EFFECTS OF LEAF REMOVAL AND SHOOT TRIMMING ON PHYSIOLOGICAL AND AGRONOMIC CHARACTERISTICS OF SYRAH GRAPEVINE IN NORTHEAST BRAZIL: PRELIMINARY RESULTS

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Summary

The São Francisco Valley, Northeast Brazil, is one of the most important wine regions with tropical conditions in the world. It is located between parallels 8 and 10°S, with an average annual temperature of 26.5 °C and 3,000 hours of sunshine per year. This work shows preliminary results on physiological and agronomic characteristics of Syrah vines,subjected to the practices of leaf removal and shoot trimming. The physiological and agronomical characteristics evaluated were the following: mass of cluster, mass of canes after pruning, mass of fresh and dry leaves, net photosynthesis (An), stomatal conductance (gs), intrinsic water use eficience (WUEi), leaf area (LA) and specific leaf area (SLA). The treatments did not show differences related to net photosynthesis (An), stomatal conductance (gs) and intrinsic water use efficiency (WUEi). The initial measurements of leaf area showed no difference between treatments. The individual leaf area was initially affected by treatments, but during ripening these effects were not revealed in the experiment. Reverse effects were observed for specific leaf area, which proved not to be affected by treatments during the immature cluster phenological phase. The studies should be continued for three more seasons ,in order to understand how the canopy management of Syrah, growing in a tropical environment, can influence the agronomical and physiological plant behavior, and the implications for the quality of grapes and wines.

INTRODUCTION

The wine industry in São Francisco River Valley, Northeast of Brazil has advanced during the last years. Today, there are seven wineries producing more than eight million gallons of wine per year, which represents 20% of national production. The tropical wines also known as "wine of the sun" are typical (and characterized as young, fruity and aromatic) whose quality is already recognized in traditional and demanding markets.

The viticulture in Northeast of Brazil is one of the most peculiar in the world, because in tropical conditions the vine does not go into dormancy, growing continuously throughout the year. Vines at different phenological stages can be found in the same period and in the same area. It is possible to harvest twice a year. The management of vineyards in these conditions requires water supply for irrigation and control of vegetative growth. The shoots have strong apical dominance and hydrogen cyanamide spraying is needed to break dormancy after pruning.

To control the vegetative growth, a strategy is to reduce the supply of assimilates by summer pruning, such as thinning, defoliation and trimming of shoots. Defoliation can be performed with different objectives, its benefits for wine grapes are associated with improvement in the sunlight and air circulation around the bunches, with positive results in pigmentation of berries and tolerance of rot (Poni *et al.,* 2006; Ianinni *et al.,* 2007).

The removal of all leaves in the region of bunches, especially in hot climates, can increase the temperature of the berries, causing a reduction in the accumulation of pigments and drastic fall in the malic acid content (Poni *et al.,* 2006).

The effects of defoliation on production are variable, depending on the length and intensity. When done up to four weeks after flowering can affect the supply of carbohydrates for fruit set, with negative consequences on production and sugar content (Poni *et al.,* 2006). These authors reported that defoliation of six basal leaves in cv. Sangiovese grown in greenhouse conditions increased the content of sugars, anthocyanins, total phenolics and acidity in the grapes, but reduced the percentage of fruit set, weight and size of bunches and berries. Similar results were found in cv. Trebbiano in the field. Ianinni *et al.* (2007) also observed an increased in content of sugars, anthocyanins and flavonoids in cv. Aglianico, for the treatments of defoliation or thinning of bunches, but the yield per plant, total acidity and pH were not affected by treatment.

Santos (2006) mentioned that trimming of shoots should be performed in two phenological stages: 'pea size' and early maturation or veraison. Defoliation can be more intense at the beginning of grape maturation, but over exposure must always avoided over-exposure the grapes to sunlight at the hottest times of the day.

This work was aimed at studying agronomical and physiological behavior of grapevine cv. Syrah subjected to the practices of leaf removal and shoot trimming in the tropical conditions of São Francisco River Valley, Northeast of Brazil.

MATERIAL AND METHODS

The experiment was conducted in a commercial vineyard of cv. Syrah grafted onto IAC 766 rootstock, located in Casa Nova City, Bahia State in Northeast region of Brazil (latitude: 9° 16'S, longitude: 40° 52'O; altitude: 413.5 m). The climate is classified as semi arid, where the total annual precipitation is 540 mm, the pan evaporation is about 2700mm and the air temperature is 26.5 °C (Moura *et al.*, 2009).

The vineyard was five years old, drip irrigated, the spacing was 3.0 x 1.0 m and the plants were vertical shoot positioned.

The treatments consisted in combinations of the practices of removal of all the basal leaves above the last bunch, applied one time in beginning of berry closure stage, and shoot trimming applied in two stages: 'pea' size grain (stage 1) and beginning of berry closure (stage 2). The control (T1) consisted of the same canopy management adopted by the grower which was two leaf removals, the first one at the 'lead shot' size grain stage and the second one at beginning of berry closure stage and one shoot trimming when the shoots passed the last trellis wire. The treatments are described below:

T1: control (farm management)
T2: leaf removal + no shoot trimming
T3: leaf removal + shoot trimming in stage 1 + shoot trimming in stage 2
T4: leaf removal + no shoot trimming in stage 1 + shoot trimming in stage 2
T5: leaf removal + shoot trimming in stage 1 + no shoot trimming in stage 2
T6: no leaf removal + shoot trimming in stage 1 + shoot trimming in stage 2
T7: no leaf removal + no shoot trimming in stage 1 + shoot trimming in stage 2
T8: no leaf removal + shoot trimming in stage 1 + no shoot trimming in stage 2

The experimental design was randomized blocks with four replications and 10 plants per treatment. Evaluations were performed on three plants in the plot during the 2010 season. The pruning was held on March 08 and harvested on July 19, totaling 134 days from pruning to harvest.

The physiological and agronomic characteristics evaluated were the following: mass of bunch, mass of canes after pruning, mass of fresh and dry leaves, net photosynthesis (An), stomatal conductance (gs), intrinsic water use efficiency (WUEi), leaf area (LA) and specific leaf area (SLA). The leaf gas exchange measurements were taken three times in the cycle from 15 days after treatment application to harvest using an IRGA (Infra Red Gas analyzer), Mod Li-COR ® 6400 XT).

RESULTS AND DISCUSSION

The results for yield, number of bunches per plant, mass of bunch, mass of canes, fresh mass and dry mass of leaves are shown in Table 1. Significant effects were observed in all treatments. The highest yield per plant was observed in the vines submitted to leaf removal and shoot trimming at 'pea' size stage (T5), leaf removal and no shoot trimming (T2) and leaf removal and shoot trimming in beginning of berry closure stage (T4). The highest number of bunches per plant was also obtained in treatments T5 and T2. However, the number of bunches per plant are determined during fruit bud differentiation in the previous cycle, i.e. the results for number of bunches per plant cannot be attributed to the treatments because they were applied only in this cycle.

Higher mass of bunches were obtained in plants with leaf removal combined with shoot trimming during the beginning of berry closure stage (T4) which differed significantly from all treatments, resulting in an increase of 50% compared to treatment T8 (no leaf removal combined with shoot trimming at 'pea' size stage), in which vines obtained the lowest mass of bunches.

Leaf removal and shoot trimming affected the vigour of the vine. The mass of canes after pruning in plants submitted to leaf removal and no shoot trimming (T2) differed significantly from T1 (control or canopy management adopted by grower) and T8. The highest fresh mass of leaves was also observed in treatments T2 and T7, differing significantly from other treatments. T7 also showed the highest dry mass of leaves, but did not differ from treatments T3 and T8. These results are in line with expectations, since the lower the intervention in pruning, the greater mass of branches and leaves.

Table 1. Mean values and coefficients of variation of agronomic treatments of Syrah vines subjected to treatments of defoliation and trimming of shoots, Casanova, BA, Brazil, 2010.

T	Y[1] (kg)	NB	MB (g)	MBr (g)	FML (g)	DMSL (g)
T1	1.36 b	12.50 b	108.6 bc	367.5 b	718.3 b	205.8 c
T2	1.80 a	16.75 a	108.1 c	663.3 a	879.2 a	217.5 bc
T3	1.30 b	15.25 a	89.6 d	425.0 ab	685.8 b	322.0 a
T4	1.83 a	12.25 b	173.2 a	480.8 ab	641.7 b	184.2 d
T5	1.90 a	16.00 a	118.0 b	453.3 ab	706.7 b	246.7 b
T6	1.15 b	10.75 b	107.6 c	425.8 ab	692.5 b	174.2 d
T7	1.25 b	13.00 b	105.7 c	468.3 ab	920.8 a	330.0 a
T8	1.00 b	11.00 b	85.9 d	334.2 b	712.5 b	372.7 a
Mean	**1.39**	**13.44**	**112.1**	**452.3**	**744.7**	**256.6**
CV	**28.88**	**19.65**	**16.81**	**32.68**	**14.05**	**42.21**

Means followed by same letter in column do not differ by Tukey test ($p < 0.05$).

[1]Y: yield per plant; NB: number of bunches per plant; MB: mass of bunch; MBr: mass of branches; FML: fresh mass of leaves; DML: dry mass of leaves.

Leaf removal and shoot trimming did not affect gas exchange or net photosynthesis (An), stomatal conductance (gs) and intrinsic water use efficience evaluated in the following phenological stages of grapevine: immature bunch ('L' Baggiolini scale), change of berry color or 'veraison' ('M' Baggiolini scale) and final maturation of bunches ('N' Baggiolini scale). Leaf area measured at immature bunch stage showed significant differences between T1 and T3 treatments. Specific leaf area at this same stage did not differ among treatments but showed differences among treatments at the final maturation of bunches. In this phenological stage, T4 and T5 had the highest and lowest average among treatments, respectively.

Table 2. Mean values and coefficients of variation of net photosynthesis (An), stomatal conductance (gs) and intrinsic water use efficiency (WUEi) of Syrah vines subjected to treatments of defoliation and trimming of shoots, Casanova, BA, Brazil, 2010.

T	An ($\mu mol\ m^{-2}s^{-1}$)			gs ($\mu mol\ m^{-2}s^{-1}$)			WUEi ($\mu mol\ mol^{-1}$)		
	[1] LBS	MBS	NBS	LBS	MBS	NBS	LBS	MBS	NBS
T1	16.9 a	17.0 a	20.0 a	0.35 a	0.37 a	0.50 a	51.2 a	49.2 a	42.9 a
T2	17.7 a l	16.1 a	16.1 a	0.40 a	0.35 a	0.40 a	46.3 a	46.3 a	41.1 a
T3	16.3 a	15.3 a	18.5 a	0.32 a	0.30 a	0.45 a	53.1 a	53.1 a	44.0 a
T4	17.0 a	15.3 a	21.3 a	0.35 a	0.35 a	0.40 a	41.7 a	41.7 a	48.3 a
T5	16.6 a	14.8 a	19.2 a	0.32 a	0.27 a	0.40 a	54.2 a	52.6 a	46.0 a
T6	19.5 a	18.1 a	20.7 a	0.40 a	0.40 a	0.40 a	54.8 a	54.8 a	42.2 a
T7	19.0 a	17.8 a	20.6 a	0.40 a	0.32 a	0. 47 a	51.3 a	58.8 a	42.4 a
T8	17.3 a	17.4 a	20.7 a	0.27 a	0.35 a	0.40 a	54.2 a	54.3 a	49.0 a
Mean	**17.5**	**16.5**	**19.7**	**0.35**	**0.34**	**0.42**	**50.8**	**51.3**	**44.5**
CV%	**15.7**	**16.1**	**14.0**	**27.2**	**35.0**	**12.3**	**18.2**	**22.6**	**15.7**

Means followed by same letter in column do not differ by Tukey test ($p < 0.05$).
[1]LBS: stage 'L' Baggiolini scale, MBS: stage 'M' Baggiolini scale, NBS: stage 'N' Baggiolini scale.

Table 3. Mean values and coefficients of variation of leaf area (LA) and specific leaf area (SLA) of Syrah vines subjected to treatments of defoliation and trimming of shoots, Casanova, BA, Brazil, 2010.

T	Leaf Area (cm^2)			Specific Leaf Area ($g\ cm^2$)		
	[1] LBS	MBS	NBS	LBS	MBS	NBS
T1	165 b	187. 8 a	162.7 a	179.9 a	107 bc	102.1 bc
T2	183.8 ab	182.8 a	181.7 a	196.7 a	107.5 b	106.6 b
T3	185.6 a	194.4 a	162.7 a	191.5 a	102.5 bc	100.5 bc
T4	166.6 ab	185.64 a	167.5 a	172.1 a	91 c	91.3 c
T5	167.6 ab	201.5 a	183.2 a	182.6 a	123.7 a	126.8 a
T6	177.3 ab	172.4 a	176.7 a	186.2 a	108.7 b	102.0 b
T7	182.4 ab	187.2 a	177.5 a	182. 7 a	106 b	102.3 bc
T8	176.1 ab	182.6 a	163.5 a	194.3 a	102.0 b	103.8 bc
Mean	**175.5**	**186.8**	**171.5**	**185.7**	**105.4**	**105.2**
CV%	**4.8**	**7.24**	**5.14**	**8.3**	**5.8**	**5.78**

Means followed by same letter in column do not differ by Tukey test ($p < 0.05$).
[1]LBS: stage 'L' Baggiolini scale, MBS: stage 'M' Baggiolini scale, NBS: stage 'N' Baggiolini scale.

CONCLUSIONS

- Leaf removal and shoot trimming applied only in beginning of berry closure increased the mass of bunch and yield per plant;
- Shoot trimming applied twice in 'pea' size and beginning of berry closure stage (T3) or one time (T7 and T8) increased vigour of vine, i.e. fresh and dry mass of leaves.
- Leaf removal and shoot trimming did not affect the gas exchange of grapevines cv. Syrah in São Francisco River Valley conditions.
- The individual leaf area was affected by treatments at immature bunch stage, but these differences were not revealed during maturation of bunches.
- Reverse effect was observed for specific leaf area, which was not affected by treatments at immature bunch stage.

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