RESEARCH CONCERNING THE GERMINATION CAPACITY FOR *BRASSICA OLERACEA VAR. ACEPHALA* SEEDS UNDER THE INFLUENCE OF CERTAIN TECHNOLOGICAL FACTORS

CERCETĂRI PRIVIND CAPACITATEA GERMINATIVĂ A SEMINȚELOR *DE BRASSICA OLERACEA* VAR. *ACEPHALA* SUB INFLUENȚA UNOR FACTORI TEHNOLOGICI

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Abstract. *Research was carried out to establish the germination capacity of the seeds from the storage samples of the vegetable specie Brassica oleracea* var. *acephala, with decorative and practical features. The experiences aimed to determine the effect of several factors on germination including: the origin of seeds, their age and various chemical treatments applied to them. In the conducted research, it was found that the source of seeds leads to significant differences in the germination of kale seeds. Different results were obtained for seed germination due to the chemical treatments applied.*
Key words*:* germination, gibberellic acid, technological factors, humidity.

Rezumat. *Cercetările întreprinse au urmărit stabilirea capacității germinative a semințelor din probele de control a speciei legumicole Brassica oleracea var. acephala cu însuşiri decorative şi utilitare. Experiențele au vizat stabilirea efectului asupra germinației a mai multor factori printre care: proveniența semințelor, vârsta acestora şi diferite tratamente chimice aplicate acestora. În urma cercetărilor realizate s-a constatat că proveniența semințelor este cauza unor diferențe semnificative în ceea ce priveşte capacitatea germinativă a semințelor de varză de frunze. Rezultate diferite obținute la germinarea semințelor s-au înregistrat şi datorită tratamentelor chimice aplicate semințelor.*
Cuvinte cheie*:* germinație, acid giberelic, factori tehnologici, umiditate.

INTRODUCTION

Brassica oleracea var. *acephala* is a vegetable species very often used as a food product, and as of lately as a decorative element in landscaping or flower arrangements, which is the motivation for this study. The kale is multiplicated only through seeds, that is why new information about seed germination capacity under the influence of different technological factors can help towards obtaining higher quantity of sowing material. The duration of germination and the mergence of the seedlings

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are also influnced by the age of the seed. The older the seeds the lenghtier the germination period and emergence of seedling (Indrea et. al., 2009). For the species from the cabbage group, as well as for most vegetabale species, seed germination depends on temperature and soil humidity (Burzo et. al., 2000). Most often in vegetable growing biostimulators are used to direct plant growing and development by adjusting the metabolic balance, and the way and moment of aplication is different according to the product used and the vegetable species to which they are applied (Mihalca, 2009). Amongst these substances are gibberellic acid, used to stimulate the energy and seed germination faculty, especially in unfavorable conditions of temperature, humidity and light (Oprea, 2012).

MATERIAL AND METHOD

The biologic material used for organizing the experience that aims to establish the influence of different technological factors on seed germination of *Brassica oleracea* var. *acephala*, is represented by seeds procured from Italy, Hungary and Romania. The seeds produced in Italy will be noted as source I and the ones produced in Hungary will be considered as source II. For organizing the experince several items were used: filter paper, seed germination stimulants and germinators. The experience had two factors and each variant had 3 repetitions. The temperature was the same for each variant and ranged between 18 and 23°C over 24 hours. The determinations that were made concerned the morphological caracteristics of the seeds and seed germination for each variant. The results were statistically processed and presented in tables, and interpreted in the paper.

To accomplish the proposed objectives kale seeds were used in the experience. Morphological characteristics of the kale seeds used are shown in table 1.

Table 1

Morphological characteristics of *Brassica oleracea* var. *acephala* seeds used in the experince

Species	Source					
	I Italy			II Hungary		
	100 pcs/g	MMB g	Plant health	100 pcs/g	MMB g	Plant health
Brassica oleracea* var. *acephala	0,31	3,1	good	0,29	2,9	good

The seeds were divided in groups of 100 pieces and weighed with a technical scale. It was noticed that the seeds from Italy have a mass of 3,1 g for 1000 pcs while the seeds from Hungary have a mass of 2,9 for 1000 pcs the latter being smaller, their mass representing 93,5% of the seeds from Italy.

RESULTS AND DISSCUSIONS

To establish seed germination a bifactorial experience was organized with 4 variants, each variant having 3 repetitions. The technological factors that were taken into consideration were the source of the seed and humidity. The humidity was ensured with the help of filter paper that was soaked in water, one of which was mantained permanantly in water in germinators and one that was folded and

kept in plastic trays. In the case of the latter humidity changed from an optimum level of 80-90% to 20-30% within 24 hours. The seeds were considered germinated when the roots appeared and were at least 1 cm in length. The first observations were made after 48 hours. Further observations were repeated every 24 hours. The results were statistically processed and are shown in table 2.

Table 2

Results concerning seed germination for *Brassica oleracea* var. *acephala* under the influence of source and humidity

Variant		Percent of germinated seeds after n hours				Total germinated seeds
Nr.	**Conținut content**	**48**	**72**	**96**	**120**	**(%)**
1.	*B. o.* var. *acephala* Source I – changing humidity (control)	4,6	25,7	20,3	8,2	58,8
2.	*B. o.* var. *acephala* Source I – constant humidity	12,3	41,5	32,6	3,3	89,7
3.	*B. o.* var. *acephala* Source I – changing humidity	3,1	15,3	10,6	6,2	35,2
4.	*B. o.* var. *acephala* Source II – constant humidity	5,8	18,3	20,5	2,8	47,4

It was found that seed germination took place over five days from the start date. Most of the seeds have germinated in day 3 and 4. In the end the percent of germination was different for each variant. The least germinated seeds (32,5 %), variant 3, are the ones from Hungary and had a changing humidity. Another low percentage was observed on variant 4 (source II Hungary) with a percent of 47.4%, a value that is also considered unsatisfactory, in spite of the optimum level of humidity. The best results were obtained by variant 2 (source I Italy) with a constant optimum level of humidity. To establish if the differences between the variants were significant the results were statistically processed using analysis of variance (table 3).

Table 3

Summary of experimental results concernig seed germination for *Brassica oleracea* var. *acephala* under the combined influence of source and humidity

Variant		Germinated seeds		±d	Difference significance
Nr.	**Content**	**Absolute number**	**% from control**		
1.	*B. o.* var. *acephala* Source I changing humidity (control)	58,8	100,0	-	-
2.	*B. o.* var. *acephala* Source I constant humidity	89,7	152,6	30,9	***
3.	*B. o.* var. *acephala* Source II changing humidity	35,2	59,9	-23,6	000
4.	*B. o.* var. *acephala* Source II constant humidity	47,4	80,6	-11,4	0

$LSD_{5\%}$ - 9,8
$LSD_{1\%}$ - 12,3
$LSD_{0,1\%}$ - 18,5

Analyzing the rezults from the table it can be observed that there are more germinated seeds from variant 2 compared to the control, with a difference of 30,9, statistically very significantly pozitive, while the differences from variant 3 and 4 are very significant and significantly negative compared to the control. The results prezented in the table have been obtained under the combined influence of 2 factors. To establish the unilateral influence of each factors on *B. o.* var. *acephala* seed germination the results have been statistically processed and portrayed in tables 4 and 5.

Table 4

Synthesis of experimental results concernig seed germination for *B. o.* var. *acephala* under the unilateral influence of humidity

Variant		Germinated seeds		±d	Significance of difference
Nr.	Content	Absolut number	Relative (%)		
1.	*B. o.* var. *acephala* - changing humidity **(control)**	47,0	100,0	-	-
2.	*B. o.* var. *acephala* - constant humidity	68,6	146,0	21,6	***

$LSD_{5\%}$ - 8,3
$LSD_{1\%}$ - 11,2
$LSD_{0,1\%}$ - 17,5

The obtained results highlight the fact that the seeds that had an optimum humidity level, germinated in a percent of 146 compared to the control, with a number of 21,6 seeds that have germinated over the control amount. This difference is very significantly positive.

Table 5

Synthesis of experimental results concerning seed germination for *B. o.* var. *acephala* under the unilateral influence of source

Variant		Germinated seeds		±d	Significance of difference
Nr.	Content	Absolut number	Relative (%)		
1.	*B. o.* var. *acephala* - source I **(control)**	74,3	100,0	-	-
2.	*B. o.* var. *acephala* - source II	41,3	55,6	- 33,0	000

$LSD_{5\%}$ - 7,9
$LSD_{1\%}$ - 11,4
$LSD_{0,1\%}$ - 15,8

Analyzing the data from table 5 it can be noticed that the seeds from source I Hungary have germinated in a percent of 55,6 compared to the control, which means 33 less germinated seeds. This difference is statistically ensured and is very significantly negative. This can be concluded from the fact that the seeds

from source II Hungary are significantly smaller than the ones from source I Italy, with 2,9 g for 1000 pcs compared to 3,1 g for the seeds from Italy.

Further on, the effect of giberelic acid (AG3) on *B. o.* var. *acephala* on seed germination was investigated. For the organization of the experience kale seeds were used, produced in 2009 and 2011. The seed samples were put in germinators at a temperature of 18-22° C and the humidity was achieved through solution of AG_3 in different concentrations. The results of the germination are presented in table 6.

Table 6

Experimental results on *B. o.* var. *acephala* seed germination under the influence of AG_3 concentration and seeds age.

Variant		Germinated seeds out of 100		±d	Significance of difference
Nr.	Content	Absolut number	Relative (%)		
1.	2009 seeds, untreated with AG_3 **(control)**	41,2	100,0	-	-
2.	2009 seeds, treated with AG_3 (100 ppm)	43,8	106,0	2,6	-
3.	2009 seeds, treated with AG_3 (500 ppm)	72,5	175,9	31,3	
4.	2011 seeds, untreated with AG_3	85,2	206,8	44,0	***
5.	2011 seeds, treated with AG_3 (100 ppm)	86,3	209,5	45,1	***
6.	2011 seeds,treated with AG_3 (500 ppm)	91,5	222,1	50,3	***

$LSD_{5\%}$ - 14,3
$LSD_{1\%}$ - 19,5
$LSD_{0,1\%}$ - 21,3

Analyzing the data from table 6 it can be observed that the germinated seeds differ from one another based on number and percent in accordance to the variant. The weakest germination is observed on variant 1 and 2 (2009 seeds without AG_3 or with AG_3 100 ppm. The same seeds but an AG3 concentration of 500 ppm have germinated in a much higher percent compared to the control (72,5%). The situation is different for 2011 seeds. Their germination for these samples is over 85% regardless the concentration of AG_3.

The statistic process of these results that are meant to establish the significance of the differences between the variants and the control indicates that the germination for the seeds from variants 3 and 6 is significantly higher than the control, a difference that is statistically very significantly pozitive.

The determination of the unilateral effect of the studied factors on kale seed germination is presented in table 7.

Table 7

Synthesis of experimental results concerning seed germination for *B.o.* var. *acephala* under the unilateral influence of seed age

Variant		Germinated seeds		±d	Significance of difference
Nr.	Content	Absolut (nr.)	Relative (%)		
1.	2009 seeds (control)	52,5	100,0	-	-
2.	*2011 seeds*	87,7	167,1	35,2	***

$LSD_{5\%}$ - 10,5
$LSD_{1\%}$ - 14,2
$LSD_{0,1\%}$ - 18,5

It can be observed that the results obtained are closer in value in the case of variants 1 and 2 (63,2 and 65,2), while for variant 3 seed germination is higher than the control with a positive difference of 18,8 seeds. This difference is statistically ensured and is distinctly significantly positive.

CONCLUSIONS

Based on the obtained results the fallowing conclusions can be drawn:

1. Kale seeds germinate in a percent of 85 under optimum conditions of environment and technology used.

2. Kale seed germination in positively influenced by the size of the seeds.

3. Out of all the technological factors studied in the experience the level of humidity influnces kale seeds germination more.

4. Kale seeds that are stored a number of years can be stimulated towards a good germination by using a solution of AG_3 in a concentration of 500 ppm.

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