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Influence of Foliar Application of Volk Oil, Dormex, Gibberellic Acid and Potassium Nitrate on Vegetative Growth and Reproductive Characteristics of Strawberry cv. 'Merak'

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ABSTRACT

Application of chemicals for strawberry forcing or production in subtropical regions in autumn or winter months, inside or outside of greenhouse has been reported as a successful method. Present study was carried out to evaluate the effects of Volk oil (2.5, 5%), Dormex (0.5, 1%), GA_3 (50, 100 mg. L^{-1}) and KNO_3 on vegetative and reproductive growth of strawberry cv. 'Merak' in subtropic conditions of Darab city in Fars province of Iran. Dormant young rooted daughter plants were potted in 3L plastic pots and after 2 weeks of establishment period the treatments were applied and then plants were grown for 3.5 months in outside conditions. Results indicated that KNO3 caused augmentation of leaf surface area, roots length, number of flowers and inflorescences. Also Dormex at 1% concentration increased flowering period and decreased number of runners. Volk oil at both concentrations improved roots length and number of achenes in primary and secondary fruits. Conclusion showed that the mentioned materials could have impact on vegetative and reproductive growth of strawberry generally. In this study KNO_3 resulted in best and maximum effects on plant growth.

Key Words: Dormex, flowering, growth, plant growth regulator, strawberry.

INTRODUCTION

Use of flower-induced and dormant daughter strawberry plants is a successful method for forcing and out of season production in warmer regions with a mild autumn and winter inside or outside of greenhouse. Dormancy breaking agents play an important role in this technique. Strawberry is a delicious fruit with high health value and is grown almost all over the world including Iran (Eshghi and Jamali 2009). Strawberry floral induction occurred at the end of summer or the beginning of fall when the days are short and temperature is low, the very same conditions that cause strawberry plants enter the dormant state, because of low-chilling requirements of this plant, about 200-300 hours, (Hancock 2006), it is possible to take and transfer rooted and induced plants from temperate north areas to south regions with milder winters. This enable the growers to harvest strawberry fruits during late fall and winter for 4-5 months. On the other hand there is always this concern that the chilling requirements of all plants would not completely be fulfilled and this might arise problems such as delay in growth, reduction of flowers and fruits which would affect the yield adversely (Rahemi and Asghari 2004). To avoid these problems in such regions dormancy breaking chemicals might be helpful (Botelho *et al.,* 2007). Dormex (H_2HCN), Volk oil and potassium nitrate are a few examples (Rahemi and Asghari 2004). Previous studies are indicative of a positive role of dormex in stimulating of bud break in peach cultivars (George and Nissen 1988, George *et al.,* 1992). Similar results have been obtained using volk oil and potassium nitrate on other plants (Erez 1987, Peri *et al.,* 1994). Gibberellic acid (GA_3) has bioregulatory proprieties and can induce and force strawberry. Reaction of strawberry to GA_3 application is similar to environmental factors such as long days and low temperature (Tehranifar and Battey 1997). Darab city (28° 44' N 55° 33 ' E) in south eastern of Fars province is considered as a semi tropical region with mild winter so it is possible to transfer induced strawberry plants from colder areas of north of Iran (e.g. Sanandaj) to Darab. So the aim of present study was to assess the effect of rest breaking agents (volk oil, dormex, potassium nitrate and GA_3) on some vegetative and reproductive parameters of 'Merak' strawberry.

MATERIALS AND METHODS

This study was carried out at Agriculture and Natural Resources College of Darab city. Induced and rooted daughter plants of Merak cultivar (from Sanandaj fields) were potted in 3 l plastic pots filled with 2:1 sandy loam soil and compost, after 2 weeks of establishment, in the beginning of November, the treatments, including: GA_3(50, 100 mg.l^{-1}), dormex (0.5, 1 %) volk oil (2.5, 5 %) and potassium nitrate (1.5, 3%) and distilled water as control, in completely randomized design with 8 replications, were foliar applied. During the experimental period plants were fertigated with Hogland solution. In the end of experiment, plants were carefully taken out of

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their pots, roots were washed with distilled water, the whole plants were oven dried for 72 hours at 70° c then weighed and their dry weights were expressed as gram. Number of runners, flowers and inflorescences were counted throughout the experimental period. Leaf area was measured using a ΔT- leaf area meter and expressed as cm^2. Length of roots was measure using a ruler and was expressed as cm. Length of flowering period was calculated and expressed as days between the first appearing flowers till end of experiment. Primary and secondary fruits were weighed in order to measure their weight as gram and number of their achenes was counted afterwards. Data was analyzed using SPSS 17 and their means were compared using Duncan's test.

RESULTS

Table 1, indicates the effect of dormex, volk oil, potassium nitrate and GA_3 on dry weight of plants, number of runners, leaf area and length of the roots. GA_3 at 50 $mg.l^{-1}$ of increased dry weight of plants but other treatments did not have a significant impact on this characteristic. Number of runners decreased when plants treated with dormex, similar results were obtained when volk oil was applied, and on the other hand plants treated with 100 $mg.l^{-1}$ of GA_3 produced the maximum number of runners. Potassium nitrate at 1.5% concentration increased the leaf area in comparison to control. Length of roots was longer than control samples in all treated plants, and maximum of this parameter was obtained when 5% concentration of volk oil was applied.

Table 1. The effect of dormex, volk oil, potassium nitrate and GA_3 on dry weight of plants, number of runners, leaf area and length of the roots.

Treatment	Plant dry weight (g)	Number of runners	Leaf area (cm^2)	Length of roots (cm)
Control[z]	12.89 bcd	3.25 b	24.67 bc	19.71 e
Dormex 0.5%	12.91 bcd	2.25 c	26.60 bc	25.57 cd
Dormex 1%	12.29 cde	2.1 c	23.02 bc	26.06 bc
Potassium nitrate 1.5%	13.39 bc	3.3 b	40.77 a	21.68 d
Potassium nitrate 3%	11.53 e	3.5 b	28.1 b	25.94 bc
GA_3 50 $mg.l^{-1}$	15.31 a	4.25 b	22.43 c	26.99 bc
GA_3 100 $mg.l^{-1}$	14.27 ab	5 a	21.72 c	27.85 ab
Volk oil 2.5%	12.25 cde	2.37 c	23.70 bc	26.46 bc
Volk oil 5%	11.28 de	2.25 c	24.69 bc	28.89 a

[z]Means followed by same letter are not significantly different at 5% probability using Duncan's test.

Table 2, indicates the effect of dormex, volk oil, potassium nitrate and GA_3 on number of flowers, number of inflorescence, length of flowering period, weight of primary and secondary fruits and number of their achenes. Only 3% concentration of potassium nitrate increased number of flowers and other treatments did not cause any significant respond. Both concentrations of potassium nitrate increased number of inflorescences while 100 $mg.l^{-1}$ of GA_3 decreased it. Length of flowering period reached its maximum amount when 1% concentration of dormex was applied. The maximum number of achenes was obtained when potassium nitrate was used as treatment also their weight was significantly higher.

Table 2. The effect of dormex, volk oil, potassium nitrate and GA_3 on number of flowers, number of inflorescence, length of flowering period, weight of primary and secondary fruits and number of their achenes.

Treatment	Number of flowers	Number of inflorescences	Length of flowering period (days)	Weight of primary fruit (g)	Weight of secondary fruit (g)	Number of achenes of primary fruit	Number of achenes of secondary fruit
Control	6 bc	3.37 bc	21.25 b	13.70 b	13.37 b	131.25 c	124.50 c
Dormex 0.5%	7.80 b	2.82 bc	26.62 ab	13.45 b	13.32 ab	170 b	157.75 b
Dormex 1%	8.20 b	3.63 b	30.87 a	13.01 b	13.80 ab	164.50 b	156.80 b
Potassium nitrate 1.5%	8.37 b	4.72 a	25.37 ab	14.55 b	14.30 ab	193.10 a	178.60 a
Potassium nitrate 3%	11.87 a	3.50 a	26.25 ab	16.66 a	14.90 a	210.25 a	195.50 a
GA_3 50 $mg.l^{-1}$	3.20 c	2.53 c	12.37 c	13.01 b	12.58 ab	117.15 cd	109.25 cd
GA_3 100 $mg.l^{-1}$	3 c	1.80 d	13.30 c	12.33 b	12.27 c	108.62 d	100.12 d
Volk oil 2.5%	5.2 bc	2.67 c	25.50 ab	13.87 b	13.09 b	153.36 b	146.12 b
Volk oil 5%	5.37 bc	3.67 b	25.50 ab	14.10 b	13.37 b	157.25 b	145 b

[z]Means followed by same letter are not significantly different at 5% probability using Duncan's t

DISCUSSION

As it has been indicated in table 1, there were no considerable differences between dry weights of plants, although GA_3 increased it. This phytohormone as a bioregulator has a great influence on over all plant growth and development and many previous studies reported a promoting impact of GA3 on growth parameters. The reason responsible for this augmentation of growth is its effect on cell division and enlargement (Reid and Ross 1993, Hedden and Phillips 2000, O'Neil and Ross 2002). Our results show a reduction in number of runners after volk oil or dormex application. This might be due to change in balance between vegetative and reproductive growth, these two compounds change this balance in favor of reproductive growth and have the capacity to induce flowers or at least force them to open earlier (Rahemi and Asghari 2004; Eshghi *et al.*, 2010). On the other hand GA_3 increased this characteristic and maximum number of runners obtained when plants were treated with GA_3, this can be due to higher rate of cell division and stimulation of vegetative growth (Arteca 1995). In strawberry GA_3 reduces flowering and as a result vegetative growth including production of runners increases (Arteca 1995). Leaf area significantly increased after potassium nitrate application probably because of a promoting role of potassium (K) in plant growth. Generally the essential element K has a great regulatory role within plant cells and organs such as, activating more than 50 enzymes, osmosis regulation and photosynthesis and loading and unloading of sugars in phloem (Mengel, 2007). An available source of K might optimize growth and increase leaf area. The lack of chilling requirement completion may cause reduction of growth (Crane and Takeda 1979). Treatments of plants with chemicals that could substitute partially for chilling requirement might solve this problem; this can be the reason behind longer roots in all treated plants in our experiment. Since roots do not have the chlorophyll for photosynthesis, root growth is dependent on above-ground organs, if the conditions change toward an optimum one for growth, higher flow of assimilates will be available for roots. Number of flowers and inflorescences increased when plants were treated with potassium nitrate, Khayat et al (2010) reported similar results for 'Selva' strawberries, and also our findings were in accordance with previous works (Erez 1987, Jacobs *et al.,* 2002, Rahemi and Asghari 2004). Mechanism is still obscure, however, as it has been mentioned earlier, the element K has important regulatory roles inside and outside of plant cells, so it can be expected that plant access to an available K source should optimize plant growth and consequently this enables plants to flower more frequently. More researches should be helpful for elucidating more exact details in this regard. Maximum length of flowering period was obtained when plants were treated with dormex. An earlier anthesis has been reported in previous studies after application of dormex treatments (Powel *et al.,* 2000, Rahemi and Asghari 2004, Botelho *et al.,* 2007, Engin *et al.,* 2010). Mechanism is still not exactly clear but dormex can inactivate the enzyme Catalase and causes an accumulation of hydrogen peroxide that impose stress to plant, this accelerates flowering and anthesis (Ore *et al.,* 2002, Perez and Lira 2005). The weight of primary and secondary fruits and number of their achenes increased significantly when they were treated with potassium nitrate. Carbohydrates are necessary for growth augmentation of fruits, and since the element K has an important role in loading and unloading of sugars in plant phloem, application of a source of K on plants might increase their fruit weight (Mengel 2007), on the other hand K regulates the osmosis and turgor pressure, more available K optimizes water entrance into the cells.

CONCLUSIONS

It seems that treatments could affect the vegetative and reproductive growth and generally this influence was promising and promoting. Best results were obtained using potassium nitrate, and this might be due to the essentiality of the element K for plant life cycle and also the fulfillment of plant chilling requirement.

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