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The Flower Fenology of Sour Cherry Cultivars

Mahmood Ansari and Gholamhossein Davarynejad

Department of Horticultural Science,
College of Agriculture, Ferdowsi University of Mashhad, P.O. Box 91775-1163, Mashhad, Iran

Abstract: Knowledge of flower phenology and reproductive activities is of significant importance, particularly in sweet and sour cherries which show different degrees of incompatibility. The main objective of this research is to understand the flower microphenology (Anther dehiscence and stigma viability) of Hungarian sour cherry cultivars (*Botermo*, *Erdijubileum* and *Sigany*) under Mashhad climatically conditions. For this purpose an experiment was conducted in 2005 and 2006 using a completely randomized design with 3 replication in 2005 and 5 replication in 2006. In order to check the phonological stages, flowers were taken in to consideration from before opening up to the browning phase of stigma. The duration of pollen shedding, stigma receptivity and climatic factors were measured. The relative time of flowering between cultivars varied from year to year. Data indicates that thermal variations strongly contribute to significant differences in the duration of stigma viability, although there were not significant differences between cultivars in anther dehiscence period.

Key words: Sour cherry . stigma viability . anther dehiscence . *Botermo* . *Erdijubileum* . *Sigany*

INTRODUTION

Sour cherry (*Prunus cerasus*) is one of the most commercially important species. Sub genus *cerasus* involves 150 species which only a few of them are of commercial avail. Knowledge of flower phenology and reproductive activities is of significant importance, particularly in sweet and sour cherries which show different degrees of incompatibility.

The full blooming time of sour cherry in Hungary usually occurs during 15-25 of April, but it might vary from April 5 of to May 15 (which is not a proper time for pollination and fruit set climatically) depending on climatic conditions [1].

There are great differences in the full bloom of fruit trees. Brozik [2] shows 3 to 8 days difference in the full bloom date of 74 clones of Pandy meggy and 2-10 days in 23 collections of *Sigany meggy*. De vries [3] reported 7-14 days difference in the full bloom of 27 early and late bloom cultivars of sour cherry. Wocior *et al*. [4] mentioned 3-6 days difference in the full bloom of 8 sour cherry cultivars. According to Soyanov and Gromesky [5], 2-3 days coverage in the full bloom of apple cultivars is ideal and in this case the pollen supply is optimum. This period for Pandy meggy is 3 days [6].

According to Nyeki [7], in sweet cherry with a blooming period of 10 to 14 days, at least 4 to 6 days of blooming coverage is necessary. He understood that in stone fruits, 3 days overlap in full bloom is adequate.

Studies showed that when more than 50 percent of flowers are bloomed, we could consider it as full bloom [7-9].

Brozik [10] believed that the optimum length of the flowering period in sweet and sour cherries should be at least 10 to 14 days. Entire pollination and fertility need 4 to 6 days blooming overlap in self-incompatible cultivars. In order to achieve high yield of sour cherry, at least 30% of flowers should set fruits [7]. Davarynejad [11] mentioned that to attain high yields and define proper pollinators in the field, knowledge of flowering and microphenology is necessary. Consequently, knowledge of flowering characteristics could play an important role from the viewpoint of assuring the successive pollination and synchronous activity of reproductive organs.

The duration of stigma viability is influenced by meteorological factors. In sour cherries, Nyeki [12] observed that stigma viability was 2-3 days in sunny and warm weather (average daily temperature 15-22°C). The duration of viability was longer (4-6 days) under cool and overcast weather conditions (average daily temperature 4-12°C).

High temperature (25°C) for Pandy meggy is harmful. In these temperatures the stigma receptivity period reduces to only a few hours. Rainy weather and

Corresponding Author: Dr. G.H. Davarynejad, Department of Horticultural Science, College of Agriculture, Ferdowsi University of Mashhad, P.O.Box: 91775-1163, Mashhad, Iran

low temperatures effectively reduce stigma receptivity. This has been reported by Williams [13] and Davarynejad [11] for apples and by Davarynejad [14] for pear trees.

Duration of anther dehiscence means the period between dehiscence of the first and last anthers within the same flower. Usually in most fruit trees, anthers dehisced only a few minutes after flower opening. Anther dehiscence in pandy cv. sour cherry occurs 1-2 hours after flower opening [15]. Soltez [16] explained that anther dehiscence period needs up to 2.5 days after flower opening and this phenomenon is highly affected by yearly meteorological conditions.

The observation of Nyeki *et al*. [17] showed that high temperatures may cause anther dehiscence exactly before opening of flower. They observed that anther dehiscence stages are similar to flower opening stages. The process of dehiscence is permanently progressed during a day. This process is intensive between 9 A.M. to 14 o'clock and reaches to the maximum at 11.

Davarynejad 1996 mentioned that 90% of anthers dehisce on the first day of the flowers opening and the maximum rate is about midday [14]. During the rainfall, the process of dehiscence is halted, but anthers swell and start to dehisce just an hour after rainfall. Heavy rainfall reduces the length of anther dehiscence up to one day [12].

The main objective of this research is to study the flower microphenology of Hungarian sour cherry cultivars (*Botermo*, *Erdijubileum* and *Sigany*) under Mashhad, climate conditions.

MATERIALS AND METHODS

The experiments were carried out for a period of two years (2005-2006) on Hungarian sour cherry cultivars cultivated in Khorasan, Iran. The flowering microphenological observations and the course of flowering were conducted on the *Botermo*, *Erdijubileum* and *Sigany* sour cherry cultivars. Changes in stigma color and the course of anther dehiscence were registered, examining 20 free standing flowers of each variety between 7 A.M. to 5 P.M.

The period of stigma viability that is important in natural pollination was examined by checking the stigmatic secretions and color changes every hour. The duration of anther dehiscence means the period between dehiscence of the first and the last anther within the same flower. Anther dehiscence was followed every hour with observation of changes in the stages of stigma.

Observations of blooming dynamic followed the method applied by Nyeki [12] on flowers distributed to the four quarters of the heavens on the end of branches, a sample comprising 100-500 flowers per variety. With the beginning of bloom, every day at the same time (between 10 and 12 AM). The number of flowers according to their stage of development from the bud phase, opening and petal shedding was registered.

The flowering index (Index-V) was calculated on the basis of 100-500 observations per cultivar according to the formula originally described by Mathe [18] and Mathe *et al*. [19]:

$$(\text{Index-V}) = (t-b)/(b+v+t)$$

Where b = number of buds, v = number of flowers at anthesis and t = number of flowers at a post-anthesis stage (at the end of flowering).

Flowers are considered to be opened if the anthers and pistils are easily recognized from above and the stigma is green or yellow. The stigma of fading flowers started browning. Those dynamic observations served as a basis of determining the start of blooming (with the first open flowers), full blooming (when more than 50% of flowers opened) and the end of bloom (when the last flower faded). For these purpose an experiment was conducted in 2005 and 2006 using a completely randomized design with 3 replication in 2005 and 5 replication in 2006

RESULTSAND DISCUSSION

Blooming time: Sour cherry belongs to the group of medium early-blooming fruit trees but it is the latest among the stone fruits [20]. The blooming time of examined sour cherry cultivars is shown in Fig. 1.

The outset of flowering in 2006 occurred earlier than the previous year. If we compare cultivars from the viewpoint of blooming time, we could see the trace of climate. Colder temperatures during the last decade of March and the first decade of April in 2005 (in comparison with 2006) caused a delay in the start of blooming. Totally, the outset of flowering in examined cultivars was distinct and *Botermo*, *Erdijubileum* and *Sigany* started to flower, respectively. The main blooming period is always more than one day.

According to Wocior *et al*. [4] the main blooming period in a sour cherry is when more than 50% of flowers are open. The course of flowering of sour cherry cultivars was studied via utilization of Index-V (Fig. 2).

The Index-V values calculated vary between-1 and +1 and when plotted against time can be fitted to a sigmoid curve. In 2005, the main blooming period of *Botermo* lasted one day but it lasted 3 days during 2006.

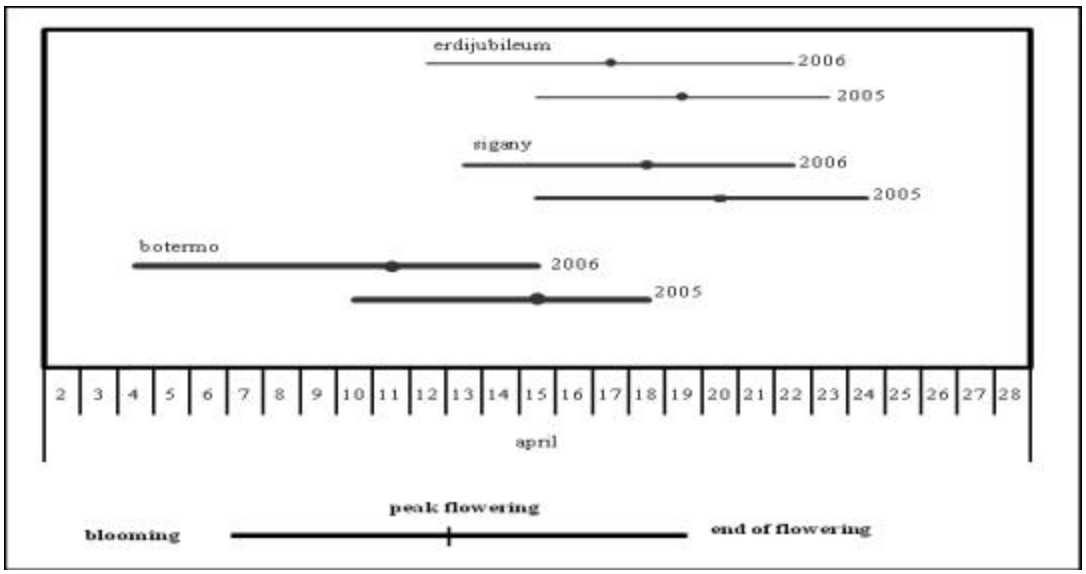

Fig. 1: Blooming time of sour cherry cultivars

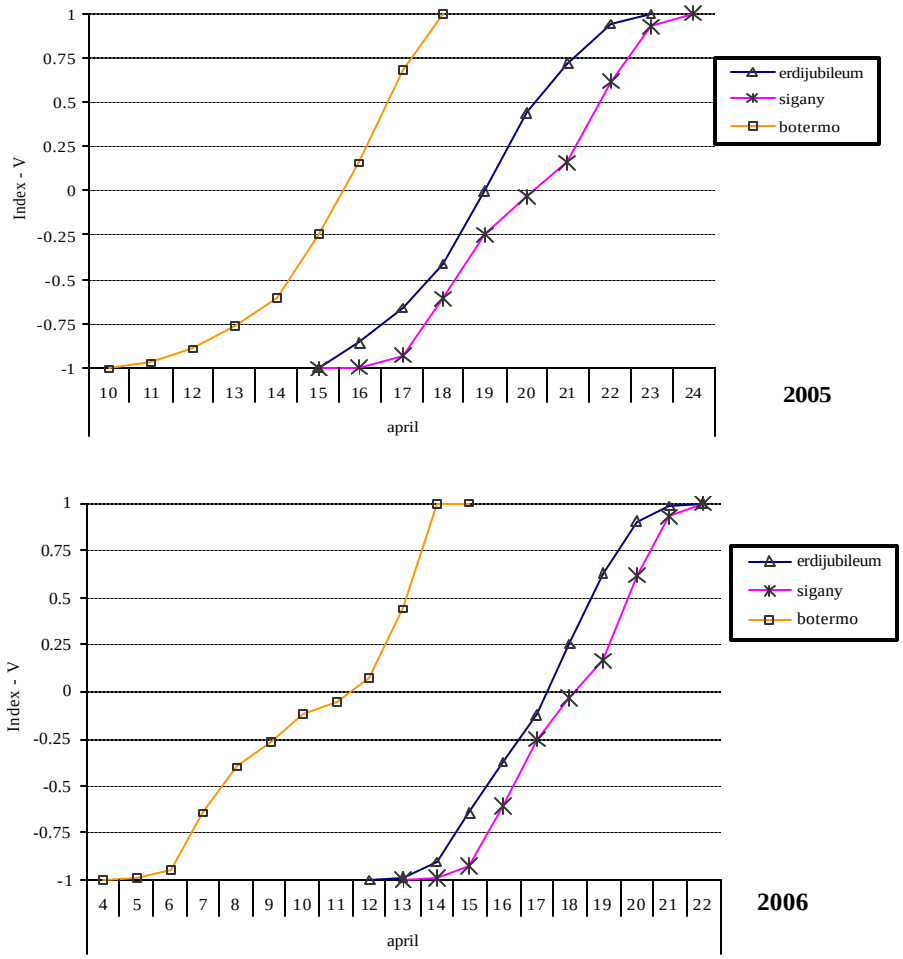

Fig. 2: The course of flowering of sour cherry cultivars (2005 and 2006)

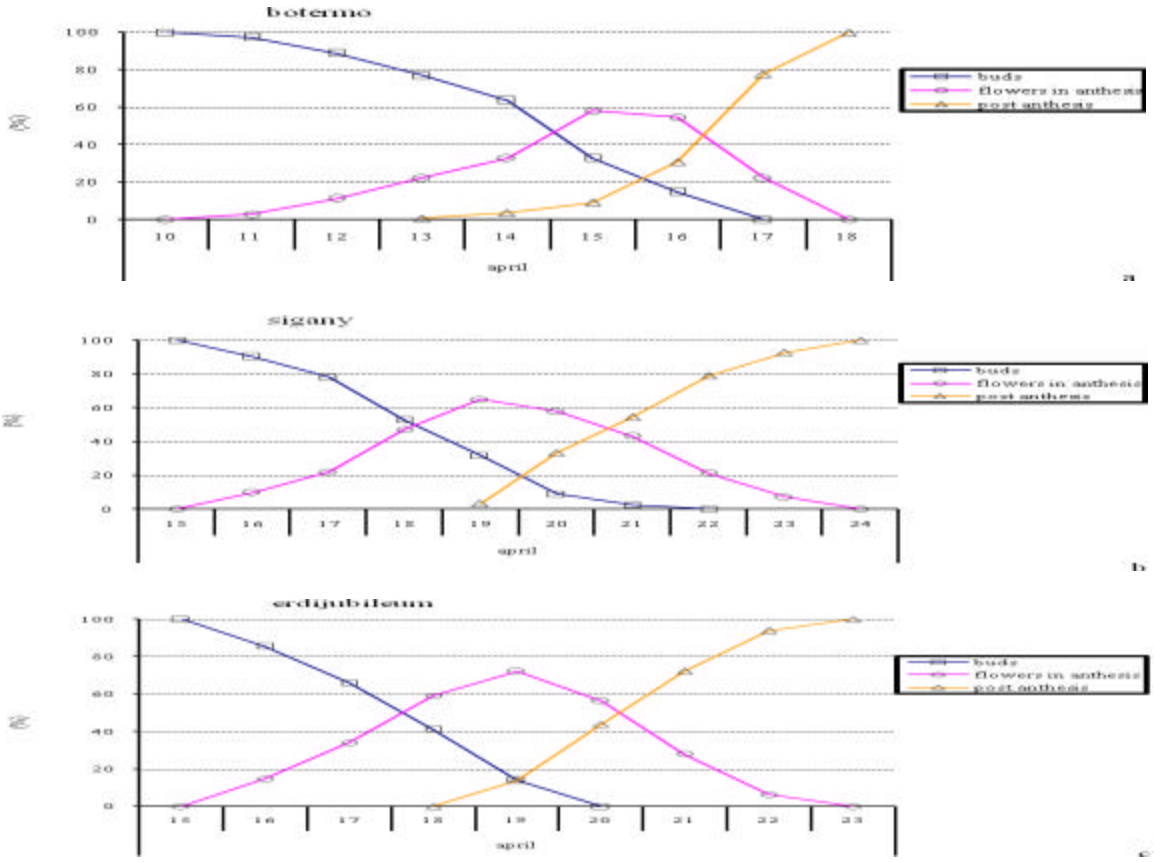

Fig. 3: Characteristic changes in the frequency distribution of the phenophases of the reproductive organs of sour cherry cultivars (2005)

Higher temperature averages during the main blooming period of *Botermo* in 2005 is a possible reason for shorter mass flowering period in comparison with 2006.

The comparison of flowering phenograms of *Erdijubileum* and *Sigany* during 2006 showed that the day of main bloom (Index-V=0) in these cultivars occurred with one day difference (Fig. 4b and c).

A characteristic feature of the flowering dynamics of sour cherry in the crossing point of the raising curve of withered flowers and that of the descending curve of buds, which coincides period when the number of open flowers culminates. Subsequently, the rate of opened and withered flowers is negatively related (Fig. 3a-c and 4a-c).

The preparation of enough pollen during the main blooming period will ensure the result of pollination. We could study the flowering period and overlapping rate of examined cultivars with the use of Index-V and overlapping diagrams.

Results derived during the main blooming period of *Erdijubileum* and *Sigany* in 2005 and 2006 showed synchronous blooming between these two cultivars. In order to achieve considerable (more than 20%) fruit set, self incompatible cultivars should overlap each other by 70% [20].

During two years of examination, the overlap of flowering between *Botermo* and two others variety was not enough (Fig. 5). As Fig. 2 shows, the period of mass flowering in *Sigany* and *Erdijubileum* occurred nearly on the same date. The best pollination occurs in such a case when mass flowering falls on the same date. Its efficacy decreases when mass flowering, as calculated by Index-V, does not coincides but takes place within one or two subsequent days.

Flower microphenology

Stigma receptivity: Outbreak of secretions on the surface of stigma shows the beginning of the receptivity period. Nearly in all flowers of examined cultivars, secretory activity started a few minutes after flower opening. Peak of secretory activity was at 7 to 10 o'clock of each day during pistil activity period.

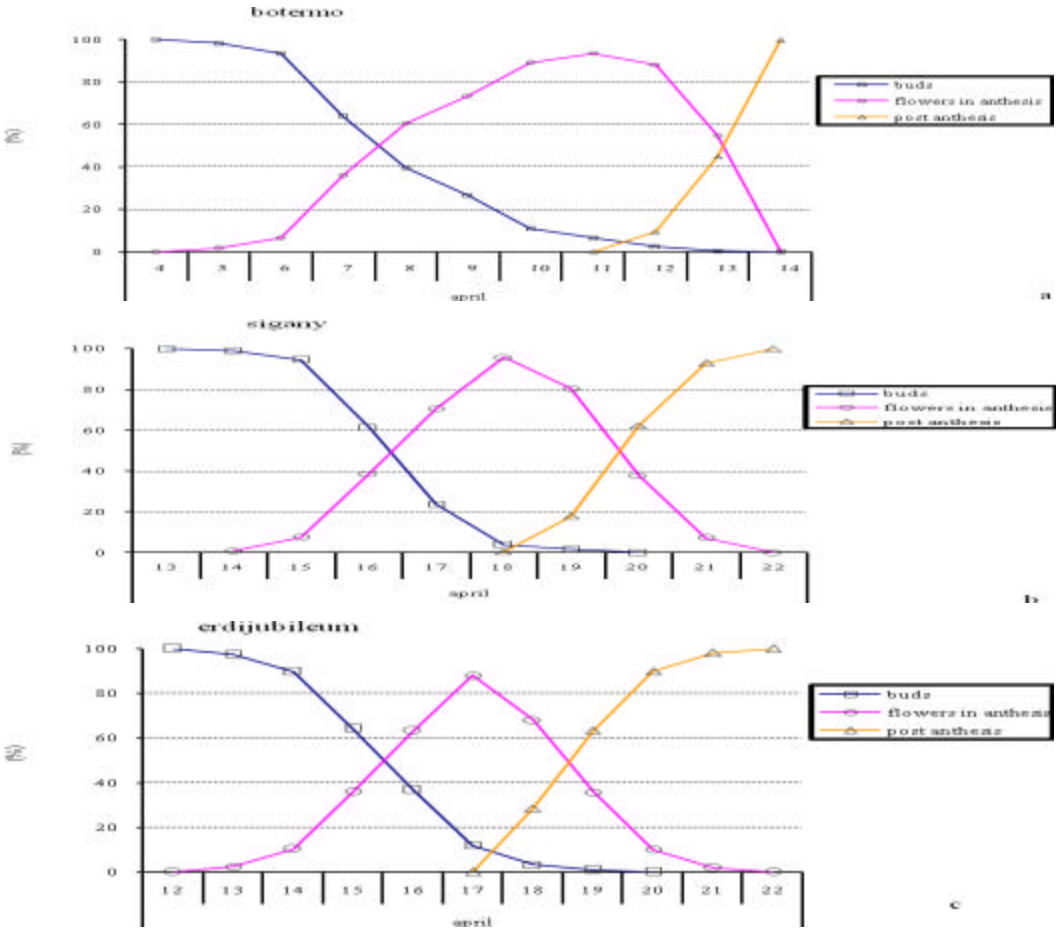

Fig. 4: Characteristic changes in the frequency distribution of the phenophases of the reproductive organs of sour cherry cultivars (2006)

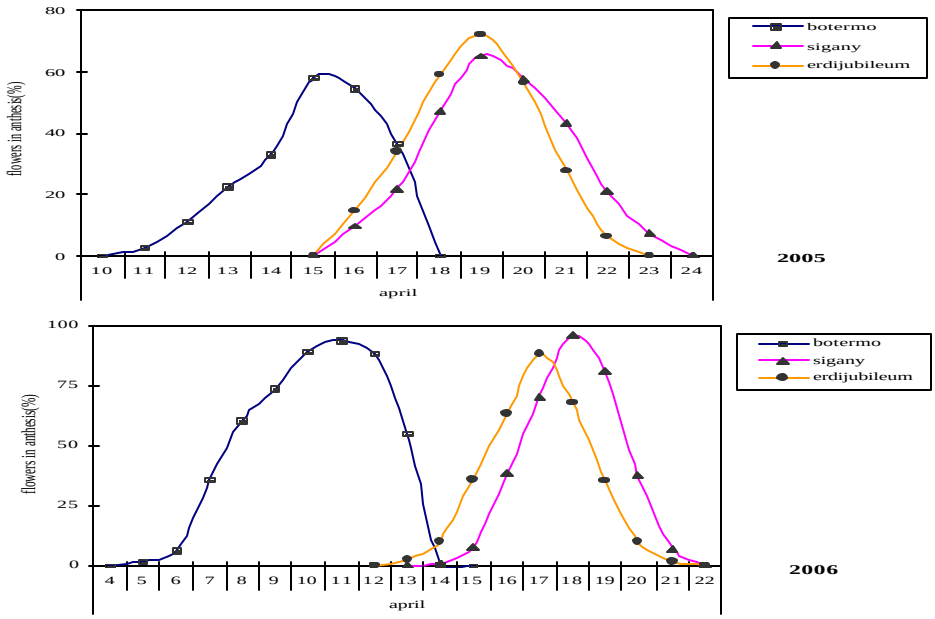

Fig. 5: Overlap of blooming period in sour cherry cultivars (2005 and 2006)

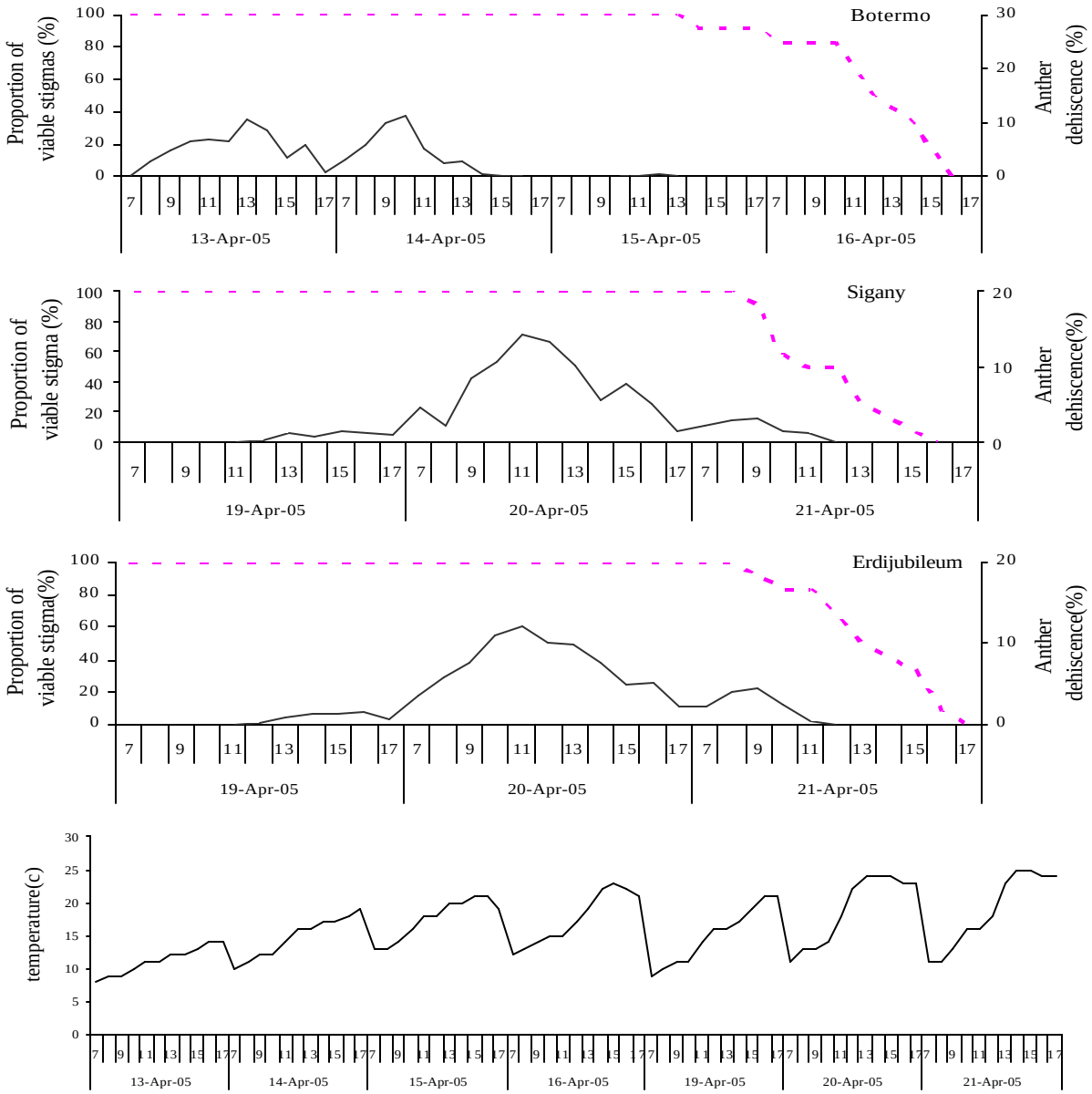

Fig. 6: Stigma viability and anther dehiscence of sour cherry cultivars (2005)

In the case of dryness, warm temperatures and air movement the secretion on the stigma surface dried and reduced to its minimu m contents.

Results in two years experiment showed that under Mashhad climatic conditions, the pistil activity period of *Botermo* is longer than two other cultivars, *Erdijubileum* and *Sigany*. Also the duration of pistil activity of *Botermo* was different during two years.

Lower temperatures during pistil activity of *Botermo* resulted in a longer receptivity period of stigma in 2006 in comparison with 2005. As we have seen, meteorological factors, especially temperature, have a high impact on the activity of reproductive organs. Information of reproductive organ activities (anther dehiscence and stigma viability) are shown in Fig. 6 and 7.

Anther dehiscence: Sexual maturation of anthers is when the anthers start to blow out. During two years of experiment, anther dehiscence started only a few minutes after flower opening. During the period when we were monitoring the anthers, maximum dehiscence occurred at 11 to 1 o'clock, in rather high temperatures of noon (15-20°C).

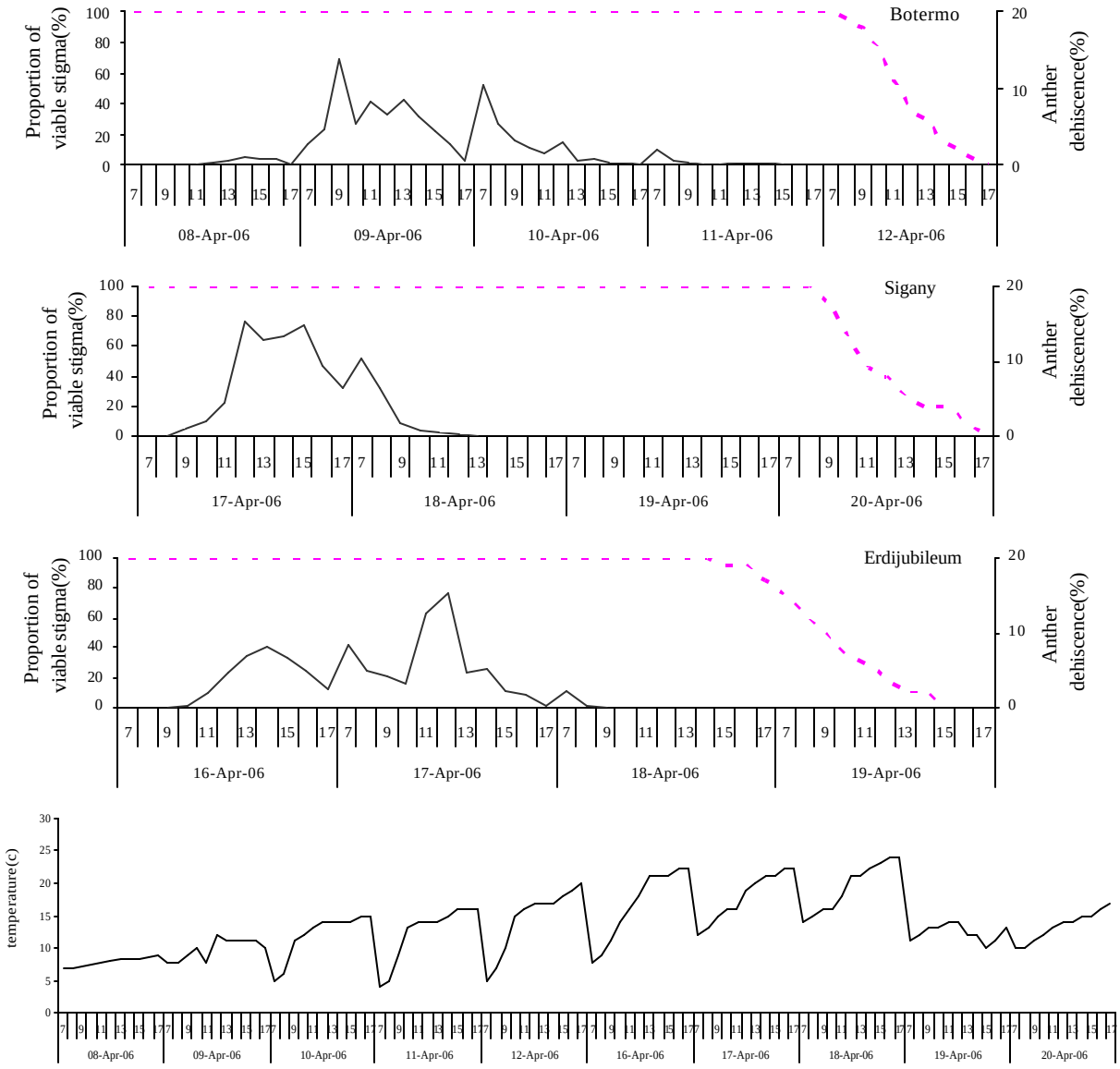

Fig. 7: Stigma viability and anther dehiscence of sour cherry cultivars (2006)

In all three cultivars the rate of dehisced anthers reached its maximum during the first two days of activity (more than 70%) (Fig. 6 and 7).

Higher temperatures on the 9th of April 2006 and sunshine stimulated anther dehiscence. On the 8th of April when it was cloudy and cool only a few anthers of *Botermo* dehisced and dehiscence became more intensive on the 9th, due to a considerable rise in temperature (Fig. 7).

Totally seasonal variations and various continents have remarkable effects on reproductive organs activity. These results are in accordance with the results of Davarynejad [11] on apples.

Synchronous activity of reproductive organs: Homogamy means that in a bisexual flower there is no time difference in receptivity of stigma and anther dehiscence at a time. In all examined cultivars, during two years of experiments, anthers dehisced in the range of pistil activity.

Herein, the best case has happened, when the pollen sheds, permanently, during the activity period of pistil and receptivity of stigma. For instance, in 2005, all during the way of secretory activity of *Erdijubileum* flowers, anther dehiscence was going on (Fig. 6); in this case receiving of pollen is insured.

Proper dispersion of anther dehiscence during the activity of pistil could ensure the successful pollination.

CONCLUSION

Analyzing the data of two years (2005 and 2006), it can be revealed that temperature had a considerable effect on the functioning of reproductive organs of sour cherry cultivars. Cloudy and cool weathers (about 10 c), resulted in longer viability of stigma and higher temperatures are resulted in shorter viability of stigma. Anther dehiscence, also, gets more intensive line with rising temperature. Totally duration of dehiscence was shorter than stigma viability and the overlap of the two periods was appropriate in all varieties.

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