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PLANT INDUSTRY

Effects of Gamma Irradiation Times on Some Flowering Characteristics and Pest Resistances in Two Almond (*Prunus amygdalus* L.) Cultivars[1]

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Abstract—This study was conducted to evaluate the effects of different gamma-radiation exposition times on some biological traits of two late-blooming almond cultivars of "A200" and "Sahand". Current season shoots of "A200" and "Sahand" were exposed to 36 μC gamma-radiation for 0, 5, 10, 30 and 150 minutes. The experiment was carried out on 4-years old trees based on completely randomized design. Analysis of variance showed that buds break date, bearing type, leaf area, resistance to aphid and mite as well as *Polystigma* were significantly influenced by different gamma irradiation times ($p < 0.05$). There were significant differences between two cultivars for bearing type, leaf area, and resistance to pests ($p < 0.05$). 30 minute gamma irradiation was increased buds break date and in this treatment, mutated trees had very late bud break date and they were late flowering habit. Gamma irradiation treatments were changed bearing type. The highest leaf area was achieved on 150 minute gamma irradiation. Short and long time treatments had not efficiency on improving resistance to *Polystigma*. The highest resistance to aphid and mite were observed on 150 minute gamma irradiation. Two studied cultivars were relatively resistance to aphid (control), but mutated trees had tended to resistance to aphid. Mutated trees had medium to relatively resistance to mite. Therefore, gamma irradiation treatments can be improved high considerable resistance to mite.

Keywords: Almond, gamma-irradiation, bud break date, pest resistance

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INTRODUCTION

Almond is one of the most important nut fruits produced in Iran which ranks 4th, among major almond producing countries. The majority of almond breeding programs in Iran is focused on cultivars with important traits such as late-blooming, frost resistance, increased self-fertility, resistance to diseases and pests, high yielding potential and good growth habit. Mutations induced by chemicals and physical agents such as α, β, X, gamma, and other irradiations have been experienced by many researchers for tree fruit breeding [2], Some irradiation induced mutant cultivars with favorable traits have been reported for apple [7], cherry [6], peach [4], apricot [3] and almond [10]. Lapins [7] reported a new gamma irradiated induced mutant of "Macintosh" apple with resistance to "*podospharea leucotricha*" and "*Venturia inaqaulis*". Monastra et al. [9] irradiated the scions of "Fascionello" almond by 3 Kr gamma-rays from Co^{60} and afforded a new mutated cultivar "supernova" with late-flowering habit, increased shelling percentage and improved self-fertility characteristics.

The aim of the present study was to evaluate the effects of 36 μC (Micro Cowry) gamma-ray at different times on some biological traits (flowering date in spring and resistance to diseases and pests) in two late-blooming almond cultivars.

MATERIALS AND METHODS

One-year old shoots of "A200" and "Sahand" almond cultivars were separated to 5 groups and irradiated by 36 μC (Micro cowry) gamma-ray at 0, 5, 10, 30 and 150 minutes from Co^{60} in nuclear partition of Science Faculty, the University of Tabriz during early spring. The irradiation treated shoots were grafted on "Azar" seedling rootstock. Grafted unions allowed to growth for one subsequent year in nursery conditions. Then after 267 trees were translocated to main garden in Sahand Horticultural Research Station in Azarshahre, Tabriz. The trees were planted in 4 east-west rows in a sandy-loam soil. All of the growing and horticultural practices such as irrigation, nutrition and weed control were same for all trees. Some biological traits were noted for grafted trees according to the almond descriptor. Buds break date was categorized as extremely late = 9, very late = 8, late = 7, medium to late = 6, early = 3, and very early = 2. Leaf area was measured with LAM for 30 leaves of all trees. Bearing type was recorded in spring as on current shoot = 1, on

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Table 1. Mean comparisons for some biological traits of two almond cultivars affected by different gamma irradiation times

Gamma irradiation times (min)	Bud break date	Bearing type	Leaf area	*Polystigma* resistance	Aphid resistance	Mite resistance
Control	5.5 b	2.1 b	321.2 bc	3.5 a	3.0 b	6.8 c
5	5.7 b	2.6 a	231.8 c	4.0 b	2.8 ab	4.3 b
10	5.4 b	2.5 a	334.8 b	3.2 a	2.7 ab	4.2 b
30	7.4 a	2.5 a	318.6 be	3.4 a	2.7 ab	4.3 b
150	5.2 b	2.5 a	488.5 a	3.2 a	2.6 a	3.0 a

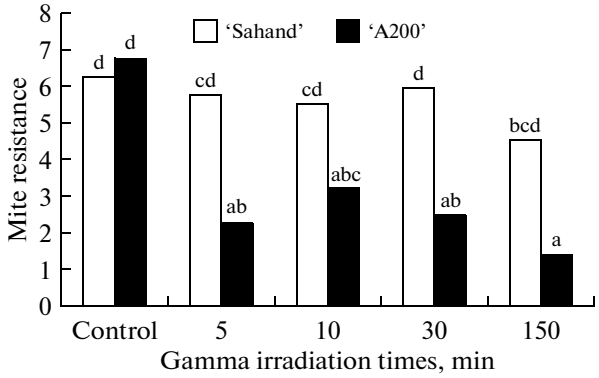
Note: Different letters in columns show significant difference based on Duncan's New Multiple Range Test ($p < 0.05$). *Polystigma*, aphid and mite resistance were grouped into non resistance = 7, medium resistance = 5, relatively resistance = 3 and resistance = 1; Buds break date were categorized as extremely late = 9, very late = 8, late = 7, medium to late = 6, early = 3, and very early = 2; Bearing type was recorded in spring as on current shoot = 1, on spore = 2 and Mixed = 3 according to almond descriptor.

Table 2. Mean comparisons for some biological traits of two almond cultivars affected by gamma irradiation

Cultivars	Bud break date	Bearing type	Leaf area	*Polystigma* resistance	Aphid resistance	Mite resistance
"Sahand"	5.39 a	3.01 b	262.6 b	5.69 b	3.01 b	5.48 b
"A200"	6.73 a	2.13 a	413.3 a	1.09 a	2.44 a	3.01 a

Note: Different letters in columns show significant difference based on Duncan's New Multiple Range Test ($p < 0.05$). *Polystigma*, aphid and mile resistance were grouped into non resistance = 7, medium resistance = 5, relatively resistance = 3 and resistance = 1; Buds break dale were categorized as extremely late = 9, very late = 8, late = 7, medium to late = 6, early = 3, and very early = 2; Bearing type was recorded in spring as on current shoot = 1, on spore = 2 and Mixed = 3 according to almond descriptor.

spore = 2 and Mixed = 3. Resistance to aphid (*Brachycaudus amygdalinum*), mite (*Panonychus ulm*) and *Polystigma occharaceum* were grouped into non resistance = 7, medium resistance = 5, relatively resistance = 3 and resistance = 1 according to almond descriptor. Experimental design was conducted to factorial arrangement based on completely randomized design. Data was analyzed by SAS (Ver. 6.1). Mean comparisons were carried out by Duncan's New Multiple Range Test at 5% probability level.



Mean comparisons for mite resistance of two almond cultivars affected by different gamma irradiation time. Mite resistance were grouped into non resistance = 7, medium resistance = 5 and relatively resistance = 3 according to almond descriptor.

RESULTS AND DISCUSSION

Analysis of variance showed that buds break date, bearing type, leaf area, resistance to aphid and mite as well as *Polystigma* were significantly influenced by different gamma irradiation times ($p < 0.05$). There were significant differences between two cultivars for bearing type, leaf area, and resistance to *Polistigma occharaseum*", as well as resistance to aphid and mite ($p < 0.05$). Lapins [7] reported a new mutant "Mclntash" apple (Macintosh 8f-2-32) with resistance to "*podosphaera Leucotricha*" and "*Venturia inaequalis*". Akhund Zadeh [1, 2] and Kikacheishvili [5] reported new cherry gamma and X-rays induced mutants resistant to *Coccomyces hiemalis*.

Significant difference was observed between 30 minute gamma irradiation and control for buds break date, but other gamma irradiation times were not difference with control for this trait. 30 minute gamma irradiation was increased buds break date and in this treatment, mutated trees had very late bud break date and they were late flowering habit. Significant differences were observed between control and gamma irradiation treatments for bearing type. Gamma irradiation treatments were changed bearing type and some of mutated trees had mixed or spore bearing type (Table 1).

Mean comparisons revealed that increasing the gamma irradiation times increased leaf area and the highest leaf area was achieved on 150 minute gamma irradiation. Resistance to *Polystigma* in 5 minute gamma irradiation was significantly lower than control and other gamma irradiation times. Therefore, short

and long time treatments of one-year old shoots by gamma irradiation had not efficiency on improving resistance to *Polystigma*. Resistance to aphid and mite were significantly difference between gamma irradiation treatments and control. The highest resistance to aphid and mite were observed on 150 minute gamma irradiation. Non significant difference was existed among other gamma irradiation times for resistance to aphid and mite. Two studied cultivars were relatively resistance to aphid (control), but mutated trees had tended to resistance to aphid. Therefore, gamma irradiation treatments were useful for increasing resistance to aphid. Control trees were non resistance (or susceptible) to mite, but mutated trees had medium to relatively resistance to mite. Therefore, gamma irradiation treatments can be improved high considerable resistance to mite (Table 1).

Table 2 shows that except for bud break date, all of the other traits in "A200" were better than "Sahand". Mean comparisons for gamma irradiation times × cultivars indicated that increasing gamma irradiation times raised resistance to mite in "A200" but it had a little effects on "Sahand" (figure). LeGava and Garacia [8] and Monastra et al. [10] introduced almond mutants with dwarf growing and late flowering habit from irradiation of Ferrgnes, Pizzuta Avola and Fascionello cultivars. Unlike above scientists' reports, bud brack date of both "A200" and "Sahand" were similar affected by gamma irradiation times.

CONCLUSIONS

Our study was conducted on 267 gamma irradiated trees from "A200" and "Sahand" almond cultivars achieved by different gamma irradiation times for obtaining the mutant trees with useful characteristics for using future almond breeding programs. Gamma irradiation times were significantly influenced studied traits but they were mainly improved on bud break date and leaf area, as well as resistance to mite. Results showed that long exposition times had significant positive effects on only bud break date, leaf area and resistance to mite. Therefore, breeder can be able to selection late flowering habit trees with high resistance to mite.

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