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SHORT COMMUNICATION

Mycorrhiza in plants of the 'Cerrado'

Summary

The object of the present paper is to give an account of the mycotrophic species of the 'cerrado', studied in Brazil. Also, this work is a contribution to the anatomical and morphological study of mycorrhizas.

The results of soil analysis of the 'cerrado' existing in the litterature show a pronunciated deficiency in minerals, which, according to the mineral deficiency theory, would limit growth and consequently produces an acumulation of carbohydrates within plant tissues. There is a growing body evidence that high light intensity, or a low nutrient supply increased the degree of mycorrhizal infection. In agreement with this our investigations showed that all the trees examined were associated with mycorrhizal fungi.

Introduction

A region of intense microbial activity exists in soil surrounding plant roots. Large numbers of saprophytic soil inhabiting microorganisms in the rizosphere interact with the plant, and more specialized parasitic micro-organisms may infect living roots and utilize them as a source of food. Host tissue becomes desorganized in the process and plant disease results – In more hightly specialized root associations the roots becomes infected, and an intimate balanced relationship is established. The morphology of the host tissue may be modified. However, the micro-organism obtain food from the host without destroying or adversely affecting the functioning to the root tissue, and under some conditions the infection is actually beneficial to the host. Such symbiotic relationships can be regarded as the highest level of parasitic specialization. The organisms in that the organs through which they absorb water and nutrients consists of root and fungus tissue. These 'fungus – roots' are called mycorrhizae.

According to Björkman [1], a high light intensity, or a moderate deficience of either available nitrogen or phosphorus in soil increased the amount of carbohydrates in the roots, this made them more susceptible to mycorrhizal infection.

The analysis of soil of the 'cerrados' existing in the literature shows a pronunciated mineral deficiency and consequently an accumulation of carbohydrates.

Thus, a few years ago, we started our work on mycorrhizae of 'cerrado' species for a test to be made of Hatch's [3] and Björkman's [1] opinion that a shortage of mineral salts in the soil is a condition for mycorrhiza formation.

Material and methods

All the material investigated, was obtained from different sites throughout the 'cerrado' regions of Rio Claro and Corumbataí, State of São Paulo, Brazil.

They were observed microscopically, and described morphologically.

The internal morphology of mycorrhiza can easily be observed by examining whole mounts under relatively low power of a compound microscope. Thin roots and sections can be mounted in lactophenol containing a dye such as cotton blue-safranin [2 4 5]. Clearing and staining is desirable for examination of thicker roots. There are many good descriptions and illustrations of the mycorrhizae observed.

Results and discussion

As a result of our investigations we are able to assert that all of the trees which we have examined, were found to be associated. What is more, mycorrhizal formations, both endotrophic and ectotrophic were observed. The characteristics presented by the mycorrhiza of the species permit us to consider them as belonging to the ectotrophic, ectendotrophic and endotrophic types, and in spite of a few small differences noted, to include them in the same series: the series employed by Gallaud, Burges or the classification employed by Melin and other authors (cited in Ref. [5]).

Of the several kinds of mycorrhizae the vesicular-arbuscular type is by far the most common [2]. It occurs on an extremely diverse groups of plants. It is world wide in its distribution and occurs on plants from the Artic to the tropics [2]. It is present in most habits.

The mycorrhizal infections caused by fungi with aseptate mycelia have sometimes been called phycomycetous mycorrhizas and, sometimes, vesicular-arbuscular mycorrhizas.

We had the opportunity to examine endotrophic types, well developed, representing the plycomycetous mycorrhizas, in some families of 'cerrado' plants.

We observed endotrophic mycorrhizas belonged to vesicular-arbucular type, on: *Aegiphila verticilata* Vell. (Verbenaceae); *Annona coriacea* Mart. (Annonaceae); *Arrabidaea brachypoda* (DC.) Dur. (Compositae); *Banisteria schizoptera* Juss. (Malpighiaceae); *Cassia occidentalis* L. (Caesalpinaceae); *Cissampelos ovalifolia* St. Hil. (*Menispermaceae*); *Cissus* Linn. (Vitaceae); *Tocoyena formosa* (Cham. and Schchtd) K. Schum. (Rubiaceae); *Hyptis rugosa* Poir. (Labiatae); *Jacaranda decurrens* Cham. (Bignoniaceae).

Generally speaking the endotrophic mycorrhizae with septate mycelia are those we most often found. They will occur in the following species:

Araliaceae: *Didymopanax vinosum* March.;
Annonaceae: *Duguetia furfuraceae* (St. Hill) Benth and Hook

Bignoniaceae: *Distictis mansoana* Bur.,
Jacaranda decurrens Cham.,
Pyrostegia venusta Miers,
Tabebuia ochraceae (Cham);
Caesalpinaceae: *Cassia calycioides* Mart.,
C. cathartica Mart.,
C. chrysocarpa Desv.,
C. chamaecrista Mart.,
C. occidentalis L.,
C. tora L.,
C. uniflora Spreng.,
C. rotundifolia Pers.,
Desmodium canescens DC.;
Caryocaraceae: *Caryocar brasiliense* Camb.;
Compositae: *Achyrocline satureioides* DC.;
Chaptalia nutans Hemsl.;
Dilleniaceae: *Davilla rugosa* Poir.;
Erythroxylaceae: *Erythroxylum suberosum* Mart.;
Gramineae: *Echinolaena inflexa* (Poir.) Chase,
Melinis minutiflora Beauy,
Stenotaphrum americanum L.;
Liliaceae: *Smylax syringoides* Grils;
Malpighiaceae: *Byrsonima intermedia* A. Juss.;
Martyniaceae: *Craniolaria integrifolia* Cham.;
Melastomaceae: *Miconia* Ruiz et Pavon.;
Mimosaceae: *Mimosa claussenii* DC.,
M. pudica L.,
Piptadenia macrocarpa Benth.,
Stryplnodendron adstringens (Mart.) Coville;
Myrtaceae: *Psidium* Linn.;
Ochnaceae: *Ouratea spectabilis* (Mart.) Engl.;
Orchidaceae: *Eulophidium maculatum* (Lindl.) Pfitzer;
Indigofera suffruticosa Mill.;
Swetia pseudelegans Mohhenbr,
Zornia diphylla Pers.,
Z. gracilis DC.;
Portulacaceae: *Portulaca oleracea* L.;
Proteaceae: *Roupala luscens* Meissn;
Rubiaceae: *Palicourea rigida* H.B.K.
Tocoyena formosa (Chem and Schchtd) K. Schum.;
Solanaceae: *Solanum grandiflorum* L.,
S. lycocarpum St. Hill;
S. palinacanthum Dun.;
Sterculiaceae: *Waltheria communis* St. Hil;
Verbenaceae: *Lippia elegans* Cham.,
Stachytarpheta cayennensis L..

Until recently the species of trees known to form ectotrophic mycorrhizas belonged mainly to Pinaceae among the gymnosperms and to the Betulaceae, Fagaceae and a few other angyosperm families. It is now certain that ectotrophic mycorrhizal infection is more widespread than was hitherto

thought, in both a taxonomic and a geographical sense. We observed ectotrophic mycorrhizas well developed, on *Campomanesia coeruelea* Berg. (Myrtaceae) and *Bauhinia holophylla* Steud. (Leg.-Caes.). The roots of *Cassia cathartica* Mart. (Leg.-Caes.) and also *Jacaranda decurrens* Cham. (Bignoniaceae) showed mycorrhizas of the ectendotrophic type.

So, fifty-six of the plants collected in cerrado presented micotrophy of the type endotrophic, two the ectotrophic and another two the ectendotrophic micotrophy.

Generally speaking the endotrophic mycorrhizae was found most often.

Morphology, detailed descriptions and classification of all mycorrhizae observed, were considered.

The writer's attention had been drawn to the fact that, when roots of same species were collected in different locations, it was very often found that the mycorrhizae were not identical; one could see plainly that the associated fungi were different. The type of mycorrhizae was probably determined by the host species. The entire root system mycorrhizal or only a portion of it may be infected.

All observations obtained for 'cerrado' species, support the mineral nutrition theory of mycorrhizae as developed by Stahl [7], Hatch [3] and consequently the theories of carbohydrates developed by Björkman [1]. Stahl [7] and Hatch [3] found that balanced high mineral nutrition reduced the degree of mycorrhizal infection while a low or unbalanced nutrient supply increased it. Björkman [1] concluded that high light intensity, or a moderate deficiency of either available nitrogen or phosphorus increased the amount of carbohydrates in the roots this made them more susceptible to mycorrhizal infection.

There is a growing body of evidence that mycorrhizae can increase plant growth, especially in infertile soils, and that such growth increases are the result of an enhanced ability of infected roots to absorb nutrients. Plants that were partially defoliated had much starch in their roots and the reduced ininfection was attributed to a deficiency of stored food [2].

Low light intensity in the greenhouse during winter may reduce mycorrhizal infection [2]. Vesicular-arbuscular infection also is reported to be most prevalent in soils of low fertility [2].

The results of soil analyses of the 'cerrados' existing in the literature shows a pronounced deficiency of Ca, P, S, N, Zn, Mo, and B which limits growth and consequently an accumulation of carbohydrates is brought about.

Thus, all species collected of the 'cerrado' that were studied possess mycorrhizae.

LILIAN ISOLDE THOMAZINI

Depto. de Botânica
Faculdade de Filosofia,
Ciências e Letras de Rio Claro
Rio Claro.-S.P., Brasil

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