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BRYOPHYTES ON THE LOWER COURSE OF THE PRAHOVA RIVER

ALEXANDRINA DIHORU

The seventy five species of Bryophytes identified within the vegetation surrounding the lower course of the Prahova river have been characterized in terms of substrate and their neighbouring plant species; these are two ecological parameters determined by the author. They are generally common species of particular chorological interest for Romanian bryoflora.

During some extended researches of the vegetation inhabiting the lower course of the Prahova river, carried out during 1969—1975, we have collected among others Bryophytes whose identification was reviewed by the late professor T. Ștefureac. On that specific area, located between the village of Brătășanca and the confluence of the Prahova and Ialomița rivers, two species of Bryophytes are mentioned (Radian 1901, Papp 1938).

Bryophytic flora is not very rich in species and populations within riverside ligneous vegetation (Cls. *Salicetea purpureae*), unlikely that of the mixt forests, more evolved (Cls. *Querco-Fagetea*), and are often to be found only in the gametophytic stage due to the floods, which makes species identification very difficult.

The Bryophytes we shall enumerate are from the following localities:

- | | | |
|---------------------------------|-----------------------|---------------|
| I. Brătășanca | VI. Patru Frați | XI. Stăncești |
| II. Confluence-Prahova-Ialomița | VII. Pădurea Malului | XII. Stejaru |
| III. Crângul lui Bot | VIII. Pucheni-Moșneni | XIII. Tinosu |
| IV. Drăgănești | IX. Predești | XIV. Tufani |
| V. Hătcărău | X. Românești | XV. Zăhanaua |

Enumeration of Bryophytes¹

a. Cls. *HEPATICOPSIDA*

1. ***Aneura pinguis*** (L.) Dum.: VIII, XI, *terricolous*, cohabits with 16, 18, 22, 32, 33, 37, 41.

2. ***Frullania dilatata*** (L.) Dum.: III, VIII, X, XII, XIII, *corticolous*, cohabits with, 3, 5, 6, 9, 12, 14, 22, 48, 49, 60, 74.

3. ***Lophocolea heterophylla*** (Schr.) Dum.: X, XIII, *saprolignicolous*, cohabits with 2, 5, 10, 12, 22, 43, 48.

¹ — The Roman figures show the localities from which various species were sampled; the Arab figures show the alphabetical order. The sign * shows species with sporogonium sampled in the respective localities.

4. *Pellia endiviifolia* (Dicks.) Dum.: VIII, IX, XI, *terricolous*, cohabit with 10, 16, 18, 21, 26, 37, 41, 61, 62.

5. *Porella platyphylla* (L.) Pfeiff.: X, *corticolous*, cohabit with 2, 3, 9, 12, 22, 48.

6. *Radula complanata* (L.) Dum.: III, IX/XIII*, XII, *corticolous* (on *Quercus robur* and *Tilia tomentosa*), cohabit with 2, 9, 10, 11, 14, 20, 22, 31, 44, 48, 49, 50, 58, 60, 64; XIII, *saprolignicolous*, cohabit with 13, 64.

b. Cls. *BRYOPSIDA*

7. *Abietinella abietina* (Hedw.) Fleisch.: III, *terricolous*, cohabit with 25, 26.

8. *Amblystegium juratzkanum* Schimp.: X, XIII, *saprolignicolous*, cohabit with 10, 22.

9. *Amblystegium serpens* (Hedw.) B.S.G.: III*, IV, X, XI*, XII* XIII, *corticolous*, often at the base of trees (*Quercus pedunculiflora*, *Tilia tomentosa*), cohabit with 2, 5, 6, 10, 16, 18, 21, 23, 48, 49, 60, 64, 66, 75; VIII*, IX, *saprolignicolous*, cohabit with 28, 32, 36, 64; *terricolous*, cohabit with 10, 16, 18, 21, 27, 30, 37, 40, 42, 61.

10. *Amblystegium varium* (Hedw.) Lindb.: IV*, XI*, XII*, XIII, *terricolous*, cohabit with 4, 9, 16, 18, 21, 27, 33, 41, 62; III*, VIII*, X*, XIII*, *saprolignicolous* (on stumps and knots), cohabit with 3, 8, 9, 14, 21, 22, 23, 28, 43, 48, 50, 60, 64; IX*, X*, XIII*, *corticolous* (especially on *Fraxinus angustifolia* subsp. *danubialis*), cohabit with 6, 14, 21, 22, 28, 48, 50, 55, 58, 59, 64.

11. *Anomodon attenuatus* (Hedw.) Hüb.: IX, X, XII, *corticolous*, cohabit with 6, 14, 21, 22, 48, 58, 60, 64.

12. *Anomodon longifolius* (Schleich.) Bruch: X, *corticolous*, cohabit with 2, 3, 5, 21, 22, 48; XIII, *saprolignicolous*, cohabit with 10.

13. *Anomodon rugelii* (C. Müll.) Keissl.: XIII, *saprolignicolous*, cohabit with 6, 60.

14. *Anomodon viticulosus* (Hedw.) Hook. & Tayl.: IX, XII, XIII, *corticolous* (on *Quercus robur*, *Fraxinus angustifolia* subsp. *danubialis*), cohabit with 6, 10, 11, 21, 22, 48, 50, 55, 60, 64; XIII, *saprolignicolous* (on rotten knots), cohabit with 64.

15. *Atrichum undulatum* (Hedw.) Beauv.: II (Papp 1938), IX–XIII, XII*, *terricolous*, cohabit with 19, 22, 23.

16. *Barbula fallax* Hedw. (= *Didymodon fallax* (Hedw.) Zand.): I*, VII, XI*, *terricolous* (often on nude soil), cohabit with 4, 9, 10, 18, 21, 22, 26, 28, 32, 33, 34, 36, 37, 38, 39, 41, 62, 64, 65, 66, 75.

— var. *brevifolia* (Brid.) Schultz: VIII, *terricolous*, cohabit with 18, 37.

17. *Barbula hornschiehiana* Schultz (= *Pseudocrossidium hornschiehianum* (Schultz) Zand.): IV–XIV, *terricolous*, cohabit with 18, 25, 26, 37.

18. *Barbula unguiculata* Hedw.: I, II*, IV, IV/XIV, V, VIII*, XI, XIV, XV, *terricolous* (often on raw substrate), cohabit with 1, 4, 10, 16, 17, 22, 24, 25, 26, 28, 32, 33, 38, 39, 41, 42, 57, 62, 63, 75; *terri-corticolous* (on the base of trees) cohabit with 9, 16, 66, 75.

19. ? *Brachythecium mildeanum* (Schimp.) Schimp.: IV, XII, *terricolous*, cohabit with 15, 40.

20. *Brachythecium populeum* (Hedw.) B.S.G.: IX/XIII*, X, *corticolous* cohabit with 6, 10, 20, 22, 47, 64.

21. *Brachythecium rutabulum* (Hedw.) B.S.G.: VIII, X*, XIII*, *saprolignicolous*, cohabit with 9, 10, 21, 22, 47; IX, X, XIII, *corticolous* cohabit with 10, 11, 12, 14, 19, 21, 22, 43, 58, 64; IV*, IX, XI*, XIII, *terricolous*, cohabit with 4, 10, 16, 20, 32, 33, 34, 35, 36, 38, 40, 43, 61.

— var. *robustum* B.S.G.: XIII, *saprolignicolous*, cohabit with 10; XI, *terricolous*, cohabit with 30, 35, 40.

— var. *flavescens* B.S.G.: VIII, *terricolous* (on raw substrate), cohabit with 9, 16, 36.

22. *Brachythecium salebrosum* (Web. & Mohr) B.S.G.: III*, IX/XII*, X*, XI*, XII*, *terricolous*, cohabit with 1, 15, 16, 18, 23, 32, 33, 40, 60; III*, IV, VIII, IX, X*, XII, XIII*, *corticolous* (on *Salix alba*, *Tilia tomentosa*, *Fraxinus angustifolia* subsp. *danubialis*), cohabit with 2, 3, 5, 6, 10, 11, 12, 14, 21, 23, 27, 38, 47, 48, 49, 58, 60, 64; VIII*, X*, XIII, *saprolignicolous*, cohabit with 3, 10, 20, 27, 47, 60, 64.

Note. On the humid soils, with *Carex acutiformis* (X), the plants have ovate, concave pseudoparaphyles quickly narrowed in recurved acumen (notice especially the first pseudoparaphylle).

— var. *eurhynchioides* Warnst.: X*, *saprolignicolous*, cohabit with 10, 21, 47.

Note. Stem leaves are smaller and almost uniplicate

— var. *homomallum* Roth: IV, *corticolous*

Note. It has a lot of rhizoids and stem leaves $\pm$ falcate.

23. *Brachythecium velutinum* (Hedw.) B.S.G.: III, X*, *corticolous* (on *Tilia tomentosa* etc.), cohabit with 9, 11, 19, 21, 22, 27, 47, 58, 64; XIII*, *saprolignicolous*, cohabit with 10; IX–XIII, XI*, *terricolous*, cohabit with 15, 22, 33.

24. *Brachythecium* spp.: IX/XIII, *terricolous*, cohabit with 41.

25. *Bryum argenteum* Hedw.: II*, III, V, VI, XI, XIV, XV, *terricolous* (often on raw substrate), cohabit with 7, 17, 18, 24, 26, 37, 38, 42, 57, 61.

26. *Bryum caespitium* Hedw.: II, III, IV/XIV, V, VI, XI, XV, *terricolous* (often on raw sandy soil of the Prahova river banks), cohabit with 1, 4, 7, 9, 16, 17, 18, 25, 37, 38, 41, 42, 63, 64, 65.

27. *Bryum capillare* Hedw.: XII, *terricolous*, cohabit with 9, 10.

Note. It may have also been *B. flaccidum*, but with the propagules not yet formed, or unnoticed by us. Some contemporary authors still use *B. capillare* var. *flaccidum* (Brid.) B.S.G., while other separate it as species, *B. flaccidum*.

28. *Bryum flaccidum* Brid.: III, VII, IX, X, XIII, *saprolignicolous*, cohabit with 9, 10, 22, 43, 48, 60, 64, 70; III, IX, XIII*, *corticolous* (on *Quercus pedunculiflora*, *Fraxinus angustifolia* subsp. *danubialis*, *Tilia tomentosa*), cohabit with 9, 10, 22, 23, 44, 48, 50, 72; VIII, IX, *terricolous* (on raw soil), cohabit with 9, 16, 18, 36, 38, 39, 41.

Note. The systematic position of this taxon is open to discussions.

29. *Bryum* spp.: XI, *terricolous*, cohabit with 32, 33, 41.

30. *Calliergonella cuspidata* (Hedw.) Loeske: VIII, XI, *terricolous* cohabit with 9, 18, 41, 61, 64.

31. *Camptothecium lutescens* (Hedw.) B.S.G. var. *fallax* (Philib.) Breidl.: XI, XIII, *terricolous*, cohabits with 21, 22, 33, 41, 44, 73; IX/XIII, XIII, *corticolous* (on *Quercus robur*), cohabits with 6, 21, 44, 48.

32. *Campylium chrysophyllum* (Brid.) J. Lange: I, VIII, XI*, *terricolous*, cohabits with 1, 16, 18, 21, 22, 29, 33, 34, 36, 37, 39, 41; VIII*, *saprolignicolous*, cohabits with 9.

33. *Campylium sommerfeltii* (Myr.) J. Lange: XI*, XIII, *terricolous*, cohabits with 1, 10, 18, 21, 22, 23, 29, 32, 39, 41, 44, 58; XIII, *corticolous* (on *Fraxinus angustifolia* subsp. *danubialis*) cohabits with 64.

Note. The species is not yet certainly limited from *C. calcareum* Crundw. & Nyh.

34. *Campylium stellatum* (Hedw.) J. Lange & C. Jens.: XI, *terricolous*, cohabits with 16, 21, 32, 36, 37, 39, 41.

35. *Ceratodon purpureus* (Hedw.) Brid.: VII, *terricolous*

36. *Cratoneuron filicinum* (Hedw.) Spruce: XI, *terricolous* (humid soil), cohabits with 16, 21, 32, 34, 37, 39, 41.

— f. *trichodes* (Brid.) Mönk.: *terricolous* (rotten bark on the soil), cohabits with 9, 28, 41, 64.

37. *Dicranella varia* (Hedw.) Schimp.: II*, IV/XIV, VI*, VIII*, XI*, *terricolous* (often on raw, sandy soil), cohabits with 1, 4, 9, 16, 18, 21, 25, 26, 29, 38, 41, 58, 17, 32, 34, 36, 39, 61.

38. *Didymodon tophaceus* (Brid.) Jur.: VI, VIII, XIV, *terricolous* (on raw soil), cohabits with 16, 18, 25, 26, 28, 37, 39, 61.

39. *Eurhynchium hians* (Hedw.) Sande Lac. (= *E. swartzii* (Turn.) Curn.): III, IV, VII/XII, VIII, IX, XI, XIII*, *terricolous* (sometimes on raw soil), cohabits with 10, 16, 18, 21, 28, 32, 33, 34, 36, 37, 38, 41, 58; XIII*, *saprolignicolous* (advanced putrefaction); VIII, *corticolous* (on the base of *Salix alba*), cohabits with 22.

40. *Eurhynchium speciosum* (Brid.) Jur.: VIII*, XI*, XIII*, *terricolous* (sometimes on more humid soil), cohabits with 9, 41, 47, 61.

— f. *tenellum* Podp.: XIII, *terricolous*.

41. *Fissidens taxifolius* Hedw.: III, IV, VIII, IX, IX/XIII, XI, XIII, *terricolous* (on raw substrate, usually nude), cohabits with 1, 4, 9, 10, 16, 18, 21, 22, 26, 30, 32, 33, 34, 36, 37, 39, 58, 61, 62, 64, 65, 75; IX, *saprolignicolous* (advanced putrefaction), cohabits with 9, 28, 36, 64.

42. *Funaria hygrometrica* Hedw.: XI*, *terricolous* (raw substrate), cohabits with 18, 25, 26, 62.

43. *Herzogiella seligeri* (Brid.) Iwats.: XIII*, *saprolignicolous*, cohabits with 3, 9, 28.

44. *Hypnum cupressiforme* Hedw.: XI, *terricolous*, cohabits with 21, 33, 41.

— var. *resupinatum* (Tayl.) Schimp.: III, IX/XIII, *corticolous* (on *Quercus robur*, *Q. pedunculiflora*), cohabits with 6, 9, 28, 31, 48.

45. *Isotheceium alopecuroides* (Dubois) Isoy.: XII, *corticolous* (on *Quercus robur*) cohabits with 48, 64.

46. *Leptodietyum kochii* B.S.G. (= *Amblystegium humile* (Beauv.) Crundw.): IX, *terricolous* (humid soil).

47. *Leptodietyum riparium* (Hedw.) Warnst. (= *Amblystegium riparium* (Hedw.) B.S.G.): VIII, *terricolous* (humid soil), cohabits with 40.

48. *Leskea polycarpa* Hedw.: III*, IV*, VII, IX*, IX/XIII, X*, XII, XIII, *corticolous* (on *Quercus robur*, *Q. pedunculiflora*, *Tilia tomentosa*, *Fraxinus angustifolia* subsp. *danubialis*), cohabits with 2, 3, 5, 6, 9, 10, 11, 12, 14, 20, 21, 22, 23, 24, 28, 31, 44, 49, 50, 55, 58, 60, 72; III*, VIII, X, XI, *saprolignicolous*, cohabits with 9, 10, 21, 22, 23, 28, 33, 44, 50, 60, 64, 72.

49. *Leskeella nervosa* (Brid.) Loeske (= *Pseudoleskeella nervosa* (Brid.) Nyh.): III, XII, *corticolous* (on *Tilia tomentosa* etc.), cohabits with 2, 6, 9, 22, 48, 50, 60, 64.

50. *Leucodon sciuroides* (Hedw.) Schwagr.: X, XII, *corticolous* (on *Tilia tomentosa*, *Quercus pedunculiflora*), cohabits with 2, 6, 9, 22, 28, 44, 48, 49, 55, 60, 64, 72.

51. *Orthotrichum affine* Brid.: XII*, *corticolous* (on *Quercus robur*) cohabits with 64, 74.

52. *Orthotrichum diaphanum* Brid.: XIII*, *corticolous* (leg. R. Wallfisch, verbal communication).

53. *Orthotrichum obtusifolium* Brid. (= *Nyholmella obtusifolia* (Brid.) Holmen & Warucke): XIII, *corticolous* (leg. R. Wallfisch, verbal communication).

54. *Orthotrichum pallens* Brunch ex Brid.: XIII*, *corticolous* (on *Fraxinus angustifolia* subsp. *danubialis*) cohabits with 2, 14, 48, 74.

55. *Orthotrichum pumilum* Sw.: XII*, XIII*, *corticolous*, cohabits with 6, 10, 14, 48, 50, 64.

56. *Orthotrichum speciosum* Nees: XII*, *corticolous* (on *Fraxinus angustifolia* subsp. *danubialis*), cohabits with 6, 22, 48.

57. *Phaseum cuspidatum* Hedw.: XV, *terricolous*, cohabits with 18, 25.

58. *Plagiommium cuspidatum* (Hedw.) Kop.: IX, X*, XII*, *corticolous*, cohabits with 6, 10, 11, 21, 22, 23, 48, 59, 64; X*, XI*, XII*, XIII (Radian 1901), *terricolous*, cohabits with 10, 22, 33, 39, 60.

59. *Plagiothecium nemorale* (Mitt.) Jaeg.: IX, X, XIII, *corticolous*, cohabits with 10, 58.

Note. Narrow decurrence is of 1—2 rows of narrow-rightangled cells. The leaves are acute-toothed at the tip and with loose areolation. Axillary and epiphyllous propagules are observed, the last ones not yet mentioned in literature.

60. *Platydictya subtilis* (Hedw.) Crum: VII*, X/XIII, XII, *corticolous* (on *Quercus robur* etc.), cohabits with 2, 6, 9, 11, 14, 20, 22, 48, 49, 50, 64; X, *saprolignicolous*, cohabits with 10, 22, 28, 47, 60; X, *terricolous*, cohabits with 22, 54.

61. *Pohlia carnea* (Schimp.) Lindb.: VI, IX, XI, XIII, *terricolous* (sometimes on raw soil), cohabits with 4, 9, 21, 25, 30, 37, 38, 40, 41.

62. *Pohlia eruda* (Bruch) Lindb.: IV/XIV, VIII, XI, XIII, *terricolous* (on raw, sometimes sandy soil), cohabits with 4, 10, 16, 18, 26, 29, 37, 41, 42.

63. *Pohlia nutans* (Hedw.) Lindb.: XIII*, *saprolignicolous* (knots of *Alnus glutinosa*).

Note. The nerve tip is dorsally toothed. Paroecious.

64. *Pylaisia polyantha* (Hedw.) Schimp. (= *Pylaisiella polyantha* (Hedw.) Grout): III, VII, IX, IX/XIII*, X, XII, XIII*, *corticolous*

(on *Quercus robur*, *Tilia tomentosa*, *Fraxinus angustifolia* subsp. *danubialis* etc.), cohabits with 2, 6, 9, 10, 11, 14, 20, 21, 22, 23, 48, 49, 50, 55, 58, 60; VIII*, IX, X*, XIII, *saprolignicolous*, cohabits with 6, 9, 10, 13, 14, 22, 28, 36, 41, 48, 60; VIII, XI*, *terricolous*, cohabits with 30, 41, 6, 16, 26.

Note. Monoecious species, usually with sporogonia, erect capsule, opercule with right and very short beak. It is different of *Homomallium incurvatum* (Brid.) Loeske not only by the substrate, usually being corticolous (not saxicolous) but also by the length of the leaves of about 2 mm (not 1 mm) and by the stuffy foliation of the stem (not scarce foliation).

65. *Rhynchostegium confertum* (Dicks.) B.S.G.: XI, *terricolous*, cohabits with 16, 26, 41, 64.

66. *Rhynchostegium murale* (Hedw.) B.S.G.: XI, *terricolous* (tree base covered with soil), cohabits with 9, 16, 18, 75.

67. ? *Schistidium apocarpum* (Hedw.) B.S.G.: VIII, *saxicolous* (on stones).

68. *Streblotrichum convolutum* (Hedw.) Beauv. (= *Barbula convoluta* Hedw.): XI, XV, *terricolous*.

69. *Taxiphyllum wissgrillii* (Garov.) Wijk. & Marg.: XIII, *corticolous* (on *Fraxinus angustifolia* subsp. *danubialis*), cohabits with 14, 48, 50.

70. *Thuidium recognitum* (Hedw.) Lindb.: XIII, *saprolignicolous*, cohabits with 28.

71. *Tortella inclinata* (Hedw.) Limpr.: XII, XV, *terricolous* (raw or sandy soil).

72. *Tortula papillosa* Wils.: III, *corticolous* (on *Quercus pedunculiflora*), cohabits with 9, 28, 44, 48, 50.

73. *Tortula ruralis* (Hedw.) Gaertn.: III, XIII, *terricolous* (arid soil), cohabits with 31.

74. *Ulota crispa* (Hedw.) Brid.: VIII, XII*, *corticolous*, cohabits with 2.

75. *Weisia controversa* Hedw.: I, III, XI, *terricolous*, (sometimes on the soil at the base of the trees), cohabits with 9, 16, 18, 41, 66.

The enumerated species belong to the following families:

Cl. *Hepaticopsida*

Lophocoleaceae: 3; *Radulaceae*: 6; *Porellaceae*: 5;
Frullaniaceae: 2; *Pelliaceae*: 4; *Aneuraceae*: 1.

Cl. *Bryopsida*

Polytrichaceae: 15; *Ditrichaceae*: 35; *Dicranaceae*: 37;
Fissidentaceae: 41; *Trichostomaceae*: 16, 17, 18, 38, 68, 71, 75;
Pottiaceae: 57, 72, 73; *Grimmiaceae*: 67; *Funariaceae*: 42;
Bryaceae: 25, 26, 27, 28, 29, 61, 62, 63; *Mniaceae*: 58;
Orthotrichaceae: 51, 52, 53, 54, 55, 56, 74; *Leucodontaceae*: 50;
Lembophyllaceae: 45; *Leskeaceae*: 48, 49; *Thuidiaceae*: 7, 11, 12, 13, 14, 70; *Cratoneuraceae*: 36; *Amblystegiaceae*: 8, 9, 10, 30, 32, 33, 34, 46, 47, 60; *Brachytheciaceae*: 19, 20, 21, 22, 23, 24, 31, 39, 40, 65, 66; *Plagiotheciaceae*: 43, 59, 69;
Hypnaceae: 4, 64.

If we centralise the species according to the character of the substrate, we can see that almost half of them are terricolous, because the soil remains often completely free after the flood has withdrawn, being thus

favourable for the growth of Bryophytes. The corticolous and saprolignicolous species are evidently fewer expressing, however, the general character of the arborescent vegetation of the meadow (Table 1).

Table 1

Categories of species according to substrate

Character of species	Nr. of species	"
1. Terricolous	31	41.3
2. Corticolous	17	22.7
3. Saprolignicolous	6	8.0
4. Petricolous	1	1.3
1+2	5	6.7
2+3	2	2.7
1+3	4	5.3
1+2+3	9	12.0
Total	75	100

The bryoflora of the lower course of the Prahova river is not only rather poor but also rather common, without rare species or different from the arealogic point of view, most of them belonging to *Trichostomaceae*, *Pottiaceae*, *Bryaceae*, *Orthotrichaceae*, *Thuidiaceae*, *Amblystegiaceae*, *Brachytheciaceae*. The Hepaticae are very scarce in that area.

The present paper provides answers to some chorological necessities regarding the bryoflora of the Romanian Plain on which we have few information.

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¹ Also see DIHORU ALEXANDRINA 1975, *Flora și vegetația zăcărilor din bazinul inferior al Prahovei*. Doctorat thesis, University of Bucharest, Faculty of Biology.

STRUCTURE DES PHYTOCÉNOSES PALUSTRES DU COURS SUPÉRIEUR DE LA VALLÉE DE LA PRAHOVA

V. SANDA, A. POPESCU, GH. ȘERBĂNESCU

The geological substratum, rich in limestone and very permeable, and the drought, more acute as compared to other massifs, determined the fragmentary installation of some paludal phytocenoses on the upper course of the Prahova valley. The paper signals out a number of 8 associations among which *Glycerietum nemoralis* and *Agrostetum gigantei* are new for science. Among the phytocenoses scarcer as spreading in our country we must point out the presence of *Typhetum shuttleworthii* Soó 27 and *Calamagrostictum pseudophragmitis* Beldie 67.

Dans les bassins supérieurs des rivières des montagnes, grâce à la vitesse avec laquelle l'eau des précipitations est entraînée en aval, les céno-
ses palustres sont cantonnées, par fragments en des microdépressions ou
endroits méandreaux où l'eau reste pendant une longue période.

Le substrat géologique, riche en calcaire et très perméable, ainsi que
la sécheresse plus accentuée par rapport aux autres massifs, ont déterminé
la réduction en surface de la végétation palustre au-dessous de 0,5% de
la surface des pâturages du massif Bucegi (6).

Conspectus de la végétation

PHRAGMITETEA Tx. et Prsg. 42

PHRAGMITETALIA W. Koch 26 emend. Pign. 53

Phragmition communis W. Koch 26 emend. Soó 47

1. *Typhetum shuttleworthii* Soó 27

NAȘTURTIO — GLYCERIETALIA Pign. 53

Glycerio-Sparganion Br.-Bl. et Sissing ex Boer 42

2. *Catabroso-Glycerietum plicatae* Br.-Bl. 49

— *catabrosetosum* Soó 57

— *glycerietosum plicatae* Soó 57

MAGNOCARICETALIA Pign. 53

Caricion gracilis (Neuhäusl 59, Bálátova-Tuláčkova 63) Oberd. 67

3. *Caricetum acutiformis-ripariae* Soó (27) 30

— *caricetosum acutiformis* Soó 57

MONTIO-CARDAMINETEA Br.-Bl. et Tx. 43

MONTIO-CARDAMINETALIA Pawl. 28

Cardamini-Montion Br.-Bl. 25

4. *Glycerietum nemoralis* ass. nova

MOLINIO-ARRHENATHERETEA Tx. 37

MOLINIETALIA W. Koch 26

Calthion palustris Tx. 37

5. *Agrostetum gigantei* ass. nova
 6. *Calamagrostietum pseudophragmitis* Beldie 67
 7. *Scirpetum sylvatici* Maloch 35
 8. *Juncetum effusi* Soó (31)49

Analyse de la végétation

1. *Typhetum shuttleworthii* Soó 27 (Tableau 1)

Les phytocénoses de *Typha shuttleworthii* sont connues chez nous seulement de Ceahlău (11) et des Sous-Carpates de Teleajen (4).

Tableau 1

Les phytocénoses de la classe *Phragmitetea*

Numéro du relevé	1	2	3	4	5	6	7	8	9	10
Surface (m ²)	25	100	10	100	100	100	100	100	100	100
Hauteur de la végétation (cm)	210	120	50	40	40	45	50	50	45	150
Recouvrement (%)	85	75	100	95	100	90	100	100	85	100

Caraéristiques aux associations

<i>Typha shuttleworthii</i>	3-4	3-4	-	-	-	-	-	-	-	-
<i>Catabrosa aquatica</i>	-	-	5	4-5	4-5	-	+	-	+	-
<i>Glyceria plicata</i>	-	-	-	+	-	4	5	5	4-5	+
<i>Carex acutiformis</i>	-	-	-	-	-	-	-	-	-	5

Phragmition + Phragmitetea

<i>Myosotis scorpioides</i>	+	-	-	+	-	-	-	-	+	+
<i>Lythrum salicaria</i>	+	+	-	-	+	+	-	-	±	±
<i>Cirsium palustre</i>	-	+	-	-	-	-	-	-	-	-
<i>Veronica anagallis-aquatica</i>	-	-	+	+	+	-	-	-	-	-
<i>Ranunculus repens</i>	-	-	-	+	+	-	+	-	+	-
<i>Epilobium hirsutum</i>	-	-	-	-	-	-	-	-	-	+
<i>Solanum dulcamara</i>	-	-	-	-	-	-	-	-	-	+
<i>Lysimachia nummularia</i>	-	-	-	-	-	-	-	-	-	+
<i>Lycopus europaeus</i>	-	-	-	-	-	-	-	-	-	+
<i>Lysimachia vulgaris</i>	-	-	-	-	-	-	-	-	-	+

Glycerio-Sparganion

<i>Mentha longifolia</i>	+	-	-	-	-	-	-	+	+	+
<i>Veronica beccabunga</i>	-	-	+	+	+	+	-	-	-	-
<i>Epilobium parviflorum</i>	-	-	-	+	-	+	-	+	+	-

Calthion + Agropyro - Rumicion

<i>Agrostis stolonifera</i>	-	+	-	+	-	+	-	-	+	-
<i>Rorippa sylvestris</i>	-	-	+	+	+	+	-	-	-	-
<i>Barbarea vulgaris</i>	-	-	-	+	-	+	-	+	+	-
<i>Poa trivialis</i>	-	-	-	+	-	+	-	+	+	-

Tableau 1-suite

Numéro du relevé	1	2	3	4	5	6	7	8	9	10
<i>Juncus articulatus</i>	-	-	-	-	-	1	-	-	+	-
<i>Cirsium oleraceum</i>	-	-	-	-	-	-	-	-	-	+
<i>Juncus inflexus</i>	+	+	-	-	-	-	-	-	+	-
<i>Caltha laeta</i>	-	-	-	-	-	-	-	-	-	+

Magnocaricion + Bidentetea

<i>Poa palustris</i>	-	-	-	+	-	+	-	-	-	-
<i>Polygonum hydropiper</i>	-	-	-	-	-	-	+	+	-	-
<i>Myosoton aquaticum</i>	-	-	+	+	+	-	+	+	-	-

1 relevé: *Lathyrus palustris* (2), *Galium palustre* (2), *Valeriana officinalis* (2).

Molinio-Arrhenatheretea + Molinieta

<i>Juncus effusus</i>	+	+	-	-	-	+	-	-	+	-
<i>Equisetum palustre</i>	+	+	-	-	-	-	-	-	-	+
<i>Potentilla reptans</i>	-	+	-	-	-	-	-	-	+	-
<i>Poa pratensis</i>	-	-	+	-	+	-	-	-	-	-

1 relevé: *Festuca arundinacea* (4), *Calamagrostis pseudophragmites* (7), *Cardamine pratensis* (9), *Filipendula ulmaria* (9).

Filipendule-Petasition

<i>Tussilago farfara</i>	-	-	+	+	+	+	-	+	-	-
<i>Equisetum arvense</i>	-	-	-	-	-	+	+	-	-	-

1 relevé: *Telekia speciosa* (1).

Alno-Padion

<i>Urtica dioica</i>	-	-	-	-	-	+	+	-	-	-
1 relevé: <i>Stellaria nemorum</i> (6), <i>Salix cinerea</i> (10), <i>Alnus incana</i> (10), <i>Impatiens noli-tangere</i> (7).										

Accompagnatrices

<i>Lolium perenne</i>	-	-	+	-	+	-	-	-	-	-
<i>Rumex sanguineus</i>	-	-	-	+	-	+	+	-	+	-
1 relevé: <i>Juncus bufonius</i> (6), <i>Galeopsis pubescens</i> (7), <i>Alliaria petiolata</i> (7), <i>Alisma plantago-aquatica</i> (6).										

L'endroit et la date de la réalisation du relevé: 1-2, Fântâna lui Gătej, 21.07.1992; 3-5, Cumpătul, Sinaia, 23.07.1992; 6 - Sinaia, vers Cabana Schiorilor, 22.07.1992; 7-10, Sinaia, vers Cumpătul, 24.07.1992.

Les deux groupes analysés par nous (les relevés n^{os} 1 et 2) de Fântâna de Gătej (Sinaia) présentent une structure ressemblante aux phytocénoses décrites par G. A. Nedelcu et collab. (4) du marais de Benii (village de Ber-tea). Outre l'espèce dominante, *Typha shuttleworthii*, en tant qu'accompa-gnatrices plus fréquentes, nous rappelons: *Lythrum salicaria*, *Myosotis scor-pioides*, *Cirsium palustre*, *Mentha longifolia*, *Juncus effusus*, *J. inflexus*, *Equisetum palustre*.

A cause de la diminution de l'humidité, les phytocénoses que nous avons analysées en 1992 sont plus réduites en dimensions et plus pauvres comme structure cénotique que celles des années antérieurs.

2. *Catabroso-Glycerietum plicatae* Br.-Bl. 49

Les cénozes du cours supérieur de la Prahova, entre Cumpătul et Poiana Tapului, sont cantonnées particulièrement sur la partie gauche de la rivière, dans des microdépressions à eau permanente, là où les deux espèces édifiatrices, *Catabrosa aquatica* et *Glyceria plicata*, forment deux sous-associations distinctes délimitées généralement aussi dans l'espace. Celles dominées par *Catabrosa aquatica* occupent la partie centrale de la microdépression où le niveau de l'eau est plus élevé, et celle édifiatrices par *Glyceria plicata* sont cantonnées principalement à la périphérie.

Les espèces accompagnatrices sont peu nombreuses et nous en rappelons: *Veronica beccabunga*, *Ranunculus repens*, *Veronica anagallis-aquatica*, *Agrostis stolonifera*, *Poa trivialis*, *Myosoton aquaticum*, *Rorippa sylvestris*.

3. *Caricetum acutiformis-ripariae* Soó (27)30

Se présente par fragments, les phytocénoses étant dominées exclusivement par *Carex acutiformis*, cantonnées dans le voisinage des peuplements d'*Alnus incana*. La végétation atteint 150 m en hauteur et à cause du grand recouvrement (100%) de l'espèce dominante *Carex acutiformis* ses accompagnatrices sont peu nombreuses et cantonnées en général à la périphérie des phytocénoses. Parmi les espèces les plus fidèles de ces phytocénoses, nous rappelons: *Lythrum salicaria*, *Solanum dulcamara*, *Lysimachia nummularia*, *Lycopus europaeus*, *Epilobium hirsutum*, *Caltha laeta* et *Cirsium oleraceum*.

4. *Glycerietum nemoralis* ass. nova (Tableau 2)

Glyceria nemoralis participe en tant qu'espèce différentielle à l'édification des groupements de l'alliance *Cardamini-Montion* (8) à savoir: *Ca-*

Tableau 2
Glycerietum nemoralis ass. nova

Numéro du relevé	1	2	3	4	5	6	7	8	9	10	AD	K
Surface (m ²)	50	100	50	100	50	100	50	100	100	100		
Hauteur de la végétation (cm)	50	90	40	60	40	45	45	40	45	50		
Recouvrement (%)	70	90	70	90	80	85	90	75	85	90		

Caractéristiques aux associations

Glyceria nemoralis 3-4 4 3-4 4 3-4 4 4 4 3-4 4 3-4 V

Cardamini-Montion + Montio-Cardaminetalia

Veronica beccabunga + + + 1-2 + + 1 + 1 1 + + + -2 V
Epilobium palustre + - + - + + + + - - + + III
Stellaria nemorum + - + - + - + + - + + + III

Glycerio-Sparganion

Epilobium parviflorum - - - + - + - - + - + II
 1 relevé: *Glyceria plicata* (3).

Tableau 2-suite

Numéro du relevé	1	2	3	4	5	6	7	8	9	10	AD	K	
Calthion													
<i>Juncus articulatus</i>	-	-	+	+	-	+	-	-	-	+	+	II	
<i>Poa trivialis</i>	+	-	+	+	-	+	+	-	-	+	+	III	
<i>Juncus effusus</i>	+	+	-	-	-	+	-	-	-	-	+	II	
<i>Myosotis scorpioides</i>	+	+	-	+	-	+	+	+	+	+	+	IV	
Bidentetea													
<i>Prunella vulgaris</i>	+	-	+	+	+	-	+	-	+	+	+	IV	
Molinietalia -- Molinio-Arrhenatheretea													
<i>Equisetum palustre</i>	+	+ 1	-	+	+	-	+	-	-	+	+ - + 1	III	
<i>Cerastium fontanum</i>	-	-	+	+	-	+	-	+	-	+	+	III	
Agropyro-Rumicetia													
<i>Ranunculus repens</i>	+	-	+	+	+	+	-	+	+	+	+	IV	
<i>Agrostis stolonifera</i>	+	-	+	+	+	-	-	-	-	+	+	III	
<i>Juncus inflexus</i>	+	-	-	-	+	+	-	-	-	-	+	II	
<i>Potentilla reptans</i>	-	-	+	-	+	+	+	-	-	+	+	III	
Filipendulo-Petasition													
<i>Tussilago farfara</i>	+	+	+	-	+	+	-	-	+	-	+	III	
<i>Lythrum salicaria</i>	+	-	-	-	+	-	+	-	-	+	+	II	
<i>Alnula longifolia</i>	-	-	+	+	-	+	+	+	+	+	+	IV	
<i>Alchemilla mollis</i>	-	-	-	+	+	-	-	-	-	+	+	II	
Alno-Padion + Fagetalia													
<i>Carex remota</i>	1-2	+	+	1-2	+	1	+	1	+	+	1 -	+ - 2	V
<i>Impatiens noli-tangere</i>	-	+	-	+	-	-	-	+	-	-	+	II	
<i>Cardamine impatiens</i>	-	+	+	+	+	-	+	-	+	+	+	IV	
<i>Rumex sanguineus</i>	-	-	+	+	+	+	-	+	-	+	+	III	
<i>Solanum dulcamara</i>	+	-	-	+	-	+	-	+	-	+	+	III	
<i>Carex sylvatica</i>	-	-	-	+	-	+	-	+	-	+	+	II	
Accompagnatrices													
<i>Lolium perenne</i>	+	-	+	-	-	+	-	+	-	-	+	II	
<i>Bellis perennis</i>	-	-	+	+	-	+	+	+	+	-	+	III	
<i>Poa annua</i>	-	+	-	-	+	-	+	-	+	+	+	III	
<i>Cerastium sylvaticum</i>	+	-	-	-	+	+	-	-	+	+	+	III	

L'endroit et la date de la réalisation du relevé: 1 - 2, Fântâna lui Gătej, 21.07.1992; 3 - 10, Boncu (Bușteni), 23.07.1992.

rici remotae-Calthetum lactae Krajina 33 et *Cardaminetum opizii* Szafer, Pawl. et Kulcz. 23. Dans l'association *Chrysosplenio-Cardaminetum* (Tx. 37) Maas 59 (3) près de *Cardamine amara* c'est l'espèce *Glyceria nemoralis* qui participe comme co-édificatrice, en peuplant les bords des ruisseaux froids de la zone du hêtre. Gh. Dihoru (3) signale à Izvorul Bradului (Mt. Siriu) une phytocénose de *Glyceria nemoralis* ayant une structure à peu près identique à celle des groupements que nous avons identifiés à Boncu (Bușteni). Ici, ces phytocénoses sont cantonnées, dans l'étage des sapinières-hêtraies dans les microdépressions des bords de la voie forestière de Valea Albă.

Dans ces phytocénoses chryo-hydrophiles abondent les espèces d'*Alno-Padion* et *Fagetalia*, dont nous rappelons: *Carex remota*, *Cardamine pratensis*, *Rumex sanguineus*, *Carex sylvatica*, etc.,

Le cours permanent des ruisseaux de montagne détermine l'installation de nombreux éléments méso-hygrophiles, comme: *Veronica beccabunga*, *Epilobium palustre*, *Stellaria nemorum*, *Myosotis scorpioides*, *Ranunculus repens*, *Poa trivialis* tous des taxa constituants des ces phytocénoses. Le relevé n° 4 représente le type selon lequel on a décrit l'association.

5. *Agrostetum gigantei* ass. nova (Tableau 3)

Agrostis gigantea domine les bords des microdépressions du cours gauche de la Vallée de la Prahove, limitrophes à celles édifiées par *Calamagrostis pseudophragmites* cantonnées toujours sur les portions plus hautes du terrain. *Agrostis gigantea* représente l'espèce dominante des ces groupements et, par conséquent, les plantes qui l'accompagnent sont moins nombreuses. Nous en énumérons: *Ranunculus repens*, *Calamagrostis pseudophragmites*, *Poa trivialis*, *Trifolium repens*, *Potentilla anserina*. Le relevé n°. 6 constitue le type selon lequel on a décrit l'association.

6. *Calamagrostietum pseudophragmitis* Beldie 67

(Syn.: *Calamagrostietum pseudophragmitis* Kopecky 68)

Occupe les graviers sur lesquels se sont déposées les alluvions annuelles qui les ont sédimenté en surhaussant le relief. Etant une espèce exclusiviste, *Calamagrostis pseudophragmites* s'accompagne de peu d'espèces méso-hygrophiles, comme: *Epilobium parviflorum*, *Agrostis stolonifera*, *Barbarea vulgaris*, *Myosoton aquaticum*, *Rumex sanguineus*, cantonnées presque toujours à la périphérie des phytocénoses.

7. *Scirpetum sylvatici* Maloch 35 (Tableau 3, relevés 12 et 13)

Ces phytocénoses ont été rencontrées tant à Fântâna lui Gătej, limitrophes à celles de *Typha shuttleworthii* et *Juncus effusus*, que dans le cours supérieur de la Vallée de la Prahova, entre Cumpătu et Poiana Țapului, en végétant parmi les buissons d'*Alnus incana* et *Salix purpurea*.

A cause de la dominance (AD = 4 - 5) de l'espèce édifiatrice — *Scirpus sylvaticus* — les autres accompagnatrices sont assez peu nombreuses. Parmi les plus fréquentes, nous signalons: *Ranunculus repens*, *Lythrum salicaria*, *Circaea lutetiana*, *Urtica dioica*, etc.

8. *Juncetum effusi* Soó (31) 49

L'association occupe les mêmes stations que *Scirpetum sylvatici*, étant cantonnée surtout à la périphérie. Les espèces accompagnatrices les plus fréquentes sont: *Galium palustre*, *Deschampsia caespitosa*, *Sparanium ramosum*, *Lysimachia nummularia*.

Note. Dans le cadre des recherches écologiques effectuées dans cette zone pendant l'année 1993 nous avons trouvé deux nouvelles stations pour les phytocénoses signalées et analysées par nous, à savoir:

1) *Typhetum shuttleworthii* Soó 27 qui est cantonnée aussi sur le côté droit de la rivière de Valea Cerbului en aval de la cabane Gura Diham. Ici, autour des groupes de *Typha shuttleworthii*, qui occupent une surface d'environ 200 m², s'installent les phytocénoses dominées par *Caltha laeta* et *Cardamine amara*, rangées dans l'alliance *Cardamino-Montion* Br.-Bl. 25 a savoir: *Carici remotae-Calthetum laetae* Krajina 33 et *Chrysosplenio-Cardaminetum* (Tx. 37) Maas 59. Ces cénoses scyaphyles et cryophyles dominées par *Cardamine amara* et *Chrysosplenium alternifolium* sont fréquen-

Tableau 3

Les phytocénoses de la classe Molinio-Arrhenatheretea

Número du relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Surface (m ²)	50	100	100	50	100	100	50	100	100	100	25	30	50	50	100
Hauteur de la végétation (cm)	40	45	50	50	40	45	50	50	50	55	150	80	90	110	70
Recouvrement (%)	100	95	100	100	85	90	100	95	100	100	90	100	100	95	95
Caractéristiques aux associations															
<i>Agrostis gigantea</i>	5	5	5	4	4-5	5	5	5	4-5	5	5	4	5	4-5	4-5
<i>Calamagrostis pseudophragmites</i>	+	+	-	+	+	+	-	+	+	+	-	-	-	-	-
<i>Scirpus sylvaticus</i>	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Juncus effusus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molinietalia + Molinio-Arrhenatheretea															
<i>Ranunculus repens</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Medicago lupulina</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Epilobium parviflorum</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Potentilla anserina</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Agrostis stolonifera</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Agropyron repens</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Poa trivialis</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Trifolium repens</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Equisetum palustre</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Lythrum salicaria</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Galium palustre</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Cardamine pratensis</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Deschampsia caespitosa</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1 relevé: <i>Mentha aquatica</i> (11), <i>Caltha laeta</i> (14), <i>Agrostis canina</i> (15)															
Agropyro-Rumiclon															
<i>Barbarea vulgaris</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Juncus inflexus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1 relevé: <i>Rorippa sylvestris</i> (11)															

Tableau 3 suite

Numéro du relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Filipendulo-Petasion															
<i>Filipendula ulmaria</i>	—	—	—	—	—	—	—	—	—	—	—	—	+	+	—
1 relevé: <i>Telckia speciosa</i> (12); <i>Carduus personata</i> (12).															
Bidention + Bidentetca															
<i>Myosoton aquaticum</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Prunella vulgaris</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Polygonum hydropiper</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Bidens vulgaris</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1 relevé: <i>Bidens tripartita</i> (14)															
Alno-Padion															
<i>Circaea lutetiana</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Solanum dulcamara</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 relevé: <i>Impatiens noli-tangere</i> (12).															
Phragmitetca															
<i>Polygonum persicaria</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Accompagnatrics															
<i>Lolium perenne</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Melilotus alba</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Urtica dioica</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Veronica beccabunga</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Tussilago farfara</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

1 relevé: *Alliaria petiolata* (13), *Allisma plantago-aquatica* (14), *Cynosurus cristatus* (15), *Carex flacca* (15), *Galium aparine* (13), *Epilobium hirsutum* (13), *Lemna minor* (14: 2—3), *Lysimachia nummularia* (15), *Lycopus europaeus* (14), *Myosotis scorpioides* (14), *Rumex sanguineus* (11), *Symphitum officinale* (13), *Sparaganium ramosum* (14), *Trifolium pratense* (15), *Urtica cracca* (15).
L'endroit et de la date de la réalisation du relevé: 1—11, entre Sinaia et Poiana Țapului, 22.07.1992; 12 et 14 — Fântâna lui Gătej, 21.07.1992; 13 et 15 — Sinaia, entre Cumpătul et Poiana Țapului, 22.07.1992.

tes autour des sources du cours des vallées montagneuses, tant dans l'étage des hêtraies, que dans celui des faux sapins. Dans Valea Cerbului elles sont situées à l'étage des forêts de sapin-hêtre.

2) Les phytocénoses dominées par *Glyceria nemoralis* ont été rencontrées à la confluence de Valea Morarului avec Valea Cerbului étant cantonnées à l'étage des mélanges de hêtre avec le faux sapin. Ces groupes sont distribués sur le versant droit de Valea Morarului étant localisés sur des pentes avec une inclinaison moyenne de 30—35° et exposition sud-ouest.

La présence des sources permanentes de pente détermine l'installation de phytocénoses luxuriantes qui, à la périphérie, sont bordées de groupes appartenant à l'association *Juncetum effusi* Soó (31) 49, où domine *Juncus effusus* en association avec *Juncus conglomeratus*.

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DYNAMIQUE DE LA DÉGRADATION AÉROBIE
DE LA MATIÈRE ORGANIQUE DANS LES ÉCOSYSTÈMES
LACUSTRES DU DELTA DU DANUBE, EXPRESSION
DE LA FONCTIONNALITÉ DES COMMUNAUTÉS
MICROBIENNES PLANCTONIQUES
DANS LES CONDITIONS DES ANNÉES
1991 — 1992

DORINA NICOLESCU, ALEXANDRA GIRIP

This paper presents the dynamics of aerobic degradation of organic matter as a result of the metabolic activity of bacterioplankton in some lacustrine ecosystems from the Danube Delta. It is rendered evident the different recirculation capacity of chemical elements from complex organic substances reflecting the state of each ecosystem.

La microflore bactérienne planctonique constitue, du point de vue structural et fonctionnel, une partie importante des biocénoses qui se trouvent à l'intérieur des écosystèmes lacustres du Delta du Danube. Ainsi, grâce à leur grande densité numérique (1, 2), les microorganismes bactériens planctoniques représentent une biomasse (7) compétitive par rapport à la biomasse des algues, surtout dans la nourriture du zooplancton, mais aussi dans celle des jeunes poissons, de la forme benthonique et phytophile détritophage — tant sous forme libre que, surtout, sous forme d'agrégats détrito-bactériens (9). En même temps dans l'acquisition de nutriments et d'énergie pour les propres synthèses cellulaires, les processus de dégradation des substances organiques complexes représentent l'une des deux voies principales et parallèles du métabolisme bactérien (la dégradation et la biosynthèse), à résultats bénéfiques pour les écosystèmes dans la remise en circulation des éléments bloqués dans des structures chimiques complexes (5). Les conditions climatiques, le régime hydrologique, les caractéristiques physico-chimiques de l'eau, mais surtout la dynamique des producteurs primaires (en particulier le phytoplancton), influencent le métabolisme des communautés microbiennes planctoniques, en déterminant une certaine dynamique de la dégradation microbienne de la matière organique (4).

MATÉRIEL ET MÉTHODE

Dans les années 1991 et 1992 on a fait des recherches dans les lacs Roşu, Matiţa, Merhei et dans les *jaşse* * Tătaru, Lopatna et Porcu (1991), des unités lacustres d'origine différente (fluviale ou maritime) d'âges différents et

* *jaşsa* (pl.) *jaşse* = dépression de petite profondeur des lacs ou du Delta du Danube à contour irrégulier et dans laquelle se développe une riche végétation d'eau.

dans des stades différents successionnels. Du point de vue des producteurs primaires, on peut dire que:

— dans les lacs Roșu, Măța, Merhei prédominent les producteurs primaires de type planctonique;

— dans les *jașe* Lopatna, Tătaru prédominent les producteurs primaires de type macrophytique;

— la *jașe* Porcu présente des conditions tout à fait particulières du point de vue du régime hydrologique (apport d'eaux au-dessous d'une île flottante), des périodes fréquentes de déficit en O_2 dissous, et, généralement, des perturbations (dégradations) au niveau biocénétique: l'inexistence des macrophytes vivants, un phytoplancton discontinu, etc....

On a réalisé la quantification de la dégradation aérobie microbienne d' O_2 en stations sur colonnes d'eau (3), en appliquant le coefficient de 0,375 pour la transformation en carbone organique oxydé. (On a fait 173 expérimentations *in situ*). Les résultats sont présentés en moyenne mensuelle ou annuelle.

RÉSULTATS ET DISCUSSIONS

Les résultats présentés dans le tableau 1 a et b, ainsi que dans la figure 1 nous permettent une appréciation pour la fonctionnalité des communautés microbiennes planctoniques par l'analyse des données sur la quantité de carbone planctonique dans le processus métabolique dans les années 1991 et 1992, deux années tout à fait différentes du point de vue hydrologique. Ainsi, l'année 1991 s'est caractérisée par des conditions climatiques instables et par un long maintien des grands niveaux, les périodes d'inondation n'ayant pas un caractère de régime; l'année 1992 s'est distinguée par les niveaux petits de l'eau, qui ont affecté en particulier le nord (Măța et Merhei).

Ainsi, la dégradation microbienne aérobie est située dans des limites de 0 à 2,134 gC/m³/24 h en 1991 et de 0,074 à 2,273 gC/m³/24 h en 1992 (Tableau 1 a et b), la dynamique mensuelle de la courbe enregistrant des maxima évidents dans la période d'été et début de l'automne (fig. 1). Le facteur principal qui induit l'allure de cette courbe est le développement du phytoplancton (8) qui, tant par la sécrétion de produits faciles à dégrader dans les périodes d'«épanouissement», que par le remplacement rapide des populations d'algues détermine l'intensification du processus de dégradation microbienne dans la masse de l'eau. Le développement du phytoplancton ainsi que l'entraînement des sédiments dans la masse de l'eau des différentes suspensions (comme dans le cas des *jașe* Tătaru et Lopatna) sont illustrés indirectement par la courbe de l'indice de transparence (T/A). Il est déjà connu que la température est un autre facteur qui influence le processus de dégradation microbienne, les valeurs négatives ralentissant les processus métabolique (4), ainsi qu'aux mois du printemps et de la fin de l'automne la température devient un facteur limitatif (Fig. 1). La dynamique de la dégradation microbienne aérobie de *jașe* Porcu en 1991 est le résultat des plusieurs facteurs tels le faible développement du phytoplancton (8), mais surtout le déficit d' O_2 dissous qui atteint l'apogée au mois de juillet 1991; dans cette situation il est sûr que les processus de dégradation microbienne se développent par voie anaérobie dans une période plus longue de temps.

Tableau 1

Taux de la dégradation microbienne dans la masse de l'eau

a) 1991

g C org. oxydé/m³/24 h

	IV	V	VI	VII	VIII	IX	X	XI	$\bar{X}_g$
Roșu	0,290	0,259	0,414	0,718	0,198	0,188	0,015	0,183	0,197
Măța	0,082	0,113	0,560	2,134	0,237	1,116	0,458	0,024	0,274
Merhei	0,216	0,026	0,518	1,418	0,500	1,324	0,344	0,018	0,253
Tătaru	0,392	0,402	0,655	0,996	0,395	0,667	0,055	0,064	0,314
Lopatna	0,547	0,199	1,283	0,091	1,141	1,405	0,216	0,239	0,424

b) 1992

Roșu	0,255	—	0,293	1,371	1,124	0,741	0,101	0,305	0,428
Măța	0,328	—	0,417	1,213	1,324	1,247	0,664	0,074	0,540
Merhei	0,428	—	0,559	1,326	1,401	2,273	1,166	0,564	0,943
Tătaru	0,299	—	0,442	0,283	0,924	0,946	0,282	0,274	0,425
Lopatna	0,218	—	0,979	0,445	1,331	1,771	0,791	0,498	0,707

La dynamique de la dégradation microbienne pendant les années 1991 et 1992 (Fig. 1, Tableau 1 a et b) met en évidence des valeurs beaucoup plus élevées en 1992 par rapport à 1991 (de 1,35 fois dans *jașe* Tătaru jusqu'à 3,73 fois dans le lac Merhei), ceci correspondant à un développement spectaculaire du phytoplancton dans en 1992 (d'après les valeurs du rapport T/A).

Une comparaison entre les 6 écosystèmes aquatiques étudiés du point de vue de la destruction microbienne aérobie met en évidence une activité métabolique élevée dans les écosystèmes du nord (Merhei, Măța, Lopatna, les plus vieux des lacs analysés) par rapport aux écosystèmes du sud (Roșu, Tătaru, beaucoup plus récents). Une analyse détaillée doit évidemment tenir compte du type d'écosystème: lac, *jașe*. Donc on peut affirmer que les écosystèmes Merhei, Măța, Lopatna, par la fonctionnalité des communautés microbiennes planctoniques présentent une forte capacité de remise en circulation des éléments bloqués dans des substances chimiques complexes, ces éléments donc utiles au développement de suite des producteurs primaires.

Sur le même plan, cette interdétermination entre le développement des producteurs primaires planctoniques (surtout) et l'intensité des processus de dégradation microbienne nous a poussés à calculer et à représenter graphiquement (Fig. 2) l'efficacité écologique de la destruction aérobie dans la masse de l'eau des écosystèmes analysés — par le rapport du quantum de la destruction microbienne à la production primaire nette du phytoplancton (%)**.

Par rapport à l'évolution dynamique de ce paramètre en 1991 (Fig. 2) et la situation annuelle ($\bar{X}_g$) (1991 et 1992 — Tableau 2), dans les 6 écosystèmes aquatiques analysés, dans le lac Roșu est mise en évidence la

** Ceci dans le cas hypothétique où les microorganismes consommeraient plutôt la matière organique provenant des algues planctoniques, ce qui est presque une réalité, étant donné les composants faciles à dégrader des algues par rapport aux macrophytes ou même des composants directement assimilables — les amino-acides.

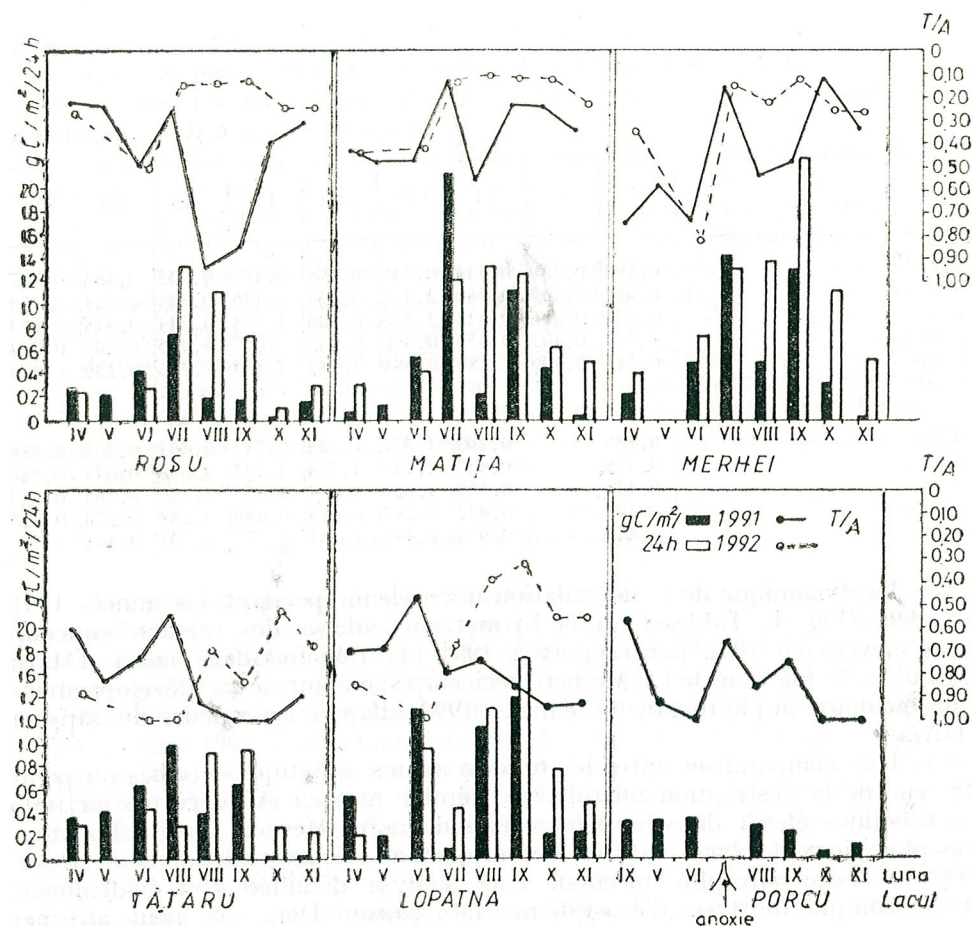


Fig. 1. — Dynamique annuelle de la destruction microbienne planctonique aérobie.

moindre activité de remise en circulation des éléments bloqués dans les substances organiques complexes issues du processus de production primaire. Les valeurs élevées enregistrées dans le lac Merhei, surtout en 1992, nous mènent à supposer l'apport de certaines quantités du détritus dans l'activité de dégradation microbienne de la masse de l'eau (surtout dans certaines périodes et zones de l'eau d'une profondeur réduite).

D'autre part, dans les *japșe*, où la production primaire macrophytique est dominante, celle planctonique ayant des valeurs plus réduites, les communautés microbiennes planctoniques dégradent dans certaines périodes jusqu'à 300% (en valeur) la matière organique produite par la photosynthèse des algues. Cela démontre que ces écosystèmes ont la capacité de remettre en fonction des éléments et de l'énergie bloquée (nécessaires pour la fonctionnalité de suite de la biocénose), par l'entraînement dans la masse de l'eau

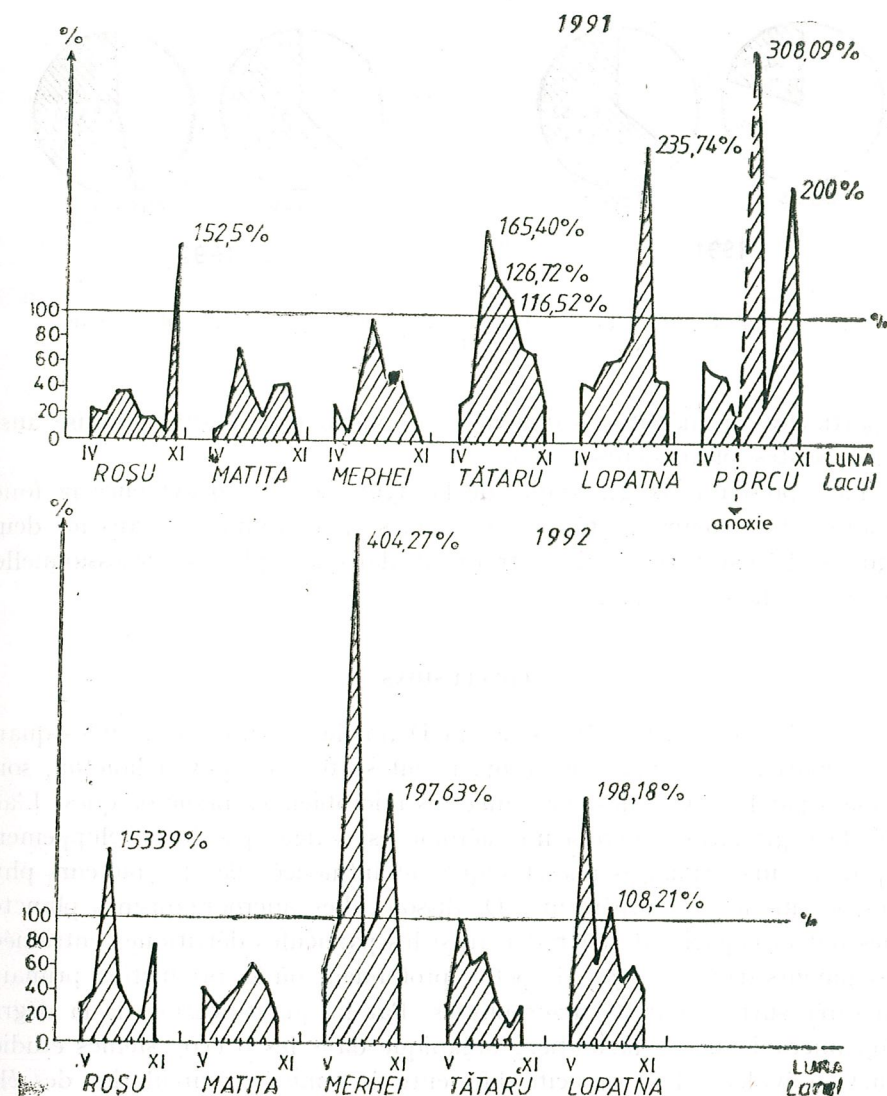


Fig. 2. — Efficacité de la destruction microbienne planctonique aérobie dans les années 1991-1992.

Tableau 2

Efficacité écologique de la destruction microbienne aérobie planctonique dans les années 1991-1992 ($\bar{X}$ g %) (à part le mois de novembre)

Années	Roșu	Matîța	Merhei	Tătaru	Lopatna	Porcu
1991	17,18	22,85	30,31	73,07	67,62	36,63
1992	38,59	41,95	123,31	45,80	70,05	—

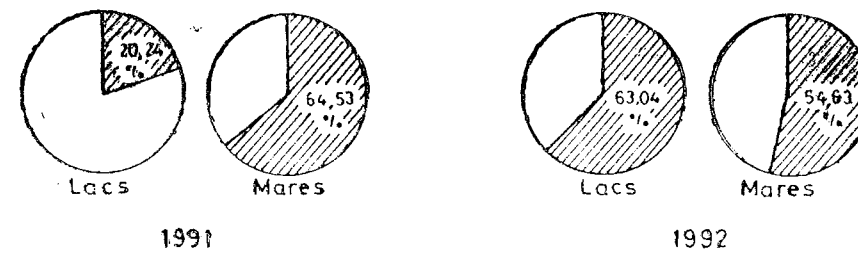


Fig. 3. — Efficience écologique de la destruction microbienne aérobie planctonique (X annuel) dans les lacs et les *jașe*.

des particules du détritus sédimenté, ce phénomène étant favorisé aussi par les petites profondeurs d'eau.

La représentation graphique de la figure 3 met en évidence la fonctionnalité des communautés microbiennes planctoniques dans les deux catégories d'écosystèmes qui se trouvent dans des phases successionnelles différentes — lacs et *jașe*.

CONCLUSIONS

Dans les écosystèmes lacustres du Delta du Danube de grandes quantités de matière organique, qui proviennent surtout du phytoplancton, sont dégradées par l'activité des communautés microbiennes planctoniques. L'activité de dégradation microbienne aérobie est exigée par le développement des producteurs primaires planctoniques et influencée par les facteurs physiques, chimiques — température, O_2 dissous. Les microorganismes planctoniques ont la capacité de dégrader aussi les particules détritiques entraînées des sédiments dans les *jașe* de petite profondeur où la production primaire est assurée surtout par les macrophytes. Par la quantification de la dégradation microbienne de la matière organique dans les 6 écosystèmes étudiés on met en évidence leur capacité différente de remise en circulation des éléments bloqués dans des substances chimiques complexes, éléments qui assurent la continuité d'une production primaire à un certain niveau, exprimant ainsi l'état de l'écosystème.

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ACTION OF ACRIFLAVINE ON GROWTH AND LACTIC ACID AND PROTEASE PRODUCTION IN *Streptococcus lactis*

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Two strains of *Streptococcus lactis* were tested for selection of mutants after acriflavine treatment. Some of these mutants presented modified abilities to metabolise lactose and/or proteins. The Lac⁻ and Prt⁻ phenotypes were associated with the loss of some plasmids from the bacterial cells.

The lactic acid bacteria are involved in the manufacture of fermented food from raw agricultural materials such as milk, meat, vegetables and cereals. These fermented foods are a significant part of the food processing industry and are often prepared using selected strains that have the ability to produce desired products or changes efficiently. The application of genetic engineering technology to improve existing strains or to develop novel strains for these fermentations is an active research area world-wide and it becomes possible to construct strains with characteristics shaped for a specific purpose.

Most of the lactic acid bacteria are well known to contain endogenous plasmids and, in some cases (lactococci), essential metabolic traits are carried by these extrachromosomal elements (Kok, 1990). For instance, the lactose-fermenting ability of lactococci has an unstable character, linked to plasmid DNA. The application of transduction techniques led to the selection of strains with a stabilized lactose-fermenting phenotype by chromosomal integration of plasmidial *lac* genes (McKay and Baldwin, 1978). In the same way there were obtained strains with a stabilized proteinase-positive phenotype. These results imply that genetic manipulations could be used to improve the bacterial strains, either by integrating *lac* or other essential genes into the chromosome, or by cloning the desired genes on a high-copy number vectors which increase the expression of these genes (gene dosage effect).

Lactose- and proteinase-negative variants have also been isolated and tested in an attempt to increase the starter population in Cheddar cheese and thus increasing the amount of ripening enzymes without increasing the rate of acid production during the manufacturing stage. Mutagenesis with different agents is one of the ways used to obtain such variants and the results are very promising. Chemicals often used to induce mutations in lactococci are: nitrosoguanidine, acriflavine and ethidium bromide (McKay and Baldwin, 1990, Gasson, 1990).

This paper presents the obtaining of different kinds of mutants after the treatment with acriflavine of some *Streptococcus lactis* strains.

MATERIALS AND METHODS

1. *Bacterial strains.* The strains used in our experiments are *S. lactis* SL14 and *S. lactis* SL16. We obtained these strains as vacuum-dried cultures and rehydrated them in milk.

2. *The media used in the experiments* (lactose broth, lactose indicator media (LIA) and milk citrate agar (MCA) were described by McKay and Baldwin (1978) and Gasson and Davies (1980). All the strains (wild type or mutants) were subcultured directly in milk or milk supplemented with either glucose (1%) or yeast extract (0.5%) or both.

3. *Mutagenesis.* To obtain mutants 10ml of lactose broth containing acriflavine at a concentration of 10 µg/ml were inoculated with 0.5 ml of fresh bacterial culture and incubated at 30°C for 24 hours. Dilutions from this suspension were plated onto LIA and MCA media and incubated for other 24h at 30°C (Efstation and McKay, 1976).

4. *Detection of variants with modified metabolic phenotypes.* Lac⁻ mutants were selected as the variants unable to acidify LIA (containing bromocresol purple as pH indicator) and protease-negative (Prt⁻) variants were selected according to Gasson (1983) and Otto et al. (1982). The proteolytic activity was determined by a colorimetric method as described by McKay and Baldwin (1974).

RESULTS AND DISCUSSIONS

Two strains of *S. lactis*, SL14 and SL16 were treated with a concentration of acriflavine (10 µg/ml) which determines a severe reduction of bacterial viability (up to 90%). Colonies appeared on MCA and LIA media were tested for lactose and casein degradation ability. Prt⁻ mutants present a reduced rate of growth after 48 hours and the colonies are very small (Pearce et al., 1974; Otto et al., 1982). Lac⁻ variants were identified on the bromocresol purple supplemented medium (LIA) as colonies which are not surrounded by a colorless area (McKay et al., 1973).

The mutants selected in these conditions as well the parental strains were tested for proteolytic activity and the ability to produce lactic acid. As indicated the growth in different liquid media (milk, milk + yeast extract, milk + glucose) and the capacity to produce lactic acid (expressed as a reduced pH value of the medium inoculated with a bacterial strain after 18–24h of incubation), more than 40% of the mutants isolated from *S. lactis* SL 16 after acriflavine action were Lac⁻Prt⁻ (Table 1). With a reduced rate (10%) were obtained variants with a reduced acid production and unable to grow in milk to high densities necessary for good fermentation practice. These strains, like SL16. 2, could be considered as Lac⁺Prt⁻ mutants. A special behaviour had other mutants (SL 16.8, SL 16.15): they coagulated very slowly the milk but this ability was rapidly increased in milk supplemented with yeast extract. In this medium the pH value was increased (5.1–5.6) as compared with parental strain (pH 4.5). In our opinion, these variants could have small mutations in *p_{prt}* gene and they still maintain a Lac⁺ Prt⁺ phenotype.

Similar variants were described by other authors (Pearce et al., 1974; Otto et al., 1982; Ramos et al., 1983), these phenotypes being associated with differences in the plasmid content. In this order, we also tried to identify plasmids in the strains used in our experiments (wild type or mutants).

Plasmid isolation from three strains of *S. lactis* (SL 16, SL 16.1 and SL 16.2) showed some variations. The parental strain contains six plasmids

Table 1

Proteolytic activity and lactic acid production in some mutants of *Streptococcus lactis* SL 16

Strain	Milk	Milk + YE		Milk + G		Phenotype
	pH	coag.	pH	coag.	pH	
SL16 M	4.5	+	4.5	+	4.5	Lac ⁺ Prt ⁺
SL16.1	6.3	—	6.3	—	6.3	Lac ⁻ Prt ⁻
SL16.2	6.3	—	4.6	+	5.3	Lac ⁺ Prt ⁻
SL16.5	6.2	—	6.2	—	6.1	Lac ⁻ Prt ⁻
SL16.8	5.6	+	4.4	—	5.6	Lac ⁺ Prt ⁺
SL16.10	6.4	—	6.3	—	6.3	Lac ⁻ Prt ⁻
SL16.15	5.3	+	4.4	+	5.1	Lac ⁺ Prt ⁺
SL16.18	4.6	—	4.5	—	4.6	Lac ⁺ Prt ⁺
SL16.20	6.3	—	6.2	—	6.3	Lac ⁻ Prt ⁻
SL16.33	4.6	+	4.5	+	4.5	Lac ⁻ Prt ⁺

YE = yeast extract; G = glucose.

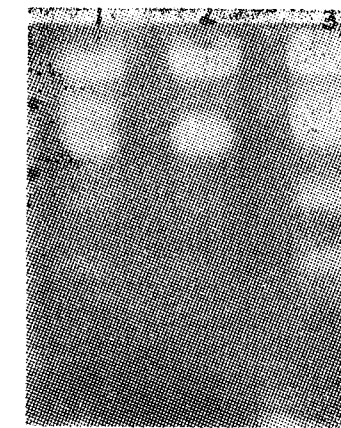


Fig. 1. — Agarose gel electrophoresis of plasmids from wild type *Streptococcus lactis* SL16 (1) and its mutants: SL16.1 (2) and SL16.2 (3). Arrows indicate the position of lactose and protease plasmids.

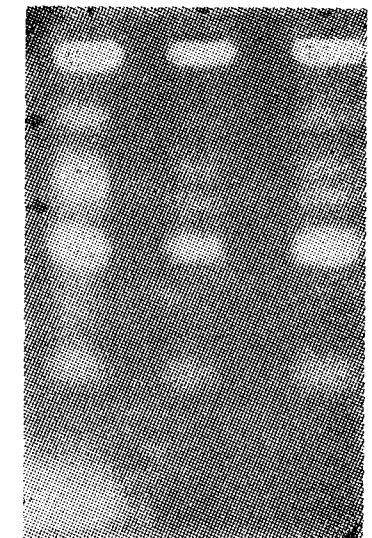


Fig. 2. — Agarose gel electrophoresis of plasmids from wild type *Streptococcus lactis* SL 14 (3) and its mutants: SL14.24 (1) and SL14.2 (2). Arrows indicate the position of lactose and protease plasmids.

(Fig. 1) with different electrophoretic mobility. Two plasmids seem to be absent in the mutant SL 16.1 (Lac⁻ Prt⁻) and only one (those with higher molecular weight) in the mutant SL 16.2 (Lac⁺ Prt⁻). These results are in agreement with the supposition that the genes for lactose fermenting ability and for protease synthesis are located on different plasmids (Efstation and McKay, 1976; Ramos et al., 1983). According to our data, *lac* gene is located on a large plasmid (40–50 Kb) while *p_{prt}* gene is on a smaller one. In a recent study Kok (1990) presented the actual progress in the know-

ledge of the genetic basis of the proteolytic system of lactococci. The genetic methodology used by now permitted to identify proteinase plasmids, ranging in size from 13.5 to 100 Kb, in an increased number of lactococcal strains. In some strains the genes for proteolytic ability are located on a plasmid which is also involved in lactose metabolism.

The treatment with acriflavine of the strain *S. lactis* SL 14 determined more variable results (Table 2). In this case, the Lac⁻Prt⁻ phenotype appeared with a reduced frequency (10%), the majority of mutants having Lac⁻Prt⁺

Table 2

Lactic acid production and proteolytic activity in some mutants of *Streptococcus lactis* SL 14

Strain	Milk	Milk + YE			Milk + G		Phenotype
	pH	coag.	pH	coag.	pH	coag.	
SL14 M	4.5	+	4.5	+	4.5	+	Lac ⁺ Prt ⁺
SL14.2	6.4	—	6.4	—	5.0	+	Lac ⁻ Prt ⁺
SL14.8	6.4	—	6.2	—	4.9	+	Lac ⁻ Prt ⁺
SL14.9	6.3	—	6.3	—	4.6	+	Lac ⁻ Prt ⁺
SL14.10	5.3	±	4.5	+	5.1	+	Lac ⁺ Prt ⁺
SL14.19	5.6	±	4.5	+	4.7	+	Lac ⁺ Prt ⁺
SL14.20	6.4	—	6.4	—	6.4	—	Lac ⁻ Prt ⁻
SL14.23	4.6	+	4.5	+	4.5	+	Lac ⁺ Prt ⁺
SL14.24	5.8	—	5.6	—	4.6	+	Lac ⁻ Prt ⁺
SL14.26	5.7	—	4.4	+	5.3	±	Lac ⁺ Prt ⁻
SL14.100	6.4	—	6.3	—	4.7	+	Lac ⁻ Prt ⁺
SL14.102	6.4	—	6.3	—	6.2	—	Lac ⁻ Prt ⁻
SL14.200	5.9	—	4.5	+	5.2	±	Lac ⁺ Prt ⁻
SL14.210	6.2	—	6.1	—	4.6	+	Lac ⁻ Prt ⁺
SL14.230	4.7	+	4.5	+	4.5	+	Lac ⁺ Prt ⁺

YE = yeast extract; G = glucose.

phenotypes. With a reduced rate were also isolated variants that we presume are Lac⁺Prt⁻ (they are not able to coagulate the simple milk but this capacity is restored in milk supplemented with yeast extract). Similar results were obtained after plasmid isolation and visualisation: location of lac gene and prt gene on different plasmids (Fig. 2).

CONCLUSION

Mutagenesis with different chemical agents, like acriflavine, permits the obtaining of different mutants with modified ability of milk fermentation. The molecular basis of acriflavine action is explained by curing plasmid DNA from bacterial cells. Our results obtained after acriflavine treatment of two *S. lactis* strains are in agreement with these data: different variants with modified phenotypes and plasmid content were isolated. These results could be a support for other studies concerning the obtaining of strains useful in food fermentation processes.

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SCHIZOPHYLLUM COMMUNE — CANKER AND DIEBACK DISEASE OF APRICOT TREES IN ORCHARDS OF SOUTH-EASTERN ROMANIA

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Schizophyllum commune, a debilitating and drying pathogen, was recorded in a high number of wooden ornamental, forest and fruit trees, sometimes also on herbaceous plants. During 1990—1993, this fungus damages apricot orchards in the South-East of the country, mainly affecting declining trees exposed to adverse climate and soil factors. In the experimental field at Băneasa-Bucharest, trees were affected to extents of 10 — 100%, the behaviour of cvs and hybrids being different from a hybrid to another, and even within the same hybrid combination.

1. INTRODUCTION

The fungus *Schizophyllum commune* Fr. ex. Fr. (syn. *S. lobatum* Went., *S. alneum* (L.) Schroet.) from Family *Pleurotaceae*, Ord. *Agaricales*, Class *Basidiomycetes*, known as a decline and drying pathogen, is spread all over the world. It was recorded on a high number of wooden ornamental, forest and fruit trees, as well as on a number of herbaceous species belonging to 510 genera (1).

In all these plants, the fungus colonizes declining branches and trunks, enhancing drying.

In Romania, this fungus was first recorded in apricot orchards in the Danube Plain (2) and it was noticed its outstanding role in the pathogen complex leading to decline of the species (2) (3).

Apricot-tree canker and dieback due to *S. commune* was recorded during 1990—1993, its outbreak being high in plantations in the South-East of Romania, and particularly in the area of Ilfov Agricultural Sector, this determining deeper investigations on the sources of this.

2. MATERIAL AND METHODS

S. commune was identified in 1990—1993 on drying apricot-tree branches and trunks in an orchard at Baneasa-Bucharest.

Observations have been made in cvs and hybrids in the plant-breeding experimental field; the number of trees affected by this pathogen was recorded, and intensity of decline was scored.

The outbreak intensity was recorded using the scale 1—4 (method of Tr. Savulescu), expressing the drying degree of branches of a tree (1 = 5 — 25%; 2 = 26 — 50%; 3 = 51 — 75%; 4 = more than 75% of branches affected).

The attacked trees were 6—17 year old. As differences have been noticed within the same hybrid combination, scoring was made for each specimen.

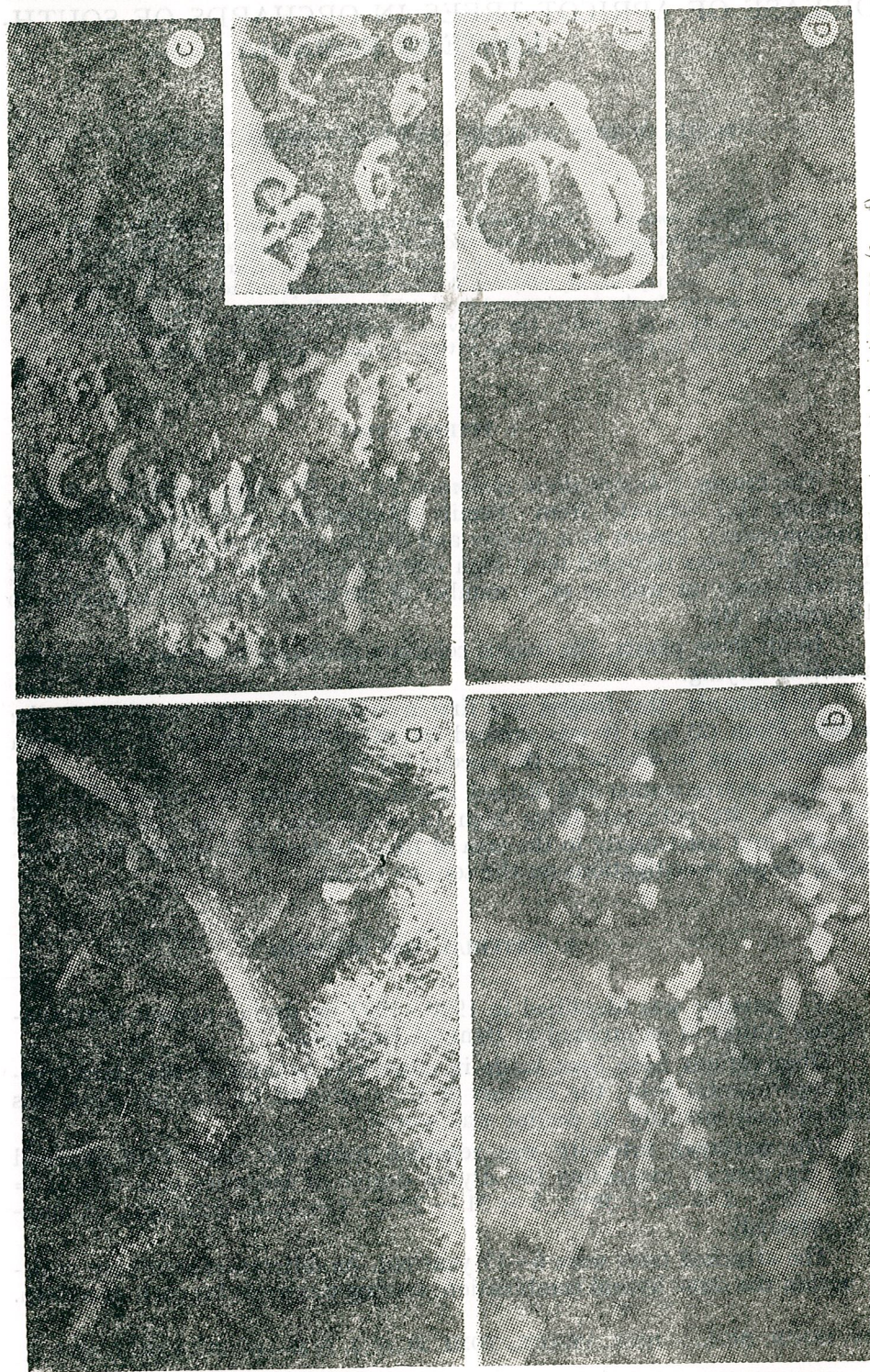


Fig. 1. — *Schizophyllum commune* producing drying of trunks and branches (a — d); basidiocarps (e — f).

3. RESULTS

Symptoms of infected trees were noticed in 1990 season: vigour reduction, leaf yellowing and poor fructification. In the following years, young and multiannual branches started to dry, and *S. commune* carpophores appeared on them (fig. 1).

The infection sources (fig. 2) for this orchard were the neighbouring parks, trees along the roads in the vicinity, various wooden plants, known as hosts of this fungus; in the Herastrau park, trees attacked by *S. commune*

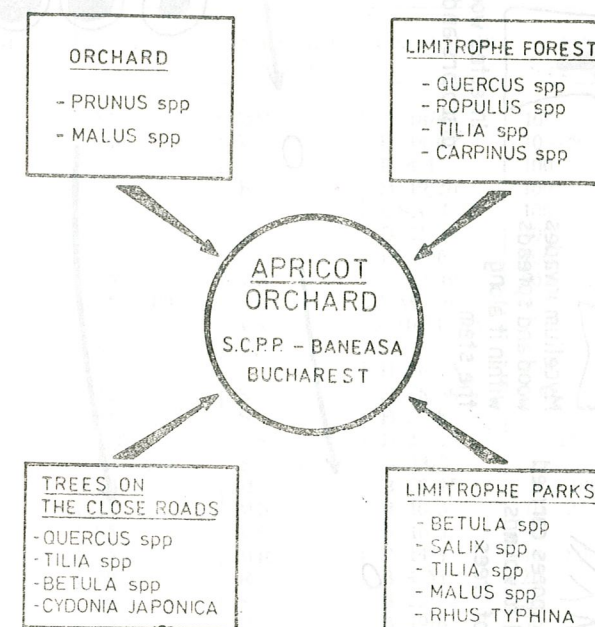


Fig. 2. — Infection sources with *Schizophyllum commune*.

were found dried or drying, showing fructifications on branches and trunks of: *Rhus typhina*, *Betula* spp., *Salix babylonica*, *Acer platanoides*, *Fraxinus angustifolia*, *Populus* sp., *Quercus* sp., *Robinia pseudacacia*, *Tilia* sp., also recorded in recent papers by Romania plant pathologists (3). *Quercus* sp. bordering nearby roads were affected by this fungus, the outbreak intensity being 10–100%.

Low temperatures in 1988–1992 winters, alternating dry summers, contributed to the decline of these trees. On this decline background and a genetic fund inherited by the new apricot cvs and recently created hybrids, the fungus spores penetrated through the wounds present on branches and trunks of these trees. The mycelium resulted from spore germination developed in the cambium tissue and phloem, spoiling the cellular structure, as a result of cellulose metabolism. Under the pressure of mycelial agglomerations, the cortex cleaved and cracked, and numerous carpophores appeared on the bark of trees attacked, imbricated along the bark crevices (fig. 3).

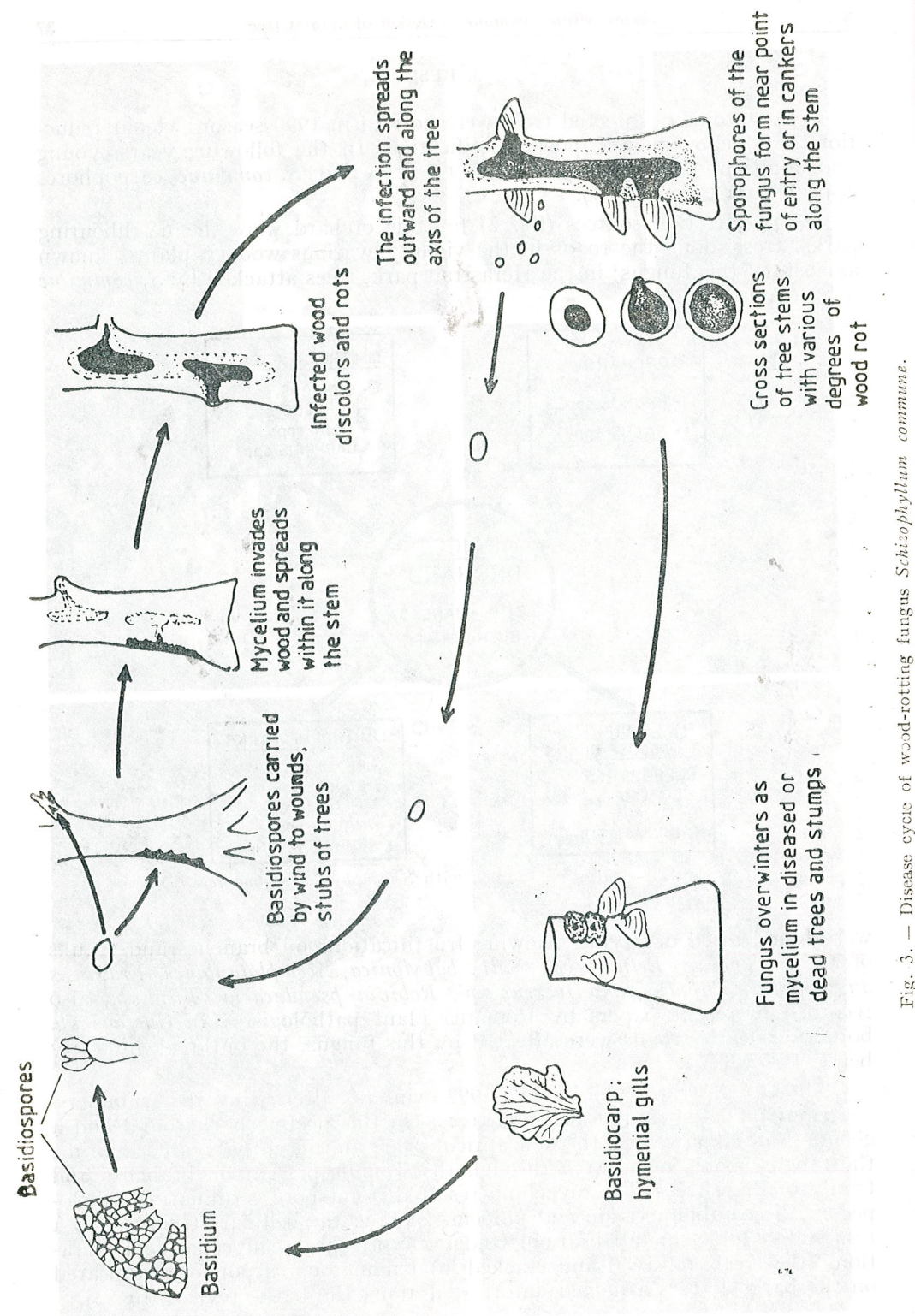


Fig. 3. — Disease cycle of wood-rotting fungus *Schizophyllum commune*.

The basidiocarps were 1–4 cm in diameter, sessile, concoid, grey-whitish in colour. On a wet weather, their colour turned to brown-greyish; on the upper part they are trementuous. On the lower part the fructification body was lined with white lamellae, forked at their end as lamellulae. Basidiospores grown between lamellulae on basidia were first hyaline, then evenly reddish, allantoid, rarely ovoid, measuring $4\text{--}6\ \mu\text{m}/3\ \mu\text{m}$.

Table 1

Behaviour of some apricot cvars and hybrids to the pathogenic activity of the fungus *Schizophyllum commune*

Cvar/hybrid	I%	Reaction to fungus	Cvar/hybrid	I%	Reaction to fungus
Royal	20	MR	B 18/44	100	VS
De Olanda	100	VS	B 14/61	10–50	R–MS
Timpuru de Chisinau	10	R	B 4/41	100	VS
Early Orange	10	R	B 19/20	100	VS
Timpuru de Bancasa	25	MS	USA 1/32	100	VS
Litoral	75–100	VS	B 25/37	100	VS
Sirena	100	VS	B 3/56	100	VS
Erevani	80	VS	B 15/10	60–100	VS
Patriarha			HW 409	10–100	R–VS
Temprano	50	S	C3R11T85	100	VS
B 26/9	45	S	B 26/35	100	VS
B 4/76	100	VS	B 18/36	100	VS
B 23/34	50–100	S–VS	B 5/28	20	MR
MR 9/5	30	MS	B 27/58	5–15	R
B 8/35	12	MR	B 14/2	30	MS
B 4/70	85	VS	B 30/15	18–100	MR–VS
MR 27/9	15	MR	B 10/3	10–25	R–MR
MR 3/22	10	R	B 16/1	40	MR
B 16/7	50	S	B 14/4	10–80	R–VS
MR 28/1	25	MS	B 4/51	20	MR
B 22/17	10	R	B 22/22	50	MS
B 31/4	65	S	B 19/6	30	MR

Resistant (R) = 10–24%
 Medium Resistant (MR) = 10.5–20%
 Medium Sensitive (MS) = 21–30%
 Sensitive (S) = 31–75%
 Very Sensitive (VS) = over 75%

In the plant breeding experimental field at Baneasa-Bucharest cvars and hybrids showed different resistance degrees to this pathogen (Table 1). Tree behaviour was variable even within the same hybrid combination, as depending on the inherited genetic endowment. Thus, in the HW 409 hybrid, some trees were affected only to an extent of 10% (thus considered as resistant to pathogen), while others up to 100% (very sensitive). The same behaviour was noted in hybrids B 27/58, B 30/15, B 14/4.

High sensitivity was shown by the cvars: De Olanda, Litoral, Sirena, Erevani, and the hybrids: B 4/76, MR 27/9, B 4/70, B 18/14, B 4/41, B 19/20, USA 1/32, B 25/37, B 3/56, B 15/100, V 3 R 11 T 85, B 24/35 and B 4/40.

Some trees though attacked, better withstood to disease, losses being more reduced, due to low attack intensities (10—15%), among which: Royal, Timpuriu de Chisinau, Early Orange, B 8/35, MR 27/9, B 22/7, B 27/58.

In the South-Eastern zone of the country, apricot orchards are endangered by this pathogen and particularly trees stressed by unfavourable abiotic factors.

Being a lignicolous, polyphagous and cosmopolitan fungus, the control of *S. commune* is difficult, the unique way being prevention of its spread by cropping apricot tree cvs resistant or tolerant, as well as application of a suitable technology for obtaining vigorous trees.

CONCLUSIONS

S. commune is a polyphagous fungus, parasitic in the cambium tissue and phloem, colonizing forest, ornamental and fruit trees, stressed by certain pedoclimate conditions.

Behaviour of apricot cvs and hybrids to this fungus is variable from a hybrid combination to another, and even within the same hybrid, trees showing different degrees of resistance or sensitivity. Trees of every age are affected (6—17 year -old in the test at Baneasa—Bucharest).

Apricot orchards in the South-East zone of this country generally demonstrated sensitivity to *S. commune*, especially when trees are stressed by unfavourable climate and soil factors.

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BIOPULPING OBTAINING FROM SAWDUST AFTER BIOLOGICAL TREATMENT

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Sawdust was chemical (sodium chloride pulping process) and biological treated (with 4 strains of *Phanerochaete chrysosporium*) to obtain mechanical pulp and biopulp. Also, we tested their capacity for increasing the strength of paper. Biological treatment led to partial depolymerization of lignin and the increase of soluble components in NaOH (twofold-threefold over control). Content of cellulose was slowly decreased. Depending on the strain time for milling and energy requirement for refining decreased up 28 — 55%. We found that biological treatment with different strains of *P. chrysosporium* influenced the handsheet properties.

Chemical pretreatments of wood are used frequently but they have disadvantages of being high consumer of energy and chemical substances and producing troublesome wastewater. Some of these troubles can be avoided by using biological pretreatments of wood chips or sawdust. The technological approaches to biopulping were made by Eriksson (1), Leatham (7), Messner (8).

Our objectives were to obtain biopulp from sawdust after biological treatment with fungi, to compare mechanical and optical properties of handsheet from pulp and biopulp and to make wrapping paper from them.

MATERIAL AND METHODS

Four strains of *Phanerochaete chrysosporium* were used for biological treatment. All strains were grown on potato-dextrose agar medium at 28°C. Inoculum was obtained by growing the strains in glucose-peptone medium for three days. The liquid of cultures was homogenized with waring blender and were added into Erlenmeyer flasks (4L) containing sawdust (150 g) potato (7.5g %) and glucose (10g%).

After biological treatment done 21 days we made chemical analyses and chemical treatment.

Pulp and paper tests were done according to TAPPI standard methods. We compared physical-mechanical properties of sheet paper from SNS process and after biological treatments.

RESULTS AND DISCUSSIONS

From the microbiological point of view the growth of hyphae in sawdust begins after a lag period of 48 h.

After 8 days of incubation mycelium was growing in all content of Erlenmeyer flask obtaining an intimate contact between fungus and sawdust.

After 21 days of incubation there was noticed a decolorized and friable sawdust (with different degrees depending on the strain of *P. chrysosporium*).

Chemical analyses of sawdust before and after biological treatment show that cellulose content is a little bit low in samples treated with *P. chrysosporium* 3, 5-1 and 5-2 (44.6–44.2% against 45.8% for control).

Lignin content is low in all samples (18.6–22.3%) against 28.5% for control) but soluble fractions in NaOH 1% were twofold-threefold over control (Table 1).

Table 1

Chemical analyses of the sawdust before and after biological treatment

Chemicals (%)	Control sample	Samples after biological treatment with <i>P. chrysosporium</i>			
		3	5-1	5-2	BKM
Cellulose	45.8	44.6	44.0	44.2	41.8
Lignin	28.5	21.2	22.3	18.6	20.6
Soluble fractions in NaOH 1%	16.1	32.0	31.6	40.0	36.6

We consider that biological treatment led to partial depolymerization of lignin and increasing of soluble components in NaOH.

The beating degree (CSF = Canadian Standard Freeness) after chemical or biological treatment had the same values but the beating time lower from 85 min (as control) to 18 min (after treatment with *P. chrysosporium* 5-2—Table 2).

Table 2

Beating time for pulps obtaining from sawdust after chemical and biological treatment

Characteristics	Chemical treatment	Chemical treatment + biological treatment with <i>P. chrysosporium</i>			
		3	5-1	5-2	BKM
Beating degree SR	49	51	51	50	49
Beating time (min)	35	20	25	18	21
Decrease of the beating time (%)	—	42	28	55	40

Depending on the strain, time for milling, the energy requirement for refining decreased up to 28–55%.

Biological treatment with different strains of *P. chrysosporium* influenced the handsheet properties. Bulk and density had constant value. Breaking length increased from 3400 m (SNS = control) to 6405 m after treatment with *P. chrysosporium* 3. (Table 3).

Tear index increased of threefold respectively fourfold over control.

Both breaking length and burst index were increased at the handsheets from biopulp together with mycelium (figs 1 and 2). We consider that hypha and polysaccharides produced by *P. chrysogenum* (0.7–0.9g/l) may be very

Table 3

Comparison of properties of pulp obtained from sawdust after chemical and biological treatment

Characteristics	SNS	Chemical and biological treatment with <i>P. chrysosporium</i>			
		3	5-1	5-2	BKM
Air dry grammage (g/m ²)	77.3	81.1	81.4	81.1	79.2
Thickness (mm)	0.135	0.145	0.140	0.140	0.14
Apparent density (g/cm ³)	0.57	0.55	0.58	0.58	0.154
Breaking length (m)	3400	6405	5000	6340	6200
Burst index (kgf/cm)	0.8	2.25	2.6	2.9	2.6
Tear abs/rel. (g/cm/cm)	18/24	61/25	59/71	61/75	60/53
Brightness (%)	44.4/43.4	40.5/40.0	36.8/35.2	41.3/38.0	41.3/40.0

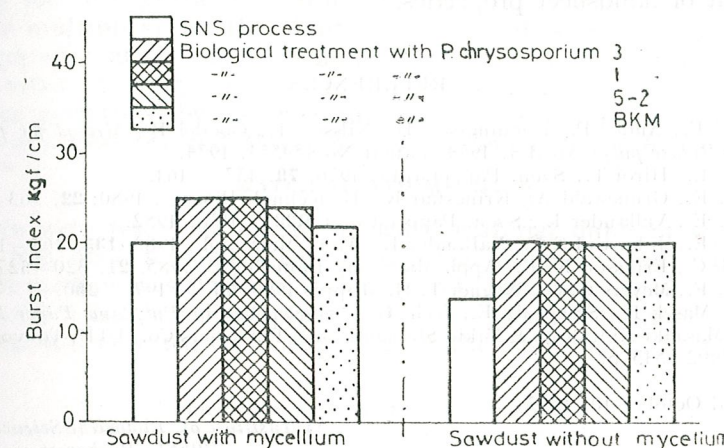


Fig. 1. — Effect of biological treatment of the sawdust with *P. chrysosporium* on burst index of handsheets.

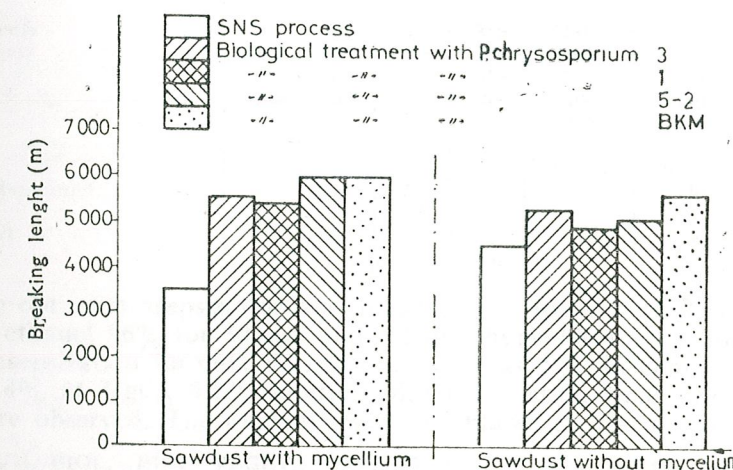


Fig. 2. — Effect of biological treatment of the sawdust with *P. chrysosporium* breaking length of handsheets.

important for improvement of mechanical properties. The same results were obtained by Eriksson (1—4) and Johnsrud (6).

The handsheet had a low reduction in brightness but this is not a trouble for wrapping paper.

CONCLUSIONS

1. Biological treatment of the sawdust determined a lignin loss of about 30% and an increase of soluble fractions in NaOH about twofold over control.

2. After biological treatment a decrease of the beating time (28—55%) was obtained.

3. Tear and burst indexes were increased about two fold over control.

4. Mycelium and exopolysaccharides produced by fungi can determine improvement of handsheet properties.

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"IN VITRO" ORGANOGENESIS AT *ALOE ARBORESCENS* (LILIACEAE)

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The "in vitro" micropropagation of *Aloe arborescens* Mill. was studied. The fragments of stem from axillary shoots were aseptized in ethanol (30 sec) and then immersed in a calcium hypochlorite saturated solution (30 min). The best medium for inoculation was MS basal medium without hormones, because the first stages of development are inhibited by the presence of hormones in culture medium. The presence of a magnetic fluid in the culture medium of the neoformed plantlets, stimulates the secondary shooting, as well as the general development of the plants and the rhizogenesis process.

Species of *Aloe* genus are native from South Africa to Arabic peninsula (2). In Europe it is cultivated *Aloe arborescens* Mill., originated from tropical and meridional Africa. It is utilized usually as a decorative plant, as well as for therapeutic and cosmetics purposes. Even if it has an easy vegetative multiplication, the limited number of shoots per plant per year suggested that the rate of multiplication could be increased through "in vitro" techniques. In vitro culture at different species of *Aloe* genus were performed by Greenewald et al., 1971 (*A. pretoriensis* (1)), Natali et al., 1990 (4) and Meyer & van Staden, 1991 (*A. barbadensis* (3)).

MATERIAL AND METHODS

There were tested as initial biological material different segments of shoots (5 mm diameter and 5 cm length), leaf fragments, stem fragments. The culture medium was MS basal with different hormonal balances (Table 1).

Because it is a succulent plant, it is very sensitive to aseptization (the sterilizer agent penetrated very easily through the tissue and caused damages).

Table 1
Chemical composition of culture mediums

Component	Culture medium						
	13	13-1	13-2	49	61	61-1	61-2
Macroelements	MS	MS	MS	MS	1/2MS	1/2MS	1/2MS
Microelements	MS	MS	MS	MS	MS	MS	MS
Vitamins	MS	MS	MS	MS	MS	MS	MS
Myo-inositol mg/l	100	100	100	100	100	100	100
IAA mg/l	—	—	—	1	1.8	1.8	1.8
BAP mg/l	—	—	—	2	—	—	—
KIN mg/l	—	—	—	—	0.011	0.011	0.011
Magnetic fluid mg/l	—	30	60	—	—	30	1380
Agar g/l	8	8	8	8	8	8	8
Sucrose g/l	30	30	30	30	30	30	30

pH 5.6—5.8

The optimum aseptization was realized with water with Tween 20 for 20 min., ethanol 96% for 30 sec. and calcium hypochlorite 7% for 30 min. At this aseptization formula necrosis percent was 5%, in comparison with 60.3—86.4% at HgCl₂ 0.1% solution (different action time). No infection cases were observed. The explants were inoculated in 100 cc conic flacon.

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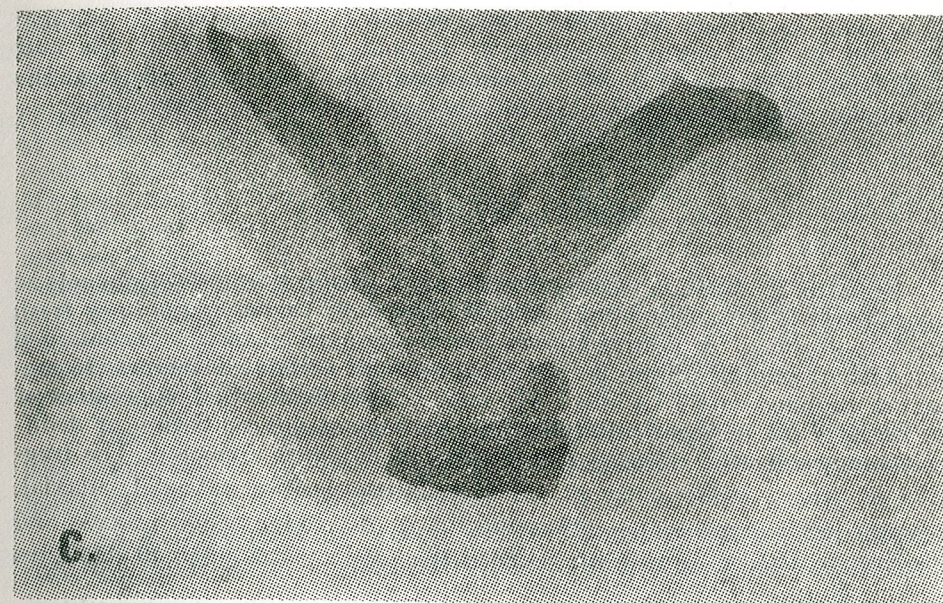
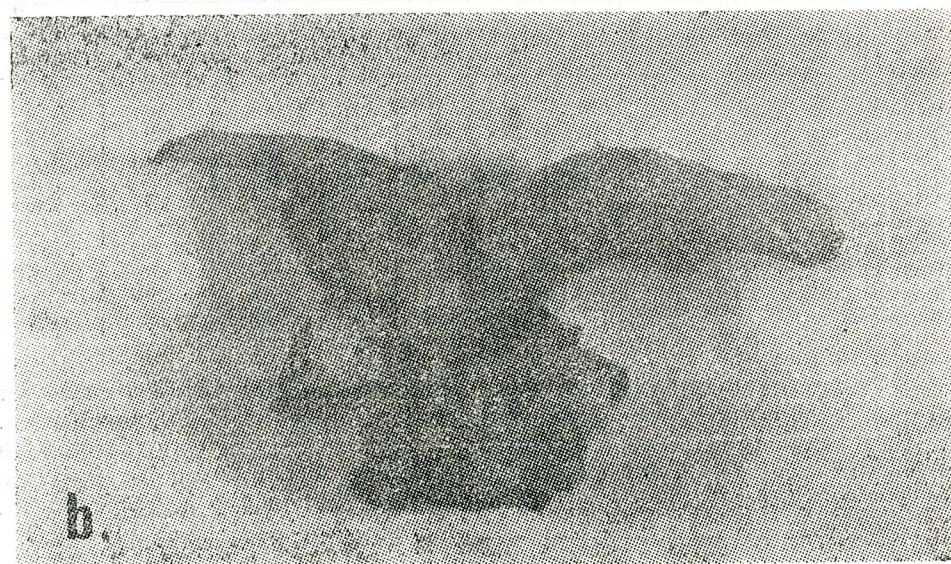
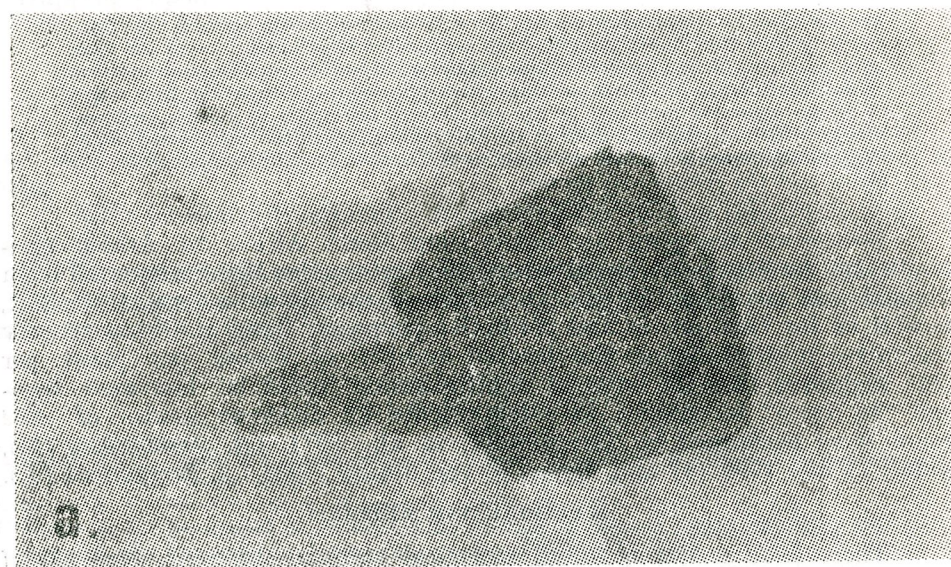


Fig. 1. — Organogenesis process in *Aloe arborescens* Mill.
 a. The main shoot at 12 days after inoculation (MS basal medium);
 b. The secondary shoots at 30 days after inoculation (MS basal medium);
 c. In vitro neoformed plant through subculture of main shoot (MS basal medium with 60 mg/l magnetic fluid);
 d. Rhizogenesis process on the 61 — 2 medium (1380 mg/l magnetic fluid).

The climate conditions in growth room were: 25°C temperature, 16h/day light, 2400 lx. The culture initiation is depending on the season, the best results being recorded in April-September months. There were observed the development stadiums of the explants through biometrical observations.

RESULTS AND DISCUSSIONS

24h after inoculation there was observed a strong synthesis of phenols at explant basis. It is recommended that in the first days a repassing on new fresh spots be performed. A positive answer concerning morphogenesis was obtained from stem fragments (5 mm) on MS basal medium without hormones (13 medium) or supplied with IAA and BAP, ratio 1:2 (49 medium). The presence of IAA or KIN (61 medium) inhibited all processes of differentiation or dedifferentiation, and after 45 days the necrosis of explants appeared. The fragments of leaves, indifferently of the inoculation position (abaxial, adaxial, vertical), didn't present any differentiation or dedifferentiation process and after 60 days they were necrotic, even if they were viable until 40–45 days after inoculation.

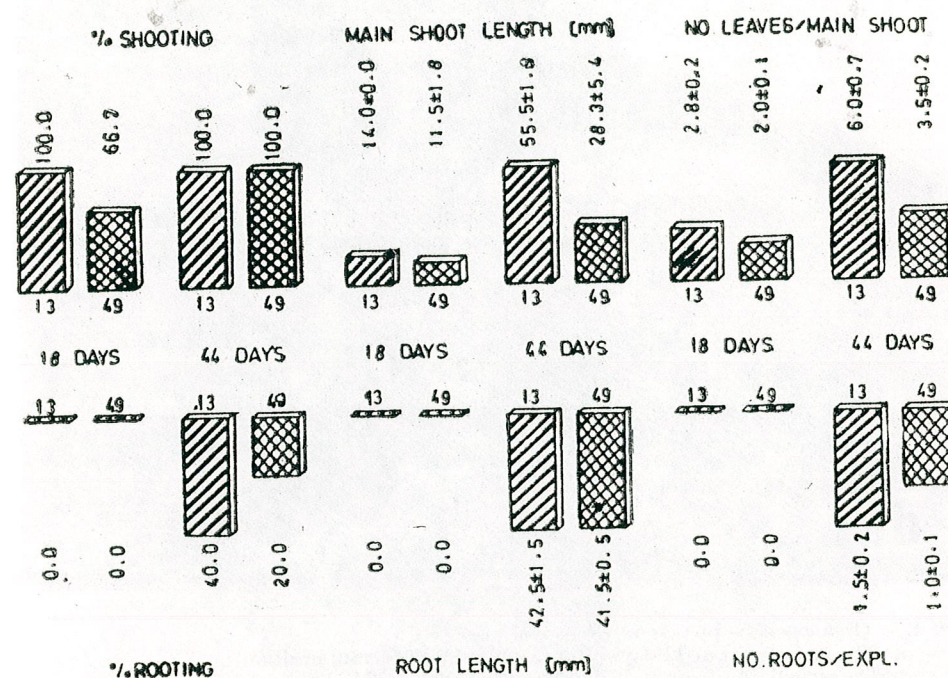


Fig. 2. — Shooting percent, rooting percent, main shoot length, root length, no. leaves/main shoot and no. roots/explant on MS basal medium without hormones (13) and on MS basal medium with 1 IAA: 2 BAP (49) at 18 and 44 days.

Caulogenesis process

The main shoots were developed at 10–12 days after inoculation (Fig. 1a). The secondary shoots were formed at the basis of the main shoots at 30–35 days after inoculation (Fig. 1b). 18 days after inoculation one shoot/explant was formed on MS basal medium without hormones (13), as well as on MS basal medium supplied with 1 IAA: 2 BAP (49). The shooting percent was 100% on 13 medium and 66.7% on 49 medium, where only after 44 days arrived at 100%, (Fig. 2). The shoots formed on 13 medium were better developed than on 49 medium, the difference between them being bigger at 44 days after inoculation. The shoots had 55.5 ± 1.8 mm length and 6.0 ± 0.7 leaves on 13 medium (Fig. 2). There were observed also a great variability concerning the length of the shoots formed on medium with 1 IAA: 2BAP, $s_x = 5.4$ mm at $\bar{x} = 28.2$ mm.

These results suggested that the evolution of normal development process is inhibited by the presence of growth regulators in medium, even if the hormonal balance is right for shooting.

Even if the shooting process was stimulated, concerning the number of shoots/explant, on 49 medium the increase with 0.5 shoots/explant did not justify hormone utilization from the economical point of view.

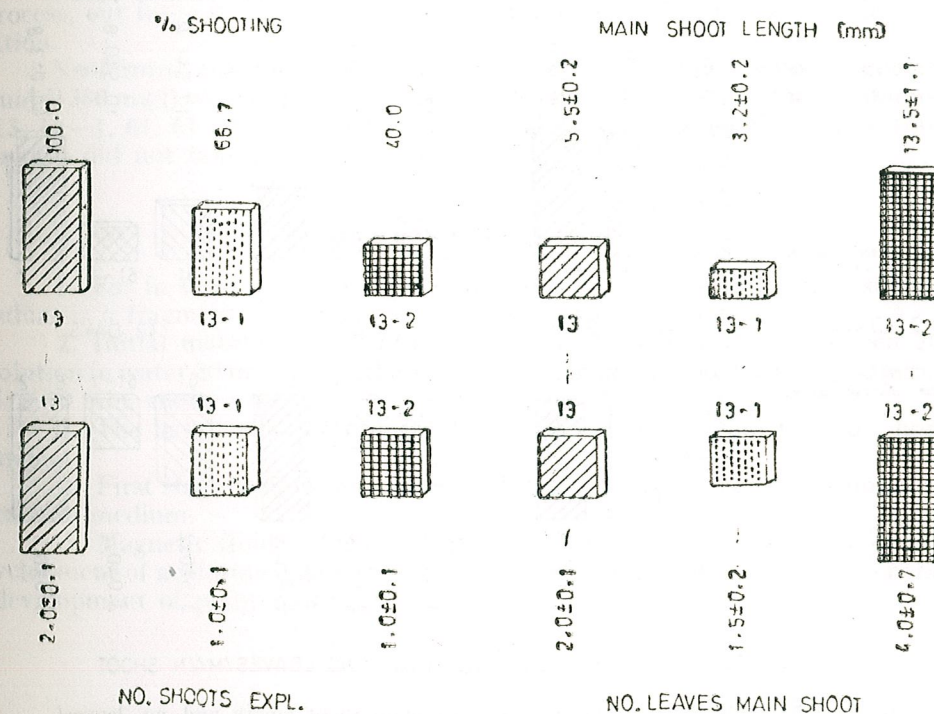


Fig. 3. — Shooting percent, no. shoots/expl., main shoot length and no. leaves/main shoot at stem fragments on basal MS medium (13), supplied with 30 mg/l MF (13-1) and with 60 mg/l MF (13-2).

Subculture of neoformed main shoots

The main shoots were subcultivated as stem fragments (5 mm), on basal MS medium (13), supplied with 30 mg/l magnetic fluid (MF) (13-1) and with 60 mg/l MF (13-2). The shooting percent at stem fragments was 100% on 13 medium and decreased with the increase of MF concentration (66.7% on 13-1 medium and 40.0% on 13-2 medium). The number of shoots/explant was twice on 13 medium confronted with the medium with MF, but the growth rhythm is higher on the medium with 60 mg/l MF (Fig. 3). The presence of magnetic fluid MF in culture medium disturbs the process of tissue differentiation in shoots and stimulates the growth of the shooting and rooting process (Fig. 1c, 1d). No secondary shoots were formed on medium without hormones, but they appeared after transfer on MS basal medium supplied with 1.8 mg/l IAA and 0.011 mg/l KIN (61 medium) at the basis of the plantlets.

Subculture of neoformed secondary shoots

The secondary shoots of 5 mm length were transferred on MS basal medium without hormones, with MF (13, 13-1, 13-2) for a first phase of development until 21 days and after this period, on MS basal medium sup-

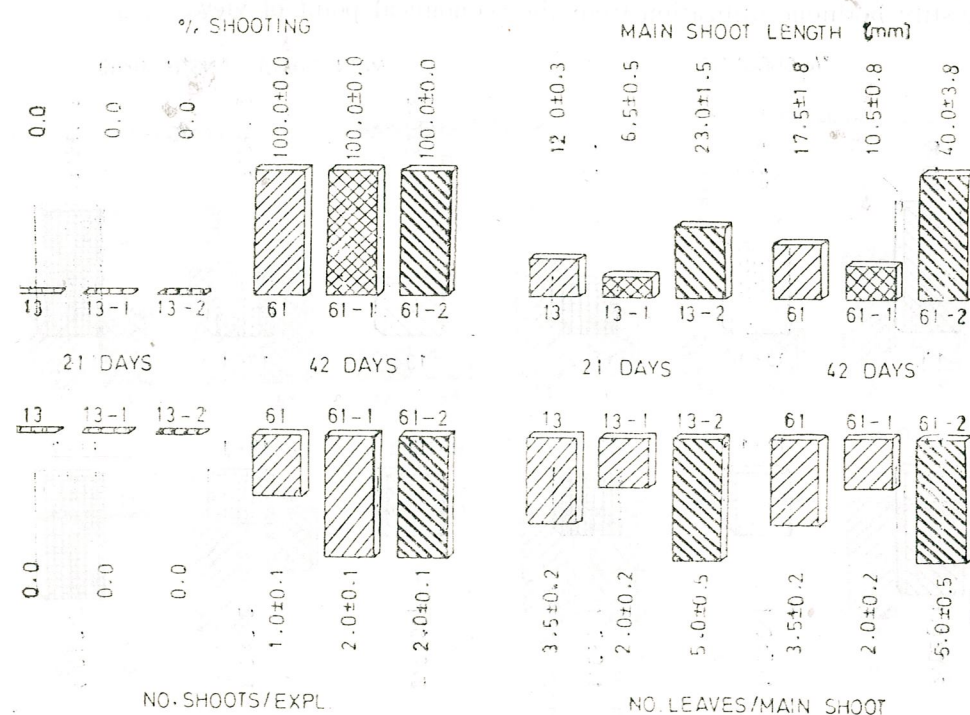


Fig. 4. — Shooting percent, no. shoots/expl., main shoot length and no. leaves/main shoot on basal MS medium (13), supplied with 30 mg/l MF (13-1) and with 60 mg/l MF (13-2) at 21 days and then transferred on MS basal medium supplied with 1.8 mg/l IAA and 0.011 mg/l KIN (61) and MF: 30 mg/l (61-1); 1380 mg/l (61-2) at 42 days.

plied with 1.8 mg/l IAA and 0.011 mg/l KIN (61) and MF: 30 mg/l (61-1); 1380 mg/l (61-2) (Fig. 4). Concerning the development of shoots, there was observed that a high concentration in MF (60 mg/l) improved the growth process: shoot length was 23.0 ± 1.5 mm at 21 days and 5.0 ± 0.5 leaves in comparison with 12.0 ± 0.8 mm length and 3.5 ± 0.2 leaves on control medium (13) (Fig. 4). The second phase of development had as aim the growth and rooting of plantlets. The best results were obtained on 61-2 medium (1380 mg/l MF): the shoots length was 40.0 ± 3.8 mm comparatively with 17.5 ± 1.9 mm on control medium (Fig. 4). The number of leaves/shoot was maintained at the same level as at 21 days. Secondary shoots number increased also, through the addition of MF, from 1.0 ± 0.0 on basal medium to 2.0 ± 0.1 on medium with 30-1380 mg/l (Fig. 4).

Rooting process

Rooting process was observed at neoformed plantlets, 30 days after inoculation (Fig. 1d). The rooting rate at just formed shoots was 40% on MS basal medium (13) and 20% on medium supplied with IAA and BAP. The number of roots/explant and their size was also superior on medium without hormones (13) (Figs. 2-4). Rooting appeared in this case as an auxiliary process, our interest being almost in shooting for the first phase after inoculation.

Neoformed plantlets transferred on medium supplied with magnetic fluid (1380 mg/l) were rooting 100%, after 21 days, while on the other mediums (13, 13-1, 61, 61-1), even with a hormonal balance proper for rooting this process did not take place.

CONCLUSIONS

1. For in vitro micropropagation at *Aloe arborescens* Mill. the best inoculum is a fragment of stem proceeded from axillary shoots.
2. Initial material aseptization 100% can be obtained with Tween 20 solution in water 20 min, pure ethanol 30 sec., calcium hypochlorite 7% 30 min., 5×10 min. sterile water.
3. The best medium for inoculation is MS basal medium without hormones.
4. First stage of development is inhibited by the presence of hormones in culture medium.
5. Magnetic fluids added in culture medium for a second stage of development of neoformed plantlets stimulate the secondary shooting, the general development of plant rooting.

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RAPHANUS SATIVUS SEEDS — SOURCE FOR NEW LECTINS

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Raphanus sativus seeds were the source of new lectins which have been purified to homogeneity by affinity chromatography on Fetuin-Sepharose. They have different specificities, for raffinose, for lactose and for fucose, similar molecular weights, about 100 — 120,000 and different pH solubilities. The lectins for raffinose are soluble on a large domain, in contrast with those of lactose and fucose which precipitate at pH 5.

Lectins are proteins (glycoproteins) capable of specific recognition of, and reversible binding to, carbohydrate moieties of complex glycoconjugates without altering the covalent structure of any of the glycosyl ligands (Kocourek and Horejsi 1983).

The main consequence of their carbohydrate binding properties is the ability to agglutinate cells or to precipitate glycoconjugates. Lectins became valuable tools for the purification of glycoproteins, for the study of carbohydrate moieties of other complex structures, and also for medical research (Pusztai 1991, Sharon and Lis 1989).

Both lectins implications in biological processes and their usefulness in sa tools for investigations, support the increased interest in these particular molecules.

A great number of the identified and purified lectins are isolated from plants. The reachest source of lectins are dried seeds (*Phaseolus vulgaris*, *Ricinus communis*, *Glycine max*, *Datura stramonium* and many others). However, lectins have been isolated from other parts of the plants like tubers (*Solanum tuberosum*), bulbs (*Galanthus nivalis*), fruits (*Lycopersicon esculentum*), stems (*Cucumis sp.*) or germinated seeds (*Triticum vulgare*) (Liener et al. 1986).

The present paper describes the isolation and purification of some lectins from *Raphanus sativus* seeds.

MATERIALS AND METHODS

The seeds of *Raphanus*, provided by a vegetable farm from the previous year crop, were ground and the resulted meal was used in further assays.

EXTRACTION 5 grams of seed meal were extracted at 4° C with 50 ml of borate buffer, 0.2 M, pH 8.2 overnight. The mixture was centrifuged for 30 minutes at 10,000 rpm. The lipidic material concentrated above was removed by paper filtration of the supernatant.

DIALYSIS The clear supernatant was dialysed against acetate buffer, 0.05 M, pH 5. Some of the extracted proteins precipitate during dialysis.

FRACTIONATION After dialysis, the extracted proteins were separated in two fractions by centrifugation: a soluble fraction — the supernatant and an insoluble one, the precipitate, which was dissolved in a minimum volume of PBS and dialysed overnight against the same buffer.

HEMAGGLUTINATING ACTIVITY The agglutinating activity was tested on both normal rabbit erythrocytes and trypsinized rat red cells. The lectins serial dilutions were performed in PBS.

HEMAGGLUTINATION INHIBITION This assay was done by replacing the PBS from every tube with 0.1 M solution of the inhibiting sugar. The lectins or crude lectin preparations serial dilutions were performed in these solutions and waited 30 minutes for lectin inhibition. In parallel a normal agglutination is performed and used as control for the inhibiting activity.

AFFINITY CHROMATOGRAPHY ON FETUIN-SEPHAROSE The fetuin — Sepharose column was prepared in accordance with the instructions for coupling ligands to CNBr-activated Sepharose 4B from Pharmacia Fine Chemicals.

I. The column was equilibrated in acetate buffer. The pH 5 soluble proteins were applied to the column. Unbound material was eluted by washing the column with the same buffer until the A 280 fell below 0.02. The lectin elution was done with 0.1 M raffinose prepared in the same buffer.

II. The same column, after 8M urea washing, was equilibrated in PBS. The pH 5 precipitated proteins, solubilized in the same buffer, were applied to the column. The elution was performed with 0.1 M lactose in PBS, and after washing the column two times its volume with PBS, a second elution is done, with 0.1 M fucose in this buffer.

PROTEIN DETERMINATION was done by the Lowry method (4).

POLYACRYLAMIDE GEL ELECTROPHORESIS was performed in 7.5% gels, in Tris Glycine buffer, pH 8.4. The purified lectins were migrated on individual gels at the same time with a set of standard proteins, migrated individually too. The considered proteins were cytochrome c, ovalbumin, bovine serum albumin, glutamate-oxalylacetate transaminase, bovine alkaline phosphatase, urease.

RESULTS AND DISCUSSIONS

Generally, the lectin presence in a total protein extract is estimated by emphasizing its hemagglutinating properties, followed by the hemagglutination specific inhibition by the heptenic sugar.

The borate buffer crude extract exhibited hemagglutination only on the trypsinized rat red cells. The hemagglutination inhibition revealed the existence of more than one inhibitor, the best being fetuin (a complex glycoprotein, containing both N- and O- glycosylated domains). The results are presented in Table 1.

The crude extract fractionation by acid dialysis resulted in two proteic populations, separated by their different solubility. Both emphasized hemag-

glutinating properties. Surprisingly, the pH 5 soluble proteins presented a stronger agglutination, both on treated and untreated red cells, stronger than in the initial extract. Apparently, one of the precipitated proteins acted as an inhibitor in the total initial extract.

The agglutination was totally inhibited by raffinose, a triglucide containing alpha-galactose, glucose and beta-fructose, also called melitose.

The affinity chromatography on fetuin — Sepharose, in the above mentioned conditions, gave a single peak, eluted with raffinose (Fig. 1a). The polyacrylamide gel electrophoresis showed a major band of about 120,000, accompanied by a minor band, with a lower electrophoretic mobility (Fig. 1b).

Table 1

The hemagglutination inhibition of crude *Raphanus* seed extract

Sugar	The last dilution with hemagglutination
None	1/2 ⁵
Galactose	1/2 ³
Mannose	1/2 ⁵
N-acetylglucose amine	1/2 ⁷
N-acetylgalactose amine	1/2
Fucose	1/2 ³
Lactose	1/2 ³
Raffinose	1/2 ³
Fetuin	none

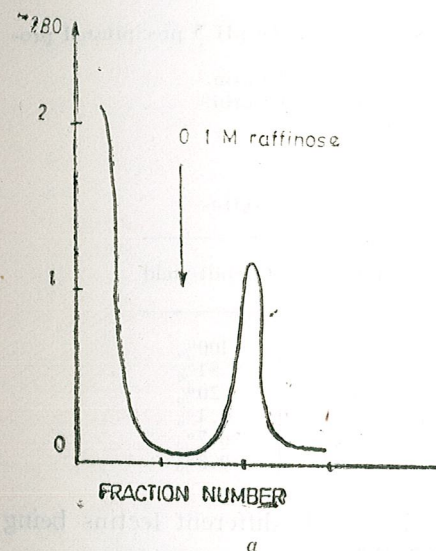
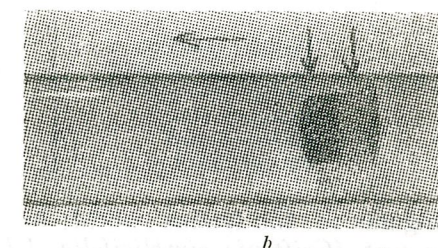


Fig. 1. a — Affinity chromatograph on Fetuin — Sepharose of the pH 5 soluble proteins; b — Polyacrylamide gel electrophoresis of the raffinose eluted lectin.



The second protein fraction, consisting of the insoluble proteins at pH 5, solubilized in PBS, emphasized agglutination only on trypsinized rat cells. The best inhibitor was fetuin, so affinity chromatography on this support was performed. The lactose elution gave a single peak, with a single band at electrophoresis (Figs 2 a and b). The protein balance stressed that protein remained on the column, fucose elution was performed, and another peak was obtained. The PAAGE, showed a single band, with a lower mobility than the others, but still higher than GOT (80,000), (fig. 2c).

A summary of the purification is presented in Table 2.

It seems that *Raphanus sativus* seeds constitute a new source of lectins and that different lectins coexist in the same seed such a behaviour is not

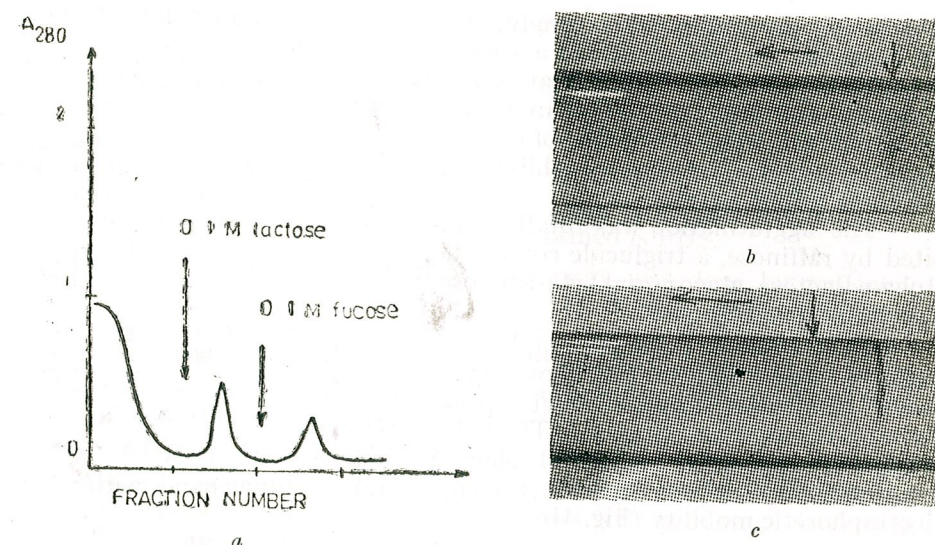


Fig. 2. a. — Affinity chromatography on Fetuin — Sepharose of the pH 5 precipitated proteins.

b — Polyacrylamide gel electrophoresis of the lactose eluted lectin.
c — Polyacrylamide gel electrophoresis of the fucose eluted lectin.

Table 2

Purification of the *Raphanus sativus* seed lectins

Procedure	Total protein (mg)	Agglutination	Overall yield
Borate extraction	188.8	1/2 ⁵	100%
Acetate supernatant	153.84	1/2 ⁸	81%
Acetate precipitate	39.86	1/2 ⁴	20%
Raffinose eluted	7.9	1/2 ¹⁰	4.1%
Lactose eluted	1.39	1/2 ⁴	0.7%
Fucose eluted	0.69	1/2 ³	0.3%

singular in the lectins world; in many other seeds different lectins being present (*Griffonia simplicifolia*, *Ulex europaeus*).

The key step of the *Raphanus* lectins separation is the affinity — chromatography on the same affinity support, fetuin — Sepharose.

Fetuin is a complex glycoprotein, also useful in other lectins separation because of its complex carbohydrate domain. It consists in both N- and O-glycosidically linked chains, with sialic acid, beta-galactose and N-acetylglucosamine residues (Edge and others 1987, Nilsen and coll. 1979).

The beta galactose presence supports the lactose elution of lectin.

The coupling to Sepharose, a polygalactosyl matrix may also support the raffinose lectin elution. An intriguing fact is this affinity separation of the fucose specific lectin.

If we look fucose as 6-deoxy-L-galactopyranose we may assume that during the complex interactions taking place in the fetuin immobilization,

either some of the fetuin molecules exhibit an accessible residue to this lectin, or the support (D-galactose-3-6-anhydro-L-galactose) becomes an affinity support.

The involvement of these lectins in physiological processes in the plant as well as some of their practical applications will be presented in another paper.

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L'EFFET DU CADMIUM SUR LES PIGMENTS CHLOROPHYLLIENS, LA PHOTOSYNTHESE ET L'ULTRASTRUCTURE CELLULAIRE CHEZ *CHLORELLA VULGARIS*

GABRIELA VLĂDEANU, H. TIȚU

La toxicité du cadmium administré comme acétate a été testée chez *Chlorella vulgaris*.

On a poursuivi l'effet du cadmium dans les processus d'accroissement des accumulations des pigments chlorophylliens, de photosynthèse et ultrastructure cellulaire.

Les concentrations 100 γ /l et 1000 γ /l acétate de cadmium ont déterminé la diminution des niveaux des processus suivis, tandis que les doses plus grandes ont détruit les cellules des algues dès le premier jour des expériences. L'ultrastructure de l'appareil photosynthétique et des autres organites cellulaires a été également altérée par l'action du cadmium.

Le cadmium, comme d'autres métaux lourds, peut affecter le métabolisme des organismes végétaux (16), (17). L'accumulation du Cd dans les plantes grandit avec l'augmentation du ion respectif dans le milieu de culture à cause de sa mobilité (15). Il produit la diminution du contenu en pigments chlorophylliens, celui en pigments caroténoïdes étant moins affecté (3), (6).

Le cadmium est un inhibiteur potentiel de la photosynthèse (5), (13), (14). En même temps, le Cd produit des dérèglements de la synthèse des polipeptides contenus dans les membranes des thylacoïdes, ce que détermine des modifications régressives de la structure interne de l'appareil photosynthétique (4), (18) ainsi que des diminutions du volume et du nombre des organites respectives (12) chez de nombreuses plantes de cultures.

Cet ouvrage s'inscrit dans la lignée des recherches susmentionnées traitant de l'effet du Cd sur certains aspects de la physiologie et de l'ultrastructure cellulaire chez l'algue *Chlorella vulgaris*.

MATÉRIEL ET TECHNIQUES

Comme matériel on a utilisé la souche de *Chlorella vulgaris* de la collection de l'Institut de Biologie de Bucarest. Les expériences qui ont duré sept jours ont été réalisées dans une chambre noire en lumière continue d'une intensité de 8000 lux et une température moyenne de +20°C. Les cultures algales se sont développées dans un milieu Arnon dans lequel on a ajouté du cadmium sous forme d'acétate (CH_3COO)₂Cd.2H₂O en concentration de: 100, 1 000, 10 000 et 100 000 γ /l. Chaque jour on a déterminé le nombre des cellules/ml de suspension algale. Après sept jours, à la fin du cycle de culture, on a déterminé: l'accumulation des pigments chlorophylliens (par la méthode Holm — extraction en acétone 80%) et la photosynthèse (par le procédé

manométrique Warburg, en utilisant comme source de CO_2 la solution Warburg n° 9 qui assure en phase liquide un contenu de $91 \cdot 10^{-6}$ mols CO_2/l .

Le rapport entre les chlorophylles *a* et *b* ($R_{a/b}$) a été calculé selon la formule élaborée par MACKINEY (19), ARNON (2) et BRUINSMA (7):

$$R_{a/b} = \frac{0,57(4,7 \cdot A_{663} - A_{645})}{4,87 (A_{645} - A_{663})}$$

où A_{663} et A_{645} représentent les adsorptions mesurées à 663 et 645 nm.

Microscopie électronique. Des épreuves des cultures liquides du témoin et de celles où l'on a ajouté de l'acétate de cadmium ont été centrifugées à 5 000 g; après 2–3 lavages à l'eau distillée, le sédiment a été fixé avec glutaraldéhyde 4% en tampon phosphate 0,1 M et ensuite avec tétraoxyde d'osmium 1%. Le matériel ainsi fixé a été mélangé à agar Noble 2%, chauffé à 45°C et, après solidification à 4°C, a été coupé en cubes de 0,5 mm³ qui ont été deshydratés et inclus en Epon 812. Les ultrasections ont été faites à l'aide d'un appareil TESLA 490A, colorées avec de l'acétate d'uranyle et citrate de plomb et examinées au microscope électronique TESLA 500.

RÉSULTATS ET DISCUSSION

I. Accroissement des cellules, pigments chlorophylliens, photosynthèse. Des données représentées dans le tableau 1, mettant en évidence le déroulement du processus d'accroissement des cultures d'algues exprimé par le nombre de cellules/ml suspension, on a constaté que la division des cellules a lieu de plus en plus lentement si la concentration du Cd dans le milieu s'accroît.

Tableau 1

Evolution du nombre des cellules chez *Chlorella* sous l'action de l'acétate de cadmium

Durée de l'expérience (jours)	La variante				
	Témoin-Arnon	100 γ $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$	1.000 γ $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$	10.000 γ $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$	100.000 γ $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$
	millions cellules/ml suspensions				
0	0,2	0,2	0,2	0,2	0,2
1	10,4	9,1	0,45	—	—
2	12,0	10,4	1,1	—	—
3	18,0	11,4	3,0	—	—
4	21,2	18,6	9,85	—	—
5	25,0	23,2	17,8	—	—
6	24,8	23,5	15,4	—	—
7	24,0	23,4	13,4	—	—

croît. A la fin du cycle de culture, la densité numérique a été de 23 400 000 cellules/ml de suspension chez la variante de 100 γ/l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ et 13 000 000 cellules/ml suspension chez la variante de 1 000 γ/ml $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ tandis que le témoin a enregistré 24 000 000 cellules/ml.

Les concentrations de 10 000 γ/l et 100 000 γ/l se sont avérées létales pour les suspensions algales, les cellules étant détruites dès le premier jour de culture.

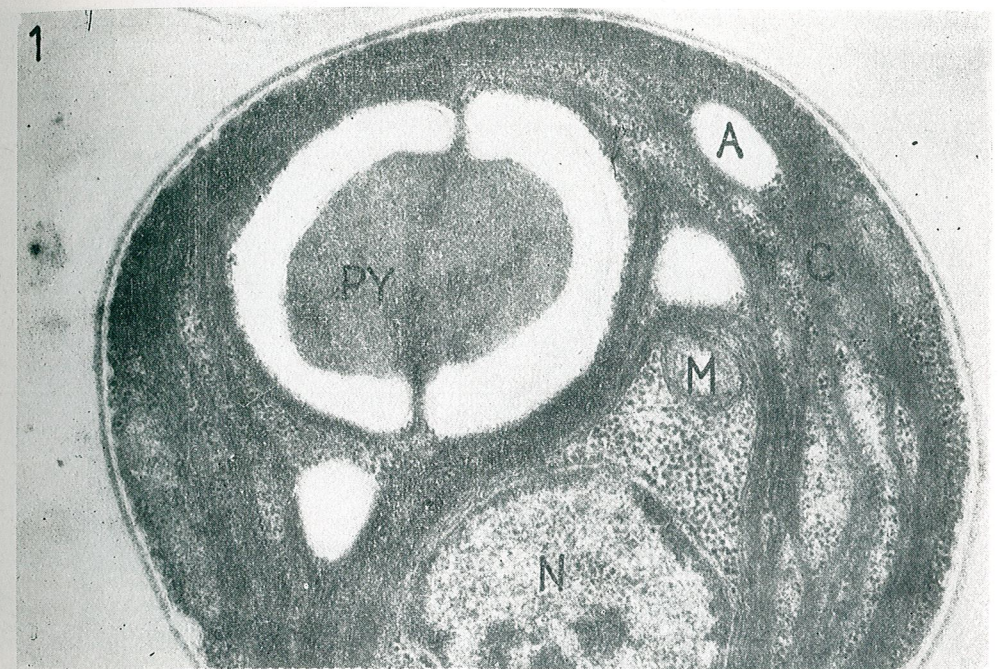


Fig. 1. — *Chlorella vulgaris*. Vue d'ensemble d'une cellule contenant la plupart des organites et inclusions habituellement rencontrés: C, chloroplaste avec pyrénioïde (PY), amidon (A); M, mitochondrie; N, noyau. Témoin. Grandissement $\times 39\,000$.

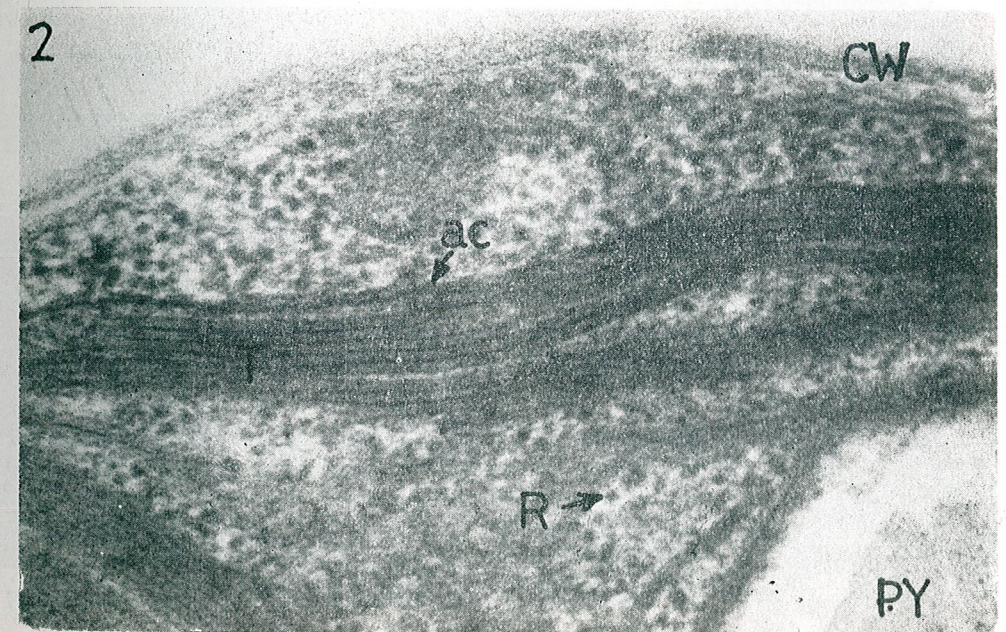
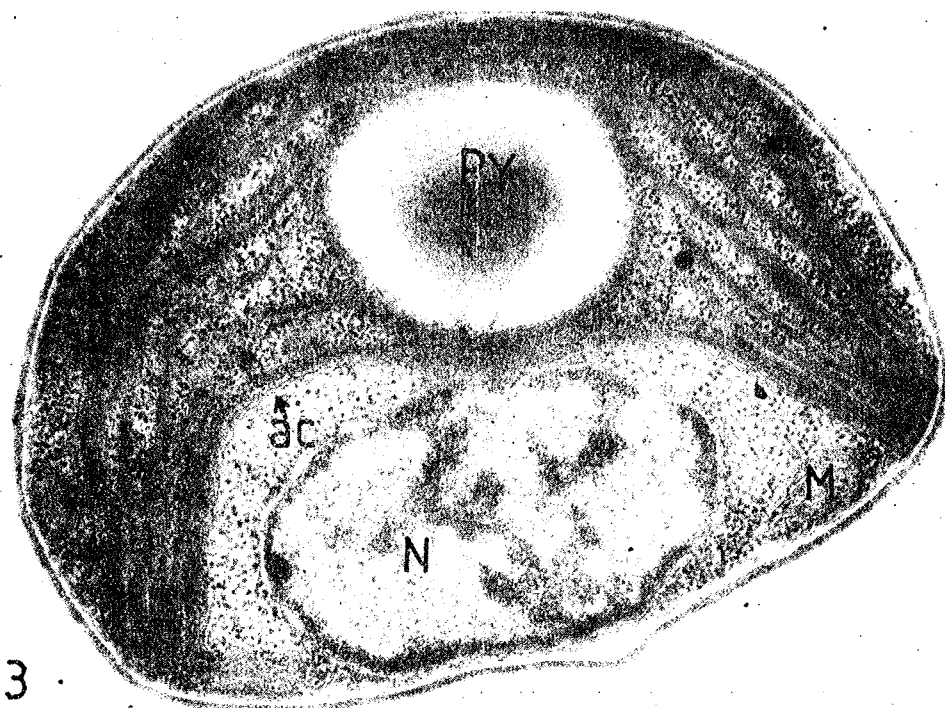
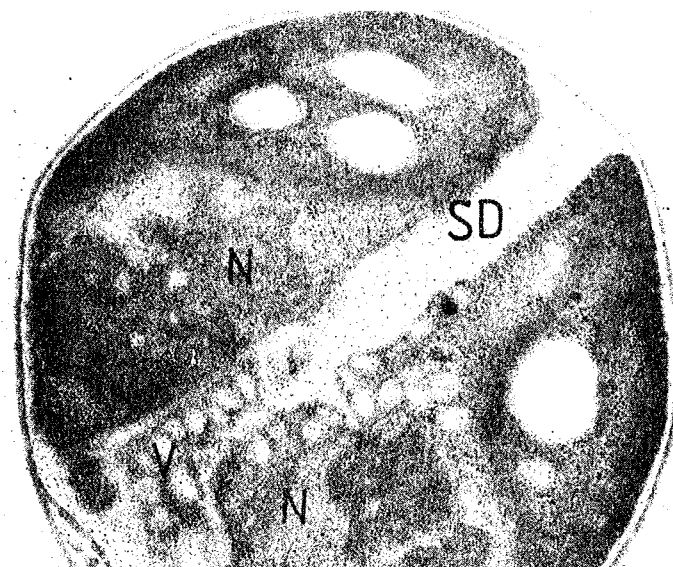


Fig. 2. — Portion de cellule avec mise en évidence des thylacoïdes (T); ac, enveloppe du chloroplaste; R, ribosomes; CW, paroi cellulaire. Témoin. $\times 100\,000$.



3
Fig. 3. — *Chlorella vulgaris*. L'ensemble des membranes photosynthétiques est composé d'un nombre plus réduit de thylacoïdes. Acétate de cadmium. 100 γ /l. $\times$ 44 000.



4
Fig. 4. — Division de la cellule. Vésicules (V) nombreuses dans la zone du septum (SD). Acétate de cadmium. 100 γ /l. $\times$ 26 000.



5
Fig. 5. — *Chlorella vulgaris*. Désintégration d'une partie des thylacoïdes (flèches simples); la membrane cytoplasmique (MC) est détachée de la paroi cellulaire (flèches doubles). Acétate de cadmium 1000 γ /L. $\times$ 35 000.



6
Fig. 6. — Hypertrophie des mitochondries et désintégration des thylacoïdes. D, dictyosome. Acétate de cadmium 1000 γ /l. $\times$ 45 000.

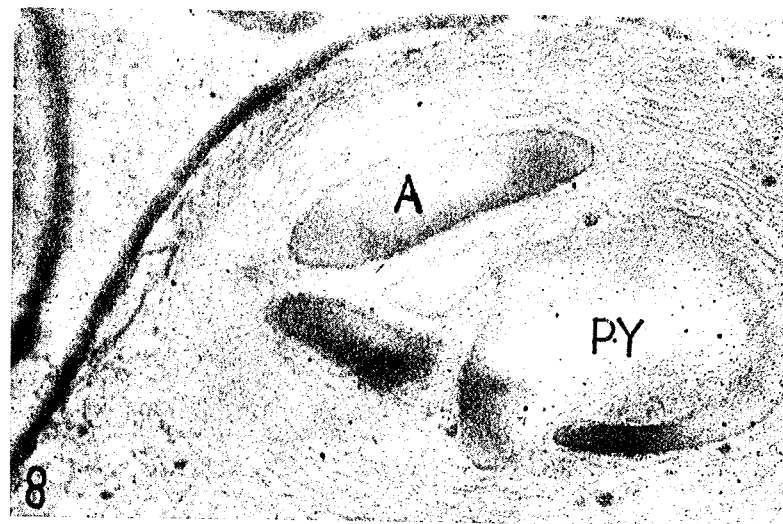
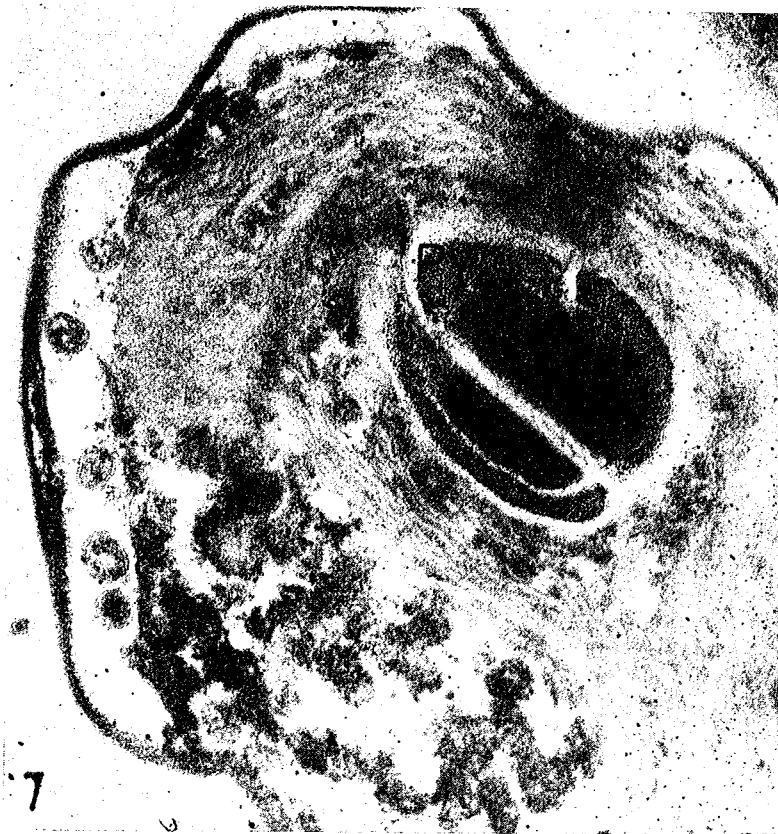


Fig. 7 et 8. — *Chlorella vulgaris*. Étapes successives de la désorganisation de l'appareil photosynthétique: dilatation des thylacoïdes, dispersion des éléments du pyrénoïde. 1 000 γ /l. $\times 39\ 000$ et $\times 46\ 000$.

En ce qui concerne l'accumulation des pigments chlorophylliens (Tableau 2), on remarque une diminution du contenu en chlorophylle *a* et *b* chez toutes les épreuves. La chlorophylle *a* est de 4,85% plus petite à la concentration de 100 γ /l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ et de 50,51% plus réduite à 1 000 γ /l $(\text{CH}_3\text{COO})_2\text{H}_2\text{O}$, par rapport au témoin. De toute façon le contenu en chlorophylles *a* + *b* a diminué significativement par rapport au témoin dans les cas des deux variantes testées: 10,38% pour 100 γ /l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ et 56,53% pour 1 000 γ /l. Le rapport entre les chlorophylles *a* et *b* enregistre un accroissement pour toutes les deux variantes avec du Cd (Tableau 2).

Tableau 2
Effet de l'acetate de cadmium sur le contenu de la chlorophylle *a* et *b*

Pigments	Le témoin Arnon	100 γ	1.000 γ
		$(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$	$(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$
		mg pigments/l g substance séchée	
Chlorophylle a	36,95	35,16	18,29
Chlorophylle b	25,91	21,18	9,04
Chlorophylle (a + b)	62,86	56,34	27,33
Chlorophylle a	1,47	1,80	2,21
Chlorophylle b			
Effet de l'acetate de cadmium sur l'intensité de la photosynthèse			
cm ³ O ₂ /h/l g substance séchée			
	5.370	4.851	2.685

Nos données présentées jusqu'ici concernant les pigments chlorophylliens des cultures de *Chlorella vulgaris* traitées au Cd sont en quelque mesure ressemblantes à celles obtenues par Dragoş et collab. (11) pour deux autres algues vertes, *Monoraphidium contortum* et *Kirchneriella subcapitata*, constatant que les deux métaux lourds Zn et Cd administrés séparément dans le milieu de culture produisent la diminution du contenu en pigments chlorophylliens en même temps que l'accroissement de la durée de la multiplication; lorsqu'on ajoute en même temps du Cd et du Zn dans le milieu de culture, le même effet inhibiteur se produit seulement si on utilise des concentrations deux fois plus grandes des deux métaux mentionnés.

Des recherches approfondies concernant la synthèse de la chlorophylle chez le haricot et l'épinard sous l'influence du Cd ont été effectuées par Pamaja et collab. (20), Hampp et collab. (14).

L'effet inhibiteur du Cd, comme le démontre le tableau 2, se manifeste dans le processus de photosynthèse chez *Chlorella vulgaris*: l'intensité de la photosynthèse se réduit par rapport au témoin de 9,6% pour une concentration de 100 γ /l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ et de 50% à la concentration de 1 000 γ /l (Tableau 2). Le cadmium n'est donc pas favorable à l'accroissement de la culture de *Chlorella vulgaris* quand il est ajouté dans le milieu dans les doses mentionnées: les organismes ne réussissent plus à parcourir le processus de photosynthèse dans les mêmes conditions de température et lumière que celles de l'épreuve témoin. Des résultats pareils ont obtenu d'autres chercheurs aussi qui ont analysé l'effet inhibiteur du Cd sur les activités des systèmes photosynthétiques PS I et PS II, des glucides ainsi que d'autres aspects du méta-

bolisme chez la lucerne, le trèfle (Becerril et collab., 1988), la tomate (Baszynski et collab. 1980).

II. *Ultrastructure cellulaire*. Les variations du contenu en pigments chlorophylliens et de l'intensité de la photosynthèse ont des répercussions aussi sur l'ultrastructure de l'appareil photosynthétique et sur d'autres organites cellulaires.

Les figures 1 et 2 reproduisent les aspects de l'ultrastructure cellulaire chez *Chlorella vulgaris* de l'épreuve témoin qui présente des ressemblances avec le contenu cellulaire d'autres formes et espèces appartenant au même genre (1), (8—9), (21—23): chloroplaste en forme de clocher avec pyrénioïde, thylacoïdes disposés parallèlement les uns par rapport aux autres et accolés par 3—5 sur une grande partie de leur longueur, amidon, plastoglobules, etc.; le cytoplasme aussi inclut mitochondries, réticulum endoplasmique, dictyosomes, peroxyosomes, ribosomes. Le noyau occupe une position pariétale et symétrique par rapport aux extrémités du chloroplaste. La membrane cytoplasmique présente de nombreuses invaginations et les portions planes apparaissent attachées à la paroi cellulaire.

La culture dans laquelle on a ajouté 100 γ /l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ se compose en premier lieu de cellules dont la structure est plus ou moins similaire à celle du témoin (fig. 3), mais le système des membranes photosynthétiques est différencié en granums composés d'un nombre plus réduit de thylacoïdes; le reste des cellules se trouvent dans un état primaire de division, ce qui démontre l'inhibition du ce processus par l'action du cadmium (fig. 4). A une dose de 1 000 γ /l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ on remarque plusieurs aspects dégénératifs du contenu cellulaire: a) distorsions et désintégrations d'une partie notable des membranes photosynthétiques, les substances de réserve (l'amidon) sont localisées seulement autour du pyrénioïde; la membrane cytoplasmique n'est pas attachée à la paroi cellulaire (fig. 5); b) l'appareil photosynthétique dont la structure interne est partiellement détruite présente l'aspect d'une masse compacte électrodense; les mitochondries sont hypertrophiées, les dictyosomes hautement désintégrés; l'enveloppe nucléaire est fragmentée (fig. 6). Ces données nous rappellent les recherches effectuées par Keul et collab. (17) dont les expériences concernant le blé et le maïs ont démontré l'inactivation par le cadmium de certaines enzymes du cycle Krebs impliquées dans le métabolisme mitochondrial; c) cellules qui se trouvent dans un état avancé de désorganisation où on ne reconnaît plus que le chloroplaste beaucoup dégénéré, sans enveloppe, muni de dilatations ou de dégradations du système thylacoïdal, gardant quand même une partie du pyrénioïde (fig. 7); d) le contenu cellulaire presque en totalité détruit: il ne restent que des rudiments de membranes simples et des substances de réserves de la structure de l'appareil photosynthétique (fig. 8). Pareilles recherches concernant l'influence du cadmium sur les microorganismes photosynthétisants doivent être continuées et approfondies au niveau cellulaire et moléculaire.

CONCLUSIONS

Nos recherches concernant l'influence de l'acétate de cadmium sur la multiplication, l'accumulation des pigments chlorophylliens, la photosynthèse et l'ultrastructure cellulaire chez *Chlorella vulgaris* ont conduit aux conclusions suivantes:

— Les concentrations de 100 γ et 1 000 γ /l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ produisent l'inhibition des processus étudiés, déterminant par la diminution du contenu en pigments chlorophylliens, la diminution de l'intensité de la photosynthèse et l'altération de l'ultrastructure des organites cellulaires.

— Les concentrations de 10 000 γ /l et 100 000 γ /l $(\text{CH}_3\text{COO})_2\text{Cd} \cdot 2\text{H}_2\text{O}$ sont létales pour *Chlorella vulgaris*.

Nous remercions la Direction de la firme SERVA d'azoir eu l'amabilité de mettre à notre disposition tous les réactifs nécessaires à l'accomplissement des recherches faisant l'objet de cette étude.

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A MATHEMATICAL METHOD FOR THE INDIVIDUAL SORTING FROM A POPULATION

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The selection of biochemical mutants assumes the analysis of an extremely large number of individuals for finding those with optimal values. A similar problem appears at the selection of genitors and hybrids for the analysis of chemical composition of fruits, because of the high cost of the chemical analysis, (2). We propose a systematic method, suitable for computer implementation, for the selection of genitors and hybrids to be analyzed for the chemical composition of fruits. The method concerns the estimation of the dependence curves for different hybrid biochemical features (a certain mother with many father genitors), (2).

The genetic control of the content in proteins of seeds and protein composition of different cereal and vegetable seeds was intensely studied during the last decades. The main difficulty of this problem is finding methods for the selection from a great number of plants of those suitable for biochemical analysis of protein composition (3,4), and other substances. As mentioned by Gottschalk (3), the selection of the biochemical mutants assumes the analysis of an extremely large number of individuals for finding those with optimal or at least promising values. At barley were analyzed 25000 M₂ plants, choosing only 20 plants with a somewhat increased lysine contents. At Sorghum were analyzed 25000 plants, only one mutant being promising for its protein quality. At barley, wheat and rice, even if there are valuable biochemical mutants, the small production does not justify their direct utilization.

A similar problem appears at the selection of tomato greenhouse genitors and hybrids for the analysis of chemical composition of fruits, due to the high cost of the chemical analysis, (2). The problem of finding the valuable genotypes at hybrids can be simplified by the establishment of the dependence between the hybrid combination value and values recorded for the genitors.

MATERIAL AND METHODS

The values recorded in five years (1985—1989) about some quantitative features of plants and fruits at 160 genitors and 150 greenhouse hybrids were statistically processed with the help of NOTEBOOK 2100 computer. The main features analyzed were: fruit weight, fruit size, number of fruits in inflorescence, fruits weight in inflorescence, pericarp thickness, number of fruit loculus (means obtained from 50 observations), as well as fruits chemical composition including content in TDS, SDS, ascorbic acid, sugar, acidity, determined using classical methods.

There was studied the combinative capacity of different genotypes (one as mother and many as father), through the analysis of the dependence curves of one character at hybrid dependent on the value of the same character recorded at the father genitors. The dependence curves were approximated with analytic curves obtained using the least-squares procedure, (1).

There is a problem with the chemical composition of fruits, because the number of determinations is not large enough for a proper establishment of

the dependence curves. A method is needed to select for the analysis of the chemical composition of fruits of those which ensure a proper estimation of the dependence curves.

RESULTS AND DISCUSSIONS

The biometrical values of genitors and tomato hybrids obtained in 1985–1989 years were processed for the establishment of the best genitors and hybrid combinations at greenhouse culture. As an example, the best results of the year 1987 are shown in Tables 1 and 2.

Table 1
Values of some tomato genitors in 1987

Genotype	Fruit weight (g)	Fruits number in infl.	Fruits weight in infl.	TDS (g%)	SDS (g%)	Ascorbic acid (mg%)	Sugar (g%)
Golden Queen	204.7	3.9	798.33	4.8	4.3	14.0	3.7
Harvestvee	111.1	4.2	466.62	4.7	3.6	17.6	2.3
ST-27	106.6	5.2	554.32	4.0	3.4	17.6	2.7
V-6730	99.1	4.8	475.68	5.0	4.0	13.0	4.0
C-2405	90.6	5.0	453.00	4.2	3.2	16.0	2.4
C-2404	86.7	7.9	684.93	5.6	5.0	26.0	4.0
Elassland	81.4	6.7	545.38	5.4	4.6	19.5	2.3
Subarc. Maxi	63.8	7.7	491.26	3.5	3.0	17.6	2.0
Ottawa-107	61.3	21.7	1330.21	4.7	3.6	17.6	2.3
Early Subarc.	35.2	5.8	204.16	5.0	3.6	21.0	2.4
Cervena Kapka	2.8	98.0	274.4	5.5	4.8	35.5	2.3

Table 2
Values of some hybrid combinations obtained in 1987

Hybrid combination (♀ × ♂)	Fruit weight (g)	Fruits number in infl.	Fruits weight in infl.	TDS (g%)	SDS (g%)	Ascorbic acid (mg%)	Sugar (g%)
Elassland × Harvestvee	144.9	3.5	507.15	5.0	4.6	19.5	3.7
Elassland × Golden Queen	104.3	8.5	886.55	5.0	4.6	17.6	3.7
Elassland × V-6730	99.0	7.4	742.5	4.8	4.0	17.6	3.6
Elassland × ST-27	93.7	6.9	646.53	4.0	3.6	28.0	2.8
C-2405 × ST-27	93.5	7.5	701.25	5.2	4.0	16.0	2.6
C-2404 × C-2405	87.1	9.9	862.29	4.4	4.0	17.6	2.4
C-2405 × C-2404	86.7	9.3	806.31	4.6	4.0	17.6	2.4
C-2404 × ST-27	84.4	8.1	683.64	5.0	4.5	22.0	2.6
Cerv. Kapka × Ottawa-107	78.0	9.9	772.2	6.7	6.0	17.6	2.6
Ottawa-107 × Cerv. Kapka	74.5	8.5	633.25	7.5	6.0	29.0	3.0
Elassland × C-2404	66.2	8.9	589.18	4.8	4.5	17.6	3.1
Subarc. Maxi × Early Subarc.	59.5	7.8	464.1	4.3	4.3	16.0	2.8

There were analyzed the dependence curves for the obtained hybrids between a mother genitor with many father genitors for the characters recorded. The analysis of the dependence curves permits to establish the following facts:

- the value of a character at mother and father genitors being known, it is possible to estimate the character value for hybrid;
- the value of the character at mother genitor being known, and the expected character value for hybrid being given, it is possible to estimate the character value for the father genitor, thus leading to controlled hybridization;
- it is possible to establish the limits in which a mother genitor optimally reacts, and to eliminate those father genitors which have a reduced limit for the transmission of the features in hybrids when they are crossed with the given mother genitor.

The dependence curves were approximated with analytic curves, obtained using the least-squares procedure, (1). In almost all the cases analyzed, the most suitable function for approximation was the polynomial function of degree two of the form $f(x) = -ax^2 + bx$, with $a > 0$ and $b > 0$.

If x_i and y_i are the character values for the father genitors and hybrids, $i = 1, \dots, n$, n being the number of the analyzed combinations, and $f(x)$ the function used for approximation, a and b can be computed by minimizing the expression

$$E(a, b) = \sum_{i=1}^n (y_i - f(x_i))^2$$

The function $f(x) = -ax^2 + bx$, with $a > 0$ and $b > 0$ has a maximum value of $y_{\text{III}} = b^2/4a$ in $x_{\text{III}} = b/2a$. If k is such that $0 \leq k \leq 1$, it can be established that

$$(1-k)y_{\text{max}} \leq f(x) \leq (1+k)y_{\text{max}} \quad (1)$$

if and only if

$$(1-k^{1/2})x_{\text{max}} \leq x \leq (1+k^{1/2})x_{\text{max}} \quad (2)$$

If we substitute k in (1) and (2) with 5%, we obtain the following result: if the above function $f(x)$ is the approximated dependence curve for a given mother genitor, this mother genitor optimally reacts with those father genitors with the character value between 77% x_{max} and 123% x_{max} yielding a character value for the hybrid combination between 95% y_{max} and y_{max} .

Table 3 shows the limits of the character values at hybrids depending on the character values at father genitors for a given mother genitor, obtained from inequalities (1) and (2), for different values of k .

Figure 1 shows the approximated dependence curves at fruit weight for Rossol (1985). Early Alberta (1986) and Severianin (1985) mother genitors. Curves of a similar shape were recorded for sugar at Elassland (1987) and Severianin (1985) mother genitors (figure 2).

At TDS it was still possible to approximate the dependence curves with polynomial functions of degree two, but for the range of values recorded the curves obtained have a little different shape, showing increasing functions (figure 3).

Also for Hilds Matine (1986) sort it was used for approximation an increasing linear function of the form $f(x) = ax$, with $a > 0$ (figure 4).

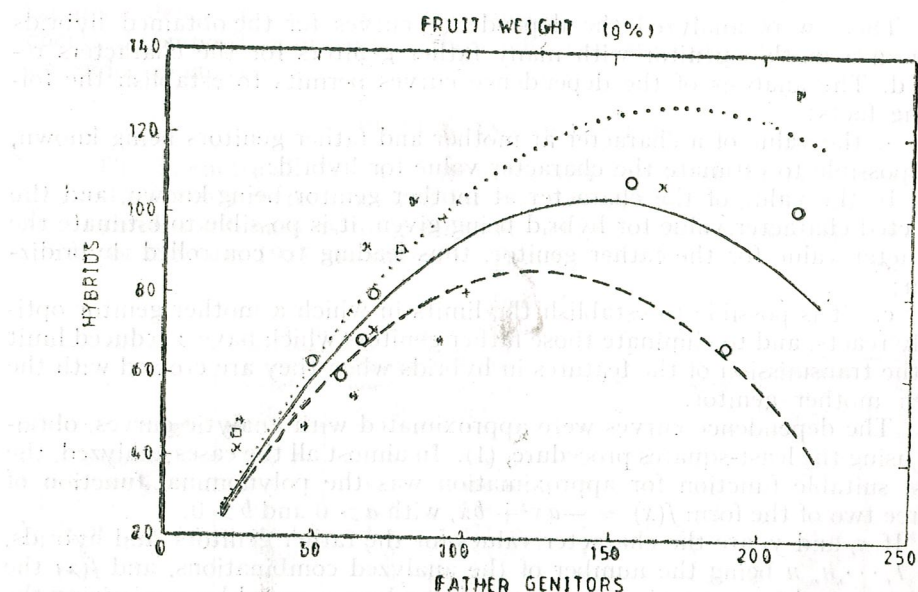


Fig. 1. — Fruit weight (g%). — and 'o': approximated dependence curve and determinations for Rossol (1985) mother genitor. --- and '+': approximated dependence curve and determinations for Early Alberta (1986) mother genitor. and 'x': approximated dependence curve and determinations for Severianin (1985) mother genitor.

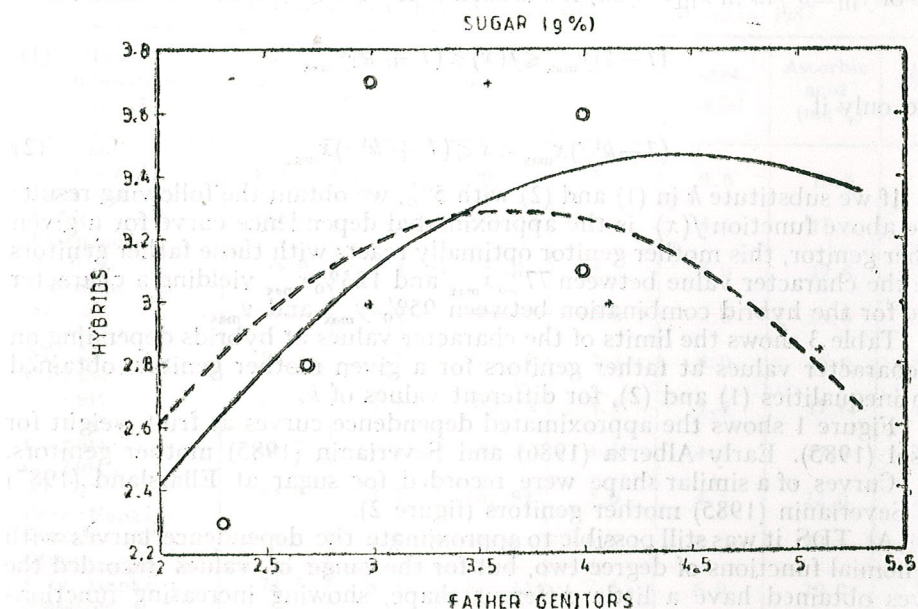


Fig. 2. — Sugar (g%). — and 'o': approximated dependence curve and determinations for Ellassland (1985) mother genitor. --- and '+': approximated dependence curve and determinations for Severianin (1985) mother genitor.

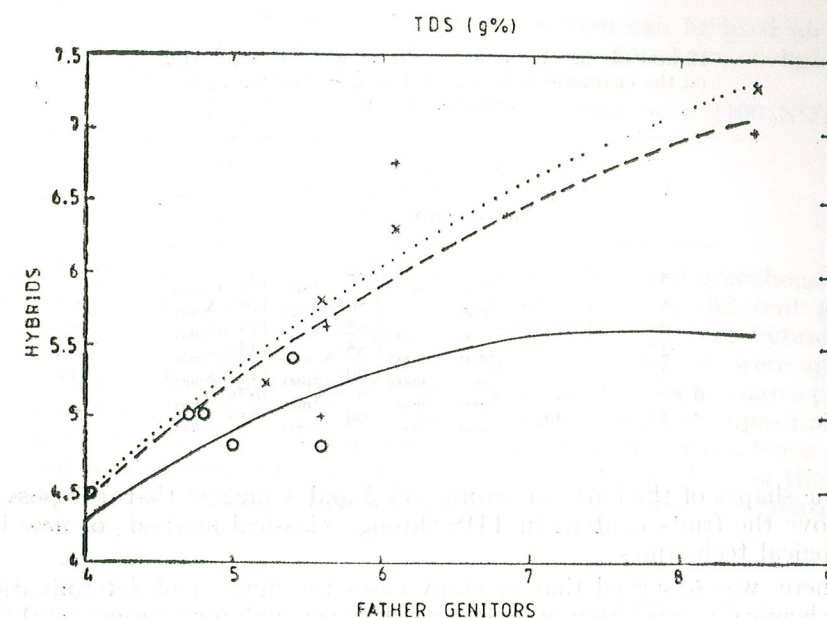


Fig. 3. — TDS (g%). — and 'o': approximated dependence curve and determinations for Ellassland (1987) mother genitor. --- and '+': approximated dependence curve and determinations for Severianin (1985) mother genitor. and 'x': approximated dependence curve and determinations for Floradade (1985) mother genitor.

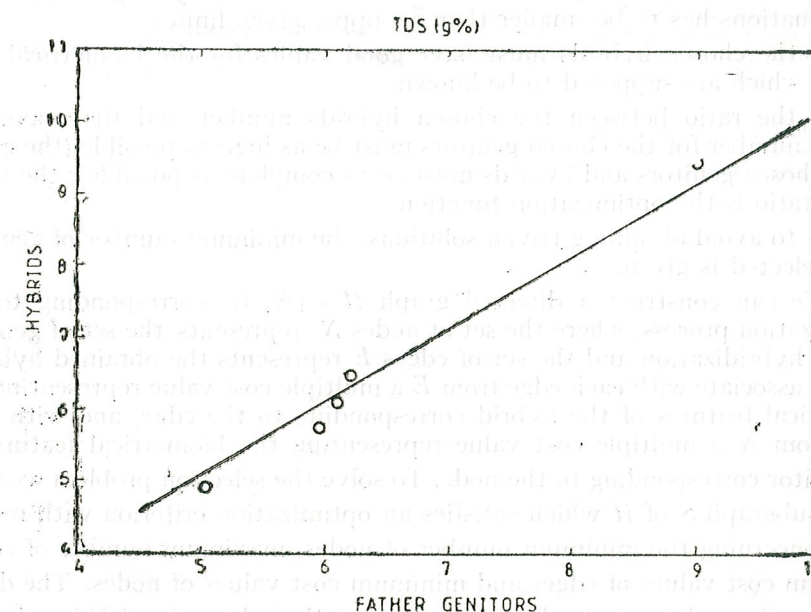


Fig. 4. — TDS (g%). — and 'o': approximated dependence curve and determinations for Hilds Matine (1986) mother genitor.

Table 3

Limits of the character values at hybrids depending on the character values at father genitors, for a given mother genitor

k	Limits of the character value at the hybrids	Limits of the character values at the father genitors
5%	$[95\% y_{\max}, y_{\max}]$	$[77\% x_{\max}, 123\% x_{\max}]$
4%	$[96\% y_{\max}, y_{\max}]$	$[80\% x_{\max}, 120\% x_{\max}]$
3%	$[97\% y_{\max}, y_{\max}]$	$[82\% x_{\max}, 118\% x_{\max}]$
2%	$[98\% y_{\max}, y_{\max}]$	$[85\% x_{\max}, 115\% x_{\max}]$
1%	$[99\% y_{\max}, y_{\max}]$	$[90\% x_{\max}, 110\% x_{\max}]$
0.05%	$[99.5\% y_{\max}, y_{\max}]$	$[93\% x_{\max}, 107\% x_{\max}]$
0.01%	$[99.9\% y_{\max}, y_{\max}]$	$[99\% x_{\max}, 101\% x_{\max}]$

The shapes of the curves from figures 3 and 4 suggest that it is possible to improve the fruits content in TDS through classical methods or new biotechnological techniques.

There was observed that in many cases the number of determinations for the chemical composition of fruit is not large enough for a proper establishment of the dependence curves. We propose a method for the selection of plants for the analysis of the chemical composition of fruits which ensures an as proper as possible estimation of the dependence curves. This method is based on the following facts:

- because of the high cost of the biochemical analysis, the number of determinations has to be smaller than an upper given limit;
- the chosen hybrids must have good values for the biometrical characters, which are supposed to be known;
- the ratio between the chosen hybrids number and the maximum hybrids number for the chosen genitors must be as high as possible (the group of the chosen genitors and hybrids must be as complete as possible); the value of this ratio is the optimization function;
- to avoid obtaining trivial solutions, the minimum number of genitors to be selected is given.

We can construct a directed graph $H = (N, E)$ corresponding to the hybridization process, where the set of nodes N represents the set of genitors used in hybridization and the set of edges E represents the obtained hybrids. We can associate with each edge from E a multiple cost value representing the biometrical features of the hybrid corresponding to the edge, and with each node from N a multiple cost value representing the biometrical features of the genitor corresponding to the node. To solve the selection problem we must find a subgraph S of H which satisfies an optimization criterion with restrictions concerning the minimum number of nodes, maximum number of edges, minimum cost values of edges and minimum cost values of nodes. The determination of graph S can be done by searching the subgraphs of H for an optimal subgraph which satisfies the given restrictions.

We note that another optimization criterion can be used for the searching process (for example, that some mother genitors have enough determinations for the estimation of the dependence curves).

All the computations and graphics were done on a 2100 NOTEBOOK computer using MATLAB.

CONCLUSIONS

Using the values recorded at 160 genitors and 150 greenhouse tomato hybrids, it was analyzed the combinative capacity of different genotypes through the analysis of the dependence curves for different hybrid features (a certain mother with many father genitors). These curves were approximated with polynomial functions of degree two using the least-squares procedure. Because the number of determinations for the chemical composition of fruit is not large enough for a proper establishment of the dependence curves, a method is proposed for the selection of plants for the analysis of the chemical composition of fruit, which ensures an as proper as possible estimation of the dependence curves.

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Radioecology and Environmental Protection by András S. Szabó, Académiai Kiadó, Budapest, 1993, 258 p., 36 fig., 100 tab.

Radioecology as a special field of ecology is defined from the point of view of the presence of radioactivity in biosphere as well as of the analysis of its natural and artificial origin.

The book comprises four chapters, its bulk being contained in the second chapter where the presence of radioactivity is described in detail correlated with different elements of the biosphere, at the same time different factors (climatic parameters, configuration and amelioration of the soil), which have an influence on the radioactive concentration of the environment, are analysed.

The radioactive substances of natural origin are either produced by the cosmic radioactivities or result from the thermic changes at the hydrosphere level. The natural radioactive emanations are present in different layers of the atmosphere. Smaller concentrations of radon and thoron are function of altitude, whilst the values measured near the level of soil are significantly greater in autumn and winter as compared to the spring and summer ones.

The radioactive substances of artificial origin, present in the atmosphere, are mainly due to the nuclear tests. These can reach the earth surface by three ways: by depositing, attracted by the gravitation force (during dry periods), by cloud transportation (during the rainy periods) and by washing of the radioactive loaded clouds, by rains.

The radioactivity of the hydrosphere is in continuous interaction with the elements of the biosphere. More important are, on the one hand, the interactions between atmosphere and hydrosphere and, on the other hand, between lithosphere and hydrosphere.

There are analysed and described in detail the values of the radioactivity and its possible changes at the level of sea, lakes and rivers. The most frequent radioactive isotopes of natural origin, present at the surface or in water are potassium, uranium and radium. The radioactive artificial contamination of the aquatic basins (still waters) is due in general to nuclear explosions, present by radionuclides ^{90}Sr and ^{137}Cs , which pollute hydrosphere and accumulate afterwards in the living organisms (plants, animals, humans).

Other factors which influence the hydrosphere radioactivity are: 1) aquatic organisms which have accumulated in time radionuclide isotopes and 2) agrotechnical and fertilizing activities of the soil which produce the concentration of many noxious materials in the hydrosphere. There are also present many radioactive substances from the atmosphere in the water circuit of nature, thus the accumulations noticed in different areas of the biosphere are perfectly explained.

As regards the natural radioactivity of the soil, this depends on geographic, orographic and other factors. In the soil, the vertical distribution of radioactive contamination is different on cultivated areas as compared to the uncultivated ones.

In order to ameliorate the radioactive pollution of soil different methods are being applied by isolating as much as possible the infestible sources, by timely fertilisation with the proper substances the areas that are going to be cultivated, etc. There are mentioned examples of radioactive contamination of soil which influence or are found in the animal and human metabolism.

There are also presented in detail the radioactive influences on the human organism, due among others to the Chernobyl catastrophe, a nuclear disaster that occurred in 1986, which led to the massive contamination of European countries, tested at high magnitudes in the nuclear weapons field.

The protection against radioactive contamination problems, similar to other protection actions of the environment, involves, among others, also firm measures of international cooperation. In the future, the guarantee and the security of nuclear weapon operation are of great importance realizing all the aspects regarding the prevention and elimination of major risks of radioactive contamination.

The book is addressed to all the experts in the domains of ecology, environment protection, agriculture and food industry, constituting an extensive guide for the knowledge of radioactive pollution phenomena and of the impact produced on the living organisms and especially on the environment.

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N. BOTNARIUC, *EVOLUȚIONISMUL ÎN CRIZĂ?* (Evolutionism in crisis?), Ed. Acad. Române 1992, București, 286 pag., 7 tab., 5 fig.

EVOLUTIONISM IN CRISIS? There is a question of modern biology as well as the title of the book published in 1992 by the Publishing House of the Romanian Academy written by the well-known biologist Professor Nicolae Botnariuc, member of the Academy.

In a period of political changes full of conceptual controversies in the social and scientific life, the analysis of evolutionism represents a consistent, clear and deliberate option of the author.

The book makes a critical analysis of the present evolutionary theories dominated by the synthetic theory of evolution (STE). It also presents the reason for this period of crisis. The author suggests a new approach for evolutionism, an approach based on the systemic theory that was successfully applied in various fields of biology but still not in that of evolutionism.

The structure of the book is extremely simple and clear as style and language despite the difficulty and profoundness of the subject.

The first part of the book considers on the evolutionism based on the Darwinian and the post-Darwinian theories referring to the transformation and diversification of species and of taxons of higher order as well as of the mechanisms of adaptation. The largest space is devoted to the STE theory which results from the Darwinism synthesis with genetics and from the modern researches (rapidly developed during the last decades) of paleontology and taxonomy. The Darwinian factors of evolution reconsidered by STE are analyzed in their logical succession, starting with the value of individual variability (variability and hazard) with superpopulation, the struggle for existence, natural selection.

The diverse diverging opinions of numerous authors related to an essential problem of evolution, namely the object of action of natural selection, are presented. They vary from the individual organism or groups of related organisms to population (species). The author remarks the interpretation of the supporters of STE who limit the action of selection to the individual. The controversy regarding micro and macro-evolution with their unity and differentiation, the speciation and the length of periods of speciation processes are brought into discussion with an ample argumentation.

Recent evolutionary theories are reviewed also, such as the theory of punctuated equilibrium and the neutralist theory of evolution — theories with less supporters.

The second part of the book describes evolution in a systemic approach. This represents an element of conceptual originality as the author considers this approach the solution for getting out of the crisis.

The completed and unitary form of the systemic theory of evolution is presented, theory which the author has begun to visualize since 1963, to define it clearly since 1967, to establish a personal scheme of the hierarchical relations in the living world in 1985, but which he completed only in this book.

In the author's conception the organizational unity of living matter is represented by "the system" included in a hierarchy where the relations among systems situated at different levels have a certain degree of subordination of the sub-system towards the integrating system.

In the organizational hierarchy the individual organisms are only living systems with a definite existence while all the super-individual systems represent forms of relations among organisms. For this reason all the functions of the super-individual systems (populations, biocoenoses, i.e.) are achieved through the individual components. Only they have the capacity of matter, energy and information exchange with the physical environment. The relations among the systems of different levels are more and more contradictory. This is most evident in the case of individual variations which are sometimes in favour of the individual but other times of the population (species).

The essential process of evolution considered by the author is in SELECTION, "characteristic for the whole organizational hierarchy, generated by the opposing and at the same time unitary relations (given by their obliged co-existence) among the systems at different levels".

"The maintenance of the population represents its survival in a concrete system where, with a certain rate, it must achieve in its specific way the transfer of matter, energy, information. In consequence — although the essential purpose of the selection process is that of utility for the population and thus it appears as the main object of selection — the qualities of the population, the compatibility with its existence in a given ecosystem and thus the results of the selection are controlled by the ecosystem by means of matter, energy and information

connections with other component populations of the biocoenosis as well as with the physical factors".

So the main object of selection is the population, as the elementary unity of evolution, self-controlled for a non-defined time period.

The macroevolution respectively new species differentiation is also seen as a system feature and not as a taxon one and represents the result of the correlated functioning of the systems at all levels. The taxonomic hierarchy is generated inside the organizational hierarchy, thus within the ecosystem.

Mihaela Paucă-Comănescu

AVIS AUX AUTEURS

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