AN INVESTIGATION ON THE BUD-BREAK AND GROWTH OF CUTTINGS OF 420 A AND 5 BB AMERICAN VINE ROOTSTOCKS IRRADIATED WITH DIFFERENT GAMMA DOSES

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ABSTRACT

Viticulture is an important and intensive agricultural branch in Çanakkale province and also in Turkey. Different American vine rootstocks are widely used against phylloxera in our country. Plant breeders have been using gamma radiation for creating new varieties of crops and for obtaining broad genetic diversity for years. In this study, four different doses of gamma rays were applied to 420 A and 5 BB American vine rootstocks when the buds on the cuttings were at the dormant stage. Then, effects of different gamma radiation doses on the cuttings of 420 A and 5 BB American vine rootstocks were investigated. The aim of the research was to study the effect of different gamma radiation doses on some growth parameters of cuttings of 420 A and 5 BB, and to determine the GR_{50} dose. The results obtained were statistically elaborated by TARIST.

KEY WORDS: American vine rootstock, nursery cutting, gamma radiation, GR_{50} dose.

INTRODUCTION

Grapes, Vitis vinifera L. and other genera of the family Vitaceae, are widely distributed in the tropics and subtropics with ranges extending into the temperate regions [1]. Viticulture is one of the most important agricultural practices, and about 3.850.000 tons of fresh grapes are produced in about 565.000 ha vineyards in Turkey [2]. However, almost all soils of Turkey are contaminated by phylloxera (Viteus vitifolii Fitch.) as a pest. In these problematic areas, as it is not possible to grow up the culture grapevine on its own roots, grafting technique especially on American vine rootstocks, which are resistant against phylloxera, has become widespreadly used in Turkey [3].

Phylloxera has been seen on grapevines in the province of Çanakkale located at the northwest part of Turkey since the beginning of 1930s. But these damaged grapevines in the province were renewed by means of new varieties in a short period. Nowadays grape varieties for table and wine are widely grown in the province, American vine rootstocks such as 5 BB, 99 R, Rupestris du Lot and 420 A have been used as rootstocks for culture varieties [4].

It is stated that although culture grapevine (Vitis vinifera L.) has no selectivity of soil, American vine rootstocks that are used as a cultural prevention method against the phylloxera pest, have selective characteristics [5, 6]. American vine rootstocks show different resistance levels to lime, salinity, aridity, diseases, phylloxera, nematode etc. In addition to this, affinity with culture varieties, rooting and adaptation capacities are quietly different from each other. Therefore, besides selectiveness of present American vine rootstocks is limited, breeding studies are required to obtain rootstocks that provide a better affinity with present varieties and a better adaptation.

Natural mutations and traditional breeding methods have been used to develop new genotypes that are superior with respect to some agronomic characteristics, high quality and more resistant to extreme conditions. As natural mutations appear in a long time period, so many researchers have carried out various studies on different plant varieties to constitute artificial mutations, which are easier, cheaper and more variable [7, 8, 9, 10, 11].

Selection of appropriate genotypes from positive or negative variations occurred by different mutagen doses is the main principle of mutation breeding. In general, vegetative and generative parts of plants such as cutting, tuber, stem, seed etc. are used in mutation applications. It is of great importance in determination of suitable mutagen doses, which have lower physiological damage and higher genetic effect and variations. According to determined appropriate dose, mutants selected from variations can be used directly as a new variety as well as plant material for hybridisation studies.

The objective of the study was to examine the effects of different gamma radiation doses on the bud-break and growth of cuttings of 420 A and 5 BB American vine rootstocks and to determine the GR_{50} doses that reduce the shoot height 50 % compared to the control samples.

MaterIals and Methods

The nursery cuttings of 420 A and 5 BB American vine rootstocks obtained from Canakkale Fruit Production Station, Agriculture and Rural Affairs Ministry and the cuttings were cut having five buds in December, 2002 [12]. Then, they were kept in 0.1 mm thick plastics bags, and stored at 4 ºC for 2 months. 20, 25, 30 and 35 Gy gamma radiation doses were then applied to the cuttings on April 12, 2002. Irradiation of the cuttings was carried out at Istanbul University, Capa Medical Faculty by means of blood ray apparatus, IBL 437 C, (5100 Ci source power). The cuttings stored at 4 ºC before and after the radiation treatments, were cut in pieces and each had two-buds in 10-12 cm long. After discarding lower bud from these two-buds cuttings, 7-8 mm thick ones were selected to use in the study. They were then planted in propagation boxes containing perlite and placed in a glasshouse after the treatment.

420 A and 5 BB American vine rootstocks were planted at 4 x 4 cm density in plastics boxes (40x50x20 cm) containing perlite (3 mm particle size), and arranged in a randomised plot experimental design in four replications. Each replication consisted of 18 cuttings with two buds. The plastics boxes were fertilized at planting with 15 g/box N-P-K as 15-15-15 %. The cuttings kept in a glasshouse for three months at 25±3 ºC were observed weekly. The two-buds cuttings were planted out on July 9, 2002 and then the values of bud-break percentage, average shoot height, average number of nodes, average internode length, number of days up to 40 % bud-break, vigour, average number of roots, and rooting percentages were determined. The lengths of internodes and shoots were measured by electronic compass. Vigour was determined according to a 0-5 scale (0: dormant bud, 1: hair formation on the bud, 2: bud-break on primer bud, 3: 1-2 leaves, 4: 3-4 leaves, 5: 5-6 leaves).

Statistical analysis of the data was carried out using TARIST computer package programme for each of American vine rootstocks [13].

RESULTS AND DISCUSSION

Four different gamma radiation doses applied to the cuttings of American vine rootstocks resulted in prolongation of bud-break times as compared to control samples. Bud-break percentages of 420 A and 5 BB

American vine rootstocks between 1 st and 8 th weeks are shown in Figure 1 and Figure 2, and vigour of the rootstocks between 1 st and 8 th weeks are shown in Figure 3 and Figure 4. 30 and 35 Gy radiation treatments significantly decreased the bud-break percentage and values of vigour of the cuttings.

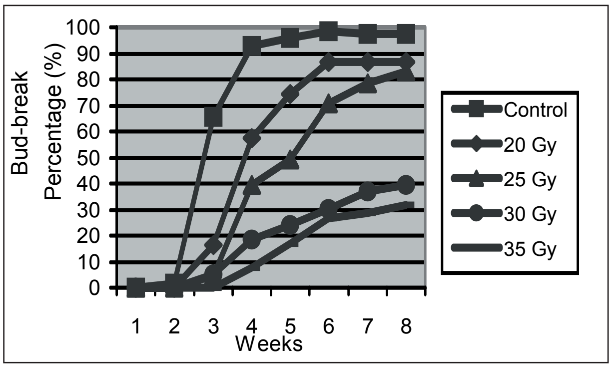

Figure 1: Bud-break percentage (%) of 420 A American vine rootstock between 1st and 8th weeks

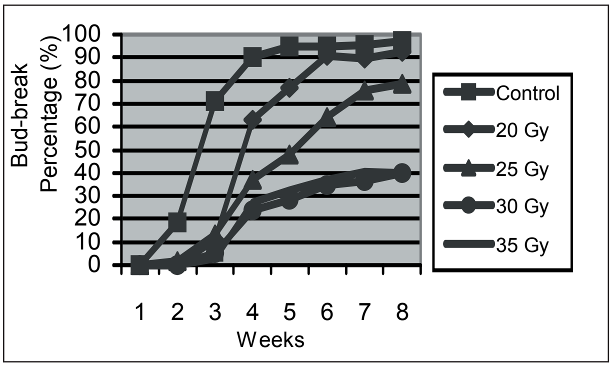

Figure 2: Bud-break percentage (%) of 5 BB American vine rootstock between 1st and 8th weeks

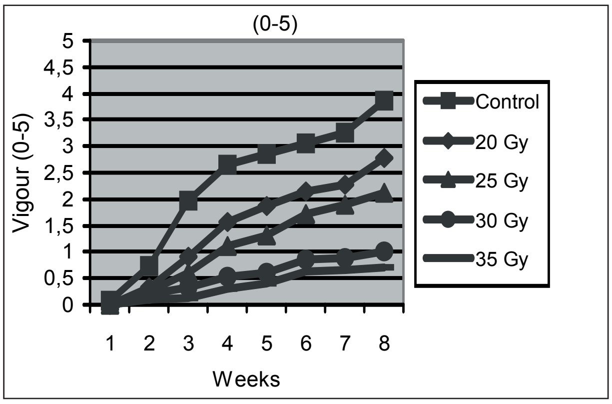

Figure 3: Vigour of 420 A American vine rootstock between 1st and 8th weeks

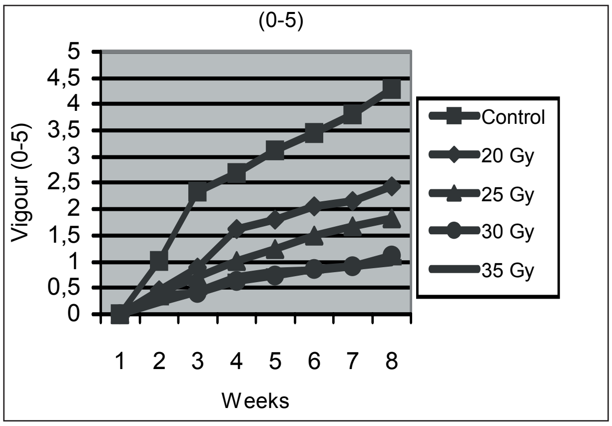

Figure 4: Vigour of 5 BB American vine rootstock between 1st and 8th weeks

Effects of four different gamma radiation doses applied to the cuttings of American vine rootstocks on the bud-break percentage, average shoot height, average number of nodes, average internode length, number of days up to 40 % bud-break stage and vigour are shown in Table 1.

Depending upon increasing radiation doses, bud-break percentages decreased and internode lengths also significantly decreased. Moreover, average number of nodes declined as well (Table 1).

Having planted both irradiated two-buds cuttings of 420 A and control samples on the same time, we observed that the control samples shooted 14 days later after plantation. Furthermore, differing bud-break times of the irradiated cuttings of 420 A were 22,3 days at 20 Gy, 28 days at 25 Gy and 44 days at 30 Gy. Bud-break time could not be determined for 35 Gy, the highest dose, since the time did not reach up to 40 %. Number of days from planting to 40 % bud-break of 5 BB was 12,5 days for the control samples whereas, it was occurred 22 days at 20 Gy, 29,3 days at 25 Gy, 42,8 days at 30 Gy and 43 days at 35 Gy. As a result, it was found that all the parameters as seen in Table 1 were highly significant ($P<0.01$).

In this research, rooting percentage of control samples of 420 A was 33,3 % and average number of roots was 5,09 whereas rooting at increasing radiation doses did not occur. For control samples of 5 BB, the results were 91,17 % and 13,67 whereas rooting percentages and average number of roots were 33,99 % and 4.9 % for 20 Gy and 7.03 and 1,38 for 25 Gy. Root development at 30 and 35 Gy radiation treatments did not occur. With increasing radiation treatments, spot-sclerosis was found on the leaves. In addition, the folia become smaller and asymmetric development and deformations were observed.

As a result, application of high gamma radiation doses had significant effects on the vegetative development

Table 1. Effects of different gamma radiation doses on the cuttings of 420 A and 5 BB American vine rootstocks

American vine rootstocks	Doses (Gy)	Bud-break percentage (%)	Average shoot height (mm)	Average number of nodes	Average internode length (mm)	Number of days up to 40 % bud-break	Vigour (0-5) [1]
420 A	Control	98.61 a	36.93 a	2.952 a	12.47 a	14.0 c	3.864 a
	20	88.20 a	25.18 b	2.198 bc	11.43 ab	22.3 bc	2.774 b
	25	82.84 a	23.07 bc	2.254 b	10.22 bc	28.0 b	2.113 b
	30	45.31 b	15.71 cd	1.721 cd	9.16 cd	44.0 a	1.012 c
	35	37.13 b	10.63 d	1.258 d	8.45 d	--	0.711 c
	LSD	16.53 **	7.83 **	0.530 **	1.66 **	10.299 **	0.723 **
5 BB	Control	96.83 a	88.12 a	4.333 a	20.33 a	12.5 c	4.300 a
	20	92.37 a	29.77 b	2.471 a	12.09 b	22.0 bc	2.424 b
	25	79.82 a	19.34 c	1.979 bc	9.78 bc	29.3 ab	1.829 c
	30	46.69 b	15.02 c	1.461 d	10.32 bc	42.8 a	1.105 d
	35	42.17 b	14.26 c	1.487 cd	9.62 c	43.0 a	0.998 d
	LSD	22.104 **	9.22 **	0.504 **	2.34 **	13.974 **	0.594 **

[1]The values of vigour (0-5) were obtained at the end of 8th week.

** Significant at 0.01.

parameters of the cuttings. The results obtained from this study were in accordance with findings of some other researchers [14, 15, 16]. Increased radiation doses had damages on the cuttings of the rootstocks. GR_{50} doses were found to be 28,13 Gy for 420 A and 15,10 Gy for 5 BB. It was determined that 20 and 25 Gy or lower gamma radiation doses are suitable for 420 A and 20 Gy or lower doses are suitable for 5 BB. These results could be used for future mutation breeding programmes or give rise to broad variations. However, appropriate doses should be determined for other varieties or species.

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