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Preliminary results of pedestrian trainning systems for cherry production in the Río Negro and Neuquen Valleys

Resultados preliminares de sistemas peatonales de conducción para la producción de cerezos en el Alto Valle de Río Negro y Neuquén

Resultados preliminares de sistemas de condução pedestres para cerejeiras no Alto Valle de Río Negro e Neuquén

Raffo, D.[1]; Curetti, M.[1]

[1]*Instituto Nacional de Tecnología Agropecuaria (INTA), Fruticultura, Rio Negro, Argentina.*

VIII Encuentro Latinoamericano Prunus sin Fronteras

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Maximiliano Dini
Instituto Nacional de Investigación Agropecuaria (INIA), Canelones, Uruguay

Roberto Zoppolo
Instituto Nacional de Investigación Agropecuaria (INIA), Canelones, Uruguay

Correspondence

Dolores Raffo,
raffo.dolores@inta.gob.ar

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Abstract

The need for increasing fruit industry competitiveness makes evaluation of production technology essential to reduce costs and to obtain fruit quality. The Kym Green Bush (KGB) system does not need support (lower cost of installation), plant vigor is controlled by dividing the axis into several temporary vertical ones, allowing the use of a wide range of rootstocks. The UFO (Upright Fruiting Offshoots) system shares the concepts of the KGB but has a supporting structure (posts, wires). The objective of this study was to evaluate the behavior of Lapins grafted onto SL64 and Pontaleb rootstocks, trained in the KGB, UFO and Central Axis (CA) systems. The trial was planted in 2014 at a distance of 2.5m × 4m (KGB and UFO) and at 2m × 4m (CA). Tree cultural practices were applied, and trunk cross sectional area, number of branches per tree, yield and fruit quality (size, soluble solids, titratable acidity, firmness and color) were measured. The KGB system was the easiest to implement and it gave the more vigorous plants in both combinations; the SL64 rootstock being more vigorous than Pontaleb. The KGB and UFO systems reduced winter pruning wages by 74 and 48%, respectively. Moreover, the Lapins/Pontaleb combination was more productive in all training systems. The KGB training system also allowed harvesting and pruning without the use of ladders.

Keywords: yield, central axis, KGB, UFO, Lapins

Resumen

La necesidad de elevar la competitividad del negocio frutícola hace imprescindible la evaluación de tecnologías de producción que permitan disminuir costos y obtener fruta de calidad. El sistema Kym Green Bush (KGB) produce un árbol que no necesita soporte (menor costo de implantación), el vigor de la planta se controla dividiendo el eje en varios ejes verticales temporales, y esto permite el uso de una amplia gama de portainjertos. El sistema UFO (Uprigh Fruiting Offshoots) comparte los conceptos del KGB, pero lleva estructura de soporte (postes, alambres). El objetivo del trabajo fue evaluar el comportamiento del cultivar de cerezo Lapins sobre los portainjertos SL64 y Pontaleb conducidos en los sistemas KGB, UFO y Eje Central (EC). El ensayo se plantó en el 2014 a una distancia de 4m × 2,5m (KGB y UFO) y 4m × 2m (RC). Se realizaron los trabajos de poda y conducción, y se midió: área seccional de tronco, número de ramas/árbol, rendimiento y calidad de frutos (tamaño, sólidos solubles, acidez titulable, firmeza y color). El sistema KGB fue el más fácil de implementar y el que originó plantas más vigorosas en ambas combinaciones; siendo el portainjerto SL64 de mayor vigor que Pontaleb. Los sistemas KGB y UFO redujeron los jornales de poda invernal en un 74 y 48 %, respectivamente. La combinación Lapins/Pontaleb fue la más productiva en todos los sistemas de conducción. El sistema de conducción KGB permitió además realizar las tareas de cosecha y poda sin el uso de escaleras.

Palabras clave: rendimiento, eje central, KGB, UFO, Lapins

Resumo

A necessidade de aumentar a competitividade do negócio de frutas torna essencial a avaliação da tecnologia de produção para reduzir custos e obter frutas de qualidade. O sistema Kym Green Bush (KGB) produz uma árvore que não precisa de suporte (menor custo de implantação), o vigor da planta é controlado dividindo o eixo em vários eixos verticais temporários, e isso permite o uso de uma ampla gama de porta-enxertos. O sistema UFO (Upright Fruiting Offshoots) compartilha os conceitos da KGB, mas possui uma estrutura de suporte (postes, fios). O objetivo foi avaliar o comportamento do cultivar Lapins no porta-enxerto 'SL64' e 'Pontaleb' realizado nos sistemas KGB, UFO e Eixo Central (CE). O teste foi plantado em 2014 a uma distância de 2,5m × 4m (KGB e UFO) e a 2m × 4m (RC). Realizou-se o trabalho de poda de formação, sendo medidos: da seção transversal

do tronco, número de galhos / árvore, produtividade e qualidade do fruto (tamanho, sólidos solúveis, acidez titulável, firmeza e cor). O sistema KGB foi o mais fácil de implementar e o que produziu as plantas mais vigorosas nas duas combinações; o porta-enxerto SL64 sendo mais vigoroso que o Pontaleb. Os sistemas KGB e UFO reduziram os salários de poda de inverno em 74 e 48%, respectivamente. Além disso, a combinação 'Lapins'/'Pontaleb' foi mais produtiva em todos os sistemas de direção. O sistema de direção da KGB também permitiu a colheita e poda sem o uso de escadas.

Palavras-chave: produtividade, eixo central, KGB, UFO, Lapins

1. Introduction

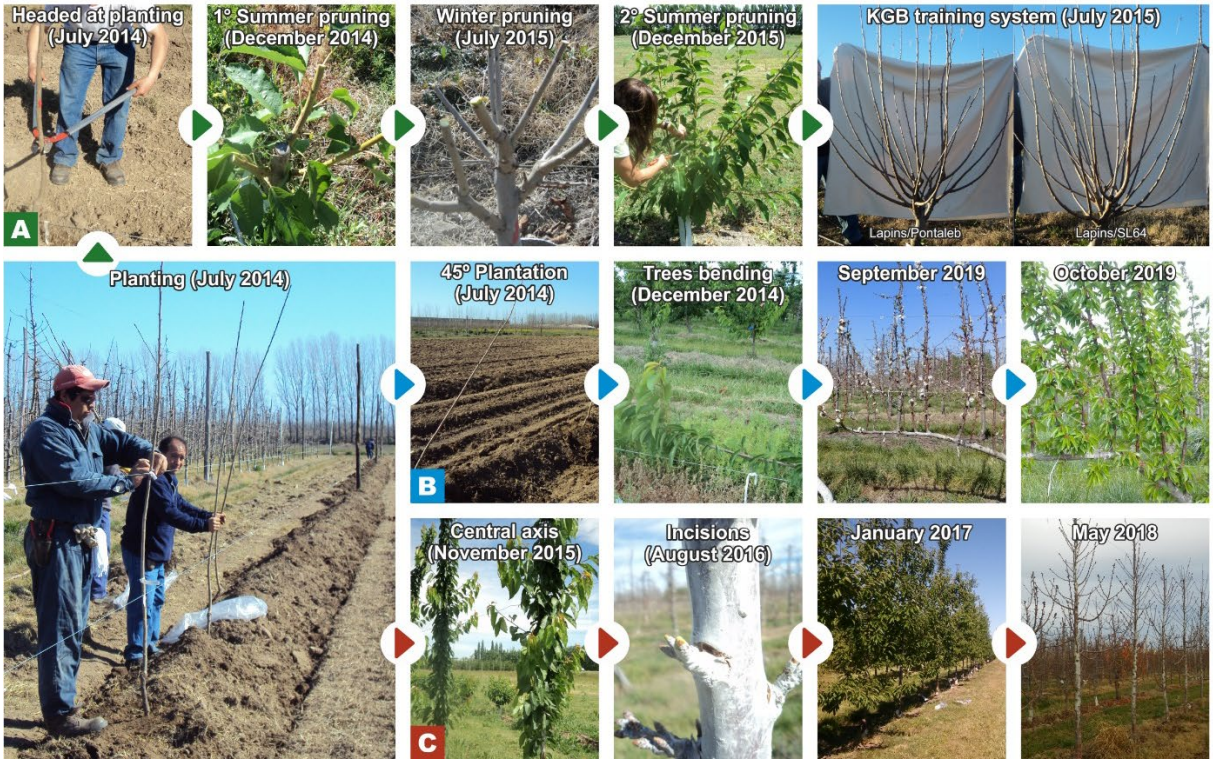
Sweet cherry production in the Río Negro and Neuquén Valleys is an attractive alternative to apples and pears, which were the main production. Fruit growers need technical guidance allowing cost reduction to maintain system profitability through enough yield with adequate fruit quality to reach market requirements. Modern sweet cherry production trends are towards pedestrian orchards[1], where rootstock:scion:training system interaction differs markedly[2]. Therefore, comparative studies of training systems are needed to evaluate yield and fruit quality under specific climatic conditions. Kym Green Bush (KGB) was developed in Australia and it does not need support (lower cost of installation). Tree vigor is controlled by dividing the axis into several temporary vertical axes, and this fact allows the use of a wide range of rootstocks[1]. The innovative Upright Fruiting Offshoots (UFO) was developed in Washington State University. This system is based on the same concept of fruiting on temporal vertical axes, but it requires a support structure (posts and wires), so it has a higher cost of installation. Both systems were designed to optimize yields and labor efficiency among other purposes. The aim of this trial was to evaluate the behavior of cv. Lapins on 'SL64' and 'Pontaleb' rootstocks conducted in the KGB, UFO and Central Axis (CA) systems.

2. Materials and Methods

The trial was planted in 2014 at 4 m between rows, with 2.5 m between plants for the KGB and UFO, and 2.5 m for CA systems. Pruning and training work were carried out as required for each system (Figure 1). Eight representative trees were selected and tagged on each training system. Trunk cross sectional area (TCSA) 10 cm above graft union was measured at wintertime. Number of branches per tree were counted in December 2016-17 in the KGB and UFO Systems. Fruit yield by tree was determined annually, and 30 randomly taken fruits were evaluated for fruit quality in 2018 harvest. Fruit size (mm) and firmness (g mm^{-1}) were evaluated using an FTA-14 electronic pressure device (GÜSS, South Africa). Total soluble solids (TSS) (%) were measured with an Atago® handheld digital refractometer (Atago CO., Ltd.). Fruit juice was also analyzed for total titratable acidity against 0.1 N NaOH to pH 8.2. Pruning labor efficiency was recorded for each system in July 2019. The pruning time per plant of each conduction system was recorded.

Data were analyzed by analysis of variance (ANOVA) with the statistical software Infostat (Universidad Nacional de Córdoba, Argentina). Means were compared using the LSD Fisher test and only $p<0.05$ are reported.

Figure 1. Time of planting and training scheme in three training Systems: ▲ Kym Green Bush (KGB), ▲ Upright Fruiting Offshoots (UFO) and ▲ Central Axis (CA)

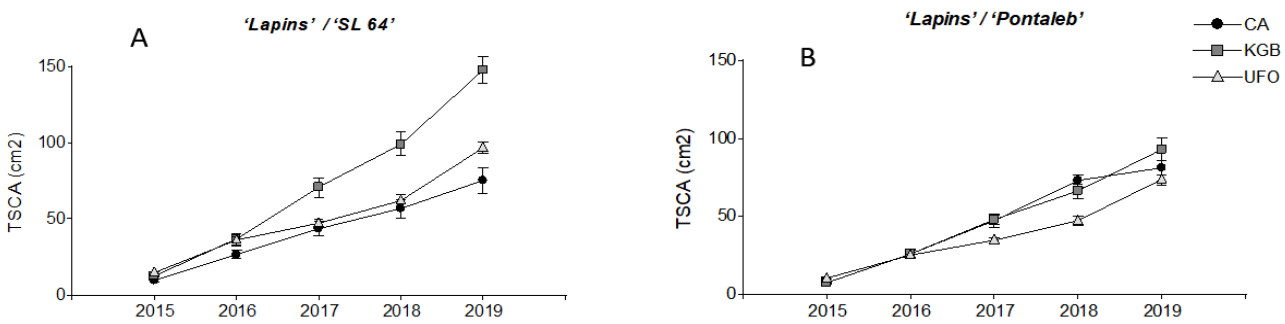


3. Results and Discussion

The KGB system was the easiest to implement and it produced the most vigorous plants (Figure 2). Cherry trees on SL64 showed greater vigor than trees on Pontaleb, which indicates that the number of axes per plant in the first combination could be increased, as was previously suggested(1).

The KGB system was the least precocious, due to the requirement of early pruning for its formation (Figure 1). Lapins/Pontaleb combination was generally more productive than Lapins/SL64 in all training systems, especially in CA and KGB (Table 1).

Figure 2. Trunk cross sectional area (TCSA, cm^2) of Lapins sweet cherry trees growing on Santa Lucia 64 (SL 64) and Pontaleb rootstocks in Central Axis (CA), Kym Green Bush (KGB) and Upright Fruiting Offshoots (UFO)



*Vertical bars indicate means standard error

Table 1. Average yield of Lapins sweet cherry trees grafted onto Santa Lucia 64 (SL 64) and Pontaleb trained to Central Axis (CA), Kym Green Bush (KGB) and Upright Fruiting Offshoots (UFO) in Río Negro

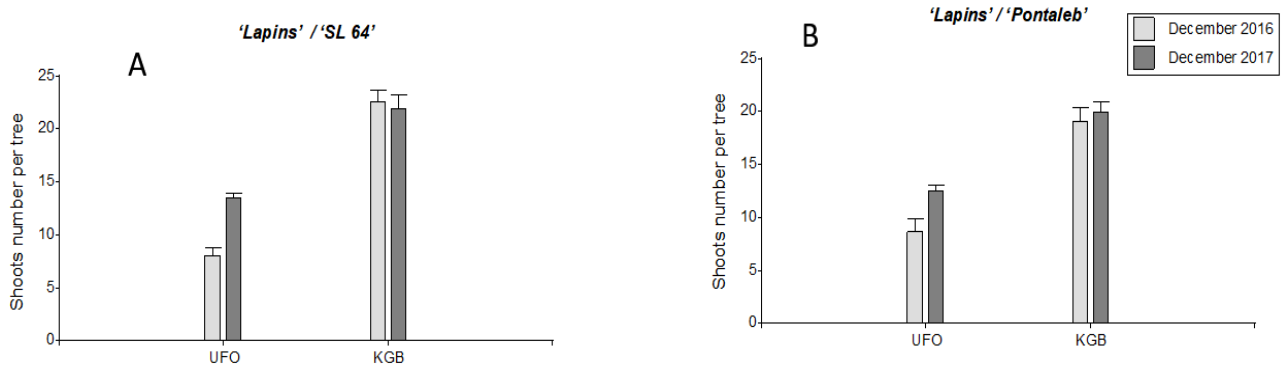
Training System	tree ha^{-1}	Rootstock	Kg tree^{-1}				Average yield (4th and 5th leaf)	Cumulative Yield
			2nd Year (2015)	3rd Year (2016)	4th Year (2017)	5th Year (2018)	Kg tree^{-1}	Ton ha^{-1}
Central Axis	1250	SL64	1.3 b*	1.2 c	5.1 bc	7.9 b	6,5	19.4
		Pontaleb	1.5 b	1.2 c	5.9 c	12.2 c	9.0	26.0
KGB	1000	SL64	0 a	0.03 a	4.1 ab	7.1 b	5,6	11.2
		Pontaleb	0.2 a	0.6 b	6.2 c	5.8 b	6,0	12.8
UFO	1000	SL64	1.6 b	1.8 d	3.4 a	2.5 a	3,0	9.3
		Pontaleb	1.5 b	1.9 d	3.8 ab	2.9 a	3,4	10.1
	p-value		0.0006	< 0.0001	< 0.0001	0.0001	-	-

*Means followed by different letters within columns are significantly different according to LSD Fisher's test (p<0.05).

Moreover, average yield tree^{-1} was lower than previous reports for each training system[1], probably due to the vigorous rootstocks used in this trial. Likewise, it is important to highlight that spring frosts occurred in September 2015 and 2016[3], that could have affected the early yields of the trees in this trial. In the UFO, expected yields were not reached, probably because many trees did not get the necessary number of developed shoots in the initial years (Figure 3), and also because the development of upright shoots was quite variable, as was previously reported for this cultivar[4]. Anyway, this cultivar/rootstock combination could be planted at higher density in this system, and thus the yields per hectare might be increased.

The average number of upright shoots per tree were higher in the KGB than in the UFO systems in both rootstocks (Figure 3). This could explain the higher yield (kg tree^{-1}) observed in both KGB combinations compared to the UFO (Table 1).

Figure 3. Average number of upright shoots per tree in Lapins sweet cherry trees growing on Santa Lucia 64 (SL 64) and Pontaleb rootstocks training as Upright Fruiting Offshoots (UFO) and Kym Green Bush (KGB)



*Vertical bars indicate means standard error

The fruit quality results are shown in Table 2. Trees trained to the UFO (planar canopy) and KGB/Pontaleb (the lesser vigorous combinations in KGB) produced fruits with higher firmness. Cherries from these treatments were more exposed to sunlight, which is positively correlated with that parameter[5]. No differences were found in total soluble solids, titratable acidity and fruit size among the different combinations (Table 2).

Furthermore, the KGB and UFO systems reduced labor needed for winter pruning and tying wages by 74 and 48%, respectively, when compared to the CA, as previously reported[6]. Harvesting and pruning in the KGB system could be done without ladders. Therefore, labor efficiency at harvest was also higher in this system.

Table 2. Average fruit quality parameters of Lapins grafted onto Santa Lucia 64 (SL64) and Pontaleb (Pont) trained to Central Axis (CA), Kym Green Bush (KGB) and Upright Fruiting Offshoots (UFO)

	Firmness (g mm^{-1})	TSS (%)	TA (%)	Size (mm)
CA - SL64	327 a*	20.3	1.5	26.7
CA - Pont	325 a	20.2	1.4	27.5
KGB - SL64	310 a	20.2	1.4	26.7
KGB - Pont	348 b	19.7	1.4	27.3
UFO - SL64	354 b	20.8	1.6	27.4
UFO - Pont	371 b	20.7	1.5	27.8
p-value	*0.021*	*0.067*	*0.194*	*0.311*

*Means followed by different letters within columns are significantly different according to LSD Fisher's test (p<0.05).

4. Conclusions

The KGB and UFO training systems behave appropriately with the semi-vigorous rootstocks used in this trial. Although yields obtained in these systems did not exceed the Central Axis, it is possible to increase planting density and expected yield. These pedestrian systems are promising because they offer an important reduction in pruning and harvesting costs, as main advantages.

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Author contribution statement

All authors contributed equally to the content.

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