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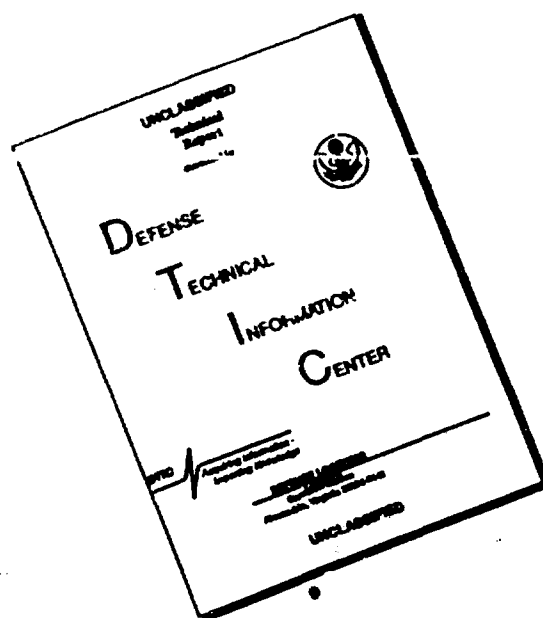
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**STUDY OF CHEMICAL MEANS OF CONTROLLING WEEDS  
IN SUGAR BEET PLANTINGS**

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In the last 15 to 20 years, the scale of application of herbicides has undergone an unusual expansion. Although chemical weeding is a normal affair in plantings of a number of agricultural crops, the use of herbicides in sugar beet plantings encounters definite difficulties, related primarily to the biological peculiarities of the crop itself. Weak and tender beet plants are sensitive during the first period of vegetation not only to weeds and dense-growing sprouts, but also to various herbicides.

Sugar beet plants, just like broad-leaved weeds, are sensitive to the available antidicot herbicides (phenoxyacetic acid derivatives, contact-action herbicides). Of course, as early as 1927, Rabate indicated the possibility of chemical weeding of sugar beet plantings and noted that acceptable results are given by 8% sulfuric acid. Positive results on the use of certain contact-action herbicides before germination of the beet have also been obtained recently [1]. However, their use is relatively ineffective on fields choked by monocot weeds, while any violation of the established periods and doses of the application may subject the young beet plants to hazard, produce thinning and even death of the shoots [2].

In our experiments on strong chernozem of the Grakovskiy experimental field of the Scientific Research Institute of Fertilizers and Insectofungicides (Khar'kovskaya Oblast), butophen (ammonium salt of 4,6-dinitro-2-sec-butylphenol), applied in doses of 4-6 kg/hectare of the active ingredient\*

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\*The doses of all the herbicides are indicated in the article according to the active ingredient.

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before germination of peas [3] and corn exerted a weak destructive action on

weeds, while the application of this preparation in somewhat smaller doses during vegetation reduced the choking of the plantings by dicot weeds to an extent of 70-98%. The weak herbicidal action of pregermination application of butophen is evidently explained not only by the dryness of the upper layer of soil and properties of the soil, but mainly by the fact that the bulk of the weeds that choke these crops, including beets, as a rule appear simultaneously with the appearance of spouts of the cultivated plants.

Sugar beet plants are sensitive to phenoxyacetic acid derivatives, and even when the rows of plantings are shielded, the use of these herbicides is not recommended. Sample treatment of small areas of sugar beets with 1 and 2 kg/hectare of 2,4-D after irrigation of the rows had a negative effect on the beets. The curling of the petioles and leaf blades, characteristic of 2,4-D was noted; they subsequently turned yellow and frequently died off. The beet roots grew out and were covered with brown incrustations; they lost the elasticity usual for normally developed roots and were soft to the touch.

Weed control with these herbicides should be practiced more widely in crop rotation fields, preceding the beet.

Great hopes are vested in antigrass herbicides -- sodium trichloroacetate, dichloralurea, and dalapon. However, the results of the studies of a number of researchers [4-6] show that the application of these herbicides does not give satisfactory results everywhere. In regions of industrial beet growing of the Ukraine, TCA and DCU do not manifest a narrowly selective action, i.e., reduce not only the weed density, but also the yield of beet roots and their sugar content. Sodium trichloroacetate, applied before preplanting cultivation (N. I. Matrich),\* reduced the weed density by

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70-90% and the beet yield by 23% for a dose of 12 kg/hectare, and 24-44% for a dose of 32 kg/hectare.

In our 1959-1963 experiments, we studied dichloralurea. DCU practically does not affect the roots even of sensitive plants [7]. Under the influence of this herbicide, the first real leaves are modified. Inhibition of the growth of the root system evidently is a result of the abrupt inhibition of the growth of the aboveground organs of sensitive plants. DCU acts only on sprouting weeds; it is practically insoluble in water, is very weakly translocated in the soil; hence, the best herbicidal properties of the preparation are manifested when it is mixed with the soil layer. In our experiments, in application during the phase of two pairs of leaves of the beet, the preparation did not act on the weeds and reduced the yield of beet roots by 10-20%. DCU, introduced into the soil before preplanting cultivation, reduced the density of blue-eyed grass

and bottle grass by 70-96%, the herbicidal effect being rather stable from year to year (Fig. 1). Dicot weeds were only slightly inhibited (0-40%).

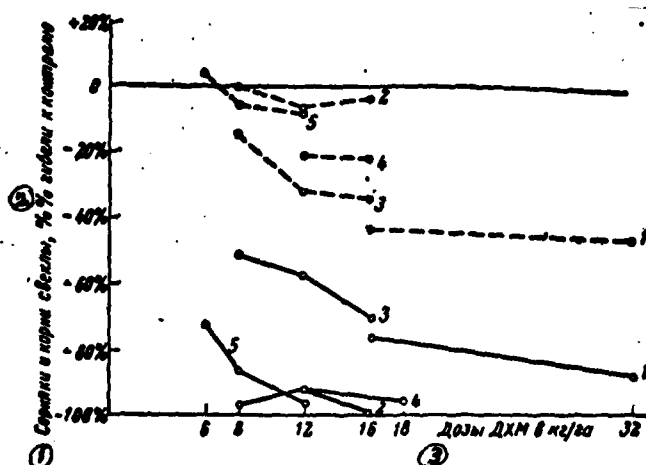


Fig. 1. Effect of dichloralurea on blue-eyed grass and bottle grass and the yield of sugar beet roots (introduced before preplanting cultivation): 1 -- 1959; 2 -- 1960; 3 -- 1961; 4 -- 1962; 5 -- 1963; -- weeds; - - - - - sugar beet.  
Key: 1) weeds and beet roots, %; 2) % destruction with respect to control; 3) dose of DCU in kg/hectare.

Sugar beet plants experience an inhibiting effect only at very young periods. The reduction of the crude weight of 200 beet plants before thinning with DCU was (in % of control) (1961 experiment): in a dose of 8 kg/hectare -- 37.5%; in a dose of 12 kg/hectare -- 41%; in a dose of 16 kg/hectare -- 53.2%. During the period of intensive growth of the beet, yellowing of the leaves was noted visually in variations where this preparation was introduced. As a result, the yield of beet roots is reduced (Fig. 1).\*

\*In all the experiments, the sugar beet plantings were weeded, and the herbicidal effect of the preparations on the beet plants was determined. The weed count was conducted on specially secured areas.

to the wide application of the herbicide on the kolkhoz and sovkhoz fields. In view of this, searches for ways to reduce the negative aspects of the effect of this preparation are of interest. The application of the preparation in a dose of 24 kg/hectare before fall plowing proved rather ineffective. Treatment of the surface of the plowed soil in the autumn

with DCU doses of 12 and 16 kg/hectare provided better destruction of monocot grass weeds (blue-eyed grass and bottle grass) during the first period of vegetation of the beet, but its toxicity was rapidly attenuated, and then the usual application of the preparation in the spring before preplanting cultivation was advantageous.

In the observance of agricultural technology, the bulk of the weeds sprout at the moment of formation of the plantings, i.e., at the phase of three to four pairs of leaves of the sugar beet [8]; hence, in spite of the rapid attenuation of the herbicidal action, autumn application of DCU may provide protection of the beet plantings from monocot grass weeds. Unfortunately, in this experiment, as a result of weevil damage to the plantings, the beets were replanted, and hence there was not the usual reduction of the yield of roots even when DCU was applied in the spring before the preplanting cultivation (Fig. 1, 1963), and we were virtually unable to determine the degree of the negative influence of DCU on the beet plants after the autumn application.

In one of the variations of this experiment (DCU in a dose of 12 kg/hectare was applied before the preplanting cultivation), the plantings were treated only between the rows, and manual weeding was not used. The death rate of the grass was 94.9% and the yield of beet roots was not reduced, i.e., DCU provided complete protection of the plantings from weeds. Of course, in this experiment 95% of the weeds were grasses.

A second way of reducing the negative effect of DCU on beets may be belt application of the preparation. The absence of the necessary sprayer for applying the belt with placement of the herbicides in the soil prevented us from evaluating this method. An attempt to apply the herbicide in a belt along a premarked field, followed by cultivation and planting of beets showed that not a belt, but the usual continuous application of the preparation is obtained after cultivation.

The negative effect of DCU on beets is related to the soil moisture content [9]. Our preliminary greenhouse experiments showed that with increasing soil humidity, the negative effect of DCU on the beet plants is reduced. And yet, the effect on weed plants was not weakened.

In the 1962-1963 experiments we studied the effect of DCU on sugar beet plants under irrigated conditions. Irrigation was begun on 9 June in 1962 and on 20 July in 1963 with the KDU-55 M sprinkler setup. The results of these experiments confirmed the fact that under irrigated conditions, the negative effect of DCU on beets is reduced (Table 1).

Dalapon (sodium salt of 2,2-dichloropropionic acid) is a powder with an 85% content of the active ingredient; it dissolves readily in water and possesses the ability to penetrate rapidly and be translocated in the plant not only along the xylem, but also along the phloem [10]; hence it can be used for application during vegetation of the beet. Certain authors consider it promising not only for controlling annual weeds (bottle grasses, etc.), but also such perennials as witchgrass, wire grass, beardgrass, etc. In our experiments, various doses of this preparation were applied during vegetation of the beet, before germination, and before preplanting cultivation.

The strongest herbicidal effect was obtained in 1961, after the application of 5 and 10 kg/hectare of dalapon during the phase of three pairs of leaves of the beet. According to a weight determination, the

Table 1

**Effect of Dichloralurea on the Yield of Sugar Beet Roots  
Under Irrigated Conditions**

① Препараты, кг/га	1962 г.					1963 г.				
	② Урожай корней, ц/га	③ Сахар, %	④ Прибавка уро- жанной кормей		⑤ Прибавка от полива, ц/га	⑥ Урожай корней, ц/га	⑦ Сахар, %	⑧ Прибавка уро- жанной кормей		⑨ Прибавка от полива, ц/га
			а/га	%				а/га	%	
⑦ Без орошения										
⑨ Контроль	238	19,9	0	0	—	151	19,2	0	0	—
⑩ ДХМ—12, внесено под культивацию	187	19,8	-51,0	-21,4	—	151	18,4	-2	-1,3	—
⑪ ДХМ—12, внесено до всходов свеклы	174	20,1	-64,0	-26,8	—	—	—	—	—	—
⑧ С орошением										
⑨ Контроль	362	19,9	0	0	+124	233	18,6	0	0	+80,0
⑩ ДХМ—12, внесено под культивацию	321	19,5	-41,0	-11,3	+134	230	18,6	-3,0	-1,2	+79,0
⑪ ДХМ—12, внесено до всходов свеклы	312	19,8	-50,0	-13,8	+138	—	—	—	—	—

## Key to Table 1:

1. Preparations, kg/hectare
2. Yield of roots, centners/hectare
3. Sugar, %
4. Additional yield of roots
5. Centners/hectare
6. Additional yield from irrigation, centners/hectare
7. Without irrigation
8. With irrigation
9. Control
10. DCU-12, applied before cultivation
11. DCU-12, applied before germination of the beets

destruction of the bottle grasses reached 93.7-99.5%. During other years, the effect of dalapon applied during vegetation was medium or weak (Fig. 2). It should be mentioned that practically no destruction of bottle grass was observed during these years, and only a weight determination permitted the establishment of a herbicidal effect of the preparation. We believe that the instability of the herbicidal effect of dalapon, applied during vegetation, depends on meteorological conditions. Low relative air humidity and high temperature reduce the penetration of the herbicide into the plant and weaken its herbicidal effect. On the contrary, an increase in the relative air humidity (78%) and light rain (0.6, 2.9, 5 mm) during the three days after spraying (1961 experiment) promoted a rapid penetration of the herbicide into the plants and the manifestation of a strong herbicidal effect of dalapon.

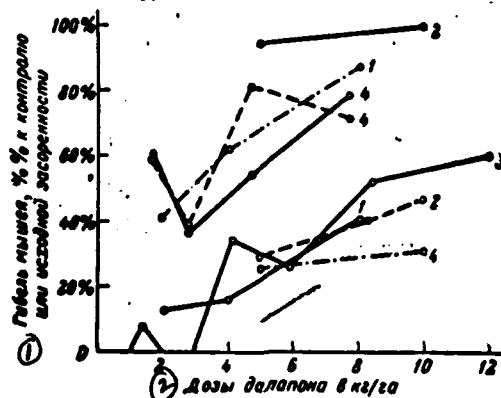


Fig. 2. Effect of dalapon on weed grasses: 1 -- 1960; 2 -- 1961; 3 -- 1962; 4 -- 1963; — application in the phase of two to three pairs of leaves of the beet; - - - application before cultivation; -.-.-.- applied before germination of the beet.  
Key: 1) death of bottle grass, % of control or initial weed density; 2) doses of dalapon in kg/hectare.

It is also interesting that during the year of the strong action of dalapon (1961), applied during vegetation, a weak effect was obtained when this preparation was applied before the preplanting cultivation. On the contrary, during a dry year (1963), the application of dalapon before preplanting cultivation was advantageous (Figs. 2 and 3). The effect of dalapon applied before germination is unstable from year to year (Fig. 2).

Dalapon exerts a negative effect upon the beet. This was manifested either in a loss of the chlorophyll color of the growing point of the beet, which was restored after several days, or in a drying of the edges of the leaves (black border) and a reduction of their size. Considering Figs. 2 and 3, it is easy to note that the negative effect of dalapon on the beet is more strongly manifested in cases of a weak herbicidal effect on weeds. This conclusion is in full agreement with the view developed above, of the dependence of the herbicidal effect of dalapon on the meteorological conditions (precipitation, humidity, and air temperature). Greenhouse experiments (1963) permit a preliminary conclusion on the presence of such a dependence on the soil humidity as well.

In our experiments, dalapon had no advantages over DCU. Endothal [11] (sodium 3,6-endoxyhexahydrophthalate) is of interest as a herbicide. In a 1961 field experiment, this preparation, applied in a dose of 6 kg/hectare before preplanting cultivation, destroyed 65% of the weeds, and reduced their weight by 86.3%; 95% of all the weeds in the experiment were blue-eyed grass and bottle grass. A 3 kg/hectare dose of the herbicide did not reduce the amount of bottle grass (dicots were reduced by 50%),



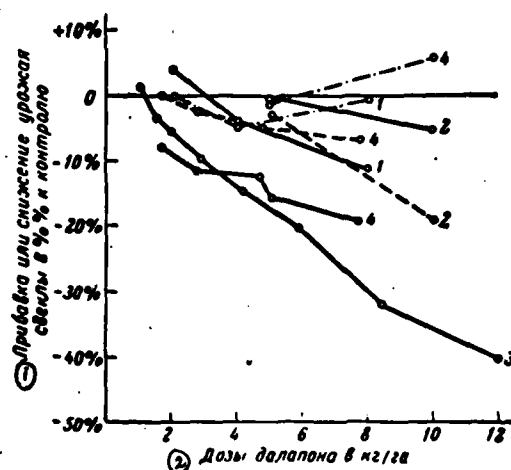


Fig. 3. Influence of dalapon on the yield of sugar beet roots: 1 -- 1960; 2 -- 1961; 3 -- 1962; 4 -- 1963; — application in the phase of two to three pairs of leaves of the beet; - - - - applied before cultivation; . . . . applied before germination of the beet. Key: 1) addition or reduction of the beet yield in % of control; 2) doses of dalapon in kg/hectare.

but its weight was reduced by 54%. The application of endothal before planting of the beets (1963) in a dose of 7.4 kg/hectare was less effective. The destruction of the weeds comprised: dicots -- 41.4%, bottle grass -- 49%. The weight of the weeds was reduced by 69.5 and 42.9%, respectively. A reduction of the weight of the beet plants before harvesting and a 0.5-0.8% reduction of the sugar content of the roots were noted, but the final yield of roots was practically not decreased.

The combination of endothal and IPA (the preparation murbetol) possesses a broader spectrum of action on weeds [12]. The separate application of the components of the preparation is less effective (Table 2).

Murbetol, applied before cultivation, reduced the weed density to a greater extent than in preplanting application. A weight calculation showed the opposite relationship (Fig. 4). The yield of sugar beet roots was reduced only in doses of 17.4 and 24.8 liters/hectare of murbetol, applied before planting (Fig. 5).

Treatment of the plantings with murbetol in doses up to 12 kg/hectare during the phase of two pairs of leaves of the beet (1962) proved ineffective. The choking of the plantings was not reduced in this period of application, although the weight of the bottle grass was reduced by 48.2%.

The new herbicide alipur [13-16], applied during the phase of two pairs of leaves of the beet in doses from 1 to 12 kg/hectare, reduced the

Table 2

Herbicidal Effectiveness of IPA, Endothal, and Murbetol  
(Greenhouse Experiment)

1 Препараты, кг/га (вно- симо до всходов свек- лы)	2 Просо		3 Сахарная свекла	
	4 общий вес рас- тения, г/сосуд	5 % гибели к контролю	6 корни, г/сосуд	7 прибавка урожая, % к контролю
8 Контроль	5,23	0	149	0
9 Мурбетол —8,6	5,67	+8,0	164	+10,0
Мурбетол —14,4	2,02	61,0	177	+18,7
Мурбетол —24,0	0	100	178	+19,4
10 ИФК —3,24	4,83	8,0	153	+2,6
ИФК —5,4	2,85	46,0	138	-7,3
ИФК —9,0	1,89	64,0	150	+0,6
11 Эндотал —5,36	5,54	+6,0	165	+10,7
Эндотал —9,0	6,33	+21,0	159	+6,7
Эндотал —15	1,29	75,0	167	+13,0

Key to Table 2:

1. Preparations, kg/hectare (applied before germination of beet)
2. Millet
3. Sugar beet
4. Total weight of plants g/pot
5. Destruction, % of control
6. Roots, g/pot
7. Additional yield, % of control
8. Control
9. Murbetol
10. IPA
11. Endothal

choking by dicot weeds by 176% in a dose of 2.9 kg/hectare, and 88.1% in a dose of 12 kg/hectare. Bottle grass was not affected. The beet plantings were greatly thinned. The yield of beet roots was reduced by 13% for a dose of 1 kg/hectare and 59.1% at a dose of 12 kg/hectare. Alipur, applied before planting of the beets (1963), only slightly reduced the weed density, but the weight of the dicot weeds was reduced by 58.6% at a dose of 4 kg/hectare and by 76.9% at a dose of 6 kg/hectare. The yield of beet roots was not reduced.

In the experiments we also tested a number of other preparations: vegadex (2-chloroallyldiethyldithiocarbamate) in doses of 3 and 6 kg/hectare, randox (N, N-diallyl-2-chloroacetamide) in doses of 2 and 4 kg/hectare, carbine (4-chloro-2-butyryl-N-(3-chlorophenyl)carbamate) in doses of 1.5 and 3 kg/hectare. The preparations were applied before preplanting cultivation and manifested very weak herbicidal action or did not affect the bottle grass weeds at all. Carbine (1.2 and 2.4 kg/hectare), applied in the phase of three pairs of leaves of the beet, also did not affect the

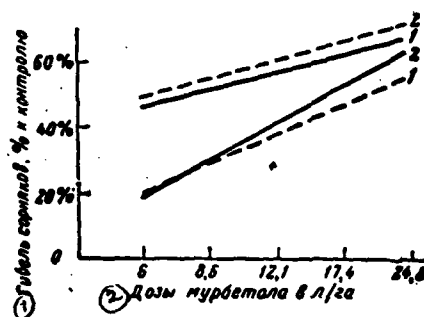


Fig. 4. Effect of murbetol on weed plants: 1 -- calculation of amount of weeds; 2 -- calculation of weight of weeds; — -- applied before cultivation; - - - - applied before planting of the beets.  
Key: 1) destruction of weeds, % of control; 2) doses of murbetol in liters/hectare.

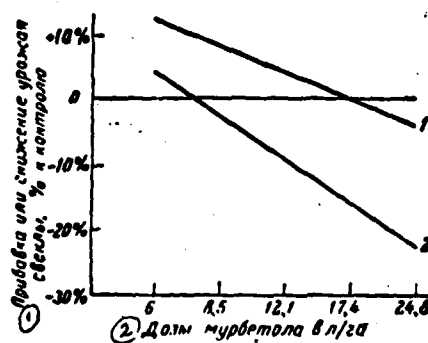


Fig. 5. Effect of murbetol on the yield of sugar beet roots: 1 -- applied before cultivation; 2 -- applied before planting of beets.  
Key: 1) weight gain or reduction of yield of beets, % of control; 2) doses of murbetol in liters/hectare.

bottle grass weeds, but the yield of beet roots in this case was reduced by 10.5% at a dose of 2.4 kg/hectare.

#### CONCLUSIONS

1. In our experiments dalapon possessed no advantages over dichloralurea. Both herbicides reduced the yield of sugar beet roots; hence, further

researches into the reduction of their negative action on beet plants (periods of application, belt application, irrigation) are essential.

2. The new herbicides endothal and murbetol are more promising: they possess a broader spectrum of action on weed plants and do not lower the yield of the sugar beet. Alipur had a weak effect on weed plants in preplanting application.

3. The chemical method of controlling weeds on sugar beet plantings has been weakly developed; hence, in addition to a detailed study of the most rational methods of utilization of already known preparations, more attention should be paid to the search for new compounds, suitable for application on plantings of this crop.

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