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Evaluation of the main limitations of Albert's Solution as a hydroponics fertilizer and optimization of its use

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Most hydroponics systems in Sri Lanka use the commercially available nutrient pack, Albert's Solution. The major drawbacks of this nutrient pack are lack of proper guidance for preparing working solutions, incomplete solubility and inadequate supply of nutrients. In order to investigate these problems and suggest solutions, the composition and maximum weight to volume ratio with the minimum undissolved matter (optimum pH & Electrical Conductivity (EC) range = 5.8 – 6.5 and 2 – 3 mS/cm respectively) and the composition of undissolved matter of Albert's Solution were determined. Field experiments were carried out to determine whether an adequate supply of nutrients is provided for tomato plants by Albert's solution (with root solution and foliar analysis). A high variation of the compositions of the elements was found due to poor mixing of the compounds in the packs. The maximum concentration of Albert's Solution with least undissolved solids was of 4 g/1 dm^3. Therefore, preparation of stock solutions having more than 4 g/1 dm^3 is not advisable. Solutions less concentrated than 4 g/1 dm^3 (with less undissolved matter) were prepared and pH and EC was measured. Fro those solutions, suitable pH and EC for plants were obtained with 1.6 g (pH 6.12 and EC 1.63 mS/cm) and 2.6 g (pH 6.01 and EC 2.92 mS/cm) in 1.0 dm^3 of tap water. The weight: volume ratio, 1.6 g / 1 dm^3 and 2.6 g / 1 dm^3 were selected for the seeding & growing stages and blooming & fruiting stages (since more nutrients are required) respectively. If the pH is adjusted manually to 5.8 the amount of undissolved matter in these solutions can be further reduced. The undissolved matter contained Ca, Fe, P, S and in some instances, Mg and Mn as well. With increasing pH (> 6.1), the amounts of Ca and Fe increased while that of P decreased. It is likely that $Fe(OH)_3$, $Ca_2(PO_4)_3$ and also $CaSO_4$ (> pH 6.5) would precipitate since their solubility product (K_{sp}) values are low. In solutions where high concentrations of Mg and Mn were present, it is likely that $Mg_3(PO_4)_2$ and $Mn(OH)_2$ precipitation also takes place. When the pH is increased from 6.1 to 6.5, the weight of Ca in the precipitate increased 3 – 4 fold while the amount of Fe in the precipitate doubled. The high absorption of macro elements by plants in the field experiment shows that the nutrient solution was suitable (pH, EC and nutrient availability) to meet the high nutrient demand at the bloom and the fruiting stages. Levels of all the essential elements other than the levels of Ca and Fe in both grow and bloom stages and the level of N in the grow stage were at sufficient levels in tomato leaves. Therefore, Ca. Fe and N need to be supplied additionally in the respective growth stages.

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