

Effect of pruning intensity on bud fruitfulness, yield and anthocyanin content of grape (*Vitis vinifera*) hybrid H-516 trained on bower system

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Abstract

The present study was conducted to standardize the pruning technique in recently released grape hybrid H-516 for processing purpose. The grapevines trained on bower system of training were pruned at 2, 3, 4 and 5-bud level during last week of January. The maximum per cent fruitful buds were recorded at 2-bud level followed by 3, 4 and 5-bud pruning level. The significantly higher number of bunches per fruitful bud (2.23 at 4th node) were observed in pruning done at 4-bud level. The yield per vine was highest (15.2 kg yield per vine) in pruning treatments where 4-buds were retained. Bunch weight and size did not differ significantly with various pruning levels. Anthocyanin (52.24 mg/100g) and total soluble solids content (18.13%) was maximum whereas, acid content (0.53%) was minimum with 4-bud pruning treatment. Present study suggested that in grape hybrid H-516, at the time of pruning, 4-buds per cane should be retained for better yield and improved fruit quality.

Key words: Grape, *Vitis vinifera*, pruning, fruitful buds, anthocyanin, H-516, Punjab Purple.

Introduction

Grape (*Vitis vinifera* L.) is one of the few fruit plants being grown in a vast geographical area extending from tropical to subtropical and temperate regions across the world. It occupies an eminent position in world food industry both in terms of acreage and economic returns. At present, in India, grapes occupy an area of 117.6 thousand ha with total production of 2483.09 thousand mt (NHB, 2013). Although in India grape is commercially grown in the states of Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu, but owing to higher productivity, the grape cultivation in northern states also fetches good return to the growers. The climatic condition *i.e.*, dry weather of arid regions in northern states, during flowering, fruit development and maturity is conducive for the production of quality grapes. In this region 'Perlette' is the dominant table grape cultivar which occupies more than 90 per cent of total area under grapes. However, it has inherited problems such as high proportion of shot berries. Monoculture of this variety has further led to glut in markets during harvesting season. In order to diversify the varietal base, a new coloured grape hybrid H-516 (developed at ARI, Pune) suitable for processing, has recently been released for commercial cultivation in northern states of India (AICRP-STF, 2009). It is rich in anthocyanins (a source of antioxidants) and suitable for preparation of juices (Ready to serve beverages and nectar) and red wine (PAU, 2013).

The productivity and quality in grapes is dependent upon a number of factors, of which, proper training and pruning are very important. However, varietal and climatic conditions in different grape growing regions are so varied that the time and method of pruning cannot be uniform (Salem *et al.*, 1997; Dhillon, 2004; Ahmad, 2008). Proper pruning of cultivars plays an important role in sustaining the productivity for longer period of time.

Some cultivars respond to lower spur length while, others to longer cane pruning. If the length of the cane is left longer than desired level for longer time, the barrenness near the head of the vine is increased at faster rate (Arora and Gill, 2009). As H-516 is a newly recommended variety, it is essential to establish the location of fruitful nodes and prune the vine accordingly. Any lapse in pruning with reference to retaining the desired number of buds on a cane (either more or less than required) may lead to failure of crop. So in order to find out optimum level of pruning in grape hybrid H-516, the present investigation was undertaken at the Department of Fruit Science, PAU, Ludhiana.

Materials and methods

The study was conducted on 5-year-old vines of grape hybrid H-516 (Catawba x Beauty seedless) at Punjab Agricultural University, Ludhiana. The pruning of vines trained on bowers system of training was done at four level *viz.* 2, 3, 4 and 5-buds per cane in the last week of January. Each treatment was replicated 4 times and there were four vines per replication in Randomized Block Design (RBD). Uniform set of cultural practices for irrigation, weed management and plant practices was followed throughout the course of investigation to keep the plant in healthy condition.

At the time of pruning, sixteen canes on each vine were tagged for recording the phenological and fruiting characteristics. Time of bud burst was considered; when about 70-75 per cent green buds appeared. The percentage of fruit set was calculated by counting the total number of flowering buds and the buds which were converted into berries. The percentage of fruitful buds at various nodal positions was determined on the basis of total number of sprouted buds on each cane in each treatment.

The data on number of bunches was recorded in last week of

May. The maturity of bunches was considered when the berries at tip of bunch had 16 per cent total soluble solids (TSS). Twenty bunches were harvested on each vine for recording bunch weight and chemical characteristics. The yield per vine was calculated by multiplying average bunch weight and number of bunches per vine. The total soluble solids were recorded with the help of hand refractometer and subsequent corrections were made at 20°C (AOAC, 2000). The acidity was determined by titrating 2 mL of juice against 0.1 N NaOH using phenolphthalein as an indicator. Anthocyanin content was determined by extraction with ethanolic-hydrochloride and intensity of colour measured colorimetrically at 535 nm against the blank (Kaur and Dhillon, 2007).

Results and discussion

Effect on plant phenological characteristics: Amongst phenological characteristics, time of bud burst, bunch emergence, flowering and fruit set did not differ significantly with different pruning levels (Table 1). The minimum time to bud burst (34.5 days) was recorded in treatment in which pruning was done at 2-bud level. The time of bunch emergence was recorded 45.8 days after pruning, in vines in which 2-4 buds per spur were retained after pruning. The flowering was observed between 64-72 days after pruning. Ahmad *et al.* (2004) reported no effect on period required for bud burst, bunch emergence and flowering with severity of pruning in case of grape cv. Perlette.

The various pruning treatments had shown non-significant effect on time of fruit set. The time of fruit set varied from 76.0-76.8 days after pruning in different pruning treatments. However, the fruit set was affected significantly with various pruning levels (Table 1). The per cent fruit set was recorded maximum (48.36) in a treatments where pruning was done at 4-bud level. This was followed by 42.51 per cent fruit set in treatment in which pruning was done at 3-bud level. The higher per cent fruit set was recorded at 4-bud level which might be due to higher flower bud differentiation up to 4th node. The result of present studies are in accordance with the findings of Chadha and Mand (1969) who showed that the difference in time taken for fruit set was non-significant, when canes were pruned to 4, 5, 6 and 7-bud level in case of Anab-e-Shahi grapes. Similarly, Chadha *et al.* (1969) reported non-significant effect of severity of pruning on time taken for fruit set in Perlette.

Effect of various pruning treatments on per cent fruitful bud in grape hybrid H 516 was significant (Fig. 1). The maximum fruitful buds (78.12 %) were obtained in 2-bud pruning treatment and the minimum fruitful buds (44.58 %) were obtained in treatment in which pruning was done at 5-bud level. These results indicate the influence of number of bud kept while pruning as reported by

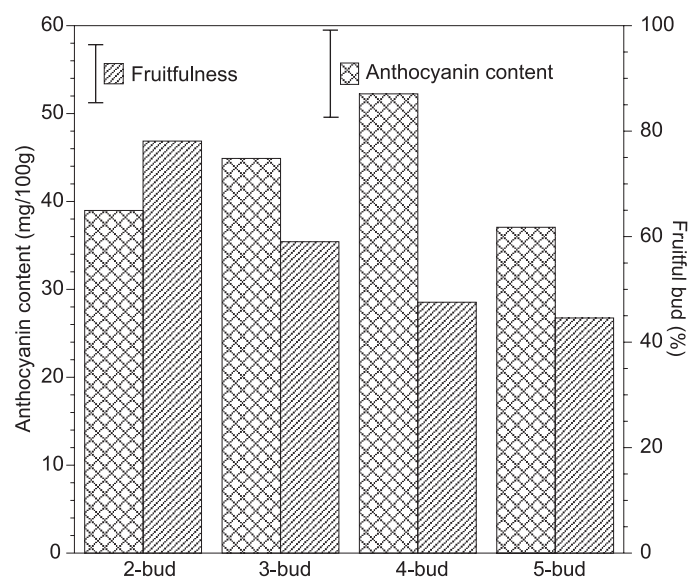


Fig 1. Effect of different levels of pruning on fruitful bud (%) and anthocyanin content of grape hybrid H-516. (Bars indicate LSD, $P=0.05$)

Khandhuja *et al.* (1976) and Arora and Gill (2009) who obtained higher percentage of fruitful buds in Beauty Seedless and Flame Seedless grapes, respectively, with 4 bud pruning level.

Effect on yield and bunch characteristics: Different levels of pruning had a significant effect on number of bunches and yield (Table 2). The number of bunches (112.8/ vine and 4.2/cane) were significantly higher, when 4 buds were retained on each cane after pruning. The minimum number of bunches (65.8/ vine and 2.4 per cane) were obtained when 2 buds per cane were left after pruning. Likewise, the vines in which pruning was done at 4-bud level recorded significantly higher fruit yield (15.2 kg/vine) as compared to other treatments. The lowest fruit yield (8.4 kg/vine) was recorded in treatment in which 2-buds per cane were retained after pruning (Table 2). Dhillon (2004) also found that retention of 4-buds per cane proved most productive, in terms of number of bunches per vine and yield. Gill and Sharma (2005) also recorded maximum number of bunches and yield per vine with 4-bud pruning per cane in Flame Seedless grapes. Arora and Gill (2009) also reported that the number of bunches per vine was significantly higher, when 4 buds were retained on each cane after pruning in Flame Seedless grapes.

The maximum number of bunches per fruitful bud (2.23) were recorded in case of 4-bud pruning treatment which was higher as compared to other fruiting nodes in various pruning treatments (Table 3). The data obtained in present studies also reveal that number of bunches per fruitful bud increased as the number of buds was increased per cane up to 4th bud and after that it again started decreasing. Further, it was also observed that fruitfulness

Table 1. Effect of pruning intensity on phenological characteristics of grape hybrid H-516

Treatment	Time of bud burst (days)	Time of bunch emergence (days)	Time of initiation of flowering (days)	Time of completion of flowering (days)	Time of fruit set (days)	Fruit set (%)
2-bud level	34.5	45.8	64.0	72.0	76.0	38.65
3-bud level	34.8	45.8	64.3	72.3	76.3	42.51
4-bud level	35.3	45.8	64.5	72.5	76.5	48.36
5-bud level	35.3	46.5	64.8	72.8	76.8	39.93
LSD ($P=0.05$)	NS	NS	NS	NS	NS	6.73

Table 2. Effect of pruning intensity on yield and bunch characteristics of grape hybrid H-516

Treatment	Number of bunches per vine	Number of bunches per cane	Yield (kg/vine)	Bunch weight (g)	Bunch length (cm)	Bunch breadth (cm)
2-bud level	65.8	2.4	8.4	128.4	19.1	7.4
3-bud level	79.5	3.6	10.4	131.2	20.5	7.6
4-bud level	112.8	4.2	15.2	134.5	20.8	8.0
5-bud level	93.8	2.6	12.4	130.9	20.1	7.6
LSD ($P=0.05$)	18.0	1.1	3.1	NS	NS	NS

of buds at the base of canes get suppressed, if the length of the cane is increased by increasing number of buds per cane. The maximum number of bunches at 4-bud may be due to maximum flower bud differentiation at this bud. The number of bunches per fruitful bud started decreasing after 4-bud due to less flower bud differentiation after this node, which may be due to the fact that some varieties bears on basal (1-4) buds and on increasing cane length they become unfruitful. Kumar and Singh (1981) also reported that highest number of inflorescence was borne at 4th node, followed by 5th, 3rd and 6th nodes (in descending order) in Anab-e-Shahi grapes. Similarly, Gill and Sharma (2005) reported that maximum percentage of fruitful buds were recorded in case of 4-bud treatment as compared to 3, 5 and 6-bud pruning treatments in Flame Seedless.

The pruning severity has non-significant effect on bunch weight, length and breadth (Table 2). The higher bunch weight (134.5 g), length (20.8 cm) and breadth (8.0 cm) was recorded in treatment when pruning was done at 4-buds as compared to other treatments. The results are in accordance with Tomer (1994) who recorded no effect on bunch size with any of pruning treatments in Cardinal grapes.

Effect on berry and juice characteristics: The higher berry weight (2.35 g) was recorded in case of 4-bud pruning treatment followed by 3-bud (2.17 g), 5-bud (2.15 g) and 2-bud (2.05 g) (Table 4). The differences in various pruning treatments with respect to berry size (length and breadth) were also found non-significant (Table 4). However, the data indicates that berry length (1.66 cm) and berry breadth (1.52 cm) was highest with 4-bud pruning treatment. Previously, Tomer and Brar (1985) and Gill (2005) reported that maximum percentage of fruitful buds were recorded in case of 4-bud treatment as compared to 3, 5 and 6-bud pruning treatments in Flame Seedless.

Treatment	Number of bunches per fruitful bud				
	1 st bud	2 nd bud	3 rd bud	4 th bud	5 th bud
2-bud level	1.15	1.65	-	-	-
3-bud level	0.29	1.19	1.75	-	-
4-bud level	0.08	0.35	1.58	2.23	-
5-bud level	0.21	0.44	0.50	1.70	1.58

Table 4. Effect of pruning intensity on berry and juice characteristics of grape hybrid H-516

Treatment	Berry weight (g)	Berry length (cm)	Berry breadth (cm)	TSS (%)	Acidity (%)	TSS:acid ratio
2-bud level	2.05	1.60	1.46	16.48	0.634	26.03
3-bud level	2.17	1.61	1.49	17.88	0.583	30.75
4-bud level	2.35	1.66	1.52	18.13	0.525	34.65
5-bud level	2.15	1.64	1.49	16.15	0.600	26.90
LSD ($P=0.05$)	NS	NS	NS	1.51	0.062	3.70

and Sharma (2005) also recorded non-significant effect on berry weight and size in grapes with different pruning levels.

The various levels of pruning significantly affected the quality (TSS, acidity, TSS: acid ratio, anthocyanin contents) of grape hybrid H516 during present study (Table 4). The significantly higher total soluble solids (18.13%), TSS: acid ratio (34.65) and lower acidity (0.53%) were recorded in treatment, in which 4 bud level pruning was done. The treatment, in which maximum 5 buds per cane were retained at the time of pruning, had lowest percentage of total soluble solids (16.15) as compared to other pruning treatments. In present study, the fruit quality was better in treatments in which 3 or 4 buds per cane were retained which might be due to optimum leaf number and higher carbohydrate assimilation in these treatments. Singhrot *et al.* (1977) also recorded significant increase in TSS content with decrease in number of buds per cane in Thompson Seedless grapes. Likewise, Thatai *et al.* (1987) and Arora and Gill (2009) reported higher TSS and lower acidity level with 4 bud pruning level. However, Tomar and Brar (1985) in Delight and Ahmad (2008) in Himrod cultivar of grapes found that quality attributes were unaffected with various intensity of pruning.

The data with respect to anthocyanin content of juice indicates that 4-bud pruning treatments had more anthocyanin content (52.24 mg/100 g) as compared to 2, 3 and 5-bud pruning treatments (Fig 1). El-Baz *et al.* (2002) reported that in grape cultivar 'Crimson', 12-bud (less number of buds) pruning treatment gave the highest anthocyanin content as compared to 14 and 16-bud (higher number of buds) treatments.

To conclude, the present study suggested that in grape hybrid H-516 (Punjab Purple) pruning at 4-bud level resulted in higher percent of bud fruitfulness and yield. The fruit quality in terms of higher TSS, lower acidity and higher anthocyanin content was also observed in vines which were pruned to 4-bud level.

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Received: October, 2013; Revised: January, 2014; Accepted: January, 2014