In this paper, a variety of graph matching algorithms such as the Similarity Flooding algorithms and the VF2 are studied and compared against each in an attempt to measure their ability to perform both syntactic (structural) and the semantic (denotation) comparison efficiently. This evaluation analysis has practical implications in data warehousing, biochemical applications and e-business. The algorithms take two graphs as input, and they return an association between the two input graphs. As a result of the comprehensive analysis, we present an argument that considers the efficiency of the studied algorithms as well as the quality of their comparisons to determine which amongst them is the best to perform both syntactic and semantic comparison, and why the algorithm performs better than the others of its kind.