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Effects of Different Plant Growth Regulators and Time of Pruning on Yield Components of *Rosa damascena* Mill.

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ABSTRACT

Damask rose (*Rosa damascena* Mill.) is an important essential oil yielding crop in Iran. In order to determine the best pruning time and effect of different plant growth regulators, three different times of pruning with seven types of growth hormones were assessed. Pruning time at 1st week of March significantly affected on plant height and flower yield but not on oil content. The longest flowering period was associated with pruning time at the 1st week of April although this treatment significanly lowered flower yield and shortened plant height. Alar, Kinetin, NAA and Cycocel application increased while GA_3 decreased flower oil content in compare to control and also showed the shortest flowering priod among treatments. Intraction effects were not significant between two factors.

Key Words: *Rosa damascena* Mill; Pruning time; Hormones; Yield

INTRODUCTION

Damask rose (*Rosa damascena* Mill.) is an important essential oil yielding crop (Elison, 1999). Genetically research on determining origin of Damask rose was started since 1940s. According to Iwata *et al*. (2000) three parental species have been identified as ancestors of *Rosa damascena* Mill. The rose oil, obtained from the flowers on distillation condition, is used in perfumery and cosmetic industries (Farooqi *et al.*, 1994; Scarman, 1996). Essential oil or rose water is produced by water or steam distillation from fresh petals. Rose water, a by-product of distillation, is used as a coolant and as a flavoring agent in sweet and meat preparations (Singh & Ram, 1987) and also uses in Moslems religious custom.

This crop is cultivated in different countries and annual world production of its oil is around 15-20 tons (Lawrence, 1991; Farooqi *et al*., 1993). The low flower yielding and oil are the main problems for rose growers (Sharma & Farooqi, 1990). Plant growth regulators have gained wide acceptance for optimizing the yield of plants by modifying growth, development and stress behaviour (Shukla & Farooqi, 1990). Synthetic plant growth regulators, such as Auxins, Cytokinins and various growth retardants when applied exogenously to the plant, influence various aspects of plant development and biosynthesis of its important components (Shukla & Farooqi, 1990; Kewalanand & Pandy, 1998).

Control of flowering is one of the most important practical aspects in application of plant growth regulators. There are many examples of utilization of plant growth hormones to regulate the flowering in aromatic plant (Shukla & Farooqi, 1990), for example, application of Ethrel (2-Chloroethyl phosphonic acid), NAA (Naphthalene acetic acid) and Kinetin improved flowering in *Jasminum Sambac* and *Rosa damascena* (Farooqi & Sharma, 1988; Sharma & Farooqi, 1990; Farooqi *et al.*, 1993). Furthermore, Cycocel and GA_3 (Gibberellic Acid) effectively increased yield and quality (eugenol, methyleugenol and caryphylline content) of oil in *Ocimum basilicum* (Shukla & Farooqi, 1990).

In rose, pruning is necessary not only to ease the harvesting flowers and other inters cultural practices but it also known to influence its yield (Paul *et al.*, 1995). Pruning seems to affect both morphological as well as yield parameters in roses (Paul *et al.*, 1995). As holds true for ornamental rose plant, pruning has been found to be fruitful even in case of the aromatic rose (Blacker, 1995). In the present investigation, the effects of pruning time and also six types of plant growth regulators are reported on flower and oil production in *Rosa damascena* Mill.

MATERIALS AND METHODS

This study was conducted on seven–year–old plants *Rosa damascena* Mill. During 2001-2002 in the field of the Zahra rose water Institute at Lalehzar plateau in Kerman province, Iran. Lalehzar slopes are arid, highland region in an altitude of 3200 m above sea level. The flowers receive additional benefits of specific geographical condition in this area during hydro distillation process, when extraction takes place at lower temperatures. At that altitude, the boiling point is lower and much of the aroma is kept intact (Jeffries, 2001). The field soil was sandy loam, alkaline with pH of

7.9 and medium in fertility.

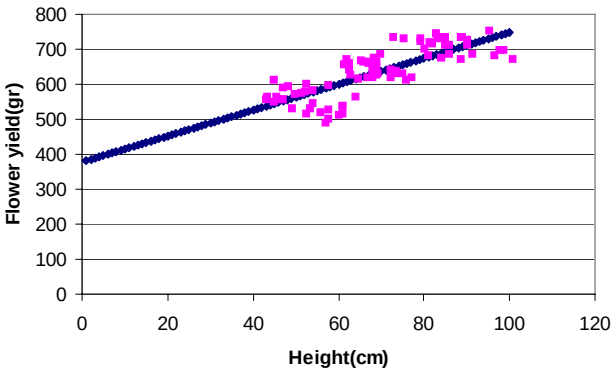
With due attention to pruning and growth hormones are two effecting factors on quantitative and qualitative traits of damask rose flower and essential oil, this experiment was conducted in a frame of factorial experiment with RCBD design laid out by two factors in four replications. "A" factor that was time of pruning from 40 cm above ground in three levels including: at the 1st week of March, at the 1st week of April and a control (without pruning). "B" factor that was plant growth regulators in seven types including: Acid Gibberellic (50 mg L^{-1}); Ethrel (1000 mg L^{-1}); Kinetin (25 mg L^{-1}); NAA (25 mg L^{-1}); Cycocel (3000 mg L^{-1}); Alar (5000 mg L^{-1}); control. These growth regulators were applied at vegetative, bud formation and flowering stages of the plants. Tween-80 (0.01%) was used as a wetting agent. Data collected at the time of flowering, during mid–May to mid-June (23 to 27 days). Characters included plant height, oil content, flower yield and flowering duration. The oil content was determined by hydrodistillation using a Clevenger apparatus, and it was expressed on fresh weight basis in which 1000 g sample was taken and distillation process was carried out by slow heating during four hours.

Analysis of variance on field data was done using SAS (Statistical Analysis System) with GLM procedure. Duncan's multiple range tests was used to compare the significant differences among various treatment means. Results are presented in the frame of text, figure and table.

RESULTS AND DISCUSSION

Analysis of variance showed that the time of pruning as well as plant growth regulators had significant effects on flower branch height ($P<0.05$). Pruning at the first week of March (about 75 days before flowering) led to more growth length than control. Wherease, pruning at the first week of April (about 45 days before flowering) caused shorter height of flower branch than control. These results showed that an adequate time is necessary in which branches can grow longer enough having more flower buds resulting in higher yield. Similar result was also reported by Paul *et al.* (1995). As it was expected, GA_3 made higher branches formation among evaluated hormones and both growth retardants namely Alar and Cycocel made shorter branches (Table I).

Fig.1. Linear simple regression of flower yield and plant height



Results showed that the time of pruning was not affected on petal oil contents ($P>0.05$), but among applied hormones, Kinetin, NAA, Alar and Cycocel increased significantly petal oil contents, wherease GA_3 decreased (Table I). Similar results were reported by Farooqi *et al.* (1993, 1994). GA_3 caused decreasing in oil contents of flower than control. It could be emphasized that GA_3 could act as a factor affecting on assimilate convey toward vegetative parts instead of flowers resulting in decreasing oil construction of flowers.

Analysis of variance indicated that the effects of two mentioned factors were also significant on flower weight ($P<0.05$). In relation to yield amount, pruning at first week of March was the best time. This result showed the necessity of a minimum time for new flower branches to form. On the other hand, Kinetin, NAA, Alar and Cycocel caused higher amount of flowers in plants rather than other treatments and also control (Table I). Farooqi *et al.* (1993) reported the same result for Kinetin application on Damask rose in India. The longest flowering period was related to pruning at the 1st week of April although had no positive effect on flower yield. In fact, late pruning time (near to flowering time) caused longer flowering period that was

Table I. Effects of various growth hormones and different pruning times on some traits of *Rosa damascena* Mill.

Treatment	Plant height (cm)	Oil content (mg/kg)	Flower yield/ Plant (g)	Average flowering period (days)
Pruning time "A"				
At 1st week of March	86.5a	0.58a	711.1a	22.9b
At 1st week of April	52.6c	0.57a	551.7c	26.1a
Control (without pruning)	68.6b	0.57a	642.1b	22.5b
Growth hormones "B"				
GA_3 (50 mg/L)	77.5a	0.50c	610b	22.3b
Ethrel (1000 mg/ L)	71.8b	0.53b	610.8b	24.5a
Kinetin (25 mg/L)	69.2b	0.62a	660.7a	23.7a
NAA (25 mg/ L)	70.4b	0.62a	650.1a	23.9a
Cycocel (3000 mg/ L)	64.3c	0.61a	646.8a	24.1a
Alar (5000 mg/ L)	63.2c	0.61a	650.8a	24.2a
Control	69.2b	0.54b	615.7b	23.9a

Means followed by similar letters are not significantly different from each other according to Duncan's test

possibly due to late flower bud information. Among plant growth regulators, GA_3 showed the shortest flowering period than others (Table I). It can be assumed that GA_3 application made vegetative buds to be strong sinking point in compare to flower buds that decreasing in amount of flower bud and eventually flowering period.

Interaction effect between two factors was not significant (P>0.05). Significant positive correlation found between flower yield and plant height (r=0.81). Regression linear model was fitted as below formula (Fig 1).

$$y=376.9+3.73x; \text{ x=plant height}$$
$$R^2=0.64; \text{ y=flower yield}$$

CONCLUSION

With considering winter frost, the proper time of Damask rose pruning should be at least 70 days prior to flowering to catch up appropriate branch growth and also flower bud formation. Authors suggest utilizing growth hormones such as Kinetin, NAA, Alar and Cycocel to increase oil content of petal and flower yield, although, more research programs are needed to optimize different concentration and time application of mentioned hormones on this plant.

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