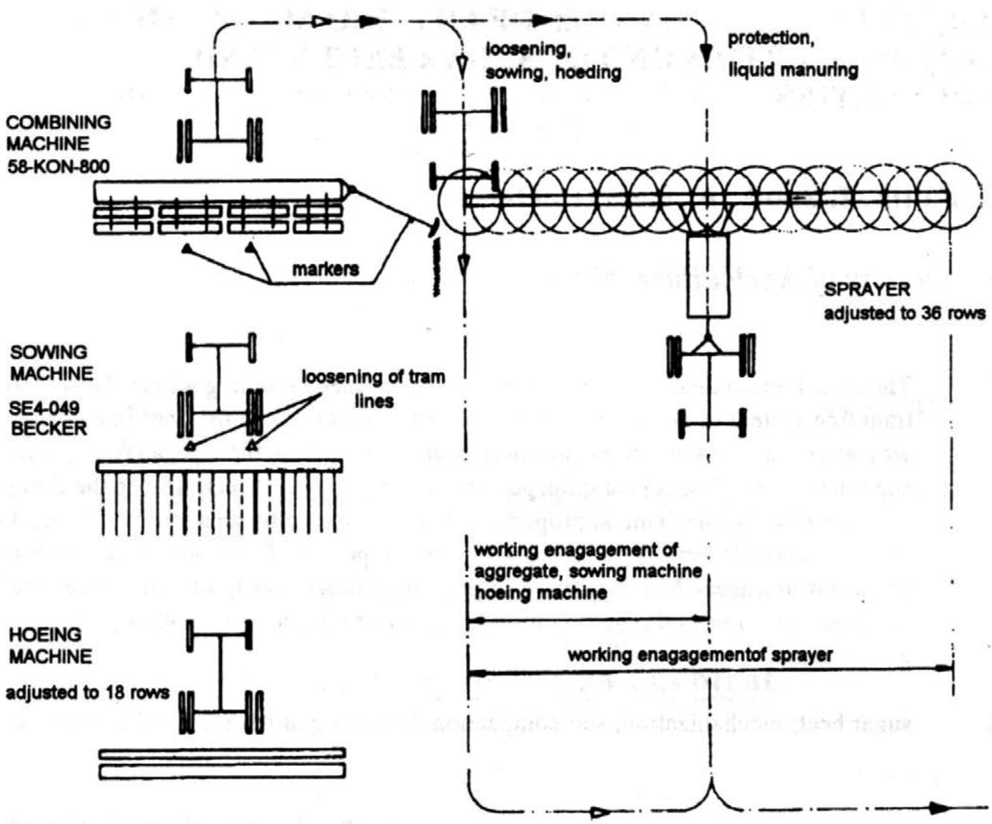
sugar beet; mechanization; soil compaction; loosening of tracks; stand properties

Sugar beet is one of the crops very sensitive to the changes of physico-mechanical soil properties caused by wheel traffic, especially in spring (smoothing, loosening, sowing, protection, hoeing).

One of the possible solutions of the given problem is the use of technology of tram lines where individual working interventions are carried out by organized wheel traffic in the same tracks (Fig. 1) (Polc, Páltik, 1989). Except for marked advantage of this technology, such as reduction of percentage of compacted soil, saving of fuels, increase in the yield, etc., multiple wheel traffic of machinery in the same lines is leaving more marked tracks in which known defects of excessive soil compaction are concentrated.

To solve this problem, we tried to design and to test different cultivators to loose the tracks arisen in operating conditions. To judge their influence on physico-mechanical soil properties and in final conclusion, on the changes of some properties of sugar beet stand.

The knowledge of whole-area soil loosening is reported in literature relatively frequently. Other situation is in the sphere of loosening of tracks during soil cultivation, sowing and stand treatment of sugar beet and similar crops. The results in this field are referred by Brunotte (1988); Bosse, Kalk (1985); Ermich, Fritzsche (1988); Páltik et al. (1993). Relatively exten-



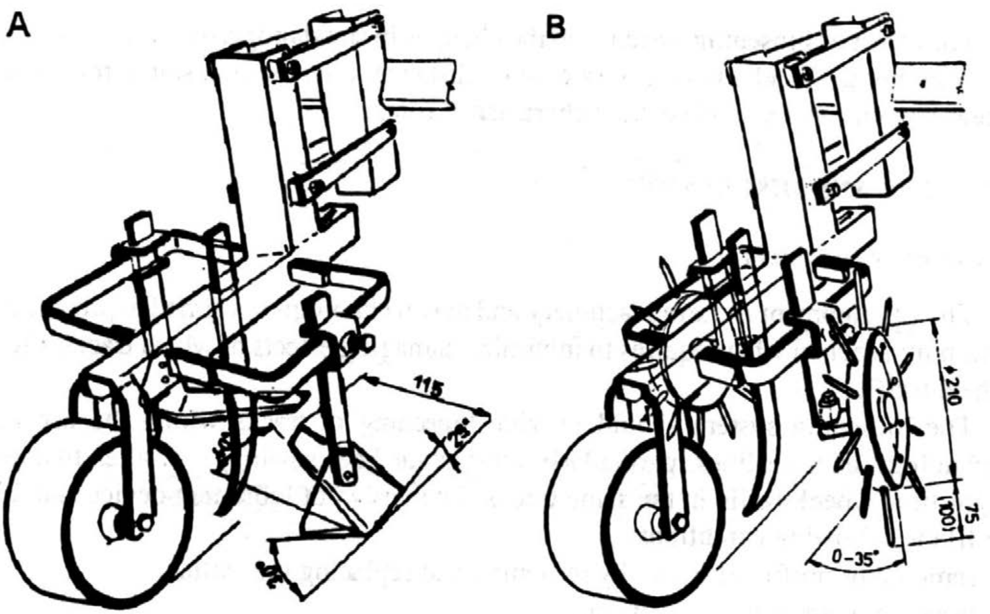
1. Diagram of technology of sugar beet cultivation using tram lines
uncompacted rowns (12 rowns = 66 %)
single-side rowns (2 rowns = 22.2 %)
compacted rowns (2 rowns = 11.1 %)

sive is the literary knowledge from the impact of soil compaction on the development of plants and on the quality of product (Sommer, Zach, 1986; Hůla, 1984).

MATERIAL AND METHOD

To reach the objective, i. e. to design and to test suitable cultivators to loose the tracks which appear during sugar beet cultivation by technology of tram lines, we were solving the following issues:

- design of cultivators,
- observation of changes in soil properties,
- study of the effect of loosening systems on stand properties.



2. Designed and studied loosening devices:
A - two single-sided shares with medium chisel shovel and sweep
B - two passive mounted finger wheels with medium chisel shovel and sweep

Within the measurements we have tested six loosening systems which are based either on the work of wedge in soil or on the principle of rotary loosening device without forced drive. The contribution presents one representative of the both above-mentioned principles which exhibited positive results (Fig. 2). This is the loosening device working on the principle of wedge (system A) and the loosening device of rotary type (system B). We also studied the energy demand of different loosening systems, not presented in this contribution.

Measurements were carried out in operating conditions of the Cooperative at Oslany, the Prievidza district, where sugar beet is cultivated for several years by the technology of tram lines. For the measurements we used: the Ibis variety with germinating rate of 97 % and monogermity of 95 %. The sowing was done by the sowing machine Becker SE 4-049 adjusted for sowing of 18 rows to the final distance of sown seed of 0.18 m.

Of physico-mechanical properties we studied the following soil properties: soil moisture, specific weight of soil, bulk density of dry and moist soils, porosity, penetrometric resistance and agglometric composition of soil.

The tractor Z 12011 with double-mounting was used as power means for loosening and sowing. The front tyres of the size 7.50 - 20 (tyre inflation of 250 kPa), rear tyres of the size 9.5/9 - 42 (tyre inflation of 140 kPa).

The effect of loosening systems on the changes in stand properties were assessed by studying the field emergence rate, plant distance, interspace in stand, root size, sugar content, yields, and celeriac character of roots.

RESULTS AND DISCUSSION

1. Design of looseners

The development of farm machinery and new technologies is aimed at preparing optimum seedbed what requires to minimize damaging effects of wheel tracks after wheel traffic.

The loosening system should provide loosening of tracks within the use of technology of tram lines, particularly after sugar beet sowing, i. e. after four to eight-time wheel traffic in the same tracks. The design of loosening device should fulfil the following conditions:

- removal of profile of tracks by loosening and replacing the earth,
- break of water capillarity of soil,
- loosening must not disturb the seedbed,
- soil after loosening should not be either of excessive clods, nor too much crushed down,
- the loosening device should be simple, it must not be clogged, to have low energy demand, etc.

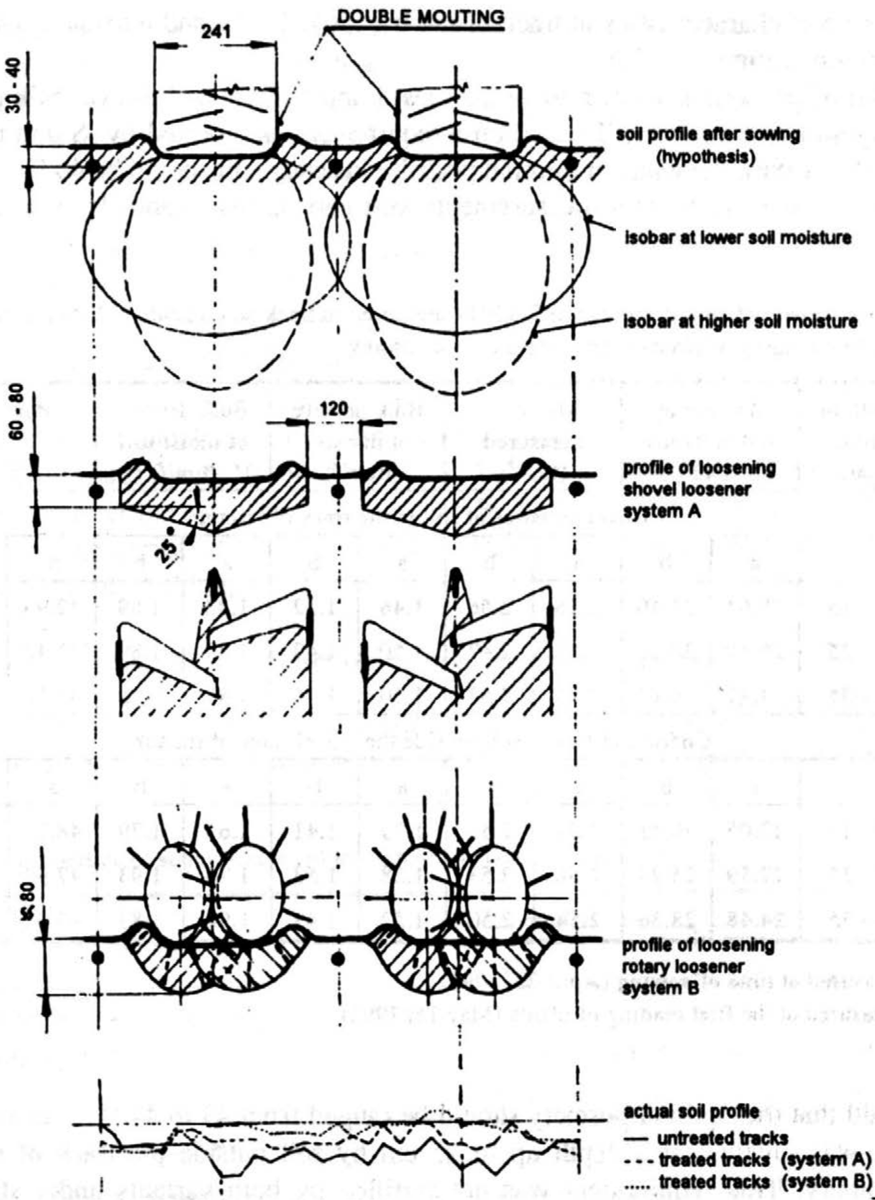
You can see the loosening devices on Fig. 2. Both loosening systems (A, B) were compared with the control variant K_1, i. e. with line which was not affected at all by the track of wheel, and the variant K_2, i. e. the line which was affected by the track of wheel but was not treated with a loosener.

The engagement of loosener, together with recession of loosener, were theroretically limited (P á l t i k et al., 1993). It follows from the analysis that the engagement of a device should be greater than is the width of tyre, not only for reasons of line loosening but also for reasons of backward replacing by wheels to the sides of bulged soil (Fig. 3).

Like engagement, the depth of loosening is also restricted by the requirement for not disturbing the seedbed. Besides it, the depth of loosening is limited by the fact that deeper soil profiles are not „ripened“ in the spring, thus eliminating the possibility of greater depths of loosening.

2. Study of changes in soil properties

To judge the consequences of wheel traffic on the change of soil properties, laboratory analyses of soil samples were used to study the following: soil moisture, maximum capillary water capacity, specific weight, bulk density, air content in soil, and porosity, that is for:



3. Presupposed soil profile after sowing in tracks of mobile machinery, loosening profile of tracks by share-type (A) and rotary (B) loosener and actual soil profile in operating trial

- soil not affected by mobile machinery (outside the track),
- soil not affected by mobile machinery after sugar beet sowing (in tram lines - in track).

The soil characteristics in track of the tractor Z 12011 and outside it using the double-mounting is in Tab. I.

Out of properties under review the most important are as follows: bulk density of dry soil and porosity. If based on a requirement as reported by S o m m e r , Z a c h (1986), the value of optimal porosity in sandy soil should be 40 %, in loam soil 47 %. Inasmuch as the measurements were carried out in sandy loam soil, it can

I. Characteristic of soil of the tractor Z 12011 measured in track and outside it during sowing and in the first reading of plants - the Cooperative at Oslany

Depth of samling (cm)	Momentary soil moisture (%)		Moisture measured (t.m^{-3})		Bulk density of dry soil (t.m^{-3})		Bulk density of moist soil (t.m^{-3})		Porosity (%)	
Characteristics of soil in the track of tractor										
	a	b	a	b	a	b	a	b	a	b
5 - 15	25.64	24.40	2.56	2.56	1.46	1.52	1.83	1.89	42.93	40.41
15 - 25	25.59	28.06	2.57	2.47	1.50	1.47	1.89	1.89	41.42	40.01
25 - 35	24.87	26.13	2.55	2.53	1.50	1.46	1.87	1.85	41.23	42.07
Characteristics of soil outside the wheel track of tractor										
	a	b	a	b	a	b	a	b	a	b
5 - 15	27.05	26.41	2.59	2.55	1.32	1.41	1.69	1.79	48.77	44.39
15 - 25	27.59	25.29	2.68	2.53	1.38	1.53	1.76	1.93	47.98	39.18
25 - 35	24.48	28.36	2.54	2.50	1.52	1.43	1.90	1.83	40.03	42.75

a) measured at time of sowing (April 23, 1992)
b) measured at the first reading of plants (May 15, 1992)

be said that the optimal porosity should be ranged from 43 to 44 %. This requirement was fulfilled at a depth up to 25 cm by soil outside the track of mobile machinery. This requirement was not fulfilled by both variants under study at a depth from 25 to 35 cm. This is confirmed by an absence of loosening in depth where the long-time effect of deep tillage was finished.

The same knowledge also confirms the changes of bulk density of dry soil. Based on the data as referred by H o f f m a n n (1980), the limit of bulk density of dry soil at a depth from 5 to 30 cm without any consequences on soil depression in sugar beet cultivation is fluctuating from 1.32 t.m^{-3} in calciferousloam soil to 1.38 t.m^{-3} in Chernozem. These requirements are not fulfilled by soil for all measured depths in tractor's wheel track, this forms a prerequisite of yield depression. With higher bulk density of soil root growth is reduced, whereby root growth reduction should not results in lower yields if the plant has enough water and nutrients. Beyond the limit of root development is considered the value of bulk density of dry soil about 1.9 $t.m^{-3}$. In evaluating the measured values it can be applied, like in evaluation of soil porosity that at depth horizon from 25 to 35 cm increased bulk density was caused in particular by unsuitable soil cultivation of several years.

Except for changes in some soil properties after wheel traffic we studied the effect of loosening devices used for agglometric soil composition. We require for sugar beet that the size of soil aggregates to 10 mm should amounted to 50 %, and the size of aggregates up to 36.6 mm to 90 % from the weight of surface sample.

The use of loosening devices resulted in increment of clod particles on the soil surface. For example, while after wheel traffic of combining machine the representation of particles up to 10 mm was 86.67 %, after a loosening system A it was 64.2 %, and after the use of system B - 69.16 %. Similar results were achieved with other size categories of cloddy particles. This fact has a good impact on the resistance to soil puddling.

3. The study of the effect of loosening devices on stand properties

To obtain a high sugar production per area unit, a high biological root yield is to be not only achieved, but to cultivate a stand which creates prerequisites by its

II. Some properties of sugar beet stand in studied and control (K_1, K_2) variants

Variants of measurements		Control variants		Loosening systems	
		K_1	K_2	A	B
Relative field emergence rate	(%)				
1 reading (15. 5. 1992)		91.02	89.35	93.52	84.34
2 reading (2. 6. 1992)		87.26	81.00	95.19	83.92
Distribution of plants in row					
Average spacing of plants in row and variability of their distribution	$\bar{x}$ (cm)	21.84	28.10	19.30	21.80
	VK (%)	64.94	74.30	51.13	59.89
Interspace	(%)	7.90	13.15	2.95	4.37
Celeriac character	(%)	16.67	23.00	7.83	17.83
Sugar content	(%)	15.81	15.74	15.44	17.39

K_1 - row unaffected by wheel track

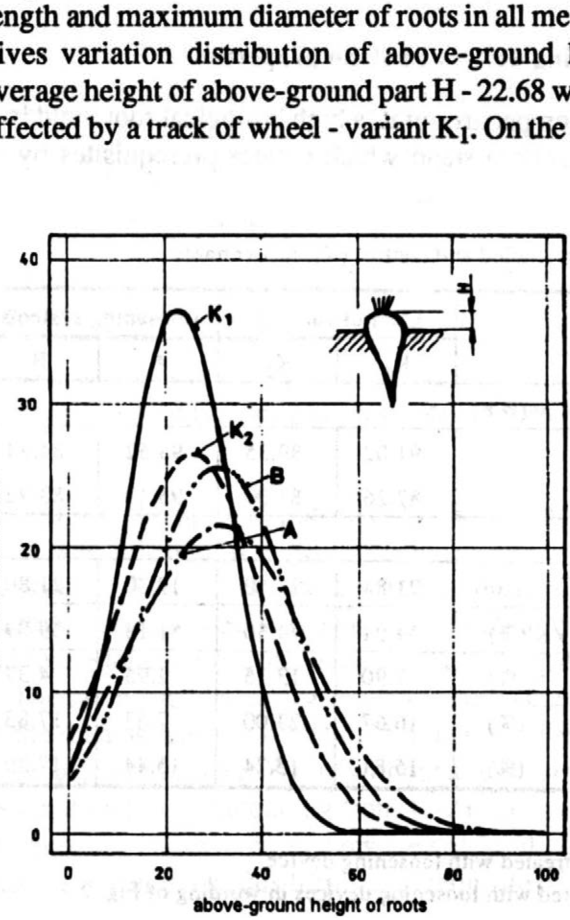
K_2 - row affected by wheel track and untreated with loosening device

A, B - rows affected by wheel track treated with loosening devices in wording of Fig. 2

physico-mechanical properties to reach losses and damage to roots during harvest as low as possible. In concrete words these are such stand properties (interspace in crop, above-ground part of roots, shape and size of roots, etc.), the best for harvest. To obtain, e.g. total losses of root mass on the level of technical possibilities of the present harvest machinery from 3 to 5 %, means, among facts, to create as possible as balanced conditions for germination, growth and development of sugar beet. Tab. II gives the values of field emergence rate, spacing of plants in row and interspace of stand for studied and control variants.

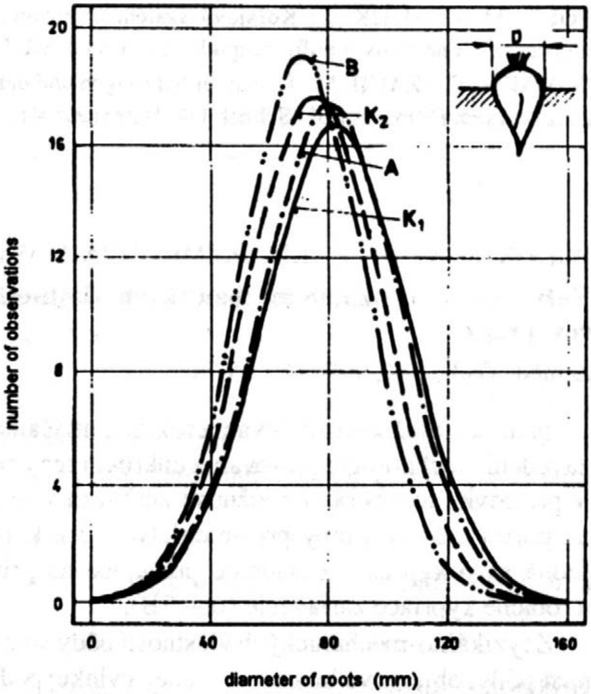
Almost single-sided worst results were obtained for row affected by the wheel track and untreated by loosening device (variant K_2 - Tab. II). Within this variant the lowest field emergence rate was measured - 81 %, the highest interspace of stand - 13.15 %, the highest average spacing of roots - 281 mm, and the highest percentage of roots of celeriac shape - 23 %.

To judge the effect of loosening devices designed for track loosening within the tram line system of sugar beet cultivation,we also studied the changes in some size properties of roots during harvest, that is: above-ground height of roots, root weight, length and maximum diameter of roots in all measured variants K_1, K_2, A, B. Fig. 4 gives variation distribution of above-ground height of roots, while the lowest average height of above-ground part H - 22.68 was achieved in a line which was not affected by a track of wheel - variant K_1. On the contrary, the highest above-ground



4. Variation distribution of above-ground height of roots in individual studied variants:
K_1 - rown unaffected by wheel track
K_2 - row affected by wheel track and untreated with loosening device
A - row affected by wheel track and treated with loosening system A
B - row affected by wheel track and treated with loosening system B

5. **Variation distribution of root diameter in individual studied variants (see variants in Fig. 4)**



height of roots is undesired as from the side of technological properties in sugar production, as in view of harvest quality.

Unfavourable effect of soil compaction on the change of root diameter (Fig. 5) can be documented in a similar way. The highest diameter of roots was reached in a row not affected by wheel track - variant K_1.

References

BOSSE, O. - KALK, D.: Untersuchungen zur Leckerung der Traktorspuren bei Saatbetbereitung. Agrartechnik, *10*, 1985: 453-455.

BRUNOTTE, J.: Erosionsminderung durch verbesserte Bestelltechnik. Zuckerrübe, *37*, 1988: 186-190.

ERMICH, D. - FRITSCHER, K.: Mechanisierunglösungen zum Milzaer Regelspurverfahren für die strukturschonende Bodenbearbeitung im Zuckerrübenanbau. Agrartechnik, *38*, 1988: 5-7.

HOFFMANN, B.: Einfluss verschiedener Raddruck-Pressungsfeuchte-kombinationen zur Bestellung auf bodenphysikalische Eigenschaften und den Zuckerrübenertrag. Bodenbearbeitungsforschung: Druckbelastung der Ackerböden, Teil 12, Kongress-und Tagungsberichte der Martin Luther Universität Halle-Wittenberg, Halle, 1980: 79-89.

HŮLA, J.: Vliv přejezdů na půdu při různé úrovni organického hnojení. Zeměd. Techn., *30*, 1984: 395-404.

PÁLTIK, J. - ŠABÍK, J. - KECSKEMÉTIOVÁ, K.: Kyprenie stôp spôsobených prejazdom techniky po poli pri pestovaní cukrovej repy. Acta technol. agric. Univ. agric. Nitra, 1993 (v tlači).

POLC, M. - PÁLTIK, J.: Koľajový systém pestovania cukrovej repy. Zborník rozširovaných zlepšovacích návrhov v poľnohospodárstve 1/89,č. SR-54-88.

SOMMER, C. - ZACH, M.: Bodenverdichtungen und deren Auswirkungen auf die Pflanzentwicklung und den Ertrag. KTBL-Schrift 308. Darmstadt-Kranichstein, NSR, 1986.

Received for publication December 9, 1993

PÁLTIK, J. - ŠABÍK, J. - KECSKEMÉTIOVÁ, K. (Vysoká škola poľnohospodárska, Nitra):

Vplyv zmien fyzikálno-mechanických vlastností pôdy na vlastnosti porastu cukrovej repy.

Zeměd. Techn., *40*, 1994 (1): 65-74.

Jednou z možností znižovania rozsahu utláčania pôdy pri pestovaní cukrovej repy je zavedenie technológie pestovania cukrovej repy použitím koľajových riadkov (obr. 1). V príspevku rozoberáme možnosti znižovania negatívneho účinku vznikajúcich koľají na porast cukrovej repy prostredníctvom ich kyprenia dvoma druhmi kypričov stôp. Jedná sa o kypriace zariadenie pracujúce na princípe práce klina v pôde (obr. 2A) a rotačné kypriace zariadenie (obr. 2B).

Z fyzikálno-mechanických vlastností pôdy sme sledovali vlhkosť pôdy, mernú hmotnosť pôdy, objemovú hmotnosť suchej a vlhkej pôdy, pórovitosť, hrudovitosť a i. (tab. I).

Vplyv kypriacich zariadení na zmeny vlastností porastu sme hodnotili prostredníctvom poľnej vzchádzavosti, vzdialenosti rastlín, medzerovitosti porastu, rozmerových vlastností buliev, cukornatosti, úrody a celerovitosti buliev.

Takmer jednostranne najhoršie výsledky sa dosiahli v riadku, ktorý bol ovplyvnený stopou kolesa a neošetrený kypriacim zariadením (variant K_2, tab. II). V rámci tohoto variantu v porovnaní s riadkami, ktoré boli ošetrované kypriacimi systémami (A, B) - tab. II bola nameraná najnižšia poľná vzchádzavosť - 81 %, najvyššia medzerovitosť porastu - 13,15 %, najvyššia priemerná vzchádzavosť buliev - 281 mm a najvyššie zastúpenie bulie celerovitého tvaru - 23 %.

K podobným výsledkom sme dospeli aj pri sledovaní niektorých fyzikálno-mechanických vlastností buliev. Utláčanie pôdy spôsobovalo zvyšovanie nadzemnej výšky buliev (obr. 4) a znižovanie priemeru buliev (obr. 5).

Na základe uskutočnených experimentálnych meraní bol dokázaný pozitívny vplyv kypriacich zariadení na niektoré vlastnosti porastu cukrovej repy.

repa; mechanizácia; utláčanie pôdy; kyprenie stôp; vlastnosti porastu

---

Contact adress:

Prof. Ing. Jaroslav P á l t i k , CSc., Vysoká škola poľnohospodárska, Tr. A. Hlinku 2, 949 76 Nitra, Slovenská republika

---

SAPAM '93

The list of read and contributed papers at the SAPAM '93 seminar. The addresses of the authors of the papers may be obtained by writing to the Department of Machinery and Production Systems, Agricultural College, A. Hlinku 2, 949 76 Nitra, Slovak Republic

A n g e l o v i č M.: Effect of the selected factors on the damage of grain maize seed (Vplyv niektorých faktorov na poškodenie zrna osivovej kukurice)

A n g e l o v i č o v á M., R a t a j V., M i h á l i k V.: Utilization of laboratory measuring technique at following the influence of nutrition on the egg shell quality (Využitie laboratórnej meracej techniky pri sledovaní vplyvu výživy na kvalitu vajcovej škrupiny)

A r t i m J., J e c h J.: Stimulation of the pea seeds by ultrasound (Stimulácia osiva hrachu ultrazvukom)

B a u e r F., S e d l á k P., Č e r v i n k a J.: Power requirements of ploughing in relation to the unwanted soil compaction (Energetická náročnost orby ve vztahu k nežádoucímu zhutnění půdy)

B i e g a n o w s k i F., K o w a l c z u k J.: Physical and mechanical properties of a garden bean from the point of grain threshing (Fyzikálno-mechanické vlastnosti záhradnej fazule, dôležité z hľadiska zberu)

B i e g a n o w s k i F., K o w a l c z u k J.: The effect of characteristics of green bean plants on the quality of work of pod harvester (Vplyv charakteristiky rastlín zelenej fazuľky na kvalitu práce kombajnu na zber strukov)

B r o z m a n D., K u b í k Ľ.: Optical detecting corn kernel defects (Optická defektoskopia zŕn kukurice)

D u n c a J.: Physical properties of grain culms (Fyzikálne vlastnosti stebiel obilnín)

F r a n č á k J.: Effect of the potato harvester on the potato tuber damages (Vplyv zberovej techniky na poškodenie zemiakových hľúz)

G o r z e l a n y J., P u c h a l s k i C.: Effects of the direction of loading forces on mechanical damage of horse bean (Vplyv smeru zaťažujúcej sily na mechanické poškodenie bôbu)

H a n o u s e k B.: The influence of parameters of elevator on the quality of harvested potatoes (Vliv parametrů vynášecího dopravníku natě na kriteria sklízených brambor)

H a n z e l í k F., D u n c a J., H l o z á k K.: Strength characteristic of the corn grains (Pevnostná charakteristika zŕn kukurice)

H l a v á č o v á Z.: Physical properties of the plant materials from view point of the accuracy of moisture measurement (Fyzikálne vlastnosti rastlinných materiálov z pohľadu presnosti merania vlhkosti)

H o r v á t h L., M a t u s J.: Einfluss der physikalischen Eigenschaften der Kunstdünger auf die Streuungstechnik (Vplyv fyzikálnych vlastností umelých hnojív na rozmetaciu techniku)

J e c h J., A r t i m J., K i c h i R.: Mechanical damage to grains by impact (Mechanické poškodenie zŕn hrachu pri ráze)

J e l í n e k A., F i a l a J., P l í v a P.: Density as basic physical property of pregerminated seeds from the view point of their seedling (Hustota jako základní fyzikální vlastnost předklíčených semen z hlediska jejich výsevu)

K r u p i č k a J.: The influence of the arrangement of threshing mechanism of combine harvester E 512 on the harm of malting barley seed (Vliv seřízení mláticího ústrojí sklízecí mlátičky E 512 na poškození obilek sladovnického ječmene)

L á s z l ó A., L á s z l o K.: Einfluss der Materialkenngrössen der flüssigen Kunstdünger auf die an die Ausbringegeräte gestellten Konstruktions-und Anwendungstechnischen Anforderungen (Vplyv materiálových parametrov tekutých umelých hnojív na konštrukčné a aplikačno-technické požiadavky a na aplikačné stroje)

L á s z l ó A., P á l y i B.: Untersuchung der die Tropfenbildungs, Verteilungskenngrössen der Spritzbrühen beeinflüssende Maschine-Wirkstoff Zusammenwirkungen (Výskum spolupôsobenia stroj - účinná látka ovplyvňujúce parametre tvorenia kvapiek a rozptylu potrebných zmesí)

N á p l a v a V., W e i n g a r t m a n H.: Stress cracks during seed corn drying (Napäťové lomy počas sušenia osivovej kukurice)

N o z d r o v i c k ý L., M i h a ľ P.: A metodology approach to the evaluation of the soil properties related to the machinery effect on the soil (Metodologický prístup k hodnoteniu vlastností pôdy vo vzťahu k pôsobeniu techniky)

P á l t i k J., Š a b í k J., K e c s k e m é t i o v á K.: The effect of changes of physico-mechanical soil properties on the sugar beet stand properties (Vplyv zmien fyzikálno-mechanických vlastností pôdy na vlastnosti porastu cukrovej repy)

P e c e n J.: Identification mechanical damage to seeds by physical methods (Fyzikální metody identifikace mechanického poškození semen)

P i s z c z a l k a J.: The finger bar for threshing of grain maize (Prútová mlatka pre výmlat zrnovej kukurice)

P o n i č a n J.: Threshing of bean by adjusted threshing mechanism of harvester (Výmlat fazule upraveným mláťacím mechanizmom obilného kombajnu)

P u c h a l s k i C., G o r z e l a n y J., G o r a c y Z.: The effect of maturity and harvest date on firmness of strawberry fruit (Vplyv zrelosti a času zberu na pevnosť plodov jahôd)

R a t a j V.: Determination of the firmness of the agricultural materials by loading (Zisťovanie pevnosti poľnohospodárskych materiálov zaťažovaním)

S l o b o d a A.: Technological principles and requirements at the lentil cutting (Technologické zásady a požiadavky na kosenie šošovice)

S o s n o w s k i S.: Possibilities of limiting the mechanical damage to beans during machine harvesting (Možnosti zníženia mechanického poškodenia semien fazule pri mechanizovanom zbere)

S r n k a F.: Contribution to the study of interaction between strenght properties of maize grain (Príspevok k poznaniu vzťahu pevnostných vlastností zrna kukurice k jej mlátiteľnosti)

S z o t B., S t e p n i e w s k i A.: Studies on mechanical properties of rape in the aspect of its quantity and quality losses (Štúdium mechanických vlastností repky vo vzťahu k ich kvalitatívnym a kvantitatívnym stratám)

S z o t B., S z p r y n g i e l M., G r o c h o w i c z M., T y s M.: The effect of the work of combine subassemblies on the extent of damage to rape seeds (Vplyv pracovných mechanizmov kombajnu na veľkosť poškodenia semien repky)

S z o t B., S z p r y n g i e l M., G r o c h o w i c z M., T y s M., R u d k o T.: The effect of the physical properties of rape and of the working parameters of the combine on the extent of rape seed losses (Vplyv fyzikálnych vlastností repky a pracovných parametrov kombajnu na veľkosť strát semien)

S z p r y n g i e l M.: The selection of working parameters of a combine aimed at grass seed loss limitation (Výber pracovných parametrov kombajna na zníženie strát semien trávy)

Š o l c M.: Physical properties of granulated fertilisers influence on spreading (Fyzikální vlastnosti granulovaných hnojiv - vliv na rozmetání)

Z e m á n e k P., V e v e r k a V.: Use of brush hoe in cultivation of vegetable stands (Využití kartáčové plečky při kultivaci porostů zelenin)

Ž u f á n e k J.: Influence of proportional quantities of carrot root upon quality of crop process (Vliv rozměrových veličin kořene mrkve na kvalitu sklizňového procesu)

INSTRUCTIONS FOR AUTHORS CONTRIBUTING TO THE SCIENTIFIC JOURNAL ZEMĚDĚLSKÁ TECHNIKA (AGRICULTURAL ENGINEERING)

Original scientific papers, short communications, and selectively reviews, that means papers based on the study of technical literature and reviewing recent knowledge in the given field, are published in this journal. Published papers are in Czech, Slovak or English. Each manuscript must contain a short or a longer summary.

The author is fully responsible for the originality of his paper, for its subject and formal correctness. The author shall make a written declaration that his paper has not been published in any other information source.

The board of editors of this journal will decide on paper publication, with respect to expert opinions, scientific importance, contribution and quality of the paper.

The paper extent shall not exceed ten typescript pages, including tables, figures and graphs. In the text it is necessary to use such units that are in agreement with the International System of Units (ČSN 01 1300).

Technical layout of the manuscript

Manuscript layout shall correspond to the State Standard ČSN 88 0220 (quarto, 30 lines per page, 60 strokes per line, double-spaced typescript). Tables, figures and photos shall be enclosed separately, not on paste-board. A figure or graph number shall be written on the reverse, along with the author's name. Texts to figures and graphs shall be indicated on a separate sheet. Tables shall be given Roman numerals. The text must contain references to all these annexes.

Layout of the paper

The title of the paper shall not exceed 85 strokes. It is necessary to avoid in the title the usage of common expressions such as A study of ..., A contribution to ..., An attempt at ...; each paper shall be a finished treatise, papers in continuation denoted e.g. Part I, II, III, etc., cannot be published; subtitles of the papers are not allowed either.

The author's names are given without academic degrees, first names are given as abbreviations.

Summary - a brief one

The summary is an information selection of the contents and conclusions of the paper, it is not a mere description of the paper. It must present all substantial information contained in the paper, but its role is not to replace this paper. It shall not exceed 170 words. It shall be written in full sentences, not in form of keynotes. It is published in the language the paper is written in, it should comprise base numerical data including statistical data.

Summary - a longer one

This summary is a basis of English translation, it should contain comments on the results of the study, references to tables and figures, or to the most important literary citations. Its extent shall be two to three typescript pages. It may be submitted in English, if it is submitted in Czech or Slovak, an annexed English vocabulary of technical and agricultural terms will be appreciated.

Key words, index terms

They follow after the brief and longer summary on the next but one line (both summaries shall have the same keywords). A key word (index term) is a noun which is necessary for subject classification of the paper. The order of key words is from common to concrete concepts. The first word is written in small letter, semicolons shall be used between these words. Their number depends on the subject-matter of the paper, it should not be smaller than three and higher than 12 words.

Introduction

This section has to present the main reasons why the study was conducted, and the circumstances of the studied problems should be described in a very brief form. Extensive historical reviews should be avoided. It does not have a title. If the paper does not include the section Review of Literature, literary citations referring to the treated problem should be given in this introductory section.

Review of literature

This should be a short section, containing only literary citations with close relation to the treated problem. It is recommended to cite the lowest possible number of authors.

Material and Methods

Only original methods shall be described, in other casesit is sufficient enough to cite the author of the used method and to mention modifications of this method. This section shall also contain a description of experimental material. A description of the method should enable any specialist to repeat the study on the basis of this description and mentioned citations.

Results

In the section Results figures and graphs should be used rather than tables for presentation of quantitative values. A statistical analysis of recorded values should be summarized in tables. This section should not contain either theoretical conclusions or deductions, but only factual data should be presented here.

Discussion

This section contains an evaluation of the study, potential shortcomings are discussed, and the results of the study are confronted with previously published results (only those authors whose studies are in closer relation with the published paper should be cited). The sections Results and Discussion may be presented as one section only.

References

The citations shall be presented pursuant to the standard ČSN 01 0197. They are arranged alphabetically according to the surname of the first author: surname (capital letters), first name abbreviation, full title of the paper, official abbreviation of the journal, volume, year of publication, number, first page, last page; in book citations place of publication, publisher and year should be given. References in the text to these citations comprise the author's name and year of publication. Only the papers cited in the text of the study shall be included in the list of references. All citations shall be referred to in the text of the paper.

Address

The author shall give his full name (and the names of other collaborators), academic, scientific and pedagogic titles, full address of his workplace and postal code.

Use of abbreviations

If any abbreviation is used in the paper, it is necessary to mention its full form at least once to avoid misunderstanding. The abbreviations should not be used in the title of the paper nor in the summary.

OBSAH – CONTENTS

SAPAM '93 1

Náplava V., Weingartman H.: Stress cracks during seed corn drying – Napäťové lomy počas sušenia osivovej kukurice 3

Pecen J.: Identification of mechanical damage to seeds by physical methods – Fyzikální metody identifikace mechanického poškození semen 15

Jech J., Artim J., Kichi R.: Mechanical damage to pea grains by impact – Mechanické poškodenie zŕn hrachu pri ráze 23

Puchalski C., Gorzelany J., Goracy Z.: The effect of maturity and harvest date on firmness of strawberry fruit – Vplyv zrelosti a času zberu na pevnosť plodov jahôd 33

Szot B., Szpryngiel M., Grochowicz M., Tys J., Rudko T.: The effect of the physical properties of rape and of the working parameters of the combine on the extent of rapeseed losses – Vplyv fyzikálnych vlastností repky a pracovných parametrov kombajnu na veľkosť strát semien 45

Poničan J.: Threshing of bean by adjusted threshing mechanism of harvester – Výmlat fazule upraveným mláťacím mechanizmom obilného kombajnu 53

Páltik J., Šabík J., Kecskemétiová K.: The effect of changes of physico-mechanical soil properties on the sugar beet stand properties – Vplyv zmien fyzikálno-mechanických vlastností pôdy na vlastnosti porastu cukrovej repy........ 65

The list of papers at the SAPAM '93 seminar – Zoznam prác zo seminára SAPAM '93 75

UPOZORNĚNÍ PRO ODBĚRATELE

Od letošního roku vyřizuje veškeré služby spojené s distribucí časopisu Zemědělská technika vydavatel - Ústav zemědělských a potravinářských informací Praha.

Objednávky na předplatné posílejte na adresu:
Ústav zemědělských a potravinářských informací
referát odbytu
Slezská 7
120 56 Praha 2

Vědecký časopis ZEMĚDĚLSKÁ TECHNIKA ● Vydává Česká akademie zemědělských věd a Slovenská akadémia pôdohospodárskych vied - Ústav zemědělských a potravinářských informací ● Čtvrtletník ● Redaktorky: MVDr. Eva Machejová, ing. Jovanka Václavíčková ● Redakce: Slezská 7, 120 56 Praha 2, tel.: 02 / 257 541, fax: 02 / 257 090 ● Sazba Studio DOMINO - ing. Jakub Černý, Pražská 108, 266 01 Beroun, tel.: 0311 / 24 015 ● Tisk ÚZPI Praha ●

Rozšiřuje Ústav zemědělských a potravinářských informací, referát odbytu, Slezská 7, 120 56 Praha 2