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Fertility and Flower Cluster Position of Two Grape Cultivars (*Vitis vinifera*) in South Jordan

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Abstract: This experiment was carried out on Souri and Zeni grape cultivars during 2001-2002 seasons to determine their fertility and some other characteristics besides the position of flower cluster on shoots under head training system with four-five eyes spurs. Data showed that the two cultivars had an average of fertility 47.16% and 58.9% for Souri and Zeni during 2001-2002, respectively and these percentages can be increased by using other training and pruning systems. The position of flower cluster is a stable genetic characteristic. The climate factors had no effect on fertility and the flower cluster position and on some other characteristics of these two grape cultivars.

Key words: Fertility, relative fertility coefficient, fruitful shoots, flower cluster

INTRODUCTION

Fertility is a genetic characteristics of grapevine cultivars, which means the ability of a certain grape cultivar on formation and production of flower parts, which determine the yield (Martin, 1968; Al-Dujaili, 1980; Lopez-Miranda *et al.,* 2000). There are two types of fertility, the first is the potential fertility, which means that the formation of flower cluster inside the eye (bud) of grapevine is not visible. The second kind called real fertility, it can be indicated by the number of flower clusters are formed on the new growing shoots (Martin, 1968; Lopez-Miranda *et al*., 2000). Fertility is very important yield indicator of any certain grape cultivar.

Air temperature during the winter and the growing season is the main climatic factor may effect on fertility. There are many non-climatic factors which effect on vine fertility among them are cultivar, percentage of eye opening, percentage of fruiting shoots, number of flower cluster on the vine, the potential fertility, absolute and relative fertility coefficient of grape vine. However the fertility of the eye depend on the number of buds left on the vine after the dormant pruning (Oslobeanu *et al*., 1980). It was found that the relative fertility coefficient for Cardinal grape cultivar for 5 year was between 0.83-1.49 (Naidenov, 1977). Kalinin (1979) found that fertility coefficient for the eye was higher than for the new shoots for Riesling grape cultivar, he related this to the effect of environmental factors (temperature) or the physiological factor or both. Al-Dujaili *et al.* (1987) indicated that the relative and absolute fertility coefficient were varied due to cultivars differences.

The percentage of dead eyes is a vartial characteristic and effected by the climate condition, that percentage was 30.03-37.2 for Ceaues grape cultivar, while it was 21-40.7 and 23.5-29.7 for Chasselas and Afuz-Ali respectively (Georgescu and Dorobantu, 1967). Al-Dujaili *et al.* (1987) came up with the same conclusion when they found that the dead eyes percentage was varied according the cultivar and temperature when six grape cultivars were studied. The fertility percentage for Ceaus grape cultivar was 37-9-51.4, 63.5-71.4% for Chasselas and 35-46.3% for Afuz-Ali. Naidenov (1977), AL-Dujaili (1980) and Al-Dujaili *et al.* (1987) pointed out that the percentage of new growth for many cultivars was different due to cultivar and climate conditions interaction.

The position of flower cluster on the new shoot is different. It depends on cultivar, and it is generally between the third and the seventh node (Martin, 1968). However Winkler *et al.* (1974) indicated that about 80% of fruiting buds were between the fourth to the sixth node, flower cluster were between the sixth to the twelfth node for the new growth of grape cultivars.

Souri and Zeni grape cultivars are very well known and widely cultivated in Jordan. Traditional training and pruning system in south Jordan consists a low head –trained vine, spur (4-6 eyes) pruned. There are no information about their fertility and other characteristics under enviromental condition prevailed in south Jordan. The objectives of this research were to determine the fertility of these two cultivars and the position of flower cluster on the new growths for these cultivars.

MATERIALS AND METHODS

This investigation was conducted during 2001-2002 seasons in vineyard belong to experiment station located at the faculty of Agriculture, University of Mutah at El

–Rabba. The vineyard was planted in 1994 with many grape cultivars between them were Souri and Zeni cultivars on American rootstock resistant to phyloxera. The vine was planted at 2.5 X 2.5 m and the soil is heavy clay.

Four vines for each cultivar were used (each vine represent a replicate) where the training was head system with four, five eyes (bud) spurs (20 eye/vine). The number of new shoots, total number of fruitful shoots, number of flower clusters, number of double shoots, number of opening eyes, number of dead eyes, number of shoots with one and two fruit clusters and determination the position of flower cluster were measured. A complete Randomized block design (RCBD) was used with four replications.

Data were statistically analyzed using ANOVA and least significant differences were used to compare treatment means according to Steel and Torri (1980). The following parameters were calculated in the research:

$$\text{Fertility percentage} = \frac{\text{No. of fruiting shoots}}{\text{total No. of new shoots on vine}} \times 100\%$$

$$\text{Relative fertility coefficient} = \frac{\text{No. of flower cluster}}{\text{total No. of new shoots on vine}}$$

If the value of this coefficient is less than one this means that some of the new growth shoots on vine are unfruitful (sterile), but if this value is more than one means that some new growth shoots bear more than one flower cluster.

$$\text{Absolute fertility coefficient} = \frac{\text{No. of flower cluster}}{\text{No. of new fruting shoots}}$$

Percentage of dead eyes was calculated as follows:

No. of opening eye = No. of total shoots – No. of double shoots

No. of Dead eyes = Total No. of eyes – No. of opening eyes.

$$\text{Percentage of dead eyes} = \frac{\text{No. of dead eyes}}{\text{total No. of eyes}} \times 100\%$$

The position of flower cluster for each vine was calculated on the percentage basis of appearance of flower cluster on new shoots.

RESULTS

There were no significant differences were recorded in the values of the total number of new shoot and the total number of the fruitful shoots between Souri and Zeni cultivars in 2001 and 2002 seasons (Table 1). It can be noticed that Zeni cultivar produce the same number of new shoots in both years and higher fruitful shoots in the first season of the experiment.

Data of Table 1 clearly indicated that there were no significant differences between the two treatments (cultivars) in their number of flower clusters during the two seasons .The same data showed that there was no significant interaction between those parameters of both cultivars in the first and second season.

The two cultivars did not show any significant differences in the values of fertility percentage during the two years (Table 1), Data of the same table indicated that there were no significant differences in this parameter value for each cultivar among the two successive growing seasons 2001-2002. These values were 51.47 and 42.86%, respectively for Souri cultivar and 67.12 and 50.68%, respectively for Zeni cultivar (Table 1). In general the fertility percentage values were lower in second season compared to the first season.

Data showed that there were no differences observed between the two cultivars in both seasons in respect to relative fertility coefficient (Table 1). The values of the same parameter were not significantly different for each cultivar among the two years.

The highest absolute fertility coefficient value was obtained from Zeni cultivar in the first season, 1.33 (Table 1). No significant differences were noticed between the two cultivars during the two successive growing seasons. It seems that climatic conditions during the two growing seasons did not have any effect on the values of this parameter for each cultivar (Table 1).

The average number of double shoots, number of opening eyes, and number of dead eyes was not significantly different between the two cultivars or for each cultivar within the two seasons (Table 2).

The results of Table 3 indicated that there were not significant differences between the two cultivars in there percentage of unfruitful shoots, it can be noticed that this percent was higher in the second year compared with the first season. Data showed that the two cultivars were not differ significantly in their number of shoots which bearing one or two flower cluster.

There were some differences between the two cultivars in the position of flower cluster on new shoots, and did not follow same pattern for each cultivar in both seasons. For Souri cultivar most of its flower clusters appeared on fourth node with 31.83%, while in the second year appeared on the fifth node with 40.54 % (Table 4). There was no any flower cluster on node seventh on the second year and it was only 2.70% on the first season. It can be noticed that the flower cluster appearing on the third node was 10.8% for both years. The percentage of

Table 1: Total number of new growth, total number of fruitful shoots, number of flower cluster fertility%, relative and absolute fertility coefficient for two grape cultivars during 2001 and 2002 seasons

	Souri			Zeni		
Cultivar	2001	2002	Means	2001	2002	Means
Total no. of new growth	17.00a*	21.00a	19.00a	18.25a	18.25a	18.25a
Total no. of fruitful shoots	8.75a	9.00a	8.87a	12.25a	9.25a	10.75a
No. of flower clusters	9.25a	9.25a	9.25a	16.25a	12.00a	14.12a
Fertility %	51.47a	42.86a	47.16a	67.12a	50.68a	58.90a
Relative fertility Coefficient	0.54a	0.44a	0.49a	0.89a	0.66a	0.77a
Absolute fertility Coefficient	1.05a	1.02a	1.03a	1.33a	1.29a	1.31a

* Treatment means having a common letter in a row are not significantly different (p=0.05)

Table 2: Number of double shoots, number of opening eyes, number of dead eyes and percentage of dead eyes for a two grape cultivars during 2001 and 2002 seasons

	Souri			Zeni		
Cultivar	2001	2002	Means	2001	2002	Means
No. of double shoots	2.0a*	3.2a	2.60a	2.25a	6.00a	4.12a
No. of opening eyes	15.0a	17.5a	16.25a	16.00a	12.25a	14.12a
No. of dead eyes	5.0a	2.5a	3.75a	4.00a	7.75a	5.87a
% of dead eyes	25.0a	12.5a	18.75a	20.00a	38.75a	29.37a

* Treatment means having a common letter in a row are not significantly different (p=0.05)

Table 3: Percentage of unfruitful shoots, number of shoots with one fruit cluster and number of shoots with two fruit clusters for two grape cultivars during 2001 and 2002 seasons

	Souri			Zeni		
Cultivar	2001	2002	Means	2001	2002	Means
% of unfruitful shoots	48.53a*	57.14a	52.83a	32.87a	49.31a	41.09a
No. of shoots with one fruit cluster	8.25a	7.75a	8.00a	7.75a	5.25a	6.50a
No. of shoots with two fruit clusters	0.5a	1.25a	0.88a	4.5a	4.a	4.250a

* Treatment means having a common letter in a row are not significantly different (p=0.05)

Table 4: Positions of flower cluster on new shoots for two grape cultivars during 2001 and 2002 seasons

	Position of cluster on the new shoot % of flower cluster on node						
	2001						
Cultivar	1	2	3	4	5	6	7
Souri	0	0	10.81	31.83	24.32	24.32	2.7
Zeni	0	3.07	24.61	49.23	20	3.07	0
	2002						
Souri	0	0	10.81	32.43	40.54	16.12	0
Zeni	0	0	20.83	50.23	29.16	0	0

flower cluster on the fifth and the sixth node was 24.32 on 2001 season, but it was 32.43 and 16.21 on the fourth and the sixth node on 2002 season, respectively (Table 4).

Zeni cultivar has most of its flower clusters on the fourth node 49.23 and 50.23% in the first and the second seasons, respectively. There were no flower clusters appeared on second, sixth, and seventh node in the second year. However there was 3.07% for both the second and the sixth node in the first year. The percentage of flower clusters appeared on third node was 24.61 and 20.83% and on fifth node was 20 and 29.16% in the first and second seasons, respectively.

DISCUSSION

A comparison study for fertility percentage among the two cultivars failed to exert any significant differences, however contradicting results were obtained by Georgescu and Dorobantu (1967), Martin (1968) and Al-Dujali *et al.* (1987), who reported that the differences of cultivars in fertility percentage could be due to environmental factors especially air temperature. This parameter is affected by some other factors rather than environmental conditions, among them is the number of flower clusters on the vine and the total number of new shoots, also fertility depends on the number of buds which left after dormant pruning (Lopez-Miranda *et al.*, 2000). The result of this work indicated that there was not any significant difference between the two cultivars in their number of flower clusters and total number of new shoots. Also it can be noticed from Table (5) that there were no high differences in temperature means during the two growing seasons of 2001 and 2002 and might be this reason that these characteristics were not effected.

Relative fertility coefficient for the two cultivars in both season were lower than one (Table 1) and this means that some shoots on vine are unfruitful, (Table 3). These results are in agreement with those reported by Al-Dujaili

Table 5: Daily and Monthly Mean Temperatures during 2001 and 2002 seasons

2001

day\month	January	February	March	April	May	June	July	August	September	October	November	December
1	10.8	10.2	19	23.3	15.9	26.1	24.4	24	25.2	18.6	16.1	10.7
2	13.4	8.6	12.2	22.2	13.8	29.6	22.8	22.5	24.4	20.1	16.5	10.4
3	7.7	9.2	9.9	26.1	12.6	24.9	23	24.7	24	22.9	15.1	9.7
4	7.5	6.4	138	14.9	16.3	22.9	21	24.5	24	18.6	16.3	8.6
5	8.6	6.4	16	12.2	17.5	21.9	20.6	27.7	22.8	19.7	15.3	4.6
6	9	6.5	16	10.2	13	18.6	22.4	26.4	23.3	18.9	13.9	9.3
7	8	6.5	14.6	12.3	16.1	17.4	23.2	25.9	24.9	24.2	13.2	10
8	7.9	5	15.2	12.1	14.1	18.9	23.9	25.9	22.2	24.5	14	10.7
9	8.1	5.7	11.5	12.6	17.6	20	24	27.5	21.2	21.9	16.2	10.7
10	8.1	7.6	11.7	16.1	14.5	22.2	24.4	29.7	22.5	21.2	15.2	9.7
11	8.7	8	12.9	13	22.9	25.2	27.7	33.7	26.8	20	14.8	9.4
12	7.8	9.5	15	12.7	19.2	26.3	26.3	26.6	21.3	23.9	13.8	9.1
13	9.2	11.1	12.6	12.7	17.8	27.1	25.6	34	21.9	23.6	14.2	10.1
14	13.4	8.7	10.6	16.4	17.8	28.6	24.9	25.9	27	21.2	15.9	9.8
15	13.7	7.7	11	12.7	22.21	27	25.5	25.1	20.5	20.2	18.4	8
16	10.2	7.8	10.4	13.6	15	23.5	25.8	23.4	20.6	18.1	12.2	8.3
17	8.3	4.8	12.3	16.8	15.7	20.3	24.2	22.9	21.4	17.9	12.2	9.2
18	8.4	7.4	16.5	16.9	16.8	21.3	19.9	23.1	21.2	18	8.2	9.1
19	6.8	6.6	17.1	16.1	26	22.8	26.5	22.5	21.6	17.3	9.6	9
20	7.8	5.9	18.6	15.9	22.7	25.2	27.1	23.7	21.3	19.3	11.7	5.5
21	7	3	16.8	21.3	24.1	26.8	26.7	24.4	22.2	21	13.2	5.8
22	6.2	5.7	5.9	14.1	20.6	25.3	27.8	24.7	23.6	16	11	7.2
23	6.6	7.5	12.8	20.6	22.6	21.6	27.6	22.3	23.2	16	9.8	10.8
24	9.5	10	10.5	14.6	24.6	21.7	26.9	23.1	22.5	17.5	11.6	7.6
25	6.9	9	12	12.9	26.3	22.5	24.4	25.7	21.8	16.7	13.4	11.2
26	4.1	11.2	16	14.7	22.6	23.8	22.9	26.1	22	16.9	11.7	13.1
27	4	16.1	18	17.3	25.9	23.8	25.1	24.7	23.4	16.3	11.6	21.4
28	6.5	17.1	20.2	23.3	28	23.6	27.1	22.8	20.5	15.2	12.5	16.6
29	6.3		19.3	24.5	20.8	24.5	27.3	22.5	18.4	14.7	13.8	13.1
30	9.9		19.1	23.2	19.9	25.2	24.3	22.5	18.2	13.6	13.8	8.3
31	12.2		20.5		21.7		26	23		8.5		7.8
Average	8.470968	8.185714	14.45161	16.51	19.50355	23.62	24.81613	25.1129	22.46333	18.79032	13.50667	9.832258

Table 5: Continued

2002

day\month	January	February	March	April	May	June	July	August	September	October	November	December
1	8.3	9.1	10	12.8	14.4	19.1	25.2	32	23.1	28.7	15.1	10.1
2	8.5	9.4	11.9	7.8	13.8	18.3	25.6	28.8	23.7	24.6	15.9	10.5
3	5.7	11.1	13.1	12.9	13.8	20.4	24.8	25.8	16.9	21	15.5	11.8
4	6	9.8	15.2	10.8	15.1	18.9	22.9	24.6	21.3	18.9	17.4	11.7
5	6.8	10.7	16.4	5.4	17.7	17.2	25.3	26.5	21	18.7	16.9	13.4
6	5.5	11.9	15.8	17.3	19.3	18.6	24.1	25.8	21.4	18.7	14.5	13.6
7	2.9	13.2	16.9	13.3	19.1	24.8	26.5	25.2	20	21.2	16.1	13.4
8	2.4	13.5	16.5	11.4	18	29.8	27.3	26.4	20.7	20	18.8	15.2
9	3.4	14.2	14.8	11.6	17.5	31.5	25.8	22.9	20.8	20.7	21.9	12.6
10	1.5	16	16.8	12	21.5	27.5	26.8	21.6	26.1	21.7	17.6	9.2
11	3.3	8.6	20.6	17.6	22.2	25.4	24.8	22.6	24.7	13.9	14.2	8.2
12	3.6	8.7	16.5	11.8	22.4	21.1	24	26	28.9	28.2	14.5	8.1
13	7.8	7.6	12.3	15.8	19.7	20	24.7	27.8	21.2	27.8	13.9	6.7
14	3.9	8.1	10.5	21.8	18.3	22.3	24	26.1	21	25.4	12.2	7
15	6.1	9.4	13.1	24	15.3	22.7	24	22.6	23.5	23.4	14.6	7.4
16	6	10.3	11.6	24.1	17	22.8	26	23.5	25.6	19	13.3	8.4
17	5.2	9.4	11.5	17.9	18.5	21.5	26.6	22.1	26.5	16.8	13.8	9.6
18	7.5	7.6	13	13.5	17	21.9	27	20.6	24.9	18.4	13.2	8.6
19	6.8	10.3	13.4	13.5	16.9	22.8	26.6	25.5	19.5	20.2	13.1	9.2
20	7	7.8	9.7	12.8	17.4	21.4	25.3	22.6	28.1	20.6	13.6	7.9
21	5.8	11.4	10	13.2	20	20	25.1	21.9	22.7	17.5	15.4	2.5
22	5.3	11.8	10.5	12	21.8	21.8	23.9	21.9	22.4	16.5	17.3	4.6
23	6.1	15.1	15.1	15.2	19.2	21.8	22.9	22.5	21.8	20.8	14	6.9
24	4.9	11.6	17.1	18.6	18	21.9	24	23.6	22.8	22	12.4	6.9
25	5.5	8.5	16.2	13.5	21.9	21.8	24.1	24.5	23.9	23	10.9	7.5
26	8.2	8.5	10.3	13.4	25.3	23.4	24.8	19.2	20.8	19.6	11.8	8.3
27	8	6.4	9.5	13.4	24.8	23.3	24.7	20.4	25.1	19.7	13.2	9
28	6.8	9	6.8	11.9	19.3	22.1	26.3	24.5	25	18.2	14.9	8.7
29	6.7		5.6	14.5	16.8	22.7	29.9	24.2	25.8	18.3	9.5	10.3
30	6.5		9.6	14.5	24.3	24.6	30.6	23.7	28.9	16.8	8.8	10.7
31	7.6		13.8		23.3		32.1	22.9		14.7		7
Average	5.793548	10.32143	13.03548	14.61	19.01935	22.35667	25.66774	24.13871	23.27	20.48387	14.47667	9.193548

et al., (1987). During the two years, relative fertility coefficient was not significantly influenced by seasons between cultivars or within each cultivar. Other investigators reported contradicting result (Naidenov, 1977; Oslobeanu, 1980; Al-Dujaili, 1980; Lopez-Miranda *et al*., 2000), while comparing this parameter between cultivars.

The value of absolute fertility coefficient, during the two seasons, were more than one (Table1), this indicates that there were some shoots had more than one flower clusters (Table 3). The finding of this work related to this parameter was in disagreement with those indicated by Martin (1968), Al-Dujaili (1980) and Al-Dujaili *et al*. (1987). This contradiction can be due to differences in genetic make-up of cultivars, then number of flower cluster and the number of new fruiting shoots during the two seasons and also due to differences in the training and the dormant pruning methods (El-Hammady, 1995) and (Shtat, 1992).

The two treatments (the two cultivars) and the interaction of growing season failed to show any significant influences concerning the following parameters: the total number of new shoots, total number of fruitful shoots, number of flower cluster, number of double shoots, number of opening eyes, number of dead eyes, number of new shoots with one flower cluster, and number of shoots with two flower clusters. These results are disagreement with those reported by Naidnov (1977), Kalinin (1979), Al-Dujaili (1980) and Al-Dujaili *et al*. (1987), who referred that the differences in these characteristics were due to cultivars and the environmental condition during growing season. The contradiction results of this study are expected due to differences in environmental condition and variation in cultivars, training and pruning methods.

It appeared from the results related to position of flower cluster that this parameter is restricted to the genetic factors of the cultivar, and the climate factors had a little effect on it.

Based on the results of this experiment during two seasons it can be concluded that all characteristics have been studied are genetically stable and climat conditions had no effect on them. It can be recommended for new planting for these two cultivars to increasing the vine bud (eye) load by using T–trellis, arbor or cane training system to increase the fertility (yield) of these two cultivars.

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