The Optimum One-year-old Shoot Length to Optimize Yield and Fruit Size of Three Fig (*Ficus carica* L.) Cultivars

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Additional index words. optimum shoot length

Abstract. The European fig cultivars Bourjasotte Noire, Col de Damme Noire, and Noire de Caromb were recently introduced to the Western Cape Province of South Africa. Producers struggle to implement effective commercial practices that will optimize yield of quality fruit. A phenological study was conducted to establish the optimum 1-year-old shoot length to maximize yield. The number of fruit, budbreak, and shoot growth on 1-year-old shoots comprising four length categories ('Bourjasotte Noire': 10 to 15, 25 to 40, 50 to 65, and 75+ cm; 'Col de Damme Noire' and 'Noire de Caromb': 10 to 20, 30 to 50, 60 to 80, and 100+ cm) were evaluated. In 'Bourjasotte Noire', all four categories seem to be suited for reproduction in the current season and also provide sufficient new shoot growth to ensure a fair yield the next season. In 'Col de Damme Noire', category four seems to be the best 1-year-old shoot length for reproduction both in terms of fruit number and fruit size. However, yield on these shoots may not be optimal the next season, because current-season shoots are too short. It seems that this cultivar will require pruning to stimulate strong new shoot growth that will ensure regular, high yields. In 'Noire de Caromb', category one shoots are very productive relative to their length. Categories two and three were also relatively productive, whereas category four was less productive but developed a large number of current-season shoots similar in length to category one that should be productive the next season. These results will allow us to develop pruning strategies to ensure an optimal balance between current-season yield and the development of new fruiting wood to ensure regular, high yields. It also suggests that the three cultivars studied will require differential application of horticultural practices to attain regular, high yields of large fruit.

The common fig (*Ficus carica* L.) is a subtropical, deciduous fruit tree (Botti et al., 2003) belonging to the Eusyce subgenus of the Moraceae (mulberry) family (Mars, 2003; Watson and Dallwitz, 2004). Figs are cultivated in most Mediterranean-type climates (Flaishman et al., 2008) with the Mediterranean basin of primary importance (Şahin, 1998). Despite possibly being the oldest cultivated fruit species (Brown, 1994), a lack of information pertaining to production practices as well as the low number of fig cultivars available commercially limit global expansion of fig cultivation (Botti et al., 2003). Even so, the commercial production of figs has expanded to the Mediterranean-type climate Western Cape Province of South Africa, where three black,

parthenocarpic, common-type figs, 'Bourjasotte Noire', 'Col de Damme Noire', and 'Noire de Caromb', have been established to provide fruit for the fresh market in South Africa and Europe.

Common-type figs produce their main crop from buds in the axils of leaves on the current season's growth (Flaishman et al., 2008; McEachern, 1996). Harvest may start in the middle of summer and can last several months until the onset of winter. At the end of the growth period, trees enter into a dormant period preceded by leaf drop. Fig buds require little or no winter chilling to break endodormancy (Ferguson et al., 1990) and growth resumes in early spring (Flaishman et al., 2008). Fig shoots have one vegetative and two reproductive buds per node, the shoot ending in a vegetative bud.

Shoots on 'Bourjasotte Noire' display plagiotropic to weak orthotropic growth, resulting in open, drooping trees. 'Noir de Caromb' displays orthotropic growth resulting in a more upright but spreading tree, whereas 'Col de Damme Noire' shoots grow strongly orthotropic resulting in a more upright, compact but large tree. 'Bourjasotte Noire' and 'Col de Damme Noire' display strong apical dominance (AD); therefore, new proleptic (N + 1) shoots develop mainly from the most distal vegetative buds of 1-year-old (N) shoots. As a result, large sections of "blind wood" are found on

strong N shoots (personal observation). 'Noire de Caromb' has less pronounced (moderate to strong) AD (as is often the case in breba cultivars) than the other two cultivars. 'Col de Damme Noire' grows extremely vigorously followed by 'Noire de Caromb' and then 'Bourjasotte Noire' (personal observation).

To maximize yield of good-quality fruit, the most productive shoot lengths (in terms of yield and fruit size) should be determined and strategies devised to maximize the number of these shoots on trees on an annual basis. It is therefore important to study the phenological characteristics of a cultivar to establish optimum shoot characteristics. The objective of this research was to identify the most suitable types of shoots by selecting distinctly different N shoots on the tree and doing a detailed, comparative study of phenological processes such as budbreak, shoot growth, and yield for each shoot length category.

Materials and Methods

The study was conducted on 'Bourjasotte Noire', 'Col de Damme Noire', and 'Noire de Caromb' trees during the 2008–2009 growing season in a 4-year-old commercial orchard in the Breede River valley (Mediterranean-type climate; lat. 33°34' S, long. 19°16' E, 217 m) near Worcester in the Western Cape, South Africa. The area accumulated 541.5 chill units from 1 May 2008 until 31 Aug. 2008 according to the Daily Positive Chill Unit model (Linsley-Noakes et al., 1995). The trees, on own roots, were planted in Oct. 2004 at a spacing of 4 × 3 m.

Four different N shoot length categories were selected and tagged per tree ('Bourjasotte Noire': 10 to 15, 25 to 40, 50 to 65, and 75+ cm; 'Col de Damme Noire' and 'Noire de Caromb': 10 to 20, 30 to 50, 60 to 80, and 100+ cm) using 12 single uniform trees per cultivar. The length and basal diameter of each of the 12 tagged shoot per category were measured. The average N shoot lengths of the four shoot categories from the shortest (category 1) to the longest (category 4) shoots were as follows: 'Bourjasotte Noire': 14.0, 38.4, 60.8, and 85.3 cm; 'Col de Damme Noire': 17.9, 44.3, 74.7, and 121.1 cm; and 'Noire de Caromb': 16.8, 44.1, 73.0, and 113.6 cm.

All trees received standard commercial practices except that tagged shoots were left unpruned. The selected shoots were evaluated in terms of the following parameters: total number of vegetative buds on N shoots; budbreak over time; number of N + 1 shoots and their individual lengths; number of reproductive buds on N + 1 shoots; number of fruit harvested per shoot; weight and diameter of harvested fruit; and fruit scars on N + 1 shoots. Fruit scars were counted as a comparison with the number of harvested fruit in case some fruits were inadvertently picked or lost.

Comparison of parameters per N shoot length category were done by analysis of variance using the general linear models procedure of SAS Version 9.1.3 SP2 (SAS Institute, Cary, NC). Single df, orthogonal polynomial contrasts were fitted where applicable.

Received for publication 12 May 2010. Accepted for publication 29 June 2010.

This material is based on work supported by Alterna Fruit and the National Research Foundation under Grant number 2069401.

Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Research Foundation.

This article forms part of a thesis submitted by Hein J. Gerber in partial fulfilment of the MScAgric degree requirements.

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Results

'Bourjasotte Noire'. The average number of new shoots (N + 1) produced (which also represents budbreak) per 1-year-old (N) shoot increased linearly from category one (C1) to four (C4) with C1 yielding an average of 1.6 shoots per N shoot compared with C4 yielding 8.8 shoots (Table 1). Budbreak percentage on N shoots increased linearly from 24.5% to 39.2% from C1 to C4 (Table 1).

The total length of new N + 1 growth increased linearly from C1 to C4. C1 shoots produced an average of 18 cm new growth as compared with C4 shoots, which produced an average of 152 cm (Table 1). The average N + 1 shoot length increased linearly from C1 (11.4 cm) to C4 (17.9 cm) (Table 1). The average length of N + 1 shoots that yielded fruit likewise increased linearly from C1 to C4. There was a linear increase in internode length from C1 to C4 (Table 1).

Total fruit per N shoot followed a linear ($P < 0.0001$) to slightly quadratic ($P = 0.0883$) trend with C1 producing only 2.3 fruit per shoot in comparison with C4 shoots producing 9.3 fruit. In fruit scars per N shoot, the quadratic trend is confirmed ($P = 0.0354$) and C1 produced significantly fewer fruit than all other categories. Yield (gram) per N shoot increased linearly from C1 to C4 shoots (Table 1). There were no significant differences between categories in the average number of fruit per N + 1 shoot or the average fruit weight or diameter (Table 1). All N + 1 shoots from the four categories used in the study were pooled per category to investigate the correlation of shoot length and diameter with the number of fruit produced. The number of fruit per shoot increased linearly with increasing length ($R^2 = 0.861$) and diameter ($R^2 = 0.873$) of shoots (Fig. 1).

The occurrence of N + 1 shoots and their fruiting characteristics were evaluated per N shoot length category and expressed in graphs (Fig. 2A–D). The length of N + 1 shoots ranged from 0.1 to 30 cm on C1 (A) and C2 (B) N shoots, 0.1 to 45 cm on C3 (C), and 0.1 to 55 cm on C4 (D) shoots (Fig. 2). All of the N shoots used in this study from C2, C3, and C4 produced fruit (on new growth), whereas 83% of N shoots from C1 produced fruit (data not shown).

The following percentages of N + 1 shoots on each N shoot category yielded fruit: 68% (C1), 76% (C2), 66% (C3), and 54% (C4) (Fig. 2). None of the four N shoot length categories produced fruit on N + 1 shoots 0.5 to 4.9 cm long. In the four categories, respectively, more than 60% of N + 1 shoots of the following length ranges produced an average number of two or more fruit per shoot: 5 to 29.9 cm in C1 and C2, 10 to 45 cm in C3, and 10 to 40 cm in C4 (Fig. 2). C1 and C2 N shoots produced slightly more fruit on N + 1 shoots 5.0 to 14.9 cm long than C3 and C4 (Fig. 2). On average, C3 produced more fruit on shoots in the range 20.0 to 45.0 cm long than the other categories. Of all N + 1 shoots produced per category, 42%, 18%, 15%, and 10% (eight, eight, 11, and 10 shoots, respectively) were of the same length

as C1 N shoots (10 to 15 cm) on C1, C2, C3, and C4, respectively. The occurrence of N + 1 shoots the length of C2 shoots (25 to 40 cm) was 5%, 11%, 22%, and 26% (one, five, 17, and 27 shoots, respectively) on C1, C2, C3, and C4, respectively. Only one N + 1 shoot the length of a C3 shoot (50 to 65 cm) was produced (on a C4 shoot) on the selected shoots over 12 trees in this trial. No N + 1 shoots the length of a C4 shoot were produced in this trial (Fig. 2).

'Col de Damme Noire'. The number of N + 1 shoots (budbreak) per N shoot increased linearly from C1 to C4 in which C1 produced 1.1 and C4 8.7 shoots, respectively. The budbreak percentage likewise increased linearly from the shortest to the longest category (Table 2).

Total new growth per N shoot increased linearly from C1 to C4. C1 produced 15 cm new growth compared with 191 cm new growth produced by C4 (Table 2). The average length of N + 1 shoots showed a quadratic increase ($P = 0.0480$) from C1 to C3 and C4, whereas the average length of N + 1 shoots yielding fruit increased linearly from C1 to C4. In C1, the average N + 1 shoot length was 12.7 cm, whereas the combined average N + 1 shoot length of C2 to C4 averaged 21.2 cm (Table 2). The average internode length of N shoots followed a quadratic trend, increasing sharply from C1 to C2 and then more gradually to C4 (Table 2).

The total number of fruit per N shoot showed a quadratic increase with an increase in N shoot length. C4 produced 10.8 fruits per shoot, which was significantly more fruits than C3, C2, and C1 shoots, respectively. Fruit scars and total yield (grams) per N shoot followed the same pattern (Table 2). There were no significant differences among the four categories in terms of the average number of fruit per N + 1 shoot (fruiting and non-fruiting shoots) (Table 2). Both average fruit weight and diameter increased linearly from C1 to C4 shoots with C1 yielding fruit with an average weight and diameter 22.6 g and 32.1 mm, respectively, whereas the averages of C4 fruit were 8.7 g and 5.2 mm more than the control (Table 2).

When all N + 1 shoots were pooled per N category, a positive linear correlation was found between number of fruit per shoot and shoot diameter ($R^2 = 0.986$) as well as shoot length ($R^2 = 0.821$) (Fig. 3).

N + 1 shoots on C1 ranged mainly from 0.1 to 40 cm with one shoot outside this range measuring 67 cm. On C2, shoots ranged from 0.1 to 35 cm, whereas on C3 and C4, they ranged mainly from 0.1 to 55 cm. One shoot of 64 cm developed on C4 (Fig. 4). In C1, 75% of the 12 N shoots produced fruit (on new growth), whereas 92% of N shoots in C2 and all N shoots in C3 and C4 produced fruit (data not shown). Of all the N + 1 shoots produced in C1, 77% yielded fruit followed by C4 with 74%, then C2 with 67%, and C3 with 52% (Fig. 4).

C1 shoots yielded a high number of fruit mostly on N + 1 shoots ranging from 5 to 40 cm in length, apart from one fruit yielding

Table 1. The effect of 1-year-old (N) shoot length on budbreak, current-season (N + 1) shoot growth, and fruiting in 4-year-old 'Bourjasotte Noire' in the Breede River valley (2008–2009).^a

One-year-old shoot length category	No. of N + 1 shoots	Budbreak (%)	New ^w growth (cm)	Avg N + 1 shoot length (cm)	Avg N + 1 shoot length (cm)	Avg bearing N + 1 shoot length (cm)	Avg in ternode length ^x	Total fruit per N shoot	Fruit scars per N shoot	Yield per N shoot (g)	Total fruit per N + 1 shoot	Avg fruit wt (g)	Avg fruit diameter (mm)
10–15 cm shoot	1.6	d	18	d	13.7	c	2.2	2.3	c	90	1.5	35.1	41.1
25–40 cm shoot	3.8	c	54	c	17.5	b	2.8	5.8	b	221	1.5	40.0	43.9
50–65 cm shoot	6.2	b	102	b	22.9	a	3.2	10.0	a	385	1.6	36.8	41.7
75+ cm shoot	8.8	a	152	a	24.4	a	3.9	9.3	a	363	1.1	37.9	42.0
Pr > F	<0.0001	0.0065	<0.0001	0.0018	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	0.0004	0.2679	0.4606	0.1809
Shoot length linear	<0.0001	0.0007	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.1953	0.6788	0.9958
Shoot length quad	0.7232	0.4103	0.4071	0.2886	0.3014	0.5455	0.0883	0.0354	0.1150	0.1150	0.2131	0.4238	0.1922

^aMeans were separated by least significant difference (5%).

^xCategories with different letters differ significantly at $P < 0.05$. NS = No significant differences between categories.

^wAverage internode length of N + 1 shoots.

^yTotal length of N + 1 shoots.

shoot outside this range measuring 67 cm. More than 60% of shoots in this range yielded fruit. C2 shoots produced fruit on a high percentage (60% and more) of N + 1 shoots ranging from 15 to 35 cm long, whereas C3 shoots yielded fruit on more than 60% of N + 1 shoots 25 to 30 cm long and 40 to 55 cm long. C4 shoots produced fruit on 60% and more of most shoots 5 to 55 cm long and also on a 64-cm long N shoot (Fig. 4).

C1 and C2 shoots produced a higher average number of fruit on N + 1 shoots ranging in length from 5 to 10 cm as compared with C3 and C4. C4 shoots produced a high percentage of bearing shoots spanning a wide range of

N + 1 shoot length categories. Both C1 and C4 seem to produce productive shoots over a wide range of shoot lengths, whereas C2 and C3 were more varied in the percentage of shoots that yielded fruit.

Of all N + 1 shoots produced per category, 31%, 44%, 25%, and 15% were of the same length as C1 (10 to 20 cm) on C1, C2, C3, and C4 N shoots, respectively. The occurrence of N + 1 shoots the length of C2 (30 to 50 cm) was 8%, 15%, 26%, and 35% of the shoots produced per C1, C2, C3, and C4, respectively. Only two N + 1 shoots in the length range of C3 N shoots occurred in this study, one in C1 and one in C4, whereas no N + 1

shoots in the length range of C4 (100 + cm) were produced (Fig. 4).

'Noire de Caromb'. The number of N + 1 shoots (budbreak) and the budbreak percentage both displayed a linear increase from C1 to C4. The average number of shoots on C1 was 1 as compared with 8.5 in C4 (Table 3). C1 had 15.5% budbreak compared 28.4% budbreak in C4 (Table 3).

The total new growth per N shoot increased linearly from C1 to C4 with C1 producing only 23-cm growth as compared with 207-cm growth produced by C4. There was no significant difference between the categories in the average N + 1 shoot length produced; however, there was a linear increase in the average length of fruit-bearing shoots from C1 to C4 (Table 3). The average length of internodes on N shoots increased linearly from C1 to C4 (Table 3).

The total number of fruit per N shoot increased linearly from C1 to C4 with C1 having on average 2.3 fruits per shoot as compared with C4 with 6.1. Fruit scars per N shoot displayed a quadratic trend with C1 and C2 producing significantly fewer fruit per shoot as compared with C3 and C4 (Table 3). The total yield (grams) per N shoot increased linearly from C1 to C4 (Table 3). The total number of fruit per N + 1 shoot was significantly higher in C1 as compared with the other categories, decreasing linearly from C1 (2.3) to C4 (0.9). There were no significant differences between categories in terms of average fruit weight or diameter (Table 3). Like with the other two cultivars, all N + 1 shoots in the four categories were pooled to correlate shoot diameter and length to number of fruit (Fig. 5). It was found that the

Fig. 1. Relationship between length and diameter of current season shoots and the number of fruits on these shoots in 'Bourjasotte Noire' (*number of shoots within the x-axis category).

Fig. 2. Characterization of various current season shoot parameters in 'Bourjasotte Noire' (*average number of fruit per fruiting shoot; *total number of shoots in specific category) per category one (A), two (B), three (C), and four (D) 1-year-old shoot length categories. Dashed line at 60% indicates shoots within specific length categories of which more than 60% were productive.

Table 2. The effect of 1-year-old (N) shoot length on budbreak, current-season (N + 1) shoot growth, and fruiting in 4-year-old 'Col de Damme Noire' in the Breede River valley (2008–2009).^z

One-year-old shoot length category	No. of N + 1 shoots	Budbreak (%)	New ^w growth (cm)	Avg N + 1 shoot length (cm)	Avg bearing N + 1 shoot length (cm)	Avg in termode length ^x	Total fruit per N shoot	Fruit scars per N shoot	Yield per N shoot (g)	Total fruit per N + 1 shoot	Avg fruit wt (g)	Avg fruit diam (mm)
10–20 cm shoot	1.1 c	14.7 b ^y	15 c	12.7 b	14.5 c	2.4 c	2.0 c	2 c	66 b	1.8 NS	22.6 b	32.1 b
30–50 cm shoot	2.3 c	16.7 b	42 c	17.7 ab	20.4 bc	3.4 b	1.8 c	3 c	63 b	1.1	26.6 ab	34.5 ab
60–80 cm shoot	5.4 b	26.5 a	114 b	23.0 a	23.3 ab	3.8 a	4.7 b	7 b	138 b	1.1	28.6 a	36.1 a
100+ cm shoot	8.7 a	30.9 a	191 a	22.9 a	28.8 a	4.3 a	10.8 a	17 a	339 a	1.4	31.3 a	37.3 a
Pr > F												
Treatment												
Shoot length linear	<0.0001	0.0006	<0.0001	0.0011	0.0026	<0.0001	<0.0001	<0.0001	<0.0001	0.3530	0.0799	0.0471
Shoot length quad	<0.0001	<0.0001	<0.0001	0.0003	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.4621	0.0109	0.0060
	0.7998	0.6906	0.7619	0.0480	0.4480	0.0212	0.0068	0.0103	0.0272	0.1216	0.5884	0.3899

^zMeans were separated by least significant difference (5%).

^yCategories with different letters differ significantly at $P < 0.05$. NS = No significant differences between categories.

^xAverage internode length of N + 1 shoots.

^wTotal length of N + 1 shoots.

Fig. 3. Response of fruit number to length and diameter of current season shoots in 'Col de Damme Noire' (number of shoots within the x-axis category).

number of fruit increased linearly with an increase in shoot length ($R^2 = 0.978$) and diameter ($R^2 = 0.946$) (Fig. 5).

The length of N + 1 shoots of 'Noire de Caromb' ranged from 5 to 40 cm in C1, 0.1 to 40 cm in C2, 0.1 to 60 cm in C3 (with an additional shoot 72 cm long), and 0.1 to 60 cm long in C4 (Fig. 6). In C1, C2, and C3, all selected N shoots produced fruit (on new growth), whereas in C4, 92% of the N shoots produced fruit (data not shown). The following percentage of N + 1 shoots in the four categories produced fruit: 100%, 74%, 72%, and 50% on C1, C2, C3, and C4, respectively.

In C1, all N + 1 shoots 5 to 40 cm long produced fruit. In C2, more than 60% of all shoots 5 to 40 cm long produced fruit. In C3, more than 60% of shoots 5 to 40 cm long and shoots 50 to 60 cm long plus an additional shoot 71 cm long produced fruit. In C4, 60% and more of shoots 25 to 60 cm long produced fruit (Fig. 6). C1 produced on average more fruit per N + 1 shoot in the 20- to 40-cm range as compared with other categories (Fig. 6). Of all N + 1 shoots produced per N shoot length category, 0%, 18%, 14%, and 23% (zero, seven, nine, and 22 shoots, respectively) were within the length range of C1 shoots (10 to 20 cm) on C1, C2, C3, and C4 N shoots, respectively. The occurrence of N + 1 shoots the length of C2 (30 to 50 cm) shoots was 25%, 21%, 28%, and 33% (four, eight, 18, 31) of the N + 1 shoots produced on C1, C2, C3, and C4, respectively (Fig. 6). Only two shoots in the length range of C3 (60 to 80 cm) shoots occurred in this study, one on a C3 and one on a C4 shoot. C1 shoots produced N + 1 shoots mostly longer than its own length (Fig. 6).

Discussion

A lower budbreak percentage is expected on longer shoots as a result of the high number of vegetative buds present in comparison with shorter N units. This was however not the case in any of the three cultivars

studied (Tables 1 to 3). The shorter average internode length on short N shoots resulted in more vegetative buds per unit length on shorter shoots (Tables 1 to 3) and this probably contributed to the lower budbreak percentages on shorter shoots.

In 'Bourjasotte Noire', the long C4 N shoots produced the most new growth, but even so, it did not produce more fruit than C3 despite producing 50 cm more growth (Table 1). C1, C2, and C3 produced fruit on a higher percentage of the N + 1 shoots in comparison with C4. C4 seems to be the least productive per unit length when compared with the other categories, although the difference is small. This is probably the result of more vigor resulting in less fruiting (Wertheim, 2005). Even so, C4 produced the highest number of N + 1 shoots of similar lengths as C1, C2, and C3 N shoots, which should be productive the next season. 'Bourjasotte Noire' did not produce many fruits on C1 shoots, yet this category is still productive relative to its length when compared with other categories.

In 'Col de Damme Noire', C4 produced the most growth in comparison with the other categories. The total number of fruit and fruit scars followed a quadratic trend, increasing sharply from C1 and C2 to C3 and especially C4, which yielded the highest number of fruit. The longer C4 shoots seem to yield the highest number of fruit per N shoot (and unit length N shoot) and the fruit are larger making C4 the most suited for yield in 'Col de Damme Noire'. C2 is unproductive relative to its size when compared with other categories, and C1 produces smaller fruit when compared with C3 and C4. A large percentage of the N + 1 shoots produced by C4 were the length of C2 N shoots, the least productive N shoot length category. None of the categories produced N + 1 shoots the length of C4 shoots.

As was the case in 'Bourjasotte Noire' and 'Col de Damme Noire', the most new growth was produced by C4 shoots in 'Noire de Caromb'. Even so, the total number of

Fig. 4. Characterization of various current season shoot parameters in 'Col de Damme Noire' (% average number of fruit per fruiting shoot; % total number of shoots in specific category) per category one (A), two (B), three (C), and four (D) 1-year-old shoot length categories. Dashed line at 60% indicates shoots within specific length categories of which more than 60% were productive.

Table 3. The effect of 1-year-old (N) shoot length on budbreak, current-season (N + 1) shoot growth, and fruiting in 4-year-old 'Noire de Caromb' in the Brede River valley (2008–2009).^z

One-year-old shoot length category	No. of N + 1 shoots	Budbreak (%)	New ^w growth (cm)	Avg N + 1 shoot length (cm)	Avg bearing N + 1 shoot length (cm)	Avg in ternode length ^x	Total fruit per N shoot	Fruit scars per N shoot	Yield per N shoot (g)	Total fruit per N + 1 shoot	Avg fruit weight (g)	Avg fruit diameter (mm)
10–20 cm shoot	1.0 d	15.5 c ^y	23 d	23.0 ns	23.0 b	2.5 c	2.3 c	3 b	76 b	2.3 a	30.0 ns	33.9 ns
30–50 cm shoot	3.2 c	20.6 bc	60 c	20.9	22.9 b	3.0 b	3.8 bc	5 b	127 ab	1.4 b	26.4	32.7
60–80 cm shoot	5.4 b	23.5 ab	134 b	26.5	29.8 a	3.2 b	5.8 ab	10 a	155 a	1.4 b	27.2	34.1
100 + cm shoot	8.5 a	28.4 a	207 a	25.1	32.7 a	3.8 a	6.1 a	9 a	191 a	0.9 b	27.4	33.3
Pr > F												
Treatment	<0.0001	0.0011	<0.0001	0.2703	0.0218	<0.0001	0.0042	<0.0001	0.0145	0.0023	0.3083	0.3662
Shoot length linear	<0.0001	<0.0001	<0.0001	0.2932	0.0048	<0.0001	0.0009	<0.0001	0.0020	0.0004	0.2932	0.8994
Shoot length quad	0.9268	0.6419	0.6993	0.7951	0.9838	0.9586	0.1786	0.0239	0.4533	0.4264	0.2628	0.9927

^zMeans were separated by least significant difference (5%).

^yCategories with different letters differ significantly at $P < 0.05$. ns = No significant differences between categories.

^xAverage internode length of N + 1 shoots.

^wTotal length of N + 1 shoots.

Fig. 5. Response of fruit number to length and diameter of current season shoots in 'Noire de Caromb' (% number of shoots within the x-axis category).

fruit per N shoot and the number of fruit scars per N shoot did not differ significantly between C3 and C4. It appears that shoot vigor is not detrimental to yield in this cultivar (Wertheim, 2005). The increase in the number of fruit per N shoot between categories from C1 to C4 was low relative to the increase in shoot length.

There was no difference in the average number of fruit per N + 1 shoot in 'Bourjasotte Noire' or 'Col de Damme Noire', yet in 'Bourjasotte Noire', C1 and C2 seem to be able to produce more fruit on a higher percentage of N + 1 shoots 5 to 15 cm long in comparison with C3 and C4. 'Bourjasotte Noire' has a shorter average bearing shoot length in C1 and C2. C3 and C4 are mainly productive on N + 1 shoots longer than 10 cm. In 'Col de Damme Noire', C1 and C2 seemed to produce more fruit (per shoot) on N + 1 shoots 5 to 10 cm long compared with the other categories. C1 and C4 produced

Fig. 6. Characterization of various current-season shoot parameters in 'Noire de Caromb' (%average number of fruit per fruiting shoot; ^ztotal number of shoots in specific category) per category one (A), two (B), three (C), and four (D) 1-year-old shoot length categories. Dashed line at 60% indicates shoots within specific length categories of which more than 60% were productive.

fruit more consistently on N + 1 shoots in 'Col de Damme Noire' when compared with the other categories. C1 and C2 had the shortest average bearing shoot lengths with the average and average bearing shoot lengths of C1 being equal. In 'Noire de Caromb', it seems that C1 shoots can produce a higher number of fruit on shorter shoots as compared with the other categories, as seen in Figure 6, and the average "number of fruit produced per N + 1 shoot." The percentage of N + 1 shoots that yielded fruit in 'Noire de Caromb' was 100%, 74%, 72%, and 50% on C1, C2, C3, and C4, respectively; hence, C1 to C3 seem to be more productive. Even so, C4 shoots produced the highest number of C1 and C2 shoots that should be productive the next season.

All shoot length categories evaluated yielded fruit in 'Bourjasotte Noire' and produced new shoots that are likely to result in a fair yield in the next season as well. Therefore, minimal pruning should be sufficient. In 'Col de Damme Noire', both C3 and C4, but especially C4, seem to be suited to

reproduction, yet they might produce a poor yield the next season because N + 1 shoots are too short. Therefore, development of C4 shoots will have to be stimulated by selective pruning. C1 shoots of 'Noire de Caromb' are productive relative to their length and yield a high average number of fruit per N + 1 shoot. C2 and C3 are fairly productive (relative to their size), and C4 produced suitable shoot lengths for the next season. Not all fig cultivars bear fruit on the same shoot types, but in general, it appears as if a wide range of shoot lengths is productive.

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