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## CHEMICAL MUTAGENESIS IN HEAD CABBAGE *Brassica oleracea* var. *capitata* L. I. SURVIVAL AND VARIABILITY OF PROPERTIES FROM MORPHOLOGICAL CHARACTERISTIC OF M<sub>1</sub> GENERATION

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**ABSTRACT:** *The purpose of study was to establish the chemical mutagen influence - ethyl methane sulphonate (EMS) on the germination and the survival of head cabbage plants in M<sub>1</sub> generation, Ditmarsko variety, as well as to establish the phenotype expression changes of properties from morphological characteristic in economic maturity.*

*Chemical mutagen EMS application in seed of 0.5 %, 0.6 % and 0.7 % concentration was studied not to cause lethality under LD<sub>50</sub> in M<sub>1</sub> generation, Ditmarsko variety. Germination and survival are relatively resistant processes, which were differently influenced by EMS concentration. Chemical mutagen gave inhibiting and stimulating effects on the property expressions from the morphological characteristic of M<sub>1</sub> generation genotypes. It resulted in a widely phenotype diversity regarding to studied indexes.*

**Key words:** *head cabbage; chemical mutagenesis; morphological characteristic; germination; survival.*

### Introduction

Experimental gene-plasma modification in different crops is of a special interest for the modern plant breeding as a possible source for genetic diversity increasing. The natural diversity in cross-pollination crops is quite a lot nevertheless the breeding needs new mutant genes due to radiation and chemical mutagens application which could be used in breeding programmes. It was established that EMS application changed the economical and morphological properties parameters (Prasad et al., 2004), increased the disease resistance (Markandey et al., 2000) and exceeded the frequency and the number of meiotic aberrations (Nandjee, 1995).

Male sterility inducing for using in hybrid variety production (Prasad et al., 2004) is of significant importance in the experimental mutagenesis in *Brassica species*. Radiation mutagenesis only in head cabbage (Nikolova et al., 1998; Petkova and Antonova, 2001)

from *Brassica sp.* crops in Bulgaria was investigated but chemical mutagen influence on the same crop was not yet. That fact together with the necessary of much more diversity imposes on carrying out of investigations for studying of chemical mutagenesis influence on some main expressions of head cabbage growth and development. The aim of current study is to be established the chemical mutagen - ethyl methane sulphonate influence on germination and survival of head cabbage M<sub>1</sub> generation Ditmarsko variety as well as the changes of properties phenotype expressions from morphological characteristic in economical maturing of M<sub>1</sub> generation.

### Material and methods

During the period April 15 - June 30, 2004 at Maritsa Vegetable Crops Research Institute, Plovdiv the chemical mutagen ethyl-methane-sulphonate (EMS) influence on head cabbage M<sub>1</sub> generation Ditmarsko variety growth

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and development was established. The experiment was set on April 14, 2004 in the molecular marker laboratory of Maritsa Institute at four variants with 100 numbers of seeds for each variant: control - untreated seeds (dry) and dry seeds treatment by soaking for 18 hours in concentration of 0.5%, 0.6% and 0.7% of EMS. After treatment the seeds from all variants were washed with water and were sowing on April 15, 2004 in the pots (trays) putted in glasshouses without heating. Germination (%) was recorded during the period April 15 - May 13, and survival (%) - before the date of planting - May 20. The plants from all variants were grown by early production technology on high bed by 90/70+40 cm scheme.

The following properties of  $M_1$  generation in economical maturity were analyzed: leaf rosette size - across (cm), rosette leaves (numbers), leaf rosette weight (kg), head weight (kg), head height and diameter (cm), inner core width and height (cm), head shape - index (head height/diameter), thickness (scale 1-5) and productivity index (head weight/rosette leaves weight + head weight, %). The readings were recorded for all plants from each variant of investigation.

Biometric records data were calculated mathematically and the variation coefficients of studied properties from morphological characteristic of tested genotypes were established (Lakin, 1990). After the present investigation plants from each variants were grown in the pots putted in glasshouses without heating to reach the next generative stage.

## Results and discussion

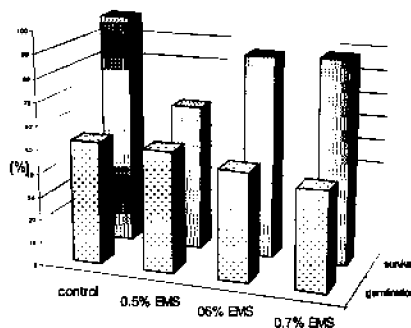
### Germination and survival

This study found out that germination processes were in reciprocal correlation with concentration values of mutagen factor ethyl methane sulphonate (fig. 1). When EMS dose increased the number of germinated seeds reduced compared to the total sown seeds as well as to the control variant - untreated seeds.

However this correlation did not concern the survival. The results showed that in tested variants with a bigger concentration of chemical mutagen the survival was higher than that one recorded for  $M_1$  generation obtained by seeds treated with the smallest concentration 0.5% of EMS. Furthermore it should note that chemical mutagen ethyl methane sulphonate

application in doses of 0.5%, 0.6% and 0.7% did not cause full lethality in  $M_1$  generation of Ditmarsko variety.

**Fig. 1. Germination and survival of  $M_1$  generation obtained by EMS treated seeds**



Differences observed in the germination and survival processes expressed by the mutagen factor influence could consider as a possible indication for inducing of genotype changes in  $M_1$  generation which phenotype expressions should be expected during vegetative and generative phases from plant growth or in the coming mutant generations.

### Morphological characteristic

In the tested variants a big number of phenotype diversity of properties from morphological characteristic was observed. It was recorded that in the plants obtained by seeds treated with ethyl methane sulphonate a big part of properties values - head weight, productivity index, head height and diameter, inner core height and width and head thickness were significant lower than those ones of the control (tabl. 1). Possibly the chemical mutagen exerted inhibiting effect on the phenotype expressions of mentioned parameters. Similar results concerning the parameter reducing of some economical and morphological properties were obtained by other researchers using the same chemical mutagen (Prasad et al., 2004). However, in our study it was recorded that EMS treatment could cause stimulating effect. Increasing of head shape index values was observed in all tested variants. Concentration 0.6% of EMS led to increasing of leaf rosette size and rosette leaves number and weight as increasing of the last mentioned parameter was recorded also for plants obtained after seed treatment with concentration 0.7% of ethyl methane sulphonate.

**Tab. 1 Morphological characteristic of  $M_1$  plants Ditmarsko variety**

Morphological properties		Tested variants			
		Ditmarsko-control	Treatment with 0.5% EMS	Treatment with 0.6% EMS	Treatment with 0.7% EMS
Leaf rosette size	cm	33.8	33.4	37.9	31.9
	%	100.00	98.82	112.13	94.38
Leaf rosette size	cm	37.6	37.7	43.4	35.1
	%	100.00	100.27	115.43	93.35
Rosette leaves	number	14.2	8.9	15.1	15.9
	%	100.00	62.68	106.37	111.97
Leaf rosette weight	kg	0.137	0.044	0.168	0.148
	%	100.00	32.11	122.63	108.03
Head weight	kg	0.360	0.061	0.212	0.196
	%	100.00	16.94	58.89	54.44
Productivity index	%	72.43	58.09	55.79	56.98
	%	100.00	80.20	77.03	78.67
Head height	cm	9.4	7.8	8.4	7.8
	%	100.00	82.98	89.36	82.98
Head diameter	cm	8.9	6.8	7.1	6.8
	%	100.00	76.40	79.78	76.40
Shape	index	1.06	1.15	1.18	1.15
	%	100.00	108.49	111.32	108.49
Inner core height	cm	3.7	3.2	3.4	3.3
	%	100.00	86.49	91.89	84.62
Inner core width	cm	2.0	1.6	1.9	1.6
	%	100.00	80.00	95.00	80.00
Thickness	scale	4.5	3.7	4.2	3.8
	%	100.00	82.22	93.33	84.44

%-compared to the control

**Tab. 2. Property variation from morphological characteristic of  $M_1$  generation Ditmarsko variety**

Studied properties	Variation coefficients			
	Ditmarsko-control	Treatment with 0.5% EMS	Treatment with 0.6% EMS	Treatment with 0.7% EMS
	(%)	(%)	(%)	(%)
Leaf rosette size	27.51	16.47	24.80	27.27
Leaf rosette size	22.61	18.04	22.35	25.64
Rosette leaves	27.46	25.84	23.84	23.90
Leaf rosette weight	65.69	43.18	56.54	52.03
Head weight	57.50	100.00	83.01	75.51
Productivity index	61.60	71.59	69.78	63.77
Head height	24.47	20.51	26.19	26.15
Head diameter	26.67	18.06	25.90	30.00
Shape-index	25.57	19.29	26.05	28.08
Inner core height	43.24	34.38	32.65	48.48
Inner core width	14.00	31.25	34.21	25.00
Thickness	11.78	22.97	23.57	25.53

The variation analysis of studied properties showed that in a big part of them  $M_1$  generation variability was higher than that one recorded for the control variant (tabl. 2). In all EMS tested variants a higher variability was observed for following properties: head weight, productivity index, inner core width and head thickness. In the variants with 0.6% and 0.7% of chemical mutagen a higher variation was recorded for height and head shape index while in  $M_1$  generation obtained from 0.7% of EMS treatment seeds high values of variation coefficients were recorded for the properties: leaf rosette size, head diameter and inner core height.

Diversity observed in  $M_1$  generation obtained from seeds treated with ethyl methane sulphonate chemical mutagen and high values of variation coefficients recorded in a significant part of studied properties in economical maturity give us occasion to expect probable changes also in generative phase of plant growth which expressions are coming to be studied and analyzed.

## Conclusion

It was established that concentration increasing of chemical mutagen ethyl methane sulphonate by head cabbage variety Ditmarsko seed treatment leads to decreasing of germinated plants as that correlation does not regard the survival. The number of survived plants obtained by seeds treated with a higher concentration of ethyl methane sulphonate is bigger than the tested variant with the lowest EMS concentration.

The chemical mutagen ethyl methane sulphonate applied in concentration of 0.5%, 0.6% and 0.7% does not cause entire lethality in head cabbage  $M_1$  germination Ditmarsko variety seeds.

The chemical mutagen causes inhibiting or stimulating influence on property expressions from morphological characteristic of  $M_1$  genotypes that together with a higher variability of a prevail part of properties determines the presence of big phenotype diversity regarding to studied properties even in the first mutant generation.

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## SUMMARY

The purpose of study was to establish the chemical mutagen influence - ethyl methane sulphonate (EMS) on the germination and the survival of head cabbage plants in  $M_1$  generation, variety Ditmarsko, as well as to establish the phenotype expression changes of properties from

morphological characteristic in economic maturity.

It was established that concentration increasing of chemical mutagen ethyl methane sulphonate by head cabbage variety Ditmarsko seed treatment leads to decreasing of germinated plants as that correlation does not regard the survival (fig. 1). The number of survived plants obtained by seeds treated with a higher concentration of ethyl methane sulphonate is bigger than the tested variant with the lowest EMS concentration. The chemical mutagen ethyl methane sulphonate applied in concentration of 0.5%, 0.6% and 0.7% does not cause entire lethality in head cabbage  $M_1$  germination Ditmarsko variety seeds

The chemical mutagen causes inhibiting or stimulating influence on property expressions from morphological characteristic of  $M_1$  genotypes (tabl. 1) that together with a higher variability of a prevail part of properties (tabl. 2) determines the presence of big phenotype diversity regarding to studied properties even in the first mutant generation.