Optimizing NPK fertilization: a comprehensive approach to integrated nutrient management[1]

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Abstract — While many software platforms aim to refine fertilization strategies, a significant number focus solely on soil fertility and nutrient outflow, inadvertently overlooking vital elements like water availability and the need for balanced nutrient supply-crucial for achieving superior productivity levels. Ignoring the nutritional well-being of crops can result in imbalanced fertilizer applications, undermining both the yield potential and the economic viability of fertilization practices. To bridge these gaps, we introduce a comprehensive fertilization guidance system designed for cocoa plantations in Rondônia. This innovative approach not only considers the soil's fertility and the need for nutrient replacement but also emphasizes the plants' nutritional condition. By utilizing multivariate nutritional benchmarks along with the Nutritional Diagnosis Composition (CND) technique, the system categorizes nutritional status into five distinct groups. It then adjusts the application rates of nitrogen, phosphorus, and potassium, aligning them with the output of dry cocoa beans, soil fertility, and the crops' nutritional health. The foundational recommendation prescribes dosages of 75 kg of N, 90 kg of P_2O_5, and 80 kg of K_2O per hectare, with specific adjustments for each nutrient to optimize fertilization effectiveness. For nitrogen, the base allocation of 75 kg/ha can be modified in increments of 8 kg/ha, reflecting variations in almond exports and the soil's organic carbon content, and includes the possibility for nutritional modulation of ±5 or 2.5 increments. Phosphorus starts with a guideline of 90 kg of P_2O_5/ha, adjustable by 5 kg P_2O_5/ha per increment, with additional adjustments based on the soil's phosphorus class, ±9 or 4.5 increments. The strategy for potassium mirrors this, beginning at 80 kg K_2O/ha and adjustable by 6 kg K_2O/ha per increment, tailored to the soil's potassium profile with potential nutritional adjustments of ±8 or 4 increments. Each increment corresponds to the export of 10 arrobas of dry almonds (150 kg/ha), with a cap set at 50 increments for maximum fertilization. This methodology not only aids in determining optimal dosages for each cocoa plantation, considering dosage segmentation but also assists in creating precise NPK blends for each fertilization recommendation. The entire process is efficiently organized in a digital spreadsheet, streamlining the establishment of the most balanced fertilization regimes based on agricultural output, foliar chemical diagnostics, and soil fertility assessment.

Index terms: DRIS, CND, *Theobroma*, foliar analysis, soil testing.