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Research Note

Effects of bearing unit, spur or cane, on yield components and bud productivity

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Introduction: The selection of the most appropriate pruning system for a grape variety is one of the most important decisions in viticulture. Spur pruning is generally used for high fertility varieties, while cane pruning is used for varieties with basal buds of low fertility (Kasimatis *et al.* 1985). Bud productivity depends on fertility (number of clusters per shoot and number of flowers per cluster) but also on bud break, fruit set and final berry weight (Bowen and Kliewer 1990).

After winter pruning the contribution of each bud to the final yield will depend on both the type of bearing unit where buds are located and the bud position in each bearing unit. On the one hand, bud break at the cane increases in a distal direction at the cane, and the percentage is higher in spurs than at the basal end of canes (Bessis 1965; Carolus 1971). On the other hand, fruitset can be lower in clusters from the basal two nodes of canes than in those from spurs (López-Miranda *et al.* 2001).

The aim of this study was to determine the relation between the influence of yield components on bud productivity and the location of buds at different bearing units. Knowledge of these relationships may allow to choose the most appropriate pruning system for medium fertility varieties like Verdejo for which the increase of fertility from proximal to distal node positions of the cane is moderate (López-Miranda *et al.* 2003).

Material and Methods: The experimental vineyard was located in the A.O. Rueda, in the south of the province of Valladolid (central-northern Spain). The study was carried out from 1999 until 2001. The cv. Verdejo (grafted to rootstock 110-R) was planted in 1979; the vine spacing was 3 m x 3 m. The vines were trellis-trained and grown under non-irrigated conditions. The study was developed by using vines with 4 two-bud spurs and 2 ten-bud canes retained after winter pruning in 4 replications of 4 plants. For all buds of the bearing units, the following parameters were controlled at harvest: number and weight of clusters; number of shoots. Bud break percentage, number of clusters per shoot, shoot productivity (total yield per shoot) and bud productivity (total yield per bud) were calculated by using the previous values.

Results and Discussion: Bud productivity had a remarkable tendency to increase from the proximal to the distal part of the bearing units. Bud productivity differed by about 380 % from the lowest to the most productive bud, because rates of bud break, number of clusters per shoot and flowers per cluster were higher at the distal end compared to the basal end of canes (Bessis 1965). Fruit set tended to decrease from the proximal to the distal part of canes (López-Miranda, 2002). Spur-buds were more productive (+130 %) than basal buds of canes. This result was due to the bud break rate which is much higher in spur-buds. Basal buds of canes could have the same fertility and the same shoot productivity than spur-buds, but their bud break was so small that productivity of basal buds was drastically reduced.

The relationships between bud productivity, shoot productivity and bud break (%) in spurs and canes in 2001 are shown in the Figure. (The relationships obtained in 1999 and 2000 were similar; data not shown). There was a closer relationship between bud and shoot productivity in spurs than in canes. Even though the regressions were statistically significant in both bearing units, R^2 values were around 0.90 for spurs and about 0.70 for canes. The relationship between bud productivity and bud break differed between the bearing units. Bud productivity in spurs did not show a statistically significant relationship with bud break. In general, R^2 values were lower than 0.30. However, in long bearing units, this relationship was statistically significant with R^2 values of about 0.70, which was similar to the relationship observed between bud productivity and shoot productivity. This shows that productivity of cane-buds was very closely correlated to both, shoot productivity and bud break.

The Table shows R^2 values and statistical significance of multiple regressions between bud productivity, as dependent term, and bud break, number of clusters per shoot and cluster weight as independent terms. These yield components were influenced by climatic conditions in different ways. Number of clusters per shoot and rate of bud break were very similar in the three years of study, while cluster weight showed remarkable variability between years due to changes in the number of flowers per cluster. In 1999, spring frost affected the number of flowers. In 2001, air temperature during bud break was higher than normal, reducing the number of flowers per cluster (Pouget 1981). In 2000, climatic conditions were optimal for the reproductive cycle and fertility and productivity reached very high levels.

In two of the three years of study, bud break was the yield component most closely related to bud productivity in canes. This yield component could explain 68 % and 71 % of the bud production variability in 1999 and 2001, respectively. After bud break, cluster weight was the yield component with the highest influence on cane-bud productivity. In 2000, 71 % of the variability of bud productivity depended on cluster weight, whereas in 1999 and 2000 this yield component could only explain about 14.5 % of the bud production variability of canes. Finally, the number of clusters per shoot was the yield component with the lowest influence on grape production of cane-buds. Only 9 % of the variability of the

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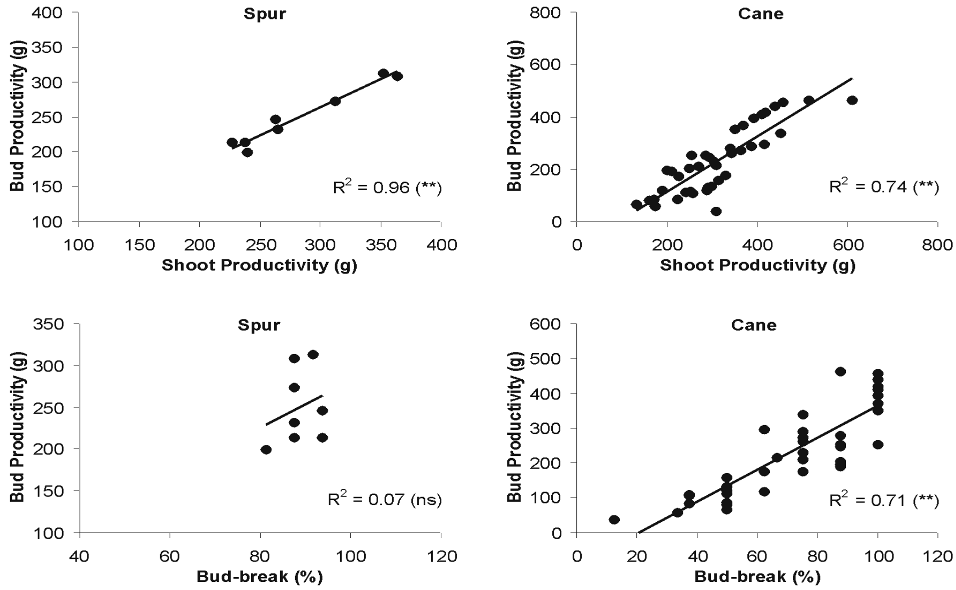

Figure: Relationships between bud productivity and shoot productivity and bud break (%) in spurs and canes in 2001. Non significant (ns); significant <0.01 (**).

Table

R^2 values and statistical significance levels of multiple regressions between bud productivity, as dependent term, bud-break percentage (BB %), number of clusters per shoot (CPS) and cluster weight (CW), as independent terms, in spurs and canes in 1999, 2000 and 2001. Statistical significant levels: non significant (ns); probability <0.05 (*); probability <0.01 (**)

Year	Spur			Cane		
1999	CPS	CPS CW	CPS CW BB %	BB %	BB % CPS	BB % CPS CW
	0.50 ns	0.74 ns	0.96 *	0.68 **	0.83 **	0.90 **
2000	CW	CW CPS	CW CPS BB %	CW	CW BB %	CW BB % CPS
	0.83 **	0.90 **	0.96 **	0.71 **	0.93 **	0.96 **
2001	CW	CW CPS	CW CPS BB %	BB %	BB % CW	BB % CW CPS
	0.78 **	0.94 **	0.96 **	0.71 **	0.87 **	0.96 **

bud productivity depended on this yield component. The influence of each yield component on bud productivity was different between buds located on short bearing units and long bearing units. On the one hand, cluster weight has been the best yield component to explain the variability of spur-bud productivity in two of the three years of study, as the R^2 values were 0.83 and 0.78 in 2000 and 2001, respectively. On the other hand, the number of clusters per shoot explained 50 %, 7 % and 16 % of the variability of spur-bud productivity in 1999, 2000 and 2001, respectively. Finally, only 22 %, 6 % and 2 % of the variability observed in the productivity of spur-buds depended on bud break in 1999, 2000 and 2001, respectively.

Selecting the most adequate practical pruning strategy, according to previous results, it should be considered that the use of long bearing units may provoke a waste of the potential productivity of basal buds of canes. Spur pruning allows to take advantage of the productivity of all the buds left on the vine, so, this pruning system may be the most appropriate for low or medium fertility varieties in which fruitfulness at different bud positions does not increase significantly.

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