agronomy

Article

Evaluation of Citriculture Mechanisation Level in Valencia Region (Spain): Poll Results

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Abstract: The increase of the technology level of citrus production operations is required to improve production profitability and reduce production costs. In the framework of the project CITRUSTECH ("Technological advances for modernisation and sustainability in citrus production"), three different poll questionnaires were developed and conducted in the Valencia region to assess the citriculture mechanisation level. In total, 142 questionaries for small and medium-size plantations, 32 for cooperative technicians and 16 for large-size plantations were conducted. From a socioeconomic point of view, clear age and sex inequalities were found. From the technological point of view, relevant differences were found between plantation sizes. The role of the cooperative mechanisation services (custom cost) and other customer services was revealed, with a higher percentage of the area under cultivation at the expense of the small-size plantations. The use of some manual tools was confirmed in pruning, even in large-size orchards. In small-size orchards, the use of backpack sprayers was verified. Regarding farm machinery, besides tractors, hydro-pneumatic sprayers and agricultural shredders were employed. No farm machinery was used during harvesting operations, apart from transport equipment, due to the reduced plantation frames.

Keywords: citrus; technology; survey; cooperative

Citation: Ortiz, C.; Torregrosa, A.; Martinez, J.M. Evaluation of Citriculture Mechanisation Level in Valencia Region (Spain): Poll Results. *Agronomy* **2022**, *12*, 1366. https://doi.org/10.3390/agronomy12061366

Academic Editors: Adriana Correa, María Dolores Gómez-López and Jesús Montero Martínez

Received: 26 April 2022
Accepted: 2 June 2022
Published: 5 June 2022

1. Introduction

The small size of agriculture production units is the main factor affecting the loss of competitiveness directly related to an inadequate availability of resources [1]. Farming systems in the Mediterranean agricultural areas of Spain are frequently characterised by the small size of the production units [2]. According to the Spanish Agriculture Ministry, citrus production costs have increased for all types of citrus products in the Valencia region during the period 2011–2017 [3]. The increase of the technology level of citrus production operations has proven to be necessary [4–6]. In Spanish citrus production, it is crucial to solve the problem of the high costs of manual operations in fresh citrus production [7,8]. Specially during low product price periods, the minimisation of production costs is necessary for citrus growers [9]. The mechanisation of some labor-consuming operations has been proposed as a possible way to reduce production costs in citrus orchards [10–12]. Previous studies have confirmed the inefficiency of farms in conventional systems managing some operations, specifically when performing pruning operations [13]. The mechanisation level of citriculture operations is reduced compared to other crops such as olive, almond, and vine. The main operations are pruning, spraying, and harvesting, at 11–14%, 15–20%, and 30–49%, respectively, of the total production costs [14,15]. The objective of this work was to assess the technological level perspective of citrus orchards in the Valencia region from the point of view of the producers.

2. Materials and Methods

Three different poll questionnaires were developed and conducted in the Valencia region to assess the citriculture mechanisation level. The questionaries were conducted in representative citrus cooperatives and companies in the Spanish Valencian region (Castellón, Valencia and Alicante). Three types of questionaries were developed according to the characteristics of the production systems in the region: for small and medium-size plantations, for cooperative technicians, and for large-size plantations (142, 32, and 16 questionaries, respectively). The questionaries were conducted in the cooperative and the company installations and were designed to ensure that respondents fully understood the questions. The questionnaire for small and medium-size plantations had questions divided into the following sections:

- General data (farm operator and management);
- Perception of their activity;
- Current mechanisation level;
- Mechanisation demands.

The questionnaire for cooperative technicians had questions divided into the following sections:

- General data about the cooperative (producers);
- General data about the cooperative (management);
- Current mechanisation level;
- Cooperative roll;
- Mechanisation demands.

The questionnaire for large-size plantations had questions divided into the following sections:

- General data (citrus producer and management);
- Perception of their activity;
- Current mechanisation level;
- Mechanisation demands.

Data were collected, processed, and analysed using Microsoft Excel and Statgraphics.

3. Results

3.1. Social Parameters

Clear age and gender inequalities were found: 100% of the polls were answered by men, and the average was 54.7 (std 8.1) years old for small and medium-size plantations. In addition, only 56.3% had agriculture as their main livelihood activity, and 44.4% considered their activity economically profitable. The role of cooperative customer services was revealed: 99.3% received technical support from the cooperative and 85.2% recieved custom costs.

3.2. Technological Parameters

From the technological point of view, relevant differences were found between plantation sizes in tractor power and hydro-pneumatic sprayer capacity. For the large-size orchards (39.7 ha, std 34.1), the average power of the main tractor was 66.8 kW (std 8.0), and for the small and medium-size orchards (2.6 ha, std 3.2), the average power of the main tractor was 50.3 kW (std 11.0), Figure 1. For the large-size orchards, the average capacity of the main hydro-pneumatic sprayer was 1480.8 L (std 445.5), and for the small and medium-size orchards, the average capacity of the main hydro-pneumatic sprayer was 1221.7 L (std 321.7), Figure 2.

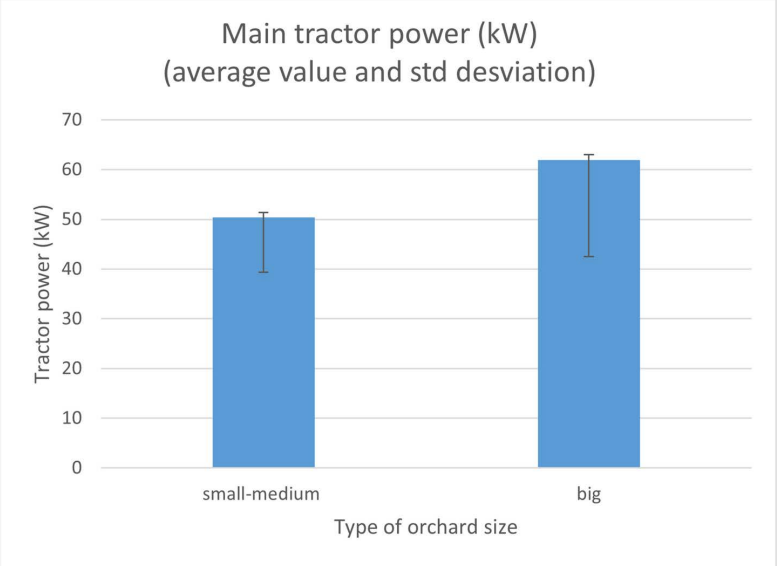

Figure 1. Main tractor power (kW) for the two types of orchards (small and medium size and big size), average value and standard deviation.

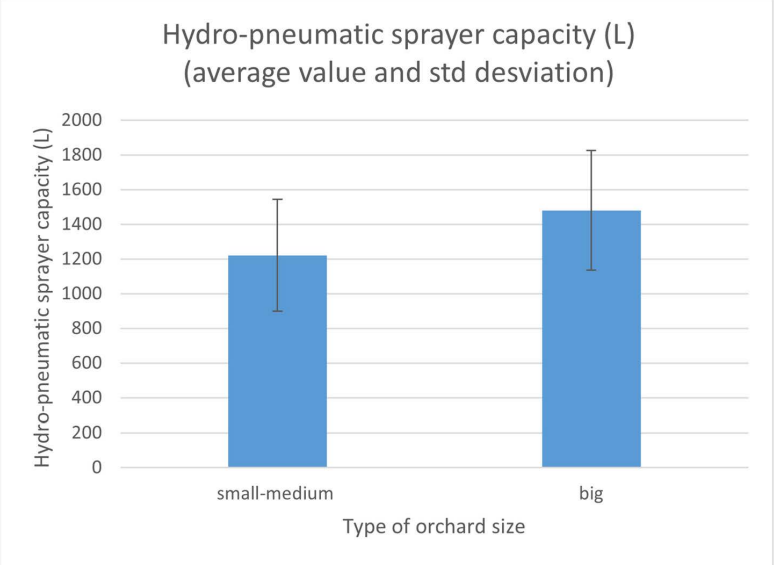

Figure 2. Hydro-pneumatic sprayer capacity (L) for the two types of orchards (small and medium-size/large-size), average value and standard deviation.

In small and medium-size plantations, hydro-pneumatic sprayers were used in 69.7% of the cases, and backpack sprayers were also used in 95.1% of the cases. In comparison, in large-size plantations, backpack sprayers were also used in 71.4% of the cases. Besides the tractor and the hydro-pneumatic sprayers, agricultural shredders were employed in both types of plantations. In the same way, no farm machinery was used during harvesting operations, apart from transport equipment, due to the reduced plantation frames. For all sizes of orchards, it was proven that manual tools were still being used for different pruning operations. The cooperative technicians confirmed the used of tractors, hydro-pneumatic sprayers, and agricultural shredders in all the applicable operations. IN addition, the use of manual tools for the pruning operations was also verified. The use of manual labor for the harvesting operations was also confirmed in all types of orchards. In order to study the possible factors affecting the answer to the question about the profitability of citrus production (only 44.4% considered their activity economically profitable), a logistic

regression was developed. Data from the small and medium-size orchards were used. The effect of the factors, farmer age, orchard area, total production, tractor power, and sprayer capacity on the answers regarding the profitability of the activity were tested. The effect of orchard area, tractor power, and sprayer capacity did not significantly affect the answers. However, the factor, farmer age, and total production significantly affected the positive appreciation of their activity as economically profitable, as shown in Table 1.

Table 1. Estimated coefficients, standard errors, Chi-square, and p-values for the fitted logistic model to the consideration of their activity to be economically profitable. cited.

Factor	Estimated Coefficients	Standard Error	Chi-Square	*p*-Value
Farmer age	0.055082	0.025737	4.9219	0.0265
Total production	0.000011	0.000000	13.2716	0.0003
Constant	2.50411	1.454630	-	-

3.3. Consideration of Citrus Production Activity

Younger citrus producers tend to consider the citrus activity economically profitable compared to the older producers, as shown in Figure 3. In addition, citrus producers with higher total citrus production were also more optimistic about the profitability of their citrus business, as shown in Figure 4. The tendency of the answers to the questions about the future of their plantations was much the same.

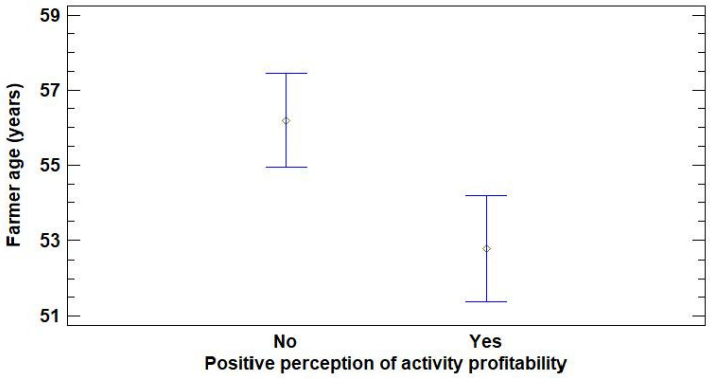

Figure 3. Answers to the questions about the positive perception of producers' activity as economically profitable according to farmer age (average values and 95% Fisher LSD intervals) for the small and medium-size orchards.

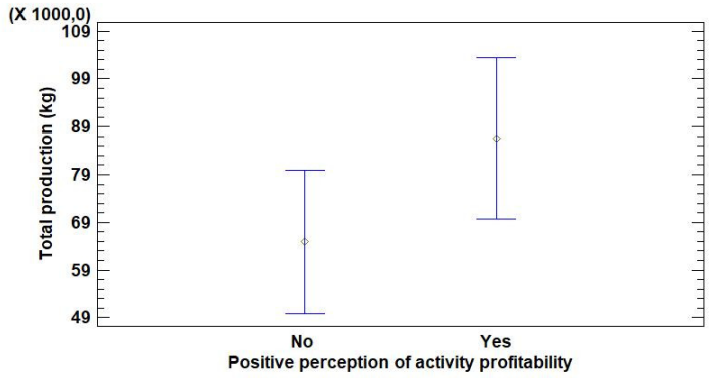

Figure 4. Answers to the questions about the positive perception of producers' activity as economically profitable according to total production (average values and 95% Fisher LSD intervals), for the small and medium-size orchards.

4. Discussion

Gender equality is a basic human right [16], and reducing the gender gap has been shown to improve productivity and increase efficiency. Clear gender inequality has been found in this study. Closing the gender gap in agriculture could generate significant gains for the citriculture sector. Related to the innovative behaviour of family farms, previous authors have found contradictory results. Farm business performance might focus on efficient production by increasing managerial ability rather than innovation [17]. The findings of the present article suggest that citrus producer innovation perspectives and optimistic behaviour in the context of their citrus business are related to total citrus production. Producers with higher total citrus production were more optimistic about the profitability of their business. Related to farm machinery, the results from this study confirm that tractors, hydro-pneumatic sprayers, and agricultural shredders are being used in all types of Valencian citrus orchards. However, no farm machinery is used for harvesting operations [7,8,10,11,14,15]. The role of cooperative mechanisation services and other customer services has proven to be crucial to develop citrus pruning and harvest machinery in the Valencian region.

5. Conclusions

Gender inequalities were found, as all the questionnaires were answered by men. The level of uncertainty of producers regarding finding their citrus production activity economically profitable was lower in elder producers than in younger ones. Citrus producers with higher total citrus production were also more optimistic about the profitability of their citrus business. Regarding farm machinery, besides tractors, hydro-pneumatic sprayers and agricultural shredders were employed in all types of orchards and confirmed by the cooperative technicians. The use of some manual tools was verified in pruning, even in large-size orchards. In small-size orchards, the use of backpack sprayers was also testified. No farm machinery was used during harvesting operations, apart from transport equipment, due to the reduced plantation frames. The role of the cooperative mechanisation services and other customer services was revealed, with a higher percentage of the area under cultivation at the expense of the small-size plantations.

Author Contributions: Conceptualisation C.O.; methodology, C.O. and J.M.M.; software, C.O. and A.T.; validation, C.O. and J.M.M.; formal analysis, C.O. and J.M.M.; investigation, C.O., A.T. and J.M.M.; resources, C.O., A.T. and J.M.M.; data curation, C.O. and J.M.M.; writing—original draft preparation, C.O.; writing—review and editing, C.O., A.T. and J.M.M.; visualisation, C.O., A.T. and J.M.M.; supervision, C.O., A.T. and J.M.M.; project administration, C.O.; funding acquisition, C.O., A.T. and J.M.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research has been funded by the European Agricultural Fund for Rural Development and cofounded by the Ministerio de Agricultura, Pesca y Alimentación (project GO "Avances tecnológicos para la modernización y la sostenibilidad en la producción de cítricos CITRUSTECH").

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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