RESEARCHES ON THE INFLUENCE OF SEVERAL PESTICIDES ON THE ROOT OF *CUCUMIS SATIVUS* L.

CERCETĂRI PRIVIND INFLUENŢA UNOR FUNGICIDE ASUPRA RĂDĂCINII DE *CUCUMIS SATIVUS* L.

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Abstract. *Originating in India, the cucumber has spread all over the world, over the 3,000–4,000 years since it started being used as food, now occupying an important place in the assortment of fresh vegetables, in the canned foods industry, in pharmaceutics and cosmetics. The chemical protection of cultivated plants has contributed, over the past few decades, to increased productions, while the substances used have accumulated in the environment. The Topsin Al 70 PU (T) fungicides and the Bordeaux mixture (B) were applied to Cucumis sativus in two ontogenetic stages in its lifetime, i.e. the seed, and the young plant ones. T stimulates the growth of the root in both ontogenetic stages, and accumulates in the inter-cell spaces when applied in the young plant stage, affecting the walls of the rhizodermic cells, of the cortex parenchyma, and of the pericycle. B inhibits the length growth of the root, in both ontogenetic stages, and in a similar manner as T, affects the cell walls, which results in the contraction of the root.*

Key words: *Cucumis sativus* L., Topsin, Bordeaux mixture, seed, seedlings growth, morphology, anatomy.

Rezumat. *Originar din India, castravetele s-a răspândit în decursul celor 3,000-4, 000 de ani de când este utilizat, în toată lumea, ocupând un loc important în sortimentul de legume proaspete, în industria conservelor, în cea farmaceutică şi cosmetică. Protecţia chimică a plantelor cultivate a contribuit în ultimele decenii la creşterea producţiei, dar în acelaşi timp substanţele utilizate s-au acumulat în mediu. Fungicidele Topsin Al 70 PU (T) şi Zeamă bordeleză (Z) au fost aplicate la Cucumis sativus în două stadii ontogenetice din ciclul de viaţă, în cel de sămânţă şi în cel de plantulă. T stimulează creşterea rădăcinii în ambele stadii ontogenetice, se acumulează în spaţiile intercelulare când se aplică în stadiul de plantulă şi afectează pereţii celulelor rizodermice, ai parenchimului cortical şi ai pericicluluі. Z inhibă creşterea în lungime a rădăcinii, în ambele stadii ontogenetice şi, similar T, afectează pereţii celulari, ceea ce are ca efect contracţia rădăcinii.*

Cuvinte cheie: *Cucumis sativus* L., Topsin, zeamă bordeleză, sămânţă, plantulă, creştere, morfologie, anatomie.

INTRODUCTION

Coming from India, the cucumber has spread worldwide, over the 3,000-4,000 years since it has been used, and now occupies an important place in the assortment of fresh vegetables, in the industry of canned foods, in pharmaceutics and cosmetics. The chemical protection of the plant has contributed, over the past

few decades, to securing increased productions (Băbeanu et al., 2002), but, at the same time, the substances used have accumulated in the environment. The danger represented by pesticides came into public attention in 1962, when Carson's book, *The Silent Spring*, was published, where the process of bioaccumulation of pesticides across the food chains is described, with the first link represented by plants (Primack et al., 2008).

The goal of the present contribution was to test the influence of the fungicides Topsin and Bordeaux mixture on the growth, morphology and anatomy of the root of cucumber, *Cucumis sativus* L., through applying those fungicides during two different ontogenetic stages of the plant's life cycle.

MATERIAL AND METHOD

Topsin Al 70 PU (T) is a fungicide which contains 70% metyl thiophanate, the action of which is preventive and curative in cereals, trees, etc. The Bordeaux mixture (Z) is a fungicide containing 80% copper sulphate, with 20% metallic copper and calcium hydroxide, having a wide gamut of action in vegetable crops, tree orchards, etc. The influence of these fungicides on the growth, morphology and cyto-histology of the root of *Cucumis sativus* L. has been studied by applying them during two ontogenetic stages in the life cycle of the plant. In the seed stage, the following concentrations of T were applied: 0.025% (V1T), 0.05%, (V2T), 0.1% (V3T), 0.2% (V4T), 0.50%, and for Z: (V1Z), 0.75% (V2Z), 1% (V3Z), 2% (V4Z). In the little plant stage, the concentrations of T applied were: 0.025% (V5T), 0.05% (V6T), 0.1% (V7T), 0.2% (V8T), and those of Z: 0.50% (V5Z), 0.75% (V6Z), 1% (V7Z), 2% (V8Z). In order to apply the fungicides in the seed stage, the seeds were hydrated for 3 hours, 20 seeds for each variant, and they were subsequently immersed into the fungicide for one hour.

The seeds, thus treated, were laid to germinate in Petri boxes. The culture vases were maintained at room temperature (18ºC), in conditions of natural lighting. To apply the fungicides in the little plant stage, the hydrated seeds were laid to germination in the Petri boxes. After the seeds had germinated, and the cotyledonous little plants were obtained, the latter were immersed for one hour, in keeping with the variants presented. The immersed little plants were washed in tap water, and then placed back into the Petri boxes. In order to determine the longwise growth of the roots, they were periodically measured, and the arithmetic mean value was calculated for each variant. The results were interpreted statistically by means of the LSD (Least Significant Difference) test.

The morphological peculiarities of the little plants' roots were determined through macroscopic observations and the periodic photography of the vegetative material. The cyto-histological modifications of the little plants' roots were evinced in cross-sections that were either fresh, or treated with Javel water and coloured with Geneva reagent, and the pictures were made under an Optika B 250 microscope with a digital camera Canon Power Shot A630.

RESULTS AND DISCUSSIONS

Growth of the root. The measurements conducted to determine the length of the roots, 11, 15, 18 and 22 days from the inception of the experiment, in the case of the seed immersion, indicate the fact that the latter stimulates growth, in nearly all the experimental variants (fig. 1). After 11 days, the most intense

lengthwise growth of the root was recorded in the control sample (M). After 15 days, and then after 18 days, the fact was noticed that, in the case of variants V2T-V4T, the greatest mean values of the root length were recorded. When 22 days had passed from the inception of the experiment, the lengthwise growth of the root was stimulated in all the experimental variants.

The results obtained agreed with the physiological effect of the cytoquininic type exerted by the metyl thiophanate and its main metabolite, carbedasyme (Huţanu-Bashtawi et al., 2008b), to stimulate seedlings growth. In the case of the seeds immersed in Z, the measurements conducted on the length of the roots, after 11, 15, 18 and 22 days from the inception of the experiment, show an effect contrary to that obtained for the immersion into T.

Thus, after 11 days a decrease in the mean value of the root length is noticed, from M to V4Z. That influence is maintained, so that, upon subsequently measuring it, a decrease in the root length mean values is found, from V1Z to V4Z. After 18 days, and then 22 days pass from the inception of the experiment, the mean values recorded for V3Z are smaller than those for V4Z.

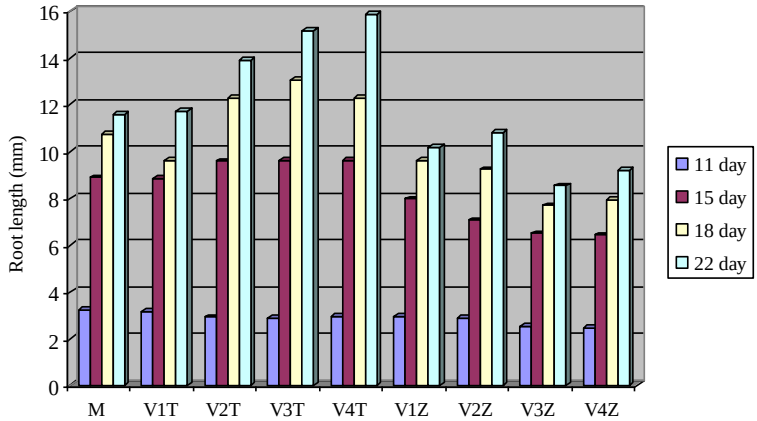


Fig. 1. Growth of the embryo roots of the little plants of *Cucumis sativus* L. obtained from seeds immersed in Topsin and in the Bordeaux mixture

In the case of the seeds immersed into T and Z, 22 days after the inception of the experiment, there occurred significant differences between the following variants: M-V3T (sig.0,042), M-V4T (sig.0,047), M-V3Z (sig.0,022), V1T-V3T (sig.0,030), V1T-V4T (sig.0,034), V1T-V3Z (sig.0,031), V2T-V1Z (sig.0,020), V2T-V2Z (sig.0,049), V2T-V3Z (sig.0,001), V2T-V4Z (sig.0,004), V3T-V1Z (sig.0,002), V3T-V2Z (sig.0,005), V3T-V3Z (sig.0,000), V3T-V4Z (sig.0,000), V4T-V1Z (sig.0,005) (sig.0,002), V4T-V2Z (sig.0,006), V4T-V3Z (sig.0,000), V4T-V4Z (sig.0,000).

On immersing the little plants into T, the same effect is found, of stimulating the lengthwise growth of the root (Fig. 2). When 10 days had passed from the inception of the experiment (3 days after immersion in T), variant V8T is

recorded as having the greatest mean value, followed by variant V6T; the same influence can be noticed in the next measurements. In the case of little plants being immersed in Z, an inhibitory effect is found upon the lengthwise growth of the roots, by comparison with M. Moreover, in the specific case of variants V6Z and V8Z, the last measurement found a decrease in the length of the roots, from 5.37 mm to 4.60 mm in V6Z, and from 5.69 to 5.28 in V8Z. That contraction of the roots was also noticed in the little plants of *Pisum sativum* that were immersed in Ridomil Gold Plus, a fungicide that contains mephenoxam (2.5%) and metallic copper (40%) (Soare et al., 2008).

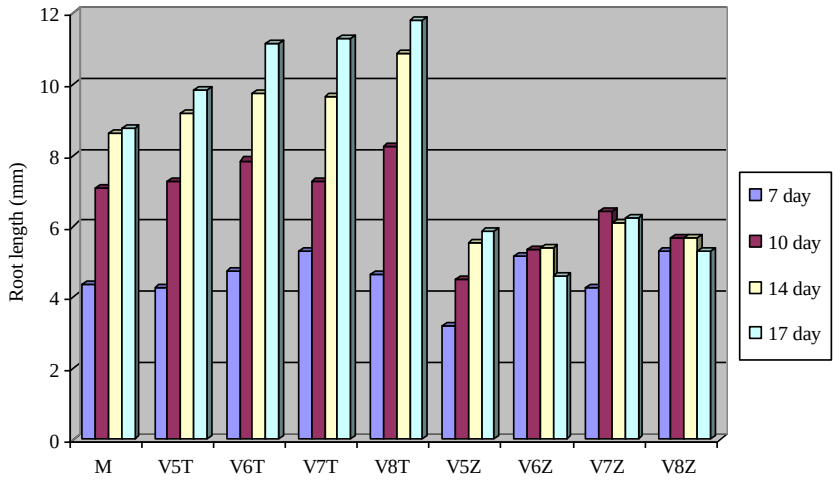


Fig. 2. Growth of the embryo roots of the little plants *Cucumis sativus* L. immersed in Topsin and in the Bordeaux mixture (orig.)

In the specific case of the little plants' immersion into T and Z, after 17 days from the inception of the experiment, one can notice there are significant differences (sig.<0.05) between the following variants: M-V7T (sig.0,036), M-V8T (sig.0,012), M-V5Z (sig.0,016), M-V6Z (sig.0,001), M-V7Z (sig.0,033), M-V5Z (sig.0,006),V5T-V5Z (sig.0,001), V5T-V6Z (sig.0,000), V5T-V7Z (sig.0,002), V5T-V5Z (sig.0,000), V6T-V5Z (sig.0,000), V6T-V6Z (sig.0,000), V6T-V7Z (sig.0,000), V6T-V8Z (sig.0,000), V7T-V5Z (sig.0,000), V7T-V6Z (sig.0,000), V7T-V7Z (sig.0,000), V7T-V8Z (sig.0,000), V8T-V5Z (sig.0,000), V8T-V6Z (sig.0,000), V8T-V7Z (sig.0,000), V8T-V8Z (sig.0,000).

Morphology of the roots. The roots of the little plants obtained from seeds immersed into T, and respectively into Z, have a normal morphology, similar to that of M (fig. 3). In the case of the variants V1Z-V4Z, the fact was found that the radices are more developed than those of the variants V1T-V4T. That can be accounted for through the fact that, although T stimulates cell division, it hinders the process of differentiation of the more specialized tissues (Huţanu-Bashtawi et al., 2008a). The little plants immersed into T have a morphology similar to that of

M, and the effect of lengthwise growth stimulation is highlighted for both the main root, and the ramifications (fig. 4).

Immersing the little plants into Z alters the normal morphology of the root (fig. 4), and the main root is affected, as can be noticed in the case of variant V6Z, no less than the ramifications, which are fewer and shorter.

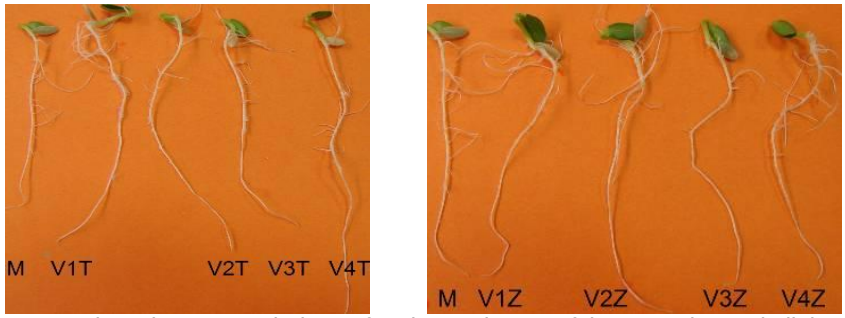


Fig. 3. *Cucumis sativus* – morphology of embryonal roots of the control sample little plants, and of those obtained from seeds immersed in Topsin and in Bordeaux mixture, 15 days after the inception of the experiment (orig.).

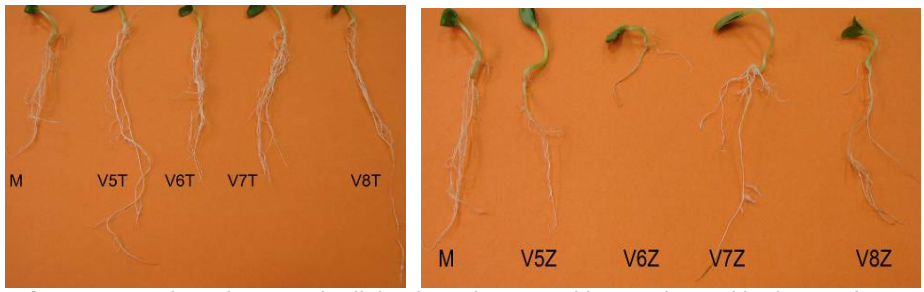
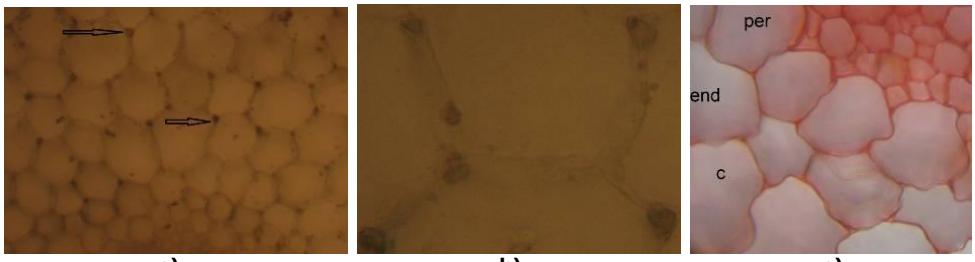


Fig. 4. *Cucumis sativus* L. : the little plants immersed in Topsin, and in the Bordeaux mixture, 30 days after the inception of the experiment, and 19 days after the immersion (orig.).

Anatomy of the root. The root of the control sample little plants and that of those obtained from seeds exhibits a primary structure specific to the dicotyledonous plants (Andrei, 1978; Fahn, 1982; Sitte, 1999; Şerbănescu-Jitariu & Toma, 1980).

In the little plants immersed in T, the accumulation of the fungicide in the inter-cell spaces of the root cortical parenchyma can be noticed (fig. 5a,b). In both the little plants immersed in T, and those immersed in Z, the fact was noticed that the walls of the rhizodermic cells, and those of the cortical parenchyma were affected (fig. 5c).

Due to the fact that T stimulates cellular division, the effect of shortening is not visible in variants V5T-V8T, while that effect is occurs in variants V5Z-V8Z, in which the same effect is found of wrinkling or corrugation of the cell walls, in a similar manner to what occurs in the case of the metamorphosed contractile roots (Fahn, 1982).



a) b) c)

Fig. 5. *Cucumis sativus* L. V8T– root cross-section: **a-b** accumulations of Topsin in the inter-cell spaces of the cortical parenchyma (arrow) (**a**-oc. 10x, ob. 10, zoom 4; orig; **b**-oc. 10x, ob. 40, zoom 4; orig.), **c**: root cross-section where the affectation is noticed of the walls of the cortical parenchyma, the endoderm and the pericycle (oc. 10x, ob. 40, zoom 4; orig.)

CONCLUSIONS

Topsin stimulates the growth of the root, and accumulates in the inter-cell spaces when applied in the little plant stage; it affects the rhizodermic walls, as well as the walls of the cortical parenchyma and the pericycle.

The Bordeaux mixture inhibits longwise growth of the root, and in a similar manner to Topsin, it affects the cell walls, which triggers the contraction of the root. Morphologically, significant alterations occur in the little plants immersed in the Bordeaux mixture.

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