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INFLUENCE OF DEPTH PLACEMENT AND DURATION OF STAY IN THE SOIL OF *AMARANTHUS* SPECIES SEEDS ON REST AND GERMINATION

Cveta MOSKOVA

University of Forestry, Sofia, Kliment Ohridski Blvd № 10, Bulgaria, Phone: +359 884 266 371, E-mail: c_moskova@abv.bg

Corresponding author e-mail: c_moskova@abv.bg

Abstract

Influence of depth placement and duration of stay in the soil of seeds of Amaranthus retroflexus L. and Amaranthus hybridus L. on rest and germination was determined. In the methodology is reported ***Omami*** *field germination, number of laboratory germination and sprouting seeds after treatment with growth regulator. It was found that where the seeds of both amaranth species: Amaranthus retroflexus L. and Amaranthus hybridus L., are left for 3, 6, 9 or 12 months at depths of 2.5, 5, 10, 20 and 30 cm, they remained latent and no germination was observed. They remain latent and this is a condition for potential growth of this weed. Under controlled laboratory conditions, the highest germination of Amaranthus retroflexus L. (8-15%) was observed in seeds left buried for 12 months; between 0.5% and 6.3% in seeds buried for 9 months and only 0.3% in seeds buried for 6 months. Hybrid amaranth has shown higher germination under laboratory conditions than common amaranth. The germination rate varied from 32.4% to 43.8% at depths of 20 and 30 cm to the difference of depths of 2.5 and 5 cm, which has been statistically proven. The germination rate (50%) was the highest where the seeds were buried for 6 months. The lowest germination rate under laboratory conditions was observed when the seeds were buried for 3 months at a depth of 30 cm.*

Keywords: *A. retroflexus L., A. hybridus L., germination at rest.*

INTRODUCTION

Amaranthus is distinguished through high plasticity and adaptability to a wide range of climatic and edaphic combinations, which together with the short life cycle creates an opportunity for spreading over large areas. They are dangerous competitors of crops in relation to vegetation factors (moisture, light, heat and nutrients). Forms large seed generation with extended period of germination, and sometimes resistant forms to some commonly used modern herbicides. Under the conditions of contemporary agriculture, species of the genus *Amaranthus* control is a top issue and in order to be successful an appropriate bioecological study of their characteristics is recommended.

MATERIAL AND METHOD

Field microtrail was carried out on the method of fractional plots with seeds of *Amaranthus retroflexus L.* and *Amaranthus hybridus L.* [1]. The influence of duration of seeds stay in the soil (3, 6, 9 and 12 months) and their depth of bury (2.5, 5, 10, 20 and 30 cm) on their dormancy and germination. Using Omami's methodology [5] is reported:

1. Number of germinated seeds in the field (in situ) - field germination.

2. Number of germinated seeds under controlled conditions (ex situ) - laboratory germination (in dark and light at different temperatures).

3. Number of germinated seeds after treatment with growth regulator IAA (indolyl - 3 - acetic acid) [2].

The data were statistically determined using method ANOVA.

RESULTS AND DISCUSSIONS

Once in the soil weed seeds are exposed on changes influenced by light, temperature, moisture, oxygen and other elements as well as damages caused by soil fauna [5]. These factors contribute in different degrees and in different ways and often cause cyclical changes in dormancy of the seeds [4]. According to Omami [6] the seed dormancy can be affected by many factors including

genetic characteristics of species, environmental conditions during the ripening of the seed and soil conditions.

The results of the conducted two-factor learning field microtrail during 2003-2005 years showed that in both species of amaranths - *Amaranthus retroflexus* L. and *Amaranthus hybridus L.* seeds stayed in soil, respectively - 3, 6, 9 and 12 months and depth – 2.5 cm, 5 cm, 10 cm, 20 cm and 30 cm, their dormancy was not affected and no germination was recorded. Field microtrail was set on alluvial-meadow, formerly waterlogged soil which mechanical composition was characterized by lamination and low permeability. During the test period no mechanical and chemical treatments of soil were made, which could alter the depth of seed placement or harm their seed coat. With this may give explanation concerning maintaining dormancy of seeds and lack of field germination of either investigated amaranths species. After evaluation the field germination, weed seeds were placed under controlled laboratory conditions in an incubator (7 days in the dark at 12°C and 14 days of light at 35°C) to provoke the dormancy brake. The results indicated that the seeds of common amaranth, stayed 3 months in the soil retain its state of dormancy, independent of their depth position. After 6 month stay in the soil laboratory germination was recorded only 0.3% on the depth of 10 cm, and after 9 months - germination was 0.5% on the depth of 20 cm, 2.5% from 10 cm and 6.3% from 5 cm. When staying in the soil for 12 months, the seeds of common amaranth had laboratory germination from 8% to 15% from the different depths positions in the soil, the highest was reported by 2.5 and 5 cm. Growth regulator IAA stimulated further germination of seeds of *Amaranthus retroflexus* L. from 2.3% to 5%.

For *Amaranthus hybridus* L. the highest average value of the character laboratory germination showed seeds digged out from a depth of 5 cm ($\bar{x}$ = 43.875) and those located at a depth of 2.5 cm ($\bar{x}$ = 43.250) - Table 1.

Table 1. The differences between depth of bury of seeds *Am. hybridus* in the soil related to the character laboratory germination, %

Variants	$\bar{x}$,%	Difference with				
		A_2	**A_1**	**A_3**	**A_5**	**A_4**
A_2 - 5 cm	43.875	-	n.s 0.625	n.s 6.0	+ 10.0	++ 11.5
A_1 - 2,5 cm	43.250		-	n.s 5.375	+ 9.375	++ 10.87
A_3 – 10 cm	37.875			-	n.s 4,0	n.s 5.5
A_5 – 30 cm	33.875				-	n.s 1.5
A_4 – 20 cm	32.375					-

$gD_{P5\%}$ = 7.9 $gD_{P1\%}$ = 10.52 $gD_{P0.1\%}$ = 13.7

Duration of the seeds stay in the soil also had an influence on their laboratory germination (Table 2). For 6 months stays of seeds in the soil, germination was the highest ($\bar{x}$ = 50.00).

Table 2. The differences between stay duration of seeds of *Am. hybridus* in the soil related to the character laboratory germination, %

Variants	$\bar{x}$, %	Difference with			
		B_2	**B_3**	**B_4**	**B_1**
B_2 – 6 *months*	50,000	-	+++ 13.9	+++ 15.95	+++ 17.15
B_3 – 9 *months*	36,100		-	n.s 2.05	n.s 3.25
B_4 - 12 *months*	34,050			-	n.s 1.20
B_1 – 3 *months*	32,850				-

$gD_{P5\%}$ = 7.07 $gD_{P1\%}$ = 9.41 $gD_{P0.1\%}$ = 12.25

Lowest laboratory germination in a combination on depth of buried on 30 cm (a_5) and remained duration of the seeds into the soil for 3 months (b_1) - Table. 3.

Table 3. The differences between combinations of factors, %

№	Variants	$\bar{x}$	Proven	Grade
1.	**A_2B_2**	56.75	A	I
2.	**A_1B_2**	55.25	A	I
3.	**A_3B_2**	52.25	A	I
4.	**A_4B_2**	47.50	A	I
5.	**A_2B_3**	44.75	A	I
6.	**A_1B_3**	44.00	A	I
7.	**A_3B_3**	42.50	A	I
8.	**A_5B_2**	42.50	A	I
9.	**A_4B_3**	41.25	A	I
10.	**A_5B_3**	39.00	A	I
11.	**A_1B_4**	38.25	A	I
12.	**A_2B_4**	36.25	A	I
13.	**A_4B_4**	35.25	Ab	II
14.	**A_3B_4**	34.25	Ab	II
15.	**A_5B_4**	34.00	Ab	II
16.	**A_2B_1**	29.50	Abc	III
17.	**A_1B_1**	29.00	Abc	III
18.	**A_3B_1**	28.00	Abc	III
19.	**A_4B_1**	22.25	Abcd	IV
20.	**A_5B_1**	12.50	Abcdf	V

$gD_{P5\%} = 15.81$ $gD_{P1\%} = 21.05$ $gD_{P0.1\%} = 27.39$

The analyses of the third stage of evaluation - treatment of the seeds with growth regulators (IAA) to promote braking dormancy showed that germination increased from 6.67% to 12.00%, but there are no difference between levels of factor A (depth burial of seeds) - Table 4.

Table 4. The differences between depth of burial of seeds in soil *Am. Hybridus*), after treatment with IAA related to the characteristic germination, %

Factor A	$\bar{x}$	**Difference with**				
		A_2	A_1	A_4	A_3	A_5
A_2	12.0	-	n.s	n.s	n.s	n.s
A_1	11.33		-	n.s	n.s	n.s
A_4	10.67			-	n.s	n.s
A_3	10.42				-	n.s
A_5	6.67					-

$gD_{P5\%} = 6.28$ $gD_{P1\%} = 8.85$ $gD_{P0.1\%} = 11.31$

The highest values were recorded in seeds remained in the soil for 3 months ($\bar{x} = 30.4$), ie IAA stimulates the most germination of seeds passed through the shortest dormancy period (Table 5).

Table 5. The differences between duration of remaining of seeds in the soil from *Am. hybridus* after treatment with IAA in regarding the characher germination, %

Factor A	$\bar{x}$	**Difference with**			
		B_1	**B_2**	**B_3**	**B_4**
B_1	30.4	-	++	++	++
B_2	0.25		-	n.s	n.s
B_3	0			-	n.s
B_4	0				-

$gD_{P5\%} = 12.61$ $gD_{P1\%} = 18.05$ $gD_{P0.1\%} = 25.39$

CONCLUSIONS

Where the seeds of both amaranth species: *Amaranthus retroflexus* L. and *Amaranthus hybridus* L., are left for 3, 6, 9 or 12 months at depths of 2.5, 5, 10, 20 and 30 cm, they remained latent and no germination was observed. They remain latent and this is a condition for potential growth of this weed.

Under controlled laboratory conditions, the highest germination of *Amaranthus retroflexus* L. (8-15%) was observed in seeds left buried for 12 months; between 0.5% and 6.3% in seeds buried for 9 months and only 0.3% in seeds buried for 6 months.

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