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Studies on Season and Intensity of Pruning on Leaf Nutrient Status in Grapes (*Vitis vinifera* L.) cv. Red Globe

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A B S T R A C T

An experiment was conducted in grapes cv. Red Globe during 2012-2013 for two seasons namely rainy and summer at Horticultural Orchard, Tamil Nadu Agricultural University, Coimbatore to study the effect of four different pruning levels on leaf nutrient status and chemical properties of vine with five replications and four treatments in a Randomized block design. Results revealed that, either in rainy or summer season all the canes of vines which were pruned for 50% of canes to 2 bud level and remaining 50% of canes to 6 bud level registered the maximum chlorophyll 'a' (0.665 mg/g and 1.375 mg/g), chlorophyll 'b' (0.494 mg/g and 0.647 mg/g), total chlorophyll content (1.160 mg/g and 2.022 mg/g), total carbohydrate content (14.63% and 15.88%), petiole nitrogen (2.816% and 2.688%), petiole phosphorous (0.827% and 0.864%) and petiole potassium content (2.782% and 2.825%), respectively. Among two seasons, summer season crop performed better than rainy season crop. It was recommended that pruning 50 per cent of the canes for vegetative growth and remaining 50 per cent of canes for crop yield in both seasons were found to be better, considering the performance in both seasons.

Introduction

Grapes (*Vitis vinifera* L.) are one of the most delicious, refreshing and nourishing fruit of the world. It's cultivation in India assumes great significance due to its high productivity (21.80 tonnes/ha) as compared to many other grape producing countries. The area under grape cultivation in the last three decades is increasing steadily with the introduction of exotic varieties. In India, grape is grown over an area of 1.18 lakh ha with annual production of 25.85 lakh tones (NHB, 2014-15). The major grape growing states of India are Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. In Tamil Nadu, grapes are grown in an area of 3,000 hectares having production of 55,600 MT with a productivity of 19.40 tonnes ha^{-1} (NHB, 2014-15). Recently, the exotic cv. Red Globe, introduced from University of California, USA which is popular in Australia, China and other grape growing countries, is also slowly gaining importance in India among the grape growers. Pruning is the most important cultural practice in the management of grapevines. Grapevines require pruning to sustain production. Vine pruning improves the nutrient uptake and utilization for development of better bunches. Nutrient status in leaves involved in development of vines, photosynthetic functioning and metabolic pathways are required in certain quantities to ensure healthy growth and

performances. The time of pruning varies greatly with the variety and local climatic conditions in different grape-growing region in India. Further, in Tamil Nadu, grapes are pruned twice in a year *i.e*., backward pruning for vegetative growth and forward pruning for fruiting to get summer and rainy season crops for which the adaptability of this new introduction is unknown.

Generally growers adopt a pruning level of 4-5 buds/cane for pruning of all matured canes in cv. Muscat which results in more exploitation of reserve food material leading to the loss of vigour, quality and early setting of senility in the vines whereas, in cv. Red Globe pruning level was unknown.

In the present investigation, attempts were made to know the nutrient status of leaves exclusively for rainy or summer season and also for both the seasons by striking a balanced pruning regardless of the type of pruning and training system.

Materials and Methods

The experiment was carried out at orchard of Tamil Nadu Agriculture University, Coimbatore during the year 2012-2013 on eight years old grapevines which were trained on bower system spaced at 3.0 x 2.5 m apart and were raised on Dog Ridge rootstock. For rainy season vines were pruned in June, 2012 and harvested during the months of October-November, 2012 and for summer season crop vines were pruned in the month of January, 2013 and harvested during the months of May-June, 2013 with four pruning levels replicated five times in a Randomized Block Design. Total of four vines were observed in each replication under each treatment for the collection of data. All the vines under experiment were given uniform cultural practices such as fertilizers, irrigation and plant protection measures.

Biochemical analysis of leaf

The different parts of the vine (leaf and petiole) were collected at different growth stages for biochemical analysis. The methods followed for each parameter while doing biochemical analysis are given as follows. Twenty petioles borne opposite to the inflorescence in each replication were collected at random during flowering phase, dried at constant 60ºC in hot air oven and used for analyzing leaf mineral content. Percentage of total nitrogen was estimated by Micro-Kjeldahl method (Humphries, 1956). Percentage of total phosphorus was estimated in triple acid extract by adopting Vanadomolybdate phosphoric yellow colour method and total potassium by Flame Photometer reading of triple acid extract (Jackson, 1973). Leaf chlorophyll content (mg/g) was calculated in the leaf which was borne opposite to the inflorescence at flowering phase and estimated for chlorophyll ‘a’, ‘b’ and total chlorophyll contents by following the method of Yoshida *et al.*, (1971). Cane total carbohydrates content was determined according to Somogyi (1952) and expressed in percentage.

Statistical analysis

The data collected were subjected to statistical scrutiny as per the methods suggested by Panse and Sukhatme (1985). The significance of the mean difference between the treatments was determined by computing the standard error and critical difference at 5% level of significance

Results and Discussion

Biochemical characteristics of leaf

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 nutrient analysis of the vine was taken up for major nutrients like (Nitrogen, Phosphorus and Potassium). Among the pruning intensities, pruning 50% of the canes for vegetative growth and remaining 50% of the canes for crop yield maintained better petiole nutrient status (Table 1) in respect to total nitrogen (2.82% and 2.69%, respectively), total phosphorus (0.83% and 0.86%, respectively) and total potassium (2.78% and 2.82%, respectively) at the time of flowering in both rainy and summer season crops, when compared to other pruning levels. Pruning 100% canes to 6 bud level in summer season and pruning 100% canes to 6 bud level in rainy season exhibited lower level of nutrients in the petiole due to relatively more number of fruiting bunches per vine, competing for drawing more nutrients for development of bunches.

This finding was strongly supported by the results of (Jeet Ram *et al.*, 1993, Cangi and Kilic 2011 and Waqar Ahmad *et al.*, 2008) indicating higher depletion of nutrients due to heavy bunch load.

Table.1 Influence of season and pruning severity on petiole nutrient status of grape vine cv. Red Globe

Treatments	Petiole nitrogen content (%)		Petiole phosphorus content (%)		Petiole potassium content (%)	
	Rainy	Summer	Rainy	Summer	Rainy	Summer
T_1	12.25	32.00	677.22	776.97	8.30	24.86
T_2	26.20	15.50	719.46	725.51	18.85	11.24
T_3	22.87	31.50	601.96	642.40	13.77	20.24
T_4	21.05	27.85	749.92	809.81	15.79	22.41
CD 0.05%	0.55	0.71	5.93	6.74	0.41	0.55

Treatment details: T_1: Pruning all the canes to 2 bud level (100%) for vegetative growth in rainy season and 6 bud level (100%) in summer season.T_2: Pruning all the canes to 6 bud level (100%) in rainy season and 2 bud level (100%) for vegetative growth in summer season.T_3: Pruning 33% of the canes for vegetative growth (2 bud level) and remaining 67% of the canes for crop load (6 bud level) in both the seasons.T_4: Pruning 50% of the canes for vegetative growth (2 bud level) and remaining 50% of the canes for crop load (6 bud level) in both the seasons.

Table.2 Influence of season and pruning severity on chlorophyll and carbohydrate status of grape vine cv. Red Globe.

Treatments	Cholorophyll 'a' (mg/g)		Cholorophyll 'b' (mg/g)		Total chlorophyll content (mg/g)		Cane total carbohydrate content (%)	
	Rainy	Summer	Rainy	Summer	Rainy	Summer	Rainy	Summer
T_1	0.611	0.872	0.414	0.514	1.025	1.386	14.47	14.91
T_2	0.564	0.978	0.447	0.534	1.011	1.511	14.02	15.65
T_3	0.617	0.990	0.486	0.551	1.103	1.541	14.35	15.09
T_4	0.665	1.375	0.494	0.647	1.160	2.022	14.63	15.88
CD 0.05%	0.004	0.020	0.003	0.005	0.006	0.030	0.020	0.040

*See Table-1 for treatment details

Treatment details

Sl. No.	Treatment details
T_1	Pruning all the canes to 2 bud level (100%) for vegetative growth in rainy season and 6 bud level (100%) in summer season.
T_2	Pruning all the canes to 6 bud level (100%) in rainy season and 2 bud level (100%) for vegetative growth in summer season.
T_3	Pruning 33% of the canes for vegetative growth (2 bud level) and remaining 67% of the canes for crop load (6 bud level) in both the seasons.
T_4	Pruning 50% of the canes for vegetative growth (2 bud level) and remaining 50% of the canes for crop load (6 bud level) in both the seasons.

The leaf chlorophyll content, a key factor in determining the rate of photosynthesis, is considered as an index of the metabolic efficiency of vine. This pigment, responsible for harnessing solar energy and converting it into chemical energy, exhibits a differential pattern of its accumulation in response to different levels of pruning done in rainy and summer seasons. Among the treatments, the canes pruned to 50% for vegetative growth (2 bud level) and remaining 50% for crop yield (6 bud level) recorded the maximum chlorophyll 'a' (0.665 mg/g and 1.375 mg/g, respectively), chlorophyll 'b' (0.494 mg/g and 0.647 mg/g, respectively) and total chlorophyll content (1.160 mg/g and 2.022 mg/g) respectively in rainy and summer seasons (Table 2). This vegetative growth developed from 50% of shoots retained for two bud level might have produced sufficient photosynthates through enhanced chlorophyll content in these vines. The chlorophyll content during summer season crop was found to be significantly higher than rainy season (Table 2). This might be due to the prevailing of high temperature; more sunshine hours and less relative humidity, which might have favoured the synthesis of more chlorophyll during summer season than rainy season. Similar results were noticed by Kumar (1999) and Fawzi *et al.,* (2010). Availability of sufficient vegetative growth in these vines with enhanced chlorophyll content due to pruning of 50% of the shoots for vegetative growth and remaining 50% of the shoots for crop yield might have accelerated the photosynthetic efficiency of the crop, which was also reflected in terms of higher total carbohydrate content (Table 2) (14.63% and 15.88%) in both rainy and summer seasons respectively. The efficient translocation of carbohydrates towards the developing bunches also leads to higher yields. Similar results were obtained earlier by Bernstein and Klein (1957) in grape var. Chasselas Dore.

Overall, it was observed that among the different intensities of pruning level in both seasons *i.e*., pruning 50% of the canes for vegetative growth (2 bud level) and 50% of the canes for crop yield (6 bud level) was found to be better, considering the performance in combining both the seasons. Among the two season crops summer season crop performed better than rainy season crop.

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