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摘心对一年两收栽培‘夏黑’葡萄不同节位冬芽花芽分化的影响

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摘 要:【目的】探讨夏季不同强度摘心对一年两收栽培‘夏黑’葡萄不同节位冬芽花芽分化的影响和确定适合一年两收栽培两代不同堂模式下‘夏黑’葡萄冬果修剪的最佳节位。**【方法】**以8 a生‘夏黑’葡萄为试材,设置花上2、4、6片叶摘心处理,不摘心为对照,从新梢5~7片叶展叶开始到果实成熟期,分别取各处理新梢第4、5、6、7、8、9节位的芽制作石蜡切片,观察并统计各处理各节位冬芽花芽分化进程的变化和成花率。**【结果】**不同强度摘心处理和对照的花芽分化起始时间基本一致,冬芽大量进入花原始体发育期均为初花期前后;3个摘心处理冬芽花芽分化开始大量进入花穗发育时期为盛花期前后,对照为果实膨大初期,3个摘心处理从进入花原始体发育期到花穗发育期经历时间比对照缩短了15~31 d。各处理及对照葡萄均为新梢中部节位(4~6节位)冬芽花芽分花能力较好。3个摘心处理各节位冬芽的成花率均显著高于对照。花上4片叶和6片叶摘心处理第4~6节位冬芽的成花率均大于75%,比对照高31.2%~48.9%,2个处理第6节位冬芽从花芽分化起始到进入花穗发育期经历的时间为29 d,比第4、5节位少8 d。**【结论】**生产上可以通过花上4或6片叶摘心促进‘夏黑’葡萄成花,冬果修剪节位宜选择第6节位。

关键词:‘夏黑’葡萄;摘心;花芽分化;一年两收;节位

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Effects of pinching on flower differentiation in winter buds at different nodes of ‘Summer Black’ grape under two-crop-a-year cultivation

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Abstract:【Objective】Flower bud differentiation is vital in two-crop-a-year cultivation of grape. Flower differentiation in buds at different nodes in the same bearing shoots needs to be explored to find the proper pruning position for a second crop. Pinching is a common method to promote flower differentiation in fruit trees, which can change the accumulation and distribution of nutrients in the tree, thus affecting the quantity and quality of flower buds. This study aims to investigate the effect of different pinching intensity on the flower differentiation in winter buds at different nodes of bearing shoots in ‘Summer Black’ grape under two-crop-a-year cultivation, and to determine the best pruning position for the induction of a second crop.【Methods】8-year-old ‘Summer Black’ grape vines were used as the material. Three different pinching positions at 2nd, 4th and 6th node above the cluster were set as the treatments, and shoots without pinching were set as the control. Buds at the 4th, 5th, 6th, 7th, 8th and 9th node in shoots in each treatment were sampled from 5- to 7-leaf stage till harvest. Fifteen winter

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buds were taken for each node in each treatment and fixed in FAA fixation solution, and paraffin sections were prepared. Flower differentiation stages in different buds were identified under optical microscope, and the percentage of buds at each differentiation stage was calculated. The flowering rate of buds at different nodes in each treatment was recorded.【Results】Flower bud differentiation could be divided into five main stages based on microscopic observation: the undifferentiated stage, the beginning of differentiation, the stage of flower anlagen, the stage of the formation of main cob of inflorescence and the stage of the formation of flower cluster. The results showed that the initiation time of flower differentiation was basically the same for the treatments and the control. The flower bud entered the beginning stage of differentiation when 7-9 leaves had fully expanded in the shoot, and most buds entered flower anlagen development stage around early bloom stage. However, the time when most buds entered the formation of flower cluster period differed between the treatments and the control. In the treatments, the formation of flower cluster occurred at full-bloom stage, but in the control it occurred 15 days later at early fruit enlargement period. In the control, the duration from the stage of flower anlagen development to the stage of formation of flower cluster was 44 days at 6th node, 52 days at the 4th, 7th, 8th and 9th node, and 60 days at the 5th node. It was 15 to 31 days shorter in the three treatments than in the control. The flower formation in winter buds at the middle nodes (from the 4th to the 6th node) in the bearing shoot was better than that at the top or bottom nodes. In the control, the winter buds at the 5th and 6th node had the highest rate of flower formation, which was lower than 50%. In the treatment of pinching at the 2nd node above the cluster, the flowering rate of winter buds at the 4th, 5th and 6th node was 66.7%, 73.3% and 60.0%, respectively. In the two treatments of pinching at the 4th and 6th node above the cluster, the flowering rate of the buds in 4th, 5th and 6th node of was higher than 75%, which was 31.2%-48.9% higher than that in the control.【Conclusion】Compared with the control, the three pinching treatments could significantly promote the flower differentiation in winter buds of 'Summer Black' grape, shorten the time required for flower bud differentiation, and significantly increase the flowering rate of winter buds. Among the three different intensity pinching treatments, the treatments of pinching at the 4th and 6th node above the cluster had the best effect in promoting flower differentiation. The flowering rate of winter bud at the 6th node of the two treatments was higher than 75%, and the time for flower bud differentiation was 29 days. Therefore, pinching at the 4th or the 6th node above the cluster can be used to promote flower formation of ‘Summer Black’ grapes, and the best pruning node was suggested to be the 6th node.

Key words：‘Summer Black’ grape; Summer pinching; Flower bud differentiation; Two-crop-a-year cultivation；Node

葡萄一年两收栽培充分利用南方温光资源优势，调节熟期、提高品质，经济效益显著，在广西、云南、广东、海南等多省份大面积推广[1-3]。‘夏黑’是一年两收栽培种植广、表现优异的重要早熟葡萄品种之一[2,4]。冬果修剪节位的冬芽良好的花芽分化是葡萄一年两收两代不同堂栽培模式的关键，而‘夏黑’葡萄冬果修剪节位冬芽花芽分化不良、成花不稳定严重影响其两收栽培的稳产、丰产，同时修剪时不同节位冬芽花芽分化情况不明确也影响了修剪节位的确定。

葡萄结果母枝不同节位冬芽的成花情况有明显差异，王海波等[5]调查促早栽培的‘夏黑’葡萄成熟后修剪萌发的新梢第2~7节位冬芽成花情况，发现高节位冬芽成花率高于低节位。邱志鹏[6]对夏季、冬季修剪的‘夏黑’葡萄不同节位芽成花率的研究也得出类似结论，冬季修剪5~8节位芽的成花率高于2、3节位，夏季修剪8~10节位成花率高于5~7节位。生产上可通过摘心、拉枝、喷施助壮素等植

物生长调节剂等栽培手段调控葡萄的花芽分化促进成花[6-7]。夏季摘心处理可以加快葡萄花芽分化进程、提高成花率[8-10]。路瑶[10]对‘夏黑’葡萄进行不同强度摘心，发现花上6片叶摘心且不留副梢最有利于结果枝的花芽分化。林玲等[11]研究发现，花上6片叶摘心最有利于第6节位芽的花芽分化。目前，尚无不同摘心强度对不同节位冬芽花芽分化影响的报道。因此笔者探讨了广西地区夏季不同强度摘心对‘夏黑’葡萄不同节位冬芽花芽分化的影响，统计和观察不同节位芽完成花芽分化所需的时间及成花率，为一年两收两代不同堂栽培模式下促进‘夏黑’葡萄冬芽花芽分化和确定其冬果修剪的最佳节位提供理论依据。

1 材料和方法

1.1 试材与处理

试验于2016年3—6月在广西农业科学院明阳葡萄一年两收示范基地进行（年均降水量1 309.7 mm，≥13 ℃有效积温7 822.3 ℃，年均日照时数1 584.8 h）。以8 a生‘夏黑’葡萄为试材，株行距1.5 m×3.3 m，采用简易避雨双十字V型架栽培，通风条件良好，管理水平中上。设置花上第2、4、6片叶摘心3个夏季摘心强度处理，分别在花序以上2片叶展叶（3月15—22日）、4片叶展叶（3月29日）和6片叶展叶（4月6日）时进行摘心处理，摘心口副梢留2片叶反复摘心，其余副梢全部抹除。对照处理不摘心，副梢全部抹除。每处理3株树，3次重复，共9株树约210根枝条。2016年3月22日（新梢5~7片展叶）开始采样，取自新梢基部开始第4、5、6、7、8和9节位的芽，每处理各节位采芽15个，冰盒带回实验室，剥取主芽于FAA固定液（90 mL 70%乙醇+5 mL 38%甲醛+5 mL冰乙酸）中固定。各采样批次对应时期及物候期见表1。

1.2 花芽分化进程的观察与划分

参照黄璐[12]的方法制作石蜡切片，花芽分化进程划分参照王海波等[5]的方法，通过石蜡切片观察并统计各处理的花芽分化进程，统计各时期不同花芽分化进程的芽数。

1.3 成花率统计

通过观察制作的石蜡切片，统计花芽分化进程处在或通过花序第一穗轴发育期的芽的比率，3次重复。

表1 各采样批次对应时期及物候期

Table 1 Sample collecting dates and corresponding phenological periods

日期 Date	物候期 Phenological period	采样批次 Sampling batch
2016-02-24	萌芽期 Germination stage	-
2016-03-22	展叶5~7片 Stage of 5 to 7 leaves spread	1
2016-03-29	展叶7~9片 Stage of 7 to 9 leaves spread	2
2016-04-06	初花期 Early flowering stage	3
2016-04-13	盛花期 Flower full-bloom stage	4
2016-04-20	坐果期 Fruit setting stage	5
2016-04-27	果实膨大初期 Early fruit enlargement stage	6
2016-05-04	果实膨大末期 Finally fruit enlargement stage	7
2016-05-12	果实着色初期 3% fruit-rendering stage	8
2016-05-19	果实着色中期 80% fruit-rendering stage	9
2016-05-27	果实着色末期 100% fruit-rendering stage	10

1.4 统计方法

数据采用Excel 2003软件进行数据处理并作图，SPSS 19.0软件进行差异显著性分析。

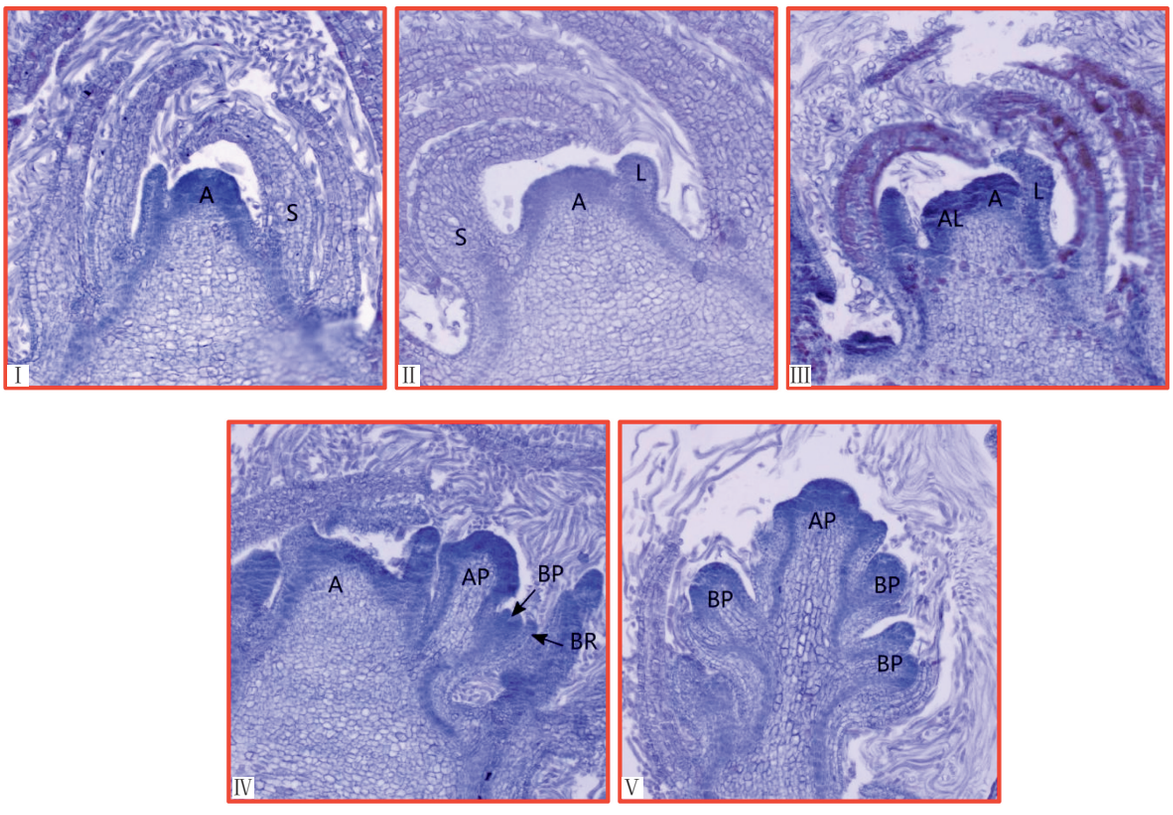
2 结果与分析

2.1 花芽分化进程划分

通过石蜡切片观察不同处理‘夏黑’葡萄各节位冬芽花芽分化进程，将花芽分化进程分为5个阶段：1、未分化期；2、始分化期；3、花原始体发育期；4、花序第1穗轴发育期；5、花穗形成期。花芽分化进程的划分参照图1。

2.2 不同摘心处理对‘夏黑’葡萄第4节位冬芽花芽分化进程的影响

始分化期是花芽形态分化起始的关键时期，标志着芽的发育起始进入花芽发育状态。同时始分化期的持续时间也会影响成花，始原始体若发育缓慢不能尽快分化则很容易发育成卷须[13]。从图2可以看出，对照处理和3个强度的摘心处理第4节位的芽均于新梢展叶7~9片时（3月29日）开始有芽进入始分化期，于初花期（4月6日）进入花原始体发育期。初花期进入或通过始分化期的芽的比率花上2片叶摘心和花上4片叶摘心处理分别为73.3%和66.7%，均高于对照及花上6片叶摘心处理的33.3%。花上4片叶摘心处理第4节位芽于坐果期



Ⅰ. 未分化期；Ⅱ. 始分化期；Ⅲ. 花原始体发育期；Ⅳ. 花序第 1 穗轴发育期；Ⅴ. 花穗发育期。A. 生长点；AL. 始原始体；L. 叶原基；AP. 花序原基；BR. 苞片；BP. 分枝原基；S. 托叶。

I. Undifferentiated period; II. Beginning of differentiation; III. Flower anlagen development; IV. Formation of main cob of inflorescence; V. Formation of flower cluster. A. Apex; AL. Anglagen; L. Leaf primordium; AP. Inflorescence primordium; BR. Bract; BP. Branching primordium; S. Stipules.

图1　‘夏黑’葡萄花芽分化各时期石蜡切片

Fig. 1　Different stages of flower bud differentiation of ‘Summer Black’ grape viewed under microscope

（4月20日）全部通过始分化期，早于其他处理。从花原始体发育到全部花芽进入花穗发育期，花上2片叶处理经历了29 d，花上4片叶摘心和花上6片叶摘心处理经历了37 d，而对照经历了52 d。

2.3　不同摘心处理对‘夏黑’葡萄第5节位冬芽花芽分化进程的影响

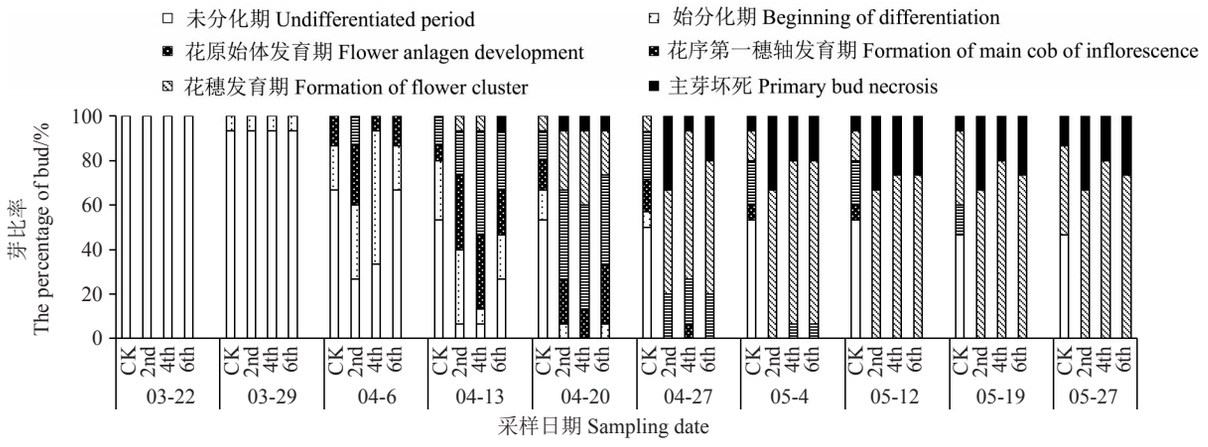
从图3可以看出，对照处理和3个强度的摘心处理第5节位的芽均于新梢展叶7~9片时开始有芽进入始分化期，与对照无显著差异。对照处理于新梢展叶7~9片时便有芽开始进入花原始体发育期，先于其他3个处理。初花期进入或通过始分化期的芽的比率花上2片叶摘心和花上4片叶摘心处理分别为86.6%和73.3%，均高于对照和花上6片叶摘心处理的比率（40%）。花上4片叶摘心处理第5节位芽于坐果期全部通过始分化期，早于其他处理。从花原始体发育到全部花芽进入花穗发育期，花上2片摘心叶处理经历了29 d，花上4片叶摘心和花上6片叶摘心处理均经历了37 d，而对照经历了60 d。

2.4　不同摘心处理对‘夏黑’葡萄第6节位冬芽花芽分化进程的影响

从图4可以看出，对照处理和3个强度的摘心处理花芽分化起始时间基本一致，第6节位的芽均于新梢展叶7~9片时开始有芽进入始分化期，于初花期进入花原始体发育期。初花期进入或通过始分化期的芽的比率花上2片叶摘心、花上4片叶摘心、花上6片叶摘心处理分别为86.6%、73.3%和44.4%，均高于对照处理的44.4%。3个摘心处理第6节位芽均于盛花期（4月13日）全部通过始分化期，比对照处理早14 d。从花原始体发育到全部花芽进入花穗发育期，3个摘心处理均经历了29 d，而对照经历了44 d。

2.5　不同摘心处理对‘夏黑’葡萄第7节位冬芽花芽分化进程的影响

从图5可以看出，对照处理和3个强度的摘心处理第7节位的芽均于新梢展叶7~9片时开始有芽

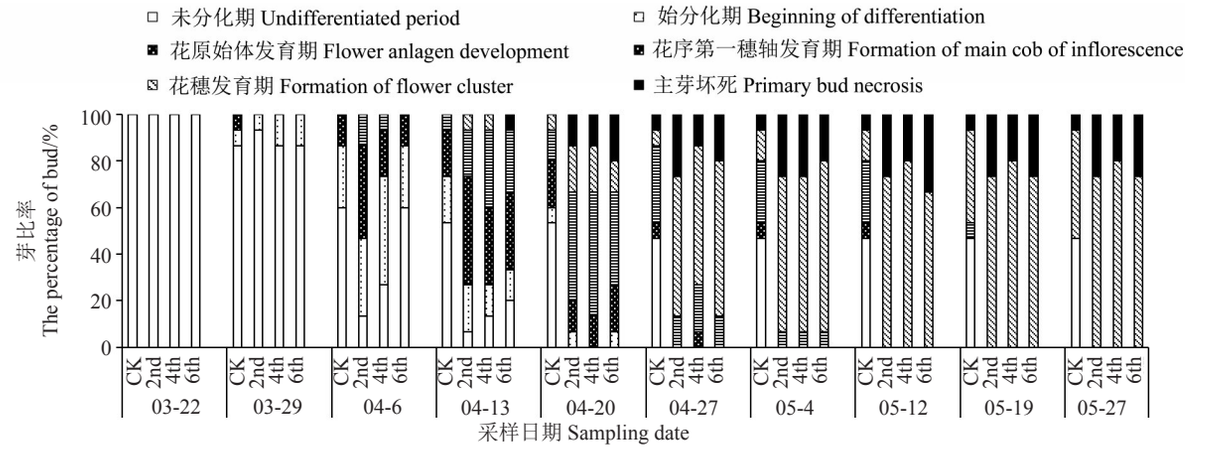


CK. 对照；2nd. 花上 2 片叶摘心处理；4th. 花上 4 片叶摘心处理；6th. 花上 6 片叶摘心处理。

CK. Control; 2nd. Treatment of pinched at the 2nd node above the cluster; 4th. Treatment of pinched at the 4th node above the cluster; 6th. Treatment of pinched at the6th node above the cluster.

图2 不同摘心处理对‘夏黑’葡萄第4节位芽花芽分化的影响

Fig. 2 Flower bud differentiation at the 4th node of ‘Summer Black’ grape under different treatments



CK. 对照；2nd. 花上 2 片叶摘心处理；4th. 花上 4 片叶摘心处理；6th. 花上 6 片叶摘心处理。

CK. Control; 2nd. Treatment of pinched at the 2nd node above the cluster; 4th. Treatment of pinched at the 4th node above the cluster; 6th. Treatment of pinched at the6th node above the cluster.

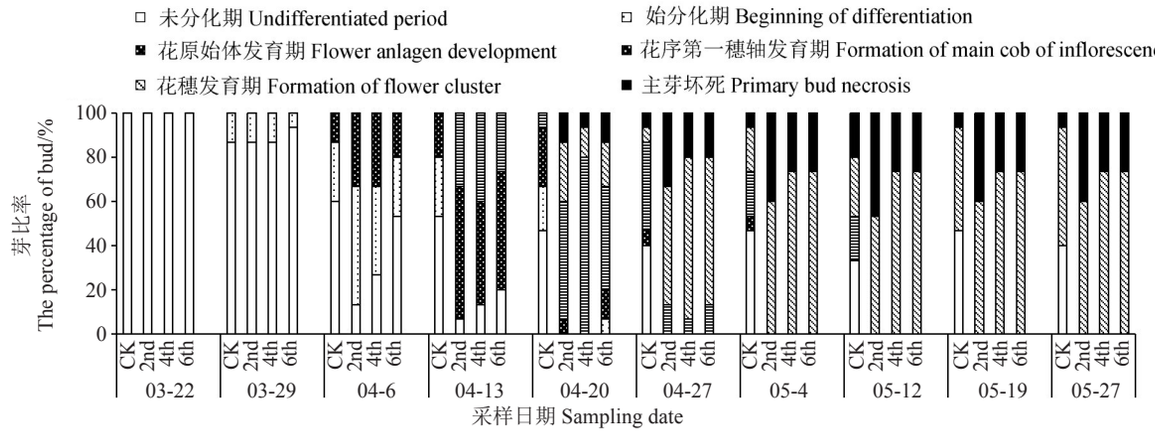
图3 不同摘心处理对‘夏黑’葡萄第5节位花芽分化的影响

Fig. 3 Flower bud differentiation at the 5th node of ‘Summer Black’ grape under different treatments

进入始分化期，且花上4片叶摘心处理于新梢展叶7~9片时开始有芽进入花原始体发育期，先于其他处理。初花期进入或通过始分化期的芽的比率花上4片叶摘心处理为73.3%，花上留6片叶摘心处理和对照处理比率仅为26.7%。花上留4片叶摘心和花上6片叶摘心处理第7节位芽均于坐果期全部通过始分化期，均早于对照处理。从花原始体发育到全部花芽进入花穗发育期，花上留4片叶摘心和花上留6片叶摘心处理均经历了29 d，而对照经历了52 d。

2.6 不同摘心处理对‘夏黑’葡萄第8节位冬芽花芽分化进程的影响

从图6可以看出，花上4片叶摘心处理第八节位的芽于新梢展叶7~9片时开始有芽进入始分化期和始原始体发育期，而花上留6片叶摘心处理和对照处理初花期才开始有芽进入始分化期与花原始体发育期。初花期进入或通过始分化期的芽的比率花上留4片叶摘心处理为80.0%，显著高于花上留6片叶摘心处理和对照处理的比率(26.7%)。花上留4片叶摘心和花上留6片叶摘心处理第8节位芽均于坐果期全部通过始分化期，均早于对照处理。从花原始体发育到全部花芽进入花穗发育期，花上留4片叶摘心和花上6留片摘心叶处理分别经历了37 d和29 d，而对照经历了52 d。

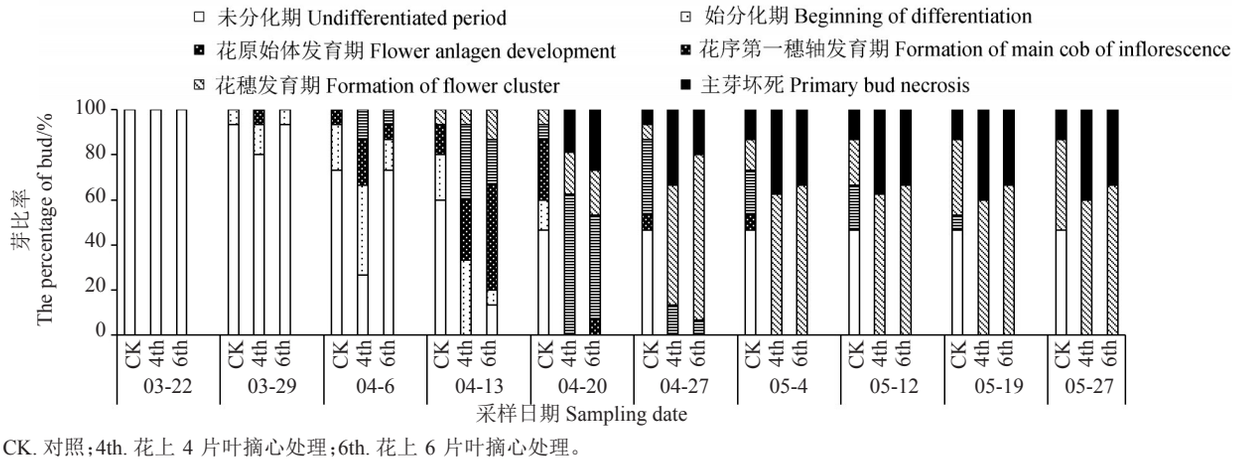


CK. 对照；2nd. 花上 2 片叶摘心处理；4th. 花上 4 片叶摘心处理；6th. 花上 6 片叶摘心处理。

CK. Control; 2nd. Treatment of pinched at the 2nd node above the cluster; 4th. Treatment of pinched at the 4th node above the cluster; 6th. Treatment of pinched at the6th node above the cluster.

图4　不同处理对‘夏黑’葡萄第6节位花芽分化的影响

Fig. 4　Flower bud differentiation at the 6th node of ‘Summer Black’ grape under different treatments

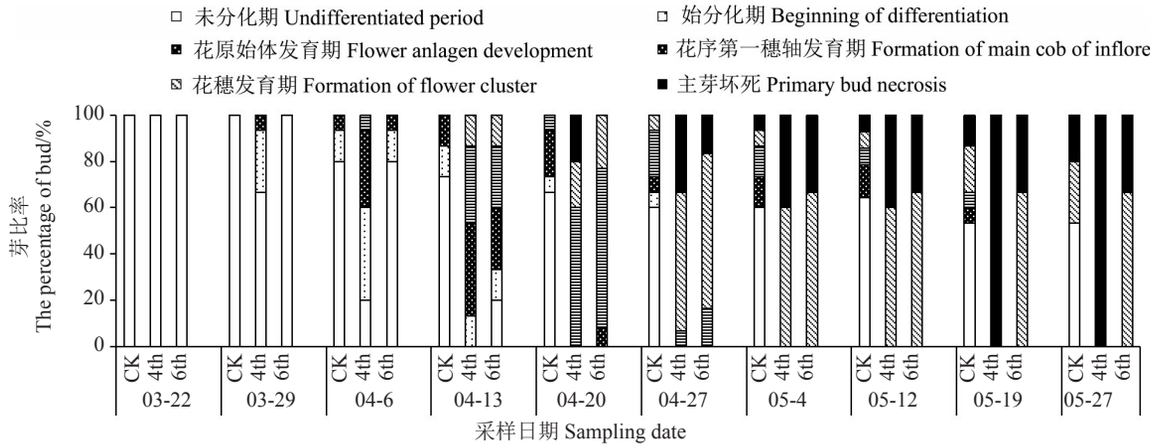


CK. 对照；4th. 花上 4 片叶摘心处理；6th. 花上 6 片叶摘心处理。

CK. Control; 4th. Treatment of pinched at the 4th node above the cluster; 6th. Treatment of pinched at the6th node above the cluster.

图5　不同处理对‘夏黑’葡萄第7节位花芽分化的影响

Fig. 5　Flower bud differentiation at the 7th node of ‘Summer Black’ grape under different treatments



CK. 对照；4th. 花上 4 片叶摘心处理；6th. 花上 6 片叶摘心处理。

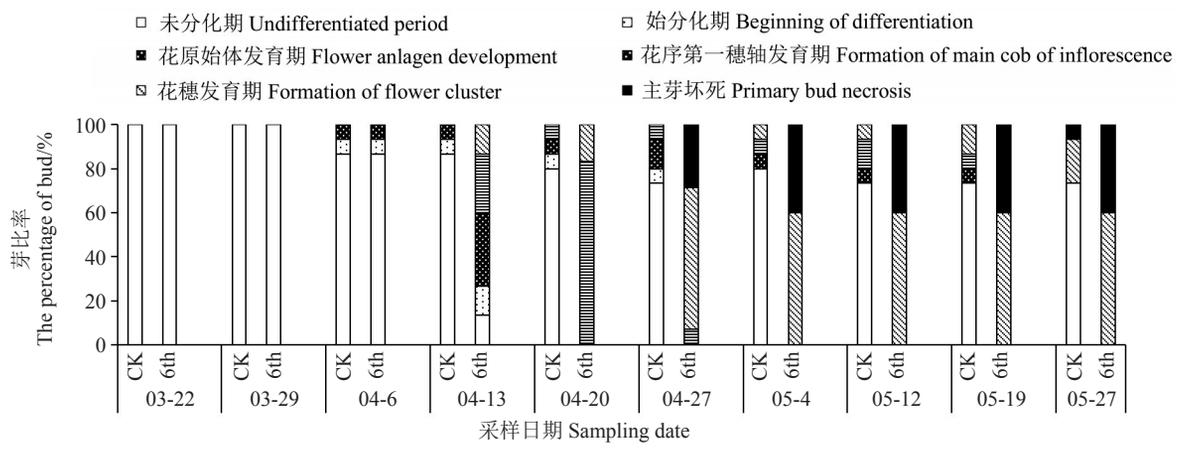
CK. Control；4th. Treatment of pinched at the 4th node above the cluster；6th. Treatment of pinched at the6th node above the cluster.

图6　不同处理对‘夏黑’葡萄第8节位花芽分化的影响

Fig. 6　Flower bud differentiation at the 8th node of ‘Summer Black’ grape under different treatments

2.7 不同摘心处理对‘夏黑’葡萄第9节位冬芽花芽分化进程的影响

从图7可以看出，花上6片叶摘心处理和对照处理第9节位的芽花芽分化起始时间一致，均于新梢展叶7~9片时开始有芽进入始分化期和始原始体发育期。初花期进入或通过始分化期的芽的比率花上6片叶摘心处理对照和均为13.3%。花上6片叶摘心处理第9节位芽于坐果期全部通过始分化期，而对照处理于果实膨大末期（5月4日）才全部通过始分化期。从花原始体发育到全部花芽进入花穗发育期，花上6片叶处理经历了29 d，而对照经历了52 d。



CK. 对照；6th. 花上 6 片叶摘心处理。

CK. Control; 6th. Treatment of pinched at the6th node above the cluster.

图7 不同处理对‘夏黑’葡萄第9节位花芽分化的影响

Fig. 7 Flower bud differentiation at the 9th node of ‘Summer Black’ grape under different treatments

2.8 不同摘心强度对‘夏黑’不同节位成花率的影响

从图8可以看出，对照处理‘夏黑’葡萄不同节位芽成花的能力不同，中部节位芽成花率高于基部和高节位芽，其中第5、6、7节位成花率最高，成花率分别为40.0%、44.4%和37.8%。花上2、4和6片叶3个摘心处理各节位芽成花率均显著高于对照。3个摘心处理下，花上4片叶摘心和花上6片叶摘心处理的第4、5、6节位芽成花率均大于75%，比花上2片

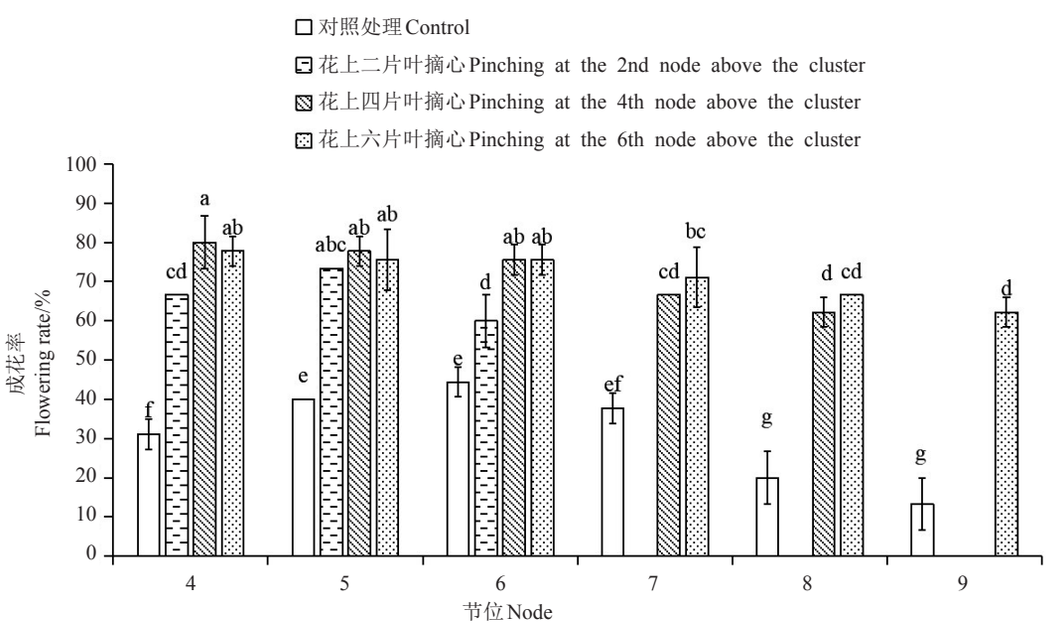


图8 不同摘心处理‘夏黑’葡萄不同节位成花率统计

Fig. 8 Flowering rates of winter buds at different nods of ‘Summer Black’ grape under different treatments

叶摘心处理高2.3%~15.6%，比对照高31.2%~48.9%。

3　讨　论

不同葡萄品种花芽分化的能力不同。晁无疾[14]研究了15个葡萄品种高节位芽花芽分化规律，发现品种间存在明显差异，且同一地区、同一品种不同栽培管理条件下也存在差异。Buttrose[15]研究‘Rhine Riesling’等5个葡萄品种的在不同光照、温度条件下的成花发现‘Rhine Riesling’成花能力较强。本研究中的‘夏黑’葡萄在一年两收栽培中易出现花芽分化不良的现象，王海波等[13]也报道了设施促早栽培模式下的‘夏黑’葡萄的成花能力弱于‘京蜜’葡萄的现象。

葡萄冬芽花芽形态分化期与对应的树体生长的物候期存在一定规律。‘维多利亚’葡萄在盛花期开始有芽进入始分化期，坐果期达到了始分化盛期，而‘红宝石’和‘红地球’葡萄在末花期才开始有芽进入始分化期，坐果期后进入始分化盛期[16-17]。本试验发现，‘夏黑’葡萄对照和各摘心处理的芽均能在新梢长至7~8节位开始有芽进入始分化期，初花期时进入始分化盛期，与王海波等[13]在研究设施促早栽培下‘夏黑’葡萄花芽分化规律的结果一致。

葡萄花芽分化由营养生长向生殖生长转变，受多种内外因素共同调控。树体营养积累的途径和流向是影响花芽数量和质量的重要因子。摘心是调控葡萄树体营养积累和流向的重要栽培措施。研究表明，花前新梢摘心会改变摘心口下1~2片叶片的氮素含量[9]，花前重摘心有助于促进叶片的生长和花穗的发育[18]，新梢留3~4节位的重摘心能显著加快修剪口下方1~2节位芽的花芽分化进程，使叶片所含营养物向芽内运输进而促进花芽分化[19]。刘万好[20]对葡萄副梢进行不同强度摘心的研究也发现，副梢不同的摘心强度会影响枝条的成熟度和贮藏营养，进而促进花芽分化。本试验中对‘夏黑’葡萄新梢进行2、4、6片叶摘心处理后得到类似结果，不同强度的摘心均能促进葡萄花芽分化。

同一结果母枝上不同节位冬芽的花芽分化能力不同，黄璐[12]研究‘巨峰’葡萄第7、8、9节位冬芽花芽分化发现第8节位的分化为花芽的能力最强。赵君全[21]研究促早‘夏黑’留10片叶后2~7节位芽的花芽分化规律发现，新梢4~5、6~7节位冬芽形成花芽的能力明显高于2~3节位冬芽。本研究发现，对照处理第4~7节位芽分化出花芽的比率（>30%）均显著高于第8~9节位，说明中部节位成花能力较强。不同强度摘心下，第4、5、6节位芽形成花芽的能力均高于第7、8、9节位芽。

葡萄花原基和卷须原基是同源器官，外界环境因素、喷施植物生长调节剂均可以影响两者相互转变。葡萄在高温（33 ℃白天—28 ℃夜晚）环境中生长时，易分化为花序原基，而在较低温度（21 ℃白天，16 ℃夜或18 ℃白天，13 ℃夜晚）环境中易分化为卷须原基[22]。细胞分裂素和矮壮素可促进花原基的形成，甚至能使已形成的卷须原基分化为花原基；而赤霉素抑制花原基的形成[23-24]。葡萄开始花芽分化的标志是在生长点变得扁平，开始分化出一个新的凸起，称之为始分化期，始分化期后快速进入花穗发育期是良好成花的保障，若冬芽的始原始体发育缓慢，未能进一步分化，而雏梢生长点持续快速分化，则易形成大量顶端二分的卷须始原始体[13]。本研究中，从花原始体发育期到全部芽进入花穗发育期，花上2、4、6片叶摘心处理相比对照花芽分化时间缩短了15~31 d，不同强度摘心处理对第6节位芽花芽分化进程影响较稳定，均经历了29 d。

综上所述，‘夏黑’葡萄花芽分化的调控的关键时期在初花期前后，夏季摘心可以促进一年两收‘夏黑’葡萄冬芽花芽分化，缩短花芽分化进程所需时间，显著提高成花率。最有利于‘夏黑’葡萄冬芽花芽分化的夏季摘心强度是花上4片叶和6片摘心，其冬果最佳修剪节位为第6节位。

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