
Flower Phenology, Ovum Longevity, Effective Pollination Period and Growth Curve of Hawthorn Fruit

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Abstract

The phenology of hawthorn flower has been examined during 1388 and 1389. The beginning and ending date of its flowering, the duration of flowers burst in a corymb, the percent of corymbs with secondary corymbs, the average of flower numbers in each corymb and the average of flower stamen and style were all evaluated. In addition, the ovum Longevity, the pollination striking period of hawthorn were examined with sampling of flowers (two, three, seven and nine days after pollination) and microscopic observations of samples took place. In this study, the ovum Longevity and the pollination period of Hawthorn are respectively 9 and 4 days. It is showed that after pollination, the pollen tube would start growing downward to the bottom of style. The Transparency and brightness of ovum would be the sign of oldness and ending of its action. In order to specify the growth of Hawthorn fruits and drawing the growth curve, the fruit diameter were measured with calliper during the specified times of 3, 6,9,12, and 17 weeks after the flowering completion. The growth curves of flowers were drawn and in contrary to the fruits with seeds, it was like stone fruits and in the form of double sigmoid. The highest level of fruit growth has been observed through the time of three to six weeks after the end of flowering.

Key words: hawthorn, corymb, pollination, ovum longevity

1. Introduction

Hawthorn with its scientific *crataegus monogyna* belongs to Rosaceae Species found in temperate regions (Grieve 2000 & Donmez 2004). Having Crataegus acid considered as a heart medicine, the fruit of Hawthorn has comestible and medical value (Healy 2002). In Iran with its climate variability the Cultivation possibility of numerous species of trees, including temperate fruit trees exists. The purpose of the cultivation of each product is achieving the maximum quality and operation of that product. To attain this purpose studying different items such as stages of flower bud formation, pollination and related environmental, agricultural and genetic factors like phenology and the flower formation, pollen germination and its tube growth, the Longevity of ovum, the effective pollination period, Fertilization, fruit formation and completion seems to be important. For the complete pollination and

fertility, in addition to adjustment factor, the micro phenology examinations of flowers are also of high importance. The flower structure and its productive organs belong to heredity features of biotypes but it is highly under the environmental conditions (Ofosu, Offei & Yamaki 2006). The Hawthorn Inflorescences is in the form of Corymb and the flowers are Pentamer.

Each corymb has 10 to 18 flowers and each flower has five floral leaf, 5 white or sugar like floral leaf and ten to twenty five style and one stamen. The Hawthorn ovum is in the middle and upside down while in each carpel two ovum exist. The inflorescence of Hawthorn flowers is usually starts about the middle of Farvardin until the end of Ordibehesht but this depends on the reign and its climate (1). Some trees produce many flowers but at the end, the rate of harvested products is too low. Researchers have related this subject to the low adjustment of ovum, shortness of pollination duration and Khordad slump (Crisosto, Wasilakakis, Lombard, Richardson & Tetley 1986).

Williams (1965) showed that the ovum longevity is the main factor in fruits formation. If there were no insemination then the Embryo sac would lose its adoptability, which turns to no Fertilization even if Pollination and the growth of Pollen tube have happened. The lower time in stigma acceptance (4, 14) and the fast growth of embryonic sac are introduced as the effective limiting factors. Mohammad Khani (1381) has reported that the adjustment of pears Ovule, the king of fruit species, last eight days and the pollination time would be equal to four days. Alizadeh and his co-workers (1389) have determined the Almonds, Shahrood species, longevity about two to four days.

After Pollination, Fertilization and fruit formation, fruits are very small. Different factors influence on growth of the fruit and its last size. Immediately after pollination and Fertilization, Ovum would grow and turn to Embryo. After flowers fertility, the Embryo and Endosperm are the IAA production source (He & Yu 2009).

In fact, the fruit formation includes the fast growth of fruiting body, which usually happens along with Pollination and Fertilization. Hang (1994) reported that the growth of fruits depends on their seeds growth and they are the inner Hormones that motivate the flesh around the seed (Bonodok, Boros & Botomolos 1998). Indeed the growing seeds are the source of growth hormones for typical growth of fruits (Cui 2006).

The small size of fruits causes some limitation for their marketing (Kemp 1996 & Tromp & Borsboom 2003). The Hawthorn tree like many other trees has many flowers and raises many fruits. The raised fruits do not have so good qualities. Heterogeneity and small size of fruits are among the limitation of Hawthorn production. Considering the vast use of Hawthorn fruit, solving this problem is an important step toward the increase of fruits quality and better production. As there has been no study about the flowers phenology, ovum longevity, Pollination period and development of Hawthorn fruit in Iran, the present study has put the attention on these subjects and in the following lines, the results would be reported.

2. Methodology

In 1388, the field operation research has been done in the garden of Sharekord Campus. Sharekord Longitude and Latitude is 22 degree and 49 min and 32 degree and 20 min and its height from the sea is 2048 meter.

2.1.The phenology and structure of flower

From the beginning of spring in 1388 and 1389, the Hawthorn trees were observed continuously and the required notes were taken for determining the following factors:

- The beginning and ending date of flowering, the time of first bud as the time of flowering date, the burst of 80 percent of flowers, the ending time flowers and the fall of 90 percent of Petals as the end of flowering.
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- The Percentage of corymbs with secondary corymb: for this purpose about 200 corymbs were examined.
- The average number of flowers in each corymb: it was determined with random enumeration of flowers of 100 corymbs on five trees.
- The average number of stamen and style in each flower: it was determined with random examination of more than 150 flowers from different parts of 10 selected trees.

2.2.The longevity of ovum and pollination period

During the time intervals of two, three, five, seven and nine days after pollination the sampling has been done and after doing different preparing stages ovum were extracted with a Fine forceps. The sample put on the Lam, and then it was slowly crushed with a Cover slip. The coloration with Aniline blue and observing the sample have been done by fluorescent microscope model BX51 OLYMPUS, made in Japan.

The fluorescent light causes the differentiation between the healthy and old samples so that the clearness of ovum was considered as the sign of the end or oldness of that. The measurement of pollination period (EPP) would be done according to the longevity of ovum and the required time for the growth of pollen tube and its reach to ovum. The equation for this measurement is as below:

EPP= required time for the growth of pollen tube and its reach to ovum - The longevity of ovum

2.3.The samples for microscopic examination and the sampling method.

During five stages (two, three, five, seven and nine days after pollination), at least ten Pollinated flowers were taken from each branch, then they were floated in the glass jars containing Fixator Carnoy in order to stabilization of samples during the microscopic observations , finally they were kept in the refrigerator with about 4 degree centigrade.

The samples were extracted from the Fixator liquid, put respectively in Ethanol 70% and 30%, and distilled water for half of the hour. Then they were put in Soda liquid 8.0 in 50-60 degree centigrade temperature and they were softened. In this stage, for extraction of Phenolic combinations from the flowers tissue the samples colour turn to red. Therefore, after tissue softness, the samples were put in the distilled water for several times for phenol extraction and their Fluoresce. In order to colouring the samples were extracted from distilled water and were soaked in Aniline blue liquid for about 15 hours, so the samples were coloured.

2.4.The way of determining Hawthorn growth

For following the way of Hawthorn growth and drawing its curve and after three, six, nine, twelve, fifteen and seventeen weeks of the end of flowering, the diagonal of fruits were measured base on ml and by Caliper.

3. The results of the study

The Hermaphrodite flowers of Hawthorn were formed on the last year branches in the form of Inflorescence corymb. The size of corymb depends on the number and size of flowers, the existence of secondary corymb and the flower stalk length. The beginning of Hawthorn flowering time was considered as development of single flowers from twenty third and twenty fifth of Ordibehesht on 1388 and 1389.

The terminal time of flowering was equal to the burst of 80% of flowers on the second and third of Khordad on 1388 and 1389. This time is the time when 90% of flowers have fallen, about fourteen days after the end of flowering in sixteenth and seventeenth of Khoradad on 1388 and 1389. The time duration of flowers burst on one corymb is about three days and their way of flower burst was form the bottom toward the end of corymb. The average number of flowers in each corymb was about 22.14 flowers. The number of flowers in different corymbs was variable between 19 to 24 flowers. The average number of stamens in

each flower was about 2.20 and it was variable between 19 to 24 pieces. The average numbers of styles in each flower were calculated as two. Among the examined flowers, there was only one flower with three styles. In fruit trees, the beginning time of flower burst and the duration of their flowering depend on the Biotypes of plants; the weather conditions would be different. Even the growing process of the flowers in the trees may be different during the different years.

3.1.The results of Studying the ovum longevity and pollination period

It is showed that after pollination, the pollen tube would start growing downward to the bottom of style. The Transparency and brightness of ovum would be the sign of oldness and ending of its action. Considering nine days after burst of the flowers, the ovum brightness would reach more than 50%, the ovum longevity is defined to be nine days.

On the other hand, five days after the burst of the flowers, the ovum would be harden and observable in the Ovary. So base on the experiments done in 1388, the pollination period for Hawthorn is calculated to be four days. The ovum longevity is the determining factor in fruit formation. If Insemination does not take place, the embryo sac will lose its adaptability. As a result, even if pollination and pollen growth have happened, the fertilization would not take place (Willams 1965).

The ovum longevity is not stable and depends on the plant Species, and weather conditions such as temperature and nutrition (Lezec, Guerif &Belouin 1998). Lezik and his co-workers (1998) havecalculated the pollination period of pears species of Bartlett and Komys respectively as six and eight days. In addition, Mohamad Khani and his co-workers (1383) has computed the pollination period of pear species of Shah Miveh to be about eight and four days. In the Hawthorn fruits, 25% of Ovums keep their adaptability until nine days after the burst of flowers. For pollen tube to reach to ovum four days would be enough. Therefore, the longevity of Hawthorn ovum is nine days and the pollination period would be about four days. The fig 1 is a sample of live ovum and fig2 belongs to pollen tube in the ovum.

3.2.The results of studying the growth of Hawthorn fruit

The highest level of fruit growth has been observed through the time of three to six weeks after the end of flowering. In comparison with previous weeks, until the ninth week the growth process would be continued with lower speed. And from the end of the ninth week to twelfth week the seep would be Impalpable. From the end of twelfth week to the end of fifteenth week, the seep of fruits diagonal has an ascending flow. After this time until the harvest date (the seventeenth week) the diagonal of fruits does not have any increase. Base on

these findings the growth curve drawn for Hawthorn fruit would be like stone fruits and in the double sigmoid form. Hawthorn like apple and pear does not belong to stone fruit species, but for having hard stones, it seems like stone fruits (fig3). The stone fruits have their own growth of diagonal and size during their growing season, so the growth curve is in the form of simple sigmoid.



Fig1. Fresh ovum Crataegus

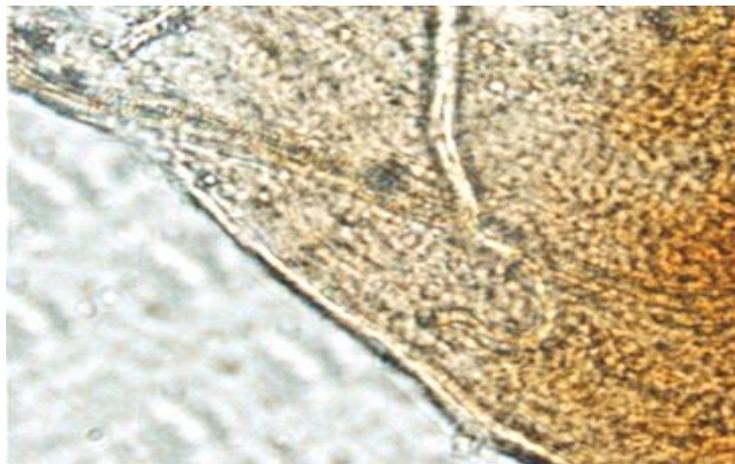


Fig 2. Pollen tube in ovum

The growth process fruits include meiosis, the growth of cells and formation of an intercellular space. The meiosis step is variable with different types of fruits. In some fruits, the meiosis process would be stop during the complete opening of flowers, such as Gooseberry and Raspberries. The period of process would last for other fruits such as Cherry

about two weeks after the opening of flowers and for Plum and peach about four weeks, for apple four to five weeks and for pear seven to nine weeks. In some fruits like Avocado and strawberry, the meiosis would continue till the fruit ripening time.

During cell division, the growth of cell starts from a specific time and continues fast. At the flowering time, there is no intercellular space between the tissues of the fruit or it is very small. Along with the cells growth and depend on the plants species or fruits biotype, the intercellular space would reach to its maximum size. At the beginning stages of cells growth, this space would increase and take the most intercellular space.

Vacuoles would be separated from Cytoplasm by Semi permeable membrane. The water and other compounds forming Sap vacuole would pass through this Membrane. Cell sap also includes substances like sugars and Organic acid. Petite colours and water in external part of skin are responsible for the colour of the fruit.

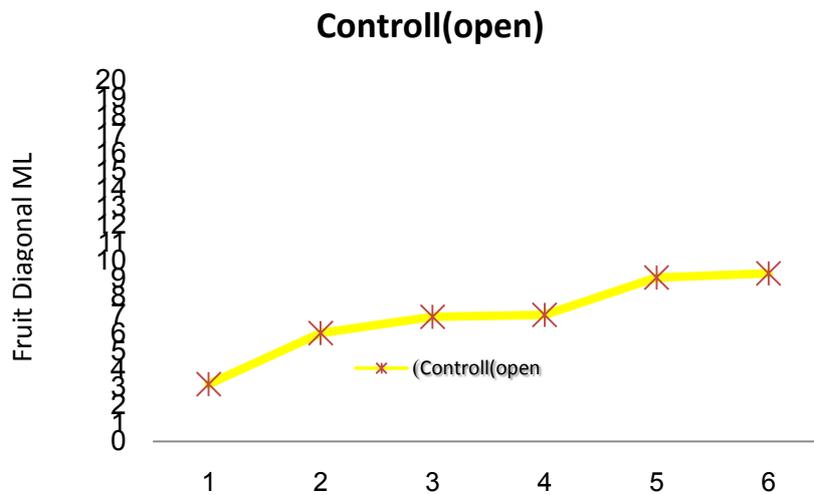


Fig.3 the growth curve

4. Conclusion

As the results of data analysis run in pervious sections, a number of findings emerged: First, it appears to be the fact that the beginning time of flower burst and the duration of their flowering depend on different factors such as the Biotypes of plants; weather conditions and even may be different during the different years. Second the flourish time of 80% of flowers would happen seventeen days after the appearance of the first flower. Third, the longevity of ovum which is the determining factor in the formation of fruits depends on the test conditions

would last four days. In addition, considering the time that pollen tube reaches to ovum is nine days, the effective pollination period would be four days.

Third, it can be concluded that base on the last number of fruits of trees in the study, the probability of self Incompatibility and Partenokarp fruit formation in Hawthorn would be rejected.

Finally The growth curves of Hawthorn flowers were drawn in the study showed that it is more like stone fruits during the time period of seven to fifteen weeks after the flower burst and in the form of double sigmoid. In contrary, the curve of the fruits with seeds is in sigmoid form.

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