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Influence of Pruning Levels on Bud Fertilities in Grape (*Vitis vinifera* L.) cv Flame Seedless and Sharad Seedless

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Abstract The experiment was carried out to improve grapevine growth and yield. Results revealed that, lesser day taken for bud sprout from pruning (18.02 Flame seedless and 17.04 Sharad seedless) lesser internodal length (3.37 cm Flame seedless and 3.41 cm Sharad seedless) productive cane per vine (39.08 Flame seedless and 39.82 Sharad seedless) unproductive cane per vine (4.55 Flame seedless and 5.01 Sharad seedless) leaf area (2601.22 cm^2 Flame seedless and 2572.46 cm^2 Sharad seedless) maximum cane length at 5^{th}, 10^{th} and 15^{th} leaf stage in T_{13} Flame sedless and at 5^{th}, 10^{th}, 15^{th} in T_{13} Sharad seedless maximum cane diameter T_1 Flame seedless and T_1 Sharad seedless, mother cane and sub cane length were maximum T_{13} treatment in both varieties while its diameter was maximum with T_1 in both varsities as well as fresh weight of the pruned wood was maximum with treatment T_{13} in both varieties. Petiole nutrient contents N, P, K percentage (2.82, 0.89, 2.88 Flame seedless and 2.95, 0.91, 2.88 Sharad seedless), commencement of flowering (27.28 days Flame seedless and 28.33 days Sharad seedless), days from flowering to harvest (85.55 days Flame seedless and 82.67 days Sharad seedless) yield per vine (12.42 kg Flame seedless and 13.71 kg Sharad seedless) yield tonnes per hectare (23 t/ha Flame seedless and 24.58 t/ha Sharad seedless).

Keywords Pruning levels, Flame seedless, Sharad seedless, Grape.

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Introduction

The grape cv Flame seedless and Sharad seedless has been recommended recently for commercial cultivation in south India. The clusters of these varieties are compact which is susceptible to bunch rot. Pruning is one of the most important cultural practices which have a profound influence on growth, yield and quality parameters. Proper pruning regulates good annual yield, size and quality of berries it helps to improve the microclimate in the canopy,promote good ripening of the grapes and creates less suitable conditions for the development of pathogens Altintas [1]. Pruning technique is a variety-specific in grapes and need to be standardized to fulfil specific objectives the present study was aimed at this target.

Materials and Methods

The present investigation Influence of pruning levels on bud fertilities in Flame seedless and Sharad

Table 1. Influence of cane pruning levels on morphological parameter of grapes in cv Flame seedless and Sharad seedless.

Treatments	Flame seedless				Sharad seedless			
	No. of days for bud sprouting from pruning	Inter nodal length (3th-5th) node (cm)	No. of productive cane/vine	No. of un-productive cane/vine	No. of days for bud sprouting from pruning	Internodal length (4th-6th) node (cm)	No. of productive cane/vine	No. of un-productive cane/vine
T_1	18.02	3.61	38.07	5.51	17.04	3.53	39.29	5.30
T_2	18.04	3.65	37.78	6.44	17.27	3.73	39.08	5.41
T_3	18.07	3.81	37.70	5.91	18.16	3.51	38.86	5.56
T_4	18.48	3.48	37.88	6.24	17.08	3.70	38.48	5.75
T_5	18.38	3.37	39.08	4.55	19.00	3.71	38.75	5.60
T_6	19.06	4.66	38.11	5.64	20.40	4.09	38.41	6.08
T_7	19.28	3.65	38.08	6.08	20.13	4.27	39.27	5.57
T_8	19.57	4.37	38.50	5.68	20.78	3.85	38.36	6.13
T_9	19.95	4.27	38.30	5.51	21.72	3.41	39.82	5.01
T_{10}	20.31	4.37	38.32	5.85	21.72	4.05	38.20	6.07
T_{11}	21.75	4.46	38.00	5.51	22.47	4.45	38.59	6.09
T_{12}	22.19	5.16	38.54	5.86	22.57	4.03	38.81	6.18
T_{13}	24.38	5.59	34.33	9.44	24.36	5.59	35.80	8.92
SEm ±	0.23	0.20	0.34	0.44	0.63	0.18	0.27	0.32
CD @ 5%	0.65	0.56	0.98	1.24	1.80	0.51	0.76	0.91
CV %	2.59	10.53	2.03	16.23	6.99	10.13	1.54	11.94

seedless grapes varieties under mild tropics was undertaken at Indian Institute of Horticultural Research Hesserghatta, Bangalore during 2014-2015. On nine years old grapevines which were trained on extended 'Y' trellies spaced at 3.0 × 1.8 m apart. For summer season crop vines were pruned on Oct, 2014 and harvested during the Feb, 2014 with thirteen pruning intensities replicated five times in a randomized block design. The following halting treatments were applied.

Flame seedless

T_1, halt at 3th node 1 sub cane and 1 bud T_2, halt at 3th node 1 sub cane and 2 buds T_3, halt at 3th node 2 sub cane and 1 bud T_4, halt at 3th node 2 sub cane and 2 buds T_5, halt at 4th node 1 sub cane and 1 bud T_6, halt at 4th node 1 sub cane and 2 buds T_7, halt at 4th node 2 sub cane and 1 bud T_8, halt at 4th node 2 sub cane and 2 buds T_9, halt at 5th node 1 sub cane and 1 bud T_{10}, halt at 5th node 1 sub cane ande 2 buds T_{11}, halt at 5th node 2 sub cane and 1 bud T_{12}, halt at 5th node 2 sub cane and 2 buds T_{13}, no halting straight cane

Sharad seedless

T_1, halt at 4th node 1 sub cane and 1 bud T_2, halt at 4th node 1 sub cane and 2 buds T_3, halt at 4th node 2 sub cane and 1 bud T_4, halt at 4th node 2 sub cane and 2 buds T_5, halt at 5th node 1 sub cane and 1 bud T_6, halt at 5th node 1 sub cane and 2 buds T_7, halt at 5th node 2 sub cane and 1 bud T_8, halt at 5th node 2 sub cane and 2 buds T_9, halt at 6th node 1 sub cane and 1 bud T_{10}, halt at 6th node 1 sub cabe and 2 buds T_{11}, half at 6th node 2 sub cane and 1 bud T_{12}, halt at 6th node 2 sub cane and 2 buds T_{13}, no halting straight cane.

Results and Discussion

The results of the present investigation as well as relevant discussion have been summarized under following heads :

Bud sprout

The different severity of cane halting had exhibited significant effect on the period required for bud sprout in both varieties of grape i.e. Flame seedless and Sharad seedless (Table 1). In variety Flame seedless T_1,The cane halt at 3th node 1 sub cane and 1 bud hastened the bud sprout by about 10 days (18.02 days) as com-

Table 2. Influence of cane pruning levels on growth parameters of grapes in cv Flame seedless and Sharad seedless.

	Flame seedless						Sharad seedless					
	Cane length (cm)			Cane diameter (mm)			Cane length (cm)			Cane diameter (mm)		
Treatments	5th leaf	10th leaf	15th leaf	5th leaf	10th leaf	15th leaf	5th leaf	10th leaf	15th leaf	5th leaf	10th leaf	15th leaf
T_1	13.55	29.67	77.91	3.80	6.46	9.68	20.49	40.96	68.58	3.45	6.32	9.38
T_2	13.83	37.85	78.00	3.80	6.00	9.66	18.43	40.43	69.28	3.10	6.63	9.53
T_3	15.12	38.74	79.05	3.58	5.56	9.66	19.60	40.20	68.92	3.38	6.18	9.37
T_4	15.65	38.38	82.84	3.75	5.97	9.45	19.66	40.40	69.08	3.32	6.20	9.32
T_5	15.01	36.33	81.25	3.36	5.77	9.65	19.64	39.41	72.45	3.17	5.62	9.59
T_6	15.11	39.12	82.88	3.55	5.98	9.54	19.82	41.30	73.74	3.36	5.86	9.37
T_7	15.52	42.72	83.39	3.74	5.74	8.76	20.19	41.80	76.71	2.89	5.96	9.16
T_8	15.02	39.85	85.58	3.65	5.10	9.36	21.07	42.88	79.04	3.13	6.14	9.15
T_9	18.81	43.05	86.65	3.59	5.32	9.55	21.50	43.87	84.29	3.33	5.95	8.85
T_{10}	19.53	43.54	89.30	3.30	4.87	9.46	23.62	43.16	83.11	2.55	5.82	8.68
T_{11}	20.14	41.79	88.94	3.34	5.31	9.27	24.32	45.82	83.49	2.26	5.80	8.50
T_{12}	20.68	43.55	89.23	2.86	5.34	9.05	25.63	45.19	81.92	2.44	5.62	7.82
T_{13}	25.48	47.85	94.38	1.59	3.44	6.10	27.75	54.74	93.66	1.37	4.64	6.47
SEm ±	0.42	0.65	0.60	0.22	0.22	0.42	0.22	0.47	0.58	0.16	0.21	0.19
CD @ 5%	1.18	1.86	1.71	0.62	0.64	1.20	0.63	1.32	1.65	0.46	0.59	0.53
CV%	5.41	3.63	1.59	14.48	9.18	10.29	2.28	2.42	1.67	12.43	7.85	4.70

pared to T_{13}, no halting (24.38 days). Similarly, in variety Sharad seedless also cane half at 4th node 1 sub cane and 1 bud took (17.04 days) for bud sprouting which was about 7 days earlier than T_{13}, no halting (24.36 days). Thus from the above results, it's clear that, with the decrease in cane halting severity, the time required for bud sprout increased. In respect of inter nodal length per cane were significantly, influenced by the cane halting. Minimum internodal length per cane in variety Flame seedless (3.37 cm) were observed in treatment 4th node 1 sub cane and 1 bud and maximum inter nodal length per cane recorded in no halting straight cane T_{13}. However, in Sharad seedless minimum (3.41) and maximum (5.59) were observed in treatment T_1 and T_{13} respectively. Internodal lengths per cane were decrease due to ABA accumulation in cane and increase in cane pruning severity. These findings are in close conformity with the observation recorded by Bhosale et al. [2].

Productive and unproductive cane per vine

In Flame seedless variety maximum number of productive cane per vine (39.08) and minimum unproductive cane per vine (4.55) were found in 4th node 1 sub cane and 1 bud, while in case of Sharad seedless variety, maximum productive cane per vine (39.82) and minimum unproductive cane per vine (5.01) were found in 6th node 1 sub cane and 1 bud. Another criterion to judge the productivity of cane in a well maintained vineyard, the vines with thicker canes and shorter internodes are known to regulate productivity of cane per vines. Similar results were noticed by Conde et al. [3].

Cane length and diameter

Higher cane length was recorded at various stages namely 5th, 10th and 15th leaf stages (Table 2). As regard cane pruning severity T_{13}, no halting recorded maximum cane length at 5th leaf stage (25.48 cm) 10th leaf (47.85 cm) and 15th leaf (94.38 cm) and maximum diameter were observed at T_1, 5th leaf (3.80 mm) 10th leaf (6.46 mm) and 15th leaf (9.68 mm) while it was minimum with T_{13}, no halting in Flame seedless. Similar results were obtained in case of Shard seedless. Cane length regulated with T_{13}, no halting straight cane by 5th, 10th and 15th leaf stages. While their diameters were regulated by T_1 4th node 1 sub cane and 1 bud respectively. This showed that, severe the pruning less was the length of the cane and severe the pruning higher the diameter of cane, the cane growth was found to be higher. The cane length and diameter was influenced greatly by the reserves carbohydrates in the trunk and canes left over after pruning. Similar results

Table 3. Influence of cane pruning levels on leaf area, mother and sub cane parameter in grapes cv Flame seedless and Sharad seedless.

	Flame seedless					Sharad seedless				
Treatments	Total leaf area per cane (cm^2)	Mother cane length (cm)	Mother cane diameter (mm)	Sub cane length (cm)	Sub cane diameter (mm)	Total leaf area per cane (cm^2)	Mother cane length (cm)	Mother cane diameter (mm)	Sub cane length (cm)	Sub cane diameter (mm)
T_1	2601.22	12.19	12.13	6.66	10.46	2572.46	12.74	10.35	12.32	10.46
T_2	2544.84	13.43	11.96	7.52	10.23	2514.53	13.44	10.23	12.35	10.46
T_3	2531.21	13.47	12.13	8.49	10.32	2513.08	13.56	10.13	12.37	10.33
T_4	2580.85	14.40	12.09	8.38	10.26	2522.48	14.60	10.17	12.29	10.27
T_5	2598.30	15.45	12.25	8.58	10.59	2508.17	15.46	9.96	12.51	10.56
T_6	2549.02	14.26	12.14	10.17	10.45	2530.68	14.46	8.28	12.39	10.41
T_7	2551.89	13.21	12.17	11.10	9.91	2547.72	15.16	9.75	12.38	10.34
T_8	2537.07	13.43	12.05	11.41	9.12	2544.68	15.56	9.73	12.31	9.31
T_9	2566.45	14.00	11.54	12.37	9.67	2558.87	16.59	9.64	11.54	9.73
T_{10}	2557.46	14.20	11.44	12.33	9.05	2565.17	16.29	8.37	11.43	9.58
T_{11}	2561.57	15.24	11.32	13.62	9.10	2565.43	16.83	8.42	11.29	9.90
T_{12}	2565.07	15.23	11.27	13.43	9.05	2460.92	17.47	8.42	11.31	9.84
T_{13}	2056.51	18.47	8.88	17.57	7.91	1976.64	19.80	6.98	10.23	7.61
SEm ±	30.17	0.42	0.17	0.18	0.16	21.94	0.13	0.52	0.04	0.08
CD@ 5%	85.79	1.20	0.49	0.51	0.45	62.38	0.36	1.49	0.11	0.24
CV %	2.67	6.55	3.31	3.70	3.63	1.97	1.84	12.65	0.71	1.89

were obtained earlier Dai et al. [4].

Leaf area, mother cane, sub cane length and diameter

In Flame seedless variety maximum mother cane lengths (18.47 cm) were recorded in T_{13}, no halting and minimum (12.19 cm) registered in 3th node 1 sub cane and 1 bud (Table 3). In case of Sharad seedless it was minimum with 5th node 1 sub cane and 2 buds while it was maximum with T_{13}, no halting. In Flame seedless maximum mother cane diameter were observed in 4th node 1 sub cane and 1 bud and minimum (8.88 mm) noticed in T_{13}, no halting while in Sharad seedless it was minimum in no halting and maximum with 4th node 1 sub cane and 1 bud. Sub cane length were maximum with no halting (17.57 cm) and it was minimum (6.66 cm) with 3th node 1 sub cane and 1 bud in Flame seedless similar observation were recorded in Sharad seedless. With respect to sub cane diameter both varieties recorded maximum diameter in T_5 and minimum with T_{13} no halting. However, comparing the effect of halting on mother cane and sub cane length as well as diameter, differential response could be noticed. Halted canes for vegetative growth resulted in higher mother cane and sub cane diameter. Similar results were obtained earlier Giudice et al. [5]. Maximum leaf area (2601.22 cm^2) were found in 3th node 1 sub cane and 1 bud and minimum (2056.51 cm^2) noticed in no halting, while in case of Sharad seedless variety maximum leaf area (2572.46 cm^2) were observed in treatment 4th node 1 sub cane and 1 bud and minimum (1976.64 cm^2) were recorded in no halting. They pointed out necessity of higher temperature for better regulative growth Korkutal [6]. Due to sever pruning carbohydrates accumulated before pruning in the vine diverted towards regulative growth thereby increase shoot length as shoot length increase number of leaves and leaf area increased.

Fresh weight of pruned wood

Fresh weight of the pruned wood was significantly maximum with no halting in both varsities while, it decreases with severity of halting respectively (Table 4). The above results indicated that the vigor for vegetative growth was influcnced greatly by the reserves in the trunk and canes left over after pruning. Similar observations were made in number of earlier studies also by other workers Roby et al. [7].

Table 4. Influence of cane pruning levels on fresh weight and petiole nutrient contents in grapes cv Flame seedless and Sharad seedless.

	Flame seedless				Sharad seedless			
Treatments	Fresh weight pruned material (kg)	Total nitrogen content (%)	Total phosphorus content (%)	Total potassium content (%)	Fresh weight pruned material (kg)	Total nitrogen content (%)	Total phosphorus content (%)	Total potassium content (%)
T_1	5.39	2.82	0.79	2.77	5.39	2.81	0.78	2.86
T_2	6.48	2.79	0.78	2.77	6.74	2.81	0.79	2.85
T_3	6.44	2.81	0.77	2.79	5.30	2.79	0.81	2.80
T_4	6.79	2.74	0.74	2.77	6.63	2.76	0.80	2.78
T_5	5.42	2.82	0.89	2.88	5.52	2.76	0.81	2.77
T_6	6.69	2.73	0.86	2.73	6.45	2.75	0.82	2.75
T_7	5.32	2.70	0.80	2.69	5.38	2.78	0.84	2.75
T_8	6.81	2.70	0.76	2.67	6.92	2.81	0.86	2.80
T_9	5.47	2.65	0.77	2.57	5.29	2.95	0.91	2.88
T_{10}	6.94	2.67	0.72	2.51	5.98	2.87	0.83	2.85
T_{11}	6.29	2.54	0.75	2.42	5.30	2.82	0.74	2.77
T_{12}	6.97	2.47	0.72	2.37	6.88	2.76	0.74	2.74
T_{13}	7.47	2.22	0.69	2.26	7.38	2.64	0.62	2.24
SEm ±	0.31	0.03	0.01	0.02	0.21	0.01	0.02	0.01
CD @ 5%	0.87	0.08	0.04	0.05	0.59	0.04	0.05	0.04
CV %	10.81	2.28	3.74	1.38	7.67	1.10	4.77	1.10

Petiole nutrient content

Fruiting is an exhaustive process and heavy crop load generally leads to depletion of nutrient reserves of the vine resulting in early senility. In this context petiole analysis of the vine was taken up for major nutrients like (nitrogen, phosphorus and potassium). Significantly maximum petiole nutrient contents total nitrogen (2.82%) phosphorus (0.89%) potassium (2.88%) recorded in 4th node 1 sub cane and 1 bud while minimum total nitrogen, phosphorus and potassium were observed in no halting in Flame seedless in case of Sharad seedless total nitrogen (2.95%), phosphorus (0.91%) and potassium (2.88%) was

Table 5. Influence of cane pruning levels on flowering and yield attributes in grapes cv Flame seedless and Sharad seedless.

	Flame seedless				Sharad seedless			
Treatments	No. of days for flowering from pruning	No. of days from flowering to harvest	Yield/vine (kg)	Yield (t/ha)	No. of days for flowering from pruning	No. of days from flowering to harvest	Yield/ vine (kg)	Yield (t/ha)
T_1	27.28	85.55	11.67	21.61	28.33	82.67	9.34	17.31
T_2	28.32	87.62	10.51	19.44	28.59	84.73	9.67	17.91
T_3	29.30	88.65	10.52	19.47	30.92	82.90	10.46	19.37
T_4	30.33	88.94	10.06	18.43	31.78	85.88	8.82	15.89
T_5	28.24	84.65	12.42	23.00	34.35	90.79	9.77	17.13
T_6	32.30	90.69	10.42	19.29	35.37	92.86	8.87	15.94
T_7	32.21	92.01	10.23	18.95	36.34	93.81	11.18	20.70
T_8	34.28	92.56	10.01	18.53	37.44	94.71	8.52	15.76
T_9	36.36	93.40	9.09	16.85	30.94	86.02	13.71	24.58
T_{10}	38.25	93.50	9.47	17.55	38.37	95.71	10.87	20.16
T_{11}	38.50	94.65	8.84	16.37	39.35	95.67	11.11	20.58
T_{12}	38.33	94.66	8.94	16.55	40.08	96.20	12.18	22.58
T_{13}	43.72	97.98	6.90	12.67	46.01	98.55	5.84	10.81
SEm ±	0.32	0.16	0.30	0.54	0.17	0.18	0.64	1.25
CD @ 5%	0.90	0.45	0.84	1.54	0.49	0.50	1.82	3.55
CV %	2.10	0.39	6.68	6.60	1.10	0.44	14.26	15.21

higher in 6th node 1 sub cane and 1 bud, while it was minimum with no halting. No halting exhibited lower level of nutrients in the petiole due to relatively more number of fruiting canes per vine, competing for drawing more nutrients for development of bunches indicating higher depletion of nutrients due to heavy crop load. This finding was strongly supported by the results of Roby et al. [7].

Flowering

Commencement of flowering was significantly affected time and severity, the number of days required for commencement of flowering was minimum (27.28 days) in 3th node 1 sub cane and 1 bud and maximum period (43.72 days) in no halting in variety Fame seedless (Table 5). Whereas in Sharad seedless minimum period (28.33 days) was noticed in 4th node 1 sub cane and 1 bud and maximum period (46.01 days) in no halting for commencement of flowering with delay in flowering time and consequent lowering temperature, the time required for flowering was increased. These results agree with the finding of Zsof et al. [8]. In Flame seedless days from flowering to harvest was minimum (85.55 days) in 3th node 1 sub cane and 1 bud and maximum (92.98 days) in no halting in case of Sharad seedless days from flowering to harvest was minimum (82.67 days) in 4th node 1 sub cane and 1 bud and maximum (98.55 days) in no halting.

Yield attributes

Yield of grapes was significantly affected by cane halting severity. The results obtained in present study in respect of yield per vine (12.42 kg) and yield toones per hectare (23.00 t/ha), showed that cane halting severity 3th node 1 sub cane and 1 bud was significantly superior than the rest of treatment in variety Flame seedless in case of Sharad seedless yield per vine (13.71 kg), and yield toones per hectare (24.58 t/ha), showed that cane halting severity 4th node 1 sub cane and 1 bud were noticed higher yield, bathe varieties yields were superior compared to no halting. The increased in yield per vine and yield toones per hectare could be explained on the basis of leaf area available for greater carbohydrates accumulation lower yield obtained in no halting straight cane was due to less number of bunches and berries per bunch and bunch weight. These results are in conformity with the results reported by Zsof et al. [8].

Conclusion

From the above results it can be concluded that among different cane pruning levels cane halt at 4th node 1 sub cane and 1 bud resulted significantly maximum, growth and yield parameters in grape cv Flame seedless. Whereas, in Sharad seedless cane halt at 6th node 1 sub cane and 1 bud was found superior then the rest of treatments under mild tropics condition.

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