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The use of cocopeat buffering for hydroponics crop production

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Hydroponics crop production relies on soilless substrates, like growth media, to support plants and facilitate water and nutrients uptake. Growth media has a direct impact on the growth and development of the plants. Generally, growers prefer organic growth media such as cocopeat and sawdust. This is due to their light weight and good water retention capacity, which is particularly important in intermittent water flow hydroponic systems. Growers generally prefer sawdust, because it is more affordable and readily available, whereas cocopeat is expensive, as it is currently imported to South Africa. However, with recent trends, the price of sawdust continues to rise and due to its non-reusable form, its continuous utilization in hydroponics becomes a challenge. On the contrary, cocopeat can be re-used multiple times. Also, it is often reported that cocopeat provides better crop yields when compared to other organic growth media. The challenge has been that cocopeat that is sold already prepared and buffered is expensive and logistically costly. The affordable cocopeat is purchased in a compressed brick form, which growers have to buffer and rinse before use. A 5kg brick of cocopeat can expand into 60 to 65L when prepared, costing up to R105 (Figure 1). In contrast, the prepared bag of 20L cocopeat can cost up to R180, leading to a cost increase of approximately five times more for a 300 m^2 tunnel fully planted using an open bag hydroponic system.

Figure 1: A 5kg brick of unprepared cocopeat (left) and a 20L bag of prepared cocopeat (right).The two forms are widely available on the market.

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Corporations that sell the prepared cocopeat tend to exploit the problem of increased price of buffered cocopeat, by trying to convince growers that this is the only form of cocopeat that is good for crop production. This signifies the need to describe the method used to prepare and buffer the brick-form cocopeat until it is suitable for use by farmers. Cocopeat is made of coconut coir, which is the outer layer of the coconut commodity. The material comprises of chemical complexes that are called cation exchange sites, which have large amounts of sodium (Na) and potassium (K) attached. The attachment between these cation sites is relatively weak. Hence, in the presence of either calcium (Ca) or magnesium (Mg), these sites will release Na or K cations and replace them with Ca or Mg, through cation exchange processes. Therefore, when the cation exchange sites bond with Ca or Mg in the place of Na and K, the media is said to be buffered. This is a precaution measure before planting, so that plant nutrient uptake does not become affected. Plants that are grown in unbuffered cocopeat tend to show severe Ca or Mg deficiency (Figure 2). This is because the exchange sites will take Ca or Mg of the nutrient solution and replace them with Na and K, which will ultimately affect Ca or Mg availability for plant root uptake.

A

B

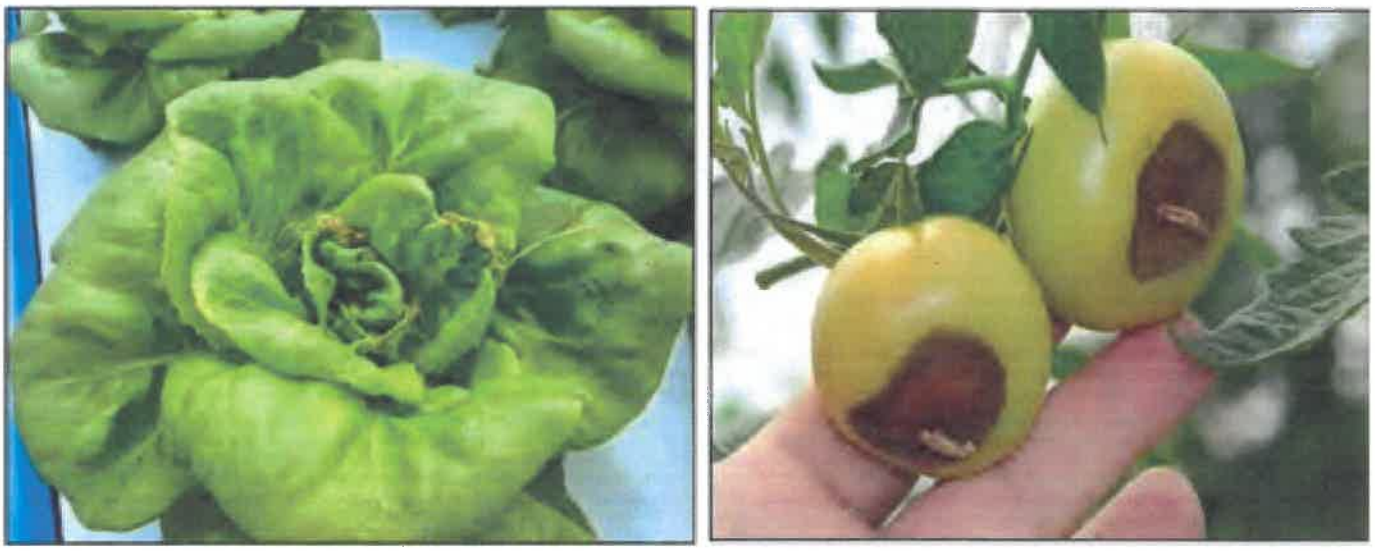

Figure 2: Calcium deficiency on lettuce (A) and tomato (B) grown hydroponically.

Buffering the cocopeat before planting prevents nutrient deficiencies and imbalances and ensures that the added nutrients are all available to the crop at the ratios provided. Cocopeat buffering involves the following steps (Figure 3): (1) soaking of cocopeat brick in water, to break it down into a loose form at a ratio of one brick cocopeat into 120L water for 48 hours at most. Normally the electrical conductivity (EC) of the solution will range from 2.0 to 5.0 mS/cm at this stage; (2) flushing of water out of the container and replacement with fresh water; (3) dissolution of 125g of Calcium Nitrate fertilizer in water before pouring into the cocopeat preparation for at least 48 hours. This will allow sufficient time for the cation exchange reaction to take place and (4) flushing of water out and thereafter rinsing with fresh water. At this stage The EC and pH will be around 0.3- 0.7 mS/cm and 6.5-7.0, respectively. The cocopeat will subsequently be ready to be used as a growth media "the dehydrated brick has been turned into super growth media". Due to insufficient efforts to inform farmers locally, preventable losses are incurred by farmers. Hence, the Agricultural Research Council, in collaboration with the Water Research Commission, developed a method for cocopeat buffering to help growers reduce production costs. This will ensure increased sustainability in grower's income generation and profitability.

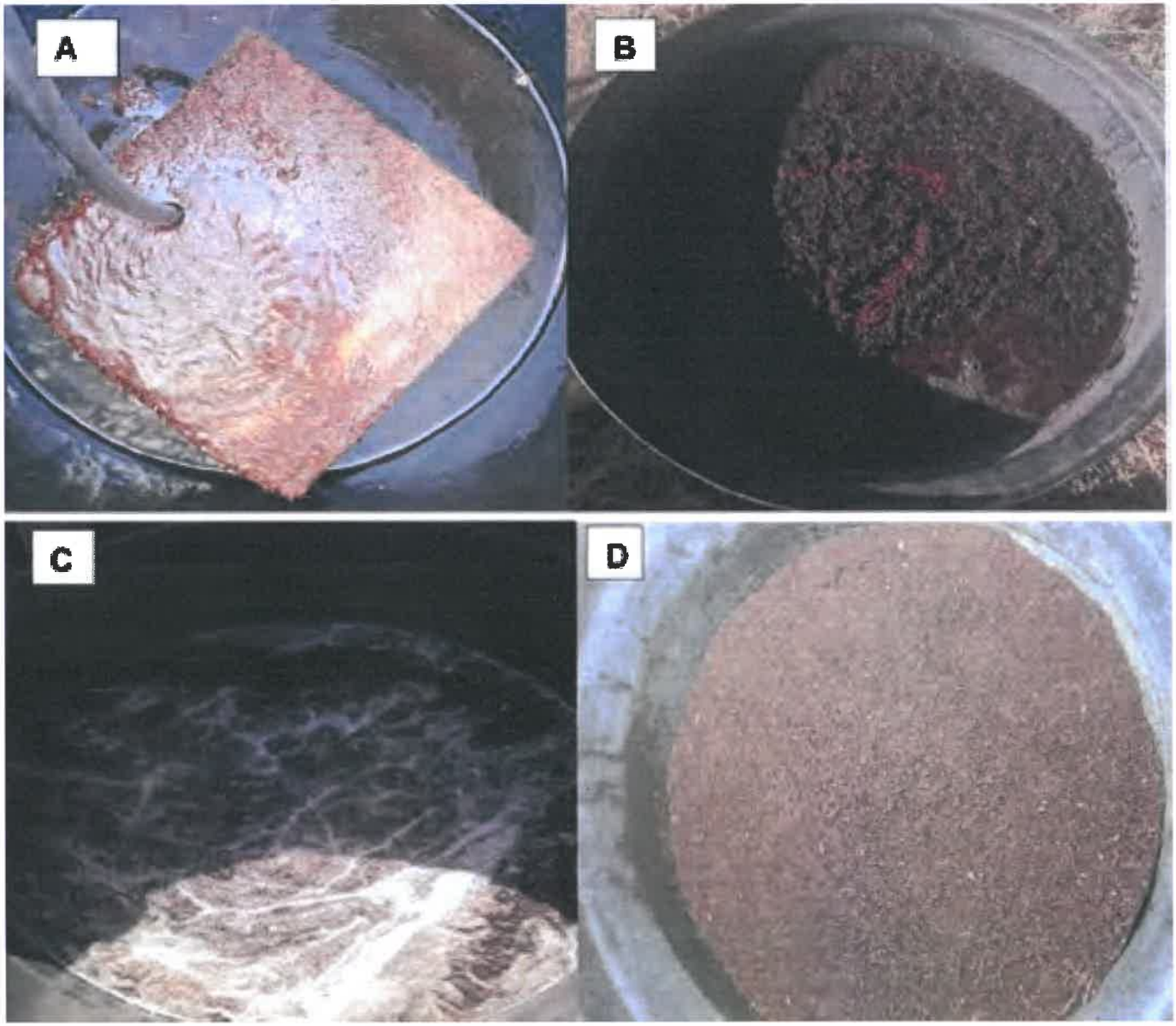

Figure 3: Hydration of coco coir brick to break it down (A); broken down coco peat ready to be buffered (B); cocopeat during the buffering process (C) and prepared cocopeat ready for planting (D). The buffering cocopeat method was developed and tested at the Agricultural Research Council – Vegetable, Industrial and Medicinal Plants research station located at Roodeplaat, Pretoria.

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