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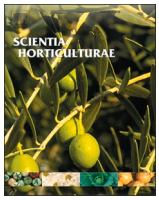

Flowering and pollen resilience to high temperature of apricot cultivars

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ABSTRACT

Prunus armeniaca L. is widely cultivated in the Mediterranean area including Southern Italy where local cultivars are recognized for their excellent quality. Gradual warming and abrupt variations of seasonal temperatures are expected to significantly impact the Mediterranean area with potential implications on many crops including apricot. In this scenario, the identification of physiological processes involved in heat-stress responses and the selection of genotypes resilient/tolerant to high temperatures and heat waves are necessary. The aim of this study was to investigate possible differences in flowering phenology and the effect of different temperatures on pollen functionality of 13 apricot cultivars traditionally cultivated in the Campania region (Southern Italy). According to phenological data collected in the field, the studied cultivars were grouped in early, intermediate, and late flowering cultivars. Single flower anthesis was on average 4.9 days in early and intermediate flowering cultivars, whereas late flowering cultivars showed a shorter duration (4.0 days). Pollen of flowers at balloon stage showed a uniformly high viability among all cultivars. To investigate on possible effects of temperature during the effective pollination period (EPP), pollen from the different cultivars was pre-incubated at 5 °C, 15 °C, and 25 °C for 48-h and germinability was then assessed after further 24 h *in-vitro* germination at the same temperature treatments. The first two temperature values correspond respectively to the minimum and maximum average temperatures of the local area; whereas 25 °C simulated the heat waves recently recorded in the farm during apricot flowering periods. As regard pollen germinability, 15 °C revealed to be the most suitable temperature for apricot pollen to germinate within the EPP. Conversely, 5 °C and 25 °C significantly reduced pollen germination in most cultivars and particularly in intermediate flowering cultivars. Noticeably, a few cultivars showed no difference in pollen germination under the different temperature treatments, preserving high pollen germinability (>70%) even at high temperatures. Overall, our findings highlighted that pollen germination is extremely sensitive to temperature with significant variations among apricot genotypes. Results confirmed that reproductive traits such as pollen germinability represent an important parameter to consider for monitoring fruit production, in the processes of cultivar selection for new orchard plantations and in breeding projects. Moreover, traditional apricot cultivars as those of the Campania region confirmed to be a precious source of genetic diversity possessing a significant pollen resilience to temperature changes.

1. Introduction

European apricot cultivation has experienced a significant cultivar turnover in the last decades mainly focusing on the cultivars that best meet the new market requirements such as early and late ripening (Ruiz et al., 2018). This phenomenon is common to other species, has intensified crop production but has also caused a drastic reduction in agro-biodiversity that, in turn, increased vulnerabilities of agricultural systems to climate variation (Pingali, 2012).

The Campania region (Southern Italy) is one of the main apricot-growing areas in Italy and among the most important in Europe. In this area apricots have been cultivated since ancient times leading to the selection of a multitude of traditional cultivars that are still cultivated by local farmers and widely recognized for their excellent qualitative and quantitative performances also outside the local area (Di Vaio et al., 2019).

The most representative cultivars of the Campania region are collected in the germplasm repository of apricot trees at Eboli (Southern Italy). This collection is of great economic and scientific interest for fruit breeders and researchers focused on genetic diversity and resilience to

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climatic changes of apricot cultivars in the whole Mediterranean area (Di Vaio et al., 2010; Rao et al., 2010; Di Vaio et al., 2019)

The projections of climate changes in the Mediterranean areas (e.g., Giorgi and Lionello, 2008) are rising concerns not only for gradual warming but also for abrupt variations of seasonal temperatures. Consequently, researchers commit to select genotypes tolerant to high temperatures or heat waves and to clarify the physiological processes involved in heat-stress responses (Hedhly et al., 2009; Mesihovic et al., 2016).

Climate change is impacting on the biological dynamics of plants showing phenological aberrancies (Walther et al., 2002; White et al., 2009). In pome and stone-fruit trees of temperate regions, extreme weather events are reported to affect reproduction in key phases (as the erratic break of the bud dormancy) that ultimately results in plant yield reductions and financial losses (Byrne et al., 2000; Legave et al., 2013; Bartolini et al., 2019). Temperature exposure over time is the main driver for spring development, including bloom timing and leaf-out (Rathcke and Lacey 1985, Bertin, 2008). This makes the species with spring flowering phenology the most sensitive and responsive to climate change in temperate regions (Schwartz, 1999).

Among reproductive traits, pollen interaction with the environment represents a potential bottleneck in plant life cycle that can limit the reproductive fitness and productivity in plant species (Aronne, 2017). Indeed, pollen functionality has been widely reported to be extremely sensitive to environmental constraints (Aronne et al., 2015; Asma, 2008; Egea et al., 1992; Pirlak, 2002). Particularly, pollen viability and germination are mostly dependent on temperature and humidity exposure of pollen grains (Aronne et al., 2021; Güçlü and Koyuncu, 2017; Sorkheh et al., 2018). As concern temperature, pollen thermo-tolerance is strictly related to the pollen developmental stage targeted by the heat treatment and consequently to the flowering stage in which temperature treatment is performed. Indeed, high temperatures have drastic implications on the functionality of mature pollen if the temperature treatment is performed in the earliest stage of pollen development (Iovane and Aronne, 2021). Regarding stone fruit crops, temperature exposure has been reported to significantly affect pollen germination. Particularly, 5 °C and 20 °C decreased pollen germination both in apricot and in sweet cherry compared to 15 °C generally considered optimum for pollen germination in most of the apricot cultivars of the Mediterranean basin (Pirlak, 2002).

Relative humidity of air, especially combined with temperature treatments, can play a key role in determining pollen sensitivity to environmental factor exposure (Aronne et al., 2006). Particularly, in some wind-pollinated species such as *Olea europaea* L. (in which pollen is dispersed in a low hydrated state), the exposure to high humidity triggers pollen sensitivity to temperature and drastically reduces pollen longevity (Iovane et al., 2022; Pacini and Dolferus, 2019; Bassani et al., 1994).

In most crop species, including *P. armeniaca*, fruit and seed production rely on successful pollen functionality (Ruiz and Egea, 2008). More specifically, pollen needs to stay viable and germinable along its journey from the anther to the stigma, succeed in all steps of gametogenesis and double fertilization to generate new seeds and consequently trigger fruit tissue formation. Indeed, both pollen viability and germination are strongly correlated with fruit and seed set (Herrera et al., 2018; Paupière et al., 2017). However, viable pollen grains might not be able to produce a pollen tube, and this is the reason why pollen viability and in vitro-germination should be both tested to evaluate pollen functionality.

Pollen viability and germination represent reproductive traits with a different ecological meaning and different response to the environment: viability tests are generally used to evaluate the effective fulfilment of the pollen grain development process; in vitro-germination tests measure the capability of pollen to elongate a pollen tube and potentiality to succeed in double fertilization (Dafni, 1992). Therefore, insights on both viability and germinability are relevant to have a complete overview of pollen responses toward different temperatures during the period from pollen dispersion till pollen germination onto the stigma. More specifically, pollen viability and germination should be assessed within the effective pollination period (EPP), defined as the number of days during which pollination is effective in fruit set because pollen functionality, stigmatic receptivity, and ovule longevity overlap (Sanzol and Herrero, 2001).

In the current climate change scenario, the aim of this study was to investigate on possible differences in flowering and pollen functionality of traditional apricot cultivars. More specifically, we hypothesized that temperatures treatments (both higher and lower than the average temperature of the flowering season) would affect pollen germination throughout the EPP of *P. armeniaca*.

2. Material and methods

2.1. Plant material

The experimental trial was conducted on different apricot genotypes belonging to the open field germplasm collection at "Improsta" Regional Experimental Farm, in Eboli (Southern Italy) (40° 33' 29" N; 14° 58' 28" E, 15 m a.s.l.). The research activities in the field were carried out in 2021, starting on February 15th and ending on March 30th. The study was performed on 13 apricot cultivars, namely: 'Don Aniello', 'Ottavianese', 'Ceccona', 'Sona Campana', 'Vitillo', 'Zi Francesco', 'Zi Luisa', 'Portici', 'Pellecchiella', 'Boccuccia Liscia', 'Portici II', 'Boccuccia Spinosa', 'Scialò'. Individual plants of all apricot cultivars were twelve-year-old, grafted on Myrabolan 29C (*Prunus cerasifera*) and vase-trained (4 m × 4 m spaced). For our study we used five single-tree replications per cultivar.

Data of minimum, maximum and medium temperature (°C) and rainfall (mm) were recorded throughout the experimental period at the agro-meteorological station located at the "Improsta" Regional Experimental Farm. Climatic data were compared with those recorded for the period from 2018 to 2020.

2.2. Flowering phenology

Considering that plants of all cultivars were subjected to the same local environmental factors, we monitored their phenology to assess possible differences in flowering related to the different genotypes. To avoid possible interference between flowering time and sun exposure, we standardized the monitoring of plant phenology by selecting only South-East facing branches.

For each cultivar the average length of the whole blooming period was determined by marking a branch with approximatively 100 flowers and recording as "start of blooming" the day with the first opening flower and as "end of blooming" the day with the last opening flower. According to blooming timing, the 13 cultivars were grouped into early, intermediate, and late flowering group.

In addition, to determine the duration of single flower anthesis, we chose and marked 8 flower buds on 8 different mixed branches for each plant. We then marked and monitored every other day each flower from "pink bud" to "all petals fallen" stage (BBCH 57–69, Pérez-Pastor et al., 2004).

2.3. Pollen viability and germinability

The effect of temperature on pollen functionality of the 13 apricot genotypes was assessed through in vitro pollen viability and germinability tests. Three temperature treatments were performed on apricot pollen: 5 °C, 15 °C and 25 °C. We chose 5 °C and 15 °C treatments because they represent respectively the minimum and maximum mean temperature recorded at the "Improsta" farm during apricot flowering of the years preceding that of this study. The third temperature treatment (25 °C) was chosen to investigate pollen response in a possible scenario

of heatwaves that actually occurred in the same area during last years.

Pollen was collected from flowers sampled on the trees of the 13 apricot cultivars. More specifically twigs with flower buds were cut in the morning and transported to the laboratory in a few hours. During transportation, twigs were placed in wooden baskets ensuring a temperature and humidity exposure ranging from 10 °C to 15 °C and 50% to 70%, respectively. Per each genotype, not less than 100 flower buds in "balloon" stage were collected (BBCH 59, Pérez-Pastor et al., 2004). At "balloon" stage, anther resulted light yellow, turgid and still undehisced, therefore preventing pollen dispersal and possible pollen damaging (including dehydration) during transportation. Upon arrival at the laboratory, anthers were detached from flower buds, were distributed in three petri dishes, and were left to dehisce by desiccating them in a closed container filled with dry silica gel. This approach allowed anthers to release pollen within few hours and to produce three bulk samples of pollen per cultivar in the same day as flower sampling from the trees.

Pollen viability was assessed through diaminobenzidine (DAB) reaction (Rodriguez-Riano and Dafni, 2000) at "balloon" stage to compare possible differences in initial pollen functionality among cultivars and to have a reference point for comparing the effect of the different temperature treatments on pollen germination over the EPP. We evaluated pollen viability on 12 pollen samples per cultivar. Each pollen sample was taken from a single bulk per cultivar and spread into a 10 μL droplet of water previously placed on a slide. One droplet of 10 μL of DAB reagent was added on each pollen sample and slides were gently warmed on a heating plate and mounted (Dafni, 1992). We scored as viable the pollen grains stained dark brown and as not viable the ones that remained faint/colourless. Viability percentage was measured counting at least 100 pollen grains per slide.

The EPP for apricot flowers is reported to vary among cultivars from 2 to 8 days (Sanzol and Herrero, 2001). Considering that no data is available on the EPP of the apricot genotypes from the Campania region, we decided to analyse the effect of the temperature treatments on pollen tube formation considering 72 h as plausible EPP. More in details, pollen from the selected cultivars was pre-incubated at 5 °C, 15 °C and 25 °C for 48 h and germination was evaluated after further 24 h *in-vitro* germination at the same temperature treatments, respectively. Pollen used for germination tests came from the same bulk samples in which viability was previously assessed. More specifically, pollen from bulk samples was placed on a series of Petri dishes lined with a solid medium made of 0.9% agar and 15% sucrose in water. For each cultivar, six Petri dishes were split in three different incubators (VELP®, FOC 200 IL) set at 5 °C, 15 °C, 25 °C, respectively, and 70% RH. Pollen grains were scored as germinated when pollen tubes were longer than the pollen diameter. For each cultivar, we scored at least 100 pollen grains per each of the four Petri dishes incubated at the same temperature.

2.4. Statistical analysis

Data were analysed with Microsoft Excel and IBM® SPSS Statistics. The Shapiro Wilk's was used to assess the normality of the datasets. Both for viability and germination, data resulted normally distributed within each of the three datasets (early, intermediate, and late flowering cultivars). In each dataset homogeneity of variance was verified by Levene's Test. Data expressed as percentage were preliminary converted with arcsine function. Differences in pollen viability among cultivars were compared with one-way ANOVA ($P < .05$). As concern germination, results were obtained in a two-factorial design (4 temperatures × 13 cultivars) and significant differences were tested with a two-way ANOVA ($P < .05$). All post-hoc analyses were performed with Tukey HSD test ($P < .05$). Statistical analysis of data on flowers at anthesis was performed using one-way ANOVA ($P < .05$) and Duncan's multiple range test ($P < .05$).

3. Results

3.1. Flowering phenology

Meteorological data recorded at the 'Improsta' farm during the apricot flowering period in 2021 showed that the average temperature was 10.5 °C, the average max temperature was 16.1 °C, the average min temperature was 4.8 °C, and 0.4 °C and 22.9 °C were the daily minimum and maximum temperature, respectively (Fig. 1). During the flowering period, rainfalls were concentrated only in a few days and did not interfere with the data collection and pollen sampling.

According to phenological data, we grouped the studied cultivars into three categories of blooming time: a) early flowering cultivars ('Sona Campana', 'Don Aniello', 'Ottavianese and 'Ceccona') with bloom starting from February 22nd to 27th; b) intermediate flowering cultivars ('Vitillo', 'Zi Francesco', 'Portici', 'Zi Luisa' and 'Pellecchiella') with bloom starting from March 2nd to 6th; c) late flowering cultivars ('Boccuccia Liscia', 'Boccuccia Spinosa', 'Portici II' and 'Scialò') with bloom starting on March 8th (Fig. 2). 'Sona Campana' showed the longest blooming period (13 days) and was the first cultivar to bloom (February 22nd) whereas 'Vitillo' showed the shortest blooming period (9 days) (Fig. 2).

Overall, the length of single flower anthesis (from "pink bud" to "all petals fallen") was on average 4.61 days, whereas 'Zi Francesco' (5.6 days) and 'Scialò' (2.88 days) showed the longest and shortest duration, respectively (Fig. 3). Focusing separately on the three groups, early cultivars did not show any statistically significant difference in blooming period with an average duration of 4.94 days. The intermediate cultivars showed on average an anthesis duration similar to the early cultivars (4.9 days); however, two of them turned out to be respectively longer ('Zi Francesco' = 5.6 days) and shorter ('Zi Luisa' = 3.5 days) than the others. Late flowering cultivars showed on average a shorter anthesis compared to the other cultivars (3.97 days); among them the anthesis of 'Scialò' cultivar (2.88 days) lasted less than the others.

3.2. Pollen viability and germinability

Viability of the pollen grains collected from flowers just before the anthesis was uniformly high in all the apricot cultivars ranging from a minimum of 82.18% ('Zi Luisa') to a maximum of 96.37% ('Sona Campana') (Fig. 4). Notwithstanding some statistically significant differences highlighted in each of the three groups, on average pollen viability at the anthesis remained hight throughout the apricot flowering period.

According to these results, for all cultivars pollen was considered of good quality and suitable to analyse the effects of temperature on gametophyte development by means of germination tests. The response of pollen of *P. armeniaca* to 5 °C, 15 °C, and 25 °C incubation within the simulated EPP (48 h pre-incubation and 24 h *in-vitro* germination) varied significantly among cultivars. Overall, pollen germination ranged from a minimum of 5.47% ('Ceccona') to a maximum of 83.50% ('Portici II') (Fig. 5). The temperature of 15 °C, reproducing the maximum mean temperature during flowering, revealed to be the most suitable temperature for apricot pollen to germinate within the EPP; indeed, the highest germination percentage was recorded at 15 °C (Portici II, 83.50%).

Compared to 15 °C, the temperatures of 5 °C and 25 °C (reproducing the minimum and the peak temperature during flowering, respectively) significantly reduced pollen germination in most cultivars (Fig. 5). Differences in pollen germination were particularly evident in the intermediate flowering cultivars in which overall germination was lower compared to cultivars of the other flowering groups with the lowest values occurring at 25 °C (Fig. 5B).

Among the 13 cultivars, one cultivar per flowering group ('Ottavianese', 'Zi Francesco' and 'Portici II') showed no difference in pollen germination to the different temperature treatments within the EPP.

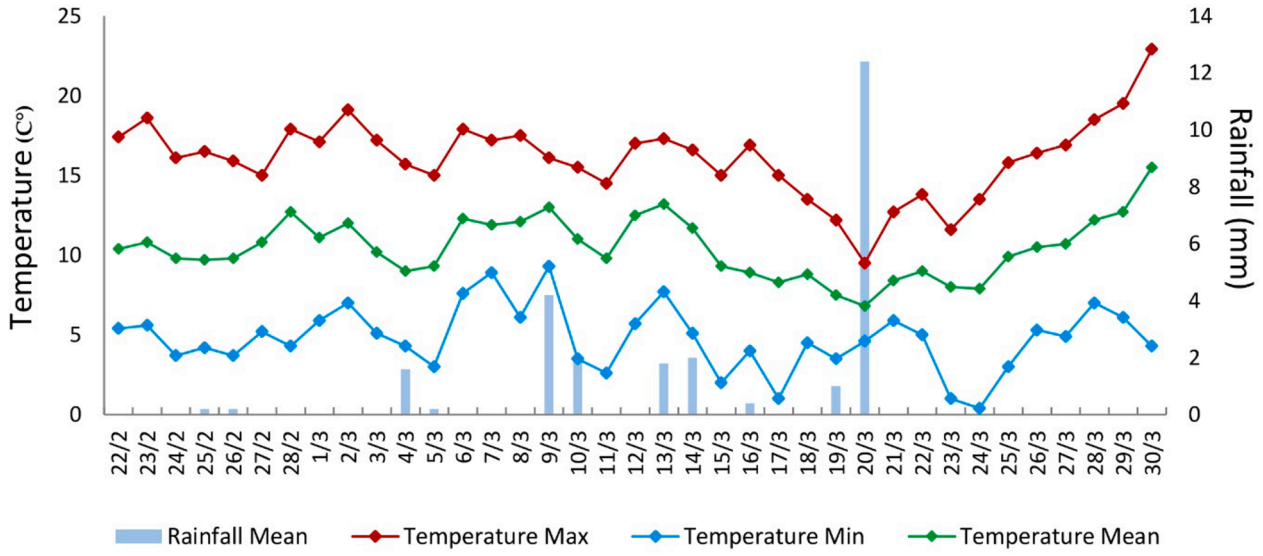

Fig. 1. The daily trend of the maximum, minimum, and mean temperature (C°) and total rainfall (mm) from February 22nd to March 30th 2021 at the experimental site of 'Improsta' farm.

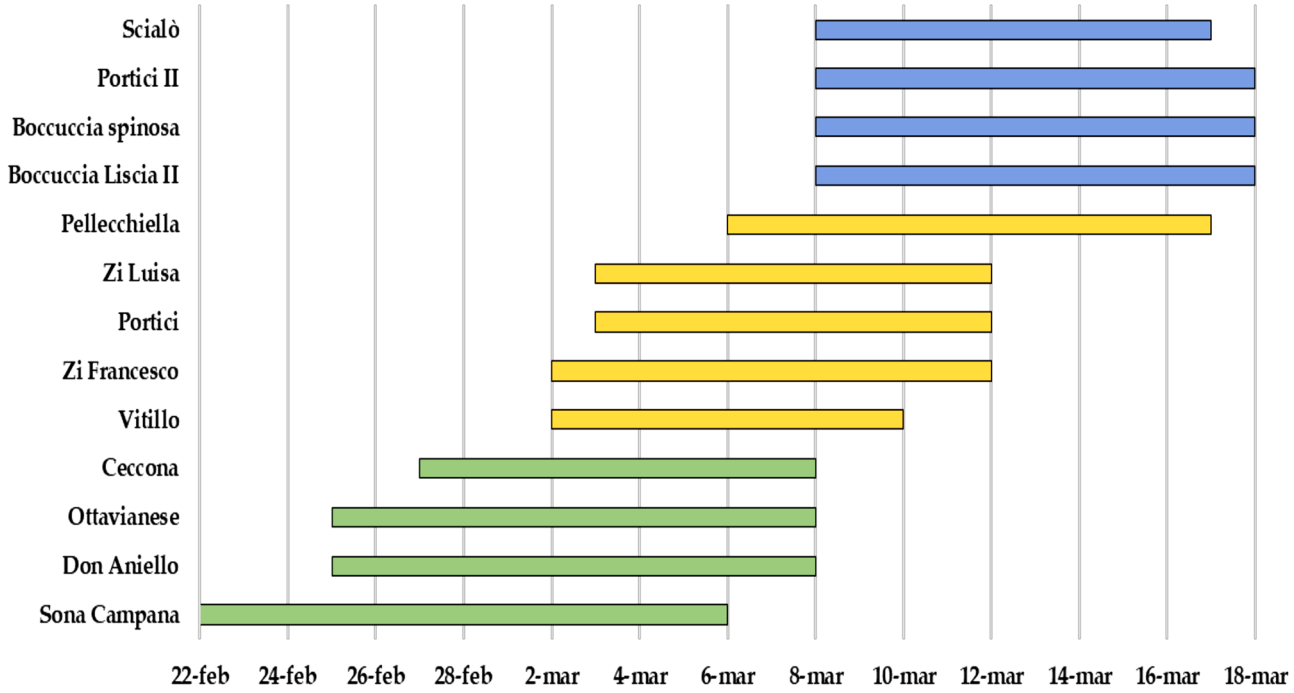

Fig. 2. Blooming period length of the studied apricot cultivars grouped as: early flowering (February 22nd to 27th) (green bars), intermediate flowering (March 2nd to 6th) (yellow bars), and late flowering (March 8th to 18th) (blue bars). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

However, the cultivar belonging to the intermediate flowering group ('Zi Francesco') showed low pollen germinability in all temperature treatments (< 30%). Differently, the two cultivars belonging to early and late flowering groups respectively, ('Ottavianese' and 'Portici II') resulted also to be the cultivars conserving high pollen germinability (> 70%) at high temperatures, therefore showing the best resilience to temperature changes during flowering.

4. Discussion

The possibility to analyse reproductive traits of different apricot genotypes by using trees of the same age and growing at the same place allowed us to reliably compare their flowering phenology and pollen functionality. Insights on the blooming time are valuable in the process of cultivar selection for breeding projects, new orchard plantations, or in predicting possible future scenario in established orchards. However, blooming time is a complex phenomenon related to environmental and endogenous cues such as development and physiological status of plants (Amasino and Michaels, 2010). Chill temperatures are known to be much involved in regulating the blooming time and inadequate chilling due to warm autumn temperatures results in delayed and erratic budbursts during the following spring (Heide, 2003; Darbyshire et al., 2017). It is reported that one of the main effects of the warmer climate in orchards is the faster bud development and earlier blooming of fruit

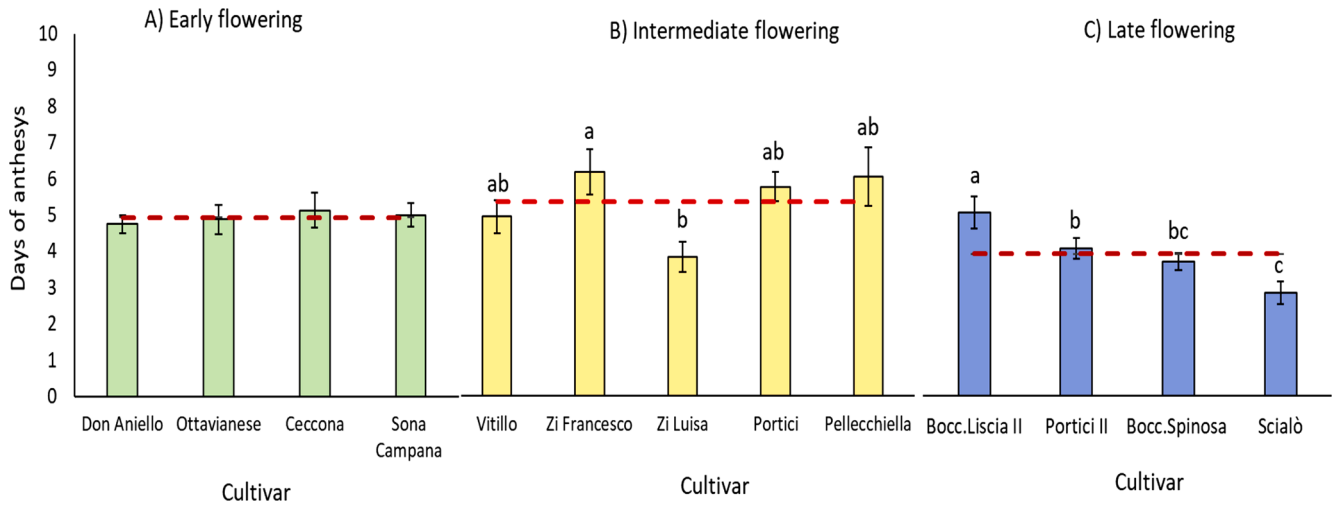

Fig. 3. Single flower anthesis in early (green bars), intermediate (yellow bars), and late flowering cultivars (blue bars). Dashed lines represent the average duration of the anthesis for each group. Data are expressed as mean number of days ± SE. Significant differences between cultivars within each flowering group are expressed with different letters ($P < .05$). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

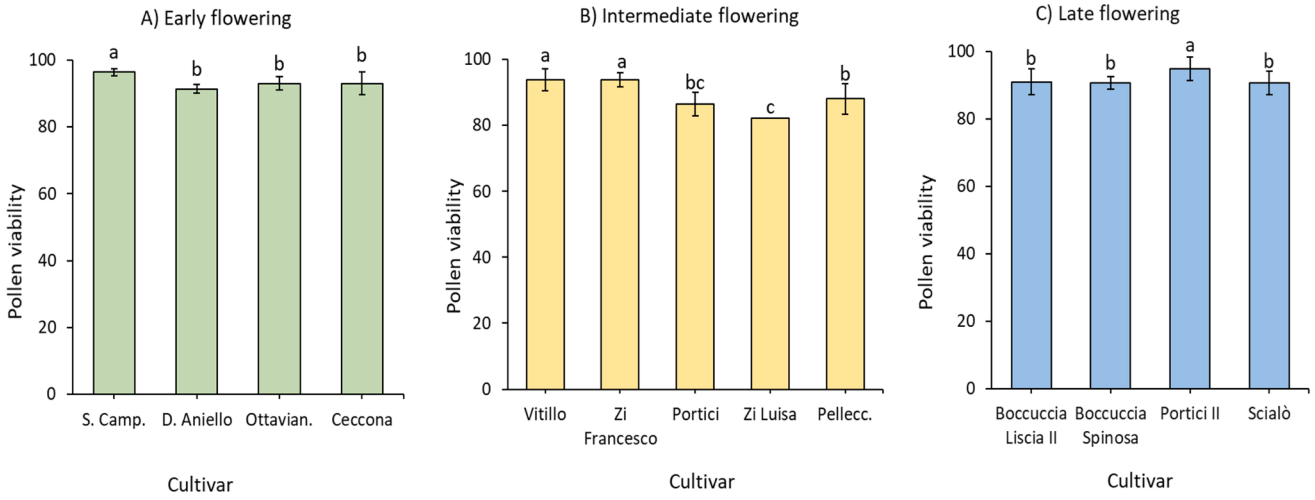

Fig. 4. Viability of pollen from flower sampled at "balloon" stage in early (A), intermediate (B), and late flowering cultivars (C). Significant differences between different cultivars within each flowering group are expressed with different letters ($P < .05$). Bars represent means ± SE.

trees, including apricots (Szalay and Papp 2006). These phenomena rise the risk of frost damage, the consequences of which depend on several factors including cultivar genotypes. In our study, we compared and categorized all cultivars according to their blooming time. Overall, our data on seasonal period and duration of the flowering agreed with those previously reported on some of the same apricot cultivars (Pellegrino et al., 2004; Forlani and Rotundo, 1977). Nevertheless, some contrasting results have been found in literature, as for the cultivar 'Pellecchiella' that was classified both as early flowering and as late flowering (Pellegrino et al., 2004). In our study, the coexistence in the same place of so many cultivars represented by plants of the same age, allowed to homogenize the effects of the environmental factors on the flowering processes and to consider the differences among cultivars as imputable only to their different genotypes.

Weather conditions can affect floral morphology and fruit set in apricot with a significant variability among cultivars (Legave et al., 2013; Ruiz and Egea, 2008), and warm pre-blossom temperatures are reported to limit the pistil development of apricot flowers (Rodrigo and Herrero, 2002)). No aberration in flower morphology was visually observed in any of the analysed cultivars. However, significant year-by-year variations in apricot floral traits are plausible and previously reported for other cultivars (Ruiz and Egea 2008); therefore, it would be worth to repeat flowering analyses on all our cultivars for several subsequent years.

In breeding programmes new commercial cultivars have been mostly selected to overcome self-incompatibility issues and increase plant productivity (Marchese et al., 2016), whereas other reproductive traits, including pollen functionality and its interaction with environmental factors, have been generally overlooked.

Our data on pollen viability of flowers at dehiscence ('balloon stage') showed that both microsporogenesis and early microgametogenesis processes had successfully occurred in all tested cultivars. Similar studies on viability of pollen from flowers at the 'balloon stage' were performed in Turkey on foreign apricot varieties reporting much lower viability percentages compared to the traditional cultivars analysed in our study (Asma, 2008; Yaman and Turan, 2021). Such differences might be related to several reasons. One might be linked to the type of test used to evaluate pollen viability: we chose the diaminobenzidine (DAB) reaction to test pollen viability considering that the tetrazolium salts, although used for a long time as also in the mentioned studies, it is now being replaced by more reliable enzymatic reactions (Dafni 1992). Moreover, the lower pollen viability in foreign cultivars tested in Turkey

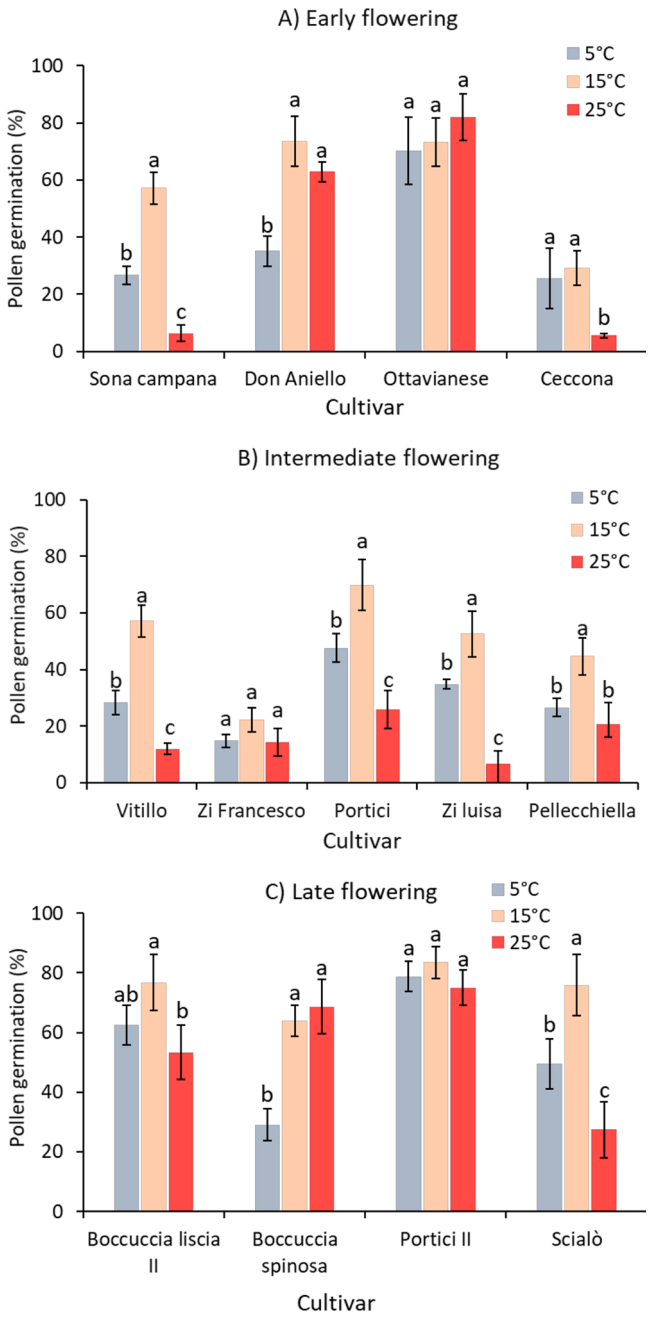

Fig. 5. Germinability of pollen sampled from flowers at "balloon" stage in early (A), intermediate (B), and late (C) flowering cultivars. Significant differences within each cultivar are expressed with different letters ($P < .05$). Bars represent means ± SE.

compared to cultivars in our study, might be linked to the low genetic erosion due to the limited replacement of typical apricot genotypes with new commercial cultivars in Campania region. Finally, we cannot exclude that the differences in pollen viabilities might be related to the interactions between the cultivars and the local weather conditions during the years of the mentioned studies.

High levels of pollen viability in all cultivars allowed us to go further focusing on the effect of temperature on pollen functionality during a time compatible with the EPP of apricot species. Results highlighted large differences among cultivars and, for most of them, 15 °C revealed to be the best temperature for pollen germination. Such results are in line with those of previous studies evaluating germination of apricot pollen at different temperatures (Pirlak, 2002). However, it is worth to consider that 15 °C corresponds to the maximum mean temperatures previously recorded at the 'Improsta' farm during the apricot flowering periods. Consequently, it seems that pollen from traditional cultivars of Campania region is resilient to the mean high temperatures occurring recently in the field. Throughout the flowering period, no specific trend was found in pollen germination to the minimum mean temperatures previously recorded at the 'Improsta' farm during the apricot flowering periods. Best resilience was showed on average by cultivars belonging to the early and late flowering groups and particularly in two cultivars ('Ottavianese' and 'Portici II'). Nevertheless, further investigations are required to deepen these results. Similarly to results on pollen germination previously obtained in several stone fruit crops (Table 2 in Luza et al., 1987; Table 1 in Pirlak 2002), also our study revealed that in most of the early and intermediate flowering cultivars pollen germination was significantly higher at 5 °C compared to 25 °C (Figs. 5A, 5B). However, no clear association between flowering timing and pollen thermo-tolerance has been reported so far in apricot pollen germination. In addition, it must be considered that pollen can react differently to temperature during pre-incubation treatments or during *in-vitro* germination. Despite pollen germination resulted lower at 5 °C compared to 15 °C, it is already reported that low temperature can increase pollen longevity and preserve pollen capability to germinate even after long storage (Dutta et al., 2013; Khan et al., 2013; Sharafi, 2011). In this regard, additional experiments should test possible effects of low temperature before and after the activation of pollen tube formation. Finally, our cultivars showed to be significantly affected by high temperatures corresponding to the heatwaves locally recorded in the recent years during the apricot flowering periods. Indeed, there was no cultivar whose pollen better germinated at 25 °C compared to 5 °C except for one (Fig. 5A, 'Don Aniello'). In this regard, it should be considered that compared to other stone fruit, apricot is an early flowering fruit species, in which the selection of cultivars with different flowering timing was meant for reducing flowering frost damage and widen the apricot harvest (Byrne, 2005; Martínez-Gómez et al., 2017). Therefore, it is plausible that reproductive traits including pollen germination are better adapted to coexist with cold rather than heat peak temperature exposure. Overall, our findings rise concerns especially considering the current scenario of climate change. In addition, our results proved that different cultivars could have different reactions to heatwaves and that pollen from different genotypes can be more or less resilient to the increase in maximum mean temperatures.

In conclusion, pollen functionality of apricots is highly sensitive to environmental conditions showing that 15 °C represent the best temperature for apricot pollen germination while cold and heat temperature peaks can drastically reduce reproductive success in apricot cultivars. Our results also showed that in apricot, within the gametophytic generation, pollen germination is the phase most affected by temperature. Moreover, results further highlighted that the traditional genotypes of apricot (such as those of the Campania region), must be considered as precious source of agrobiodiversity because of their best conserved reproductive traits. Among them, pollen reaction to temperature should no longer be neglected in the processes of cultivar selection for new orchard plantations or breeding projects.

CRediT authorship contribution statement

Maurizio Iovane: Conceptualization, Data curation, Investigation, Writing – original draft, Writing – review & editing. **Luigi Gennaro Izzo:** Data curation, Investigation, Writing – original draft, Writing – review & editing. **Aurora Cirillo:** Data curation, Investigation, Writing – original draft, Writing – review & editing. **Leone Ermes Romano:** Investigation, Writing – review & editing. **Claudio Di Vaio:** Conceptualization, Writing – review & editing. **Giovanna Aronne:** Conceptualization, Funding acquisition, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare no conflict of interest.

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