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TREATMENT OF SUNFLOWER WITH GROWTH RETARDANT

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Summary

Results analyzed in the present paper deal with investigations on treatment of sunflower sowings with the growth regulator CCC (2-chloroethylamonium chloride), aiming at shortening the stem, increasing the plants' resistance to crushing and leveling the plants' height in the sowings. Investigations are carried out at the Institute for Wheat and Sunflower, General Toshevo, Bulgaria in the period of 1975-1977, using cultivar Peredovik sown at a density of 71,000 plants/ha. The concentration of doses of the CCC used for the treatment varied from 0.05 to 1.0 percent. Treatment was applied during two vegetation stages of sunflower, 7th leaf and budding stage, as seed material had been treated with 0.60 and 1.08 solution before sowing.

Results obtained show that treatment of seeds does not affect sunflower growth and productivity. The retardant manifests its biggest effect when treatment of plants is carried out at 7th leaf stage. Plants treatment at this stage lowers their height with 13-14 cm depending on the concentration of the preparation used increases the stem diameter, practically eliminates stem-crushing and increases yields from seed and oil with respectively up to 9.8% and 15.2%.

Introduction

Sunflower cultivars that are widely grown in our country are distinguished for their high stem. Every year that causes stem crushing, most often in cases of stronger winds during flowering-ripening periods as it leads respectively to considerable losses of the heads that have fallen on the ground or stood lower than the level of the cutting device of the combine-harvester. On the other hand, besides their high stems, cultivar grown here are strongly differ by their height within the sowings, which causes difficulties in harvesting.

The problem of decreasing sunflower stems height by applying growth regulators have never been closely investigated, counting upon the tendencies in breeding work toward developing cultivars and hybrids of short stems. Dorrel, D.G. (1973) reports about using growth retardants as a means of shortening sunflower stems, which in double treatment in 7-leaf stage and 10 days after with CCC in concentration 0.1 to 1.0% determines decrease of plants' height to 25% without any changes in seed yield, contents and composition of oil and germination of seeds. In using the retardant SADH (2,2 dimetyl-hydrazide) by the same author in doses 0.6% the shortening of the stem is 25-31% and at 3.0% it reaches 36-47%, while at the last concentration the yield decreases to a half. Gorgiev, T. and U. Uzumov (1973) determine that in treating with 1000 ml ETHREL in 400 litres water per hectare the stems shorten by 20-30 cm, the seed

yield increase with 5.2%, the contents of oil increases from 45.0 to 45.5%, broken plants decrease from 18% to 8% and the losses at harvesting is from 5.14% to 3.1%.

Materials and Methods

The experiments were conducted during the period 1975-77 in the field experiment at the Institute for Wheat and Sunflower, General Toshevo on slightly leached chernozem. Sunflower cultivar Peredovic grew at density 71,000 plants per hectare (70 cm between rows and 20 cm between plants in the rows). Yield experiments were done by the block scheme in four repititions at a size of the plot 42 m^2. Growth regulator CCC (2-chloroethylamonium chloride) was used as a retardant. With three experiments parallelly set was done the treatment of seed material before sowing of plants in 7-leaf stage and budding stage. In the experiments with treatment of the plants the following doses of the retardant were used: 0.5%, 0.15%, 0.30%, 0.60% and 1.0% and at treatment of seeds 0.60% and 1.0% solution. 300 litres per hectare working solution was used in treating the plants, while check plants were treated to the same quantity of water. Treatment of seeds was done by soaking them for a duration of 6 hours in the indicated solution and to the check in pure water immediately before their sowing.

Height of plants and thickness of stems at 15 cm from the ground were measured on 50 plants from each repitition at the interval of 15 days after the treatment and in stage full blossoming of sunflower. On the same number of plants was set the percentage of the broken ones before the harvesting. Yield of seeds was set by gathering all the heads, including those of broken plants. The contents of oil was determined by the method of skimmed remainder. Yield parameters of the crop were determined as a medial value of 20 heads for every variant.

Results and Discussion

In treating the seeds exterior symptoms of the status and growth of the plants during vegetation period were not observed. In treating the plants, already on the second day from the spraying, partial or full yellowing of the leaves occurs more strongly expressed with the more fit ones but without morfological mutation in their form. This change in color gradually restores more quickly with the young leaves and at about a week later the leaves acquire dark-green color, compared to the untreated plants, which keeps till the end of vegetation. At the same time the lower 1-2 pair of leaves in treating the plants with concentration of the solution above 0.60% begin to wither and towards the stage of blossoming wither in full. In treating the plants in budding stage partial necrosis is observed and wilting of corolla leaves of heads still at the time of blossoming of sunflower.

The results of measuring the height and thickness of the plants are shown in Table 1. No difference is found in plants' height or thickness of stems between treated and untreated plants. The greatest is the reducing effect on the height of the plants at treating in 7 leaf stage of sunflower growth. Decreasing plants' height treated at this stage at using the fullest concentration of retardant 1.0% is from 41 to 47 cm throughout separate years, and at lowest 0.05% solution from 11 to 16 cm. Medial reduction of height from the three

TABLE 2. Percent of Crushed Plants in the Sowing Treated in 7-Leaf Stage Recorded With Harvesting.

Treatment	Crushed plants totally				Crushing zones along the stem height							
					upper half				lower half			
	1975	1976	1977	Av.	1975	1976	1977	Av.	1975	1976	1977	Av.
0,05 %	9,1	6,4	19,7	11,7	3,7	3,3	9,2	5,4	5,4	3,1	10,5	6,3
0,15 %	5,7	4,9	14,2	8,3	2,9	2,6	8,2	4,6	2,8	1,3	6,0	3,7
0,30 %	2,6	2,8	12,2	5,8	1,4	1,8	6,8	3,3	1,2	1,0	5,4	2,5
0,60 %	0,9	1,2	8,0	3,1	0,6	0,7	5,3	2,3	0,3	0,5	2,7	1,2
1,00 %	0,5	0,6	5,1	2,1	0,3	0,2	3,6	1,4	0,2	0,4	1,5	0,7
Control	12,6	10,2	23,9	15,6	4,2	3,9	9,8	6,0	8,4	6,3	14,1	0,6

TABLE 1. Plants' Height and Thickness of Stems in Full Flowering Stage.

Treatment	1975			1976			1977			Average		
	H		d	H		d	H		d	H		d
	cm	σ	mm	cm	σ	mm	cm	σ	mm	cm	σ	mm
a) Treatment of seeds												
0,60 %	209	11,73	34,4	177	12,22	28,4	231	12,71	30,6	206	12,22	31,2
1,00 %	207	12,06	34,1	175	11,40	28,3	233	13,52	30,4	205	12,33	31,0
Control	211	11,49	34,0	178	12,12	28,7	230	13,93	30,6	206	12,51	31,0
b) Treatment in 7-leaf stage												
0,05 %	202	8,56	34,1	160	7,34	29,0	215	10,88	30,4	192	8,93	31,2
0,15 %	198	6,14	34,5	142	5,67	29,3	213	7,43	30,9	184	6,41	31,6
0,30 %	189	4,36	35,4	139	3,89	30,8	203	5,15	31,3	177	4,47	32,5
0,60 %	179	3,71	34,8	138	3,46	30,0	193	4,63	31,0	170	3,93	31,9
1,00 %	165	3,28	32,3	135	3,18	27,9	184	4,37	29,3	161	3,61	29,8
Control	214	12,54	33,5	176	11,08	28,2	226	14,21	30,0	205	12,61	30,6
c) Treatment in budding stage												
0,05 %	209	11,04	31,8	172	11,84	29,0	223	13,87	30,7	201	12,25	30,5
0,15 %	201	10,43	32,2	163	9,96	29,3	216	10,44	31,1	193	10,28	30,9
0,30 %	195	9,19	32,6	157	9,52	30,6	212	9,37	31,5	188	9,36	31,6
0,60 %	190	8,66	32,4	148	7,18	29,9	208	8,21	31,3	182	8,01	31,2
1,00 %	185	7,14	31,0	146	6,29	28,1	201	7,73	30,1	177	7,05	29,7
Control	212	12,28	31,5	179	13,16	28,5	224	13,81	30,5	205	13,08	30,2

H - Plants height

d - Stem thickness

σ - Average quadratic aberation in the height

years is within the boundaries of 13-14 cm depending on the dose of preparation. Treating in budding stage maximum reduction of height during different years is within the boundaries of 23-33 cm at fullest concentration and 1-7 cm at lowest and medial from the three years is from 4 to 8 cm corresponding to the lowest and fullest dose of retardant. In condition of poorer growth like the year 1976, reducing effect of low doses is increase and in conditions favorable to more vigorous growth in height like in the year 1977, the effect of lower concentrations is decreased, which is observed in both stages of its application.

Except on shortening the stem, treating during vegetation with CCC influences the decrease of the differences in height between separate plants in the sowing, which is observed from the data of average quadratic aberration. The lowest is the size of average quadratic aberation is using the retardant in 7 leaf stage and it diminishes with increase of doses, which is an evidence of greater vertical levelling of sowings.

Thickness of stems expressed by their diameter at 15 cm height above the ground grows parabolically with the increasing the dose of treatment and reaches maximum height at concentration of 0.30% while at greatest dose diminishes under that of untreated plants. With treated plants in 7 leaf stage, maximum increase of thickness reaches 1.9 mm, while in budding stage 1.4 mm.

Shortening of plants under the effect of retardant and increased thickness of stem considerably influence the stability of breaking of sunflower (Table 3). The percentage average of broken plants for the three years with treated crops is 2.1% to 11.7%, lowest at the highest dose and highest at maximum. With untreated crops broken plants reach 15.5%. While with treated plants at doses greater than 0.05% the percentage of broken plants at the upper half of the stem prevail, with untreated ones and those treated at lowest concentration, the breaking is greater at the lower half of the stem. Analogical is the tendency with the size of breaking at the treatment in budding stage, but because of the lower degree of decrease of plants' height, differences between treated and control crops are less.

Yield of seeds at treating of seed material do not show any practical aberrations of yield of control. Marked differences in quantity of crops are obtained in treatment during vegetation of sunflower (Table 3). Applying the retardant in 7 leaf stage, the yields from treated crops increase at the average with 3.2 to 9.8% in comparison to the control, where the greatest is the increase at using the doses 0.30% and 0.60%. Greatest differences in the increase of crops are established during 1977 reaching 17.4% and lowest during 1975 - 3.8%. At the best used dose of preparation the increase is lowest. In treating crops in budding stage, the influence of the retardant on the productivity of seeds is negative and leads to decrease of yields average to 1.4 - 4.8% in comparison to untreated crops and reaches to 5.8% during different years. The depressing influence of the retardant during this stage grows with the increase of the dose of preparation.

Oil yield changes approximately in the same order like those of obtained seeds -- unestablished influence on the size of obtained oil in treating the seeds, marked positive effect on the quantity of oil in treating of plants in 7 leaf stage with increase of average oil yield to 15.2% and reaching during

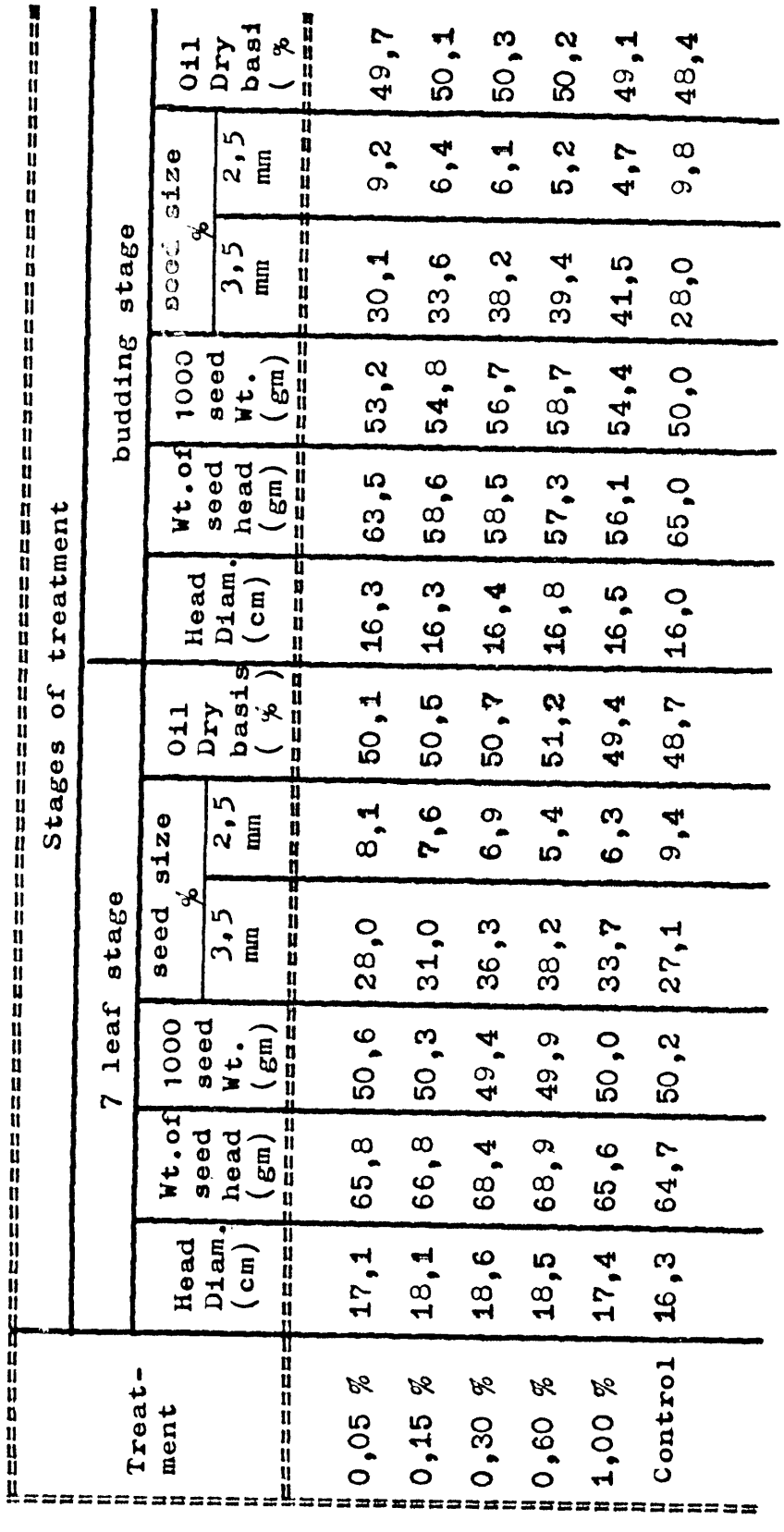
TABLE 3. Yields of Sunflower Seeds per Hectar (11% Moisture).

Treatment	1975		1976		1977		Average	
	kg	%	kg	%	kg	%	kg	%
a) Treatment of seeds								
0,60 %	3329	100,8	2942	98,9	3412	100,7	3228	100,2
1,00 %	3276	99,2	2992	100,6	3338	98,5	3202	99,4
Control	3303	100,0	2975	100,0	3388	100,0	3222	100,0
B) Treatment in 7-leaf stage								
0,05 %	3412	104,3	3005	104,2	3439	108,1	3285	103,5
0,15 %	3304	101,0	3135	108,7	3525	104,7	3321	104,6
0,30 %	3396	103,8	3185	110,4	3673	109,1	3418	107,7
0,60 %	3348	102,3	3155	109,4	3953	117,4	3485	109,8
1,00 %	3332	101,9	3100	107,5	3395	100,8	3276	103,2
Control	3272	100,0	2885	100,0	3368	100,0	3175	100,0
c) Treatment in budding stage								
0,05 %	3298	101,7	2922	99,2	3389	100,4	3203	100,5
0,15 %	3200	98,7	2884	97,9	3340	98,9	3141	98,6
0,30 %	3145	97,0	2831	96,1	3317	98,3	3098	97,2
0,60 %	3084	95,1	2817	95,6	3287	97,4	3063	96,1
1,00 %	3051	94,2	2799	95,0	3251	96,4	3034	95,2
Control	3242	100,0	2946	100,0	3374	100,0	3187	100,0

TABLE 4. Yields of Sunflower Oil Per Hectar.

Treatment	1975		1976		1977		Average	
	kg	%	kg	%	kg	%	kg	%
a) Treatment of seeds								
0,60 %	1487	100,4	1293	99,5	1436	99,9	1405	100,0
1,00 %	1478	99,8	1321	101,6	1402	97,5	1400	99,6
Control	1481	100,0	1300	100,0	1438	100,0	1406	100,0
b) Treatment in 7-leaf stage								
0,05 %	1521	105,6	1409	110,0	1454	104,1	1461	106,4
0,15 %	1485	103,1	1482	115,6	1503	107,6	1490	108,5
0,30 %	1529	106,1	1519	118,6	1569	112,3	1539	112,1
0,60 %	1529	106,1	1511	117,9	1706	122,1	1582	115,2
1,00 %	1486	103,1	1413	110,3	1420	101,6	1440	104,9
Control	1441	100,0	1281	100,0	1397	100,0	1373	100,0
c) Treatment in budding stage								
0,05 %	1467	102,5	1290	100,6	1436	100,9	1398	101,4
0,15 %	1455	101,7	1268	98,9	1373	96,5	1365	98,9
0,30 %	1425	99,6	1237	P96,5	1376	96,7	1346	97,6
0,60 %	1386	96,9	1233	95,4	1349	94,8	1319	95,6
1,00 %	1363	95,2	1213	94,6	1331	93,5	1302	94,4
Control	1431	100,0	1282	100,0	1423	100,0	1379	100,0

TABLE 5. Effect of Retardant on Yield Parameters in Sunflower (1975-1977).



Treatment	Stages of treatment													
	7 leaf stage						budding stage							
	Head Diam. (cm)	Wt.of seed head (gm)	1000 seed Wt. (gm)	seed size %		Oil Dry basis (%)	Head Diam. (cm)	Wt.of seed head (gm)	1000 seed Wt. (gm)	seed size %		Oil Dry basi (%
				3,5 mm	2,5 mm					3,5 mm	2,5 mm	
0,05 %	17,1	65,8	50,6	28,0	8,1	50,1	16,3	63,5	53,2	30,1	9,2	49,7
0,15 %	18,1	66,8	50,3	31,0	7,6	50,5	16,3	58,6	54,8	33,6	6,4	50,1
0,30 %	18,6	68,4	49,4	36,3	6,9	50,7	16,4	58,5	56,7	38,2	6,1	50,3
0,60 %	18,5	68,9	49,9	38,2	5,4	51,2	16,8	57,3	58,7	39,4	5,2	50,2
1,00 %	17,4	65,6	50,0	33,7	6,3	49,4	16,5	56,1	54,4	41,5	4,7	49,1
Control	16,3	64,7	50,2	27,1	9,4	48,7	16,0	65,0	50,0	28,0	9,8	48,4

separate years to 22.1% and its decrease with 1.1 to 5.6% in doing the treatment in budding stage (Table 4).

The data of the influence of retardant on yield parameters (Table 5) show, that the diameter of heads increases with treated plants in both stages of vegetation, where the increase of its applying in 7 leaf stage is greater and reaches to 2.3 cm, while with treatment in budding stage to 0.8 cm. With treatment at first stage, the weight of full seeds of one head is greater compared to the control with 0.9 to 4.1 grams but without any important difference in 1000 seed weight. At the same time the weight of full seed in the head of the treated plants in budding stage is considerably lower, with 1.5 to 8.9 grams and the 1000 seed weight with 3.2 to 8.7 grams higher compared to control. This shows that in using the retardant in budding stage a considerable part of head florets do not form seeds as a result of which comes the bigger 1000 seed weight and the higher percentage of fraction of seeds above 3.5 mm.

The oil contents of seeds with treated plants is higher compared to control and during separate years reach to 3.9% more and is more slightly influenced by the stage of application of retardant.

Conclusion

Seed treatment on sunflower with CCC does not have any influence on growth and produce. In treating the crops in 7 leaf stage plants' height decreases at 13-14 cm parallel to the increase of dose of preparation. Stem thickness increases parabolicly and reaches its maximum at treatment to 0.30% solution of CCC. At applying the retardant during this stage, differences in height between separate plants in crops are least. Broken plants through the period blossoming-ripening of sunflower are 56% less in treated crops. Yield of seed in using the retardant increases at the average to 9.8%, and of the oil to 15.2%. Treatment of crops in budding stage reduces plants' height in a lower degree and lessens seed yield to 4.8% and that of oil to 5.6%. Greatest is the effect of CCC on decreasing plants' height and on increasing seed and oil yield at treatment in 7 leaf stage with concentration 0.30% to 0.60%.

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