

MODELLING POLLEN TUBE GROWTH AND OVULE VIABILITY IN SOUR CHERRY

R. Cerović, N. Mičić and G. Đurić
ARI 'Serbia', Fruit and Grape Research Centre Čačak
Kralja Petra I/9
32000 Čačak, Yugoslavia

S. Jevtić
ARI 'Serbia'
Zeleni venac 2/III
11000 Beograd, Yugoslavia

Keywords: Temperature, pollinators, field conditions, laboratory conditions, pistil

Abstract

Pollen tube growth and ovule vitality were studied in sour cherry cv. Čačanski Rubin in several combinations of pollination under field and laboratory conditions at constant temperatures at anthesis. On the basis of these studies, which revealed the existence of a year-to-year variation in fertility, a mathematical model of quantitative growth characteristics of pollen tubes in the pistil and the duration of ovule vitality has been developed. The analytical evaluation of the efficacy of pollen tube growth in the style and ovary and the ovule viability by means of the multiple regression model offers great possibilities in defining the area of the optimal combination of the factors studied, as well as the estimation of the moment at which they could take place. The possibility of a comparative analysis of the mentioned factors for defining the effective pollination period is especially important, i.e. the prediction of single and combined effects of these factors on the changes in the fertility of cv. Čačanski Rubin, depending on the temperature conditions in the field.

1. Introduction

Čačanski Rubin is the first sour cherry cultivar to be bred in Yugoslavia. Evaluation done so far has shown it to have irregular bearing, unsatisfactory for commercial yields (Cerović, 1992). The degree of fertility, being the major determinant of cropping both in this sour cherry and in other fruit crops, is affected by various factors, the two of which are distinguished.

The first factor is the varying degree of pollen tube growth in the pistil as affected by temperature conditions and pollinators, which has already been observed in the field and laboratory conditions with this sour cherry cultivar (Cerović, 1992; Cerović and Ružić, 1992a), but also with other fruit crops, e.g. with almond (Socias i Company et al., 1976) and pear (Vasilakakis and Porlingis, 1985). The other factor is the viability of embryo sacs and ovules. The senescence of ovules in sweet and sour cherries, and the resulting loss of their viability, became progressive 5-6 days after anthesis in the field (Stösser and Anvary, 1983). In cv. Čačanski Rubin variation was observed under laboratory conditions in ovule longevity, depending on the constant temperature (Cerović and Ružić, 1992b).

The above-mentioned two factors directly influence the effective period of pollination (EPP) and might limit the cropping of some fruit species more than inadequate pollen

transfer (Williams, 1970). The aim of the present work was to develop a mathematical model of functions of quantitative characteristics of pollen tube growth in the pistil and the viability of ovules under differing experimental conditions for the prediction of single and mutual effects of these factors on the changes in the fertility of cv. Čačanski Rubin as affected by temperature conditions in the field.

2. Material and methods

For developing the model of pollen tube growth and ovule viability in cv. Čačanski Rubin, the results obtained from monitoring these parameters from the papers relating to the field conditions have been used (Cerović, 1991; Cerović, 1992), as well as those from the work done in laboratory conditions, at constant temperatures (Cerović and Ružić, 1992a,b). The setting up of the experiment, choice of pollinators and time of pollination have been described in detail in the mentioned papers.

3. Results

The estimation of the efficacy of pollen tube growth in the style and ovary was given as the average number of pollen tubes that penetrated the upper third of the style and the locule of the ovary, which was recorded at all the temperatures studied for each combination of pollination at full bloom of sour cherry cv. Čačanski Rubin.

Under field conditions, of the three combinations of pollination (self-, cross- and open), the highest average number of pollen tubes in the upper third of the style and ovary tissue was recorded with cv. Heimanns Konservenweichsel as a pollinator (30.1 in the upper third of the style and 4.1 in the ovary tissue), and the lowest with self-pollination (the values being 16.9 and 2.3, respectively) (Figure 1). The mean daily temperature at full bloom of cv. Čačanski Rubin in the field was 11.2° C.

Mathematical statistical analysis of the efficacy of pollen tube growth in the style and ovary of cv. Čačanski Rubin at five constant temperatures in laboratory with three combinations of pollination (self-, and pollination with cvs. Heimanns Konservenweichsel and Šumadinka, respectively), by the multiple correlation method, shows that the pollen tube growth in the combination of the two factors studied was best fitted and represented by the multiple regression of the parabola type (Figure 2). The analysis of the relation of the parameters studied in the upper third of the style revealed that the highest average number of pollen tubes in that region with self-pollination was obtained in the range of 11 and 17.2° C, 4-9 days after the moment of pollination. In the combination of pollination with cv. Heimanns Konservenweichsel, the greatest penetration in that region was recorded between 9.8 and 17.5° C over the period of 3-8 days, whereas with cv. Šumadinka as a pollinator that range was from 10.2 to 17.4° C in the period of 4-8 days. The model analyzed shows that the maximum number of pollen tubes that penetrated to the upper third of the style was observed with cv. Heimanns Konservenweichsel, on Day 3, whereas the penetration was slowest with self-pollination, after Day 4. Maximum penetration at the temperature below 10° C was observed only with cv. Heimanns Konservenweichsel as pollinator, whereas with self-pollination the lower temperature limit was 11° C.

