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AN INVESTIGATION OF NOVEL CHEMICAL COMPOUNDS WITH RADIOPROTECTIVE ACTION

A. D. Mehandjiev, G. N. Vassilev*, S. B. Noveva

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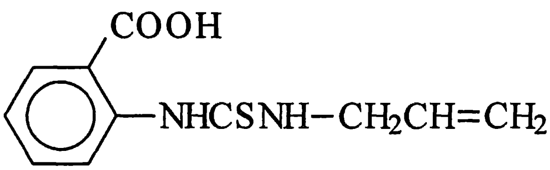
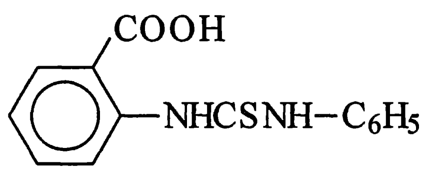
The studies on new highly efficient chemical compounds with radioprotective effect are of great importance for the radiological defence of living organisms, irradiation mutagenesis and environment preservation.

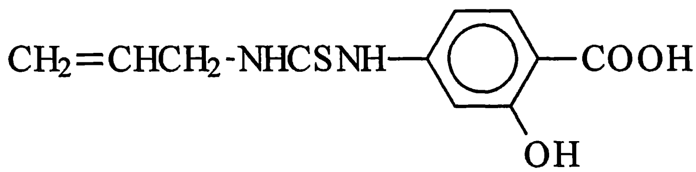
In a series of experiments the biological effects of derivatives of the anthranilic acid have been investigated. As their representatives ATB (I, o-allylthioureidobenzoic acid) and PTB (II, o-phenylthioureidobenzoic acid) in which the amino group is replaced with allylthioureido (I) and phenylthioureido (II) groups have been studied. They emerged as growth regulators with a distinct stimulating and cytokinin activity. These compounds stimulate the uptake of amino acids in barley seedlings [1]. Also, the treatment of soya seeds with PTB leads to the increase of essential amino acid content [2]. The metabolism of C^{14}-labelled ATB and PTB in green and etiolated plants of wheat and colrabi was studied. It was established that both substances are detected in the plants but are not metabolised in 44 h. Thus, their physiological activity is due to their intact action [3].



I



II



III

The second group under study consisted of derivatives the tuberculostatic drug 4-aminosalicylic acid represented by ATUS (III, 4-allylthioureidosalicylic acid) in which

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the amino group is substituted with an allylthioureido group. This compounds has displayed a high cytokinin and a high stimulating activity [4]. It was established that ATUS causes morphogenesis in the vine and tomatoes [5], depletes the effects of potassium fasting in beans and restores photosynthesis intensity [6, 7].

The preliminary experiments with these compounds showed that they can also display radioprotective effects.

The aim of the present studies is to establish the action of o-PTB on the biological and the genetic effects of γ-rays applied in the post-irradiation period. The biological and the sensibilising effects of γ-rays applied in the post-irradiation period of ATUS will be established in our next work.

Material and method. Dry peas seeds, the Pleven-4 variety were irradiated with γ-rays Co^{60} at doses 40 and 80 Gy after which they were immediately treated with o-PTB (2-phenylthioureidobenzoic acid) administered in three concentrations—10^{-3}, 10^{-4} and 10^{-5} M at an exposure of 5 hours and at a temperature of 23–24 °C.

The effect of the post-irradiation treatment was assessed in M_1 after the percentage of surviving plants.

In M_2 the frequency and spectrum of the induced chlorophyll and morphological mutations were studied. The classification of LAMPRECHT [8] was used for the determination of chlorophyll mutations and for the morphological ones the definitions of BLIXT et al. [9] were employed. Mutational frequency was calculated as number of mutants per 100 M_2 plants.

Results and discussion. The results demonstrative of plant survival following the actions applied are presented in Table 1. A dose of 80 Gy which is close to the critical one was used experimentally. The post-irradiation treatment with PTB at concentration of 10^{-3} M had an inhibitory effect on the cropped and survived plants.

As a result the percent of survived plants is lowered to 87.95% as to the pure irradiation. In the two remaining concentrations the percent of survival is increased from 1.2 to 6. In the single treatment with PTB 10^{-4} M 76.12% survived as compared to the control.

Table 1

Survival of plants in M_1 irradiation and treatment with PTB

Treatment	Sown seeds (No)	Survived plants (No)	Survival (in %)	Survival to irradiation (in %)	Survival to control (in %)
γ-rays 80 Gy+PTB 10^{-3}	200	73	36.50	87.95	47.09
γ-rays 80 Gy+PTB 10^{-4}	200	84	42.00	101.20	54.19
γ-rays 80 Gy+PTB 10^{-5}	200	88	44.00	106.02	56.77
PTB 10^{-4} M	200	118	59.00	—	76.12
γ-rays 80 Gy+H_2O	200	83	41.50	100.00	53.54
Controls	200	155	77.50	—	100.00

Stronger protective effect is displayed in the experiments carried out in 1999. Two doses of 40 and 80 Gy (Table 2) were used that year. In the group of 40 Gy, PTB increased the percent of the surviving plants from 3.87 to 21.35 compared to the single irradiation. In the dose of 80 Gy, PTB increased the percent of survival from 1.97 to 13.82. This shows that the dose of irradiation exercises a significant influence on the protective effect of the treatment applied. The independent trial of PTB showed an effect close to the one of the control. Applied, however, following the irradiation this

Table 2

Survival of plants in M_1 when treated with γ-rays and PTB

Treatment	Treated seeds (No)	Surviving plants (No)	Survival (in%)	Survival to irradiation (in %)	Survival as to the controls (in %)
γ-rays 40 Gy+PTB 10^{-3}	150	112	74.67	108.74	80.03
γ-rays 40 Gy+PTB 10^{-4}	150	107	71.33	103.87	76.45
γ-rays 40 Gy+PTB 10^{-5}	150	125	83.33	121.35	89.29
γ-rays 40 Gy+H_2O	150	103	68.67	100.00	73.58
γ-rays 80 Gy+PTB 10^{-3}	150	58	38.70	113.82	41.47
γ-rays 80 Gy+PTB 10^{-4}	150	58	38.70	113.82	41.47
γ-rays 80 Gy+PTB 10^{-5}	150	52	34.67	101.97	37.15
γ-rays 80 Gy+H_2O	150	51	34.00	100.00	36.43
PTB 10^{-3}	150	120	80.00	99.17	85.72
PTB 10^{-4}	150	123	82.00	101.65	87.86
PTB 10^{-5}	150	111	74.00	91.73	79.29
Controls	150	121	80.67	100.00	86.44

compound increased the percent of surviving plants and exerted a favourable influence on their development.

At γ-ray irradiation at a dose of 80 Gy, 3.09 % of mutation of 4 mutational types were recorded. When the seeds are treated with PTB after the irradiation, mutation frequency is twice higher and depending on the concentration it varies from 5.68 to 6.80 % (Table 3). It is highest at the low concentration of 10^{-5} (6.80 %) and more mutational types are observed when the treatment with PTB was carried out at a concentration of 10^{-3} M (6 types). On the frequency of mutations predominantly of the morphological type, the concentration of the tested compound has not exercised any significant influence.

Table 3

Frequency of the induced chlorophyll and morphological mutations (mutants of the 100 M_2 plants) upon post-irradiation treatment with PTB

Treatment	Plants (No)	Mutations (No) chlorophyll	Mutations (No) morphol.	Total (No)	Mutations (%)	Mutational types (No)	mp
γ-rays 80 Gy+PTB 10^{-3}	157	1	9	10	6.37	6	0.0195
γ-rays 80 Gy+PTB 10^{-4}	176	—	10	10	5.68	5	0.0174
γ-rays 80 Gy+PTB 10^{-5}	103	—	7	7	6.80	5	0.0248
γ-rays 80 Gy+H_2O	194	—	6	6	3.09	4	0.0124
PTB 10^{-4}	252	—	2	2	0.79	2	0.0056
Controls	253	1	—	1	0.39	1	0.0039

In conclusion it must be noted that PTB displayed radioprotective effect as a result of which more plants in M_1 crop up and survive and in M_2 the amount of the induced mutations is increased.

The results obtained are of great importance for the irradiation mutagenesis and irradiation protection of the organisms. Thus, the studies on new types of radioprtectors are not the only subject of interest but the investigations on their influence on the mutation process in plants are also very important.

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Institute of Genetics
Bulgarian Academy of Sciences
1113 Sofia, Bulgaria

**Institute of Organic Chemistry*
Bulgarian Academy of Sciences
1113 Sofia, Bulgaria