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# Contributions to the Knowledge of Synanthropic Flora from The Pitesti Area

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**Abstract.** The research of the synanthropic plant species characteristics from the urban environment offers information about their relation with the anthropic environment, on one hand, and on the other hand, they can be used as indicators of the pollution level**.** The research was performed in the city of Pitesti from June 2008 to may 2009, to compile an inventory of the flora, to establish the biological and ecological spectrum, the phytogeographic elements and their economic importance. The fresh above ground phytomass of the synanthropic species from 22 sample locations, was determined. The dry matter, the total nitrogen and phosphorus content, for six species of the dominant synanthropic plants, were also determined. It was identified 214 species of 38 families. The biological and ecological spectra show the high percentages of hemicryptophytes (35%), eutrophic species (54%), xeromesophilous-mesophilous species (29%) as well as eurytherm (20%) and euryacide species. The phytogeographic spectrum shows a high number of species from Eurasia (96 species). From the total number of identified species, 54% are polyploid and 27% present economic importance. It was found that the phytomass from stationaries varies between 281.7 g $m^{-2}$ and 21.5 g $m^{-2}$, for a number of 35 species. The highest dry matter content (64.01%) was recorded in *Conyza canadensis*, the highest value of N (8,200 ppm) in *Lactuca serriola* and the highest total P content (301.5 ppm) in *Erigeron annuus.* The results enable us to estimate the value of the synanthropic plants as ecologic indicators in the Pitesti area.

**Keywords:** life forms, phytogeographic elements, ecological groups, alien plants, phytomass

## INTRODUCTION

Pitesti the capital of the Arges County is located in Romania’s central-south (North-West of Muntenia), at the confluence of the rivers Arges and Doamnei, the Pietmont Cotmeana and the Pitesti planes, and the intersection point of the 45°51'30" parallel Nordic latitude with the 24°52'30" meridian East longitude (the 45° parallel Nordic latitude is passing through Merisani, a village located 12 km north of Pitesti). The altitude of Pitesti is between 256 m (South) and 316 m (West). In North-West the terrace Trivale-Papucesti there are 373 m altitude and in the East the Valea Mare-Podgoria 406 m altitude. (West-North-West of the village Mica/Bascov the highest point is at 493 m) The city’s center extended gradually on the right side of the river Arges, NW and SE on about 12 km between Bascov and Prundu. Pitesti has a continental-temperate climate with vast water resources connected to the river Arges and the antrophic lakes of Bascov and Budeasa. The soil in the Pitesti area are submountain as the city is located in an area of transition from hilly with brown, forest clayey-illuvial luvisols soils to low hilly soils – high plains with pseudogleic soils. In the city, the dominant soil is luvisol and relatively fertile. On the high planes of Pitesti the predominant soil is luvisol while in the Arges basin the soil is alluvial, compacted, permeable and fertile (Miu, 2006).

The climate diagram (Fig. 1) reveals that, at the city's level, for the 1969-2009 period the absolute minimum temperature was -24.4°C and the absolute maximum 38.8°C; the average minimum of the coldest month was -5°C and the average maximum of the warmest month was 27.5°C; the multiannual daily average was 11.5°C. The multiannual monthly average for precipitations was 663.3 mm.  The rainfall excedent had values of 109 mm while its deficit reached 151 mm.

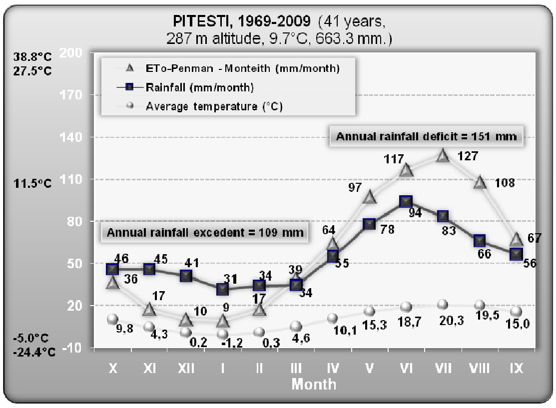


Fig. 1 Climate diagram for Pitesti (1969-2009; 41 years record)

The life of plants is in many ways influenced by the human activity. In the urban environment, the synanthropic plants can be found in various places such as green spaces, abandoned sites, around tress parking lots, walls fences, railways and sidewalks. The study of synanthropic plants in the urban environment represents an important objective considering that, on one hand, those species can offer information about their relationship with their living environment, about their capacity to adapt to the conditions of the urban ecosystem and to produce an offspring better adapted to the environment, and on the other hand, they can be good atmospheric pollution indicators. The practical applications of similar studies include the urban zone management with respect to nature preservation in the urban environment and the employment of synanthropic plants as bio-indicators in the urban environment monitoring (Cilliers and Bredenkamp, 2000; Chylinski and Fornal, 2005; Silc and Kosir, 2006). The aim of the present paper is to present the floral inventory of the synanthropic species at the Pitesti level, to establish the life forms, the phytogeographic elements and that of the ecologic categories according to climate factors – temperature, light, water – and edaphic factors – chemical elements, soil reaction.  This enables us to estimate the value of the synanthropic plants as ecologic indicators in the Pitesti area.

## MATERIALS AND METHODS

The research was performed during June 2008 – May 2009 and was carried out in two phases, one in the field and one in the laboratory. During the first phase in-field research was conducted from June to October 2008 and March to May 2009 to identify the synanthropic species in various phenological phases, collecting botanical material to confirm and/or identify its class in the laboratory conditions. During the second phase, the species identification was concluded – according to Ciocarlan (2000) and Popescu and Sanda (1998) - the vascular flora was catalogued, and the results from the work of both phases were interpreted. The synanthropic plants were listed by order and family following the "Romanian Flora" guidelines (Ciocarlan, 2000), each species being followed by a series of biological, phytogeographic and ecologic indicators having listed the place and the collection date, the number of chromosomes, its economic importance and its degree of presence in Pitesti. The fresh above ground phytomass of the synanthropic plants from the 22 locations were determined with a one square meter metric frame. The plants were then grouped by species and their weight has been recorded. For six synanthropic species - *Conyza canadensis* (L.) Cronq., *Cichorium intybus* L., *Erigeron annuus* (L.) Pers., *Echinochloa crus-galli* (L.) Beauv., *Lactuca serriola* Torn. and *Polygonum aviculare* L. – which are dominant in the probe areas in the city, it was determined the dry matter content (%) and the total N (ppm) and total P (ppm) from fresh substance. To determine the dry matter content was employed a method which by drying the plant to 105°C the plant's humidity level was established. To determine the total N content the Kjeldahl method was used and by digesting with $H_2SO_4$ and $HNO_3$ it was determined the total P; than was used the field photometer LASA 100 AGRO. The statistic method applied to process the data was the variance analysis for monofactorial experiments while the Duncan test (α=0.05 confidence level) was used to establish statistical confidence.

## RESULTS AND DISCUSSION

Following the research were identified a number of 214 synanthropic plant species. Species were from 26 orders and 38 families and the family grouping is presented in fig. 2. Most species were from the following families: Asteraceae (42 species), Poaceae (23 species), Brassicaceae (18 species), Fabaceae (18 species) şi Lamiaceae (11 species). Other families were present with a smaller number of species (2-4) or even a single species (9 families) (Fig. 2). When analyzed from their life expectancy, was found that 77 species (36%) are annual, 14 species (7%) are biennial and 99 species (46%) are perennial. The remaining species (11%) were either annual-biennial (6%), annual-biennial-perennial (1%) or biennial-perennial (2%) (Fig. 3).

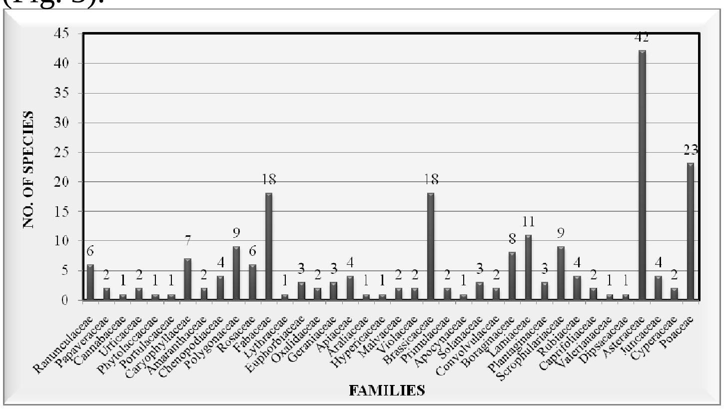


Fig. 2. Synanthropic plants classification by family

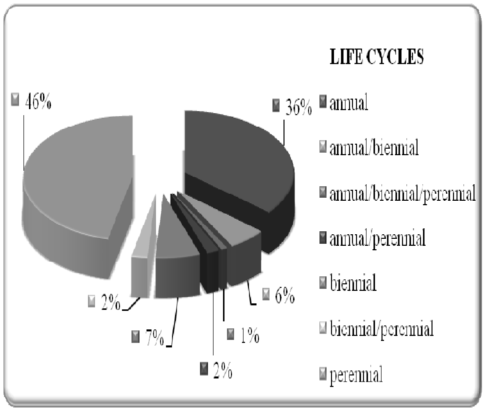


Fig. 3. Synanthropic plants classification by life cycle

The general classification of the identified synanthropic plants by the biological criteria was done using the Raunkiaer system which considers the temperature factor - the minimum temperatures during the year – (Anghel, 1971). In this system the main criteria used to establish the groups is the plants adaptability to the unfavourable condition for vegetation, which is to say, the mode in which the seed and the sprouts survive through the winter – the coldest months of the year (Chirila, 2001). The biological spectrum (that of the biform) for the researched area shows that most species were hemicryptophytes (35%) and therophytes (25%)

while the geophytes and the hemitherophytes representing 7% each while the chamaephytes making up only 2% of the total identified species. The other species are characterized as beeing hemitherophyte-hemicryptophyte (3%), therophyte-hemicryptophyte (2%) and therophyte- hemitherophyte (17%, Fig. 4).

Following the phytogeographic criteria, which makes reference to the geographic territory in which those plants can be found spontaneously, the plant species identified belong to the following categories of elements: European (61%), continental (8%), balkanic (1%), Atlantic (1%), Mediterranean (9%), adventives (5%) and cosmopolites (15%). Among the phytogeographic elements were identified 96 species from Eurasia, which are predominant, while the Pontic-Mediterranean species, Atlantic-Mediterranean species, Pontic species, Pontic-Balkanic species plants were rare (Fig 5).

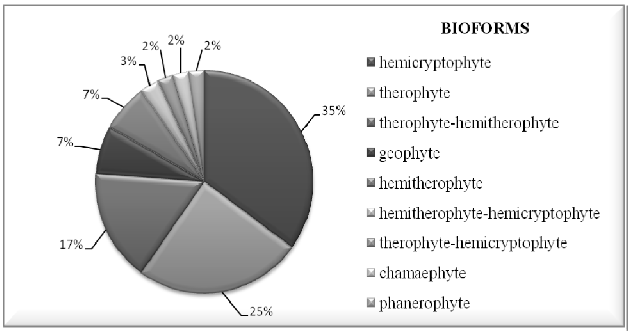


Fig. 4. Synanthropic plant species classification by their life form

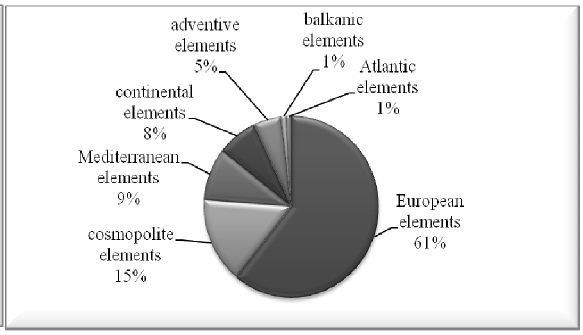


Fig. 5. Synanthropic plant species classification by their area of origin

Among the species of synanthropic plants identified found representatives of foreign species (alien plants) both archaeophytes – plants introduced to Europe before 1492 – as well as neophytes – plants introduced to Europe, brought from other continent, after 1492. Among the archaeophytes found were: *Agrostemma githago* L., *Cardaria draba* (L.) Desv., *Lamium amplexicaule* L., *Polygonum aviculare* L., *Sonchus arvensis* L., *Sonchus oleraceus* L., *Setaria viridis* (L.) Beauv., *Setaria pumilla* (Poiret) Schultes (Morariu, 1943, quoted by Chirila, 2001). From the neophytes, the most notable are: *Amaranthus retroflexus* L., *Ambrosia artemisiifolia* L., *Conyza canadensis* (L.) Cronq., *Erigeron annuus* (L.) Pers., *Galinsoga parviflora* Cav., *Xanthium italicum* Moretti, *Xanthium strumarium* L. . Two archaeophytes – *Cardaria draba* (L.) Desv. and *Portulaca oleracea* L.– are considered invasive species (Anastasiu and Negrean, 2005), as well as from the neophytes: *Conyza canadensis* (L.) Cronq., *Erigeron annuus* (L.) Pers., *Ambrosia artemisiifolia* L. and *Xanthium italicum* Moretti. *Agrostemma githago* L. is found on the Red List published for Romania (Anastasiu and Negrean, 2005).

The synanthropic plant species were analyzed by their ecologic criteria, in which case the species reaction to the main ecological factors was considered. By their ratting on the trophic scale the identified plants belong to the following categories: eutrophic (54%), mesotrophic (15%), oligotrophic (6%) and euritrophic species (3%). Other species were considered eutrophe-mesotrophe (8%), mesotrophe-eutrophe (7%) or oligotrophe-mesotrophe (3%) (Fig. 6).

As far as the synanthropic plant species classification by their water needs, using the Ellenberg humidity scale with 7 grades ($U_1$-$U_6$, $U_0$), were observed that of 27 species (13%) are xeromesophytes and 6 species (3%) are mesoxerophytes ($U_2$), 39 species (19%) are mesophytes ($U_3$), 8 species (4%) are mesohygrophytes ($U_4$), 4 species (2%) are hygrophytes

($U_5$) and 5 species (2%) show a large amplitude against the soil humidity. As placing a species in a category is at times difficult – given the fact that many species have either a great demand for water or the ability to resist water excess (Chirila, 2001) – the remaining species are characterized as xeromesophilous-mesophilous (60 species; 29%), mesophilous-mesohygrophilous (30 species; 15%) or other types that outline the high degree of adaptability of the synanthropic plants to humidity in the various urban environments (Fig. 7).

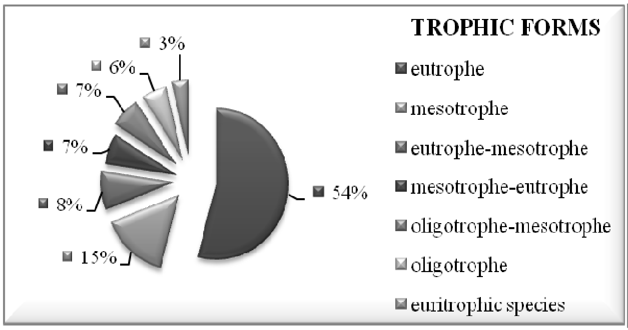


Fig. 6. Synanthropic plant species classification by their trophic scale

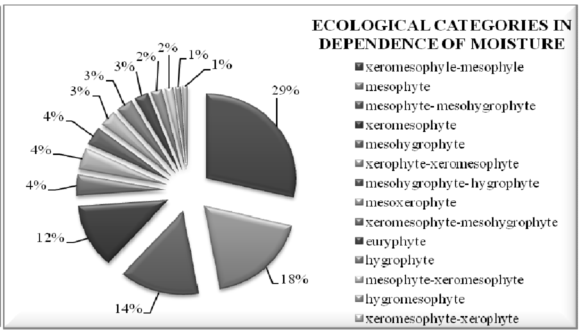


Fig. 7. Synanthropic plant species classification by their humidity scale

With respect to their N need or their adaptation degree to the presence of this element, 68 of the identified synanthropic plant were nitrophytes. Species were classified according to Ellenberg's six grades scale for N. Most species (21%) belong in the $N_3$ category – species which grow on soils with a moderate N content – 17% to the $N_4$ category – species which grow on soils rich in N - 15% to the $N_2$ category – species which grow on soils with low N content – 4% to the $N_5$ category – species which grow on soils with very rich N content and 2% to the $N_1$ category – species which grow on soils with poor N content. As the degree of adaptability of a species to the presence of N can vary, the remaining nitrophilic plant species belong to the following categories: $N_{1-2}$, $N_{2-3}$, $N_{3-4}$, $N_{4-5}$ (Fig. 8). By other ecologic characteristics analyzed (such as the Ca soil content) was observed that 18 species are calcicoles/calciphytes and 9 are calcifuges. Among the plant species analyzed were identified 12 species of halophile, tolerable and facultative plants. The plant species classification on the scale by the acidity (pH level) shows that around 37% of those species are euryacide**,** around 19% are acidophytes and 6% are neutrophytes; other species are characterized as acid-neutrophilic, neutro-basophilic or acidophilic-alkalophilic – the species affinity to a certain degree of acidity or alkalinity is quite relative (Chirila, 2001). With respect to the light factor (the light scale), most synanthropic plant species are heliophytes and heliosciophytes and by their temperature factor (the heat scale) most plants are eurytherms (20%).

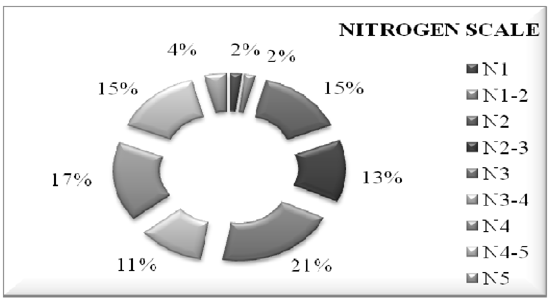


Fig. 8. Synanthropic plant species classification by their N scale

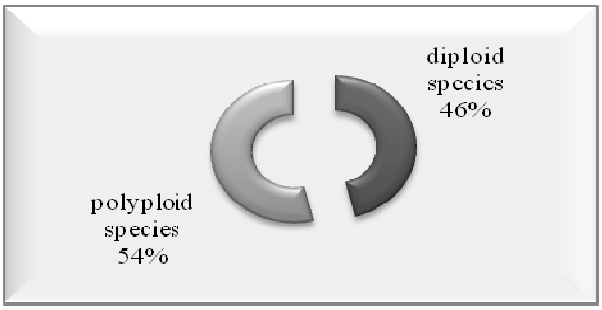


Fig. 9. Synanthropic plant species classification by their degree of polyploidy

By their degree of polyploidy, the synanthropic plant species polyploid (54%) were more numerous than the diploid species (46%) which seem more adapted to the urban environment (Fig. 9).

By their economic importance, many of the identified synantrophic plant species are important medicinal (26 species), some can serve as animal feed (12 species), other are toxic (12 specii), tinctorial (9 species), ornamental (8 species), melliferous (6 species) and nutritious (6 species) (Fig. 10). Although some synanthropic plants might have some economic values, most are unwanted and must be eradicated. There are over 40 types of pollen from those plants that can induce allergies. In the spring and the beginning of the summer many of the following allergies can be induced by the plants: *Urtica sp., Plantago sp.*, *Artemisia absinthium* L., *Artemisia vulgaris* L., *Ambrosia artemisiifolia* L. etc.

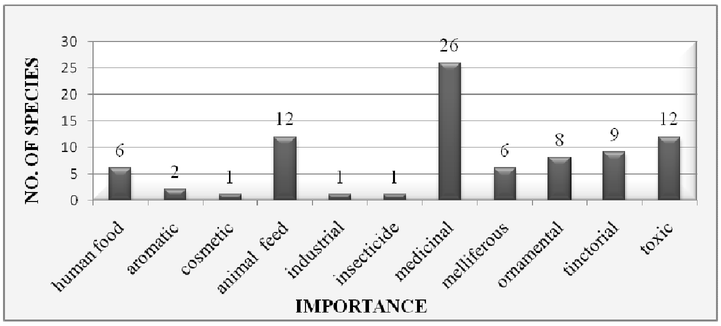


Fig. 10. Synanthropic plant species classification by their economic importance

The fresh above ground phytomass of the synanthropic plants oscillated between 281.7 g $m^{-2}$ şi 21.5 g $m^{-2}$ for a number of 35 species. The dominant species (through their phytomass) in the 22 sample locations were, as follows: *Lolium perenne* L., *Hordeum murinum* L., *Cichorium intybus* L., *Malva sylvestris* L., *Cirsium arvense* L., *Polygonum aviculare* L., *Lactuca serriola* Torn., *Conyza canadensis* (L.) Cronq., *Achillea millefolium* L., *Erigeron annuus* (L.) Pers., *Elymus repens* (L.) Gould (of which 3 species of grasses-Gramineae). All of these are eutrophic and mesophilous or xeromezophilous species; 8 of them are nitrophytes; 4 species are important medicinal and 3 species are important as animal feed (fodder) (Fig. 11).

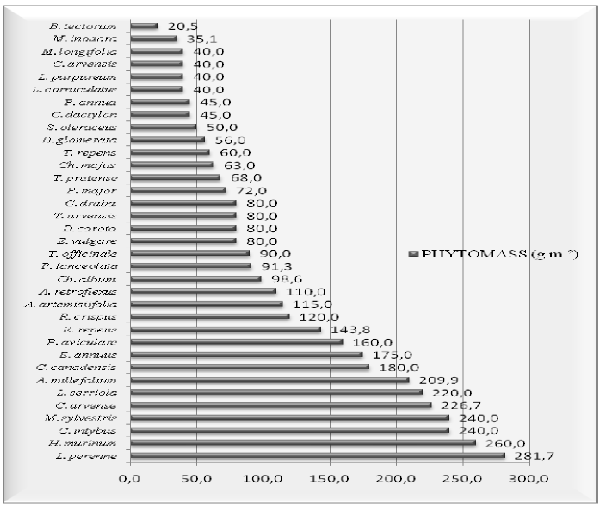


Fig. 11. Average synanhropic plants phytomass variations in 22 sample locations in Pitesti

There were 12 operations to determine the content in dry matter, the total nitrogen (N) and phosphorus (P) from six dominant synanthropic plant species in Pitesti: *Conyza canadensis* (L.) Cronq., *Cichorium intybus* L., *Erigeron annuus* (L.) Pers., *Echinochloa crus-galli* (L.) Beauv., *Lactuca serriola* Torn and *Polygonum aviculare* L. .

From fig. 12 it can be noticed that *C. Canadensis* has the highest dry matter content (64.01%) followed by *P. aviculare* (49.9%), with the differences between those two and the following in the group beeing quite semnificative. Next follow the species *L. serriola* (42.56%), *E. annuus* (41.26%) and *C. intybus* (40.73) which are quite homogenous in dry matter content and the lowest on the scale was found to be *E. crus-galli* (26.69%) with a semnificantly lower percentage than the rest of the species.

With respect to the total N content (ppm) from fresh substance, from fig. 13 it was observed that the highest determined value was for *L. serriola* (8,200 ppm), significantly different from the other species and the lowest value was recorded for *C. intybus* (1,336 ppm); the total N in *E. canadensis*, *P. aviculare* and *E. crus-galli* had minor variations but quite different from that of *E. annuus* were the total N in raw substance was 3,400 ppm.

In fig. 14 the highest total P was determined for *E. annuus* (301.5 ppm), a value that stands quite apart from the other plant species which therefore can be grouped, based on their homogeneity, in their own class. The lowest total P was determined for *E. crus-galli* (64.5 ppm).

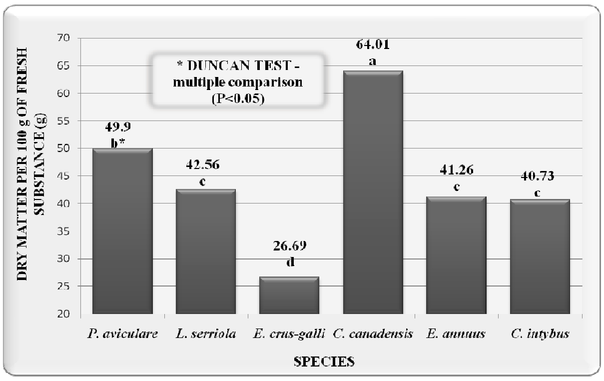


Fig. 12. Dry matter variance at different synanthropic plants

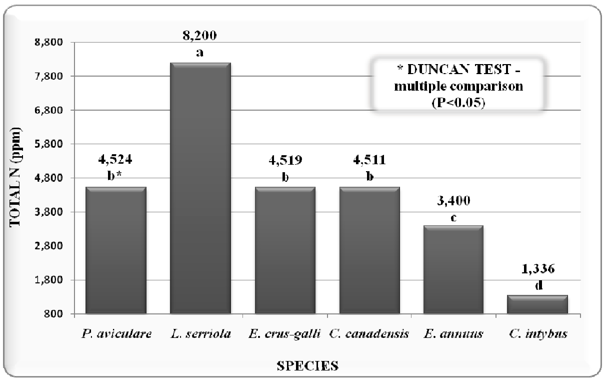


Fig. 13. Total N content variance from fresh substance at different synanthropic plants

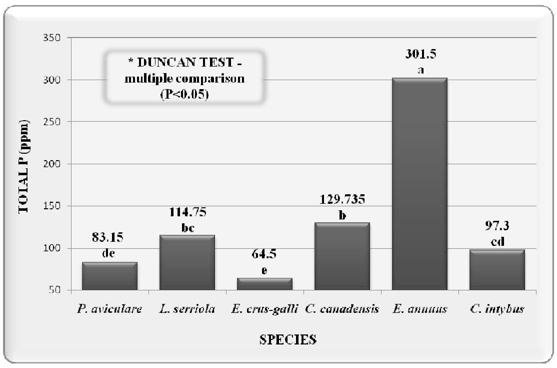


Fig. 14. Total P content variance from fresh substance at different synanthropic plants

## CONCLUSIONS

Following our research were identified in Pitesti a number of 214 synanthropic plant species. Species were from 26 orders and 38 families. Those species were analyzed from the biologic, phytogeographic and ecologic point of view and the following conclusions were drawn:

- most species were from the following families: Asteracee (42 species), Poaceae (23 species), Brassicaceae (18 species), Fabaceae (18 species) and Lamiaceae (11 species)
- were found that 77 species (36%) are annual, 14 species (7%) are biennial and 99 species (46%) are perennial;
- most species were hemicryptophyte (35%) and therophytes (25%); 61% of the synanthropic plant species identified were (based on their areal) European and 15% were cosmpolites; from the total number of archaeophytes and neophytes identified, 6 species are considered invasives and one species is on the Red List for Romania;
- on the trophic scale, most species were eutrophe (54%) and mesotrophe (15%); on the humidity scale, the most species were xeromesophilous-mesophilous species (29%); 68 of the synanthropic plant species identified were nitrophytes; based on their pH, heat and light preferences most species were euryacide (37%), eurytherm (20%), heliophytes and heliosciophytes;
- the synanthropic plant species polyploid were more numerous (54%) than the diploid species (46%); 58 species had an economic importance;
- the fresh above ground phytomass of 35 synanthropic plants from 22 sample locations varied from 281.7 g $m^{-2}$ for *L. perenne* to 20.5 g $m^{-2}$ for *B. tectorum*
- highest dry matter content was recorded on *C. canadensis* (64.01%), followed by *P. aviculare* (49.9%); the highest total N determined was for *L. serriola* (8,200 ppm) which was quite detached from the rest of the plants; the highest total P was found in *E. annuus* (301.5 ppm) also standing apart from the group.

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