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Vine Protection on Family Farms: Decision Making and Pesticide Use

Joana Neto[1], Ana A. Aguiar[1], Cristina Parente[2], Cristina Amaro da Costa[3], and Susana Fonseca[1]

1. GreenUPorto-Sustainable Agrifood Production Research Centre, Faculty of Sciences, University of Porto, Portugal

2. Department of Sociology, Faculty of Arts and Humanities, University of Porto, Portugal

3. CERNAS-IPV - Research Centre for Natural Resources, Environment and Society, ESAV, Polytechnic Institute of Viseu, Portugal

Abstract: Family farming is defined as the one which is managed by the family and uses mostly family labor. In the north of Portugal, family farm products are primarily intended for consumption by the household, and secondarily for local sale. Grape production is in many farms the main source of income, and is the one in which the farmer is willing to apply more pesticides to guarantee the quantity and quality required for processing. However, vineyard family farmers do not always register their practices and are rarely subject to any controls. Therefore, the way in which decision-making and compliance with the rules are carried out in these farms are not known. To understand the decision-making processes regarding phytosanitary treatments of these farmers, as well as their perception and caution with the use of pesticides, a checklist-type questionnaire was applied to a sample of 109 family farmers in the NUTIII region in Portugal. Issues related to: i) sociodemographic characteristics, and ii) agricultural practices related to the vineyard protection, were analyzed. The univariate data analysis was associated with the application of a principal component analysis (PCA). The obtained results reveal that the use of pesticides in family farm vineyards is a widespread practice and that the decision making and choice of the pesticide is, in most situations, carried out without the necessary caution, technical monitoring or registration. Respondents with a higher level of education say that they are more careful about the use of pesticides and individual protection. The younger and more educated age groups are more compliant when it comes to regulatory obligations such as the registrations.

Key words: viticulture, small-farms, survey, risk, safety, perception, phytopharmaceutical product

1. Introduction

According to the Food and Agriculture Organization (FAO) of the United Nations (UN), family farming constitutes almost 90% of the world's agricultural holdings and about 70% of the world's produced food [1-3]. It is defined as one that is managed by the family members and uses mostly family labor. Given its relevance in the world's food production, the UN decreed the year 2014 [4] as the year of family farming and later, the decade between 2019 and 2028 as the decade of Family Farming [5]. The topic was widely debated, regulated [6, 7], and a subject of study, such as the one presented here.

Corresponding author: Ana A. Aguiar, E-mail: aaguiar@fc.up.pt.

The north of Portugal is known for the existence of a high diversity of crops on farms, a situation more common in family farms where different species of vegetables, fruits, and even domestic animals are produced. The produced goods are primarily intended for consumption by direct and indirect family members, and secondarily for local sale [8-10]. Many of these farms produce wine grapes, a produce that is an important source of annual income, contributing for the family's economic stability. As the production of grapes constitutes in many farms the main or even the only source of income, it is the culture in which the farmer is willing to apply more inputs, such as fertilizers and pesticides, to guarantee the quantity and quality required by those who buy the grapes or the wine. From risk estimation to decision making and the

selection of control methods and products to be applied, the management of crop protection has a differentiating role in these family farmers [11].

On the other hand, in Portugal, vine is the crop where pesticides are used the most, where the control of several key pests and diseases becomes necessary every year [12], and the acquisition and application of pesticides are only allowed to authorized applicators [13]. Medium and large winegrowers keep records of the production inputs used, namely pesticides, and are submitted to inspections and traceability. However, small winegrowers — those who produce in a family farming system — do not always keep records and are rarely submitted to controls. Therefore, it is unknown how decision-making and compliance with standards and rules are carried out. As such, it is important to identify their cultural practices, with the application of surveys being the most appropriate methodology.

This study aimed to understand the behavior of family farmers — vineyard owners — in the decision-making process regarding phytosanitary treatments and the risk perception and caution taken in the use of pesticides.

2. Materials and Methods

The study was based on an extensive approach, with the application of a survey addressed to family farmers — vineyard owners. The starting question guiding the analysis was to know how the application of phytosanitary treatments was decided and what cautions were taken (or not), based on sociodemographic variables such as age and education.

In this sense, a checklist-type survey was prepared, with closed-ended questions — thus reducing the need for long answers by the respondent — consisting of a simple list of statements (actions) or characteristics in which it is indicated whether they are present (or desirable) or not, with one or various options possible. For this study, questions related to i) sociodemographic characteristics: age, sex (Male; Female), education level (Level 1, less than primary education; Level 2, completed primary education; or Level 3, secondary or higher education); agricultural professional training (Yes or No) and household number; and ii) agricultural practices: control methods used (Biological control; Biotechnical control; or Chemical control), recording pesticides applications (Yes or No), use of specialized technical support for treatment decisions (Yes or No), perception of side effects in the field (if one have the perception or have experienced side effects of pesticide application: Yes or No), treatment decision-making process (according to Agricultural warnings public service: by Technical or neighbor advice; by Direct observation/experience, dosage calculation (by Technical advice; according to the Label instructions; or by Experience — "by eye"), perception regarding the risk associated with the use of pesticides (consider pesticides Dangerous — to be avoided; Indispensable, even if harmful; or Safe), use of protective equipment such as gloves, mask, glasses, hat, coat, suit and boots (Yes or No); performance of pesticide residues analysis in grapes (Yes or No).

The survey was validated using focus groups, one in Viseu and another in Vairão (Vila do Conde). In each focus group, 20 privileged informants, with practical and experiential knowledge about the problem under analysis, participated. Data collection, which took place between December 2017 and July 2018, was carried out with the application of the checklist-type survey, in face-to-face conversations, after informed consent of respondents over 18 years old.

The checklist survey was applied to 109 family farm owners, that were easier to contact and recruit and volunteered to answer the survey. It is therefore a non-probability sampling method, allowing to be just an exploratory study about this subject. The surveyed farmers owned farms located in the regions (NUTS III) of Tâmega and Sousa (69 farms), Viseu, Dão and Lafões (32), Aveiro (6), Ave (1), and the Porto Metropolitan Area (1). The analysis of univariate data was associated with the application of principal components analysis (PCA).

3. Results and Discussion

Of the 109 respondents, with an average age of 58 years (ranging from 29 to 90 years), all affirmed to use pesticides in the vineyard, with only 31% recording the pesticide applications; 87% stated that the decision to treat is made only by observation and experience. Regarding the dosage calculation to spray, 39% said they followed technical advice, 39% follow the label instructions and 22% said it was calculated "by eye". About the use of personal protective equipment (gloves, hat, boots, mask or suit), 83% affirmed to wore at least one of the items mentioned, and 17% affirm to wore nonprotective equipment. Only 25% of respondents classified pesticides as dangerous, and 65% consider their use recommended and indispensable (Table 1).

Table 1 Relative frequency of response of the 109 surveys analyzed.

Sociodemographic			Agricultural Practices		
Age	< 50 years	24%	**Control Method**	Chemical Control (Chemical C)	100%
	50-70 years	66%		Biological Control (Biological C)	15%
	> 70 years	19%		Biotechnical Control (Biotechnical C)	15%
Sex	Male	68%	**Recording Pesticide Applications (PA)**	Yes	31%
	Female	32%		No	69%
Education Level	Level 1 (ESC N1)	53%	**Technical support for treatment decisions**	Yes	26%
	Level 2 (Esc N2)	18%		No	74%
	Level 3 or + (Esc N3+)	19%	**Perception of side effects in the field**	Yes	30%
Agricultural Professional Training (AP)	Yes	60%		No	70%
	No	40%	**Treatment Decision**	Agricultural warnings service (Ag)	6%
Household	1 or 2	50%		Technical or neighbor advice	7%
	3 or +	50%		Observation/Experience	87%
			Dosage Calculation	Technical advice	39%
				Label instructions	39%
				"By eye"	22%
			Pesticides Risk Perception	Dangerous	25%
				Indispensable	65%
				Safe	10%
			Use of protective equipment	Yes	83%
				No	17%
			Pesticide residues analysis in grapes (PR)	Yes	3%
				No	97%

When analyzing the answers by age groups (< 50 years old; 50-70 years old; > 70 years old) (Fig. 1), it is possible to observe that the most represented age class is the 50-70 years old (n = 66). Likewise, male is the most represented sex in the three age classes (53-79%), although the age group of < 50 years is the one with the highest percentage of female in the sample (approximately 40%). This data is in agreement with the study of Carvalho et al. (2012) [14] carried out in the Douro region. The younger class is also the age group with the highest level of education (approximately 50% of respondents with Level 2 education, and approx. 40% of respondents with a Level 3 or higher education). Regardless of education level, all classes have a relatively high percentage of individuals with agricultural professional training (60-65%).

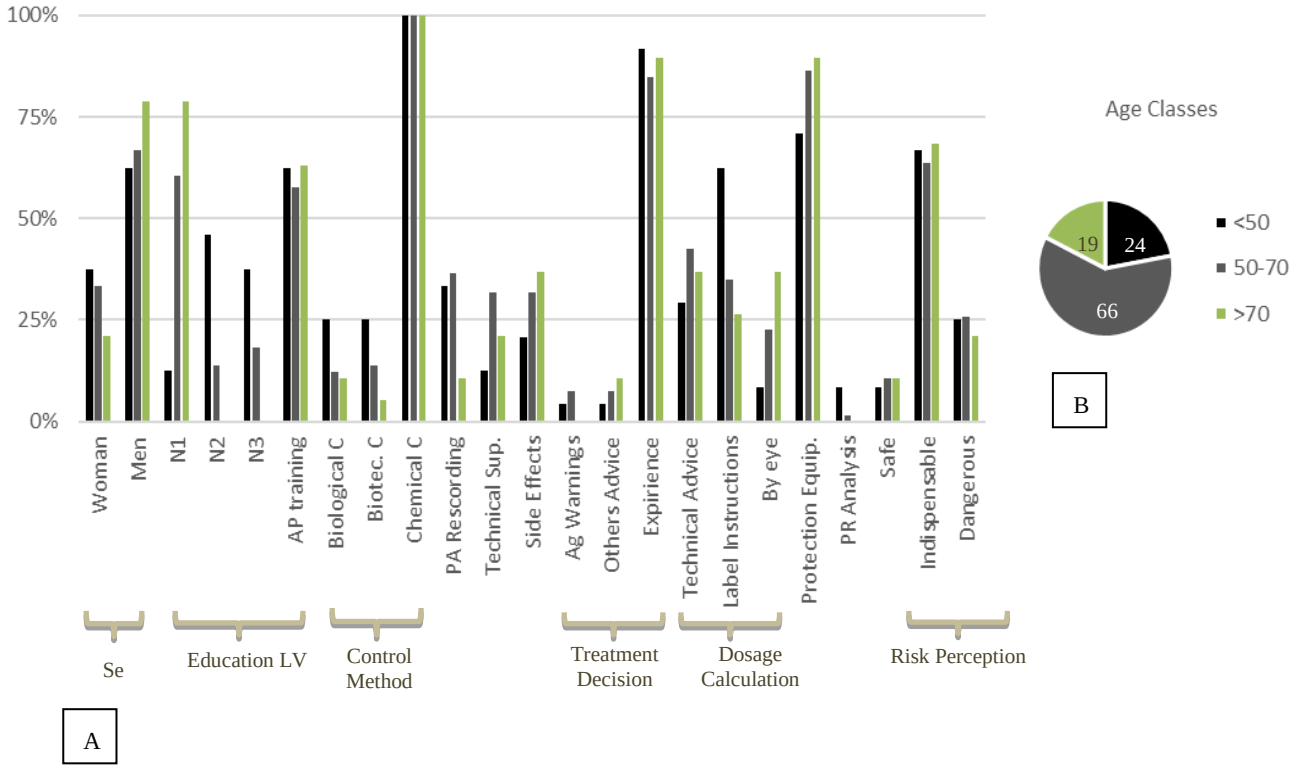

Fig. 1 A) Relative frequency of response according to age group (< 50 years; 50-70; > 70 years). B) Distribution of respondents by age groups.

The younger age group is also the one the most represented in answers related to the use of alternative pests and diseases control methods such as Biotechnical or Biological Control, although still with a low percentage of users within the sample (25%) (Fig. 1). On the other hand, this younger age group is less fearful of the use of pesticides when compared with other age groups, as represented by the lower use of technical support (13%) and the lower caution taken in the use of personal protective equipment (< 50 years: 71%; 50-70 years: 86%; > 70 years: 89%) — important risk-preventive actions to be considered when using chemical pesticides [15].

In PCA (Fig. 2) a significant positive correlation is observed between the Education Level variable and the variables Treatment Decision and Dosage Calculation, indicating that the respondents with a higher level of education express more caution regarding the use of pesticides and show more confidence in their knowledge regarding the method of use. Furthermore, the education variable presents a significant negative correlation with the Age variable, confirming that the younger age group have a higher level of education [14]. The younger and more educated group, and those with more agricultural training, are more compliant about regulatory obligations such as recording pesticide applications (35-40%) or performing pesticide residues analysis in grapes (2-8%) (Fig. 1). This observation is confirmed by the PCA, which indicates a significant positive correlation between the Education Level variable and the Treatment Decision variable (the highest score is attributed to the decision that resorts to specialized technical advice), and also with the Dosage Calculation variable. The use of chemical control is consistent and transversal to all age classes (100% of respondents) and a high percentage of respondents, from each class, classify pesticides as recommended and indispensable (65-70%). However, the variable Technical Support has a significant negative correlation with the variable Perception related to Pesticides, indicating that farmers who resort to technical support are more confident about the use

and handling of pesticides. Older and less educated group show less caution in the use of pesticides, namely in dosage calculation, and claim to experience more pesticide side effects in the field. Furthermore, the age variable presents a significant negative correlation with the pesticide residue analysis and biological control variable, confirming the observation that the younger age group seem to show greater concern with regulatory issues related to the sale and distribution of grapes.

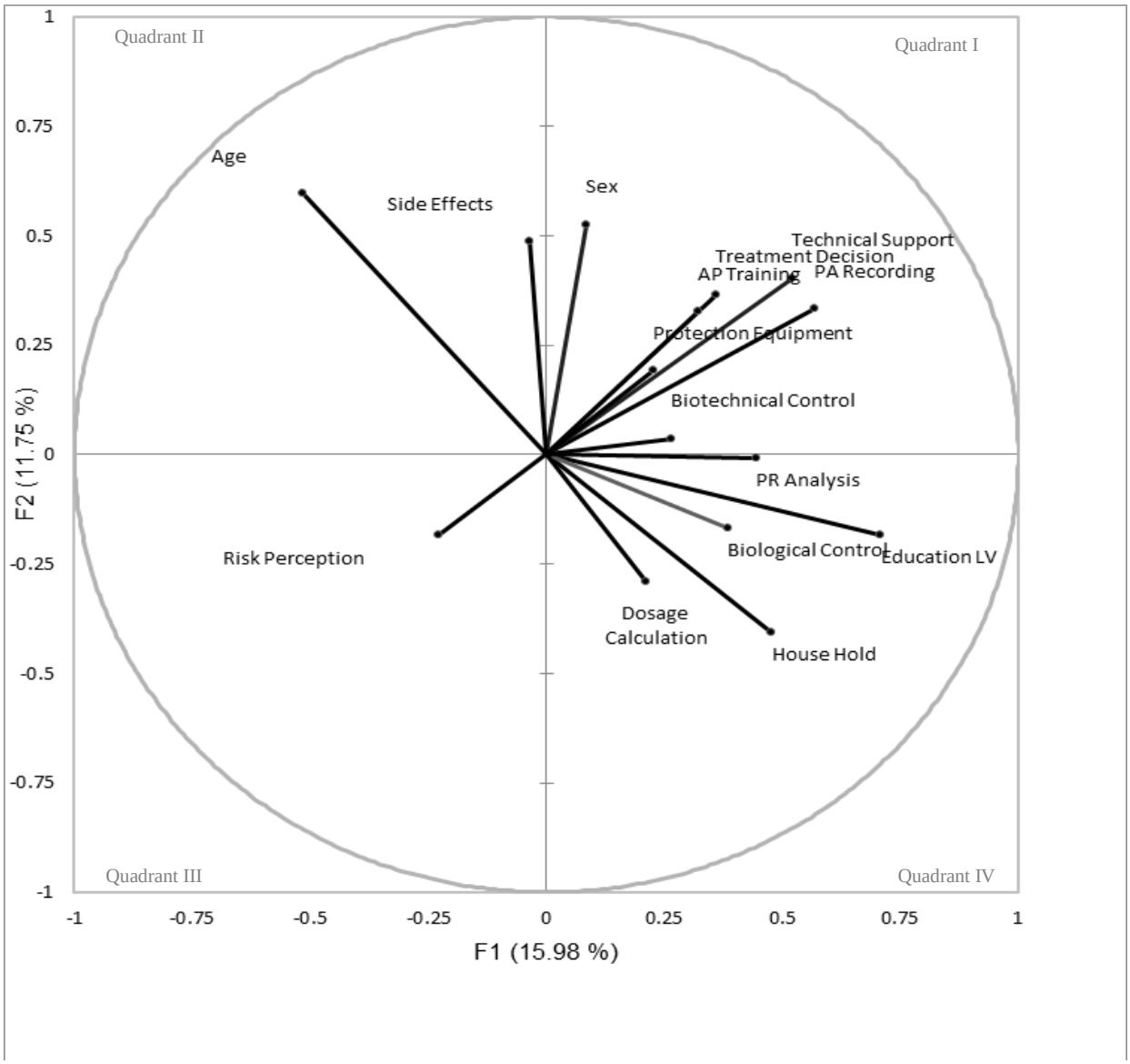

Fig. 2 Principal Component Analysis of survey responses. The graph places in the plane the correlations (Pearson (n)) established between the variables in function of the factor axes. Correlations exhibit values between -1 and 1, these extreme values coinciding with the lower and upper semicircle, respectively; variables that share the same quadrant show a stronger and more positive correlation with each other.

4. Conclusion

The results reveal that the use of pesticides in the vineyard in family farming is a widespread practice and that the decision-making and product choice is — in most situations — carried out without the necessary caution, specialized technical monitoring, or registration. Respondents with a higher level of education express more caution regarding the use of pesticides and individual protection equipment and show more confidence in their knowledge of how to use them. The younger and more educated group, and those with more agricultural training, are more compliant about regulatory obligations such as recording pesticide applications.

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