The effectiveness of paprika seeds germination in relation to the physical properties

Paweł Sobczak[1], Janusz Zarajczyk[2], Józef Kowalczuk[2], Kazimierz Zawiślak[1], Marian Panasiewicz[1], Jacek Mazur[1], Agnieszka Starek[1]

[1]Department of Food Engineering and Machinery, University of Life Sciences in Lublin, Poland, Doświadczalna 44, 20-280 Lublin, telefon: 48 81 461 00 61, e-mail: pawel.sobczak@up.lublin.pl
[2]Department of Horticulture Machinery and Tools, University of Life Sciences in Lublin, Poland

Received April 10.2013; accepted June 18.2013

Summary. The paper presents an assessment of the strength of paprika seeds germination, depending on their size. Three fractions of paprika seeds were assessed, i.e. seeds of the size range from 1 to 2 mm, next the range of 2 to 3.15 mm, and the fraction in the range above 3.15 mm. A control sample in the study were not calibrated paprika seeds. The germination strength was determined according to the PN-69/R65950 norm using paper as a substrate. 50 seeds from each fraction were used for the research. The strength of germination was determined in three replications. Paprika seeds germination depends on their size. Seeds in the range greater than 3.15 mm had the highest strength of germination of 80% after 14 days from sowing.

Key words: germination strength, paprika seeds, separation.

INTRODUCTION

For a long time the industry connected with seed processing, where seeds are used in herbalism, horticulture and market gardening, has been facing the problems related to seeds purification, separation and processing. It especially regards economic entities involved in export activities of these products. Each producer aims at achieving the highest quality of seeds on offer. A measurable indicator of quality of seeds on offer is their high strength of germination. Germination is defined as a complex of processes occurring in a seed, the result of which is the activation of a germ which consequently leads to the growth of a seedling. Cardinal thermal points are determined for the germination of a seed, i.e. the minimal, maximal and optimal temperature for the process, whereas the optimal temperature does not guarantee the highest germination capability. The value of cardinal points depends on the species of seeds and is connected with their origin [5, 9].

The germination strength of particular seeds depends on the thickness and hardness of the husk, as well as the presence of physiologically active substances on the husk, called growth regulators, which delay or halt the germination process. One of the methods for stimulating the seeds for germination is their scarification, that is abrasion of the seed coat in order to weaken it [2].

Some of the seeds may have different types of fungi on their surface, e.g. *Alternaria dauci* and *A. radicina,* which negatively influence the germination process [11]. The process which reduces the quantity of fungi on the surface of seeds is their treatment in different kinds of solutions [3].

In the food processing industry the process of separation is conducted for a wide range of materials, which include: cereal seeds, seeds of other plants, and fragmented herbs. The necessity to purify and separate tens of millions of tons of seeds representing four basic cereals and a various range of food materials clearly manifests the depth of this problem. The process of separation often involves several stages, e.g. cereal seeds are firstly separated in a harvester, secondly in machinery for purification, and part of seeds, later on, in different processes of technological processing [13, 14]. Taking into consideration the fact that separation processes involve seeds of, at least, a few hundred plant species (i.e. seeds of basic species and weeds), it is easy to understand the difficulties which accompany the process. Hence, a special care should be taken while selecting the machinery which executes the separation processes, and selecting optimal parameters for these processes which are adjusted to specific materials. That is why, the processes of separation and purification are often based on the use of aerodynamic properties, the shape of material or its surface structure in order to separate the required material [12, 15].

The most common method of separation in agriculture and the food industry is sieving. It is characteristic of high efficiency, accuracy of purification and a wide range of the applied material. On the basis of distribution curves of the purified material it can be concluded that it is possible to separate the material according to a particular property, as well as make an assessment of the loss volume in relation to the separated impurities. Such research was carried out on seeds of selected carrot varieties [1] and other grain materials [4, 6, 7, 8]. The assessment of the purity of seeds was conducted with the use of complex separation, that is pneumatic-sieve separation. While applying only a sieve, the effect of purification was low. Generally, it may be stated that the use of a sieve of a bigger diameter of apertures results in an increase of material purity with a simultaneous increase of material loss. For the research seeds the best results were achieved while purifying the material in an aspiration canal, in which the velocity of the air stream was 2.0 $m \cdot s^{-1}$, and then sifting it through a sieve with oblong 1.6 mm wide apertures [10].

THE AIM AND SCOPE OF THE RESEARCH

The aim of the paper was to identify the effect of selected physical properties of paprika seeds on their germination strength. Assessed were three fractions of paprika seeds, i.e.: seeds within the size range from 1 mm to 2 mm, next the size range from 2 to 3.15 mm and fractions from the range above 3.15 mm. The control group in the research were not calibrated paprika seeds. For each assessed fraction of seeds their hardness was determined with the use of a texture analyser. The research was conducted in 30 replications.

RESEARCH METODOLOGY

The germination strength was determined according to the PN-69/R65950 norm using paper as a substrate. 50 seeds from each fraction were used for the research. The strength of germination was determined in three replications. The separation of paprika seeds was carried out with the use of a vibrating sieve separator AS 200 (Fig. 1), using sieves with oblong apertures with the following sizes: 0, 1, 2, 3, 15 mm.

Fig. 1. Vibrating laboratory sifter AS 200

RESULTS

Table 1 presents the research results of the germination strength of particular paprika seeds fractions.

Table 1. The strength of germination of particular seeds fractions

Fraction	Germination strength [%]	
	After 6 days	After 14 days
Above 3.15 mm	52	80
2-3.15 mm	32	56
1-2 mm	20	47
Seeds before calibration	32	59

While analysing individual research results of the germination strength it can be stated that an essential part is played by the size of seeds. With the increase of seed sizes, the germination strength also increases. Small seeds germinate much later and the number of seedlings is smaller compared to the seeds from the biggest fraction. Among seeds which did not undergo the process of calibration there is a vast discrepancy in the number of seedlings.

The paprika seeds provided by the producer are of various sizes. The size distribution of the analysed seeds is presented in Figure 2.

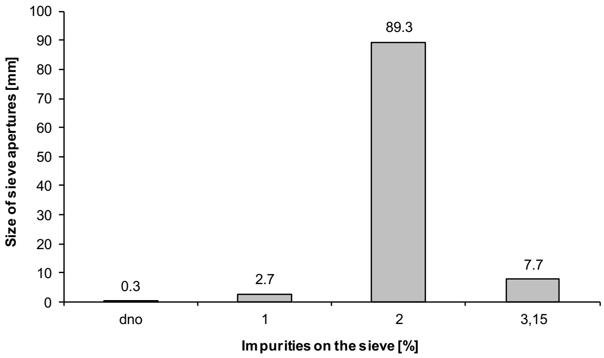

Fig. 2. The size distribution of paprika seeds

The biggest quantity (almost 90%) of paprika seeds belongs to the fraction from the range 2-3.15 mm. In the analysed material there is 7.7% of seeds from the fraction above 3.15 mm, while there is 2.7% of seeds from the smallest fraction. The remaining mass of the sample which is on the bottom of the separator are impurities.

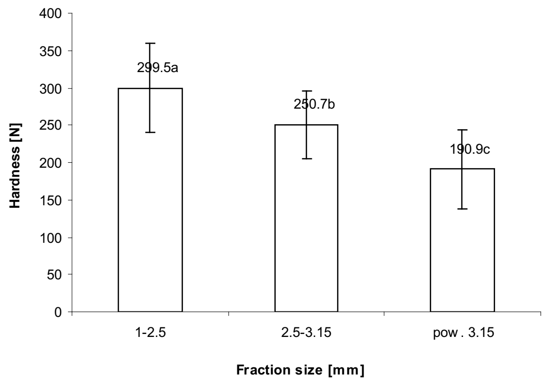

Fig. 3. The hardness of paprika seeds after separating into fractions

Table 2. The analysis of the variance of paprika seeds hardness in relations to the size at the level of significance a=0.05

Source of diversity	Degrees of freedom	Sums of squares	Average squares	The value of a testing function F	F_{α}	p
Fraction size	2	175762.1	87881.05	31.4177	3.11	$p<\alpha$
Error	85	237760.5	2797.182			

The hardest paprika seeds are in the range between 1 and 2.5 mm. Their hardness amounted to 300 N, with a relatively high discrepancy (standard deviation 59). The statistical analysis at the level of significance 0.05 proved fundamental differences in the hardness of paprika seeds from the range between 2.5-3.15 mm and seeds bigger than 3.15 mm. The hardness of seeds with the size above 3.15 mm was over 190 N.

CONCLUSIONS

On the basis of the conducted research the following conclusions were formulated:

1. The germination strength of paprika seeds depends on their size. The biggest seeds (above 3.15 mm) had the highest germination strength of 80% after 14 days following sowing.
2. Among seeds which did not undergo calibration there is a vast discrepancy of the germination strength value in the conducted research, which is caused by different sizes of seeds in the samples.
3. Approx 90% of paprika seeds are characteristic of size within the range 2 – 3.15 mm.
4. The hardness of paprika seeds depends on their size. Smaller seeds are characteristic of higher hardness.

REFERENCES

1. **Choszcz D., Jadwisieńczak K., Konopka S. 2008**. Efektywność czyszczenia nasion marchwi (*daucus carota L.).* Inżynieria Rolnicza, 9(107), 33-38.
2. **Domoradzki M., Korpal W., Weiner W. 2007.** Badania procesu mechanicznej skaryfikacji nasion. Inżynieria Rolnicza, 5(93), 97-106.
3. **Dorna H., Kaniewski R., Jarosz M., Banach J., Szopińska D. 2010.** Zdrowotność i kiełkowanie nasion marchwi traktowanych wyciągiem wodnym z konopii siewnych (*Cannabis Sativa L.*). Progress in Plant Protection. Postępy w Ochronie Roślin, 50(1), 373-377.
4. **Feder S., Kęska W., Włodarczyk K. 2008.** Pneumatyczne wspomaganie procesu przesiewania mieszanin ziarnistych na przesiewaczu płaskim. Inżynieria Rolnicza, 4 (102), 263-270.
5. **Gładyszewska B. 1998**. Ocena wpływu przedsiewnej laserowej biostymulacji nasion pomidorów na proces ich kiełkowania. Rozprawa doktorska. AR Lublin.
6. **Kęska W., Feder S., Włodarczyk K. 2005.** Wstępne wyniki badań nad pneumatyczną intensyfikacją procesu sortowania mieszanin ziarnistych na sicie wibracyjnym. Inżynieria Rolnicza, 3(63), 235-242.
7. **Komarnicki P., Banasiak J., Bieniek J. 2008.** Rozkład aerodynamicznych parametrów stanu równowagi procesowej czyszczenia ziarna. Inżynieria Rolnicza, 4(102), 389-396.
8. **Komarnicki P., Banasiak J., Bieniek J. 2008a**. Warunki równowagi procesowej czyszczenia masy zbożowej na powierzchni roboczej sita żaluzjowego. Inżynieria Rolnicza, 4(102), 397-404.
9. **Lityński M. 1982.** Biologiczne podstawy nasiennictwa. PWN, Warszawa.
10. **Mieszkalski L., Anders A. 1999.** Analiza parametrów separacji okrywy nasiennej z mieszaniny powstałej po obłuskaniu nasion rzepaku. Inżynieria Rolnicza, 2(8), 29-36.
11. **Nowicki B. 1995.** Patogeniczne grzyby zasiedlające nasiona marchwi. Acta Agrobotanica, 48(2), 49–57.
12. **Oszczak Z. 2006.** Optymalizacja parametrów pracy pneumatycznego separatora kaskadowego. Inżynieria Rolnicza, 7, 359-365.
13. **Panasiewicz M., Zawiślak K., Kusińska E., Sobczak P. 2008.** Purification and separation of loose material in a pneumatic system with vertical air stream. TEKA Commission of Motorization and Energetics in Agriculture, 8, 171-176.
14. **Pastushenko S., Tanaś W., Ogiyenko N. 2009.** Research on influence of cavitation process on clearing vegetables and melon seeds by hydro-pneumatic separator. TEKA Commission of Motorization and Energetics in Agriculture, 9, 223-230.
15. **Sobczak P. 2009.** Separacja w produkcji pasz przemysłowych. Pasze Przemysłowe, 3/4, 6-9.

EFEKTYWNOŚĆ KIEŁKOWANIA NASION PAPRYKI W ZALEŻNOŚCI OD ICH WŁAŚCIWOŚCI FIZYCZNYCH

Streszczenie. W pracy przedstawiono ocenę siły kiełkowania nasion papryki w zależności od ich wielkości. Ocenie poddano trzy frakcje nasion papryki, tj.: nasiona o wielkości z przedziału od 1 do 2mm, następnie z przedziału od 2 do 3,15 mm oraz frakcje z przedziału powyżej 3,15mm. Próbą kontrolną w badaniach były nasiona papryki nie kalibrowane. Siłę kiełkowania nasion wyznaczono wg normy PN-69/R65950 stosując jako podłoże bibułę. Do badań przeznaczono 50 nasion z każdej frakcji. Siłę kiełkowania oznaczono w 3 powtórzeniach. Siła kiełkowania nasion papryki zależy od ich wielkości. Nasiona największe powyżej 3,15 mm posiadały najwyższą siłę kiełkowania wynoszącą 80% po 14 dniach od wysiewu.

Słowa kluczowe: siła kiełkowania, nasiona papryki, separacja.

Badania finansowane ze środków KBN prowadzonych w latach 2011-2013 jako projekt badawczy nr NN 313757140.