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IMPACT OF CANOPY MANAGEMENT ON GROWTH AND YIELD OF WINE GRAPES UNDER NORTHERN DRY ZONE OF KARNATAKA

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ABSTRACT

An investigation was conducted to know the "Impact of canopy management on growth and yield of wine grapes under northern dry zone of Karnataka" at division of fruit science, UHS, Bagalkot during 2015-16. For the study varieties and cane regulation were considered as main and sub treatments respectively. Medika was superior with respect to growth (inter-nodal length of cane 4.31 cm, inter-nodal length of fruiting shoot 4.74 cm, and girth 4.77 mm and superior bunches-length-25.33 cm, breadth 9.59 cm, weight 326.50 g). Shiraz resulted to be early variety (bud burst 10.75 days, panicle initiation 17.33 days and duration of maturity 114.25). Grenache Blanc gave maximum yield (24.00 kg/vine). Among cane regulation, vines with 25 canes was found to be superior over other treatments *i.e.* inter-nodal length 4.36 cm and girth of the cane 5.46 mm; inter-nodal length 4.59 cm and girth of the fruiting shoot 5.03 mm, chlorophyll content of leaf 29.07, bunch characters (24.22 x 9.33 mm LxB and 299.78 g). Hence cane regulation (25 canes/vine) is essential form of canopy management which could lead to tremendous improvement in yield and quality parameters of wine grapes.

INTRODUCTION

Grape (*Vitis vinifera* L.) belongs to the family Vitaceae, originated in Caucasia or Asia Minor. The grape is one of the ancient fruit crops of India and which is cultivated in an area of 1.19 lakh hectare with the production of 25.85 lakh tons and productivity of 21.80 MT/ha (NHB, 2014). Historically, it is grown mostly for wine making in the world over. Wine grape cultivation is gaining strong impetus in tropical climatic conditions of the world. In contrast, prominent area and production accounts for table grapes in India, while wine grapes are grown over an area of 5.00 thousand hectares with annual production of 50.00 thousand tones for production of 25.00 million liters of wine (NHB, 2014).

In India, approximately 72-76 per cent of the production goes for table purpose, 22-24 per cent raisin, 3.50 per cent for wine and 0.50 per cent for juice due to limited domestic consumption of wine (annual per capita consumption of wine in the country is a mere 9 milliliters, approximately 1/8000th that of France).

Among the viticulture practices, crop load adjustment should be considered as one of the technical cultural practices suitable to modify grapevine physiology and plant production towards a defined goal (Mattii and Ferrini, 2005). Higher number of shoots per vine, *i.e.* increased shoot density impairs the productivity of shoots and as well as, canopy management gives adequate protection against diseases by changing microclimaite (Basu 2014).Taking into account, the fruit production habit wherein the plants produce clusters in the last growth branches (vine leaves) that originate in the development of the previous season (vine shoots), cane regulation is used to limit the number of canes, creating a balance between vigour and production, regulating the productive and vegetative potential and avoiding the aging of the vine. Therefore, cane regulation allows for the distribution of load units in the plants and yields in the good number of berry and size of the clusters with better quality.

In the present investigation, attempts were made to know the impact on growth and yield of vine by striking a balance between vigour and capacity through regulating the number of canes per vine in Shiraz, Medika and Grenache Blanc.

MATERIALS AND METHODS

The study was conducted at the Division of Fruit Science, Sector 70, the Main Horticultural Research and Extension Center, Bagalkot during 2015-16. It is situated under northern dry zone of Karnataka (Zone-3 and Region II) located at 16° 10[1] North latitude, 74° 42[1] East longitude with an altitude of 542 meters above the mean sea level. The average annual rainfall of 548 mm, average temperature of 23.01°C and mean relative humidity ranged from 32-92 per cent. The soil of the experiment site is red sandy loam with good physical properties and drainage. Nutrient status of the soil is 168.03 kg/ha N, 160.00 kg/ha P_2O_5 and 556.34 kg/ha K_2O with alkaline pH (8.05) and 0.15 dS/m EC.

The experimental design adopted for the present investigation was split plot design with three main treatments (Shiraz, Medika and Grenache Blanc) four sub treatments- cane regulation (C_1-Control, C_2-33 canes/vine, C_3-33 canes/vine and C_4-33 canes/vine) and replicated four times.

Growth parameters: The distance between the fourth and fifth node of the cane and fruiting shoot was recorded by using measuring scale 45th and 90th day after back and fore-pruning respectively. Similarly, the girth of cane and fruiting shoot using vernier calipers. Chlorophyll content was calculated in the leaf which was borne opposite to the inflorescence in each replication at 45th and 90th day after fore-pruning using chlorophyll meter SPAD-502.

Yield and yield attributing parameters: The number of days from pruning to visible bud sprouting, panicle initiation and days taken for harvesting in each treatment was counted and recorded in days. Number of panicles on each tagged cane and number of panicles per vine was counted and recorded in all the treatments. The bunch parameters, length (cm), weight (g) and breadth (cm) was measured and mean were derived by averaging of five bunches during harvest. Mean length (mm) and diameter (mm) of the berry obtained by measuring six berries on 120th day with the help of digital vernier calipers and by weight (g) of berry was derived by averaging the weight of six randomly selected berries. For the calculation of yield per vine (kg), the mean bunch weight was multiplied by average number of bunches per vine. Yield t/ha was obtained by multiplying yield (kg/vine) with total number of vines per hectare.

Statistical analysis

The analysis of data was done by following the Fischer's method of analysis of variance as given by Panse and Sukhatme (1967). The level of significance used in 'F' and 't' test was $p = 0.05$ and critical difference (CD at 5%) values were worked out whenever 'F' test was significant.

RESULTS AND DISCUSSION

Growth parameters

The data pertaining to the effect of varieties and cane regulation levels on growth parameters are presented in Table 1. It revealed that the growth parameters were found to significantly different among the varieties with respect to growth parameters such as inter-nodal length of cane, inter-nodal length of fruiting shoot and girth of fruiting shoot. Among varieties, at 45th day after pruning, Medika recorded the maximum inter-nodal length of cane (4.31 cm), inter-nodal length of fruiting shoot (4.74cm) and girth of fruiting shoot (4.77mm). The minimum was recorded in Grenache Blanc with inter-nodal length of cane (3.51 cm), inter-nodal length of fruiting shoot (3.79 cm) and girth of fruiting shoot (4.64 mm). Similar trend was observed at 90th day. This is because genotypic vigorous character of Medika which has contributed for significant increase in inter-nodal length and girth of cane. According to Shikhamany (2008), vigour of the grape vine has been an important growth attribute for distinguishing different grape varieties.

The data in the Table 1 depicts that, cane regulation significantly influenced on the growth of the vine. As the number of canes per vine decreased, the vine showed the better growth *i.e.* negative correlation existed between the number of canes and growth of the vine. At 45th day after pruning significantly, the highest was recorded in 25 canes per vine with the maximum girth of the cane (0.64 mm), inter-nodal length of fruiting shoot (0.34 cm) and girth of fruiting shoot (0.42 mm). Similar trend of result was obtained at 90th day after pruning. The lowest was noted in vines without cane regulation (control) *i.e.* minimum girth of the cane (4.51 mm), inter-nodal length of fruiting shoot (3.63 cm) and girth of fruiting shoot (3.74 mm). This might be due to reduction in cane number in cane regulated vines reduced the sink and allowed greater allocation of assimilates where as in control treatment due to the competition of the shoot for nutrients and water that might have resulted in to dilution effect. The results are in agreement with findings of Bravdo *et al.* (1985) in cv. Cabernet Sauvignon and Naor *et al.* (2002) who opined that decreased number of canes per vine by thinning resulted in increase of all vegetative parameters measured, indicating an increase in the relative sink strength. The overall balance between the losses attributable to shoot removal and gains made by remaining shoots resulting in cumulative net increase in vegetative growth.

Chlorophyll content

The perusal of data on chlorophyll content of the leaf depicted

Table 1: Influence of cane regulation on growth of wine grapes (*Vitis vinifera* L.)

Treatments		Inter-nodal length (cm) of cane		Girth of cane (mm)		Inter-nodal length of fruiting shoot		Girth (mm) of fruiting shoot		Chlorophyll content	
Varieties		45th day	90th day	45th day	90th day	45th day	90th day	45th day	90th day	45th day	90th day
V_1- Shiraz		3.78	4.29	4.96	5.24	4.23	4.51	4.26	4.59	20.74	32.05
V_2- Medika		4.31	4.36	5.23	5.58	4.74	4.92	4.77	5.05	27.79	33.03
V_3-Grenache Blanc		3.51	4.06	4.99	5.2	3.79	4.08	4.64	4.82	29.69	40.27
SEm±		0.16	0.1	0.26	0.19	0.11	0.14	0.15	0.12	0.58	0.54
C.D. at 5%		0.43	NS	NS	NS	0.3	0.38	0.4	0.35	1.6	1.49
Canes per vine											
C_1-Control		3.91	4.09	4.51	4.59	3.63	3.93	3.74	3.99	22.23	28.76
C_2- 33 canes/vine		3.77	4.16	4.96	5.47	4.27	4.46	4.72	4.97	25.41	33.61
C_3-29 canes/vine		3.87	4.33	5.32	5.64	4.53	4.78	4.74	5.05	27.58	37.14
C_4-25 canes/vine		3.91	4.36	5.46	5.67	4.59	4.84	5.03	5.28	29.07	40.96
SEm±		0.15	0.1	0.31	0.24	0.17	0.18	0.19	0.21	0.86	0.59
C.D. at 5%		NS	0.22	0.64	0.5	0.34	0.37	0.42	0.43	1.8	1.25
SEm±	V at same or different C	0.27	0.18	0.26	0.41	0.27	0.3	0.33	0.33	1.41	1.04
C.D. at 5%	V at same or different C	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.19

V-Variety, C- Cane, NS- Not significant

Table 2: Influence of cane regulation on yield and yield contributing parameters of wine grapes (*Vitis vinifera* L.)

Treatments		Bud burst (days)	Panicle initiation (days)	Duration of maturity (days)	No. Panicles per cane	No. Panicles per vine	Bunch characters Length (cm)	Breadth (cm)	Weight (g)	Berry characters Length (cm)	Breadth (cm)	Weight (g)	Yield per vine (kg/vine)	Yield (t/ha)
V_1- Shiraz		10.75	17.33	114.25	2.36	61	25.67	7.83	227.92	11.78	11.64	1.53	8.1	17.99
V_2- Medika		10.96	18.17	115.67	2.39	59.42	25.33	9.59	326.5	12.56	12.26	2.02	12.32	31.02
V_3-Grenache Blanc		13.81	21.83	128.08	4.16	105.5	18.75	8.89	218.25	11.23	11.93	1.39	13.97	29.84
SEm±		0.22	0.69	2.63	0.09	0.65	0.55	0.2	6.37	0.12	0.3	0.16	0.23	0.52
C.D. at 5%		0.6	NS	5.29	0.24	1.81	1.52	0.55	17.69	0.32	NS	0.45	0.63	1.45
C_1-Control		12.83	20.33	126.67	2.38	86.44	21.44	8.04	178.56	10.51	10.66	1.03	15.15	33.65
C_2- 33 canes/vine		12.33	19	119.11	2.78	75.33	23.33	8.69	257.78	11.78	11.4	1.28	11.67	25.98
C_3-29 canes/vine		11.28	18.89	116	3.29	70.11	24	9.02	294.11	12.37	12.79	1.87	10.72	23.16
C_4-25 canes/vine		10.91	18.22	115.56	3.43	69.33	24.22	9.33	299.78	12.77	12.92	2.41	9.77	22.34
SEm±		0.35	1.09	4.03	0.17	0.93	0.97	0.44	7.08	0.3	0.26	0.19	0.35	0.65
C.D. at 5%		0.73	2.29	8.46	0.36	1.96	2.04	0.92	14.88	0.63	0.55	0.39	0.74	1.36
SEm±	V at same or different C	0.56	1.77	6.59	0.16	1.54	1.55	0.69	12.39	0.29	0.49	0.33	0.61	1.1
C.D. at 5%	V at same or different C	NS	NS	NS	NS	NS	NS	NS		NS	NS	NS	1.28	2.32

V-Variety, C- Cane, NS- Not significant

that, chlorophyll content significantly differed among the varieties and cane regulation, at both the intervals of observation (Table 1). At 45th day after pruning, the highest chlorophyll content was noted in Grenache Blanc (29.69). This might be due to varietal character with respect to leaf size. Smaller leaf size of Grenache Blanc might have helped for better interception of sunlight and microclimate of canopy with less relative humidity. Both these factors might have favoured the synthesis of more chlorophyll. Similar results were noticed by Slavtcheva *et al*. (1997) and Kumar (1999) in grape cv. Bangalore Blue. Among treatments, twenty five canes per vine recorded significantly, the highest (29.07) chlorophyll content and the lowest (22.23) in control treatment. Probably, removal of canes might have enhanced the availability of sufficient carbohydrates for vegetative growth. This in turn accelerated the photosynthetic efficiency of the crop, which was also reflected in terms of increased total sugar content of berries. The efficient translocation of carbohydrates towards the developing bunches also leads to higher yields (Table 2).

Yield and yield attributing parameters

The data on influence of cane regulation on yield and yield attributing parameters are tabulated in Table 2.

Earliness

The perusal of data depicted (Table 2) as among the varieties, the early bud burst, panicle initiation and duration of maturity was in Shiraz (10.75, 17.33 and 114.25, respectively) and late variety was Grenache Blanc (13.81, 21.83 and 128.08, respectively) this might be due to Grenache Blanc genotypic character of late type, consumes more number of days to bud burst and panicle initiation and leading to the maximum duration of maturity. These findings are in agreement with Veena *et al*. (2015), white grape varieties takes more number of days to bud burst compared to black grape varieties.

Among different levels of cane regulation (Table 2) twenty five canes per vine recorded the early bud burst (10.91 days), early panicle initiation (18.22 days), less duration of maturity (115.56 days) whereas, vines without cane regulation treatment (control) recorded the late burst (12.83 days), late panicle initiation (20.33 days), maximum duration of maturity (126.67 days). This was strongly supported by the findings of Joon and Singh (1983), the number of days taken for sprouting, flowering and ripening was significantly affected by the intensity of pruning in Delight grapes. The bunches of vines pruned to two bud with 40 spurs treatments were at par and ripened earliest (152 days) and Bravdo *et al*. (1985) opined that, the higher crop load delayed the date of harvest in Cabernet Sauvignon

Number of panicles

Significantly, the highest number of panicles per cane and vine recorded in Grenache Blanc (4.16 and 105.50, respectively) and the lowest in Medika (2.39 and 59.42, respectively) because of the genotypic feature of Grenache Blanc with relation to maximum fruitful buds per cane might have resulted in the maximum number of panicles compared to other varieties. This is in conformity with the findings of Veena *et al*. (2015) and Hachcholli *et al*. (2016) reported maximum number of bunches in Grenache Blanc.

Bunch and berry characters

Medika reported superior bunch (length 25.33 cm, breadth 9.59 cm, weight 326.50 g) and berry characters (length- 12.56 mm, breadth- 12.26 mm, weight- 2.02 g) among varieties. Smaller bunch size (length-20.33 cm, breadth-8.89 cm, weight-218.25 g) with small berries (length- 11.23 mm, breadth- 11.93 mm, weight- 1.39 g) were found in Greneache Blanc because the genotypic character of this variety itself is to bear small size bunches. Whereas, Medika being a hybrid of Pusa Navarang and Flame Seedless, it might have inherited the characteristic of bold berry from the Flame Seedless. The similar results were reported by Hachcholli *et al*. (2016) that among different wine varieties studied, Medika reported significantly superior over others in bunch and berry characters and increase in the berry size contributed to the increased berry weight and resulted in superior bunches (Kanthikumar and Sharma, 2016)

Twenty five canes per vine showed superior bunches (length 24.22 cm, breadth 9.33 cm and weight 299.78 g) and berry characters (length 12.77 mm, breadth 12.92 mm, weight 2.41 g). vines without cane regulation showed inferior bunch size (length 21.44 cm, breadth 8.04 cm and 178.56 g weight) and berry characters (length 10.51 mm, breadth 10.66 mm and weight 1.03 g). Control treatment had more number of canes per vine which has resulted in late bearing and inferior bunches because of inverse relation between carbohydrate accumulation and cane regulation levels. High shoot density vine which also created the shady condition while cluster development hence delayed maturation and impacted on berry characters

Yield

The perusal of data on yield per vine and yield per hectare revealed significant difference between the varieties (Table 2). Among the varieties, Grenache Blanc recorded the highest yield (24.00 kg) and the lowest was in Shiraz (14.58 kg). The reason might be genotypic character of the Shiraz to bear lesser number of berries per bunch, with average of two seeds per berry and lesser number of panicles. These results were in accordance with findings of Hachcholli *et al.* (2016) that among different genotypes of wine grapes, Grenache Blanc recorded the maximum number of panicles per vine (110.44) which contributed to the higher yield compared to Shiraz.

Trait yield showed significant difference among the different levels of cane regulation. Control treatment *i.e.* vines without cane regulation gave significantly the highest panicles per vine (86.44) and yield (15.15 kg/vine and 33.65 t/ha) compared to 25 canes per vine, which recorded the lowest panicles per vine (18.22) and yield (9.77 kg/vine and 22.34 t/ha). Reason for maximum yield in control might be positive correlation of number of canes per vine with the number of panicles, which contributed for the total yield of vine. But from perusal of yield data of cane regulated vines, even with reduction of 34, 42 and 50 per cent of shoots the yield difference was only 07, 20, and 25 per cent respectively. Because cane regulated vines gave the higher bunches per cane and bold berries which compensated by heavy bunches. The similar trends were obtained by Myers *et al.* (2008) in Sangiovese grape vines, Somkuwar *et al.* (2010) in grape vines and Naor *et al.* (2002) reported that Sauvignon Blanc. Shoot thinning tended to reduce total yields, mainly due to a reduction in cluster numbers (Reynolds 2005).

Interaction of variety and cane regulation significantly, influenced on the yield trait. The maximum yield was noted in Grenache Blanc without cane regulation (23.00 kg/vine and 20.67 t/ha) and minimum in Shiraz with 25 canes per vine (6.33 kg/vine and 12.87 t/ha). This might be due to lesser response of Shiraz to cane regulation.

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