Among 29 organic acids whose effects on the \textit{in vitro} enzymatic substrate reducing activity on the MoFe-protein of nitrogenase have been investigated, 12 acids stimulate the \textit{in vitro} \textit{C}_2\text{H}_2\text{-reducing activities in proportion to the H\textsuperscript{+}-reducing activities. A second group comprised of eight acids significantly stimulates the H\textsuperscript{+}-reducing activity but has only modest stimulatory effects on \textit{C}_2\text{H}_2\text- and \textit{N}_2\text{-reducing activities. A third group of nine acids causes only slight increases of MoFe-protein substrate reducing activities. The stimulatory effects of acids on MoFe-protein substrate reducing activity depend on their mode of interaction with molybdenum. Hydroxycarboxylic acids acting as bidentate ligands such as homocitric acid and its derivatives leave a sufficient number of molybdenum coordination sites available for interactions with the substrates, they have the highest stimulatory effects both on the \textit{C}_2\text{H}_2\text- and \textit{N}_2\text{-reducing activities, and their H\textsuperscript{+}-reducing activities are not inhibited by CO. Acids acting as tridentate ligands, which include citric acid, have weaker stimulatory effects on the \textit{C}_2\text{H}_2\text- and especially on the \textit{N}_2\text{-reducing activities, and CO inhibits their H\textsuperscript{+}-reducing activity. Whereas with the first group of acids the \textit{C}_2\text{H}_2\text{-reducing activities are linearly correlated with H\textsuperscript{+}-reducing activities, the \textit{N}_2\text{-reducing activities are directly correlated with H\textsuperscript{+}-reducing activities in the presence of CO, and the association is exponential rather than linear. This exponential dependence is consistent with a stepwise mechanism of nitrogen reduction via diazene and hydrazine as the intermediates, the latter blocking one molybdenum coordination site prior to its reduction to NH\textsubscript{3}. In the reduction of \textit{C}_2\text{H}_2 to \textit{C}_2\text{H}_4, no such blockage occurs as product \textit{C}_2\text{H}_4 does not accumulate at the active site and is not reduced further.