The reaction of chlorine atoms with propylene and one of its deuterium isotopomers in solid para-hydrogen (\(p-H_2\)) matrices at 3.2 K has been studied using infrared spectroscopy. Irradiation at 365 nm of a co-deposited mixture of Cl\(_2\), C\(_3\)H\(_6\), and \(p-H_2\) at 3.2 K produces a series of new lines in the infrared spectrum. Several of the new lines are readily assigned to the gauche and trans conformers of 1,2-dichloropropane (CH\(_3\)CHClCH\(_2\)Cl) resulting from the addition of two Cl atoms to C\(_3\)H\(_6\). Weak lines observed at 802 and 975 cm\(^{-1}\) and at 813 and 981 cm\(^{-1}\) that become more prominent upon secondary irradiation at 254 and 214 nm are assigned to the allyl radical (C\(_3\)H\(_5\)) and an HCl-allyl radical complex (HCl-C\(_3\)H\(_5\)), respectively\(^a\). Of the remaining lines, a strong line at 650 cm\(^{-1}\) and weaker lines at 532, 1008, 1133, 1150, 1215 and 1382 cm\(^{-1}\) are concluded to be due to a single carrier based on their behavior upon subsequent annealing to 4.5 K and irradiation at 254 and 214 nm. When the positions and intensities of these lines are compared to the MP2/aug-cc-pVDZ predicted vibrational spectra of the possible species that could result from the addition and abstraction reactions of one Cl atom with C\(_3\)H\(_6\)\(^a\), the best agreement is found with the 2-chloropropyl radical (CH\(_3\)CHClCH\(_2\)\(\cdot\)). Isotopic experiments were performed with 3,3,3-C\(_3\)H\(_3\)D\(_3\) and the corresponding infrared peaks due to the deuterium isotopomer of this radical (CD\(_3\)CHClCH\(_2\)\(\cdot\)) have also been observed. A final set of experiments were performed following irradiation of the Cl\(_2\)/C\(_3\)H\(_6\)/\(p-H_2\) mixture at 365 nm, in which the matrix was irradiated with filtered infrared light from a globar source, which has been shown to induce a reaction between isolated Cl atoms and matrix H\(_2\) to produce HCl and H atoms\(^b\). In our experiments, the major products observed after infrared irradiation are HCl, 2-chloropropane (CH\(_2\)CHClCH\(_3\)) and the isopropyl radical (CH\(_3\)CH·CH\(_3\)) and the possible mechanisms of formation of these species will be discussed.