

Morphological Variations in Walnut Varieties of the Mediterranean Regions

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ABSTRACT

To study morphological variation of walnut and the rate of its apomixis in Mediterranean climate 40 Varieties were selected from Austria, Germany, Check Oslavakia, United State, Hungary and France. This research was done in research Garden of the Vienna Agricultural University. The highest percentage of apomixis was related to Molotai variety from Hungary and the lowest was related to Geis 120 variety from Germany. Although, the recent variety was without apomixis, but from morphological characteristics point of view was one of the best varieties. Other varieties were having variable behavior and they ranged in to three groups: I, II, III. Significant correlation was observed between number of fruits per tree with total yield per tree, mean weight of single fruit per tree, and the flowering duration. On the basis of cluster analysis, walnut varieties ranged into three groups and, pulkau 5050 was grouped single in cluster.

Key Words: Walnut (*Juglans regia*); Morphology; Apomixis; Cluster analysis

INTRODUCTION

Walnut is monoecious and dichogamous. Male flowers appear like long catkins and with yellow to green color hanging like clusters on one year old branches. Female flowers appear like short terminal clusters. Walnut varieties are classified with respect to blooming period as divided to early, middle and late flowers to increase efficient period of pollination. It is suggested to plant all of these varieties together to increase pollination efficiency (Meuse, 1963; Baalov, 1975; Mentzener, 1988; Atefi, 1990; Atefi, 1997).

Although, now molecular indexes like isoenzymes and DNA markers are used. But in walnut, because of sufficient varieties and easy application, morphological indexes might be appropriate for classification. The phenomenon of apomixes in walnut can be a prominent physiological index for grouping. One of plant families that have apomixes is walnut (Juglandaceae) and especially Iranian walnut *Juglans regia*. The majority of walnut trees in the country are being propagated sexually leading to segregation of characteristics, apomixis in good genotypes in country is necessary to solve the problem of genetic variation. Therefore, identification of cultivars that have apomixis is very important.

Zarubin (1948) reported apomixes. He succeeded to produce 50% of fruits through apomixes from protogynous trees. On the basis of these studies, walnut is in the list of plants that reproduce and propagate sexually and through apomixis (Mentzener, 1988; Valdiviesso, 1990; McGranahan & Leslie, 1990; Crawford, 1996).

Loiko (1995) studied fruiting in Iranian walnut trees in the region of Russian Bailo Russia with an intense cold

winter (-34 to -44°C). Result showed that germination of the seeds was between 16 to 50%. Shoots of Apomixst seeds yielded after five years and embryogenesis studies showed that about 70 to 80% of fruits production was is through parthenogenesis (Huber, 1961). Overall, rate of apomixst fruits differs from year to year and depends on climate and variety. The present study was aimed at investigations on morphological variation of walnut and the rate of its apomixis in Mediterranean region.

MATERIALS AND METHODS

This experiment was carried out in research station of Vienna Agricultural University of Austria. The height was 162 m above sea level, and the amount of rainfall was 500 to 550 mm and average of temperature was 9.3°C and the soil was sandy-loamy.

Eighty walnut trees, planted 9 m apart, were grafted on seeding with 40 varieties of *J. regia* and *J. nigra species*. Different horticultural practices including fertilizer, application spraying and irrigation and other cultural practices were made on regular intervals each year. The studied traits include: duration of flowering, average numbers and weight of fruits on each tree, cleanliness and separation of crust from kernel, the ripening time of fruits, colorness of crust of kernel and percentage of apomixis.

To determine duration of flowering, duration of bud opening until its pouring in male and female flowers was calculated. Then, these degrees took codes. To study separation of green crust, we choose randomly 10 fruits of each variety and experimented varieties classified in three very good, good and bad groups. The rate of fruit ripening

was determined and these varieties are divided into three groups including precious mid fruiting groups. To study Apomixy, 31 trees belong to 19 varieties were checked. In this research, three manners of Apomixy measuring methods including regular isolating with pergamin paper pocket, eliminating female flower stigma with blade and cloths bags (Satorious, 1990; Crawford, 1996). For this purpose, a number of flowers randomly was chosen and then isolated with cloths bags. Isolation of female flowers is to maintain flowers against entrance of pollen, because the stigma of not pollinated flowers maintain active in a long time. Cloth bags were soon dried. These bags were 25-45 cm in size and placed on branches that carry female flowers. To determine the rate of apomixis, a number of flowers were isolated and after three weeks bags were taken off and flowers counted and recounted after 14 days again. During harvest also the number of fruits was counted. Varieties having fruits in the bags were recognized as varieties with apomixis. The degree of apomixis was determined as number of fruit calculated to number of isolated flowers. The table of characters was done with Microsoft Excel and cluster analysis of varieties with software of SPSS. For cluster analysis, linkage manner inside group and square oglidious distance was used.

RESULTS AND DISCUSSION

Pulkau 5050 variety had maximum number of fruits (2336) while, Wieselburg had the minimum (14) (Table I). The number of fruit cannot be a good character for evaluation of mean fruit weight in walnut trees. The Pulkau 5050 variety had the maximum number of fruits but mean fruit weight of Fr2 Papiern was more than other studied varieties. Although the number of Pulkau 5050 was more than Fr2 Papiern, but the quality of Fr2 Papiern was better than Pulkau 5050 and mean fruit weight in Fr2 Papiern was nearly double of Pulkau 5050.

Cleanliness study of walnut crust shows that the majority of varieties except Geis 1242 variety were clean and acceptable (Table II). Regarding duration of fruit ripening, Killinger variety was precious. If this variety can adopt the cold areas of Iran, it can be a good type. Franquette is also introduced as a late fruiting variety (Table II).

Geis 120, Mayette, and Killinger are varieties in which their hull after ripening is easily separated, but Geis 286, Blutnuss and Parisinenne are varieties in which their hull can not be easily separated after ripening.

Studying dichogamy in of male and female flowers shows that Geis 267 and Killinger (*J. nigra*) had minimum difference (8 days) (Table I). Numbers of fruits per tree, mean yield per tree, fruit weight per tree and dichogamous behavior of flower anthesis was significantly different and this relationship was found negative. While fruit yield per tree with fruit weight hadn't significant correlation leading to the conclusion that mean fruit weight is not a good

Table I. Phenotypic measurements of trait under study in walnut varieties

Variety	Stock	number of fruit per tree	Yield (weight) per tree(kg)	Weight (g) per fruit	Flowering duration (day)
Geis 267	J.r.	726	8.10	11	21
Geis 120	J.r.	1502	20	13	15
Geis 120	J.n.	568	7.47	13	15
Geis 139	J.r.	621	6.33	10	16
Geis 1239	J.r.	751	702	9	13
Geis 175	J.r.	74	1	14	20
Geis 252	J.r.	665	5.78	9	15
Geis 286	J.r.	1078	9.28	9	11
Geis 674	J.r.	980	10.62	11	13
Blutnuss	J.n.	80	.77	10	10
Geis 1099	J.r.	1295	13.13	10	11
Geis 1247	J.r.	1489	16.39	11	11
Geis 1320	J.r.	1798	18.410	10	10
Esterhazy II	J.r.	875	10.68	12	19
Parisinenne	J.r.	1099	11.83	11	11
Mayette	J.r.	705	8.17	11	14
Franquette	J.r.	252	2.71	11	13
Pferdenuss	J.r.	895	10.5	12	11
Blutnuss	J.r.	521	6.82	13	8
Killinger	J.n.	1050	9.08	9	21
Killinger	J.r.	932	9.32	10	16
Julie Kern	J.r.	1005	8.30	8	15
Keiter s.	J.r.	519	3.72	7	20
Pferdeblutn	J.r.	93	2.23	23	16
Uss	J.r.	16	.23	14	20
Wieselburg	J.r.	1360	20.36	15	9
Fr2 Papiern	J.r.	2336	18.68	8	16
Pulkau 5050	J.n.	731	10.05	14	13
Tiszacasecsei 34					

Table II. Information about ripening, separation of hull and cleanliness of fruit's shell in different varieties of walnut

Variety	stock	Ripening	Separation of fruit hull	Cleanliness of walnut's shell
Geis 120	J.r.	Mid-fruiting	Very good	Cleane
Geis 139	J.r.	Mid-fruiting	Good	Cleane
Geis 1239	J.r.	Late- fruiting	Good	Cleane
Geis 175	J.r.	Precious	Good	Cleane
Geis 252	J.r.	Late-fruiting	Bad	Nearly cleane
Geis 286	J.r.	Mid	Good	Cleane
Geis 674	J.r.	Mid	Bad	Cleane
Blutnuss	J.r.	precious	Good	Cleane
Geis 1049	J.r.	Precious	Good	Cleane
Geis 1247	J.r.	Precious	Good	Dirt
Geis 1320	J.r.	Precious	Good	Nearly Cleane
Esterhazy	J.r.	Precious	Bad	Cleane
Parisinenne	J.r.	Late-fruiting	Good	Cleane
Mayette	J.r.	Late-fruiting	Very good	Cleane
Franquette	J.r.	Very latr fruiting	Good	Cleane
Pferdenuss	J.r.	Precious	Good	Cleane
Blutnuss	J.r.	Precious	Good	Cleane
Killinger	J.r.	Very precious	Very good	Cleane
Julie kern	J.r.	Precious	Good	Cleane
Pferdeblutnuss	J.r.	Precious	Good	Cleane
Wieselburg	J.r.	Mid-fruiting	Good	Nearly Cleane
Tiszacasecsei34	J.r.	precious	Good	Cleane

Table III. Phenotypic correlation coefficient among traits in genotypes under study

	Average number of fruit/tree	Average number of fruit/tree	Average number of fruit/tree
Yield (weight) per tree (kg)	0.94**		
Average weight (g) per fruit	-0.38*	-0.17	
Flowering Duration (day)	-0.42**	-0.44**	0.05

*: Significant at level 5%; **: Significant at level 1%

Table IV. Cluster analysis for genotypes under study

Flowering Duration (day)	Average weight (g) per fruit	Yield (weight) per tree (kg)	Average number of fruit/tree	Genotypes	Clusters
16.38	11.61	6.63	601.90	Geis139- Geis-297-Mayette- Geis1239 Tiszacsecsei 34- Geis 252- Geis 120 Tiszacsecsei2- Blutnuss-Reiter 286-Parisinenne- Geis 674 Killinger-Juliekern-Esterhazy II Weinsbery I-Pferdeblutnuss-Killinger-Pferdeblutnuss-Blutnuss-Blutnuss-Alsozentival11- Weinsberg I Tiszacsecsei56-Milotai14-Tiszacsecsei 13 Pfenenuss-Geis 175-Tiszacsecsei 172-Franquette	Cluster1
11.2	11.8	15.18	1302	Geis 120- Geis 1247- Geis1049 Fr2.Papiern- Geis 1320	Cluster 2
13	8	18.68	2336	Pulkau 5050	Cluster 3

parameter to select high yield varieties. On the basis of number of fruit per tree, fruit yield per tree, mean fruit weight per tree and dichogamous nature of flower anthesis, varieties (Table I) were put into three groups or clusters. Regarding average number of fruit per tree, Pulkau 5050 variety in cluster 3, had the highest number of fruit. This was true for mean fruit weight per tree, but regarding individual fruit weight per tree, this variety was comparable with other groups. Difference in time between male compared to other clusters. In Table IV, apomixis percentage for some of studied varieties is shown. Maximum (58%) apomixis was observed in Milotai 4/R variety and minimum (0%) apomixis in 1B, 2L, 7Z, Geis 120 varieties was observed.

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