

compounds proved to be quite effective in terms of antibacterial and antifungal action.

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**SYNTHESIS AND GROWTH-REGULATORY ACTIVITY OF
2-ARYLBUTENE-1,4-DIOIC ACIDS**

**¹Tulaidan H. M., ¹Symchak R. V., ²Zahrychuk H. Ya.,
¹Baranovskyi V. S.**

¹Ternopil Volodymyr Hnatiuk National Pedagogical University

²I. Ya. Horbachevsky Ternopil National Medical University, Ternopil,
Ukraine

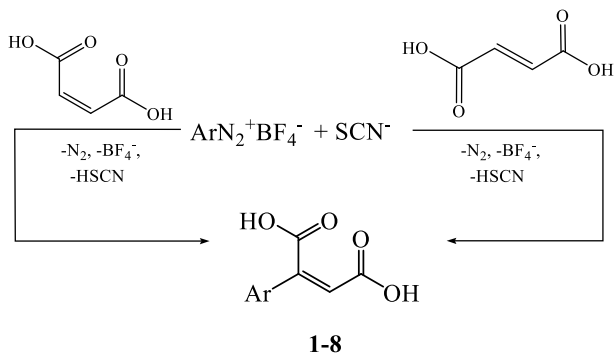
E-mail: baranovsky@tnpu.edu.ua

Saturated and unsaturated dicarboxylic acids are important in modern crop production as growth promoters and plant protection agents. Their use contributes to increased yields, improved stress resistance, and reduced dependence on chemical pesticides. In particular, succinic acid helps to increase yield, improve

***Хімія навколишнього середовища, природних та
біоактивних сполук***

photosynthesis, nitrogen fixation and other metabolic processes in plants. It also increases plant resistance to stress factors and can be used as a natural pesticide. Some dicarboxylic acids, such as malonic and maleic, have fungicidal and bactericidal properties. They can inhibit the development of phytopathogens and stimulate plant defense mechanisms, which makes them promising for biological plant protection [1].

In order to obtain new derivatives of dicarboxylic acids, we obtained their arylation products – 2-aryl-2-butenedioic acids **1-8** by the interaction of aryldiazonium tetrafluoroborates with maleic and fumaric acids in the presence of rhodanide anions according to the scheme:



Ar = Ph (**1**), 4-MeC₆H₄ (**2**), 4-MeOC₆H₄ (**3**), 4-BrC₆H₄ (**4**), 4-COOHC₆H₄ (**5**), 4-SO₃HC₆H₄ (**6**), 4-SO₂NH₂ (**7**), 4-CONH₂C₆H₄ (**8**)

These reactions occur at –28 –18°C, in the presence of a catalyst – copper (II) tetrafluoroborate in a water-acetone (1:2) solution. The optimal ratio of reagents: aryldiazonium salt – maleic or fumaric acid – potassium rhodanide – copper (II) tetrafluoroborate is 1.0 : 1.0 : 1.1 : 0.11. The yields of arylation products **1-8** under the studied conditions are 50-79% based on unsaturated acid.

The structure of the obtained compounds **1-8** was confirmed by IR and ¹H NMR spectra. Analysis of the IR spectra shows the absence of the rhodane group in any of its isomeric forms in their structure (characteristic absorption bands in the region 2170-2140 (SCN) and 2080-2040 (NCS) are not observed). In addition, broad bands with maxima at 3440-3424 cm⁻¹ indicate the presence of hydrogen-bonded

hydroxy groups in their structure.

Thus, arylation reactions [2] of unsaturated dicarboxylic acids with aryldiazonium salts allow modifying these compounds by introducing aromatic fragments while simultaneously preserving both carboxyl groups, which opens up wide possibilities for obtaining new derivatives with practically useful properties based on them.

The study of the growth-regulating activity of synthesized arylation products was carried out on seeds of winter wheat of the first reproduction variety "Lazurna" which were treated with solutions of the corresponding substances **1-8** with a concentration of 0.002%. Distilled water was used as a control. The studies were carried out in accordance with DSTU 2240-93. To determine the germination energy and seed germination, 4 samples of 100 seeds were taken for one variant of the studies. Filter paper was used as a bed, germination was carried out on paper. The filter paper was moistened by spreading the seeds. Germinated seeds were counted in two periods: on the 3rd day, germination energy was determined, on the 7th - germination. Germination was determined as the arithmetic mean of the germination results of four samples [3].

At the initial stage (day 3), the germination energy index varied slightly (CV = 7%). Thus, the absolute majority of the experimental variants prevailed over the control – 3.7 – 18.8%. The most significant increase relative to the control variant was noted with substance **6** – 18.8; relative to the variant with succinic acid – 4.3%. Substance **1** was characterized by a somewhat lower value, + 13.6% to the control and equivalent to succinic acid. The germination energy in the variant with substance **2** was insignificantly higher than in the control (+3.7%) and significantly lower relative to succinic acid (-8.7%). Substances **6-8** contributed to a significant increase in germination energy relative to the control and a insignificant decrease relative to succinic acid in the variant with substance **5**.

On the 7th day, the germination energy varied within 4% between the variants. The variant with the use of substance **5** contributed to the smallest increase in this indicator relative to the control - 7.1% and a slight decrease (by 2.2%) relative to succinic acid. The variant with substance **2** was equivalent to succinic acid and higher than the control by 9.5%. Compounds **1, 4, 7** had the same

effect: +10-12% to the control and +2-3% to succinic acid. Substance **6** was the most effective +14.3% to the control and + 4.3% to succinic acid.

In general, the results of the study showed that compound **6** – 2-(4-sulfophenyl)butene-1,4-dioic acid – has a sufficiently high growth-regulatory activity, while a negative effect is observed for compound **5** – an arylation product containing a carboxyl group in the aromatic fragment.

Thus, the obtained data confirm the promising use of the compounds synthesized by us as seed germination stimulants and plant growth regulators.

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