Studia Universitatis "Vasile Goldiş", Seria Ştiinţele Vieţii
Vol. 23, issue 3, 2013, pp. 395-397

DETERMINING THE AMOUNT OF PHOSPHORUS (P) ABSORBED BY ROOTS, AND THE REST OF THE SUNFLOWER (HELIANTHUS ANNUUS) SEEDLINGS IN THE FIRST DAYS OF GERMINATION, FROM KNOPP NUTRIENT SOLUTION

Andreea Ioana RUSU, Aurel AREDELEAN, Violeta TURCUS
"Vasile Goldiş" Western University Arad, Faculty of Medicine, Pharmacy and Dentistry, Romania

ABSTRACT. In this research, seedlings introduced in the absorption medium were not immersed in the solution used as substrate as a whole but separately the roots and in other flasks the part of the seedling above the hypocotyl that is from the basis of the radicle upwards, comprising the shoot. The determinations of the absorption of P in the seedling was done assessing the amount of P, respectively of phosphate remaining in the solution after the plant material was kept in the solution for 1 hour and the amount of P that penetrated the organs and eventually extracted from tissues or organs of seedlings was not determined. The method for determining the P from the Knopp medium, remaining after seedling organ removal was done by standard procedure EN ISO 6878 which came into effect in August 2008, imposed by current law in our country, for assessments of phosphorus in water.

Keywords: radioactive isotope, Knopp solution, specific absorption, total absorption

INTRODUCTION

After the end of the Second World War there was a socio-economic growth in the belligerent countries, even in Romania. After the war, higher education was restructured and since 1950 scientific research has taken off. The Romanian Academy received funding and has built a number of research institutes such as the Institute of Atomic Physics in Magurele and one in Cluj, as well as the Chemistry Institutes in Bucharest and Cluj were founded, actions which continued with the establishment of research teams in universities.

In 1967, a multidisciplinary team led by Academician Emil Pop, director - at the time he published in a professional journal dedicated to the work of biology, an article on the determination of the absorption capacity of epigeal cotyledons and accumulation in these embryo organs of 32P.

It is interesting to mention in this respect the researches done by Cache et al (1969) who studied issues related to the use of phosphorus in the reserve tissue of the seeds, according to the same type of radionuclide, but in which 32P uptake was examined in the hypogeal cotyledons. But, the authors established, using radioactive isotopes, the absorption of phosphorus from the external environment also begins with seed germination. As the embryo develops, absorption intensity increases significantly.

Since vital dyes are not compounds for nurturing living things, including plants, we have considered it opportune to organize an experiment that uses as experimental model an absorption substrate formed of nutritive solution that is currently used in the nutrition studies within researches concerned with vitro-culture, or hydroponics done in greenhouses with vegetable or floricultural profile. For this, of the multitude of recipes of existing culture media we chose *Knopp* liquid nutritive medium, consisting of a balanced mixture of four inorganic salts. Therefore, according to the *Knopp* medium recipe, in its composition – of the four salts used for its preparation – KH2PO4 is found, in a concentration of 0.25g/l. Thus, the seedlings used in the experiment had phosphorus in a concentration of 0.25g/l available in the nutritive substrate.

Knopp nutritive solution has the following chemical composition in g/l: Ca(NO3)2 0.25 g, KH2PO4 0.25 g, MgSO4 0.25 g, KCl 0.25 g, and traces of FeSO4.

MATERIALS AND METHODS

In this research, seedlings introduced in the absorption medium were not immersed in the solution used as substrate as a whole but separately the roots and in other flasks the part of the seedling above the hypocotyl, that is from the basis of the radicle upwards, comprising the shoot – an extra-radicular part – that generally is not responsible with nutrition, but which during germination and seedlings development can supplement the radicular absorption, respectively seedlings with eater and some mineral salts found in the water from the soil, until the epigeal cotyledons elevate (together with the epicotyl and shoot) above the soil.

From this, it was clear that, the determinations of the absorption of **P** in the seedling was done assessing the amount of **P**, respectively of phosphate remaining in the solution after the plant material was kept in the solution for 1 hour and the amount of **P** that penetrated the organs and eventually extracted from tissues or organs of seedlings was not determined. The method for determining the **P** from the *Knopp* medium, remaining after seedling organ removal was done by standard procedure EN ISO 6878 which came into effect in August 2008, imposed by current law in our

***Correspondence:** Andreea Ioana Rusu, "Vasile Goldiş" Western University Arad, Faculty of Medicine, Pharmacy and Dentistry, Romania*
Article received: May 2013; Published: September 2013

country, for assessments of phosphorus in water (running water, stagnant water, industrial waste water or soil water).

However, we believe that the experimental data obtained by performing such research can be very helpful in terms of documentation for plant physiologists in the absorption area performed in organs of seedlings and, in particular, the **P** element.

Next, we elaborate on some key issues regarding the organization of the experiment. First, note that the experiment was organized on 50 seedlings for each plant species, the 50 specimens were divided into 10 groups of 5 roots each or of 5 seedling fragments consisting of organs located above each hypocotyl; the 5 samples of plant material were immersed for 1 h in 200 ml *Knopp* solution, which was placed in beakers. After the passing of this time duration the plant material was removed from the solution containing the *Knopp* culture medium and was kept for 15 minutes suspended by plastic rods, rigidly, to seep into the beakers the remaining solution from seedlings organs; then the volume collected in the beaker was measured, after which the amount of phosphate was determined, respectively of **P** remained in the containers. Measurements were processed mathematically calculating the arithmetic mean per plant organ of the five, which were immersed in the solution bottle. The plant material was weighed after retaining it at 105°C for three days in the oven, placed on aluminum foil; the absorption data are reported to dry weight of plant material having absorbed nutrient solution. Pressured for time, some of the experiments performed to determine the absorption of **P** were done earlier if seedlings were big enough.

The average data results, in absolute values or as a percentage (%), were shown in Figures 1-4. We will present and discuss these results below.

RESULTS AND DICUSSIONS

In the graphs from Figures 1-4 are represented by histograms the results obtained when analyzing P absorption from the *Knopp* nutrient solution in the first four days of germination.

As shown in Figure 1 which represents the absorption analysis of **P** in the embryonic stem sunflower seedlings radicle, **P** enters from the very first day of germination – and was absorbed more intensely by the radicle, compared to the rest of the seedling, which has resulted also from the data showing the total absorption in percentage values (Fig. 3).

CONCLUSIONS

Regarding the specific absorption (Fig. 4), resulted in the reporting of the total absorption to the dry weight of the organs concerned, in sunflower it reveals the same aspects. The phenomenon of the absorption of P is clearly stronger in the root than in the rest of the seedling, which, as is known, contains high amounts of saturated fat (extracted by crushing them and thus obtaining the sunflower oil).

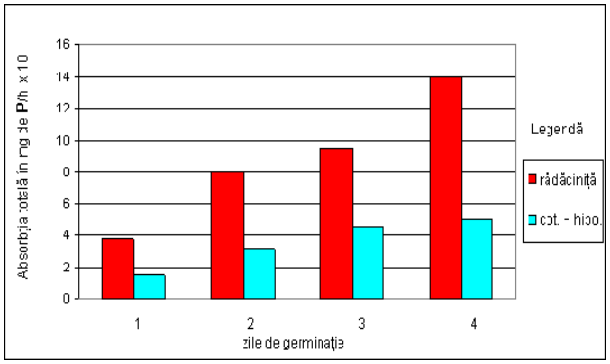

Fig. 1. Data regarding the total absorption of **P** (in mg/h x 10-4) in the organs of sunflower (*Helianthus annuus*) seedlings during the first 4 days of germination, from *Knopp* nutritive solution (abbreviations: P – phosphorus; cot – cotyledons; hipo – hypocotyl).

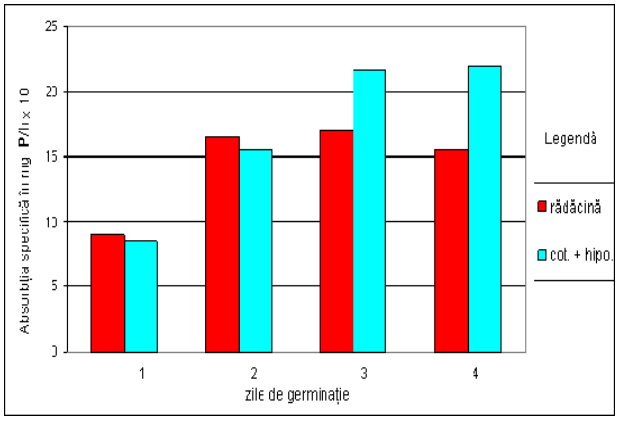

Fig. 2. Data regarding the specific absorption of **P** (in mg/g x 10-2) in the organs of sunflower (*Helianthus annuus*) seedlings in the first 4 days of germination, reported to dry weight, from *Knopp* nutritive solution (abbreviations: P – phosphorus; cot – cotyledons; hipo – hypocotyl).

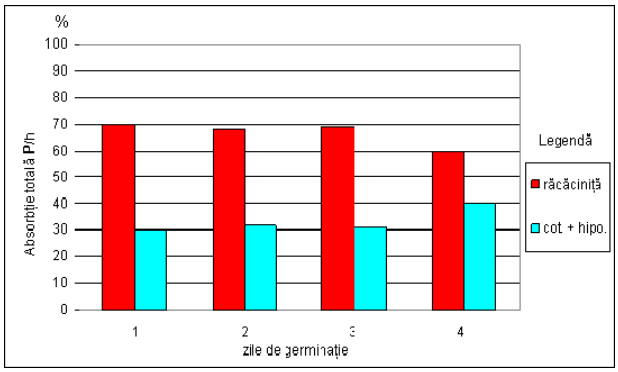

Fig. 3. Expressing in percentage values of the total absorption capacity of **P** in the organs of sunflower (*Helianthus annuus*) seedlings, found in the first 4 days of germination, related to the respective parameter recorded for the entire seedling; reference data considered 100% (abbreviations: P – phosphorus; cot – cotyledons; hipo – hypocotyl).

Studia Universitatis "Vasile Goldiş", Seria Ştiinţele Vieţii
Vol. 23, issue 3, 2013, pp. 395-397

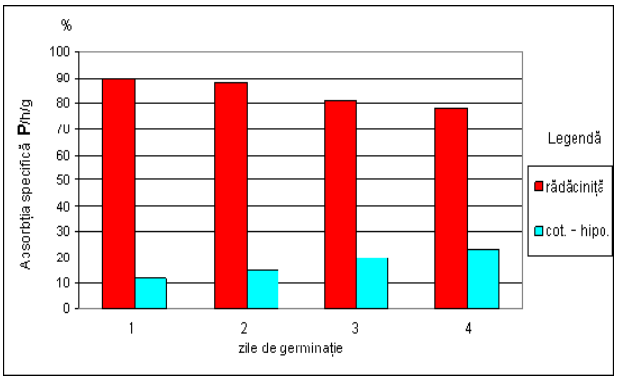

Fig. 4. Expressing in percentage values of the specific absorption capacity of **P** in the organs of sunflower (*Helianthus annuus*) seedlings found in the first 4 days of germination, related to dry weight, compared to the respective parameter per the entire seedling; reference data considered 100% (abbreviations: P – phosphorus; cot – cotyledons; hipo – hypocotyl).

ACKNOWLEDGEMENTS

This work was supported by Structural Funds POSDRU/CPP107/DMI 1.5/S/77082 "Doctoral scholarship complex training in ecoeconomy and bioeconomy for safety, food security and feed from anthropic ecosystems".

REFERENCES

Bajenescu N., Corbeanu S., 1963, Cercetări cu p32 asupra dinamicii absorbţiei fosforului la floarea soarelui. Comunic. Acad. RPR, p. 1 3 7, 629.

Bajenescu N., Corbeanu S., 1966, Studiul procesului de absorbţie a fosforului la porumb cu ajutorul P32. Anal. Inst. De cercet. Pentru cereal şi pl. tehnice Fudulea, Ser.3, p. 3 2, 123.

Giurgiu M., 1966, Absorbţia fosforului în decurs de 24 ore la floarea soarelui, St. şi cerc. Boil. Ser.Bot, p.1 8, 4, 389.

Ivanov E.I., 1957, Izotopii radioactivi ăn medicină şi biologie. Ed. Med. Bucureşti.

Jurbiţkii Z.I., Haun Wey-Nan., 1959, Vlianie nad zemnîh organov rastenîi na pogloscenie p32 kornevoi sistemoi, Fiziol. rast, p. 6, 5, 522.

Pop E., Soran V., Cosma D., 1961, Câteva date privind evoluţia capacităţii de absorbţie a cotiledoanelor. St. şi Cercet. Biol. Cluj, 12, 1, 61. SORAN V., 1959, Cercetari privind dezvoltarea regiunilor absorbante ale sistemului radical şi rolul acestora in absorbţie.-Studii şi cercetări de biologie Cluj, p.2, 241.

Soran V., 1959, Delimitarea regiunilor absorbante ale rădăcinii prin metoda dozării cantitative a coloranţilor vitali absorbiţi şi acumulaţi.-Studii şi cercetări de biologie, Cluj, p.10, 33.

Soran V., 1959, Cercetari privind dezvoltarea regiunilor absorbante ale sistemului radical şi rolul acestora in absorbţie.-Studii şi cercetări de biologie Cluj 10, p.246-266.

Soran V., 1959, Delimitarea regiunilor absorbante ale rădăcinii prin metoda dozării cantitative a coloranţilor vitali absorbiţi şi acumulaţi.-Studii şi cercetări de biologie, Cluj.10, p.33-50.

Soran V., 1960, Cercetari privind dezvoltarea regiunilor absorbante ale seminţelor în cursul germinaţiei, Stud.şi cercet. de Biologie (Cluj), 1960, 1 1, 1, 41 cu sistemul radical dezvoltat). Lucrare de dizertaţie, Univ. Babeş-Bolyai Cluj, fac. St.Naturale.

Soran V., 1962, Insemnătatea rădăcinii ca organ absorbant al plantelor superioare.-Natura-seria biologie, Nr.3, p.17-23.