Abstract

To increase the profitability in agriculture, low cost, readily available, simple, attractive technologies which can utilize space and water efficiently are required. Simplified hydroponics is a system that is affordable and also adaptable to any part of Sri Lanka. So far, no scientific research involving simplified hydroponics technique has been reported in Sri Lanka. For this technique to be used locally, it is important to develop a formulation for a nutrient solution which is of low cost, suitable to the climatic conditions in Sri Lanka and compatible with locally available, low cost growing media such as rice hull and river sand. The possibility of introducing a buffer system and use of silicon as a beneficial element were considered when designing the new formulations.

In this study, two new formulations "new formulation with silicon" (NFS) and "new formulation without silicon" (NF) were prepared using locally available commercial grade chemicals. A buffer system KOH / KH_2PO_4 (with a capacity of 4 mmol / dm^3), was incorporated into the new formulations. Potassium silicate with a molar ratio of Si : K of 1: 0.53 (prepared using sodium silicate and KOH) was selected as the source of silicon in the new formulation, NFS. The composition of formulation, NF was (in ppm), N = 167, P = 80, K = 281, Ca = 234, Mg = 57, S = 251, Cu = 0.01, Fe = 3.9, Zn = 0.13, Mn = 1.2 and Mo = 0.13. The composition of formulation, NFS was the same as that of NF, except for S (111 ppm) and Si (100 ppm). In both formulations, the ratio of N: K was 1 : 1.7.

The "inertness" of the medium (rice hull : sand = 3 : 2) was evaluated by determining the cation exchange capacity (CEC), anion exchange capacity (AEC) and by leaching studies with distilled water and Albert's solution. Both CEC (7.38 Cmmol/ 100 g) and AEC (14.17 x3 Cmmol/ 100 g) were low. Only very small quantities of nutrients (except Si) are leached from the medium. Unlike with sand, leaching of silicon ions from rice hull increased with time. Since rice hull was used as a medium in this study, it was not possible to study the effect of silicon on plant growth.

"Albert's solution" (CIC) is the commercially available nutrient pack widely used by farmers and for research in Sri Lanka. The drawbacks of this nutrient pack were studied and solutions were sought. On analyzing the "Albert's solution", the compositions of the working solutions prepared were found to vary greatly especially with respect to the micro nutrients. The most suitable weights of "Albert's solution" for plants were 1.6 g (pH 6.12 and EC 1.63) and 2.6 g (pH 6.01 and EC 2.92) in 1.0 dm^3 of tap water. The weight of undissolved matter of both the solutions increased when the pH was increased from 5.8 to 6.5. At pH above 6.1 in the working solution of "Albert's solution", it is likely that Fe, Ca and PO_4^{3-} precipitate while at pH 6.5, SO_4^{2-} precipitates as $CaSO_4$. Mn also precipitates in samples having higher amounts of Mn at this pH. When the pH is increased from 6.1 to 6.5, the amount of Ca in the precipitate increases by 3 – 4 fold while the amount of Fe in the precipitate increases by two fold.

Trial 1 was carried out for bean and tomato plants with the new formulations with "Albert's solution" (Al) as the control in the low country wet zone. The variation in average pH of the root solution of beds (compared to the pH of the applied solution), was