A new group of diazaheterocyclic salts derived from imidazole was synthesized by addition of acrylonitrile to N-1. The 1-(2-cyanoethyl) imidazole derivatives were quaternized with high-reacting halogen derivatives (halogen esters and halogen amides) and the structure of the obtained compounds were proved by spectral methods (IR, 1H-NMR, 13C-NMR, 2DCOSY, HITCOR). For all those compounds the biological effect on the wheat seeds germination was tested. The tests were conducted in controlled temperature room and results showed that the hypocotyls length varied as a function of concentration and structure of each investigated compound. The investigated compounds exhibited a general stimulating activity on the hypocotyls growth, especially at lower concentrations. A possible relationship between structure and biological activity is mentioned.

Keywords: imidazoles; N-alkylation; wheat; hypocotyls elongation; auxines; chemical structure-biological activity relationship

Due to the societal demands, the synthesis of new materials of potential practical applications has become a big challenge of the modern science [1-3]. Overtime, nitrogen heterocycles have demonstrated a renewed interest as highly valuable materials in the fields of agriculture, medicinal chemistry, opto-electronics and analytical chemistry [4-23]. Diazoles, especially imidazole, benzimidazole and their analogues, usually possess diverse biological activities like anticancer, antibacterial and antifungal, antituberculosis, etc. [24-26]. One of the most used way of synthesis of azaheterocyle involve ylides, as intermediary reactive species [27-35].

In recent years, the plant’s seed germination represents an excellent way to test the biological response to various chemical stimuli [5, 36]. The germination test determines the actual germination potential of normal seeds within a seeds lot, which can be used to compare the quality of different lots and to estimate the field planting value. Nevertheless, germination tests are very simple, little time consuming, cheap and therefore could be ideal methods for testing the biological activity of some new synthesized compounds, including – in our case – the imidazolium salts. Therefore, this paper reports their biological activity on wheat germination and seedling growth.

**Experimental part**

**Equipment, materials and methods**

Apparatus

The germination test was performed in a growth chamber Conviron MP4030, model G30, with programmed temperature, humidity and light.

Biological material

Seed samples of wheat (Triticum aestivum L.), Magistral variety, (yield 2011) achieved from S.C.D.A. Suceava, for which the germination rate was measured, were used.

Treatment solutions

The imidazole derivatives (1a, 1b; 2 a-c and 3 a-i) prepared as above were previously prepared and there aqueous solutions were used for the seed treatments.
The germination rate was $G_r = 94 \pm 1.8\%$ and for the treated seed $G_r$ varied between $93 \pm 2.0\%$ and $95 \pm 0.8\%$, depending on the used imidazole derivatives.

On the other hand, according to the variance analysis (table 2 - 4), almost all imidazole derivatives produce the elongation of the hypocotyls, especially for the imidazolium salts obtained with the methyl- and ethyl bromoacetate ($3b, 3c, 3e, 3f, 3h$ and $3i$ – table 1, underlined values) where the auxin-like effect are the most obvious.

Regarding the influence of the concentration, the main tendency are the increasing of the biological response – namely the elongation of the hypocotyls – with the decreasing of the concentration; the most biological active concentrations are those of $5 \times 10^{-5}$ m and $1 \times 10^{-5}$ m, respectively.

There was found an interesting relationship between the structure of the investigated compounds and their biological activity as the data in this paper demonstrated. Auxins, such as indole 3-acetic acid (IAA), stimulate the
Wall Loosening Factors --such as elastins -- to loosen the cell walls and also stimulate cell division if cytokines are present [41]. It seems that those biological effects, considered as an auxin-like action of the imidazole derivatives, by the stimulation of cell elongation, are linked with the presence in the molecules of the methoxy, respectively ethoxy radicals.

Nevertheless, the investigated compounds acted as a completely different and unknown mechanism. We can only hypothesize that the investigated imidazole derivatives might create a non-specific stress, against which the living seedling reacts by intensifying its metabolism. At higher concentrations, the toxicity of the derivatives interacts with the stimulatory effects and -- as result -- the plantlets presents a less obvious elongation or even growth inhibitions (such as 3d, 2c, 3a, 3b, 1b and 2a at 1 x 10^{-3} m).

### Conclusions

The effect of some new imidazole derivatives on germination and seedling growth of wheat was investigated. The length of hypocotyls varied as a function of concentration and structure of each investigated compound.

An obvious relationship between the chemical structure and the biological activity was observed at the derivatives obtained by the quaternization of 1-(2-cyanoethyl) imidazole derivatives at N-3 with methyl- and ethyl bromoacetate. Those imidazolium salts present a very significant increased stimulatory activity on cell elongation, especially at lower concentrations (5 x 10^{-5} m and 1 x 10^{-5} m). All the obtained results were statistically validated.

### References


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