Agrotechnol 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2168-9881.C1.022

Clay-humus complexes in a mixed grove in hyper-arid desert of Punjab, India: Infrared spectroscopy

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Humification is possibly the best way of sequestrating and retaining carbon in soils, which could be linked to tree species cover. Therefore, an intensively managed multi-species orchard at Abohar in hyper desert in Punjab (30°08'N; 74°12'E; 180 m a.s.l.) was selected for the study. Samples were collected from genetic surface soils under 6 tree-species and under cotton. Clays and organic matter (SOM) were extracted, and clays were fractionated into natural, mineral, clay-humus, and clay-carbonates. The absorption peaks Infra-red Spectroscopy showed that SOM composed of functional groups of alcohols, phenols, amides, quinine, aldehydes, humic acids, fulvic acids, ketones, alkynes, alkyle halides and aromatic benzene compounds, while clays contained illites, kaolin, montmorillonite, chlorite, and palygorskite. Inorganic carbon (atom %) ranged between 11.61 and 50.41 in soils. The variation of SOM was narrower than that of oxidizable organic carbon to humus ratio. The conversion of organic matter to humus was best performed in the soils under guava followed by date palm and Indian jujube. Data showed that humus was retained in soils through complexation reactions with clays, and clay mineral occurrence was little influenced by tree species, but humus composition was influenced by it.

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Enhancing photosynthesis and overcoming nitrogen deficiency by over-expression of uroporphyrinogen III methyltransferase (UPM1) in *Arabidopsis thaliana*

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Siroheme is an iron-containing tetrapyrrole and is the prosthetic group of nitrite reductase (NiR) required for NO3-assimilation. It is synthesized from uroporphyrinogen III, an intermediate of chlorophyll biosynthesis. Uroporphyrinogen III methyltransferase (UPM1), responsible for two methylation reactions to form dihydrosirohydrochlorin, diverts uroporphyrinogen III from chlorophyll biosynthesis pathway to siroheme biosynthesis. AtUPM1 [At5g40850] was used to raise *Arabidopsis thaliana* transgenic sense and antisense plants to modulate siroheme biosynthesis. Over-expression of AtUPM1 resulted in higher NiR gene expression, protein abundance and enzymatic activity as compared to the WT. Higher NiR expression in AtUPM1 overexpressors co-modulated nitrate reductase (NR) gene and protein expression and increased NR activity. Enhanced NiR and NR activities increased the total protein content of overexpressors. Overexpression of AtUPM1 induced a coordinated upregulation of most of the genes of the chlorophyll biosynthetic pathway resulting in higher Chl content. Higher chlorophyll and protein content in sense plants contributed to increased photosynthetic electron transport, carbon assimilation and plant biomass. Under N starvation, overexpressors had higher nitrite reductase and nitrate reductase activities, protein content and photosynthetic electron transport rate than that of wild type. Results demonstrate the role of UPM1 in regulation of C and N assimilation and protection of plants from N-deficiency.

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