

## The hierarchy of impact of technical and economic factors on farmers' dissatisfaction with orchard sprayers

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**Summary.** There has been a hierarchy of technical and economic factors affecting the satisfaction of the farmers who own orchard sprayers available on the market in Poland. The most important factors, which cause dissatisfaction with the market offer of orchard sprayers, are: too high a price to purchase the sprayer, followed by high prices of spare parts and high costs of services provided by the service personnel.

**Key words:** orchard sprayer, assessment, hierarchy.

### INTRODUCTION

An important role in agricultural production costs is played by the costs of mechanization. In the fruit farms their participation depends on the participation of the orchards in the structure of agricultural farms, which ranges from 23 to 68% [4]. A correct choice of orchard sprayer is an important factor in the costs of chemical protection in the orchards. Available literature presents traditional methods for optimizing the selection of farm machinery including orchard sprayers [1] as well as shows the proposal of new algorithms [5, 2, 8]. The analysis of the current status, in which there are many models of orchard sprayers that differ not only on price but also design solutions and the value of technical and operating parameters, obliges these methods to take into account a number of new criteria. These criteria include the technical and economic factors that affect the efficiency of orchard sprayers and thus the satisfaction of fruit growers with their possession. The authors are well acquainted with opinions of the owners of owned fruit farms expressing dissatisfaction with the sprayers. Thus there comes the need for research to identify and prioritize in order of importance the factors that cause of dissatisfaction of the owners with owned orchard sprayers. Knowledge of the hierarchy will add to knowledge of the selection criteria for an orchard sprayer. This knowledge will also

be useful to producers of fruit sprayers to fit of the market offer to the needs of the farmers.

The aim of this study was to prioritize the most important technical and economic factors that cause dissatisfaction of farmers with sprayers available in the market.

### RESEARCH METHODS

In terms of the significance of technical and economic factors that cause dissatisfaction of farmers with sprayers available in the market of fruit the prioritization was made using expert and mathematical method known in literature under the name of the expert evaluation method [6] as well as the Delphi method [9]. In the initial stage of research based on the experiences from own studies [7,3,10] and interviews with the owners of 28 fruit farms technical and economic factors that have impact on the discontent of growers offered on the market orchard sprayers were distinguished. The identified factors are summarized in Table 1. The identified factors were included in the questionnaire prepared for the test, which was delivered to the experts.

Considering the large number of factors in order to facilitate an expert assessment procedures objective tree was used, which is based on a combination of factors in groups and evaluating separate groups of factors and a separate assessment of factors in group [7,3]. So six groups of factors of the so called second level were distinguished. In each group, 3 to 6 factors were distinguished that were affecting the group, and indirectly the main objective, i.e. dissatisfaction of farmers with sprayers available in the market.

According to the principle of the target tree it is assumed that the impact of six groups of factors (level II targets) on the main goal is 100%. It was similarly assumed, that the impact of factors in this group in total

**Table 1.** Summary of technical and economic factors of II and III order affecting the dissatisfaction of fruit growers with the orchard sprayers

Factor label	Factor name
<b>C1</b>	<b>Inadequate technical and operational parameters</b>
C 11	Insufficient capacity of the pump in relation to demand
C 12	Insufficient fan output
C 13	Inadequate storage capacity
C 14	Turning radius too large
C 15	Adverse fan gear ratio
<b>C2</b>	<b>Dimensions of the sprayer and design solutions inadequate to applied technologies and working conditions</b>
C 21	No section compensation
C 22	Too little protection of components susceptible to damage
C 23	Limited access to a liquid tank
C 24	Too high width and wheelbase
C 25	Irregular snap output
C 26	Inadequate lighting or its thereof
<b>C3</b>	<b>Unsatisfactory reliability and efficiency of service and access to spare parts</b>
C 31	sprayer failure rate too high
C 32	Unsatisfactory access to spare parts and / or inadequate supply of spare parts
C 33	Unsatisfactory work of service staff (eg, too long waiting for the arrival of service staff)
<b>C4</b>	<b>Manufacturer's range of accessories too limited</b>
C 41	No braking system manufacturer in the offer
C 42	No manufacturer's offer for choice of sizes and types of tires
C 43	No manufacturer offers for choice fan equipment
C 44	No possibility to choose the type sprayer control components
C 45	Lack of facilities to facilitate the preparation of the solution, and rinse containers in manufacturer's offer
<b>C5</b>	<b>The adverse factors affecting the ergonomics and the comfort of operation</b>
C 51	Ease to rinse tank after the treatment
C 52	Limited access to the main control valve
C 53	Too high level of noise generated by fan
C 54	Insufficient access to the tank
C 55	Unable to reverse without PTO switching off
C 56	Limited access to parts subject to adjustment, maintenance or replacement (eg filters, sprayers)
<b>C6</b>	<b>Unsatisfactory economic aspects</b>
C 61	Too high price to purchase the sprayer
C 62	Too high costs of services provided by service departments
C 63	Too high prices of spare parts

is also 100%. Second order factors influence the main objective and the impact of factors centered around the second order factor on that factor is called the local priority. So the effect of third level factors on the level of the main objective is called the system priority [7,3]. The importance of different groups of factors and factors in

the group was evaluated by an expert through a break of 100%, respectively, in the order of importance among the various groups of factors, and 100% for individual factors in the group. In this way, the expert considering separately the validity of the groups of factors and, separately, the validity of the factors in this group had

an easier task because at the time he focused on a small number of factors. In addition, an expert was given the opportunity to add and evaluate other factors that were not included in the questionnaire research, which were considered important by him. On the basis of expert assessments values for local priorities were produced. The values of system priorities were obtained by multiplying the local priority value of IIIrd order factor by the local priority value of IInd order factor. System priority values were expressed in percentages and their sum was 100%.

Group of experts were the owners of fruit farms, who were elected on the basis of self-assessment and assessment by the people conducting research. Assessment of the expert fitness to take part in the research included such criteria as practical experience in the orchard production, field experience in the use of orchard sprayers as well as theoretical and practical knowledge of modern solutions in the orchard sprayers. It was also required that an expert's work experience at the farm was not less than 5 years.

The experts represented the farms in the counties of Grójec, Lowicz, Sochaczew, and Kutno. The area of orchards ranged from 4 to 35 ha with the fact that in many households in addition to apple trees cherries and plums were cultivated. Most farms were equipped with BURY WULKAN sprayers although some farm used PILMET Slezia sprayers. Compliance in the opinions of

experts was checked in the first place based on the coefficient of variation, whose value for the needs of expert and mathematical method is standardized [7,3]. If the value of the coefficient of variation was less than 0.25 the congruity of ranks appointed by experts was sufficient. For values above those, 0.3 was considered to be low.

Subsequently, the experts congruity was tested with the coefficient of concordance and  $\chi$ -square test [7,3].

In case of the absence of a satisfactory compliance expert opinions the test procedure assumed second stage of the study. At this stage experts who were not convergent in their opinions were informed of the evaluations given by the other experts and asked to respond to them.

## RESULTS

Based on the survey evaluation of 30 factors was obtained. The determined values of the priorities of the system factors and their ranking is shown in Figure 1.

According to the evaluation procedure the parameters were divided into four validity ranges (high - I, higher than average - II, medium - III, lower than average - IV) by setting their "importance / weight" and the average value of the parameter in the interval (table1). "Weight of priorities" indicates the degree of accomplishment of the main target by a group of factors, which was in this

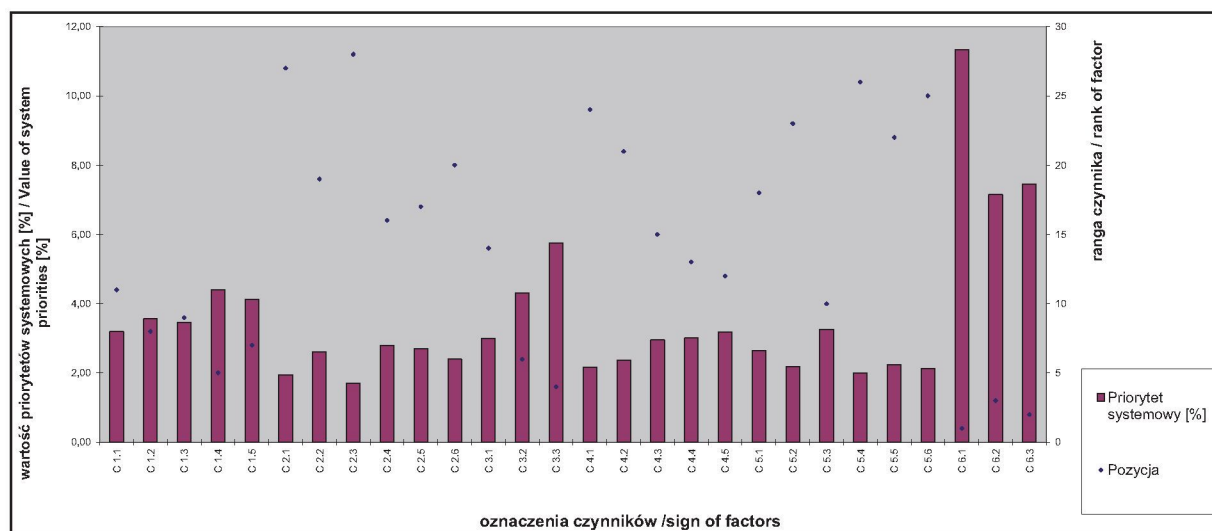


Fig. 1. The values of the priorities of local, III order factors

Table 1. System priorities ranges

Range number	Range limits	Labels of factors included in the range	„weight of priorities”	Mean value of system priorities in the range
I	8,96-11,37	C 6.1	11,34	11,34
II	6,54-8,95	C 6.2, C 6.3	14,60	7,29
III	4,12-6,53	C 1.4, C 1.5, C 3.2, C 3.3	18,58	4,64
IV	1,7-4,11	C 1.2,C 1.3,C 5.3,C 1.1,C 4.5,C 4.5,C 3.2,C 4.4,C 2.4,C 2.5,C 5.3,C 2.2,C 2.6,C 4.4,C 5.7,C 5.2,C 4.1,C 5.6,C 5.4,C 2.1,C 2.3	55,49	2,64

interval and is determined by the sum of the system priorities of these factors.

The range of high importance included one single factor marked as C 6.1 i.e. too high purchase price of the sprayer, whose „priority weight” is 11.34%.

The second range has two factors marked with C 6.2 and C 6.3 - high prices of spare parts and high costs of services provided by service departments, whose „priority weight” is 14.60% and the average value of the priorities is 7.29%.

The third range includes four factors whose „priority weight” is 18.58%, while the fourth range has 21 factors with „weight of priorities” of 55.49%. Although the „weight” factors in these ranges is significant, the average factor value in the range is 4.64 and 2.64% only.

### CONCLUSIONS

1. The most important factors that affect fruit growers dissatisfaction with the offer of orchard sprayers on the Polish market is too high purchase price of the sprayer, whose „priority weight” is 11.34%.
2. With regard to validity of the factors then two factors come: high prices of spare parts and high costs of services provided by service departments, whose „priority weight” is 14.60% and the average value of the priorities is 7.29%.
3. Other factors were in the range of average and below average. „Weight of priorities” in these ranges is 18.58% and 55.49%, while the average priority value range is 4.64% and 2.64%, respectively.

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#### HIERARCHIA WPLYWU CZYNNIKÓW TECHNICZNYCH I EKONOMICZNYCH NA STOPIEŃ NIEZADOWOLENIA ROLNIKÓW Z POSIADANYCH OPRYSKIWACZY SADOWNICZYCH

**Streszczenie.** Istnieje hierarchia technicznych i ekonomicznych czynników wpływających na satysfakcję rolników, którzy posiadają opryskiwacze sadownicze dostępne na rynku w Polsce. Najważniejszymi czynnikami, które powodują niezadowolenie z oferty rynkowej opryskiwaczy są: zbyt wysoka cena zakupu opryskiwacza, za którymi idą wysokie ceny części zamiennych oraz wysokie koszty serwisu.

**Słowa kluczowe:** opryskiwacz sadowniczy, oceny, hierarchia.