Botrytis cinerea Pers.:Fr., the anamorph of *Botryotinia fuckeliana* (de Bary) Whetzel, is a necrotrophic fungal pathogen responsible for grey mould, which affects a wide range of plants. In grapevine (*Vitis vinifera* L.), *B. cinerea* can affect all the herbaceous organs, but it is particularly damaging on ripening berries, leading to severe losses and alterations of the wine quality.

The species *B. cinerea* is composed of four transposon genotypes: i) *transposa* (containing both Boty and Flipper elements), ii) *flipper*-only (containing only Flipper), iii) *boty*-only (containing only Boty), or iv) *vacuma* (containing neither Boty nor Flipper). Frequencies of strains belonging to the different transposon genotypes in the fungal population from vineyards were highly dependent on geographic location, isolation year and sampling time over the season.

Several studies have been carried out in the last century to investigate the effect of different environmental conditions on biology and epidemiology of *B. cinerea* (see chapter I). All these previous studies did not take into account the phenotypic variability among strains of the pathogen and none of them were connected with the recent advances on genetic diversity in the pathogen populations. The aim of this Doctoral work was: i) to investigate the effect of different environmental conditions on biology and epidemiology of *B. cinerea* strains belonging the two transposon types *vacuma* and *transposa*, and ii) develop a new weather-driven mechanistic model in order to predict risk of grey mould in vineyards from early growth of inflorescences to berry ripening.

The effect of temperature and wetness duration on infection of *Vitis vinifera* inflorescences (from "inflorescence clearly visible" to "end of flowering" stages) and young berry clusters (at "fruit swelling" and "berries groat-sized" stages) was investigated by artificial inoculation with conidial suspensions of *B. cinerea* strains belonging to the transposon genotypes *transposa* and *vacuma* (see chapter II). The results showed that the ability to cause infection was a strain rather than a transposon genotype attribute. Infection incidence was also affected by growth stage of the inflorescence or berry cluster, temperature and wetness duration. Based on these data, an equation was developed to account the combined effects of temperature and wetness duration on relative infection incidence.

Similar assays were performed on *Vitis vinifera* mature berries. Artificial inoculations on unwounded and wounded mature berries were carried out using conidial or mycelial inoculum of *B. cinerea* strains belonging to the transposon genotypes *transposa* and *vacuma*. The effect of temperature, wetness duration and relative humidity on infection was investigated (see chapter III). In these assays, the most and least virulent *B. cinerea* strains belong to the *transposa* and *vacuma* transposon genotypes, respectively. However, there are also strains belonging to either *vacuma* or *transposa* genotypes that may show intermediate or similar infection capabilities. Wounding of

berries increased incidence of infection. Based on these data, two equations were developed to describe the combined effect of temperature and relative humidity, or temperature and wetness duration, on relative infection incidence following inoculation by mycelium or conidia, respectively.

The effect of temperature, water activity, relative humidity and grape berry composition on conidia germination and colony growth was investigated (see chapters II and IV). Different agar-medium were inoculated with *Botrytis cinerea* strains belonging to different transposon genotypes. The results showed that the response to different environmental factors is similar among strains of *B. cinerea*. Then, equations were developed to account for the combined effect of temperature, water activity and time on conidia germination and colony growth.

As a step forward, studies were conducted to investigate how temperature, relative humidity, water activity, grape berry juice and mature berries influence conidial production in *B. cinerea* strains (see chapter V). Strains showed different capability of producing conidia and accounted for the lowest experimental variance. Moreover, the general response to different environmental conditions is similar among different *B. cinerea* strains. Based on these results, equations were developed to account for the effect of temperature and relative humidity on conidia production, and the length of latent period (i.e., the time elapsed between inoculation and initiation of sporulation) on mature berries as a function of the degree-days.

A new model for *Botrytis cinerea* on grapevine was elaborated following a mechanistic approach which accounts for production of conidia on various inoculum sources (i.e, overwintered sources, bunch trash, and ripening berries) and for different infection pathways (i.e., conidial infection of inflorescences, young clusters, and ripening berries by conidia, and berry-to-berry infection by mycelium) (see chapter VI). The model considers two main infection periods (i.e., “inflorescences clearly visible” to “berries groat-sized”; “majority of berries touching” to “berries ripe for harvest”) and was validated over a 6-year period (2009 to 2014) in 13 vineyards located in different grape-growing areas of Italy and in France. The model is more complete than the others proposed in literature and represents an improvement to control grey mould in vineyards.

Lastly, the results obtained during Doctoral work were globally discussed (see chapter VII).