Potassium is the third major nutrient after nitrogen and phosphorus. However, soil test for potassium often fail to reveal the true fertilizer demand in the field resulting to unreliable and inefficient fertilizer application to crops. This necessitated this field experiment to be carried out in soils of Nyamira county Kenya with an objective of fitting the experimental data into four parametric adsorption models and ascertain the most suitable adsorption isotherm which best fitted and described the studied soils. For adsorption studies 2.50 g soil samples were shaken with 25 ml 0.01 M CaCl₂ containing K concentration of 0, 25, 50, 75, 100, 125, 150, 175, 200, 225 and 250 mg L⁻¹ using potassium chloride for 24 hours at 25±1 °C to achieve equilibrium concentration. Langmuir, Freundlich, Temkin and Van Hauy adsorption models were applied to the data to check potassium adsorption in the soils. From the results, the physical-chemical properties of the soils revealed that the studied soils were acidic in nature with a mean pH of 5.19. The soils were non-saline with electrical conductivity mean of 0.25 mmhos/cm. The cation exchange capacity of the soil was 21.25 cmol/kg. Basic nutrients were low (Available K was 60.2mg/kg, available P (Olsen) was 9.71 mg/kg and the organic carbon found to have a mean of 1.82.) By application of the models, potassium adsorption data revealed that Freundlich model showed a good fit of K adsorption (r²=0.957), then Van Hauy isotherm (r²=0.923), followed by Temkin model (r²=0.839) and finally Langmuir model which did not fit well to the data (r²=0.359).

Key words: Potassium adsorption isotherms, Freundlich model, Van Hauy isotherm, Temkin model and Langmuir model.