REFLECTION OF SOME FOLIAR-APPLIED HERBICIDES ON THE LENGTH OF THE PLUMULE AND THE ROOT OF THE GERMINATING COTTON PLANTS

Dimitar Stoychev[1], Maya Dimitrova[2], Grozi Delchev[1]

[1]Cotton and Durum Wheat Research Institute, 6200 Chirpan, Bulgaria

[2]Agriculture University, 4000 Plovdiv, Bulgaria

INTRODUCTION

- Cotton is a spring crop and becomes overgrown with late-spring weeds like *Amaranthus ssp., Xanthium strumarium L., Solanum nigrum L., Chenopodium album L., Hibiscus trionum L., Portulaca oleracea L., (Aristolochia clematitis L.)* and others. Many of these weeds grow for the second time (later), which leads to a reduction in the yield, deterioration of the quality of the fibre and makes the gathering of the cotton more difficult. In an attempt to solve this problem, various anti-deciduous herbicides have been applied during the cotton vegetation (the bud-formation phenophase), which coincides with the forming of the reproductive organs of the plants.

INTRODUCTION

- **The purpose of the present research is to determine the influence of the applied herbicides on the germination of the cotton seeds after they have been treated with the herbicide as well as on the length of the primary plumule and root.**

MATERIAL AND METHODS

- The research was conducted from 2005 to 2007 in the experimental field of the Cotton and Durum Wheat Research Institute in the town of Chirpan, on leached black-earth smolnitza with pH-5,8 and humus content of 3,12. The experiment was made without irrigation on the grounds of the block method and includes 13 types with different herbicides and doses, which are described in table 1.

- The size of the experimental area was 10 m². The cotton type is Avangard-264 with density of the crops of 16500-17000 plants per are after a previous yield of durum. All of the types were placed on areas that have been treated with a combination of the herbicides Dual gold 960 EK-120ml/da + Goal 2E – 100ml/da, applied after sowing and before the germination of the cotton.

- The cotton seed obtained from each type was ginned and the laboratory germination, the length of the primary plumule and root were determined under laboratory conditions. The mathematical processing of the data has been preformed based on the variance method.

Variants of the trial

Variant	Actively substance	Produce	Rate ml/da
1	Check	*No treat*	Three earth up
2	240 g/l oxifluorfen	*Goal 2E*	80ml/da
3	240 g/l oxifluorfen	*Goal 2E*	60ml/da
4	240 g/l oxifluorfen	*Goal 2E*	40ml/da
5	330 g/l pendimetalin	*Stomp 33 EK*	500ml/da
6	330 g/l pendimetalin	*Stomp 33 EK*	400ml/da
7	330 g/l pendimetalin	*Stomp 33 EK*	300ml/da
8	400 g/l oxidiargil	*Raft 400 SC*	80ml/da
9	400 g/l oxidiargil	*Raft 400 SC*	60ml/da
10	400 g/l oxidiargil	*Raft 400 SC*	40ml/da
11	750 g/kg izoxaflutol	*Merlin 750 WG*	6g/da
12	750 g/kg izoxaflutol	*Merlin 750 WG*	5g/da
13	750 g/kg izoxaflutol	*Merlin 750 WG*	4g/da

RESULTS *AND* DISCUSSION

The germination capacity is one of the most important characteristics of the field properties of seeds.

The obtained results show that the applied herbicides do not suppress the laboratory germination capacity of the cotton seeds.

On average, for the period of time from 2005 to 2007 the values of the treated types fluctuate between 97,7% and 98,9%, while with the untreated type the germination capacity is 97,9 %.

Laboratory germination (%) for separately years of examination and average for period

Variant	Germination 2005	Germination 2006	Germination 2007	Average for the period 2005-2007
1.	97.5%	99.8%	96.5%	97.9%
2.	98.0%	99.3%	99.3%	98.9%
3.	98.3%	99.8%	98.0%	98.7%
4.	97.0%	99.3%	96.5%	97.6%
5.	97.5%	99.5%	98.5%	98.5%
6.	97.0%	99.5%	97.8%	98.1%
7.	97.8%	99.3%	97.0%	98.0%
8.	96.5%	99.5%	98.8%	98.2%
9.	98.0%	99.5%	97.0%	98.2%
10.	97.5%	98.3%	97.3%	97.7%
11.	99.3%	99.3%	97.0%	98.5%
12.	98.5%	99.8%	98.0%	98.8%
13.	97.5%	99.8%	96.8%	98.0%

Length of the cotton plumule (cm).

Factor A / Factor B	Length of the plumule 2005	Length of the plumule 2006	Length of the plumule 2007	Mean (Factor B)
Check	4,5	4,5	6,1	5,0
Goal 2E-80ml/da	4,6	4,0	7,1	5,2
Goal 2E-60ml/da	3,2	3,7	6,3	4,4
Goal 2E-40ml/da	4,9	4,3	6,1	5,1
Stomp 33 EK-500ml/da	5,6	3,6	7,3	5,5
Stomp 33 EK-400ml/da	3,3	3,9	5,2	4,1
Stomp 33 EK-300ml/da	3,7	3,7	5,7	4,3
Raft 400 SC-80ml/da	4,6	3,4	6,1	4,7
Raft 400 SC-60ml/da	2,5	6,2	5,5	4,7
Raft 400 SC-40ml/da	4,4	5,1	5,3	4,9
Merlin 750 WG-6g/da	2,6	5,4	5,9	4,6
Merlin 750 WG-5g/da	5,5	5,1	7,1	5,9
Merlin 750 WG-4g/da	3,8	5,5	5,7	5,0
Mean (Factor A)	4,1	4,5	6,1	-

The performed variance analysis shows that regarding the total variation of the data, the greatest influence on the length of the cotton plumule has been exercised by conditions during the years (factor A) – 36.2% with a level of probability of p≤0.1 %. The influence of the applied herbicides (factor B) is weaker -10.5% (at p≤0.1 %).

A reduction in the length of the cotton plumule is detected with the types that have been treated with Stomp 33 EK-400 ml/da with 18% (level of proof of p≤1%) and Stomp 33 EK-300 ml/da with 14% (p≤5%). An increase of 18% in the length of the cotton plumule compared to the control measure is detected in type 12, which has been treated with Merlin - 5 gr/da with 18% (level of proof of p≤1%). There is a proven interaction between the years and the herbicides (AxB)-22.6% with a level of proof of p≤1%. This means that the influence of the tested herbicides on the length of the cotton plumule depends on the certain meteorological conditions.

Analysis of variance for length of the cotton plumule

Source of variation	Degrees of freedom	Sum of squares	Influence of factor, %	Mean squares
Total	155	326.4	100	-
Tract of land	3	14.4	4.4	4.8***
Variants	38	226.2	69.3	6.0***
Factor A-Years	2	118.0	36.2	59.0***
Factor B-Herbicides	12	34.4	10.5	2.9***
A x B	24	73.8	22.6	3.1***
Pooled error	114	85.9	26.3	0.8

The generalizing stability criterion YSi of Kang, which shows the stability and the values of increase or reduction of the tested indicator, gives the highest positive mark to type 12 – Merlin – 5 g/da. This type combines high values of the plumule length and great stability of this indicator over the years.

The types Stomp 33 EK-400 ml/da, Stomp 33 EK-300 ml/da also demonstrate great stability over the years but we have established certain suppression on the growth and the development of the cotton plumule.

Stability parameters for the length of the cotton plumule

Variants	$\bar{x}$	σ_i^2	S_i^2	W_i	YS_i
Check	5.0	-0.2	-0.3	0.2	10+
240 g/l oxifluorfen 80ml/da	5.2	2.5*	1.9	4.7	8+
240 g/l oxifluorfen 60ml/da	4.4	1.7	-0.4	3.4	3
240 g/l oxifluorfen 40ml/da	5.1	0.5	1.0	1.4	11+
330 g/l pendimetalin 500ml/da	5.5	6.8**	12.1**	12.0	6+
330 g/l pendimetalin 400ml/da	4.1	-0.1	-0.1	0.3	0
330 g/l pendimetalin 300ml/da	4.3	-0.1	-0.2	0.3	2
400 g/l oxidiargil 80ml/da	4.7	2.5*	5.0*	4.7	1
400 g/l oxidiargil 60ml/da	4.7	13.8**	27.7**	23.8	-2
400 g/l oxidiargil 40ml/da	4.9	2.2	0.6	4.2	9+
750 g/kg izoxaflutol 6g/da	4.6	7.4**	14.3**	13.1	-4
750 g/kg izoxaflutol 5g/da	5.9	0.2	0.6	0.9	15+
750 g/kg izoxaflutol 4g/da	3.7	4.7**	-0.2	8.5	-9

The results from the variance analysis of the length of the root are identical with those of the plumule. The greatest influence on this indicator has been exercised by the conditions over the years (factor A)-41.0%.

The influence of the herbicides (factor B) is 9.9% as both factors have been established with a level of probability of p≤1%.

A proven reduction in the length of the cotton root was detected in the types treated with Stomp 33 EK-400 ml/da (13.5% with a level of proof of p≤5%) and Stomp 33 EK-300 ml/da (with 11.2% also with a level of proof).

There was no mathematically proven increase of the root in any of the tested types. The proven interaction between the two factors (AxB) is 17.1%.

Length of the cotton root (cm)

Factor A / Factor B	Length of the root 2005	Length of the root 2006	Length of the root 2007	Mean (Factor B)
Check	6,7	9,7	10,4	8,9
Goal 2E-80ml/da	8,0	7,2	11,2	8,8
Goal 2E-60ml/da	7,0	8,2	13,3	9,5
Goal 2E-40ml/da	8,3	8,5	11,4	9,4
Stomp 33 EK-500ml/da	8,3	7,7	11,6	9,2
Stomp 33 EK-400ml/da	6,7	7,6	8,7	7,7
Stomp 33 EK-300ml/da	6,6	8,2	9,0	7,9
Raft 400 SC-80ml/da	6,3	7,4	9,7	7,8
Raft 400 SC-60ml/da	6,1	9,7	8,2	8,0
Raft 400 SC-40ml/da	7,2	8,7	9,9	8,6
Merlin 750 WG-6g/da	6,5	9,9	9,8	8,7
Merlin 750 WG-5g/da	9,0	8,5	11,0	9,5
Merlin 750 WG-4g/da	7,2	8,4	10,1	8,5
Mean (Factor A)	7,2	8,4	10,3	-

Analysis of variance for length of the cotton root

Source of variation	Degrees of freedom	Sum of squares	Influence of factor, %	Mean squares
Total	155	618.9	100	-
Tract of land	3	13.5	2.2	4.5*
Variants	38	420.8	67.9	11.0***
Factor A-Years	2	253.8	41.0	126.9***
Factor B-Herbicides	12	61.3	9.9	5.1***
A x B	24	105.6	17.1	4.4***
Pooled error	114	184.6	29.8	1.6

When assessing the stability of the influence of each herbicide on the length of the cotton plumule regarding the meteorological conditions, it was established that with the two types Stomp 33 EK-400 ml/da and Stomp 33 EK-300 ml/da, with which there a proven relation between the length of the root and the applied herbicides, demonstrate great stability which is both linear and non-linear.

This is the result of the reduction of the length of the root as a result of the influence of the herbicide regardless of the meteorological conditions over the years of testing.

Stability parameters for the length of the cotton root

Variant	$\bar{x}$	σ_i^2	S_i^2	W_i	YS_i
Check	8.9	3.4	6.5*	6.4	10+
240 g/l oxifluorfen 80ml/da	8.8	6.4**	12.6**	11.5	5+
240 g/l oxifluorfen 60ml/da	9.5	15.3**	3.9	26.6	5+
240 g/l oxifluorfen 40ml/da	9.4	1.4	3.0	3.0	12+
330 g/l pendimetalin 500ml/dka	9.2	5.3*	10.2*	9.6	7+
330 g/l pendimetalin 400ml/dka	7.7	1.2	-0.5	2.6	-1
330 g/l pendimetalin 300ml/dka	7.9	1.0	0.9	2.4	2
400 g/l oxidiargil 80ml/da	7.8	-0.2	0.3	0.4	0
400 g/l oxidiargil 60ml/da	8.0	14.2**	23.9**	24.6	-5
400 g/l oxidiargil 40ml/da	8.6	0.3	0.2	1.2	5+
750 g/kg izoxaflutol 6g/da	8.7	6.3*	12.8	11.3	4
750 g/kg izoxaflutol 5g/da	9.5	3.1	4.4	5.9	14+
750 g/kg izoxaflutol 4g/da	8.5	-0.3	-0.5	0.1	4

The generalizing stability criterion YS_i of Kang, taking into consideration both the stability and the values of increase or reduction of the tested indicator, gives a low mark to the types Stomp 33 EK-400 ml/da and Stomp 33 EK-300 ml/da.

This is so because, despite of being stable over the years of testing, there is a reduction of the length of the root with them, which leads to retardation in the growth and the development of the cotton plant.

CONCLUSIONS

The herbicides applied during the cotton vegetation (bud-formation phenophase) do not influence the laboratory germination of the cotton seeds of the treated plants.

There is a proven reduction in the length of the cotton plumule and root of the types treated with Stomp 33 EK-400 ml/da (with respectively 18% and 13,5%) and Stomp 33 EK-300 ml/da (with respectively 14% and 11,2%). There has been an increase of 18% in the length of the cotton plumule compared to the control measure and this increase has been registered after applying Merlin – 5 g/da.

There is no mathematically proven increase of the root in any of the tested types.

Thank you!