horticulturae

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Productivity and Fruit Quality of 'Falstaff^{PBR}' Pear Variety Grafted on Different Rootstocks

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Abstract: 'Falstaff^{PBR}' is a pear variety released by CREA and New Plant in 2012. This study focused on the effects of various clonal rootstocks on the main productive and qualitative traits of 'Falstaff^{PBR}' scion. The rootstocks used were 'EMC', 'EMH', and 'BA29' for quince (*Cydonia oblonga*) and pear 'Farold 40' (*Pyrus communis*). Plants were planted in 2009 with a layout that, depending on the used rootstock, varied between 60 and 120 cm on the row, according to the rootstock standard planting system, and 350 cm between rows. The average yield calculated in the trail field in the 4 years of production (2014–2017) was over 22.7 tons ha^{-1} on 'BA29', 22.8 tons ha^{-1} on 'EMH', 16.3 tons ha^{-1} on 'Farold 40', and 18.4 on 'EMC'. Fruits of the plants grafted on 'Farold 40' always had a medium-to-high size, while fruits produced by the plants grafted onto 'BA29' have been larger in size since the first years of production. The plants grafted onto 'EMH' produced fruits with the highest percentage of red overcolor. The 'EMH' rootstock is optimal for 'Falstaff^{PBR}' as it gives the plant an intermediate vigor between 'BA29' and 'EMC', and a good yield per hectare from the first planting years; the average fruit size is excellent.

Keywords: *Pyrus communis*; 'Falstaff^{PBR}'; rootstocks; yield; quality

Citation: Caracciolo, G.; Pietrella, M.; Pallotti, G.; Faedi, G.; Sirri, S.; Baruzzi, G. Productivity and Fruit Quality of 'Falstaff^{PBR}' Pear Variety Grafted on Different Rootstocks. *Horticulturae* **2024**, *10*, 237. https://doi.org/10.3390/horticulturae10030237

Academic Editor: Darius Kviklys

Received: 29 January 2024
Revised: 27 February 2024
Accepted: 27 February 2024
Published: 29 February 2024

1. Introduction

The CREA pear breeding program started in 1968 and some of its main objectives are diversifying the product (red-fleshed, red-skinned fruit, and interspecific hybrids), renewing and extending the ripening calendar in both the early and the late season, and obtaining varieties and selections that are tolerant to fire blight (*Erwinia amylovora*) and *Cacopsylla pyri* [1].

In the last ten years, this program has been co-funded by New Plant Soc. Cons. a r.l., which brings together three growers' organizations of the Emilia-Romagna region: Apo Conerpo, Apofruit Italia, and Orogel fresco. The 'Falstaff ^{PBR}' variety was obtained in 1991 from a 'Abbé Fétel' × 'Cascade' cross, selected in 1999 with the code 91-12-16-180, and evaluated as a selection by CREA and New Plant consortium from 2008 to 2012 in a farm located in Campogalliano (MO). In 2012, it was released as a variety named 'Falstaff^{PBR}' and a CLUB was set up, commercially managed by CO.PE.RO (a consortium made up of Newplant, Apo Conerpo, Apofruit, and Orogel fresco) with the aim to enhance, promote, plan, control, and protect the production and commercialization of 'Falstaff^{PBR}' and of other pears mainly with red peel in the national, European, and non-European context [2].

The 'Falstaff^{PBR}' tree has a strongly upright habit and produces flower buds at the top of one/two-year branches, which bear fruits in the following year that can cause the bend branch due to their weight [3]. Because of this behavior, the branch totally reduces apical vegetation by producing one or two branches at the curvature point, one of which can be used to replace the original one. The tree vegetates later than 'Abbé Fétel' (+10–12 days) and blooms, on average, 4 days later, with a flowering of medium intensity and 6–7 flowers per bunch carried by apical buds and large '*lamburde*' placed on branches of a large caliper; the more the branches have a larger diameter, the more the fruits will be bigger in size [3]. The fruit set is good, and only 10–12% of the fruit is detached, which is, on average, more than in other cultivars that, with more intense flowering, bring 4–6% of the fruit to ripen. [4]. Maturation occurs at the same time as 'Abbé Fétel', when flesh firmness is 4.8–5 kg cm^{-2} and Soluble Solid Content (SSC) is higher than 13° Brix (usually 15° or more) [3].

The choice of appropriate rootstock is crucial for the success of a cultivar, as it affects different physiological parameters, including water absorption, mineral uptake efficiency [5,6], leaf gas exchange [7], plant size, blossoming, timing of fruit set, yield efficiency, fruit quality, and fruit size [8–14], the latter being an important marketing aspect since consumers tend to prefer large fruits [15]. However, there is no universal rootstock able to perform any graft optimally in every soil condition; rather, there is a great variability depending on site-specific characteristics as well as peculiar scion responses. In this sense, the identification of the best grafting combination for each production area is the key for early and stable production of any pear orchard.

Usually, European pear scions are grafted on either quince (*C. oblonga*) or common pear (*P. communis*). The choice of rootstock to use depends usually on the characteristics of the scion; quince is chosen since plants are less vigorous, which make them ideal for high-density plantations and more precocious, whereas *Pyrus* rootstocks have higher compatibility and are more tolerant to coldness and chlorosis. On the other hand, they are slow to bear fruits, while one drawback of quince is its incompatibility with some pear varieties [16–18]. Quince rootstocks such as 'BA29', 'Adams', 'Sydo', or the East Malling (EM) series ('EMA', 'EMC', 'EMH') are employed for the ease of managing with standard cultural practices and dwarfing characteristics, and because they induce early and regular cropping producing fruits of good size and quality [18], while *Pyrus* rootstocks such as 'Pyrodwarf', the 'Fox' series, or the 'Farold' series (hybrids of 'Old Home' (OH) and 'Farmingdale') are used for their grafting compatibility and improvement of fruit size and quality, among others [18,19].

For these reasons, the choice of right rootstock is crucial for successful fruit production. The selection of the rootstock, on the other hand, depends on many factors, including the training system, spacing, plant vigor, and environmental conditions, both atmospheric and of the soil [16,20,21]. Therefore, it is not possible to efficiently select a rootstock based only on its characteristics, since many other significant factors are involved. In order to be able to enhance the agronomical features of a plant, different rootstocks have to be tested in order to evaluate the graft success and plant growth response of pear cultivars/genotypes and to select the better performing rootstock [22,23]. In our trials, we selected four different rootstocks: three quince (*C. oblonga*) ('Quince C' (EMC), 'Quince H' (EMH), and 'BA29'), as well as 'Farold 40' among clonal *Pyrus communis* L. rootstocks. The clonal quince rootstocks with dwarfing characteristics ('EMH' and 'EMC') are suitable for high-density orchards, and increase the early start of production and fruit quality [24]. 'BA29' quince ensures a good grafting compatibility with the main varieties; it is quite vigorous with a later start of production compared to the less vigorous quince, but it gives a high and consistent production of high-quality fruits [25]. 'Farold 40', among the pear clonal rootstocks, is one of the most interesting and appreciated rootstocks as it confers a similar or slightly higher vigor than 'BA29', but with a slower start of production compared to quinces [26].

This study is focused on the effects of various pear and quince rootstocks on the main productive and qualitative traits of scion pear cv 'Falstaff^{PBR}'.

2. Materials and Methods

The orchard was established in 2011 in the Po Valley of the Emilia-Romagna region (Campogalliano (MO), 44°41′25.36″ N 10°50′20.03″ E) http://tinyurl.com/568j9hp5. (accessed on 28 Janruary 2024) The climate is humid-subtropical (Cfa), bordering Mediterranean hot summer (Csa) according to the Köppen and Geiger classification, with temperatures ranging from 30 °C in July (day max) to 0 °C in January (day min, 30 years mean) and 70% relative humidity with 852 mm of annual precipitation, mainly in spring and autumn. The soil has a mean-to-fine texture, well-drained with ca 4% active limestone (*w*/*w*). Four rootstocks have been tested, three of which are quince (*C. oblonga*): 'Quince C' (EMC), 'Quince H' (EMH), and 'BA29'. The fourth rootstock is a clonal *Pyrus communis* and is a hybrid of 'Old Home' (OH) and 'Farmingdale' (F), named 'Farold40'. Pruning was performed on vigorous branches or for thinning; girdling was performed at the second leaf after orchard establishment. The first production was carried out in 2013 and the study was conducted from 2014 to 2017. 'Falstaff^{PBR}' was grown using four rootstocks, ten trees for each, according to the cultivation technique traditionally used in that area [3]. Briefly, a spindle-shaped training system was used; the orchard, grassed in the inter-row, was irrigated, weeded, or tilled along the rows and covered with a hail ne for protection. The training system was a free wall. Depending on the rootstock, the planting system varied between 60 cm on the row with the dwarfing rootstocks ('EMC' and 'EMH') and 120 cm for the more vigorous rootstocks ('Farold 40' and 'BA29'), whereas the between-rows distance was set to 350 cm for all rootstocks. The orchard, with grass in the inter-row, tree growth was assessed in the autumn of 2017 by measuring the trunk diameter at 10 cm above the graft union. The trunk diameter (d) was used to calculate the trunk cross-sectional area (TCSA) with the formula TSCA = $\pi \times (d/2)^2$.

During the 4-year trial, to monitor the fruit ripening process and ascertain the proper harvesting time, the Index of Absorbance Difference (I_{AD}) was measured every 2 days, starting one week before the presumed harvest on 30 fruits per rootstock using a Difference Absorbance (DA)-Meter (Sintéleia, Italy). The I_{AD} is assessed as the difference between the absorbance values at 670 nm and 720 nm, near the chlorophyll a absorbance peak [27].

During the 2014 to 2017 harvest seasons (late August to early September), the marketable ripe fruits from each scion/rootstock combination were picked, and the total production was weighed. Forty fruits per rootstock were weighed, and flesh firmness and total soluble solids content (SSC) were measured. For all such fruits, the maximum fruit diameter at the widest part of the fruit (i.e., caliper) was measured. The percentage of red overcolor was evaluated in 20 fruits per rootstock each year, according to the ECPGR Pyrus descriptor [28]. This descriptor refers to the amount of over-coloration, or blush coverage on the fruit skin, based on visual assessment (Supplementary Table S2). Flesh firmness was recorded using a fruit texture analyzer (FTA GÜSS instruments, Strand, South Africa), with an 8 mm-diameter probe tip; the measure was taken at 6 mm depth and expressed in kg 0.5 cm^{-2}. A scale and an electronic fruit size measure were connected to a Portable Notebook to record the fruit weight in grams and its diameter in millimeters. Fruits were squeezed by a manual fruit squeezer. Four replicates for each thesis were considered; collected juices were used to evaluate SSC, measured by a digital handheld pocket refractometer (AtagoTM 3810, Tokyo, Japan) and expressed as ○Brix.

Data were expressed as the mean ± standard deviation (SD). Statistical comparisons were made within each year of study. Differences among pear rootstocks were evaluated by one-way ANOVA, and the Duncan (LSD) test for mean comparisons was used. Differences at $p < 0.05$ were considered significant and were indicated with different letters. All analyses were performed using the free software PAST (version 4.03) [29].

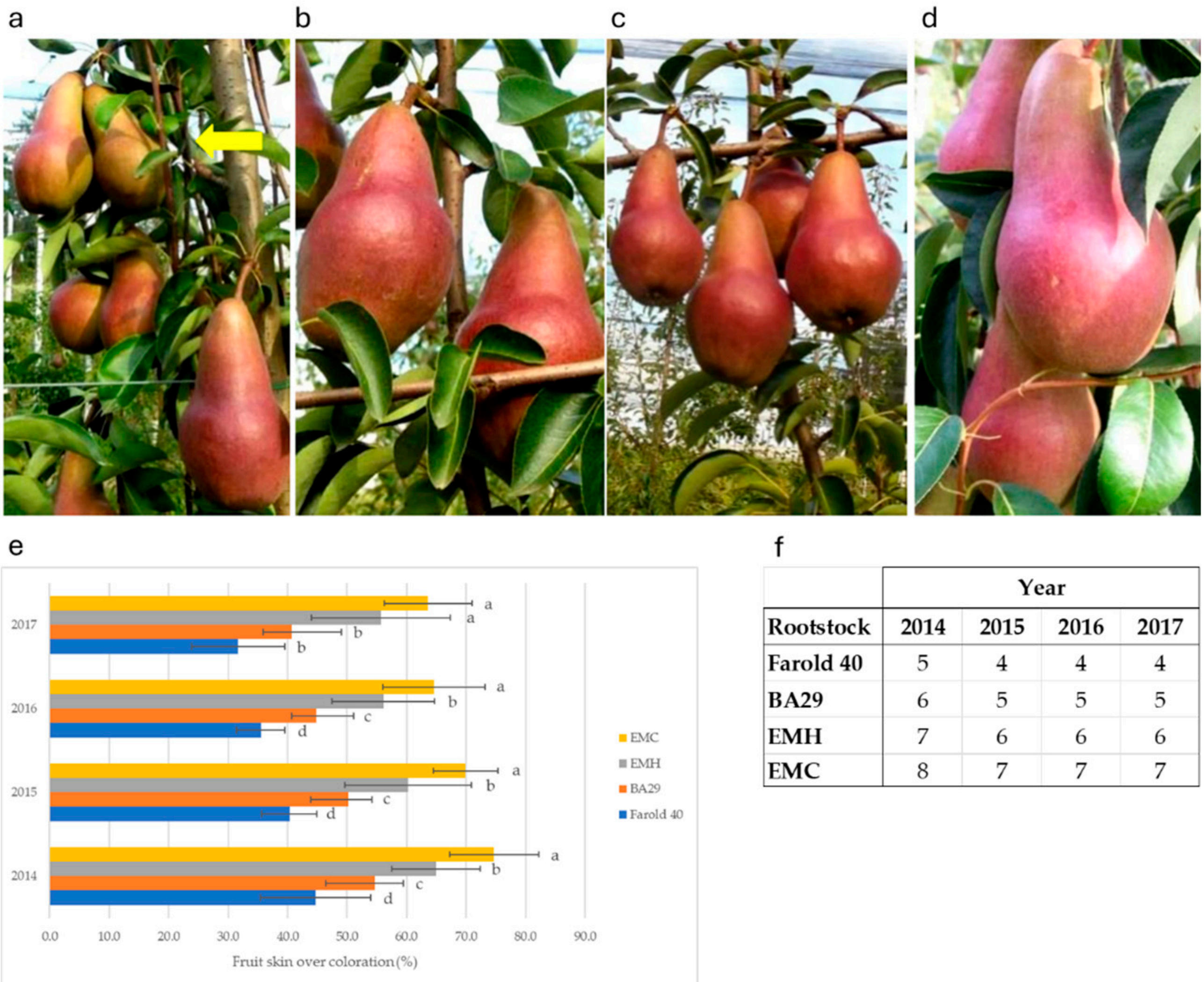
3. Results

3.1. Plant Phenology and Morphology and Pomological Characteristics

The plant showed a strong upright growth habit, typical of many other red-peel pear cultivars and selections. This cultivar seems more suitable to grow in wall forms rather than volume forms, such as spindle. No evident disaffinities were found with the tested rootstocks and no intermediate was needed to allow for normal growth. The study confirmed that flowering occurred with little delay (+4 days) compared to cv. 'Abbé Fétel' (Table 1). Similarly, phenological observations at ripening stage showed similar characteristics among all used rootstocks; however, a larger number of fruits with low levels of overcolor was recorded (Figure 1). According to visual assessment, 6% of fruits had a <10% red overcolor in 'Farold 40' and, to a more limited extent, 'BA29'; all combinations showed a larger number of fruits with color reduction in the last years of assessment, which were characterized by higher temperatures (Supplementary Table S1). Most of the fruits with a reduced overcolor were in the innermost, highest, or most covered parts of the tree.

Table 1. Comparison of phenological phases in 'Falstaff^{PBR}' and cv 'Abbé Fetel' during 2014–2017 seasons. The last column indicates the difference (in days) of cv 'Falstaff^{PBR}' with respect to cv 'Abbé Fétel'.

Phenological Phase	Falstaff^{PBR}					Abbé Fétel					Diff
	2014	2015	2016	2017	Mean	2014	2015	2016	2017	Mean	
White button	29-Mar	05-Apr	30-Mar	25-Mar	30-Mar	23-Mar	02-Apr	27-Mar	24-Mar	27-Mar	+3
Full bloom	03-Apr	09-Apr	05-Apr	01-Apr	04-Apr	29-Mar	05-Apr	01-Apr	28-Mar	31-Mar	+4
Fruit set	07-Apr	14-Apr	08-Apr	03-Apr	08-Apr	03-Apr	09-Apr	05-Apr	02-Apr	05-Apr	+3



	Year			
Rootstock	2014	2015	2016	2017
Farold 40	5	4	4	4
BA29	6	5	5	5
EMH	7	6	6	6
EMC	8	7	7	7

Figure 1. Ripened fruits grafted on (**a**) 'Farold 40', (**b**) 'BA29', (**c**) 'EMH', and (**d**) 'EMC'. (**e**) Over-coloration (amount of blush) recorded yearly in the fruits for each rootstock; (**f**) over-coloration according to the ECPGR Pyrus descriptor coding [28]. Yellow harrow identifies fruits with low overcolor. Different letters represent significant differences at $p \leq 0.05$.

'Falstaff^{PBR}' plants grafted on 'BA29' showed a very high vigor that requested thinning (that is, cutting a limb to its branch of origin) during winter pruning. Conversely, 'EMC'-grafted plants were the least vigorous (Figure 2).

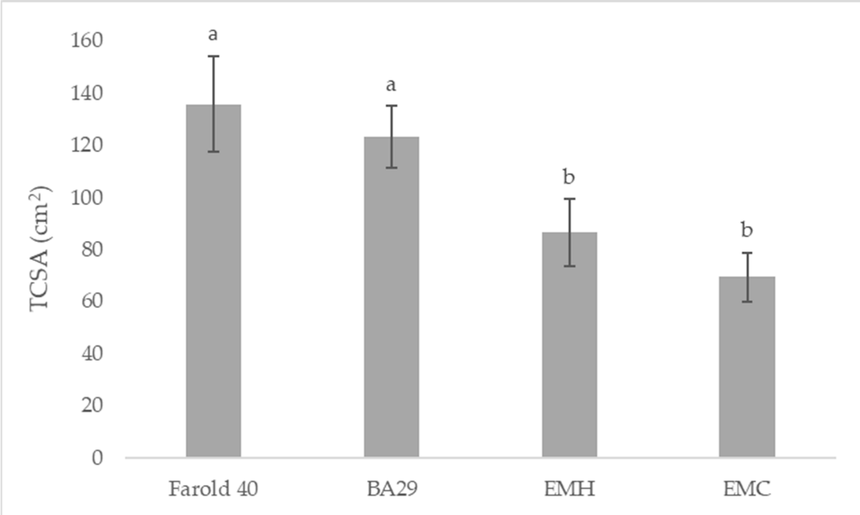


Figure 2. Trunk cross-sectional area (TCSA) of 'Falstaff' pears on different rootstocks related to the year 2017. Different letters represent significant differences at $p \leq 0.05$.

3.2. Production and Fruit Quality at Harvest

A DA-meter was used to identify the right ripening stage and achieve a relative degree of homogeneity of fruits at harvest; to this extent, it was previously established that the I_{AD} of 'Falstaff^{PBR}' fruit should be, on average, in the range of 1.80–1.85. The said values correspond to an average firmness of 4.7 kg/0.5 cm^2, which was reached, on average, +4 days at 'Abbé Fétel'. To monitor the evolution of ripening and further different behaviors among the different tested rootstocks, fruits were inspected with DA-meter in the week before the supposed harvesting time. At the first measuring time, fruits produced by trees grafted on 'F40' and 'BA29' had the highest values, but throughout ripening, at measurements carried out in the following days, no significant differences were observed among the tested rootstocks (Figure 3).

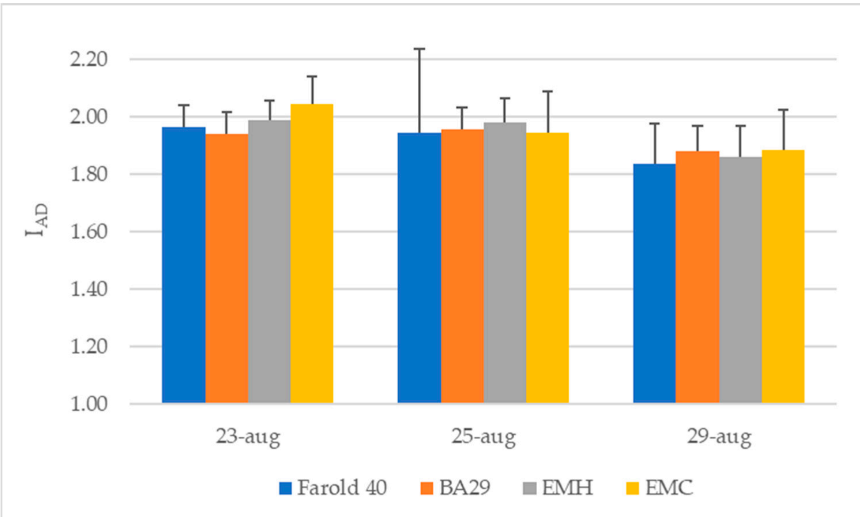


Figure 3. I_{AD} values measured in the last week (23–29 August) before harvesting to monitor ripening on the plant, in relation to the different rootstocks used. Differences are not statistically significant at $p \leq 0.05$.

Annual yields depicting the different behavior of the analyzed rootstocks are shown in Table 2. Yield trends and values are similar between 'Farold 40' and 'EMC' and between 'BA29' and 'EMH', respectively. As a matter of fact, starting from 2016, 4 years after the start of fruiting, 'BA29' and 'EMH' evidenced a higher yield compared to 'EMC' and 'Farold 40'; the latter showed a much slower increase in production, which remained steady for 3 years. On the other hand, in the last year considered there was a generalized increase in yield for all rootstocks, although 'BA29' and 'EMH' showed a yield 30% higher than 'Farold 40' and 'EMC'. The total production topped 90 tons per hectare with 'BA29' and 'EMH', whereas it was lower for EMC and 'Farold 40', with the latter showing the lowest aggregate production in our experimental conditions. Looking at single plant production, the situation did not change, with a 25% higher yield for 'BA29' and 'EMH' (Figure 4). Production of marketable fruits in 2017 ranged from 10.67 to 10.97 kg plant^{-1} for 'Farold 40' and 'EMC' from 14.17 to 14.58 kg plant^{-1} for 'EMH' and 'BA29', respectively.

Table 2. Annual yield in kg per hectare obtained at harvest time for 'Falstaff^{PBR}' according to rootstock. Different letters in the same column refer to statistical differences ($p < 0.05$). Statistical comparisons were made within each year.

	2014	**2015**	**2016**	**2017**	**sum**
Farold 40	12,752 ^{b}	14,408 ^{b}	13,830 ^{c}	24,008 ^{b}	64,998
BA29	16,376 ^{a}	12,687 ^{c}	28,943 ^{a}	32,795 ^{a}	90,801
EMH	14,398 ^{ab}	17,010 ^{a}	27,962 ^{a}	31,887 ^{a}	91,257
EMC	13,204 ^{b}	18,589 ^{a}	17,222 ^{b}	24,683 ^{b}	73,698

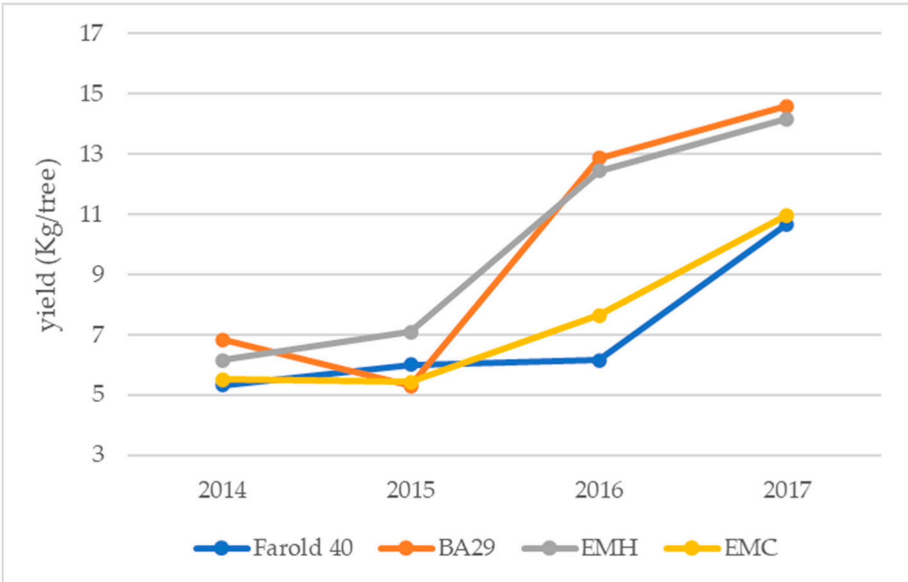


Figure 4. Annual yield (in kg per tree) obtained at harvest time for 'Falstaff^{PBR}' pears according to rootstock.

Among the determinants driving consumers' choices, the shape and size of fruits have a key role. The caliper was similar for all rootstocks (Figure 5), despite relative heterogeneity in fruit weight. However, when analyzing fruit size in detail, apart from 2015, the number of fruits with a >70 mm caliper was relatively similar through the years, with 'EMC' showing a more heterogeneous distribution (Table 3). Notably, 'BA29' was the only rootstock not showing a significant decrease in caliper in 2015. When looking at the overall production, all rootstocks showed good calipers despite of the yield, with more than 65% of the fruits larger than 70 mm. The best performing was 'EMH' with 74% of the fruits. Only a few fruits had smaller calipers (<65) (Figure 6).

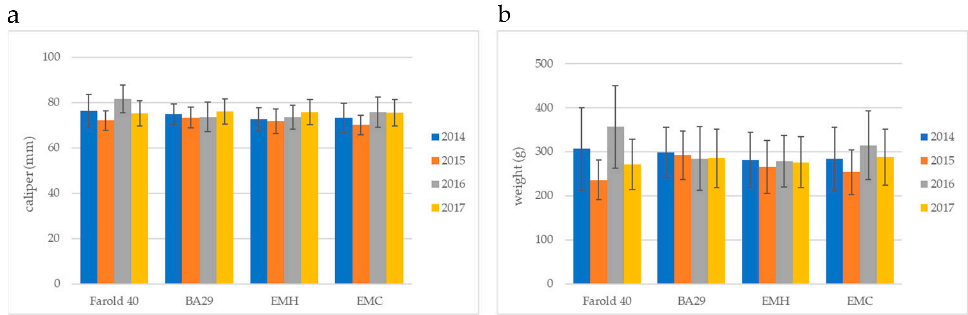


Figure 5. Measurement of commercial fruits: (**a**) caliper and (**b**) weight.

Table 3. Caliper distribution (±70 mm) of 'Falstaff^{PBR}' according to rootstock, in percentages. 70 (mm) identifies average calipers for 'Falstaff^{PBR}' fruits.

Rootstock	Caliper	2014	2015	2016	2017
Farold 40	70−	39.1	59.5	9.1	27.5
	70+	60.9	40.5	90.9	72.5
BA29	70−	24.5	39.2	35.2	30.5
	70+	75.5	60.8	64.8	69.5
EMH	70−	30.7	54.8	35.5	12.5
	70+	69.3	45.2	64.5	87.5
EMC	70−	37.3	74.0	18.2	54.5
	70+	62.7	26.0	81.8	45.5

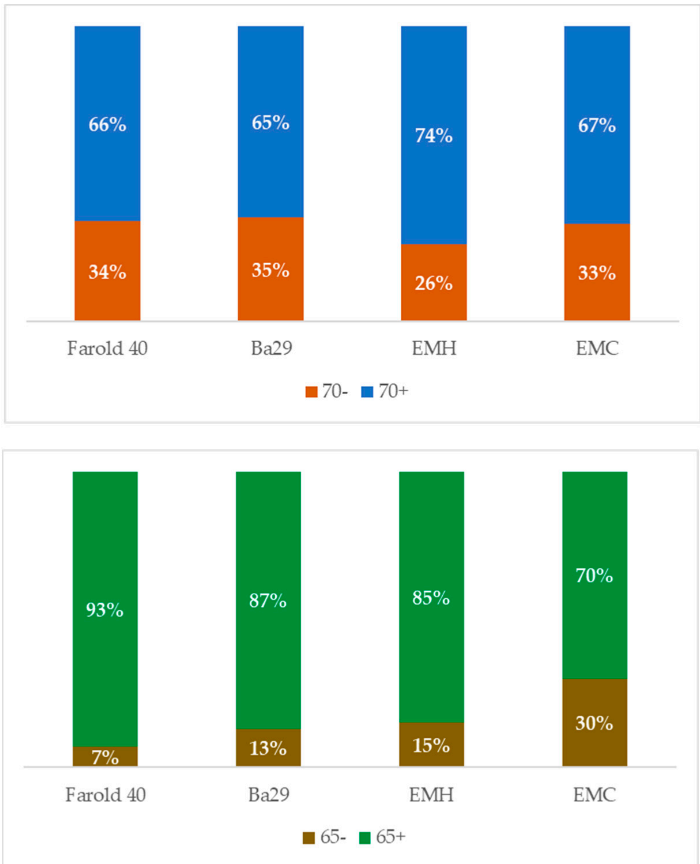


Figure 6. The cumulative average caliper according to rootstock. The calipers used are those commonly utilized to divide fruits according to qualitative (in this case dimensional) standards.

During the 4-year trial, flesh firmness at ripening stage and soluble solids content did not vary significantly among rootstocks (Table 4). The average fruit firmness at harvest was 5.1 kg 0.5 cm^{-2}. Fruits produced on 'BA29' and 'Farold 40' stood out in 2014 and 2015 (5 and 5.3 respectively), while those produced by plants grafted on the dwarfing rootstocks 'EMC' and 'EMH' stood out in 2016 and 2017 with 5.3 and 4.9 kg 0.5 cm^{-2}, respectively. In each case, the differences were not statistically significant. Regarding the total soluble solids content (SSC), the lowest content was recorded in 2014 with 13.9° brix on average for all rootstocks, while the highest values were recorded in 2015 by fruits produced by trees grown on 'EMC', followed by those harvested in 2017 with, on average, 15.9° for all rootstocks, and in 2016 with an average value of 15.3° brix detected in fruits of the variety grafted on 'BA29' and 'EMC'. In each case, the differences were not statistically significant.

Table 4. (a) Flesh firmness expressed in kg 0.5 cm^{-2}; (b) soluble solids content (SSC) expressed as ° Brix. Numbers represent mean values ± standard deviation measured at harvest time. Differences are not statistically significant at $p \leq 0.05$.

(a)	2014	2015	2016	2017
Farold 40	5.04 ± 0.26	4.48 ± 0.56	5.15 ± 0.51	4.72 ± 0.37
BA29	4.98 ± 0.39	5.34 ± 0.45	5.02 ± 0.69	4.81 ± 0.44
EMH	4.72 ± 0.41	5.29 ± 0.51	5.14 ± 0.55	4.87 ± 0.41
EMC	4.48 ± 0.35	5.08 ± 0.49	5.28 ± 0.25	4.91 ± 0.26
(b)	**2014**	**2015**	**2016**	**2017**
Farold 40	13.9 ± 0.4	14.9 ± 1.3	14.9 ± 0.5	15.8 ± 0.5
BA29	13.9 ± 0.2	16.0 ± 1.0	15.3 ± 0.9	16.1 ± 0.5
EMH	14.0 ± 0.4	15.3 ± 0.8	15.1 ± 0.5	15.8 ± 0.6
EMC	13.9 ± 0.5	16.4 ± 1.6	15.3 ± 0.4	15.8 ± 0.2

4. Discussion

In pear crops, as well as for other fruit crops, it is well known that different rootstocks may influence not only the vigor but also other physiological characteristics of the plant [30–35], which could be photosynthesis, mineral status, secondary metabolites accumulation, abiotic and biotic stress tolerance, and even grafting success [36]. Therefore, choosing the best rootstock for the scion is crucial for its optimal exploitation and the successful development of the cultivar [22].

In this work, four different rootstocks were analyzed: three quinces ('Ba29', 'EMC', and 'EMH') and a *P. communis* one ('Farold 40'). The choice of the above-mentioned rootstocks was made considering the characteristics of soils where 'Falstaff^{PBR}' would have been grown commercially. Usually, quince rootstocks are commonly used to control plant growth, yield precocity, and, in some cases, improve both fruit quality and size [18,19]; moreover, their dwarfing characteristic is very useful when working in high-density orchards, a common practice in Europe (and Italy in particular), where cold hardiness is not a concern [23,37]. The downside is that, influencing dwarfing, quince rootstocks may become too weak to sustain the growth of the scion for many seasons, thereby limiting the life span of the plant [38].

Differences have been identified since grafting. It has been reported that some plants of 'EMC' and 'EMH' initially failed to produce viable plants and needed to be re-grafted [39], although we did not observe this phenomenon in our case. However, in some cases, incompatibility is not considered to be a totally negative characteristic, since it may help to control excessive growth, but usually it lowers the yield potential of the grafted cultivar [40]. To overcome this, scions are usually grafted onto an intermediate stock [41]. Conversely, 'BA29' did not evidence any graft disaffinity with 'Falstaff^{PBR}', but rather confirmed the relatively high vigor with respect to the other tested rootstocks, even with respect to 'Farold 40', which required specific pruning. This was carried out by removing overcrowded branches (thinning) on the trees. This is part of the typical winter pruning and has among its advantages a reduction in the chance of infections due to greater air circulation. In the case of BA29, it was necessary to operate robustly to decrease its vigor. Its tolerance to drought may represent an added value, although its susceptibility to *Erwinia amylovora* and other pests could be problematic, together with its agronomical management [42]. Tree vigor measurement, carried out by looking at the trunk cross-sectional area (TCSA), evidenced a bipartite trend: 'Farold 40' and 'BA29', the two less dwarfing rootstocks, showed a trunk diameter significantly higher than those of the EM series, which was in accordance with the vigor registered in the orchard.

The Index of Absorbance Difference (I_{AD}) is an established method to assess ripening stages non-destructively using VIS technology [43]. For pears, its use was outlined in the "Abbé Fétel" pear [44] and a consumer test was performed [45] to identify the most desirable fruit, which was found to have an I_{AD} value of 1.8–1.9 at harvest. The I_{AD} values at picking time in 'Falstaff^{PBR}' fruit should be, on average, in the range of 1.80–1.85 and these values correspond to an average hardness of 4.7 kg/0.5 cm^2, resulting, on average, +4 days at 'Abbé Fétel'. In order to follow the final stages of the ripening process a portable device based on visible/Near Infra-Red (vis/NIR) spectroscopy was used to check for differential responses of rootstocks, but no significant differences were found, thereby suggesting a lack of influence in the testing conditions.

Productivity was analyzed one year after the end of the juvenile phase to minimize possible differences in fruit load and size due to the non-homogeneous distribution of fruits. The highest cumulative yield, 90 t ha^{-1} over 4 years of assessments, was reached by two rootstocks ('Ba29' and 'EMH'), which had an average yield in the 3rd and 4th year of production equal to 30 t ha^{-1}. 'Farold 40' showed a yield at least 20% lower than the two quince rootstocks, confirming its delay in entering production [41]. Calipers were in line with the other rootstocks, but plants grafted on this rootstock were also those showing higher numbers of less overcolored fruits. In general, this may depend not only on the fruits' position on the plant but also on temperatures, as anthocyanin production is induced by light but repressed by high temperatures [46]. Summer 2016 and, especially, summer 2017 were particularly hot (Supplementary Table S1) and this may explain, at least in part, the general decrease in fruit overcolor. It was reported elsewhere [47,48] that rootstocks may have an influence in anthocyanin accumulation. Athough no conclusive reports were published for the pear crop, a similar role explaining the said difference may be conceivable. Soluble solid content was similar in all scion-rootstock combinations analyzed, in that no significant differences could be identified within-year, although a seemingly lower amount of sugars could be spotted in Farold 40-grafted fruits. Similarly, no appreciable differences could be identified for flesh firmness, suggesting that rootstocks could not be responsible for sugar accumulation in the fruit under the conditions present in this current trial.

The intermediate vigor induced by 'EMH' was also confirmed using 'Falstaff^{PBR}' variety. The yield and the caliper were similar to the one obtained with 'Ba29', whereas the overcolor was more stable and higher than other rootstocks.

'EMC' is the dwarfing rootstock of general choice and, even in this case, the grafted scion showed the least vigor. Given its rooting system, it has low tolerance to abiotic stress, such as coldness, drought, and waterlogging, which could explain the low yield, although in 2017 it was substantially similar to that of 'Farold 40'. However, its low cumulative yield suffered from an inadequate planting layout given its dwarfing characteristics. We opted to maintain the same between-rows distance to be able to have a direct comparison of the behavior of the plants with respect to its fruit production and other fruit characteristics, such as caliper and over-coloration. Therefore, a more compact layout, typical of high-density orchards, could be applied for EMC. In this sense, it is noteworthy that the preliminary results indicated a predicted yield of 23–25 tons per hectare at the third leaf stage.

Fruit weight varied among samples, whereas caliper was similar, suggesting that, in some cases, the fruit does not elongate. The low mean weight of 'Farold 40', especially in 2014, may indicate alternative bearing or suboptimal thinning, but this did not affect the caliper.

In summary, the plants grafted on 'Farold 40' produced shorter fruit than the fruit obtained on 'Ba29', 'EMH', and 'EMC'. The average fruit weight was 255 g. The overcolor, particularly in the inner parts of the tree, occupied a smaller area. The productivity of the last 2 years and the cumulated productivity was lower, on average, than that obtained on quinces.

The 'Falstaff^{PBR}' variety grafted on 'BA29' yielded fruits of good size, despite the high production, in line with those obtained on 'EMH' and larger than that on 'EMC'. Over time, several fruits with less over-coloration were placed on branches or in covered parts of the tree.

The variety grafted onto 'EMH' is of intermediate vigor between 'BA29' and 'EMC', while the number of fruits was close to that found on 'BA29' with a good fruit average size and similar production. The over-coloration of the fruit was extensive, except in rare cases, and the trial evidenced good compatibility between variety and rootstock. 'EMC' proved to be an optimal rootstock for 'Falstaff^{PBR}'. 'Falstaff^{PBR}' on 'EMC' is of more limited vigor but still showed the usual upright growth habit. This rootstock suffered more than others from the adverse weather conditions in terms of high temperatures and drought. This was probably due to its dwarfing characteristics and a more superficial and limited rooting system. As a result, productivity and caliper were lower than the other quince rootstocks; on the other hand, over-coloration was good. Thanks to its characteristics, this rootstock could be suitable for high-density plantings (less than 0.50 m on the row).

5. Conclusions

The choice of the rootstock affects the behavior of the scion; therefore, it is necessary to carefully evaluate which one should be used. The 'Falstaff^{PBR}' showed a strong upright growth habit, typical of many other red-peel pear cultivars and selections. In the experimental conditions we analyzed, using 'EMH' and 'BA29' would be a proper choice in terms of yield and ease of field management, although the latter would need more interventions to control its growth. However, if high-density orchards are planned, a dwarfing quince such as 'EMC' would be the best option.

During the study, empirical observations were made regarding the behavior of the plants with respect to the rootstock, which resulted in a series of advice that may be useful to help growers to optimize the plant maintenance and management.

On the most vigorous rootstocks, producing few branches between the basal and upper parts, it could be advisable to make an annular incision only from the second year onwards; in this way, branches can be sprouted on empty parts of the trunk.

This cultivar seems more suitable to grow in wall shapes rather than volume shapes, such as spindle.

Some advice for plant management:

- Winter pruning should be carried out in the Fleckinger 'D or E' phase (appearance of bunches and green buttons);
- Pruning is completely different on 'Abbé Fétel'. No shortcuts should be made on branches;
- Falstaff^{PBR}' has a very assurgent growth habit. In June, if necessary, branches, even if productive, can be thinned at the top of the tree;
- Branches that are too vigorous or aged must be removed;
- Branches that have produced fruit in the distal part may give mixed buds in the proximal part in the following year.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/horticulturae10030237/s1, Table S1: Atmospheric con-ditions (temperature and rainfall) present in the orchard during the evaluations; Table S2: ECPGR descriptor used to assess the average coverage of pear fruit skin blush, according to [28].

Author Contributions: Conceptualization, G.C., G.P. and G.B.; methodology, G.C. and G.P.; validation, G.C., S.S. and M.P.; formal analysis, G.C. and M.P.; investigation, G.C., G.P. and S.S.; data curation, M.P.; writing—original draft preparation, G.C., M.P. and G.F.; writing—review and editing, G.C., M.P. and G.F.; supervision, G.B.; project administration, G.C. and G.B. All authors have read and agreed to the published version of the manuscript.

Funding: Pear and apple breeding activity by CREA and New Plant Soc. Cons. A r.l. (funding n. BRE.ME.PE. 2020).

Data Availability Statement: Data are contained within the article and Supplementary Materials.

Acknowledgments: The authors wish to thank the "New Plant Soc. Cons. a r.l." for the experimental collaboration.

Conflicts of Interest: The authors declare that this study received funding from New Plant Soc. Cons. a r.l. The funder had the following involvement with the study: Giuseppe Pallotti.

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