Iran Agricultural Research, Vol. 28, No. 2, 2009 and Vol. 29 No. 1-2, 2010
Printed in the Islamic Republic of Iran
Shiraz University

Overcoming Winter Rest of Grapevine Grown in Subtropical Regions Using Dormancy-Breaking Agents

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Abstract- Although, grapevines do not have a high chilling requirement, its fulfillment is critical for normal development of the vines. In tropical and subtropical regions such as Farrashband, in the south of Iran, there is no adequate winter chilling to release bud dormancy in grapevines. So it is necessary to consider the effect of chemical dormancy–breaking agents on bud dormancy. In the present research an aqueous solution of dormex (3.5 and 7% , v/v), volk oil (3.5 and 7% , v/v) and potassium nitrate (1.5 and 3% , w/v) were sprayed at two separate dates (26th Jan. and 11th Feb. 2007) on pruned canes of vines in Farrashband region, Fars province, Iran. Results indicated that the application of dormancy-breaking chemicals in the first spray was more effective than that of the second date with respect to advancing budbreak as well as flowering. Dormex (3.5%) and KNO_3 (1.5%) were found to be more effective than other treatments. The highest cluster weight was obtained in dormex (3.5%) and KNO_3 (3%). Dormancy-breaking chemicals and time of application had little effect on TSS, total acid and the vitamin C of ripened fruits. In general, dormancy-breaking agents and time of application positively affected advancing budbreak as well as flowering as a result of increased yield. In warm climates where the amount of chilling is not sufficient, the application of dormancy-breaking chemicals (Dormex, KNO_3, Volk oil) at the proper time may overcome bud dormancy.

Keywords: Chilling requirement, Dormancy-breaking agent, *Vitis vinifera*, Winter chilling

INTRODUCTION

Although the *Vitis vinifera* is assumed to have originated in moderate climates, it has also been well established in warm sub-tropical regions from ancient times (10). On the other hand, global warming will cause the extension of the conditions of warm climates toward temperate zones in the near future. The most important problem

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related to the cultivation of grapevines in subtropical regions is considered to be the lack of adequate chilling.

Compared to many other deciduous fruit crops, grapevines require relatively little exposure to chilling to terminate rest. Previous studies indicate that the chilling exposure necessary for normal bud growth ranges between 50 and 400 h at temperatures ≤ 7°C (2 and 3). Erratic and/or delayed budbreak, decreased shoot and cluster numbers per vine, and poor uniformity of fruit development are commonly reported in regions where grapevines suffer from inadequate winter chilling (9 and 10).

Many dormancy-breaking agents such as mineral oils, dinitro-orthocresol (DNOC) and thiourea have only a weak or no effect on grapevine bud opening (11). On the other hand, hydrogen cyanamide, H_2CN_2, commercially known as dormex which was originally developed for breaking dormancy in grapevines, is most efficient (9). The mechanism by which dormex exerts its dormancy-breaking effect is not clear, but it has been shown to inactivate catalase enzyme in grape buds shortly after its application (12), leading to the accumulation of hydrogen peroxide and the development of oxidative stress (12 and 13). Studies by Smit (17) and George & Nissen (5) have shown that dormex can induce earlier and more uniform budbreak on grapevines. The time of dormex application is critical; early application of dormex may advance fruit maturity by 2-6 weeks. This advancement can be useful in warm climates, where double cropping of grape is considered.

Under mild winter climatic conditions, similar to that of the Farrashband region in the south of Fars province in Iran, problems arise because the grapevines enter dormancy and then without adequate winter chilling, fail or partially fail to release dormancy, with delayed budbreak and greatly reduced flowering and cropping. In warm regions, a considerable number of grapevine buds fail to grow due to insufficient winter chilling.

Dormex was also reported to be effective in stimulating budbreak of peach (4), apple (6) and pistachio (15).

The effects of hydrogen cyanamid, volk oil and potassium nitrate for breaking the dormancy of table grapevines in sub-tropical Iran have not been previously reported. The aim of this study was to evaluate the effects of the before mentioned dormancy-breaking chemicals on breaking flower buds and yield improvement of table grapes, ‘Askari’ cultivar.

MATERIALS AND METHODS

Experiment Site and Materials

The experiment was carried out in Farrashband region, south of Fars province, Iran. Farrashband is located 127 km south-west of Shiraz with a longitude of 52° 5´, 28° 52´ latitude and elevation of 750 m above mean sea level. The climatic condition is arid with a mean annual rainfall of 250-300 mm, mainly in autumn and winter.

Dormant canes of 5 year-old ‘Askari’ vines were pruned to three buds on each cane 10 days before the first application of chemicals, to allow the healing of cuts. The vines were arranged with 3 m between rows and 2.5 m between vines within the rows. Control vines were also pruned at the same time. Dormex, a commercial formulation of hyderogen cyanamide (49% a.i. SKW Co., Germany) at the rate of 3.5 and 7%, volk oil at the rate of 3.5 and 7% (v/v) and potassium nitrate with a concentration of 1.5 and 3% (w/v) were applied on two separate dates, 26th Jan. and 11th Feb.2007.Vines were sprayed to the run-off point (approx. 200 ml per vine).

Control vines were simultaneously sprayed with distilled water. The experiment was arranged as a completely randomized block design, with 7 treatments (each date) and 4 replications (56 vines for both dates).

Measurements

Following spraying, the time taken for bud break and flower opening were recorded. At the harvest time the number of clusters per vine, weight of clusters, yield (kg per vine), size and weight of berries were recorded. The qualitative characteristics of the fruit such as vitamin C, total soluble solids (TSS) and total acid were also measured. Vitamin C was determined by titration with indophenols (18) and expressed as mg vitamin C per 100 ml juice. TSS was measured by a refractometer. Acidity was determined by titration of fruit juice with 0.1 N NaOH and expressed as mg acid in 100 ml juice.

The data were statistically analyzed using MSTATC software and means were compared by Duncan's new multiple range test (DNMRT).

RESULTS AND DISCUSSION

Budbreak and Flowering

Overall application of dormancy-breaking chemicals on 26th Jan. 2007 (1st application) were more effective than the application on 11th Feb. 2007 (2nd date) on advancing budbreak and flowering (Table 1). The application of dormex (3.5%) and KNO_3 (1.5%) on the 1st date significantly advanced bud break and flowering compared to controls and other treatments (Table 1). The results suggest that dormex was effective in overcoming dormancy in partially chilled grapevines. Also the time of application and concentrations of dormex affected bud break and flowering time. Timing is a function of the dormancy stage of buds (16). George and Nissen (5) reported that under warm subtropical conditions, hydrogen cyanamide had the potential to advance bud break and flowering. Potassium nitrate and volk oil act as rest-breaking chemicals. Rahemi & Asghari (15) reported that dormex, potassium nitrate and volk oil alone or their combinations had a positive effect on advancing bud break and yield of pistachio trees in subtropical regions of Iran. Botelho et al. (1) reported that garlic extract (1.5 and 3%) and hydrogen cyanamide (1.5%) improved and advanced up to 70% bud sprouting after 35 days for chilled and non-chilled grapevine cuttings.

Yield

Bunch production and yield of treated vines at the first date application were significantly greater than that of the 2nd date treated and untreated vines (Table 1). Volk oil at 7% (first date) produced the greatest number of cluster and yield (8.3 kg per vine). However, dormex at 3.5% and KNO_3 at 3% had the highest cluster weight of, 94.31 and 94.8 g, respectively (Table 1).

Second date application of treatments was less effective and produced lower yield as compared with the first application. Dormex at 3.5% (2nd date) had the lowest cluster weight and yield (Table 1).

Table 1. Effect of dormex, KNO_3 and volk oil on the time of bud break and yield of grapevine

Treatments	Budbreak (d fter 1st spray)	Flowering (d after 1st spray)	Yield (kg per vine)	No. of cluster per vine	Weight of cluster (g)
26 Jan. 2007					
Control	**53.0 d***	**66.17 e**	**3.07 cde**	**41.99 g**	**73.13 c**
Dormex 3.5%	**34.5 n**	**60.00 i**	**5.09 bc**	**53.99 ef**	**94.31 a**
Dormex 7%	**40.5 k**	**57.00 k**	**4.00 bcde**	**48.00 fg**	**83.52 b**
KNO_3 1.5%	**38.0 m**	**61.25 h**	**4.28 bcde**	**63.10 bc**	**67.96 cd**
KNO_3 3%	**38.5 l**	**55.0 l**	**5.40 b**	**57.00 cde**	**94.80 a**
Volk oil 3.5%	**46.25 i**	**58.00 j**	**4.92 bcd**	**61.06 cd**	**80.61 b**
Volk oil 7%	**48.0 i**	**61.50 g**	**8.30 a**	**132.10 a**	**62.85 d**
11 Feb. 2007					
Control	**50.5 g**	**66.67 d**	**2.85de**	**44.84 g**	**63.70 d**
Dormex 3.5%	**52.0 f**	**65.50 f**	**2.67 e**	**68.12 b**	**39.30 f**
Dormex 7%	**55.2 c**	**68.25 c**	**2.86 de**	**55.32 de**	**51.75 e**
KNO_3 1.5%	**50.2 h**	**65.50 f**	**2.82 de**	**54.18 ef**	**52.10 e**
KNO_3 3%	**52.5e**	**71.00 a**	**3.21 bcde**	**43.56 g**	**73.72 c**
Volk oil 3.5%	**57.5 a**	**70.25 b**	**3.79 bcde**	**61.13 cd**	**62.02 d**
Volk oil 7%	**56.0 b**	**65.50 f**	**2.94 cde**	**56.15 de**	**52.40 e**

*** Means followed by the same letters in each column are not significant at 5% probability using DNMRT**

Dormex at 3.5% (first date) and volk oil at 3.5% (second date) produced the greatest berry diameter, length and weight (Table 2). Significant differences were observed between the time of application and yield. Rahemi & Asghari (15) reported that depending on the application date dormex increased yield of pistachio trees. George and Nissen (5) have shown that dormex can produce a greater number of shoots per spur and a higher number of bunches per shoots on spur. The effect of these chemicals on increasing yield was similar to the results obtained by Kuden et al. (8) in pistachio, Jackson and Bepete (6) and Jacobs et al. (7) in apple and Perez and Lira (13) in grapevine.

Fruit Quality

Dormancy-breaking chemicals and time of application had little effect on TSS, total acid and vitamin C of grapes. KNO_3 at 1.5 and 3% (first date) had significantly greater TSS as compared to other treatments and controls (Table 3). KNO_3 at 1.5% and volk oil at 7% (second date) produced the lowest TSS. Untreated vines produced fruits that had the greatest vitamin C (Table 3), however all treatments (both dates) reduced vitamin C when compared with untreated vines. KNO_3 at 3% and volk oil at 7% (second date) had the highest total acid.

Powell (14) reported that dormex at 2, 3 and 4% by volume had no significant effect on TSS content of mature kiwifruit.

Table 2. Effect of dormex, KNO_3 and volk oil on berry property of grapevine

Treatments	Berry diameter (cm)	Berry length (cm)	Berry weight (g)	L/D
26 Jan. 2007				
Control	1.20 e*	1.43 bcd	1.18 c	1.19 cd
Dormex 3.5%	1.35 a	1.80 a	1.94 a	1.33 b
Dormex 7%	1.10 bcde	1.34 cde	0.94 cd	1.22 bcd
KNO_3 1.5%	1.14 abcd	1.32 cde	1.09 c	1.16 cd
KNO_3 3%	1.24 abc	1.50 bc	1.48 b	1.21 bcd
Volk oil 3.5%	1.06 cde	1.36 bcde	0.98 c	1.28 bc
Volk oil 7%	1.28 abc	1.40 bcde	1.62 b	1.10 d
11 Feb. 2007				
Control	0.87e	1.42 bcd	1.18 c	1.64 a
Dormex 3.5%	1.17 abcd	1.40 bcde	1.16 c	1.20 bcd
Dormex 7%	1.10 bcde	1.29 cde	1.07 c	1.18 cd
KNO_3 1.5%	1.08 bcde	1.20 de	0.92 cd	1.11 d
KNO_3 3%	1.32 ab	1.60 ab	1.63 b	1.21 bcd
Volk oil 3.5%	1.35 a	1.59 ab	1.76 ab	1.18 cd
Volk oil 7%	0.98 de	1.16 e	0.66 d	1.18 cd

*** Means followed by the same letters in each column are not significant at 5% probability using DNMRT**

Table 3. Effect of Dormex, KNO3 and volk oil on vitamin C, TSS and TA of grapes

Treatments	Vit. C (mg/100 ml Juice)	TSS (%)	Total acid (mg/100 ml Juice)
26 Jan. 2007			
Control	5.10 a*	15.23 b	1.40 ef
Dormex 3.5%	4.05 bcd	13.30 f	1.70 cd
Dormex 7%	3.48 cde	14.23 de	1.75 c
KNO_3 1.5%	3.04 e	16.23 a	1.78 c
KNO_3 3%	3.55 cde	16.17 a	1.25 fg
Volk oil 3.5%	3.15 e	14.00 e	1.20 fg
Volk oil 7%	4.78 ab	13.20 f	1.85 bc
11 Feb. 2007			
Control	4.79 ab	15.47 b	1.65 cd
Dormex 3.5%	3.59 cde	15.25 b	1.35 ef
Dormex 7%	3.26 de	14.42 cd	1.50 de
KNO_3 1.5%	3.39 cde	12.25 g	1.30 efg
KNO_3 3%	3.09 e	14.76 c	2.15 a
Volk oil 3.5%	3.40 cde	15.14 b	1.10 g
Volk oil 7%	4.19 bc	12.14 g	2.00 ab

*** Means followed by the same letters in each column are not significant at 5% probability using DNMRT**

CONCLUSION

In general, dormancy-breaking agents and time of application positively affected advancing budbreak, flowering and yield. In warm climates where chilling is not sufficient, the application of dormancy-breaking chemicals (dormex, KNO_3, volk oil) in proper time can overcome bud dormancy.

REFERENCES

1. Botelho, R.V., A.P. Pavanello, E.J.P. Pires, M.M. Terra and M.M.L. Muller. 2007. Effects of chilling and garlic extract on bud dormancy release in Cabernet Sauvignon grapevine cuttings. Amer. J. Enol. Vitic. 58: 402-404.

2. Dokoozlian, N.K. 1999. Chilling temperature and duration interact on the bud break of 'Perlette' grapevine cutting. Hort. Science, 34: 1054-1056.

3. Dokoozlian, N.K., L.E. Williams and R.A. Neja. 1995. Chilling exposure and hydrogen cyanamide interact in breaking dormancy of grape buds. HortScience, 30: 1244-1247.

4. George, A.L., J. Lloyd and R.J. Nissen. 1992. Effect of pruning date, paclobutrazol and hydrogen cyanamide on dormancy release for low chill Flordaprince peach in subtropical Australia. Aust. J. Exp. Agric. 32: 89-98.

5. George, A.P. and R.J. Nissen. 1990. Effects of hydrogen cyanamide on yield, growth and dormancy release of table grapes in subtropical Australia. Acta Hort. 279: 427-436.

6. Jackson, J.E. and M. Bepete. 1995. The effect of hydrogen cyanamide (Dormex) on flowering and cropping of different apple cultivars under tropical conditions of sub-optimal winter chilling. Sci. Hort. 60: 293-304.

7. Jacobs, T.N., G. Jacobs and N.C. Cook. 2002. Chilling period influence the progression of bud dormancy more than does chilling temperature in apple and shoots. J. Hort. Sci. Biotech. 77: 333-339.

8. Kuden, A.B., A. Kuden, Y. Nikpeyma and N. Kaska. 1995. Effects of chemicals on budbreak of pistachios under mild climate conditions. Acta Hort. 419: 91-99.

9. Lavee, S., Y. Shulman and G. Nir. 1984. The effect of cyanamide on budbreak of grapevines *Vitis vinifera* L. , Proc.of Symp. on Bud Dormancy in Grapevine: Potential and Practical Uses of Hydrogen Cyanamide on Grapevine. Univ. of California, Davis, pp. 17-29.

10. Lavee, S. 2000. Grapevine (*Vitis vinifera*) growth and performance in warm climates. ***In:*** Temperate Fruit Crops in Warm Climates. A. Erez, (***ed***.) pp. 342-366, Kluwer Academic Publishers, London, UK.

11. Nir, G. and S. Lavee. 1993. The common and different responses of dormant grapevine buds to chemicals of various groups. Hort. Science, 28: 571.

12. Or, E., I. Vilozny, A. Fennell, Y. Eyal and A. Ogrodovitch. 2002. Dormancy in grape buds: isolation and characterization of catalase cDNA and analysis of its expression following chemical induction of bud dormancy release. Plant Sci. 162: 121-130.

13. Perez, F.J. and W. Lira. 2005. Possible role of catalase in post-dormancy bud break in grapevines. J. Plant Physiol. 162: 301-308.

14. Powell, A.A. 1997. The effects of dormex on replacing lack of chilling in kiwifruit. Retrieved from: http://www.aces. edu.

15. Rahemi, M. and H. Asghari. 2004. Effect of hydrogen cyanamide (dormex), volk oil and potassium nitrate on bud break, yield and nut characteristics of pistachio (*Pistacia vera* L.). J. Hort. Sci. Biotech. 79: 823-527.

16. Siller-Cepeda, H., L.H. Fuchigami and T.H. Chen. 1992. Hydrogen Cyanamid – induced bud break and phytotoxicity in Redheaven peach buds. HortScience, 27: 874-876.

17. Smit, C.J. 1985. Advancing and improving bud break in vines. Deciduous Fruit Grower 35: 271-278.

18. Ting, S.U. and L. Russeff. 1981. Citrus Fruits and Their Products Analysis Technology. Marcel Dekker Inc. NewYork, USA. pp. 124-125.

برطرف کردن خفتگی زمستانه انگور در مناطق گرم به وسیله مواد شیمیایی بر طرف کننده خفتگی

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چکیده - اگرچه انگور نیاز سرمایی بالایی ندارد، اما تامین آن برای رشد بهینه حیاتی است. در مناطق گرمسیر و نیمه گرمسیر از جمله جنوب ایران، سرمای کافی برای برطرف کردن خفتگی جوانه انگور وجود ندارد. بنابراین بررسی اثر مواد شیمیایی برطرف کننده خفتگی ضروری است. در این پژوهش دورمکس (۳/۵ و۷%)، روغن ولک (3/5 و ۷٪) و نیترات پتاسیم (۱/۵ و۳%) در دو زمان (۵ و ۲۰ بهمن ماه) روی بوته های انگور هرس شده در منطقه فراشبند محلول پاشی شدند. نتایج نشان داد که کاربرد مواد شیمیایی برجلو انداختن شکفتن جوانه و گلدهی در زمان اول بسیار موثرتر از زمان دوم بود. دورمکس در غلظت %۳/۵ و نیترات پتاسیم در غلظت% ۱/۵ در این مورد بسیار موثرتر از سایر تیمارها بودند. دورمکس %۳/۵ و نیترات پتاسیم%۳ بیشترین وزن خوشه را ایجاد کردند. مواد شیمیایی و زمان کاربرد اثر کمی برTSS، اسید کل و ویتامین ث انگور داشتند. به طور کلی، مواد شیمیایی و زمان کاربرد هم اثر مثبتی برجلو انداختن شکفتن جوانه و گلدهی داشتند و هم عملکرد را افزایش دادند. در مناطق گرم که میزان سرما کافی نیست کاربرد مواد شیمیایی برطرف کننده خواب (دورمکس، نیترات پتاسیم و روغن ولک) در زمان مناسب می تواند خفتگی جوانه را برطرف کند.

واژه های کلیدی: برطرف کننده خواب، سرمای زمستانه، مواد شیمیایی، نیاز سرمایی، *Vitis vinifera*

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** مکاتبه کننده