Here we give the approximation properties with rates of multivariate generalized discrete versions of Picard, Gauss-Weierstrass, and Poisson-Cauchy singular operators over $\mathbb{R}^n$, $n \geq 1$. We treat both the unitary and non-unitary cases of the operators above. We derive quantitatively $L^p$ convergence of these operators to the unit operator by involving the $L^p$ higher modulus of smoothness of an $L^p$ function. (Received June 05, 2015)