

Soil Evolution Affected by Eucalypts

The effects of fertilizer applications on growth

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Introduction

The present outline report is intended as a guide for the discussion of two distinct phenomena :

- I. the influence of eucalypts on soil evolution;
- II. the effects of fertilizers on eucalypts.

Although the above subjects are somehow interrelated and also should be considered within the general framework of site-plant relations (item 2-c of the Draft Agenda), it is convenient to discuss them in two separate chapters.

This paper is not intended as a progress report, but is to provide background information for determining the present state of knowledge as well as future research needs.

I. Soil stabilization : Soil evolution as affected by eucalypts

At the First World Eucalyptus Conference, Roma 1956, soil stabilization by eucalypts has been thoroughly reviewed by De Philippis (25) and Monjauze (20). Therefore, it is not intended here to repeat or add evidence on the benefits to be derived from planting eucalypts for control of water and wind erosion, sand dune fixation, drainage of swamps, etc.

According to the recommendations of the above Conference, research was to be intensified on the influence of eucalypts on soil evolution. It is felt that a summary of the research done in this field may be useful as background information for further discussions and recommendations concerning soil stabilization by eucalypts.

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(1) *Status of research*(a) *Soil physics*

Hydrological aspects of eucalypt plantations are being discussed in another background paper (item 3-g of the Draft Agenda). However, it is worth mentioning that investigations in Italy and Sicily have shown that soil moisture depletion by eucalypt windbreaks may extend as far as 15-20 m. distance from the trees (8).

Investigations on the effects of eucalypt plantations on sand deposit during a strong sandstorm have shown that the proportion of fine particles increases in the zone of maximum sand deposit (14).

(b) *Soil chemistry. The soil profile and its development*

In Western Australia, Hatch (10) determined the amounts of litter deposited by *E. marginata* and the weight of the Ao horizon. Data are presented showing the more common inorganic constituents occurring in the litter; the amounts of these nutrients returned to the forest floor are calculated. Experiments on the decomposition of litter have shown that the leaves lost 40 % of their oven-dry weight within 18 months after leaf fall. In conjunction with this loss of weight, considerable amounts of the inorganic constituents of the leaf litter are leached out of the leaves. The humus formed is mildly acid, and the organic matter level of the surface soil largely governs the cation exchange capacity of the A1 horizon. Considerable increases in water-soluble calcium and magnesium have been noted in the surface soil. Similar conclusions were reached in a previous study (32).

Examinations of surface soils from regularly burnt firebreaks and adjacent protected *E. marginata* forest showed that if the burning does cause any temporary loss of organic matter and inorganic nutrients from the surface soil, the losses are replaced by the natural leaching from the following year's leaf fall (11).

Data are available on litter fall in *E. diversicolor* forests in Western Australia (5, 16), the amount of litter deposited by well-stocked stands is about 45-48 cwt./acre (16). Analysis of soil samples taken from under *E. camaldulensis* and *E. viminalis* in Victoria also indicated the accumulation of a number of elements under the influence of the eucalypts (12).

Wasjutin (33) reports that no native flora or fauna develops in pure eucalypt plantations in Brazil; a poor type of humus is formed, and the soil becomes exhausted.

In Israel, the cation exchange capacity on a calcareous loamy sand was found to be higher under 8 year-old *E. camaldulensis* than in the

open. Although no increase was recorded of the exchangeable potassium percentage, the absolute amounts of exchangeable potassium were higher, while the pH was lower, than outside the plantation. On exposed sites, the amounts of exchangeable sodium and chloride under eucalypts may be higher than those in the open because of interception of sea salt nuclei and leaching of saline litter (13).

Thorough investigations on the influence of eucalypts on the soil have been carried out in Italy (9, 18, 21). The amounts of humus in the A horizons varied considerably, and increases in the nitrogen content of the surface layers were observed only in a few cases. However, the nitrogen percentage under eucalypts was higher than that under leguminous grassland. There was a clear and general increase in the availability of exchangeable bases. Humus accumulation was found to be in inverse proportion to the ratios of exchangeable bases, the phosphoric anhydride content, and the content of free ferric acid. The humus seemed to be of the mull type. Soil evolution phenomena appeared to be negligible, and there was no evidence of depletion of bases and phosphoric ions or accumulation in illuvial horizons (9).

Liani (17) reviewed the methods for the quantitative determination of free and soluble iron under eucalypts; he studied a method of extraction based on the use of chelates. The same author investigated the influence of *E. globulus* on calcareous soils in Sicily (18). No displacement of iron sesquioxide or lime was noted; however, the decomposing litter gave an acid reaction, and the thin humus horizon had no calcium. No increases in phosphorus or potassium were recorded.

Investigations in Morocco have been summarized by various authors (1, 2, 3, 19). Since the early days of the research it became clear that the increase of the amount of exchangeable bases in the upper soil horizons improves the soil; however, this improvement is related to the permanence of the forest cover. Soil potassium is critical and is liable to be depleted within a relatively short period (19). The essential problem of soil improvement is to obtain a better evolution of the organic matter. The pH seems to be subjected to important fluctuations which can reach or exceed two pH units. Mineralization trials in the laboratory have shown that the upper horizons can be activated only to a small degree; nitrification for all the horizons seems to be quite low (1).

De Beaucorps (2) has studied the amounts of mineral nutrients immobilized in the tree crop, the mineral composition of the litter, and the amount of litter fall. He showed that there is a considerable increase in the amounts of exchangeable potassium and a slight decrease in exchangeable calcium. He concludes that on red sandy clay the cultiva-

tion of eucalypts is not liable to be affected by a decrease of soil fertility, however, on leached soils, some fertilization (Ca, P, K) will be required. Studies on the evolution of the organic matter under eucalypts show that a thin humiferous soil horizon is formed, underneath this *O to 1 horizon* no accumulation of organic matter takes place because of the formation of soluble organic compounds (fulvic acids), the low nitrogen content of the litter, and the almost complete lack of nitrogen fixation from the air. Clear-cutting of the forest causes the organic matter to be destroyed. Disk-ploughing is recommended to incorporate the organic matter into the soil and to reduce the loss of nitrogen. Seasonal variations of the exchangeable potassium and the humic and fulvic acids content of the soil also were shown to occur.

In Madagascar, the formation and composition of an organic-mineral soil complex was studied for ferralitic soils on gneiss, soil development under *Melia* sp. and native forest was more favourable than under eucalypts (24).

In Portugal, there is evidence to show that on grey-brown podzolic or brown forest soil, hardwoods with *E. globulus* and others give a better soil-vegetation equilibrium than pines by producing a mull humus and a non-leaching soil (22). Recent studies on various soils under *E. globulus* show large variations in the amounts of litter and the organic matter contents of various soils horizons; the types of humus formed include both sand mull, duff mull, and mor, the latter being considered as representing the most favourable equilibrium condition between vegetation and soil. The importance of the organic matter content of the soil is stressed (23).

(c) *Soil biology*

In Italy and Sardinia, investigations were carried out by Florenzano (6) on the microbiology of eucalypt soils and adjacent soils devoid of eucalypts. It was found that some particular microbiological conditions exist in the soil under eucalypts: the bacteria content generally is lower, while the number of fungi is very high, with actinomycetes particularly abundant. While the number of nitrogen-fixing bacteria does not vary, ammonification is reduced and shows an irregular course; nitrifying bacteria are scarcely represented, and decomposition of cellulose, almost exclusively due to fungi, is also lower. The organic matter of the eucalypts litter was proved to have an inhibiting power on the microbic flora of the soil. Additional data by the same author (7) showed that in Sicily, on calcareous soils, the microbiological conditions are quite different. In pure eucalypt stands, the total microflora is extremely rich in

bacteria, but limited to the superficial horizons, in mixed stands with leguminous species, micro-organisms are less numerous and mainly consist of fungi and actinomycetes, with no appreciable variation between the superficial and deeper soil layers. Nitrogen-fixing bacteria are well represented but are inactive on account of limiting factors (phosphorus and potassium). In pure stands, ammonification, nitrification, and cellulose-dissolving processes are identical to those on land not under eucalypts, in mixed stands, however, ammonification, nitrification, denitrification, and cellulose-dissolving processes were abnormal and inhibited.

Rambelli (28) made a comparative study of the microbiological activities in soils planted with eucalypts and in agricultural land in order to determine the influence of eucalypt litter on the soil microflora as well as variations which may have occurred in the course of time. His results differ to some extent from those obtained by Florenzano (6) on the same soils, which implies that variations have taken place in the meantime. The soil under eucalypts showed a slightly higher microbial population, greater aeration and increased ammonifying and denitrifying capacity, whereas the nitrogen-fixing and nitrifying activities were negligible and the cellulose-dissolving activities inferior to those on agricultural land. In another paper, Rambelli (27) studied and described the fungus microflora isolated from soils under eucalypts; some of the 29 strains isolated were discovered in the soil for the first time, and the antibiotic activities of the individual strains are tabulated. Another report lists the microfungi from different soils planted with eucalypts (29).

Pochon (26) found that in Morocco, an accelerated mineralization of organic matter with a slight formation of humus is associated with a very high activity of cellulolytic bacteria and an absence of nitrogen-fixing bacteria. Phenomena of antagonism, in which actinomycetes and fungi play the main part, are important. Data by de Beaucorps (2) show the almost complete absence of nitrogen-fixing bacteria, a decrease with depth of microbiological activities, and low anaerobic and high aerobic cellulose-dissolving processes. In Algeria, Vargues (31) recorded varying amounts of saprophytes and *Azotobacter* under eucalypts; in laboratory experiments, eucalypt litter extracts were found to reduce NO_2 production, but *Azotobacter* cultures were not affected. The presence of an antibacterial substance is suggested as one of the causes for the observed reduction of microbiological activity under eucalypts.

In Madagascar, Dommergues (4) has studied the influence of eucalypt stands on soil biology. He shows that on recent sand dunes the conversion of the natural forest into a *E. robusta* plantation strongly

modified the microbiology of the superficial soil layers: while the nitrogen-fixing power of the soil was reduced by 2/3, there was a twofold increase in cellulose-dissolving processes. Significant increases in both nitrogen-fixing power, cellulose-dissolving processes and ammonification were found under *E. grandis* and *E. robusta* stands planted on various prairie soils such as *Aristida* sp. grassland.

(2) *Status of research*

Data supplied to the 4th Session of the Eucalypt Working Group, FAO Joint Subcommittee on Mediterranean Forestry Problems, Lisbon 1960, show that the following institutes are carrying out research on soil influences of eucalypts:

- (a) *Centro di Sperimentazione Agricola e Forestale, Rome.* Influence of eucalypts on soil, bacteriological and mycological research on soils under eucalypts.
- (b) *Station de Recherches Forestières, Rabat.* Evolution of soil fertility under eucalypts (in connexion with fertilizer trials).

(3) *Research needs*

The above summary shows that already a fair amount of research on soil evolution and maintenance of fertility under eucalypts is available from various countries. As a whole, the results tend to indicate a favourable influence on soil chemism, evolution of organic matter and microbiological processes. Proper management practices may contribute to the improvement of the soil; in most cases, even without fertilizer applications, soil fertility is not liable to be adversely affected by cultivation of eucalypts.

Research should be developed according to the following lines:

- (a) In various parts of Australia, research is recommended on soils as affected by the major commercial species, in relation with management and regeneration practices, in order to maintain or improve the fertility of the site as well as the most desirable composition of the forest. Investigations mainly should be extended to include — in addition to the sclerophyllous forests of Western Australia — the main commercial forests types east of Flinders Range.
- (b) More data are required on the effects of eucalypt plantations on tropical soils. Research should include complete investigations of the nutrient cycle, evolution of organic matter, and microbiological activities, as affected by stand composition and

management practices. It is suggested that two or more institutes be entrusted with this research which could be supported at least partly by FAO.

- (c) In the Mediterranean region, additional research should deal with influences of eucalypts on the soil as affected by time. Long-term investigations should deal with variations liable to occur within the rotation and throughout successive rotations. In addition, the effects of cultural operations and soil cultivation should be studied to determine the most suitable techniques for maintaining and improving the fertility of the site.

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II. EFFECTS OF FERTILIZER APPLICATIONS ON GROWTH OF EUCALYPTS

(1) Summary of practices and status of research

The prospects of increasing the growth and yield of forest plantations by fertilizer applications are well recognized nowadays. However, with regard to eucalypts, fertilizer applications still are mostly at the experimental stage.

So far, only in Portugal fertilization of eucalypts (mainly *E. globulus*) seems to be carried out on a commercial scale. Goes (6) reports that on acid soils, good results have been obtained by fertilizer applications at the time of planting; the amounts per tree are 120 gr. Thomas phosphate, 60 gr. calcium cyanamide, and 20 gr. potassium chloride. In various regions such as the high plateaux of Latin America (6), it is common practice for farmers to add a shovel of dung or manure in the planting hole prior to planting.

In Australia, sand culture experiments by Winterhalder (17) have shown that *E. gummifera*, *E. pilularis*, and *E. saligna* seedlings can exist on low potassium and calcium concentrations without significant reduction in growth; soil culture experiments also demonstrated the low potassium and calcium requirements of *E. gummifera* and *E. saligna*. Analytical data on leaves from pot trials indicated the range of mineral content under different nutrient conditions.

Pot trials to test the effect of various fertilizers on *E. marginata* seedlings growing on laterite soil showed that heavy dressings of mixed inorganic fertilizers containing nitrogen proved toxic. Light dressings of NP and NPK produced vigorous plants but poor survival. Best results were obtained with an enriched compost which produced vigorous growth and 100 % survival; the controls all survived but were less than half the height of the plants receiving compost (10). However, nitrogen fertilizer applications in a *E. marginata* forest failed to show any effect of treatment on girth increment and leaf composition; the experiment consisted in testing the effect of adding 2 cwt./acre of blood and bone and potato manure for three consecutive years, and the final measurements were taken seven years after the beginning of the trial (9). *E. marginata* plants responded to fertilizer application by vigorous leaf production in the spring, but survival was unsatisfactory (10). *E. gomphocephala* failed to respond to superphosphate, but a definite response was obtained with ammonium sulphate at the rate of 15 gr. per plant (15).

Vageler (16) presents the results of analyses of the mineral composition of roots, stem and foliage of eucalypts growing in Brazil, and discusses on this basis their soil requirements. A similar approach has been taken in Israel by Karschon (13) who has tabulated the nitrogen, phosphorus and potassium contents of *E. camaldulensis* and *E. gomphocephala* leaves; he believes that standard fertilization practices could be developed for soils inducing low leaf nutrient contents, if it can be shown that fertilizer applications which would raise the leaf nutrient content to and above the assumed standard values, will have a beneficial effect on survival and growth.

In Fidji, excellent responses were shown by eucalypts to the application of a complete fertilizer in the holes at the time of planting; after 8-9 months' growth, *E. grandis* was more than twice as high as the untreated controls (3). In Hongkong, experience has shown that eucalypt plantations usually stagnate after planting, but responded immediately to small applications (15-30 gr. per plant) of ammonium sulphate; plantations which have received fertilizer, survive the winter better and resume growth more vigorously next year (4).

In Israel, data have been reported on the results of fertilizer applications in a young *E. gomphocephala* plantation (8, 11). The experimental design was fully factorial with regard to the three major nutrients, each nutrient being on two levels, i.e. zero and an amount presumed to be adequate. The rates of application per hectare were as follows: 500 kg. ammonium sulphate, 750 kg. superphosphate, and 250 kg. potassium chloride. Fertilizer applications were made twice, when the plantation was two and three years old. Height growth was found to be significantly affected by nitrogen fertilization, although the soil was relatively rich in available nitrates; there were no significant responses to phosphorus and potassium fertilization. Nitrogen and phosphorus applications increased the amounts of these elements in the leaves.

Data on the effects of potassium fertilization have been published in connexion with research on leaf absorption of wind-borne salt and leaf scorch in *E. camaldulensis* (12). Dressings of potassium chloride had some influence on the potassium content of the leaves; however, they failed to depress the leaf sodium or to correct or reduce foliage scorch.

In Italy, the effect of soil amendments on survival and growth of eucalypts on solonchak soil was investigated (7). Ferrous sulphate, at the rate of 10 tons per ha., proved more efficient than gypsum, applied at the rates of 10 and 20 tons per ha.

In Madagascar, experimental plots on lateritic clay, established by planting balled stock of *E. robusta*, have shown that the effect of compost («fumier de parc») application in the nursery persisted even after five years, the treated plants being almost 50 % higher than the untreated controls. In addition, it was found that the soil of the plots planted with compost-treated stock had a much higher nitrogen-fixing power than the soil planted with untreated stock (2).

Fertilizer application trials in *E. gomphocephala* plantations in Morocco, on deep sandy soils, have been reported by de Beaucorps (1) and Marion (14). At the time of planting, the plots were given the following amounts per hectare: N — 400 kg. ammonium sulphate, P — 300 kg. superphosphate, K — 150 kg. potassium chloride, NPK — the above amounts applied together. In plot EU PL 3 52/53, survival and height were not significantly affected by different fertilizer treatments at the end of the first year, but were significantly higher than in the untreated controls. After four years, there were statistically significant differences between treatments in both survival and growth, as shown by the following averages (14):

<i>Treatment</i>	<i>Average height</i>	<i>Survival</i>
	m.	%
N	4.27	90.0
P	4.86	92.5
K	5.09	90.5
NPK	5.74	90.4
control	3.14	76.6

As nitrogen is the most expensive and the less efficient fertilizer, the rates of application per hectare suggested are 200-300 kg. superphosphate + 100 kg. potassium chloride. The use of fertilizers is recommended mainly for sandy soils of intermediate depth (2 — 4 m.), especially when the sand overlays an impervious clay horizon (1).

(2) *Organization of research*

According to data supplied to the 4th Session of the Eucalyptus Working Party, Lisbon 1960, research on fertilizers is carried out by the following institutes :

- (a) *Forest Research Institute, Ilanath.* Additional sample plots of *E. camaldulensis* and *E. gomphocephala* have been laid out on various soils. The value for field survival and growth of late-season nitrogen fertilization in the nursery is being investigated. Research is also done on the effects of gibberellic acid on tree growth.
- (b) *Centro di Sperimentazione Agricole e Forestale, Rome.* Research is reported on nutrition problems (foliar analysis, cation exchange of eucalypt roots). Fertilizer trials also are under way.
- (c) *Station de Recherches Forestières, Rabat.* Investigations are being continued on the use of fertilizers on deep sandy soils in semi-arid areas. The effect of fertilizer application after timber harvesting, as part of normal management practice, is also being investigated.

(3) *Research needs*

The possible scope of fertilizer applications has to be considered within the broader perspective of increasing the yields of eucalypt plantations. Intensive cultivation, including fertilizers, forms the basis of what has been referred to by FAO's Mediterranean Project as «Tree Farming Sylviculture».

Data are needed on tree responses and the economics of fertilizer applications to various eucalypt species under different climatic and

edaphic conditions. The proper design of the experiments, according to the principles of modern statistics, is of the outmost importance.

In order to introduce sound fertilization practices adapted to local conditions, the following information will be required :

- (a) Kind and amount of fertilizers required for particular species under specific environmental conditions, time and frequency of applications;
- (b) effect of fertilizer treatments on survival, growth rate, yield, quality, adaptation to environmental conditions (drought, frost resistance), insects and diseases;
- (c) costs of fertilizer applications (cost of fertilizer, transport, labour, etc.);
- (d) influence of fertilizer applications on costs and financial returns of plantations because of improved survival, higher yields, shorter cutting cycle, etc.

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ÉVOLUTION DU SOL AFFECTÉ PAR L'EUCALYPTUS

EFFETS DES APPLICATIONS D'ENGRAIS SUR LA CROISSANCE

Sommaire

La culture de l'eucalyptus pour la production de bois est devenue de plus en plus accessible à l'agriculture; des méthodes intensives d'aménagement sont maintenant à la portée de ce qui a été référé dans le Projet Méditerranéen de la FAO comme "arboriculture". La tendance consiste clairement à augmenter la production de bois et les rendements financiers en boisant des terrains pouvant produire des rendements économiques, en faisant une sélection convenable d'espèces et d'écotypes, par une préparation et une culture convenable du terrain en améliorant les conditions du sol, et par l'adoption de meilleures méthodes d'aménagement. L'arboriculture mène nécessairement à une plus grande connaissance des nécessités d'informations précises sur les besoins en minéraux des eucalyptus, et sur les possibilités d'améliorer la croissance et d'empêcher l'appauvrissement du terrain par des applications d'engrais.

L'évolution du sol sous l'eucalyptus doit être considéré comme faisant part du cycle nutritif général. D'une part la chute de litière rend annuellement la nourriture au sol, affectant ainsi la chimie du terrain, l'évolution de la matière organique, et le procès microbiologique. D'autre part une grande quantité de nourriture prise par les arbres est enlevée par la récolte du bois. Des données connus jusqu'à présent indiquent qu'en général l'eucalyptus n'influe pas défavorablement sur le terrain; des méthodes convenables d'aménagement peuvent contribuer grandement à l'amélioration du terrain. Il faut plus de recherche sur l'évolution du sol, sur l'influence des plus importantes espèces commerciales de bois d'Australie, sur les effets de l'eucalyptus sur les terrains tropicaux, et sur l'évolution du sol dans la région Méditerranéenne sur laquelle a influé la culture et les méthodes d'aménagement.

De nos jours, les perspectives d'augmenter la croissance et la production des forêts par des applications d'engrais sont bien reconnues. Pourtant, l'emploi des engrais sur les plantation d'eucalyptus généralement est encore dans une phase expérimentale.

LA EVOLUCIÓN DEL SUELO BAJO EUCALIPTOS

EFFECTOS DE FERTILIZANTES EN EL CRECIMIENTO

Resumen

El cultivo del eucalipto para la producción de madera viene tornandose más y más agrícola en su aspecto; las prácticas de ordenación intensiva están casi a la altura de lo que se refiere en el Proyecto Mediterraneo de la FAO como "arboricultura". La tendencia consiste claramente en aumentar los rendimientos financieros y de madera reforestandose suelos apropiados para producir rendimientos económicos, por la selección apropiada de especies y ecotipos, preparación necesaria del suelo y su cultivo, la mejora de las condiciones del suelo, y mejores prácticas de ordenación. La "arboricultura" resulta necesariamente en un mayor conocimiento de la necesidad que hay de informaciones precisas de los requerimientos del eucalipto, y de las posibilidades de me-

jorar su crecimiento y evitar el empobrecimiento del suelo por la aplicación de fertilizantes.

La evolución del suelo plantado con eucaliptos debe ser considerada como parte del ciclo general nutritivo. Por un lado, la caída del barrujo devuelve anualmente nutrientes al suelo, afectando así la química del mismo, la evolución de la materia orgánica y procesos microbiológicos. Por otro lado, una cantidad apreciable de nutrientes asimilada por los árboles es retirada cuando se recoge la madera. Los datos disponibles indican hasta ahora que, en el conjunto, el eucalipto no afecta adversamente el suelo; las prácticas de ordenación apropiadas pueden contribuir mucho a la mejora del suelo. Se necesitan más pesquisas sobre la evolución del suelo bajo el afecto de las mayores especies comerciales de madera en Australia, de los efectos del eucalipto en suelos tropicales, y la evolución del suelo en la parte mediterránea afectada por el cultivo, y prácticas de ordenación.

Hoy día se reconoce perfectamente las posibilidades de aumentar el crecimiento y rendimiento de los bosques con la aplicación de fertilizantes. La fertilización de eucaliptos, todavía, está aun en el período experimental.

A EVOLUÇÃO DO SOLO POR INFLUÊNCIA DA EUCALIPTOCULTURA EFEITOS DAS APLICAÇÕES DA ADUBAÇÃO NO CRESCIMENTO

Resumo

A cultura de eucaliptos para colheita de madeira está se tornando cada vez mais agrícola em sua execução; práticas de manejo intensivas já estão ao alcance daquilo que se chamou de "Tree Farming Sylviculture" no Projeto Mediterrâneo da FAO. A tendência consiste, claramente, em aumentar os rendimentos financeiros e de madeira, florestando-se solos adequados para produzir rendimentos econômicos, fazendo seleção de espécies e ecótipos, bem como preparação do solo e cultivo adequados, melhoria das condições do solo e melhores práticas de manejo.

A arboricultura, necessariamente, leva a um maior reconhecimento da necessidade de informações exatas sobre as necessidades minerais dos eucaliptos e sobre as possibilidades de aperfeiçoar o crescimento e impedir o empobrecimento do solo através de aplicações de fertilizantes.

A evolução do solo com eucaliptos deve ser considerada como parte de um ciclo alimentar geral. De um lado, a queda anual das folhas devolve nutrientes ao solo, influenciando desta maneira a química do mesmo, a evolução da matéria orgânica e os processos microbiológicos. De outro lado, uma apreciável quantidade de nutrientes absorvidos pelas árvores é removida pela colheita da madeira. Os dados disponíveis indicam até agora que, como um todo, os eucaliptos não afetam adversamente o solo; práticas de manejo apropriadas podem contribuir muito para a sua melhoria. Maiores pesquisas são necessárias sobre a evolução do solo, na medida em que é afetado pelas espécies mais importantes de madeira comercial na Austrália, sobre os efeitos dos eucaliptos no solo tropical, e a evolução do solo na área mediterrânea, na medida em que é afetada pelas práticas de cultivo e manejo.

As perspectivas de aumento do crescimento e rendimento das florestas através de aplicações de fertilizantes são hoje reconhecidas. Entretanto, a fertilização dos eucaliptos de um modo geral se encontra ainda em estágio de experimentação.