Struvite precipitate obtained from yeast industry anaerobic effluent with high ammonium nitrogen (NH4–N) was investigated for fertilizer effect on plant growth and nutrition according to applications of N, nitrogen/phosphorus/potassium (NPK), and control. Optimum struvite formation conditions were determined via Box–Behnken design. Optimum condition was obtained at pH 9.0 and Mg/N/P molar ratio of 1.5:1:1. Under these conditions, heavy metal concentrations in the obtained struvite precipitate (except Cu) were below the detection limits. In addition to high N, P, and Mg content, energy-dispersive X-ray (EDX) analysis showed that the struvite also included the nutritional elements Ca, K, Na, and Fe. X-ray diffraction (XRD) analysis revealed the complex structures of NaAl(SO4)2(H2O)12, NaMn2+Fe2(PO4)3, and (Na2,Ca)O2(Fe,Mn)O.P2O5 in the precipitate. High Na+ and Ca2+ concentrations in the anaerobic effluent reacted with phosphate during struvite precipitation. Different applications and struvite dosages significantly affected fresh and dry weights and nutrient element uptakes by plants (P<0.05). N, P, and Mg uptakes of plants were significantly higher at struvite ×2, ×3, and ×4 dosages compared with NPK application. For adequate nutrition and supply of optimum dry weight, struvite ×2 dosage (5.71 g struvite/kg soil) was found appropriate for both maize and tomato plants.