Alleles dynamics

I write the differential equation for the allele in a diploid population, so that I write the alleles dynamic far from Hardy-Weinberg equilibrium.

I assume that the differential equation for the allele is like a chemical equations, where the alleles are the chemical substance and the reaction is a male-female mating.

I write the population gene diffusion of two alleles probability, when two parents have two offspring (I use a fixed number of offspring for mating, to simplify the problem):

\[
\begin{align*}
AA + AA & \rightarrow (AA + AA + AA + AA)/2 \rightarrow AA + AA \text{ (no gene reaction)} \\
AA + Aa & \rightarrow (AA + Aa + Aa + Aa)/2 \rightarrow AA + Aa \text{ (no gene reaction)} \\
AA + aa & \rightarrow (Aa + Aa + Aa + Aa)/2 \rightarrow 2Aa \\
2Aa + 2Aa & \rightarrow (AA + Aa + Aa + aa) \rightarrow AA + 2Aa + aa \\
Aa + aa & \rightarrow (Aa + Aa + aa + aa)/2 \rightarrow Aa + aa \text{ (no gene reaction)} \\
aa + aa & \rightarrow (aa + aa + aa + aa)/2 \rightarrow aa + aa \text{ (no gene reaction)}
\end{align*}
\]

The discrete equation for the gene variations are:

\[
\begin{align*}
AA(t + 1) &= AA(t) - AA(t) \ a(t) + Aa(t)^2/2 \\
Aa(t + 1) &= Aa(t) + 2 \ AA(t) \ a(t) - Aa(t)^2 \\
aa(t + 1) &= aa(t) - AA(t) \ aa(t) + Aa(t)^2/2
\end{align*}
\]

there is the invariance of the sum of the alleles \( AA(t + 1) + Aa(t + 1) + aa(t + 1) = AA(t) + Aa(t) + aa(t) = 1 \), so this is a probability dynamics.

The differential equation for continuous process is:

\[
\begin{align*}
\frac{d}{dt} AA &= -AA \ aa + Aa^2/2 \\
\frac{d}{dt} Aa &= 2 \ AA \ aa - Aa^2/2 \\
\frac{d}{dt} aa &= -AA \ aa + Aa^2/2
\end{align*}
\]

I think that can be used to study the alleles dynamics for new genetic diseases far from the equilibrium.