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Influence of Pollen Source and Pollination Time on Fruit Set of Ferragness Self-Incompatibility Almond

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Abstract: Different experiments have showed that interruption in pollination is an important problem in most almond orchards. As most of the almond cultivars are self- incompatible, pollination cannot be performed desirably and as a result a failure in almond yield is occurred. Thus under this circumstance, determination of selective cultivars compatibility and choosing appropriate pollinizers are so important in almond orchards establishment. Thus, in order to select of best pollinizer and also determining of pollination time influence on fruit set of Ferragnes, an experiments in Horticulture Research Station of karaj, based on random complete block design with three replication on trees 8 years old. Four cultivars of Tuono, Fragiulio, Sahand and Shekofeh selected as the pollinizer treatments for pollinating the Ferragnes cultivar. In this test, used pollens, had high percent of germination (%85), before crossing. After pollination, in order to study of how formation of fruit, pollinated flowers were accounted in several times and did statistical accounts on them. Significant differences were also observed between pollination treatments for the mean values of the percentage of fruit set, with the higher value corresponding to fruit set from open-pollination 38.79% and it's lowest with Tuono pollenizer with average of percent fruit set was 22.60%. In final fruit set, not only there was more different between pollenizers for fruit setting in Ferragnes almond in each stage of pollination after flower opening, but also it was observed more different between pollenizers for fruit setting in various stages of pollination after a range of flower opening times.

Key words: Almond % Pollination % Fruit set % Compatibility % Incompatibility

INTRODUCTION

Almond (*prunus dulcis*) is one of the most important nut crops of the temperate regions in the world that enjoys the high economical value because of the easiness of the harvest, the simple preservation and the transportation, the adaptation with the calcareous soils and in the semi arid regions and the high nutrient value and the diversity of the usage (Kester *et al*., 1990). Most of the cultivars of almond are self incompatible and require cross-pollination. Self-fertility is limited in almond by gametophytic self-incompatibility, where the growth of self pollen tubes is prevented by cytotoxic proteins that are produced in the stigmatic tissue (Socias I Company, 1990). Also it must be noted that in the cultivars of almond, there is the cross-incompatibility (kester *et al*., 1990). So the recognition the groups of the compatible and incompatible almonds are very important. To obtain the economical performance, at least we must plant two cross incompatible cultivars that have the necessary overlapping blooming times (Kester and Griggs, 1959) and accompanying with applying bees for cross-

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pollination at the blooming (Dicenta *et al*., 2002). Despite existing superior self-incompatible cultivars in almond plantation, there are most important factors of its production limitation including, problem in pollination and fertilization especially in the unsuitable combination of cultivars for flowering overlap and pollination compatible. For these basis, in the recent years, self-compatibility has been introduced in breeding programmes as an important trait (Kester and Asay, 1979; Socias i Company, 1990; Vargas *et al*., 1997; Dicenta *et al*., 2002, Kodad and Socias i Compani, 2006 and Dicenta *et al*., 2009). However from the economical point of view of the growth the some of superior self incompatible cultivars in the gardens are more important than self-compatibility cultivars. But, Different experiments have showed that interruption in pollination is an important problem in most almond orchards established by these self incompatible cultivars. As in the almond cultivars which are self- incompatible, pollination can not be performed desirably and as a result a failure in almond yield is occurred. Thus under this circumstance, determination of selective cultivars compatibility and choosing appropriate pollinizers are so important in almond orchards establishment. On the other hand, period of stigma receptor in almond is very limitatative and critical. Thus, determination of suitable pollination time for pollination management can be useful for rising yield. Due to the importance of evaluating the pollination needs of self-incompatible almond cultivars, the aim of this work was to study the influence of pollen source and pollination time on fruit set of commercial self-compatibility Feragnes almonds in Iranian condition.

MATERIALS AND METHODS

Selection of the Pollinizer Cultivars: After the necessary studies by considering the quality of the fruit, the flowering overlap, cultivar of the Ferragnes as the mother parent and Fragiulio, Sahand, Shekofeh and Tuono as the pollinizers for it was considered.

This experiment was done in Kamal Abad situated in 15 Kilometers of the west of Karaj belonging to the Seed and Plant Improvement Institute (SPII). For doing this work, branches that had the enough flowers in the phase of the swelling of the flower bud and some days before opening the flowers from the selective pollinizers for supplying pollen were collected. Also branches in different parts of the trees of the Ferragnes as the receiver of the pollen and along labeling in the phase of swollen of the flower buds (Ballone stage), the flowers were isolated to prevent their pollination and to transfer the unwanted pollen on them. To prevent the free pollination, the mull bags in the dimensions of 50×70 were used.

The Experimental Treatments: The main experiment was performed with four treatment and in three replications in the completely randomly design. Four cultivars of Tuono, Fragiulio, Ferragnes and Shekofeh selected as the pollinizer treatments for pollinating the Ferragnes cultivar. Their pollen was collected and was pollinated the Ferragnes in the different times manually.

To prepare and collect the pollen grains before opening the flowers, the branches that were in the length of 0/5 - 1 meter with the flower buds of them were cut and transferred to the lab.

The branches of the selective cultivars were placed in the container and 20 liters buchets containing the water and sucrose 4% (as far as 15cm) and in the usual temperature of the lab (17-25°C) with the suitable distance from each other. After some days (5-7 days), the flowers were prepared to supply pollen near the phase of the anthesis. The flowers were separated manually or by a small scissors and were collected by a forceos or rubbing the flowers on their web of the pollen and were placed on the paper of celephon to dry about 12 hours. Then the pollen grains were transferred in the small glass vials and were preserved till performing the pollination in the refrigerator in 4°C.

Study of Pollen Grain Germination in the Lab: To ascertain viability of the collected pollen grain, the pollen grain was cultured in-vitro. For this reason, the medium containing sucrose 15%, 20 ppm boric acid and agar 2% was used. The culture of the pollen grain in Petri dishes containing the above compounds was done.

After culturing the pollen grains, the Petri dishes were transferred to the growth chamber with 25°C. After 24 hours, the pollen grains were studied and numerated under the binocular microscope and the percent of their germination was determined.

The Artificial Pollination in the Field Condition: To pollinate with the considered pollens and regarding to the time of opening of the flowers of each branch by removing the mull bags, 80-130 flowers were preserved and the other flowers were omitted. The omitted flowers included the unopened flowers and the flowers that have been opened very early. In the manually pollination of prepared branches 1, 3 and 5 day after opening the flowers in each unit of the experiment, the controlled pollination was performed in the morning and in the

afternoon. After opening each mull bag, the pollen grains were transferred on the stigma with the special branches that were indicated by the label. Along the pollination, the insects were prevented to go inside the place of the related flowers. To ascertain the re- pollinate of the opened flowers inside the bag was done with the related pollen grain. After the last pollination, the number of the pollinated flowers was recorded in each branch, the unopened flowers were omitted and the bags again were placed on the branches. The operation of the isolation was done the pollinated branches to prevent the pollination by the pollens of the other cultivars.

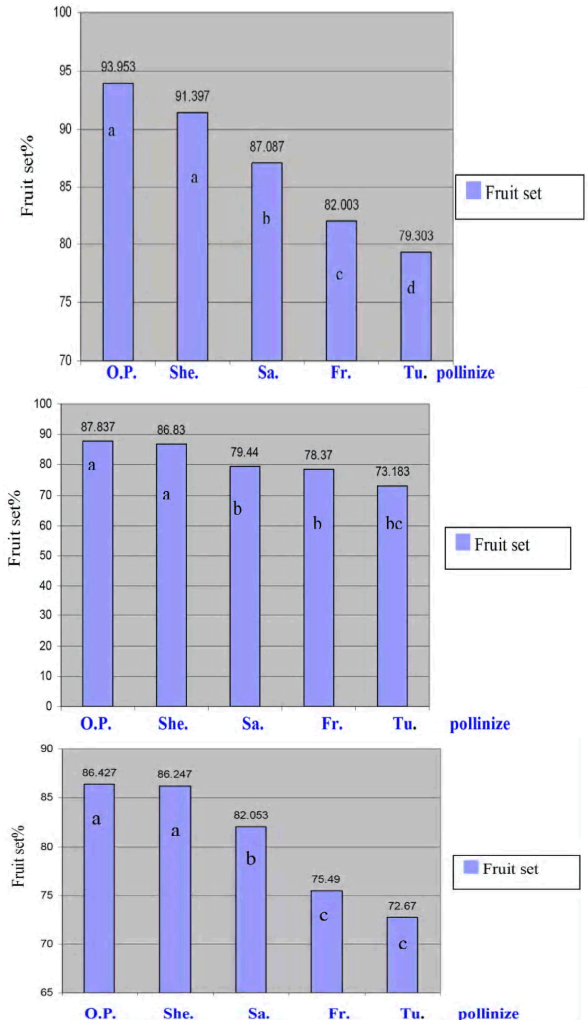
RESULTS AND DISCUSSION

Pollen Culture: In order to ensure of pollen germination of gathered pollens, they test *in vitro* included 15% sucrose, 20ppm acid boric and 2% agar. Results showed that the percent of pollen germination of selected cultivars in this research, determined 80-95%. In pollen germination test, it was found that no significant different between cultivars from germination of pollen 6 hours after culturing. The percent of germination is fixed after 24 hours and only length of pollen tubes increased after 24 hours. In whole case, this result obtained which not only had no significant different between ability of germination pollen of almond cultivars, but also can determined germination of pollen 6 hours after culturing in temperature 20±2°C.

Results Related to Study Percent of Fruit Set in Ferragnes Using Different Pollen Source and Pollination Times: In order to determining percent of fruit set and also pollinated flowers drop, the results were noted for Ferragnes in 3 times after pollination.

Therefore pollinated flowers and percent of fruit set in each treatment, accounted in 3 times after pollination individually and were analyzed based on RCBD (Random Complete Block Design) with 3 replications.

Results of Pollination and Fruit Set in First Accounting: In first accounting, the percent of fruit set in each treatment (branch) was evaluated based on number pollinated flower and number of fruit set 20 days after pollination in 3 times after 1, 3 and 5 days after flower opening. Results showed that percent fruit set in first accounting which there was significant difference between treatments statistically. Therefore, the highest and lowest fruit set percent 1 day after flower opening in ferragnes was 91.39% and 79.30% with Shekofeh and



O.p.= Open pollination, She.= Shekofeh, Sa.=Sahand, Fr.= Fragiulio, Tu.=Tuono,

Fig. 1: Influence of pollen source on fruit set of Ferragnes in first accounting 20 days after pollination: 1day after opening (above), 3 day after opening (middle) and 5day after opening (below).

Tuono pollens respectively (Fig.1above). Percent fruit set after 3 and 5 days after flower opening was almost similar to percent fruit set after 1 day after flower opening (Fig.1). Such similarities could be due to the independent fruit growth from pollination that is to say pollinated and no pollinated flowers can be growth initial stages. Similar results have been reported by Kester and Griggs (1959), Socias I Company (1990), Oukabli *et al*. (2000), Kodad and Socias i Compan (2006) and Ortega *et al*. (2004, 2006).

Results of Pollination and Fruit Set in Second Accounting: In this stage, average percent of fruit set in each treatment was accounted in way which mentioned in

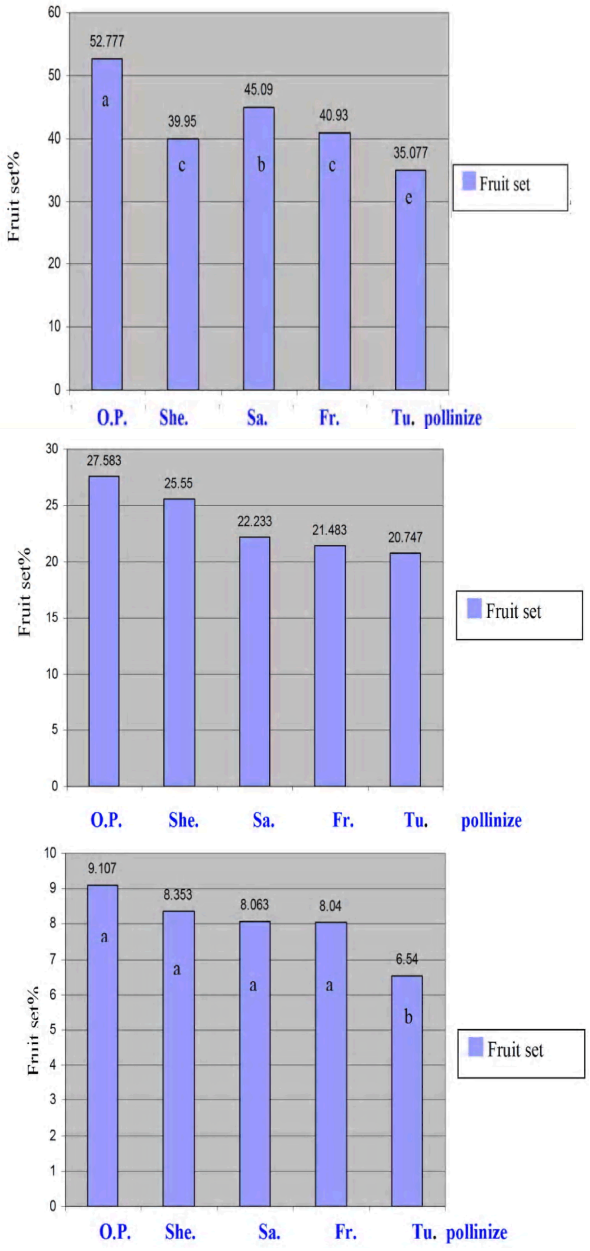


Fig. 2: Influence of pollen source on fruit set of Ferragnes in first accounting 40 days after pollination: 1day after opening (above), 3 day after opening (middle) and 5 day after opening (below)

first accounting. Results showed that average of percent fruit set in second accounting between treatments was different statistically. The highest and lowest percent of fruit set with open pollination and Tuono pollinizer was 52.77% and 35.07% repectivlly (Figure.2). Although, there were lower different between pollenizers for fruit setting

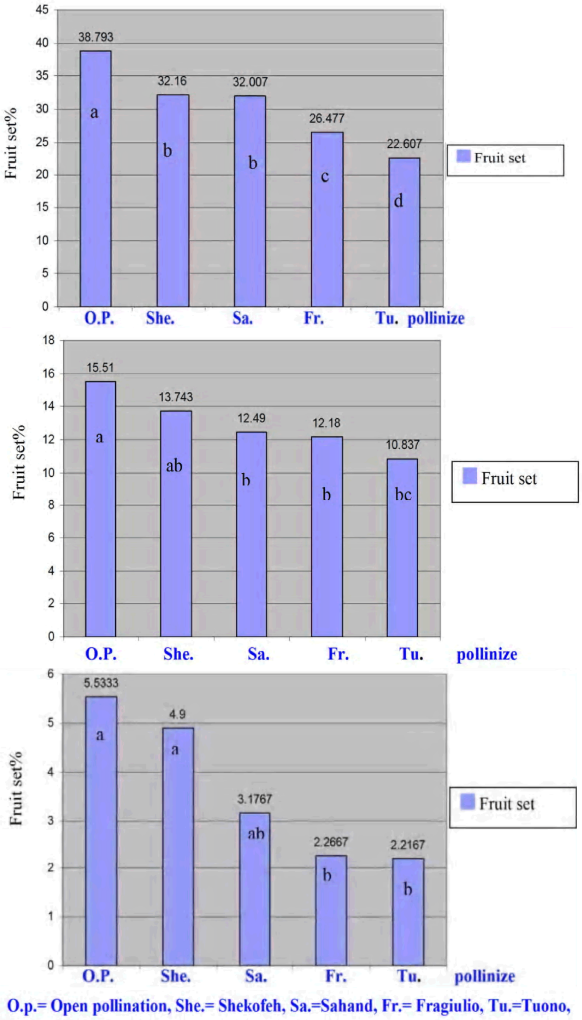


Fig. 3: Influence of pollen source on fruit set of Ferragnes in first accounting nut at nut harvest time: pollination 1day after opening (above), 3day after flower opening (middle) and5day after opening (below)

in Ferragnes in each stage of pollination after flower opening (Fig.2 above), but there were more different between pollenizers for fruit setting in Ferragnes in various stages of pollination after a range of flower opening times (Fig.2). Such differences mainly due to the lack flower pollination on time. These results by some means agreed with those of Kester and Griggs (1959) and Dicenta *et al.* (2002), who reported the fruit set is higher in pollination of flowers that were opened freshly in relative to those pollinated, delayed.

Results of Pollination and Fruit Set in Third Accounting: Results of accounting fruit set in this stages showed that significant differences between pollination treatments.

The higher and lowest values of the percentage of fruit set were 38.79% and 22.60 in proportion to open-pollination and Tuono pollenizer respectively (Fig. 3).

In this stage, not only there was more different between pollenizers for fruit setting in Ferragnes in each stage of pollination after flower opening (Fig.2 above), but also it was observed more different between pollenizers for fruit setting in Ferragnes in various stages of pollination after a range of flower opening times (Fig.2). Differences between pollination treatments were observed for fruit set could be mainly because of the lack flower pollination on time and incompatible pollen. In other reports (Kester and Griggs, 1959; Garcia, 1978; Vasilakakis and Porlingis, 1984; Socias i Company and Felipe, 1987 and Dicenta *et al*., 2002), Pollen potential showed some variability between genotypes as pollinizers, also the higher fruit set in pollinating flowers that were opened freshly in relative to those pollinated delayed.

It is concluded that there was influence of pollen source and pollination time on the fruit set of Ferragnes self-incompatibility cultivar. These results emphasize the importance of early pollination as well as the selection of appropriate pollinizers with the same flowering period Ferragnes to improve almond yields in Iran.

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