

TEEAL 2006-2008

KOMODITAS: KARET

AGRICULTURAL ECONOMICS AND POLICIES (2 jdl)

Economic analysis of smallholder rubber plantations in West Garo Hills District of Meghalaya

Indian Journal of Agricultural Economics. 2007. 62 (4). 649-663

Author(s): Goswami-S-N. Challa-O

Author Affiliation: National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur - 440 010 (Maharashtra), India

Abstract:

This study (i) estimates the costs and returns of smallholder rubber plantations in West Garo Hills district, Meghalaya, India; (ii) measures the extent of labour absorption in smallholder rubber plantations; and (iii) evaluates the productivity of capital invested in such plantations. The study pertains to the year 1998-99. A positive net present value, a benefit-cost ratio of 2.41% and an internal rate of return of 14.40% imply that investments made in smallholder rubber plantations are highly remunerative. An important feature of the rubber plantations is that they are highly labour intensive

Descriptors: costs. crop-production. labour-requirements. plantations.

production-economics. productivity. profitability. returns. rubber. small-farms

Perennial crop supply response functions: the case of Indian rubber, tea and coffee

Indian Journal of Agricultural Economics. 2006. 61 (4). 630-646

Author(s): Parmod-Kumar. Anil-Sharma

Author Affiliation: National Council of Applied Economic Research, Parisila Bhawan, New Delhi - 110 002, India

Abstract:

This study estimates the supply response functions of rubber, tea and coffee in India, using aggregate acreage and production data ignoring the age-group dynamics. The short-run supply functions show that growers respond positively to price incentives. As the price rises in the short run, growers indulge in intensive cultivation to take benefit of price incentives. In the long run, it is observed that, in all three crops, own expected price had a positive effect on the planted area, whereas the expected price of competing crops led to a decline in the area planted

Descriptors: acreage. coffee. prices. production. rubber. supply-response. tea

CROP HUSBANDRY (3 jdl)

Sazonal production and latex characteristics in rubber tree (*Hevea brasiliensis* Muell. Arg.) clones in Lavras, State of Minas Gerais, Brazil

Bragantia. 2006. 65 (4). 633-639

Author(s): Mesquita-A-C. Oliveira-L-E-M. Cairo-P-A-R

Author Affiliation: AD:

Abstract:

In spite of being the cradle of the species of the genus *Hevea*, Brazil contributed, in 2001, with only 1.5% of the world production of 7.132 million tons and it consumed around 3.5% of a total of 7.03 million tons of the world demand. The most productive clones are the orientals RRIM 600, PB 235 and PR 255, with production around 1,500 kg of dry rubber/ha/year. The cultivation of those clones in different regions in Brazil shows adaptation to several climatic patterns. The aim of this work was to evaluate the productive behavior of clones of rubber tree, associated to seasonal climatic and physiologic factors in relation to the latex production in Lavras, State of Minas Gerais, Brazil. The research was conducted in the experimental area of Biology Department of Federal University of Lavras, sector of Plant Physiology, between June 2001 and July 2003. The plant water relations and nutritional factors were appropriate to the productive period. The productivity of clone RRIM 600 was higher than the others and presented positive correlation to the environmental factors during the experimental period. The nutritional factors of the latex and the obstruction index showed significant correlation to the production

Descriptors: *Hevea-brasiliensis*; correlation characters; production; rubber plant

Phenotypic expression of rubber tree clones in the northwestern region of Sao Paulo state

Bragantia. 2006. 65 (3). 389-398

Author(s): Goncalves-P-S. Aguiar-A-T-E. Gouvea-L-R-L

Author Affiliation: AD:

Abstract:

The development of new clones with high production combined to other desirable secondary characters is fundamental for a sustainable and competitive rubber tree cultivation. The objective of this study was to evaluate, during a period of 13 years, the phenotypic expression of superior characters of 17 clones of rubber tree grown in the plateau region of São Paulo State, Brazil. The treatments were arranged in a randomized block design with three replicates and six plants per linear plot. The clone IAC 40 exhibited the highest yield (2.316 kg ha⁻¹ year⁻¹) followed by IAC 300 (1.921 kg), whereas the control clone RRIM 600 had 1.493 kg ha⁻¹ year⁻¹ over six years of tapping. The percentage of plants able for opening ranged from 40% for IAC 329 to 100% for IAC 327. Except for IAC 56, IAC 331 and IAN 3156, with 7.21 mm, 7.18 mm and 6.40 mm respectively, all other clones had lower thick virgin bark at opening compared to the control clone RRIM 600, which recorded 6.38 mm. Except IAN 3.156

all clones showed low incidence of panel dryness. The good performance of all clones, both from IAC and Amazone (IAN, Fx and RO) allow their recommendation for small scale cultivation, when they would be further tested in different environments of the São Paulo State, aiming recommendations in large scale

Descriptors: Hevea-brasiliensis; bark-thickness; tapping; anthracnosis; rubber-yield

Water-stress-induced changes in resin and rubber concentration and distribution in greenhouse-grown guayule

Agronomy Journal. 2006. 98 (3). 766-773

Author(s): Veatch-Blohm-M-E. Ray-D-T. McCloskey-W-B

Author Affiliation: Dep. of Plant Sciences, Univ. of Arizona, Forbes 303, Tucson, AZ 85721, USA

Abstract:

Guayule (*Parthenium argentatum* A. Gray) is naturally subject to periods of water stress in its native habitat. It has been shown that, under cultivation, rubber yields increase with increasing irrigation, but rubber concentration per plant decreases. The effect of irrigation on resin concentration is unclear. The purpose of this study was to understand how resin concentration is affected by water stress, and why water stress increases rubber concentration. Greenhouse-grown guayule plants were subjected to water stress in four experiments, each of 3 mo duration. Two experiments were conducted in the summer, the active growth period, and two experiments were conducted in the winter. The water-stressed plants were irrigated when the average soil water potential reached either -0.6 MPa (first summer experiment) or -0.3 MPa (all subsequent experiments). Water-stress effects were monitored by measuring growth, C exchange, biomass, and resin and rubber production. Water-stressed plants had lower C exchange, growth, and leaf-to-stem ratio than well-watered plants. Resin concentration did not respond consistently to water stress. Rubber concentration was generally higher in the water-stressed plants than in the well-watered plants as a result of decreased leaf biomass in both the summer (33 vs. 45 g kg⁻¹) and winter (36 vs. 52 g kg⁻¹) and decreased stem diameter in the summer (8.1 vs. 11.0 mm). Rubber is deposited mainly in the bark; therefore, reduced leaf biomass and stem diameter contribute to higher rubber concentration in the water-stressed plants by increasing the relative amount of bark

Descriptors: bark. biomass-production. crop-yield. dry-matter-accumulation. greenhouse-crops. growth. irrigation. plant-water-relations. resins. rubber. soil-water-potential. water-stress watering

PLANT PROPAGATION (2 jdl)

A quantitative analysis of the primary system of laticifers in the stem of young plants of clones and seedlings of rubber tree

Bragantia. 2007. 66 (3). 465-468

Author(s): Moraes-L-A-C. Moraes-V-H-de-F

Author Affiliation: Embrapa Amazonia Ocidental, Caixa Postal 319, 69011-970 Manaus (AM), Brazil

Abstract:

Field studies were conducted in Brazil to compare the frequency of the laticifers of the primary system with the number of laticifer rings in young seedlings and clones of the rubber tree (*Hevea* spp.) in order to better understand of early yield tests. A low frequency of primary laticifers in the first 4 internodes of seedlings was found, while a frequency significantly higher of this type of laticifer was found in the clones, from the first to the fourth internode. Since the primary system of laticifers originated in the subapical meristem, the observed differences were determined by the size of the apical bud. It was more than 3 times larger in the first whorl of clones than in the first whorl of seedlings (epicotyls) and it was also significantly larger in the second whorl. The main rubber production analysed in the early tests in plants of one-year-old clones was therefore derived from the laticifers of the primary system, sloughed off in plants older more than 3 years. This fact explained the lack of correlation between the early test of clones and the HMM test in 3-year-old. On the other hand, this correlation has been reported for the early test of seedlings and the HMM test for 3-year-old clones

Influence of six rootstocks on yield of superior rubber tree clones

Bragantia. 2007. 66 (2). 277-284

Author(s): Cardinal-A-B-B. Goncalves-P-de-S. Martins-A-L-M

Author Affiliation: PG-IAC em Tecnologia da Producao Agricola, Campinas, SP, Brazil

Abstract:

In rubber tree (*Hevea brasiliensis*) cultivation, the most used propagation method is budding. The expected uniformity by using vegetative propagation is, however, not verified in commercial fields, because high variation for vigour and yield traits is induced by the rootstocks used. Based on this and on the economic importance of the rubber tree in Sao Paulo, Brazil, a study was conducted to determine the best combination of clones and rootstocks with high vigour and productivity for planting in the state. Five-year data on dry rubber yield from an experiment in split-plot design with four replications, conducted in Pindorama, Sao Paulo, were analysed. Treatments consisted of 36 different combinations, subjected to analysis of variance and mean comparisons of six rootstocks and six scions. Strong effects of rootstock over the analysed variables, as well as differential behaviour among the tested combinations, were observed. It is concluded that PB 235, GT 1 and IAN 873, which had the largest yields, are recommended for the conditions of Planalto Paulista. The use of unselected seedlings (SNS) as rootstocks is not recommended as they showed very low yields compared to the selected rootstock seedlings

Descriptors: budding. clones. crop-yield. productivity. rootstocks. rubber. scions. seedlings. vegetative-propagation. vigour

CROPPING PATTERN AND SYSTEMS (1 jdl)

A logistic analysis of the factors determining the decision of smallholder farmers to intercrop: a case study involving rubber-tea intercropping in Sri Lanka

Agricultural Systems. 2006. 87 (3). 296-312

Author(s): Iqbal-S-M-M. Ireland-C-R. Rodrigo-V-H-L

Author Affiliation: Rubber Research Institute of Sri Lanka, Dartonfield, Agalawatta, Sri Lanka

Abstract:

The factors influencing the decision of smallholder farmers to adopt new farming technologies were studied with reference to rubber-tea intercropping in Sri Lanka. Rubber-tea intercropping has been recommended previously to rubber farmers as a means to improve productivity and income during the early pre-tapping phase of rubber growth. Although crop trials have shown that the two crops are agronomically compatible and potentially produce a combined economic yield superior to the yield of a sole crop grown on the same area of land, there is little evidence of widespread adoption of this practice among smallholder farmers in Sri Lanka. The aim of the study was to determine the major factors that influence the decision to undertake rubber-tea intercropping and to construct a predictive model that describes the likelihood of adoption of intercropping by traditional smallholder rubber growers. A rapid rural appraisal (RRA) was undertaken based on semi-structured interviews of 90 smallholder farmers in the main rubber growing low wet zone of Sri Lanka. Among a number of factors shown to significantly influence the decision to intercrop tea with rubber, three were shown to operate independently, namely level of income, source of income (i.e. solely from own farm or from farm plus additional off-farm enterprises), and availability of land considered suitable for tea cultivation. A statistical model developed through correlation and logistic analysis, which predicts the likelihood of a smallholder adopting intercropping based on these factors, is presented and discussed. The most likely combination of circumstances (82% probability) under which rubber-tea intercropping is practiced is shown to be where the farmer's income is greater than Rs. 10 000 per month, where the farmer's income is based solely on own farm enterprises, and where more than 80% of the farmer's land area was judged to be suitable for tea cultivation. Conversely, 30% of smallholder farmers that chose not to intercrop did possess land suitable for tea cultivation. Qualitative responses to the RRA indicated that limitation of technical knowledge was the main problem subsequently faced by rubber farmers who had adopted rubber-tea intercropping. Results indicate that there is need for both income support through farm subsidies and further agricultural extension services, if rubber-tea intercropping is to be adopted more widely in Sri Lanka. The wider usefulness of the developed logistic model in determining the likelihood of adoption of intercropping by smallholder farmers is discussed

Descriptors: cropping-systems. decision-making. income. innovation-adoption. intercropping. land-capability. mathematical-models. small-farms. tea

PLANT GENETICS AND BREEDING (2 jdl)

Simultaneous selection for short plant height and high rubber yield in rubber tree

Bragantia. 2008. 67 (3). 649-654

Author(s): Costa-R-B-da. Resende-M-D-V-de. Goncalves-P-de-S. Oliveira-L-C-S-de. Itavo-L-C-V. Roa-R-A-R

Author Affiliation: Universidade Catolica Dom Bosco (UCDB), Programa de Mestrado em Desenvolvimento Local, Av. Tamandare, 6000, Jardim Seminario, Caixa Postal 100, 79117-100 Campo Grande (MS), Brazil

Abstract:

Goals of this work were to evaluate genetic variability and potential of successful simultaneous selection for short stature and high rubber yield, considering relational variables: rubber yield per height unit (PBA) and rubber yield per plant basal area (PBB), both as new traits in rubber tree genetic improvement. Selection based on these variables allows identification of new genetic material suitable for high density plantations. Twenty-two half-sib progenies of half-sibs were established in Votuporanga, Sao Paulo, Brazil. The trial was carried out with 22 treatments with five replications each and 10 plants per plot, planted in single lines at density of 3x2 m. Plots were randomly distributed. At 3 years old, progenies were evaluated and showed that a combination of those two traits increased genetic variability available for selection. Results also demonstrated that it is possible to have an efficient genetic improvement for simultaneously increasing rubber yield while reducing plant height. Therefore, it is possible to improve these two traits (PB and PBB) simultaneously, without losses on the main traits (PB). High correlations between PBB and PBA (0.842) and between PBB and height (-0.578) show that selection based on PBB will lead to height reduction. The type of selection proved itself efficient for increasing rubber yield while substantially reducing plant height and less reducing trunk perimeter. All these effects are desirable in a rubber tree genetic improvement program aiming at selection of genotypes suitable for higher density plantations

Descriptors: crop-yield. genetic-improvement. genetic-variation. plant-density. plant-height. rubber. selection genetic variability. Genotypic variability.genotypic variation

Comparative studies on crosslinked and uncrosslinked natural rubber biodegradation by *Pseudomonas* sp

Bioresource Technology. 2006. 97 (18). 2485-2488

Author(s): Roy-Ram-Vinod. Das-Mithu. Banerjee-Rintu. Bhowmick-Anil-K

Author Affiliation: Indian Inst Technol, Agr and Food Engrn Dept, Microbial Biotechnol and Downstream Proc Lab, Kharagpur 721302, W Bengal, India EMA: rb@agfe.iitkgp.ernet.in

Abstract:

A comparative study on biodegradation of di-cumyl peroxide (DCP) crosslinked and uncrosslinked natural rubber by *Pseudomonas* sp. was carried out. Decrease in organic carbon content along with the changes in tensile strength of the treated rubber, both DCP crosslinked and uncrosslinked natural rubber, indicated rubber hydrocarbon

utilization by the *Pseudomonas* sp. A decrease in 60.88% MPa and 41.66% MPa was observed after five month's old treated uncrosslinked natural rubber and DCP crosslinked rubber, respectively. Biodegradation was more pronounced in natural uncrosslinked rubber, which was further confirmed by the formation of aldehydic compounds with decrease in CH, stretching frequencies. (c) 2005 Published by Elsevier Ltd

Descriptors: Bioprocess-Engineering organic-carbon; natural-rubber; di-cumyl-peroxide: biodegradation-, crosslinked-, uncrosslinked- rubber-tensile-strength; rubber-hydrocarbon-utilization; aldehydic-compound-formation *Hevea-brasiliensis* (Euphorbiaceae-): species-; *Pseudomonas*- (Pseudomonadaceae-): genus-

PLANT PHYSIOLOGY-BIOCHEMISTRY (5 jdl)

Induction of peroxidase, scopoletin, phenolic compounds and resistance in *Hevea brasiliensis* by elicitor and a novel protein elicitor purified from *Phytophthora palmivora*
Physiological and Molecular Plant Pathology. 2008. 72 (4-6). 179-187

Author(s): Dutsadee-C. Nunta-C

Author Affiliation: Department of Biochemistry, Faculty of Science, Prince of Songkla University, Hat-Yai, Songkhla 90112, Thailand

Abstract:

Elicitor and a new protein 75 kDa elicitor were purified from the culture filtrate of *Phytophthora palmivora*, a pathogen of *Hevea brasiliensis* (rubber plant). Elicitor was obtained by using a one step of DEAE cellulose chromatography and the new elicitor was obtained by two steps of chromatography: a DEAE cellulose column followed by a hydrophobic column. Both elicitors were stable to heat and a wide range of pH values, but were sensitive to Protease K. Both elicitors induced scopoletin, peroxidase isozymes (with substrate o-dianisidine and scopoletin) and total phenolic compounds in cell suspension of *H. brasiliensis* with similar kinetics. In addition, both elicitors induced peroxidase enzyme (o-dianisidine), total phenolic compounds and enhanced local resistance against *P. palmivora* on young rubber tree seedlings. However, the increase of peroxidase enzyme and total phenolic compounds in rubber tree seedlings was different from those in cell suspension. Furthermore, during the expression of local resistance the zoospore of *P. palmivora* induced the peroxidase enzyme (o-dianisidine) more rapidly and with higher level than the control plants. *H. brasiliensis* is more responsive to the new elicitor than elicitor in triggering defense responses. That is the new elicitor was active at a concentration lower than those required for elicitor, about a 30-fold decrease for activation defense responses in cell suspension. For induction of peroxidase enzyme (o-dianisidine), phenolic compounds and local resistance of rubber plants against *P. palmivora*, the 75 kDa protein was active at about a 2-fold lower concentration when compared to elicitor

Descriptors: disease-resistance. elicitors. enzyme-activity. enzymes. fungal-diseases. peroxidase. phenolic-compounds. plant-diseases. plant-pathogenic-fungi. plant-pathogens *Hevea-brasiliensis*.

Identification and comparison of natural rubber from two *Lactuca* species

Phytochemistry. 2006. 67 (23). 2590-2596

Author(s): Bushman-B-S. Scholte-A-A. Cornish-K. Scott-D-J. Brichta-J-L. Vederas-J-C. Ochoa-O. Micheltore-R-W. Shintani-D-K. Knapp-S-J

Author Affiliation: The Center for Applied Genetic Technologies, University of Georgia, 111 Riverbend Road, Athens, GA 30602, USA

Abstract:

Renewed interest in the identification of alternative sources of natural rubber to *Hevea brasiliensis* has focused on the Compositae family. In our search for Compositae models for rubber synthesis, we extracted latex from stems of two lettuce species: *Lactuca serriola*, prickly lettuce, and *Lactuca sativa* cv. Salinas, crisphead lettuce. Both species contained cis-1,4-polyisoprene rubber in the dichloromethane-soluble portions of their latex, and sesquiterpene lactones in their acetone-soluble portions. The rubber from both species and their progeny had molecular weights in excess of 1,000,000 g/mol, and polydispersity values of 1.1. Rubber transferase activity was detected across a range of farnesyl diphosphate initiator concentrations, with decreased activity as initiator concentrations exceeded putative saturation. These results add lettuce to the short list of plant species that produce high molecular weight rubber in their latex. Due to the genomic and agronomic resources available in lettuce species, they provide the opportunity for further dissection of natural rubber biosynthesis in plants

Descriptors: chemical-composition. enzyme-activity. enzymes. latex. lettuces. plant-composition. rubber. sesquiterpenoid-lactones. stems. transferases

Magnesium ion regulation of in vitro rubber biosynthesis by *Parthenium argentatum* Gray

Phytochemistry. 2006. 67 (15). 1621-1628

Author(s): Costa-B-M-T-da. Keasling-J-D. McMahan-C-M. Cornish-K

Author Affiliation: Department of Chemical Engineering, University of California, Berkeley, CA 94720-3224, USA

Abstract:

Natural rubber is produced by a rubber transferase (a cis-prenyltransferase). Rubber transferase uses allylic pyrophosphate to initiate the rubber molecule and isopentenyl pyrophosphate (IPP) to form the polymer. Rubber biosynthesis also requires a divalent metal cation. Understanding how molecular weight is regulated is important because high molecular weight is required for high quality rubber. We characterized the in vitro effects of Mg²⁺ on the biosynthetic rate of rubber produced by an alternative natural rubber crop, *Parthenium argentatum* (guayule). The affinity of the rubber transferase from *P. argentatum* for IPP . Mg was shown to depend on the Mg²⁺ concentration in a similar fashion to the *H. brasiliensis* rubber transferase, although to a less extreme degree. Also, in vitro Mg²⁺ concentration significantly affects rubber molecular weight of both species, but molecular weight is less sensitive to Mg²⁺ concentration in *P. argentatum* than in *H. brasiliensis*

Descriptors: application-rates. biosynthesis. enzymes. magnesium. molecular-weight. rubber. rubber-plants. transferases

Isolation and characterization of iso inhibitors of the potato protease inhibitor I family from the latex of the rubber trees, *Hevea brasiliensis*

Phytochemistry. 2006. 67 (15). 1644-1650

Author(s): Sritanyarat-W. Pearce-G. Siems-W-F. Ryan-C-A. Wititsuwannakul-R. Wititsuwannakul-D

Author Affiliation: Department of Biochemistry, Faculty of Science, Mahidol University, Rama 6 Road, Bangkok 10400, Thailand

Abstract:

Three iso inhibitors have been isolated to homogeneity from the C-serum of the latex of the rubber tree, *Hevea brasiliensis* clone RRIM 600, and named HPI-1, HPI-2a and HPI-2b. The three inhibitors share the same amino acid sequence (69 residues) but the masses of the three forms were determined to be 14,893 plus or minus 10, 7757 plus or minus 5, and 7565 plus or minus 5, respectively, indicating that post-translational modifications of the protein have occurred during latex collection. One adduct could be removed by reducing agents, and was determined to be glutathione, while the other adduct could not be removed by reducing agents and has not been identified. The N-termini of the inhibitor proteins were blocked by an acetylated Ala, but the complete amino acid sequence analysis of the deblocked inhibitors by Edman degradation of fragments from endopeptidase C digestion and mass spectrometry confirmed that the three iso inhibitors were derived from a single protein. The amino acid sequence of the protein differed at two positions from the sequence deduced from a cDNA reported in GenBank. The gene coding for the inhibitor is wound-inducible and is a member of the potato inhibitor I family of protease inhibitors. The inhibitor strongly inhibited subtilisin A, weakly inhibited trypsin, and did not inhibit chymotrypsin. The amino acid residues at the reactive site P1 and P'1 were determined to be Gln45 and Asp46, respectively, residues rarely reported at the reactive site in potato inhibitor I family members. Comparison of amino acid sequences revealed that the HPI iso inhibitors shared from 33% to 55% identity (50-74% similarity) to inhibitors of the potato inhibitor I family. The properties of the iso inhibitors suggest that they may play a defensive role in the latex against pathogens and/or herbivores

Descriptors: alanine. amino-acid-sequences. aspartic-acid. complementary-DNA. enzyme-inhibitors. glutamine. glutathione. latex. proteinase-inhibitors. rubber Identifiers: cDNA. protease inhibitors. Protein sequences

Initiator-independent and initiator-dependent rubber biosynthesis in *Ficus elastica*

Archives of Biochemistry and Biophysics. 2006. 448 (1-2). 13-22

Author(s): Espy-S-C. Keasling-J-D. Castillon-J. Cornish-K

Author Affiliation: Department of Chemical Engineering, University of California, Berkeley, CA 94720, USA

Abstract:

The rubber-producing tree, *Ficus elastica* (the Indian rubber tree), requires the same substrates for rubber production as other rubber-producing plants, such as *Hevea brasiliensis* (the Brazilian or Para rubber tree), the major source of commercial natural

rubber in the world, and *Parthenium argentatum* (guayule), a widely studied alternative for natural rubber production currently under commercial development. Rubber biosynthesis can be studied, in vitro, using purified, enzymatically active rubber particles, an initiator such as FPP, IPP as the source of monomer, and a metal cofactor such as Mg²⁺. However, unlike *H. brasiliensis* and *P. argentatum*, we show that enzymatically active rubber particles purified from *F. elastica* are able to synthesize rubber, in vitro, in the absence of added initiator. In this paper, we characterize, for the first time, the kinetic differences between initiator-dependent rubber biosynthesis, and initiator-independent rubber biosynthesis, and the effect of cofactor concentration on both of these processes

Descriptors: biosynthesis. cofactors. in-vitro-culture. in-vitro-production. rubber *Ficus-elastica*

PLANT PHYSIOLOGY-GROWTH AND DEVELOPMENT (1 jdl)

Modification of ramaer's technique to obtain twin plants of rubber tree

Bragantia. 2006. 65 (4). 559-561

Author(s): Moraes-L-A-C. Moraes-V-H-F

Author Affiliation: AD:

Abstract:

The objective of this work was to enhance the success of obtaining twin rubber plants of equal size, by turning easy the Ramaer's technique, which consist of using seeds in the final stage of germination when radicle shows more than 3 cm length and the longitudinal splitting in two halves of equal size up to the cotyledonary arms. A longitudinal sectioning in two stages was tested, first of emerging tip of the radicle, 3.0 mm long, up to 1.0 cm above the root collar. After the regeneration of two equal radicles, the sectioning was concluded according to the Ramaer technique. The percentage of equal sized twin plants was 82.5 with the modified method and 52.5 with the Ramaer technique

Descriptors: Hevea; cotyledonary-buds; rootstock-effects

PLANT DISEASES (1 jdl)

Induction of peroxidase, scopoletin, phenolic compounds and resistance in *Hevea brasiliensis* by elicitor and a novel protein elicitor purified from *Phytophthora palmivora*

Physiological and Molecular Plant Pathology. 2008. 72 (4-6). 179-187

Author(s): Dutsadee-C. Nunta-C

Author Affiliation: Department of Biochemistry, Faculty of Science, Prince of Songkla University, Hat-Yai, Songkhla 90112, Thailand

Abstract:

Elicitor and a new protein 75 kDa elicitor were purified from the culture filtrate of *Phytophthora palmivora*, a pathogen of *Hevea brasiliensis* (rubber plant). Elicitor was

obtained by using a one step of DEAE cellulose chromatography and the new elicitor was obtained by two steps of chromatography: a DEAE cellulose column followed by a hydrophobic column. Both elicitors were stable to heat and a wide range of pH values, but were sensitive to Protease K. Both elicitors induced scopoletin, peroxidase isozymes (with substrate o-dianisidine and scopoletin) and total phenolic compounds in cell suspension of *H. brasiliensis* with similar kinetics. In addition, both elicitors induced peroxidase enzyme (o-dianisidine), total phenolic compounds and enhanced local resistance against *P. palmivora* on young rubber tree seedlings. However, the increase of peroxidase enzyme and total phenolic compounds in rubber tree seedlings was different from those in cell suspension. Furthermore, during the expression of local resistance the zoospore of *P. palmivora* induced the peroxidase enzyme (o-dianisidine) more rapidly and with higher level than the control plants. *H. brasiliensis* is more responsive to the new elicitor than elicitin in triggering defense responses. That is the new elicitor was active at a concentration lower than those required for elicitin, about a 30-fold decrease for activation defense responses in cell suspension. For induction of peroxidase enzyme (o-dianisidine), phenolic compounds and local resistance of rubber plants against *P. palmivora*, the 75 kDa protein was active at about a 2-fold lower concentration when compared to elicitin

Descriptors: disease-resistance. elicitors. enzyme-activity. enzymes. fungal-diseases. peroxidase. phenolic-compounds. plant-diseases. plant-pathogenic-fungi. plant-pathogens

PROCESSING AGRICULTURAL PRODUCT (2 jdl)

Finishing of Cotton by Polyacrylic Rubber in Presence of NaH₂PO₄ as Catalyst Under Thermal Treatment

Journal of Natural Fibers. 2008. 5 (4). 383-395

Author(s): Das-D. Munshi-R

Author Affiliation: National Institute of Fashion Technology, Government of India, Block-LA, Plot 3B, Sector III, Salt Lake City, Calcutta-700 098, India

Abstract:

Cotton fabric was modified using polyacrylic rubber as a finishing agent in the presence of ammonium chloride, magnesium chloride, and sodium salts of phosphoric acid as catalysts, employing a pad-dry-cure technique. Treatment with 8% polyacrylic rubber in presence of 1.2% NaH₂PO₄, followed by drying of the padded fabric at 95° C for 5 min. and curing of the dried fabric at 140° C for 5 min., produced balanced improvements in properties such as tear strength, flexibility, tensile strength elongation at break, moisture regain, abrasion resistance, and wrinkle recovery. Functional group analysis and IR spectroscopy indicated that the NaH₂PO₄ catalyst allowed esterification of carboxyl groups of polyacrylic rubber with the cellulose constituents of cotton and the process ultimately led to some degree of crosslinking of the chain polymers of cotton

Descriptors: polyacrylic-rubber; finishes-on-cotton-cellulose; crosslinking-of-cellulose; esterification

Green Composites from Natural Fibers and Natural Rubber: Effect of Fiber Ratio on Mechanical and Swelling Characteristics

Journal of Natural Fibers. 2008. 5 (1). 47-60

Author(s): John-M-J. Varughese-K-T. Thomas-S

Author Affiliation: Fibres and Textiles Competence Area, Materials Science and Manufacturing, CSIR, Port Elizabeth 6000, South Africa

Abstract:

Sisal and oil palm fibers were incorporated into a natural rubber matrix, and the influence of fiber ratio on the cure and tensile properties of hybrid fiber-reinforced natural rubber composites were analyzed. Tensile strength and modulus was found to decrease with the loading of oil palm fiber. Longitudinally oriented composites showed better mechanical properties than transversely oriented composites. Maximum torque values were found to increase with oil palm fibers content. A positive hybrid effect was observed for the tensile properties. Anisotropic swelling experiments were performed to determine the extent of fiber/matrix interaction

Descriptors: natural-reinforcement; composites; natural-rubber-matrix; swelling-experiments

PROCESSING OF AGRICULTURAL WASTES (1 jdl)

Technology to separate rubber crumb from fiber

Applied Engineering in Agriculture. 2006. 22 (4). 563-570

Author(s): Anthony-W-S

Author Affiliation: USDA-ARS Cotton Ginning Research Unit, 111 Experiment Station Rd., Stoneville, MS 38756, USA

Abstract:

Tests at a research laboratory and field evaluation at a commercial tyre recycling facility demonstrated the reliability and economic value of a new machine to separate the waste fluff produced by tyre recycling plants into marketable products such as crumb rubber and fibre. Two new fluff recycling machines were designed, constructed, patented, and tested in the lab (prototype and improved), and one (prototype) was tested in a commercial plant. Processing the fluff from several recycling plants with the prototype machine yielded from 34% to 87% crumb and from 1% to 26% fibre. The crumb was mostly 300 microns or smaller. The quantity of un-ground rubber in the fluff ranged from 2% to 64% and greatly impacted the amount of recoverable crumb and fibre. Field tests at a commercial tyre recycling facility were successful and the prototype machine yielded 70% crumb, 13% clean fibre, 9% partially cleaned fibre, 5% large pieces of un-ground rubber, and 3% cyclone waste. Evaluation of the improved machine with fluff from five recycling plants produced 40% to 67% crumb, mostly 300 microns or smaller. The highly variable raw material yielded from 1% to 21% clean fibre, 9% to 30% rough fibre, and 3% to 48% un-ground rubber. Economic evaluation for three tyre recycling plants that processed between 2 and 5 million tyres annually indicated that their gross income could be increased from \$0.67 to \$1.94 million per

year depending on the quantity of tyres processed and the landfill costs. The machines process about 1490 kg/h/m (1000 lb/h/ft) of width and cost about \$100 000

Descriptors: costs. economic-evaluation. equipment. equipment-performance. evaluation. fibre. income. industrial-wastes. performance-tests. prototypes. recycling. rubber. rubber-industry. separation. separators. technology. tyres. waste-utilization

SOIL CLASSIFICATION AND GENESIS (2 jdl)

Decomposition of the rubber tree *Hevea brasiliensis* litter at two depths

Chilean Journal of Agricultural Research. 2008. 68 (2). 128-135

Author(s): Greggio-T-C. Assis-L-C. Nahas-E

Author Affiliation: Universidade Estadual Paulista, Facultad of Ciencias Agrarias y Veterinarias (FCAV/UNESP), Departamento of Producao Vegetal, 14884-900 Jaboticabal, Sao Paulo, Brazil

Abstract:

The decomposition of soil litter contributes to maintaining agricultural sustainability, since the nutrients released by microbial activity are determinants of the net productivity of the agroecosystem. The decomposition of rubber tree (*Hevea brasiliensis*) leaves located on the surface and buried in at 10 cm depth in Forest and Savannah (Cerradao) soils (Oxisols) in two reserves of Jaboticabal, Sao Paulo, Brazil, was studied, with emphasis on the production of CO₂ and the monthly variation of the remaining amounts of litter mass, soluble substances, cellulose and lignin. To evaluate CO₂ production, *H. brasiliensis* leaves were incubated for 30 days in soils from the 0-2 cm and 10-12 cm layers. CO₂ production increased in the 0-2 cm layer in comparison to the 10-12 cm layer. Litter mass and soluble substance loss was of 62 and 72% at the end of nine months of incubation, and of 38 and 65%, respectively, in the first three months, being greater in the deeper (71-74%) than in surface layer (48-55%). Forest soil stimulated more litter mass loss and cellulose decomposition (only in the surface layer) than Savannah soil. The cellulose (25%) content decreased and lignin (30%) increased in the initial months of incubation, however, at the end of the period of this study the same content (29%) was found

Descriptors: carbon dioxide; carbon sequestration; cellulose; decomposition; forest litter; forest soils; lignin; microbial activities; nutrients; Oxisols; soil types; sustainability; South America; America; Developing

Impact of effective soil volume on growth and yield of rubber (*Hevea brasiliensis*)

Geoderma. 2007. 141 (3-4). 332-340

Author(s): Rao-D-V-K-N. Jessy-M-D

Author Affiliation: Crop Management, Rubber Research Ins of India, Kottayam - 686 009, India

Abstract:

Soil is a three dimensional body that is exploited by plant roots to extract water and nutrients. Depending on the conditions of soil development, part of the soil volume may be occupied by coarse fragments, which cannot be penetrated by plant roots. In a part of one study, we applied factor analysis to the available soil survey data to understand the basic relationship among soil properties and soil qualities using sand, silt, clay, coarse fragments (2 to 50 mm size) and depth. Subsequent to analysis of regression of available water capacity (AWC) on factor scores, we then utilized the results to evaluate the role of effective soil volume (ESV) on the plant performance in terms of growth and yield of rubber. Sixty two soil series, which are under rubber plantations in traditional region of cultivation in India, had varied weighted means of coarse fragment content ranging from less than 15 to 81% by volume along with variation in other soil properties too. Factor analysis extracted two factors, which described a total variance of 72%. The first factor was named as 'surface area factor' (that described 46% of variance) to which sand fraction was negatively related while silt and clay were positively related. The second factor was identified as 'soil water availability factor' (that described 26% variance) to which coarse fragments were negatively related whereas depth showed a positive relation with the same. AWC regressed on the scores of both the factors significantly indicating the most likely influence of soil texture, coarse fragments and depth on the availability of water, obviously along with plant nutrients when soil water is regarded as soil solution. Results of analysis of data generated in Part II of the study indicated that increased FLESV (first layer effective soil volume, corresponding to the depth of 0-11 cm) increased the growth of rubber trees observed during second, third, fourth, fifth and seventh year after planting with correlation coefficients (Pearson's) 0.432**, 0.383*, 0.321*, 0.357* and 0.325* respectively (* and ** indicate significance at 5 and 1% level, respectively). During the second year of growth, a significant correlation was observed between growth and ESV at 0-22 cm ($r=0.366^*$) as well as 0-44 cm ($r=0.346^*$). Rubber latex yield was found to be influenced by the FLESV (First Layer Effective Soil Volume) only that is the surface 0-11 cm layer ($r=0.381^*$). The present fertilizer recommendations for rubber plants do not take the effective soil volume into account. Generally the properties measured in <2 mm soil fraction are taken into consideration and rating charts for advisory purposes are prepared based on the STCR (soil test crop response) studies and rubber nutrition also follows the suit. In the future, the effective soil volume should be considered for development of fertilizer recommendations for rubber in a field where coarse fragments comprise a significant portion of soil

Descriptors: clay-fraction. factor-analysis. growth. latex. rubber. sand-fraction. silt-fraction. soil-depth. soil-formation. soil-physical-properties. water-availability. yields

SOIL CHEMISTRY AND PHYSICS (2 jdl)

Chemical degradation of a Ferralsol (Oxisol) under intensive rubber (*Hevea brasiliensis*) farming in tropical China

Soil & Tillage Research. 2007. 93 (1). 109-116

Author(s): Zhang-Hua. Zhang-GanLin. Zhao-YuGuo. Zhao-WenJun. Qi-ZhiPing

Author Affiliation: State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, China

Abstract:

Impacts of intensive management practices on rubber (*Hevea brasiliensis*) farms (e.g., land clearance, fertilization, and rubber tapping) have not been adequately investigated. In this study, soil was taken from fields of grass (before rubber plantation), immature rubber (before tapping), and mature rubber (after tapping) at a tropical farm in Hainan, China. Soil organic matter, plant nutrients, cations, and soil pH were determined. Rubber cultivation resulted in significant decline of soil organic C and microbial biomass C. Available P was extremely low for all soils, resulting from the naturally low P content and the high sorption capacity of highly weathered Ferralsol. Furthermore, soil pH decreased by about 0.5 units, accompanied by an increase of exchangeable Al by more than one-fold. Regression analysis demonstrated that soil acidification was characterized by the depletion of base cations and release of Al. To maintain tropical soil quality, farming practices such as liming and organic amendment should be included in the best management practices of rubber farm

Descriptors: acidification. aluminium. cations. chemical-degradation. Ferralsols. liming. nutrient-availability. organic-carbon. Oxisols. phosphorus. soil-amendments. soil-fertility. soil-organic-matter. soil-pH. soil-types.sorption. sustainability. tropics

Impact of effective soil volume on growth and yield of rubber (*Hevea brasiliensis*)

Geoderma. 2007. 141 (3-4). 332-340

Author(s): Rao-D-V-K-N. Jessy-M-D

Author Affiliation: Crop Management, Rubber Research Ins of India, Kottayam - 686 009, India

Abstract:

Soil is a three dimensional body that is exploited by plant roots to extract water and nutrients. Depending on the conditions of soil development, part of the soil volume may be occupied by coarse fragments, which cannot be penetrated by plant roots. In a part of one study, we applied factor analysis to the available soil survey data to understand the basic relationship among soil properties and soil qualities using sand, silt, clay, coarse fragments (2 to 50 mm size) and depth. Subsequent to analysis of regression of available water capacity (AWC) on factor scores, we then utilized the results to evaluate the role of effective soil volume (ESV) on the plant performance in terms of growth and yield of rubber. Sixty two soil series, which are under rubber plantations in traditional region of cultivation in India, had varied weighted means of coarse fragment content ranging from less than 15 to 81% by volume along with

variation in other soil properties too. Factor analysis extracted two factors, which described a total variance of 72%. The first factor was named as 'surface area factor' (that described 46% of variance) to which sand fraction was negatively related while silt and clay were positively related. The second factor was identified as 'soil water availability factor' (that described 26% variance) to which coarse fragments were negatively related whereas depth showed a positive relation with the same. AWC regressed on the scores of both the factors significantly indicating the most likely influence of soil texture, coarse fragments and depth on the availability of water, obviously along with plant nutrients when soil water is regarded as soil solution. Results of analysis of data generated in Part II of the study indicated that increased FLESV (first layer effective soil volume, corresponding to the depth of 0-11 cm) increased the growth of rubber trees observed during second, third, fourth, fifth and seventh year after planting with correlation coefficients (Pearson's) 0.432**, 0.383*, 0.321*, 0.357* and 0.325* respectively (* and ** indicate significance at 5 and 1% level, respectively). During the second year of growth, a significant correlation was observed between growth and ESV at 0-22 cm ($r=0.366^*$) as well as 0-44 cm ($r=0.346^*$). Rubber latex yield was found to be influenced by the FLESV (First Layer Effective Soil Volume) only that is the surface 0-11 cm layer ($r=0.381^*$). The present fertilizer recommendations for rubber plants do not take the effective soil volume into account. Generally the properties measured in <2 mm soil fraction are taken into consideration and rating charts for advisory purposes are prepared based on the STCR (soil test crop response) studies and rubber nutrition also follows the suit. In the future, the effective soil volume should be considered for development of fertilizer recommendations for rubber in a field where coarse fragments comprise a significant portion of soil

Descriptors: clay-fraction. factor-analysis. growth. latex. rubber. sand-fraction. silt- fraction. soil-depth. soil-formation. soil-physical-properties. water-availability. yields

VETERINARY SCIENCE AND HYGIENE (1 jdl)

Effect of rubber flooring on claw health in lactating dairy cows housed in free-stall barns

Journal of Dairy Science. 2006. 89 (11). 4251-4258

Author(s): Vanegas-J. Overton-M. Berry-S-L. Sisco-W-M

Author Affiliation: Veterinary Medicine Teaching and Research Center, University of California Davis, Tulare, CA 93274, USA

Abstract:

Multiparous dairy cows between 10 to 30 d in milk (DIM) were enrolled in a clinical trial to evaluate the effects of rubber flooring on the development of claw lesions, locomotion scores, clinical lameness, and rates of hoof growth and wear. Two groups of cows were housed in identical free-stall facilities, except that 1 pen (rubber, n=84) had rubber alley mats covering the entire concrete floor of the pen, whereas cows in the second pen were exposed to concrete flooring (concrete, n=82) without rubber alley

mats. All cows were evaluated 3 times between 10 and 30, 74 and 94, and 110 and 130 DIM for (1) the presence of claw lesions on their rear feet, (2) the occurrence of clinical lameness based on a locomotion score, and (3) rates of claw growth and wear as observed on the dorsal wall of the right lateral claw. No differences between flooring groups at the time of enrollment were detected for lactation number, mean DIM at first examination, body condition score, and proportion of cows with claw lesions at the first examination. Odds of developing claw lesions between examinations were not different for cows exposed to the rubber surface compared with those exposed to concrete. Cows on concrete, however, had greater odds of developing or exacerbating existing heel erosion than cows on rubber flooring. Regardless of the flooring surface, the lateral claw was more likely to develop lesions than the medial claw. Odds of becoming lame by the third examination and the proportion of cows requiring therapeutic hoof trimming because of lameness were greater for concrete-exposed cows than those on rubber. Cows on rubber flooring had decreased claw growth and wear between the first and last examination compared with cows on concrete. Regardless of flooring surface, second-lactation cows had greater wear rates than those in third or greater parities. Results of our study suggest that a soft flooring surface, such as interlocking rubber, is beneficial for hoof health

Descriptors: animal-welfare. body-condition. cattle-housing. claws. cows. dairy-cows. floors. foot-diseases. lameness. rubber. stalls animal rights. cattle sheds. flooring