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Yield and Quality Management of *Rosa hybrida* 'Poison' with Plant Growth Regulators

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Abstract: This study evaluated the effects of different levels of salicylic acid (SA) (50, 100, 150 and 200 mg l^{-1}), gibberellins (GA_3) (150, 200, 250 and 300 mg l^{-1}) and cycocel (CCC) (500, 1000, 1500 and 2000 mg l^{-1}) at pre-harvest period on the quality, yield and vase life of rose (*Rosa hybrida* 'Poison'). Treatments were compared with control plants (distillation water). Results showed that the effects of plant growth regulators on bud length, vase life and yield were significant at $P \leq 0.05$ and on fresh weight and flower height were significant at $P \leq 0.01$. The highest yield was obtained in 200 mg l^{-1} GA_3 with 192 cut flowers per year per m^{-2} and the highest vase life was obtained from 150 mg l^{-1} SA (12.67 days). 300 mg l^{-1} GA_3 with 49.33 cm flower height was the best between treatments.

Key words: Gibberellin · Salisylic acid · Cycocel · *Rosa hybrida* · Quality · Yield

INTRODUCTION

Rose is one of the most popular flowers that are used as a pot and cut flower. Yield and quality improvement are the aim of florist to achieve. The lowest yield in the area unit and low quality are two problems in Iran compared to other countries such as the Netherlands, Colombia, Kenya and USA. It may be overcome by optimizing of production conditions and the use of plant growth regulators (PGRs). Good quality production is required to manipulate in growth factors including light and temperature, which is very difficult and expensive. Since, plant flowering and growth depended in PGRs equilibrium, however, it is expected to control the plant responds hormonal balance changing [1]. Plant growth retardants are one of the most effectiveness PGRs that are exceedingly applied in ornamental plants. These compounds delay cell division and growth in the beneath apex, but they do not have any effect on meristem [2] and reduce growth without any change on shape, leaves and shoot numbers. These compounds may increase yield and quality of cut flower via controlling plant height, acceleration of flowering and increasing of flower primordia [1, 2]. Gibberellins, especially gibberellic acid (GA_3) play an important role in the growth and development of plants. Gibberellins are a rather diverse group of plant substances that enhance any physiological or biochemical process in plants. The use of GA_3 for boosting the growth and vigor of various horticultural plants is very old and well documented [3]. GA_3 improves yield and quality of ornamental plants via plant growth incitation and stem elongation [4]. Arun *et al.* [5] studied the effects of different levels of GA_3 on growth and flowering of rose "First red" and found that GA_3 could improves plant and flower neck height, as well flowering stalk. They observed that all treatments increased bud length, flower diameter and produce the most cut flowers in unit area. GA_3 enhances plant growth and internode length by increasing the cell division and enlargement, also increase cell size, stem height, stem thickness and number of leaves. In other studies on the effect of GA_3 on ornamental plants showed that, GA_3 accelerated flowering and enhanced plant height [3].

Abdi *et al.* [6] showed that the salicylic acid caused a significant increase on the plant density and dry weight of root and shoot. Spraying maize plants '*Single hybrid'* 10 with SA increased dry weight of stem, leaves and whole plant [6]. SA increased the most amino acids, except methionine, in the plants [7]. SA plays an important role in the resistance of old leaves against pathogens, which acts as an induction signal for specific defense responses of plants. It acts by producing low weight proteins which play an interesting role in the resistance [4, 8].

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Plant growth retardants are biggest group of PGRs in floriculture industry. Bhattacharjee and Singh [9] evaluated the effect of daminozide and CCC on rose 'Raktagandha' and observed that these compounds had significant effect on vegetative growth and flowering caused to hosten first bud manifestation, increasing bud length, flower diameter and yield of cut flowers till 9%. Hisamatsu *et al.* [10] controlled the height of *Pyracantha coccinea* 'Kasan' and 'Lalande' by CCC. On other hand, paclobotrazol and CCC, two plant growth retardants, caused to consuming less carbohydrate for shoot growth of pelargonium 'Red elite' [11].

This experiment was carried out for evaluation of different levels of GA_3, SA and CCC on the quality and yield of rose 'Poison'.

MATERIALS AND METHODS

Two years old roses 'Poison' were planted in 70% cocopeat and 30% perlite (v/v). They were pruned 5 times and sprayed 30-40 days interval with PGRs. This experiment carried out in greenhouse hydroponic system with 20-25°C, 50-70% RH and environmental photoperiod. Fertigation was done according Rosen-tantau® Co. using crystalon fertilizer as drop irrigation (Figure 1).

One liter PGRs solutions were prepared for 30 plants and sprayed 5 stages on foliage. The trial conducted using randomized complete block design with GA_3 (150, 200, 250 and 300 mg l^{-1}), CCC (500, 1000, 1500 and 2000 mg l^{-1}), SA (50, 100, 150 and 200 mg l^{-1}) and control (distillation water) in 3 replications. Bud and flower neck length and flower stem height by ruler, flower bud diameter by caliper, fresh weight and dry matter by careful scale (0.01g) and vase life in the preservative solution with 250 mg l^{-1} 8-HQC, 2% sucrose and 0.4 mM STS, were evaluated. For measurement the dry matter, cut flowers were located in oven with 105°C for 24 h.

Fig. 1: Fertigation of pruned stocks

Statistical Analysis: Of data were carried out by MSTATC and SPSS soft ware, means were compared using LSD test and diagrams were drawn with excel software.

RESULTS AND DISCUSSION

The effect of PGRs on bud length was significant ($P \leq 0.05$). The results revealed that the highest bud length (4.16 cm) was obtained by 1500 mg l^{-1} CCC, followed by 150, 200 and 250 mg l^{-1} GA_3, while the differences between them were not significant (Table 1).

Arun *et al.* [5] reported that GA_3 and SA increased length of floral bud in rose 'First red'. Also, Bhattacharjee and Singh [9] reported the bud length was increased significantly by using 1000 mg l^{-1} CCC on rose 'Ractagandha' [4, 9]. These findings confirmed our results. Gul *et al.* [3] applied 0, 100, 200 and 300 mg l^{-1} GA_3 on *Araucaria heterophylla* and showed that the internode length was significantly ($P \leq 0.001$) affected by GA_3 concentrations. Maximum internode length (8.6 cm) was found at 300 mg l^{-1} GA3, followed by 200 mg l^{-1} GA_3 (6.6 cm), while minimum of that was recorded (2.9cm) in control plants.

According to our results, 150, 200 and 250 mgl^{-1} GA_3 with 47.35, 46.46 and 45.46 g per flower stalk, respectively, were better than other treatments ($P \leq 0.01$). Fresh weights of CCC treatments were less than that of control (Table 1). Significant increase in fresh weight of flower is in order to promoting effect of GA_3 on vegetative growth. Also, different concentrations of SA, increased fresh weight, however this increasing was not significant (Table 1).

Table 1: Mean comparison of bud lenght, fresh weight and vase life

	Traits		
Treatment (mg^{-1})	Bud length (cm)	Fresh weight (g)	Vase life (days)
Control	3.476 cde*	43.33 ab	9.667 bc
GA (150)	3.990 ab	47.35 a	11 ab
GA (200)	4.050 ab	46.46 a	10 bc
GA (250)	3.820 abc	45.46 a	11 ab
GA (300)	3.310 de	33.45 cde	9.500 bc
SA (50)	3.150 e	36.30 e	10 bc
SA (100)	3.840 abc	35.21 bcde	11 ab
SA (150)	3.797 abc	42.79 abc	12.670 a
SA (200)	3.633 bcde	37.73 abcd	9.500 bc
CCC (500)	3.600 bcde	31.53 de	11.50 ab
CCC (1000)	3.727 abcd	38.83 abcd	11 ab
CCC (1500)	4.157 a	35.56 bcde	11.3 ab
CCC (2000)	3.717 abcd	39.90 abcd	8.500 c

* Values in each row followed by the same letter are not significantly different by LSD

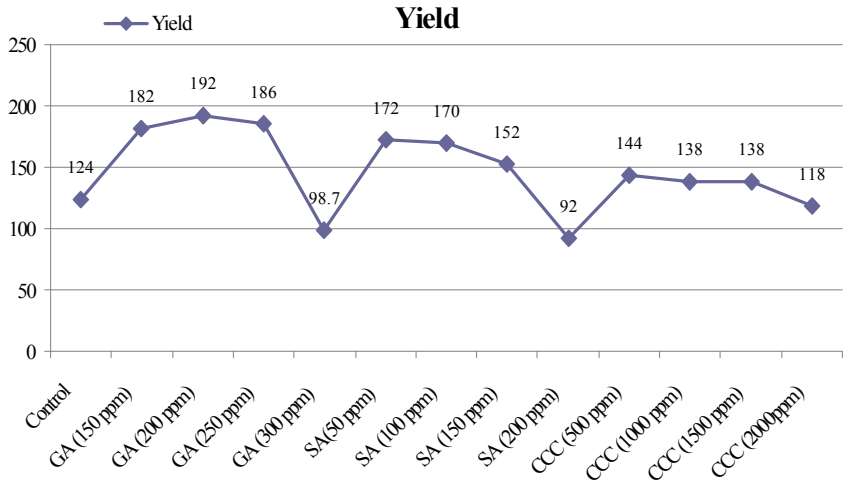

Fig. 2: Effect of plant growth regulators in yield of cut flowers in *Rosa hybrida* 'Poison'

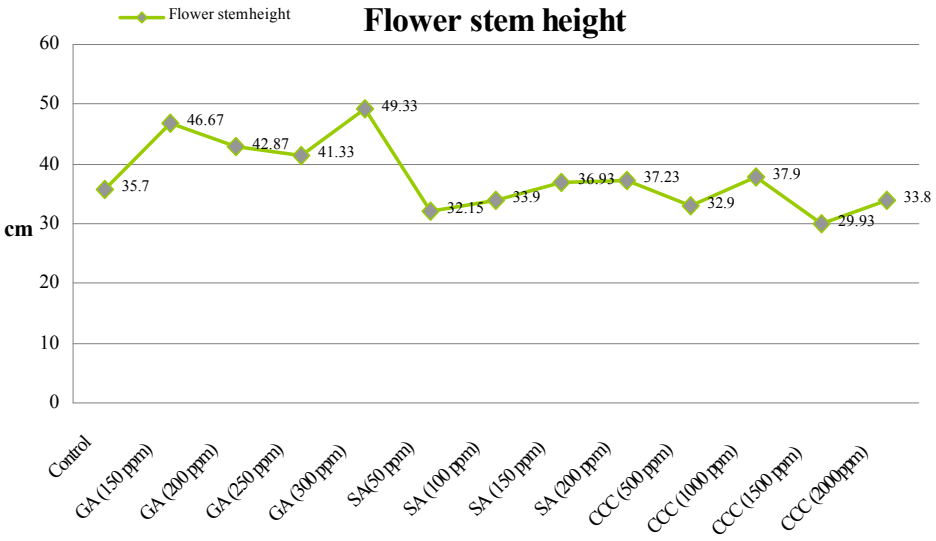

Fig. 3: Effect of plant growth regulators on yield on flowers stem height of *Rosa hybrida* 'Poison'

Kumar and Singh [12] showed spraying of 100 and 200 mg l^{-1} GA_3, increased flower weight in carnation 'Red corso'. Latimer and Baden [7] examined the different GA_3 levels on *Pelargonium* 'Ringo rose' and 'Ringo white' and found that the 150 mg l^{-1} CCC decreased shoot weight. In current study, all levels of CCC, diminished shoot weight, as well. Flower stem height is one of the most important qualitative factors, which was influenced by GA_3 and CCC. The least and highest flower stem height were obtained by using 1500 mg l^{-1} CCC (29.93 cm) and 300 mg l^{-1} GA_3 (49.33 cm). This trait was 35.7 cm in control plants (Fig. 2). Our results showed significant increase in flowering stem height under GA_3 treatments and extremely decline under CCC application (Figure 2). Roberts *et al.* [13] confirmed the effect of GA_3 on increasing of internode length. Also, Saffari *et al.* [14] sprayed the 50 mg l^{-1} GA_3 on *Rosa damascena* and found that this compound could increase flower stem height (77.5 cm) compared with control (69.2 cm) (17). They revealed that 3000 mg l^{-1} CCC decreased flower stem length about 5 cm compared with control. Plant growth retardants decreased the inter node length and elimination of apical dominance [1, 15].

Gul *et al.* [3] evaluated of 100, 200 and 300 mg l^{-1} GA_3 on *Araucaria heterophylla* and observed that maximum plant height (42.4cm) recorded at 300 mg l^{-1} GA_3 while minimum (26.5 cm) was observed in control plants.

In our experiment, different levels of SA had not significant effect on flower stem length compared to control plants (Fig. 1). The most vase life (12.67 days)

was obtained at 150 mg l^{-1} SA (P = 0.01). Other levels of SA, GA_3 and CCC increased the vase life a little compared to the control plants (9.67 days), but no this increasing was significant (Table 1).

SA reduced the synthesis of ethylene and it is able to blocks the synthesis of auxins [16, 17]. As mentioned above, SA increased the dry matter and consequently vase life [18]. Also SA acts as an internal signal and causes a kind of systhemic resistance in mature organs, so the this resistance transports to the immature organs [8]. SA participates in signal regulation of gene expression in the course of leaf and petal senescence [19].

GA_3, CCC and SA had significant effect on the number of cut flowers per unit area ($P \leq 0.05$). The highest yield was obtained at 200 and 250 mg l^{-1} of GA_3 with 192 and 186 cut flowers m^{-2} y^{-1}, respectively (56.8 and 50% increasing of yield compared to control). The 300 mg l^{-1} GA_3 decreased the yield (Figure 3).

Barzegar Fallah [20] applied 0, 10, 25 and 50 mg l^{-1} GA_3 on *Aquilegia* × *hybrida* and observed that the most yield was obtained in 10 mg l^{-1} GA_3, while 50 mg l^{-1} GA_3 caused to diminishing of cut flowers. Also, Bhattacharjee and Singh [9] showed that 300 mg l^{-1} GA_3 decreased yield of rose 'Raktagandha' to 11-20%. In current study, 300 mg l^{-1} GA_3 reduced yield of cut rose 'Poison'.

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