EFFICIENT USE OF BAGASSE ASH FOR PLANT BIOMASS PRODUCTION

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Abstract
The Brazilian sugarcane industry produces over 9 million tons of water free bagasse ash yearly. This by-product contains varying amounts of minerals essential for plant nutrition, including phosphorus (P) and potassium (K). The P-concentration in bagasse ash is up to 5g/ kg ash and the reuse of P from bagasse ash could reduce the rock phosphate consumption by at least 45,000t annually. Here we study (i) the availability of P from bagasse ash to soybeans, (ii) the potential of additional fertigation to increase the P-uptake by improving the soybean nutrition, and (iii) the potential of fertigation to increase the growth of bagasse ash- and triple-superphosphate-treated (TSP) soybeans. In this experiment soybeans inoculated with N-fixing rhizobia were cultivated in pots under greenhouse conditions. Nutrient poor substrate was homogeneously mixed with three concentrations of P (0-164mg/ L) in form of bagasse ash (processed at 600°C, air-fuel ratio approx. 2.5) or TSP, respectively, and the K-concentration was adjusted to the highest K application present in the ash treatment. Half of the replications of each treatment were additionally fertigated once the week with a modified 1/3-strength Hoagland's solution, without P. Soybean plants were harvested for biomass and P-recovery analyses after 14 and 41 days. The availability of P in bagasse ash was significantly lower compared to TSP. As a result, the ash-treated plants produced significantly less total-biomass with a higher root fraction and accumulated less P (total and relative). An increase in ash and thus in total P eliminated the differences in total-biomass accumulations but not in root mass fraction. Furthermore, the additional nutrient supply via fertigation significantly increased the biomass accumulation but not the P-uptake. In conclusion, (i) for receiving comparable fertilization effects of P applied as bagasse ash and TSP, a high dose of bagasse ash application, i.e. 140t/ ha, is needed. This is economically not feasible since estimated production of 75t/ha of sugarcane generates only 91kg/ ha of water free bagasse ash. (ii) Additional fertigation improves the soybean growth but irrespective of the P-source applied it has no effect on P-uptake. The next studies are focused on bagasse processing methods and conditions, and post-processing ash modifications by thermochemical treatments for increasing the availability of P to soybeans.

Keywords: bagasse ash, phosphorus availability, nutrient poor substrate, soybeans, fertigation

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