GEN4OLIVE

DELIVERABLE 1.3

FINAL REPORT ON END-USER NEEDS AND URGENT OLIVE BREEDING LINES

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Project Acronym: GEN4OLIVE

Project title: Mobilization of Olive GenRes through pre-breeding activities to face the future challenges and development of an intelligent interface to ensure a friendly information availability for end users

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Project Duration: 48 months

Project Officer: Grazyna Galazka

Project Coordinator: Conchi Munoz Diez, UCO, cmdiez@uco.es

Author(s): Milena Ailén Ferrari, Galpagro, mferrari@galpagro.com

Teresa Carrillo Cobo, Galpagro, tcarrillo@galpagro.com

Contributing partner(s): Bert Pöpping, FOCOS, bert.popping@focos-food.com

Carmen Diaz-Amigo, FOCOS, carmen.diaz.amigo@focos-food.com

Konstantinos Salis, EFE, saliskonstantinos@yahoo.com

Hristofor Miho, UCO, hmiho@uco.es; gen4olive@uco.es

Songul Acar, ORI, songulacar76@hotmail.com

Guillaume Besnard, CNRS, guillaume.besnard@univ-tlse3.fr

Gloria Rodriguez Lepe, SCI, grodriguez@vectorhorizonte.com

Nathalie Chavrier, CTA, nathalie.chavrier@corporaciontecnologica.com

Macarena Urena Mayenco, CTA, macarena.urena@corporaciontecnologica.com

Marisol Castro Ruiz, CTA, marisol.castro@corporaciontecnologica.com

Enzo Perri, CREA, enzo.perri@crea.gov.it

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STATUS	
Draft	
Final	x

TYPE		
R	Document, report	x
DEM	Demonstrator, pilot, prototype	
DEC	Websites. Patent fillings, videos, etc.	
OTHER		

DISSEMINATION LEVEL		
PU	Public	x
CO	Confidential, only for members of the Consortium (including the Commission Services)	

Related Deliverables/Project-related Documents

ABBREVIATION	TITLE	STATUS
GA	Grant Agreement	Finalized
CA	Consortium Agreement	Finalized
D.1.1	GEN4OLIVE Stablish links Activities Plan	Month 10
D.1.2	Definition of harmonised and common protocols for carrying out all olive genotypes analysis and characterization	Month 10

Revision History

DATE	LEAD AUTHOR, INSTITUTION	COMMENTS
06/09/2021	Milena Ailén Ferrari (GALPAGRO) Teresa Carrillo Cobo (GALPAGRO)	1st draft version
08/10/2021	Hristofor Miho, UCO	Final version

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1. INTRODUCTION

It is well known that there are programs for the genetic improvement of the olive tree that seek to obtain varieties that have greater production, that are more resistant to certain diseases and to climatic conditions in the area, among others. But what remained unknown is within those categories, which are the ones that must be prioritized when carrying out an olive breeding program, based on the most urgent needs of the end users. This prioritization is important to find the most proper solutions regarding olive genetic resources with a view to the needs of the market.

In that sense, a series of decisions were taken in order to create a useful survey to assess the end-users and with the aim of reaching as many people as possible.
The results were positive, it was possible to evaluate an extensive list of final users from different countries and conclusions were obtained that helped to delineate the future actions of the project.

Sections 1, 2 and 3 of Chapter 2 present the actions carried out with the aim of achieving the results described above. Section 2.4 shows the results of the surveys distributed to end users and chapter 3 describes the final conclusions.

2. REPORT OF END-USER NEEDS AND URGENT OLIVE BREEDING LINES

2.1. Identification of end-user needs

On December 10th 2020, an event was organized at Galpagros's Rural Innovation Hub El Valenciano. This event had 3 main objectives:

- Present the project
- Network with other projects related to olive grove genetic improvement (INNOLIVAR and LIFE Resilience)
- Attract end users and relevant people from the sector in order to make a first approach to identify their needs.

Regarding the last objective, the target audience was identified and, taking all security measures related to Covid-19, a hybrid event was organized. In order to make the event more attractive, an olive oil tasting was organized.

For this event, a questionnaire to identify end users' needs and urgent olive breeding lines was created by Galpagro and Cordoba University (UCO). The questionnaire had a total of 20 questions and was distributed to each attendant to complete.

Figure 1: Event at Galpagro's Rural Innovation Hub El Valenciano

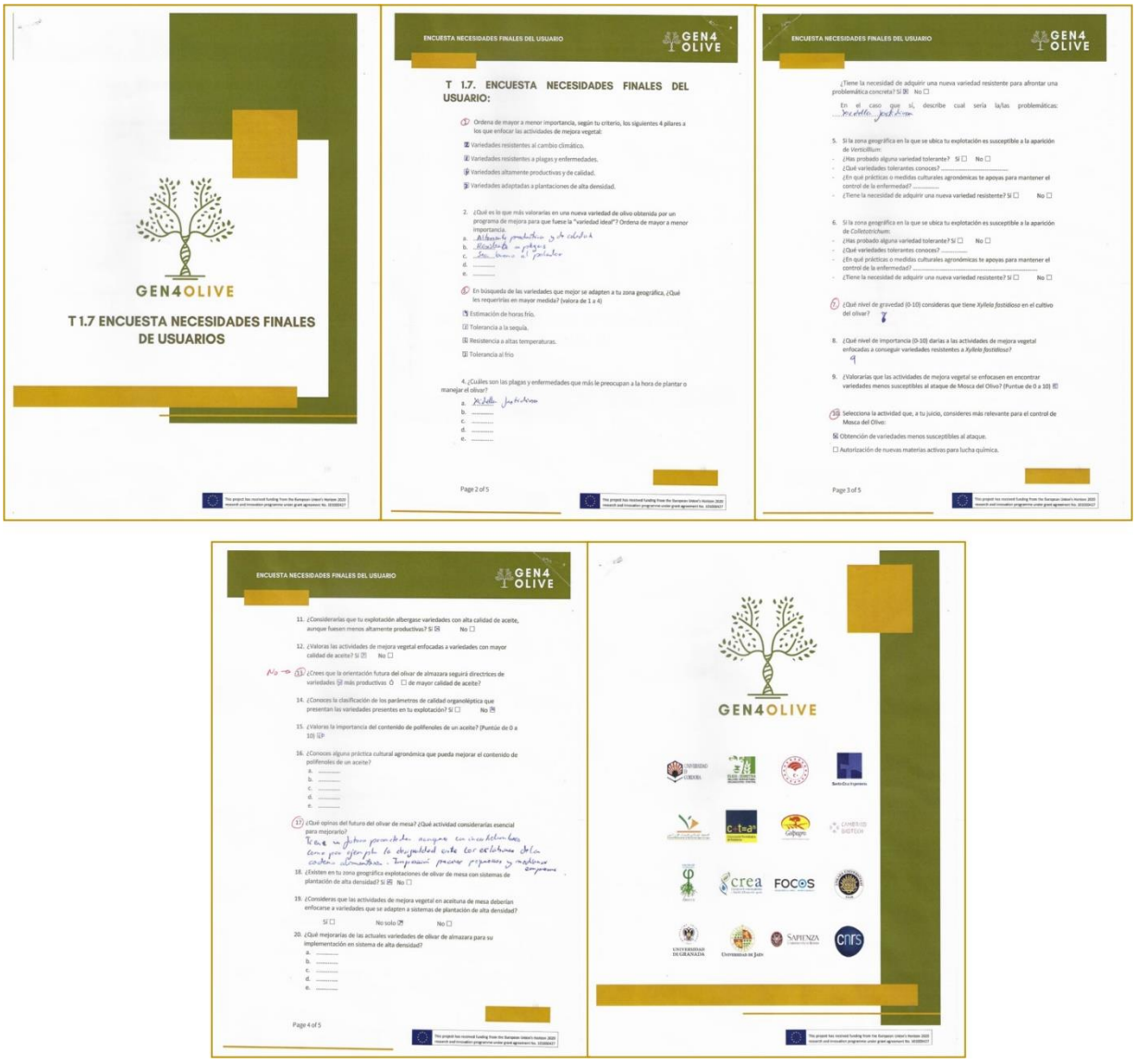


Figure 2: Questionnaire created for the event at the Rural Innovation Hub El Valenciano, completed by a participant.

A low number of entirely completed questionnaires were collected from this event, the possible cause was the extension of the questionnaire. In that sense, a decision was made to take this questionnaire as a first draft and based on it to create another one less extensive and more attractive. For that end, FOCOS, SCI, EFE, UCO and Galpagro collaborated to create a final questionnaire. In the process, relevant questions that were not previously identified were added thanks to the contribution of the partners.

2.2. Creation of the survey

The draft of the questionnaire was distributed among the rest of the project partners in order to choose the most relevant questions that the final questionnaire will have. Each partner had to indicate the ten most important questions in the survey, assigning a number from 1 (most important) to 10 (least important). Additionally, they had to identify to which group or groups each question should be addressed to: Farmer, Breeder, Owner/worker in a Nursery or Industry (retailers, entrepreneurs, etc.).

From the returned questionnaires, an evaluation was carried out by Galpagro to select the questions that were voted as most important. From it, the top 10 questions with the highest scores were selected for each group (the questions can be read in section 2.5).

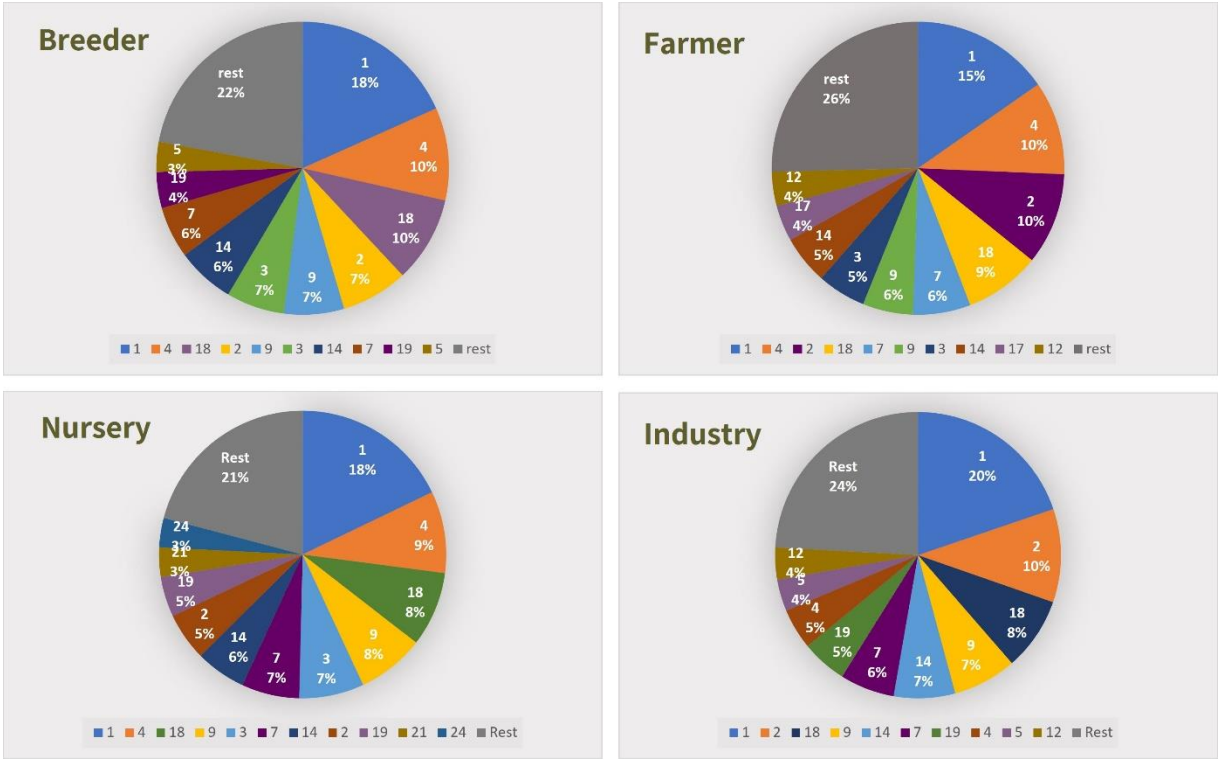


Figure 3: partners' evaluation of the questions for each end user

Due to the Covid situation, a decision was made to create an online survey with the previous selected questions, this way a larger audience would be reached. The features that this survey would have, such as: identification of the country of residence of the participant, option to leave a comment and option to leave email to receive information about the project progress, were discussed among the partners Galpagro, FOCOS, EFE and UCO. Additionally, with the help of different language speaking partners, the survey was translated into 7 different languages: English, Spanish, Italian, Turkish, German, French and Greek. This also contributed to the objective of reaching the larger audience possible in order to do a relevant study of end-user needs.

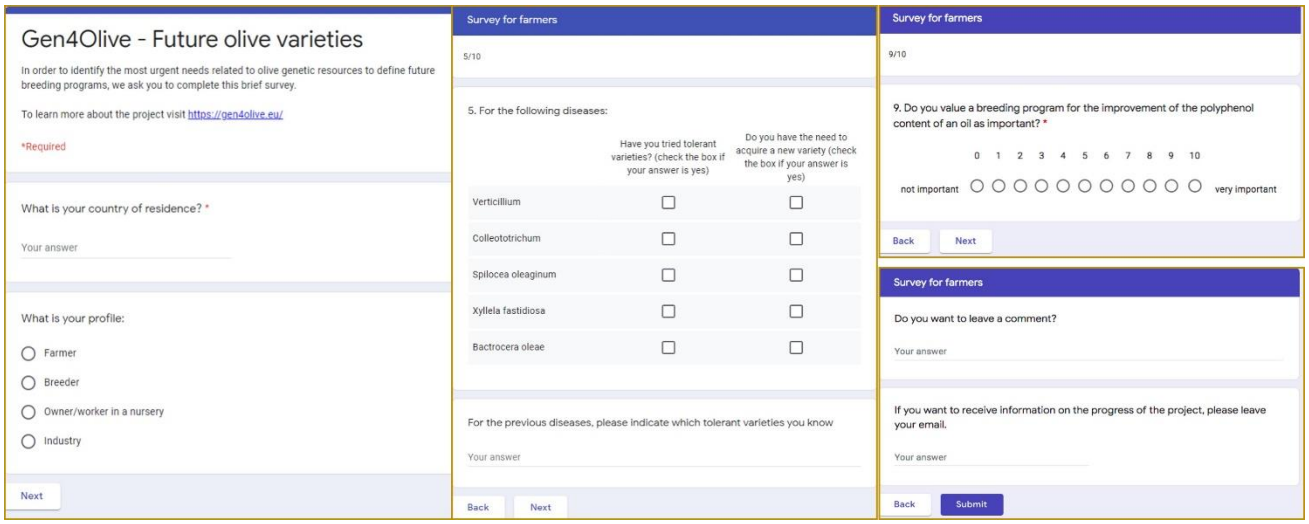


Figure 4: Online Survey (English version)

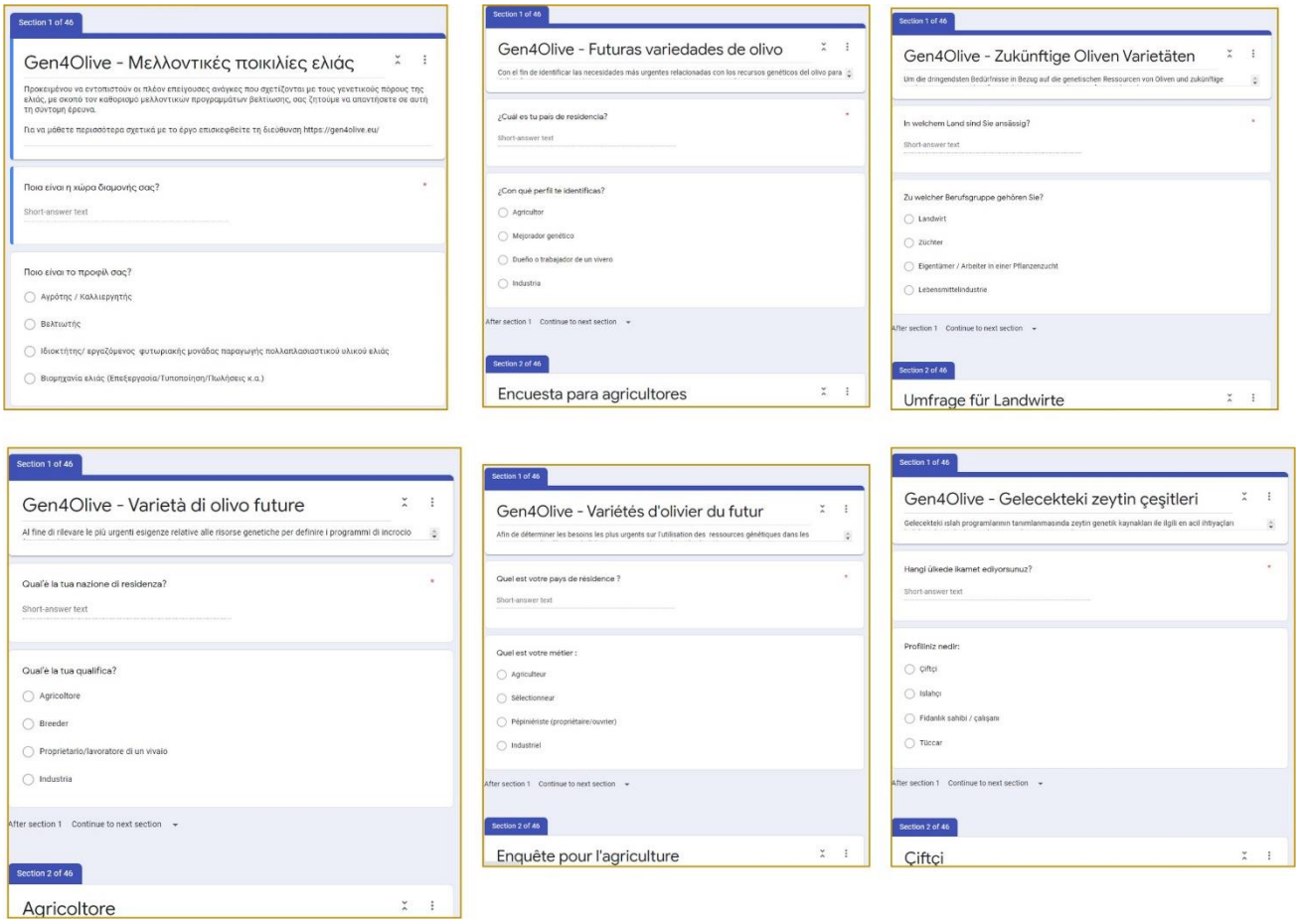


Figure 5: Online Survey in 6 different languages.

2.3. Dissemination of the survey

The survey was published on the project social media: twitter, linkedin, facebook and was distributed among the partners in order for them to share it with their contacts. Specifically, the survey

was shared with the International Olive Council (IOC), part of Advisory Board of GEN4OLIVE, in order for them to express their expertise opinion in determining current and future urgent needs for breeding programs. Additionally, IOC contributed with the dissemination of the survey by publishing it in their website (https://www.internationaloliveoil.org/gen4olive-project/) and by requesting their Germplasm Banks to complete it.

The survey remained opened for 4 weeks, where posts and reminders to complete it were done during that period.

Thanks to the effort of each partner and the project's communication strategy, the survey was completed by a total number of 315 people from different nationalities (figure 6) , distributed as follows: 178 farmers, 44 Breeders, 30 Owners/workers in a Nursery and 63 people related to the Industry.

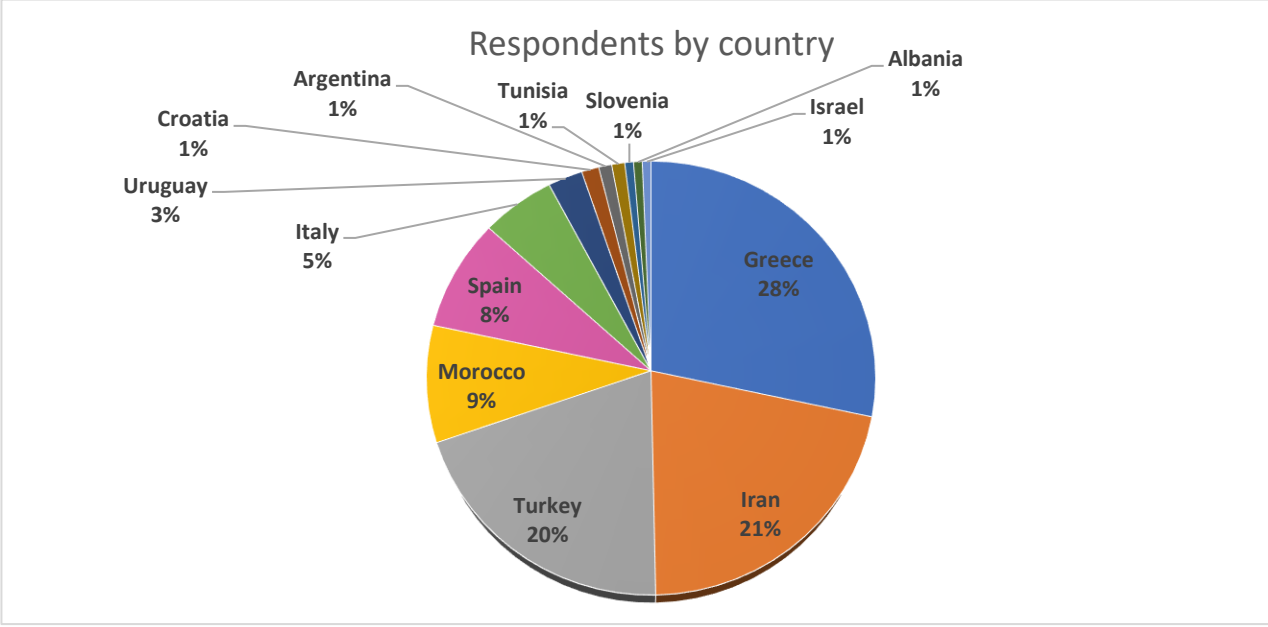


Figure 6: Percentage of respondents by country.

Additionally, a list of 175 emails were collected from the surveys from people interested in receiving news about the progress of the project. This list was shared with the partners in charge of the communication of the project.

2.4. Survey results

Presented in the following sections are the results from the survey per end user and the results in general, without segregation per end user.

2.5.1 Results per end user

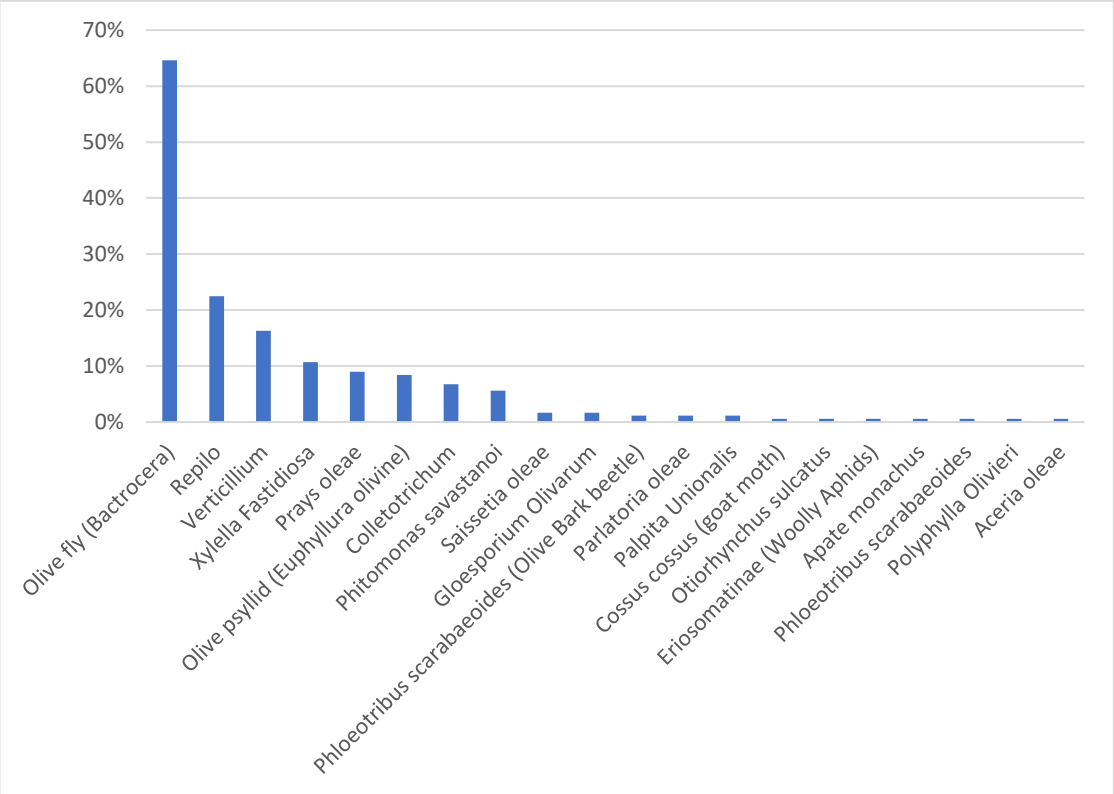
2.4.1.1. Survey for Farmers

Total responses: 178

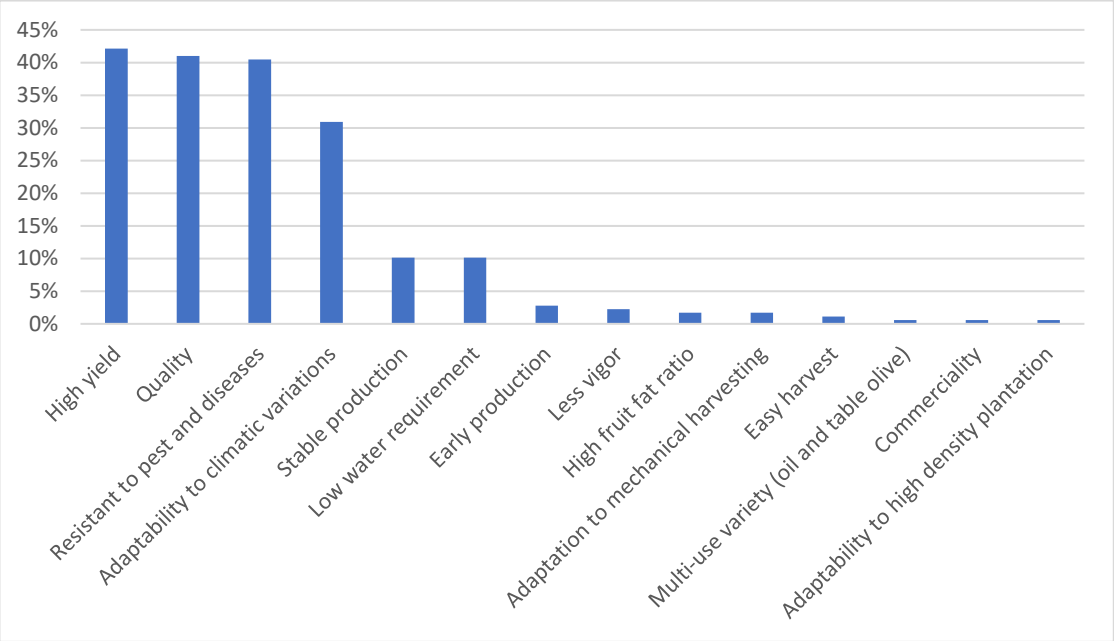
A. Please, rank the following criteria to focus plant improvement activities in order of importance from 1 to 4, where 1 is most important to you and 4 is least important to you.

1. Below are the criteria ordered from highest to lowest importance, according to the respondents:Climate change resistant varieties
2. Pest and diseases resistant varieties
3. Highly productive and quality varieties
4. Varieties adapted to high density plantations

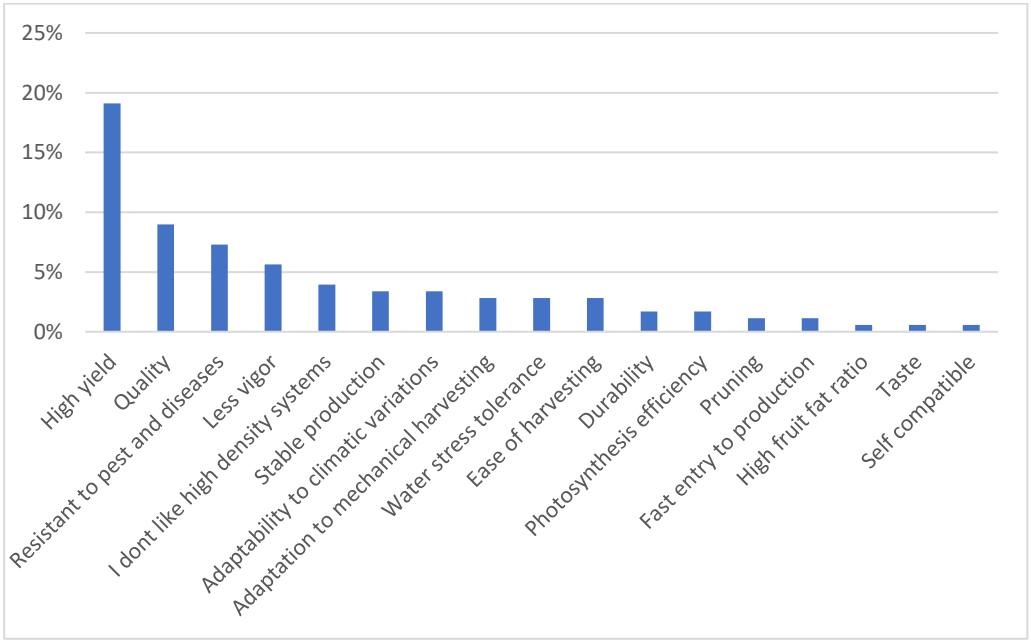
B. What are the pests and diseases that most concern you when planting or managing the olive?



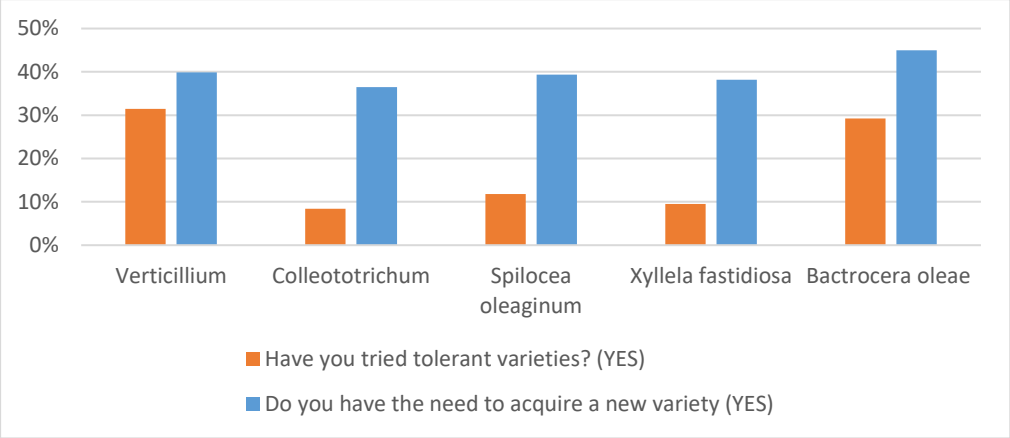
C. What would you value the most in a new olive variety obtained by a breeding program to obtain the "ideal variety"? (of most important to least important)

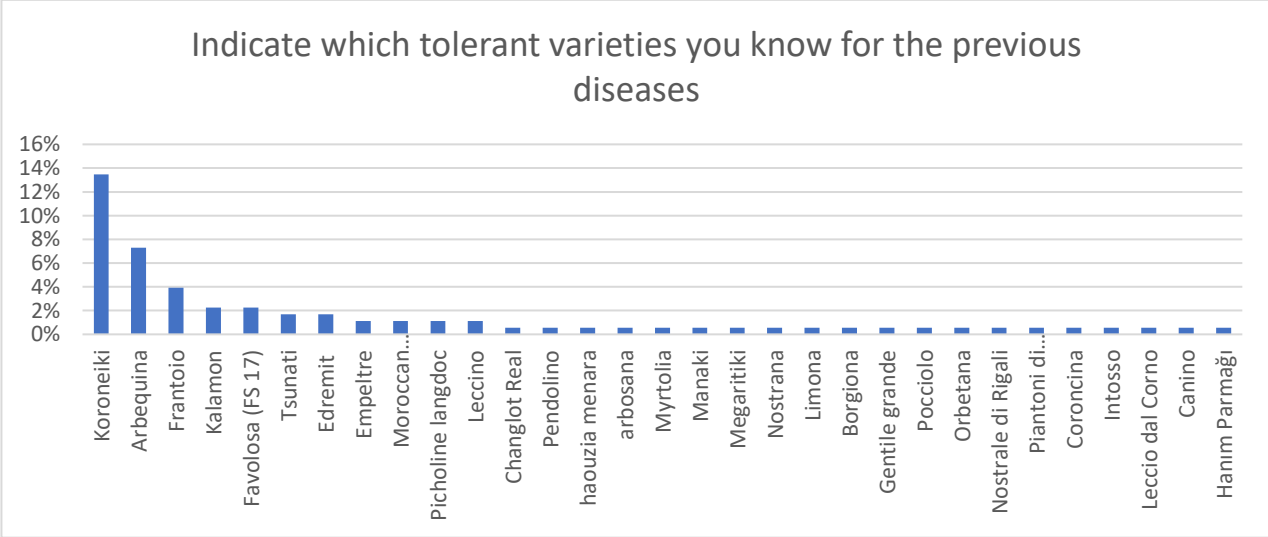


D. What would you improve on the current olive oil varieties for their implementation in a high-density system?

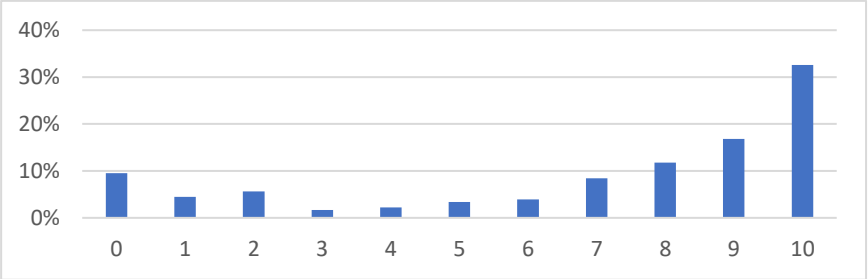


E. For the following diseases





F. Which level of importance would you give to plant improvement activities focused on obtaining varieties resistant to Xyllela Fastidiosa?



G. Which quality would you appreciate most in a variety to suit your geographic area? (from 1 to 4, of most important to least important)

Spain (13 votes)

1. Drought tolerance
2. Cold resistance
3. High temperature resistance
4. Chilling hour reduction

Morocco (14 votes)

1. Drought tolerance
2. High temperature resistance
3. Cold resistance
4. Chilling hour reduction

Greece (50 votes)

1. Drought tolerance
2. High temperature resistance
3. Chilling hour reduction
4. Cold resistance

Italy (17 votes)

1. Drought resistance
2. Cold resistance
3. High temperature resistance
4. Chilling hour reduction

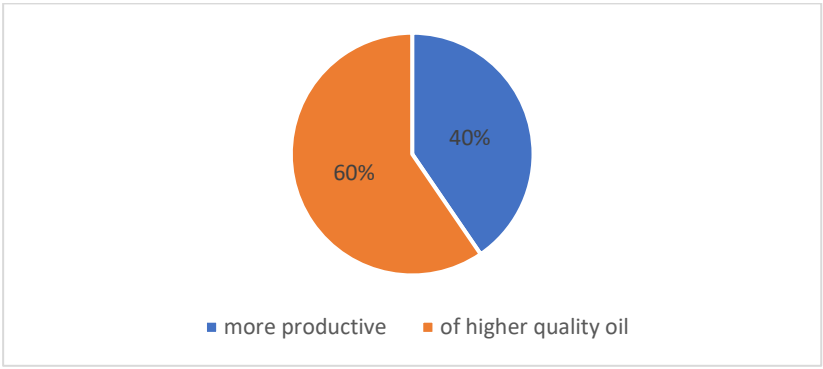
Turkey (30 votes)

1. Drought tolerance
2. High temperature resistance
3. Chilling hour reduction
4. Cold resistance

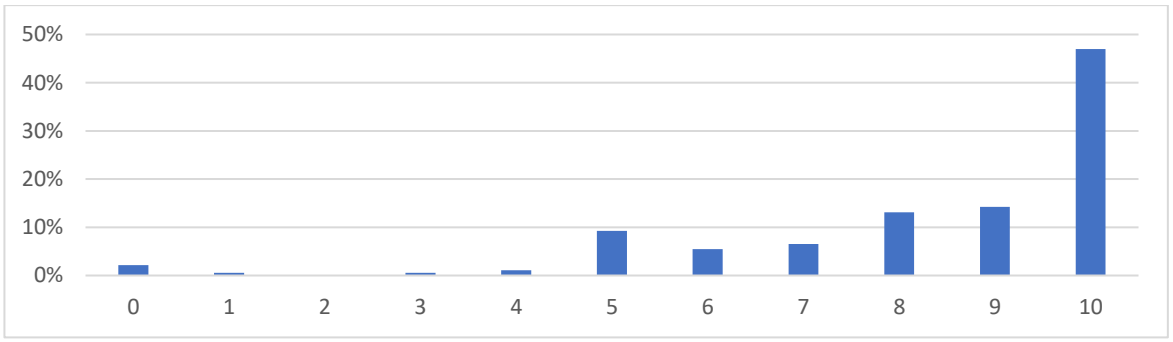
Iran (40 votes)

1. High temperature resistance
2. Chilling hour reduction
3. Drought tolerance
4. Cold resistance

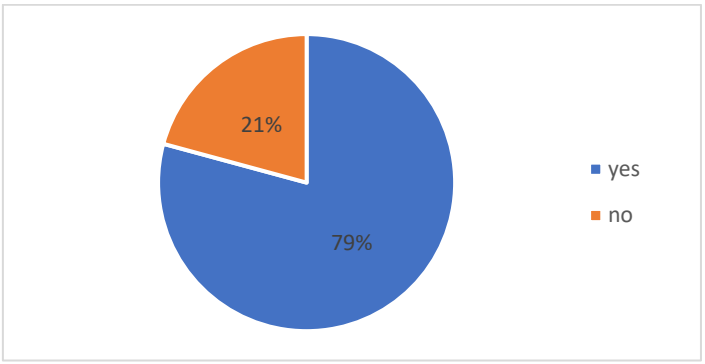
H. Do you consider that the future orientation of the olive grove will follow guidelines for varieties:



I. Do you value a breeding program for the improvement of the polyphenol content of an oil as important?



J. **Would you consider a high quality olive oil variety for your farm, even if they were less highly productive?**



2.4.1.2. Survey for Breeders

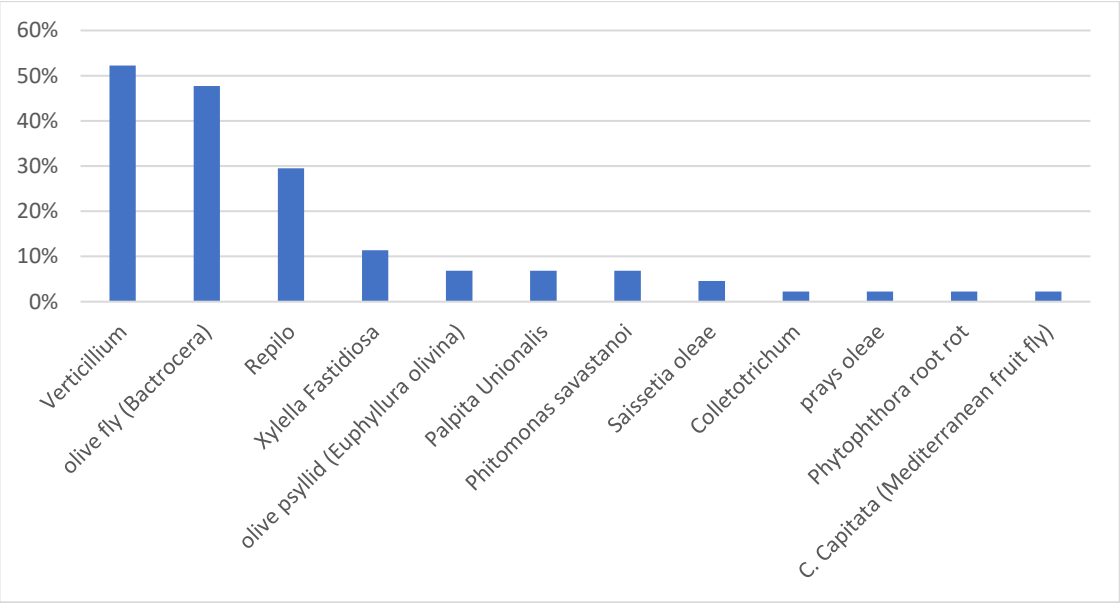
Total responses: 44

A. Please, rank the following criteria to focus plant improvement activities in order of importance from 1 to 4, where 1 is most important to you and 4 is least important to you.

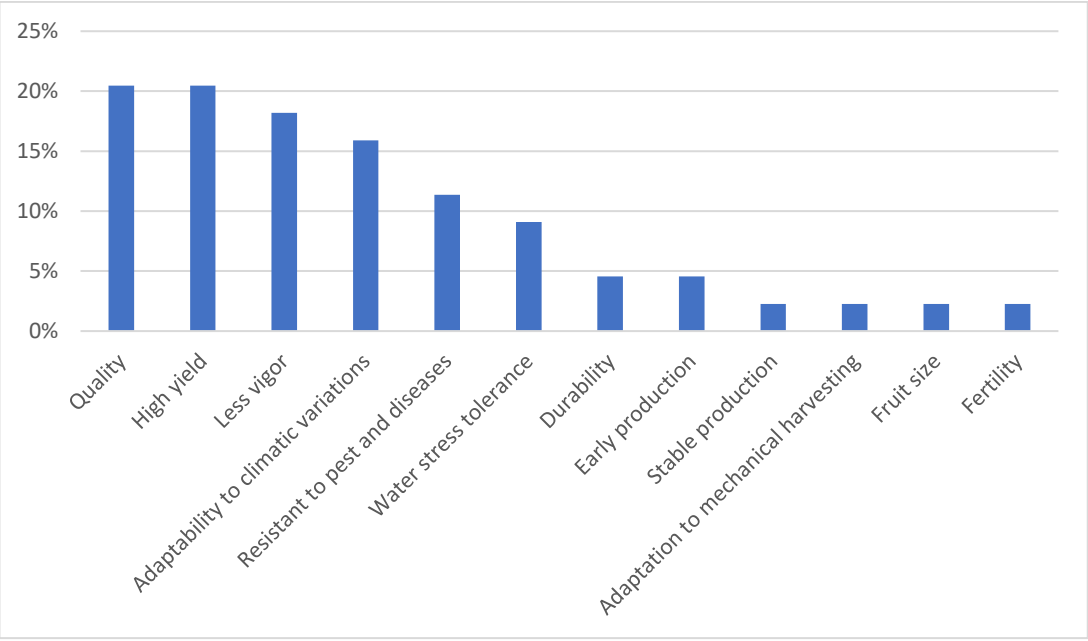
Below are the criteria ordered from highest to lowest importance, according to the respondents:

1. Climate change resistant varieties
2. Highly productive and quality varieties
3. Pest and diseases resistant varieties
4. Varieties adapted to high density

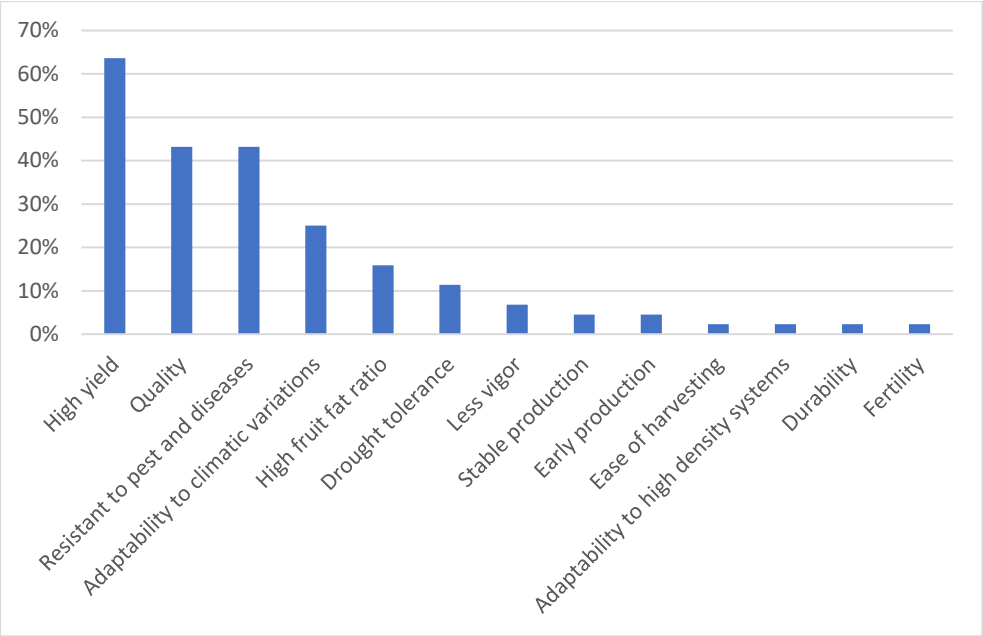
B. What are the pests and diseases that most concern you when planting or managing the olive?



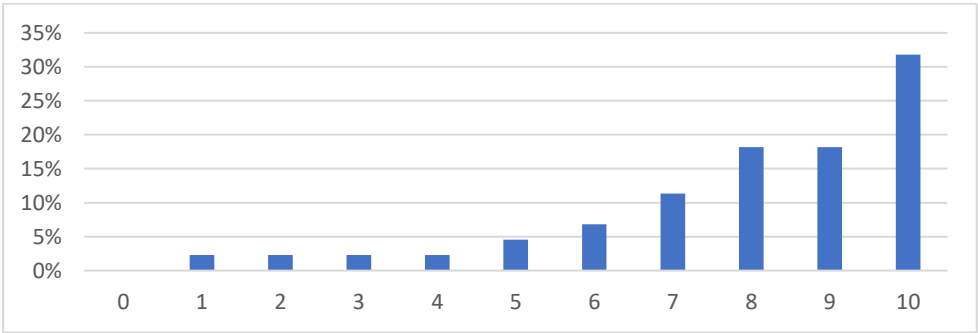
C. What would you improve on the current olive oil varieties for their implementation in a high-density system?



D. What would you value the most in a new olive variety obtained by a breeding program to obtain the "ideal variety"? (of most important to least important)



E. Which level of importance would you give to plant improvement activities focused on obtaining varieties resistant to Xyllela fastidiosa?



F. Which quality would you appreciate most in a variety to suit your geographic area? (from 1 to 4, of most important to least important)

Morocco (4 votes)

1. Drought resistance
2. Chilling hour reduction
3. High temperature resistance
4. Cold resistance

Iran (7 votes)

1. Cold resistance
2. Drought resistance
3. High temperature resistance
4. Chilling hour reduction

Spain (6 votes)

1. Chilling hour reduction
2. Cold resistance
3. High temperature resistance
4. Drought tolerance

Uruguay (1 vote)

1. Chilling hour reduction
2. Cold resistance
3. Drought tolerance
4. High temperature resistance

Greece (2 votes)

1. Drought tolerance
2. High temperature resistance
3. Chilling hour reduction
4. Cold resistance

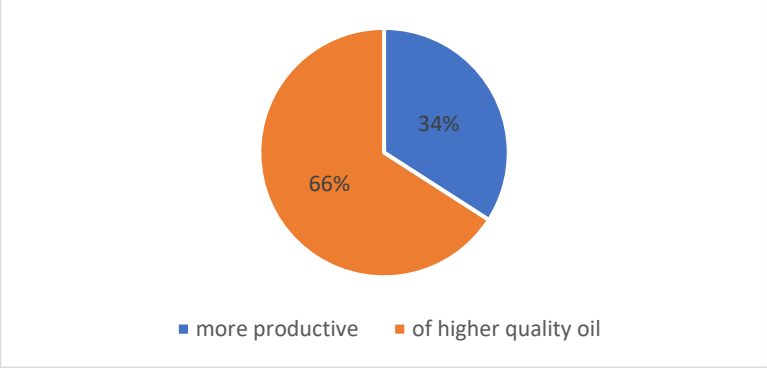
Turkey (14 votes)

1. Drought tolerance
2. High temperature resistance
3. Chilling hour reduction
4. Cold resistance

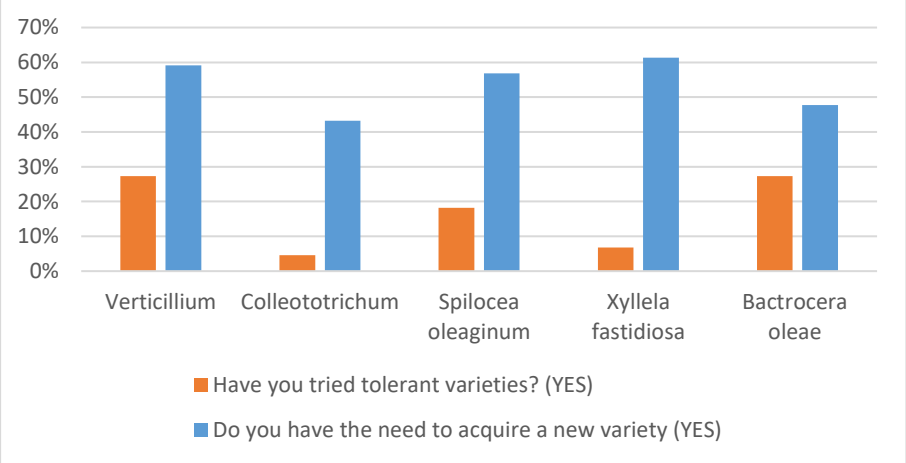
Italy (1 vote)

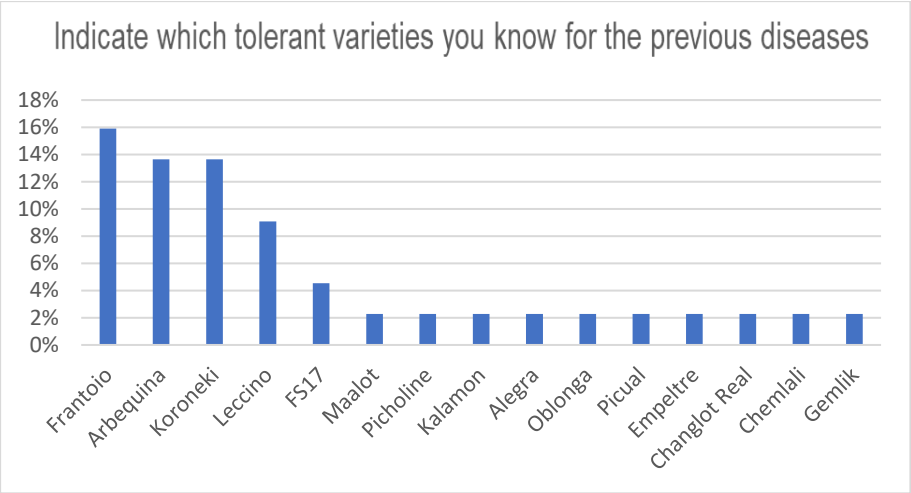
1. Chilling hour reduction
2. Cold resistance
3. Drought tolerance
4. High temperature resistance

G. Do you consider that the future orientation of the olive grove will follow guidelines for varieties



H. For the following diseases:





I. What do you think of the future of the table olive? What activity would you consider essential to improve it?

The answers provided by the respondents were[1]:

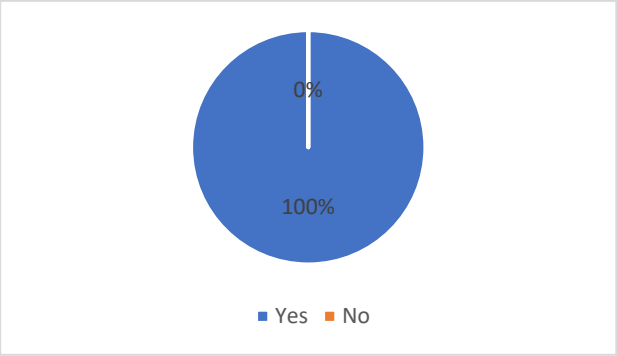
We need varieties fit for harvester.
Possibility for mechanical harvest, pest resistance and high quality.
Good taste and caliber.
Olive caliber, olive flesh texture.
Big size and rounded.
Introducing the benefits of olives to the people.
Table olive will be used more in future, and high-density system.
The future of olives is very bright and great. In the next 20 years, products will mostly be shifted to oil rather than canned food. The first step and the most important step is training.
Increase in consumption, mass production in Iran.
More Ads.

[1] some answers were slightly modified for their understanding.

Tolerance to abiotic stress.
We need to improve table olive fruit characteristics for our country because of the high demand.
Increase production and increase farmers' knowledge and use of new machine tools.
Improve the size of the fruits and easily separate their seeds.
It is difficult due to the costs of manual collection. The activity to improve it would be mechanized harvesting.
Mechanized harvesting.
Productivity, Mechanical Harvesting, Fruit Size, Verticillium Xylella and Fly Resistance, Ripening season
It is economically very profitable at the macro-regional level. The aspect to improve is the reduction of the processing time from harvest until it reaches the industry.
Improve scientific dissemination.
Disease tolerance and ease of harvest.
More varieties available, more research work in that sense.
Find varieties resistant to hits and varieties of a small size.
When making table olives we add a lot of chemicals for coloring and bitterness, so we have to try to reduce these rates.
Self-fertility, resistance to stress
The valorization
I believe in table olives with the right choice of varieties for each region
It has a future. Existence of water.
Homogeneous fruit.

More varieties should be used in the industry.
Table olive cultivation is very important in our country, work can be done for new quality varieties to improve
It will increase in the world. Different machining techniques and health benefits.
Increasing table consumption all over the world, obtaining new value-added products.
The taste of pickled olives is not soft enough to eat a plate in one sitting. I think the method of producing pickled olives will be changed.
Flesh to seed ratio.
Improvement of alternative quality varieties
New Technology
Selection and hybridization studies towards new table olive variety breeding, which are easy to separate the seed.
Efficiency and quality should be improved.
Like the Quince variety, it is important that its oil is of high quality (considering that un-marketable products are converted into oil) and its ability to be processed in different maturities (green crushing or drawing, black turning, etc.).
Improve productivity
Resistance to manipulation.
Flesh to seed ratio.

J. Would you like to acquire a new resistant variety to face a specific problem?



2.4.1.3. Survey for Nursery

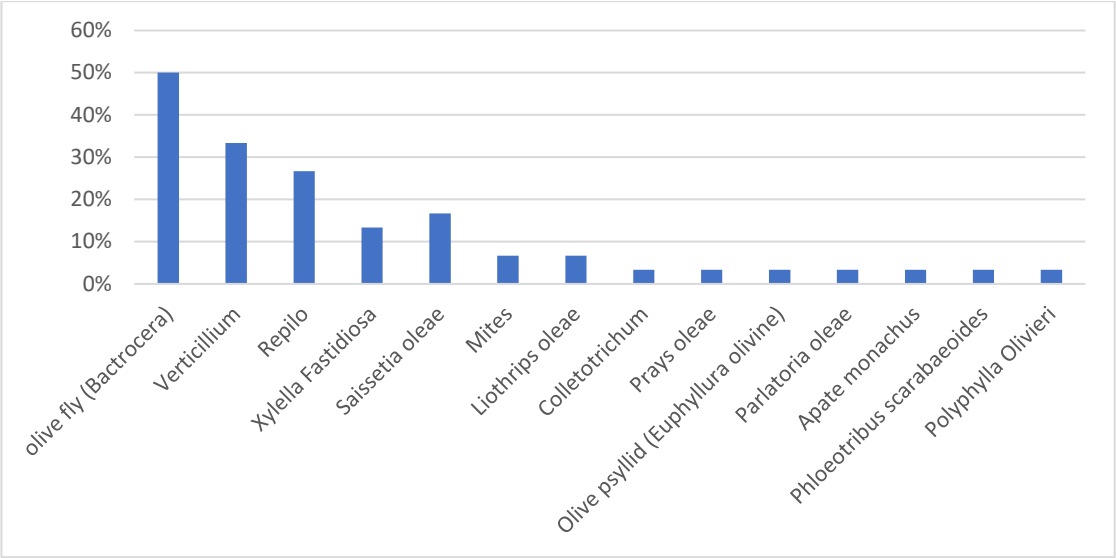
Total responses: 30

A. Please, rank the following criteria to focus plant improvement activities in order of importance from 1 to 4, where 1 is most important to you and 4 is least important to you.

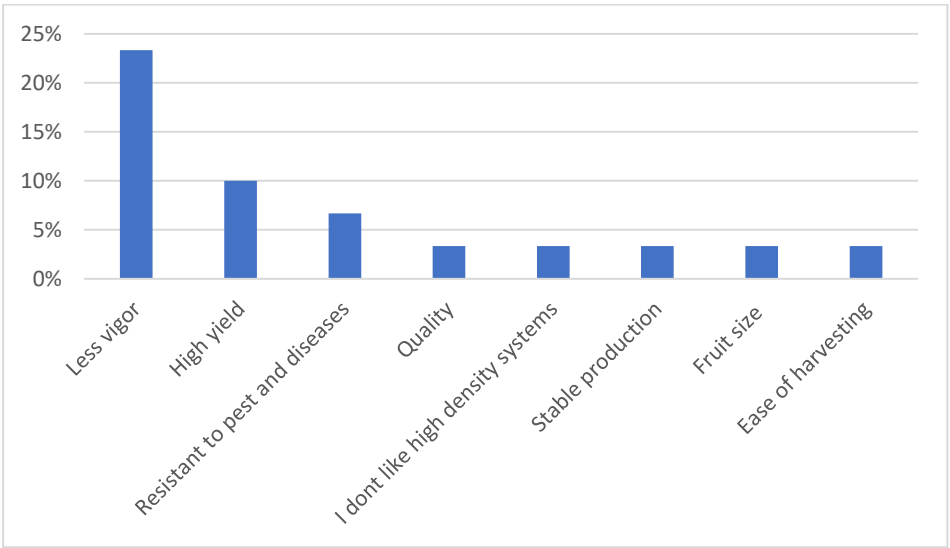
Below are the criteria ordered from highest to lowest importance, according to the respondents:

1. Climate change resistant varieties
2. Pest and disease resistant varieties
3. Highly productive and quality varieties
4. Varieties adapted to high density

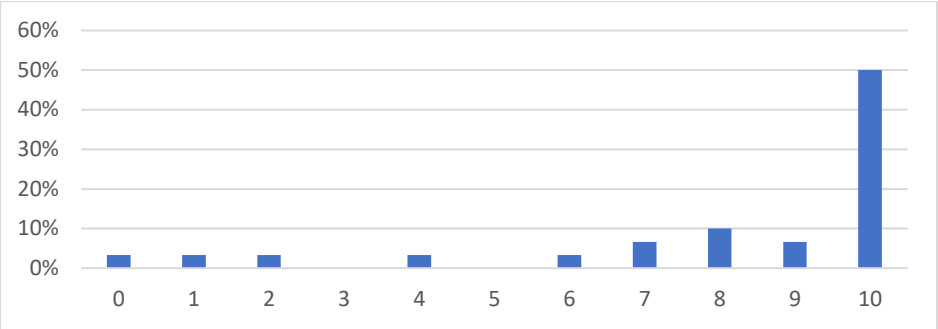
B. What are the pests and diseases that most concern you when planting or managing the olive?



C. What would you improve on the current olive oil varieties for their implementation in a high-density system?



D. Which level of importance would you give to plant improvement activities focused on obtaining varieties resistant to Xyllela fastidiosa?



E. Which quality would you appreciate most in a variety to suit your geographic area? (from 1 to 4, of most important to least important)

Iran (7 votes)

1. High temperature resistance
2. Drought tolerance
3. Chilling hour reduction
4. Cold resistance

Italy (2 votes)

1. Drought tolerance
2. Cold resistance
3. Chilling hour reduction
4. High temperature resistance

Morocco (4 votes)

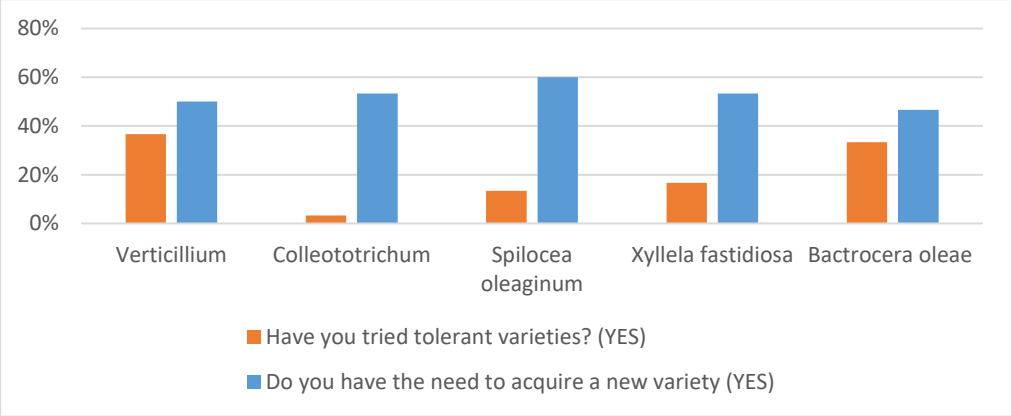
1. Drought tolerance
2. High temperature resistance
3. Cold resistance
4. Chilling hour reduction

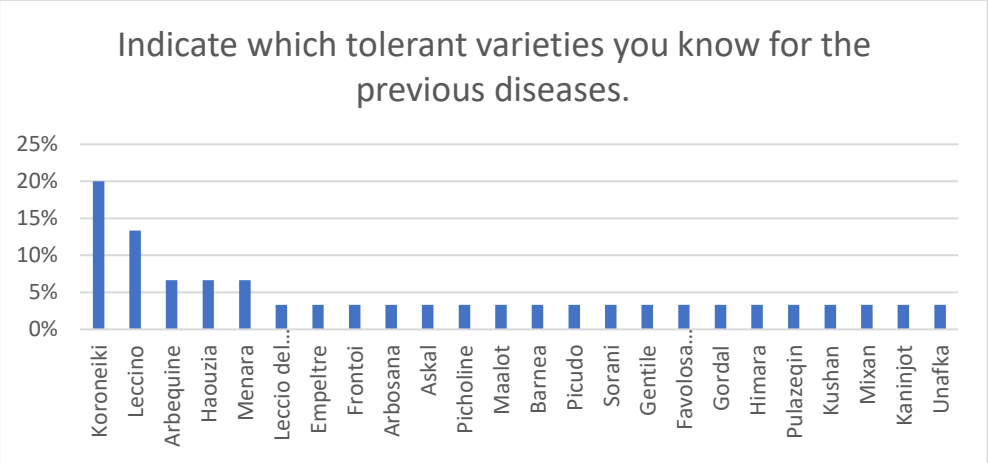
Greece (8 votes)

1. Chilling hour reduction
2. Drought tolerance
3. High temperature resistance

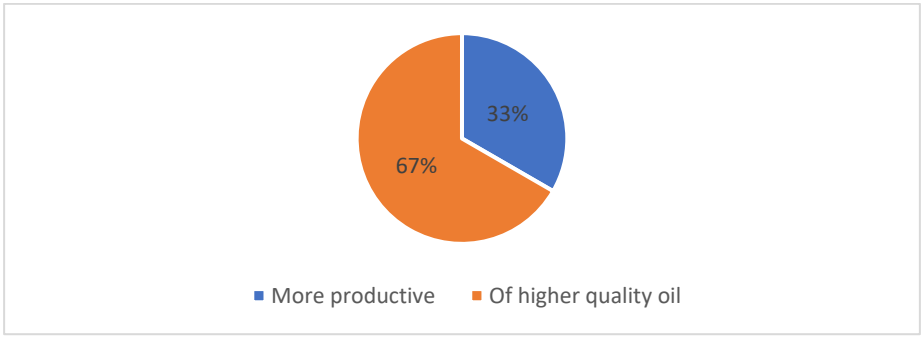
4. Cold resistance

F. For the following diseases:

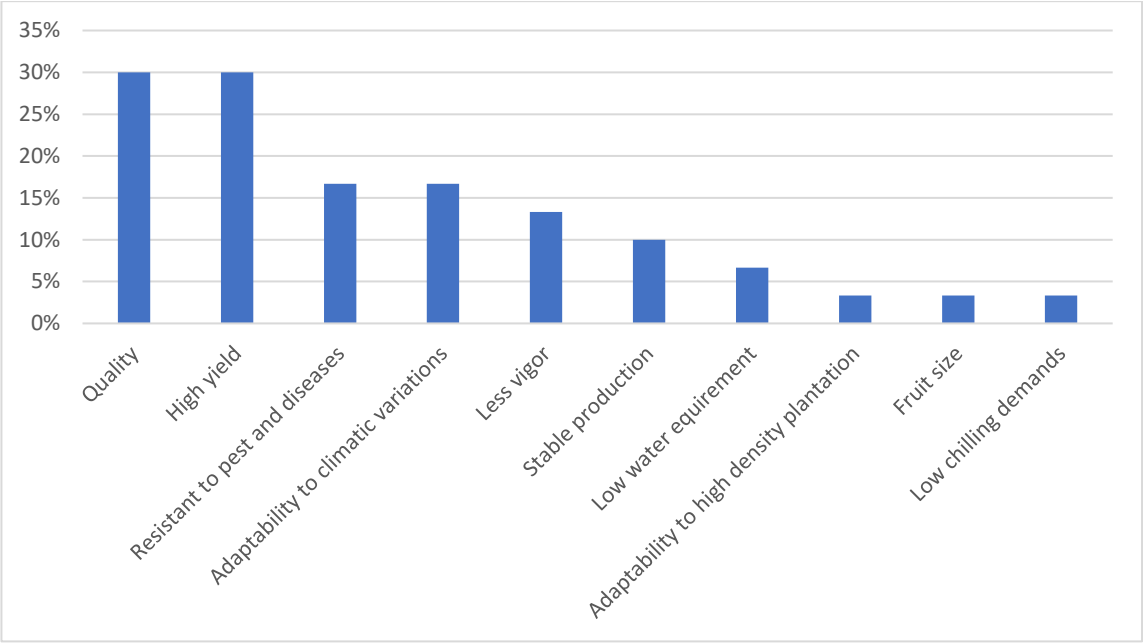




G. Do you consider that the future orientation of the olive grove will follow guidelines for varieties



H. What would you value the most in a new olive variety obtained by a breeding program to obtain the "ideal variety"? (of most important to least important)



I. What do you think of the future of the table olive? What activity would you consider essential to improve it?

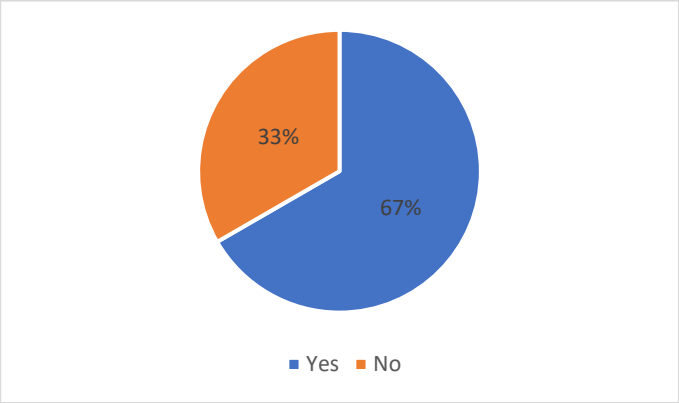
The answers provided by the respondents were[2]:

Varieties tolerant to Bactrocera.
Post harvest processing
Not basic change in consumption. Adaptation to mechanical harvest
For the olives table, our goal should be focus on three topic: High-yielding, dwarf cultivars, and access to early fruit cultivars.
High quality table olives, tolerant, productivity.
Increase production

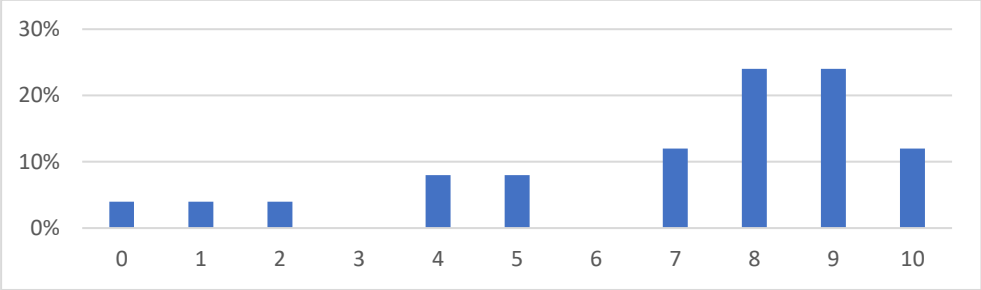
[2] Some answers were slightly modified for their understanding.

The future is brilliant. Improvement depends on 3 different Societies, Farmers, Olive Goods Producers and Consumers. By the way we have to be updated.
Consume rate will increase. Improvement: good varieties to produce more high quality and bigger olives.
Increase production.
More favorable irrigation techniques
Year after year the demand for olives increases, but care must be taken to obtain varieties that have a large olive core and that the core is easy to detach, aldo that it is produced year after year without alternation.
Table olives will be in great demand. Improve training and dissemination.
I think there is a good future for table olive.
I think the future of table olives will be prosperous, so we need to work to improve varieties that are more production intensive.
Improve: Caliber, resistance to the disease e insects.
Disease resistance.
As a food it has good prospects in the world market, but it is necessary to achieve stable production.
Tree size.
Vertical production.
Adaptation to high density production.
There is a future in cultivation, as long as the goodwill of the trade is transferred to the producer.
Improve: taste, robustness, resistance to climate change.

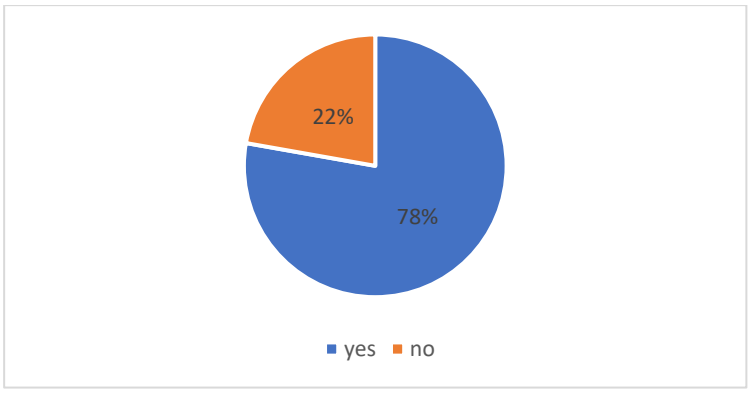
J. Do you consider that table olive breeding activities should focus on varieties that are adapted to high-density systems?



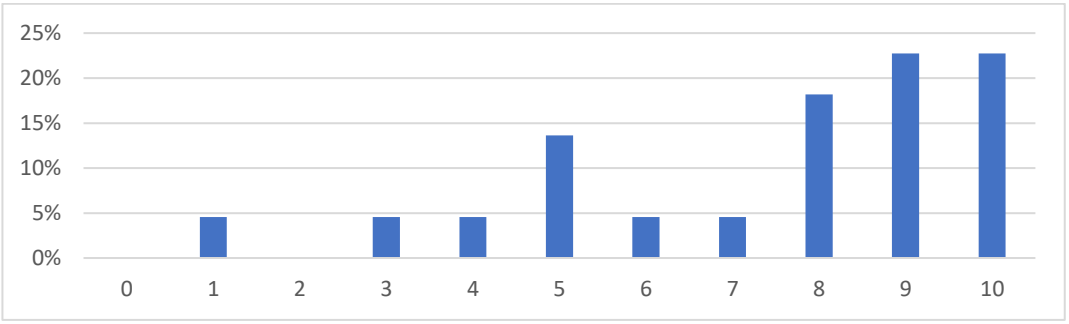
How important do you think an improvement breeding program of table olives adapted to high-density systems is?



K. Do you think that juvenile phase, from the time of propagation to the time of production, should be reduced?



If your answer to the above question is YES, how important do you think an improvement breeding program of the juvenile phase is?



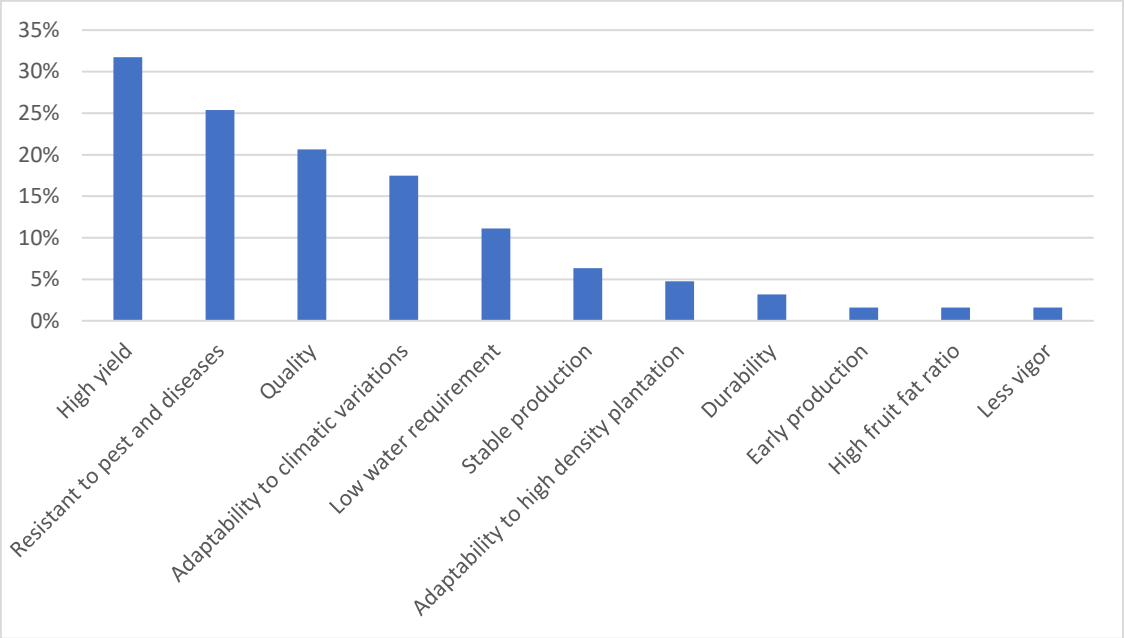
2.4.1.4. Survey for Industry

Total responses: 63

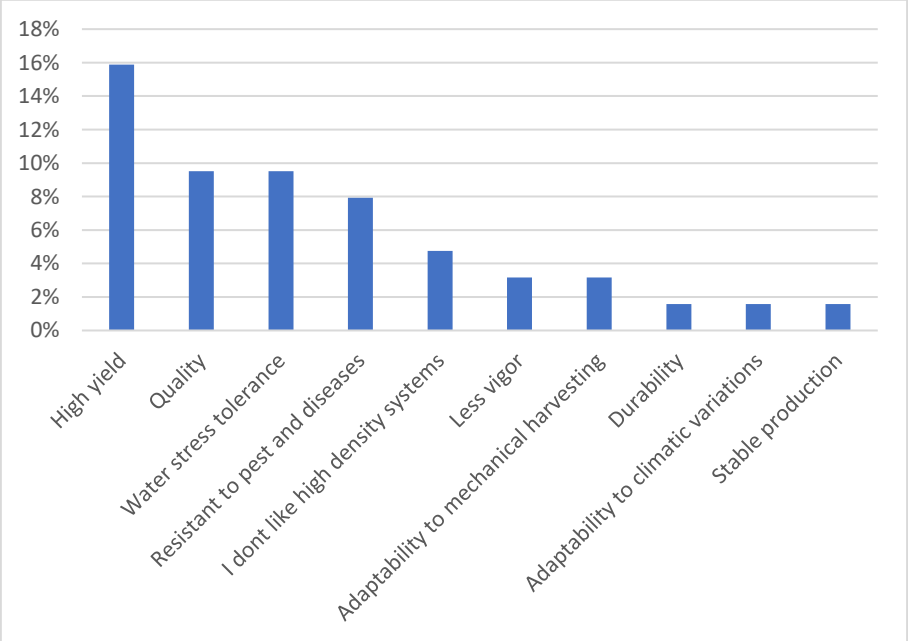
A. Please, rank the following criteria to focus plant improvement activities in order of importance from 1 to 4, where 1 is most important to you and 4 is least important to you.

1. Climate change resistant varieties
2. Pest and disease resistant varieties
3. Highly productive and quality varieties
4. Varieties adapted to high density plantations

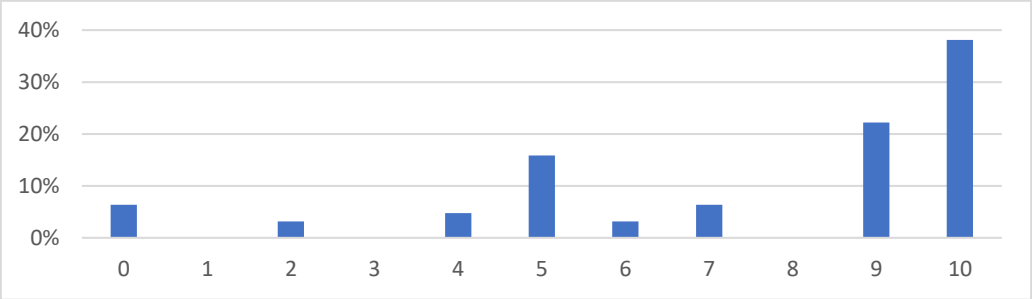
B. What would you value the most in a new olive variety obtained by a breeding program to obtain the "ideal variety"? (of most important to least important)



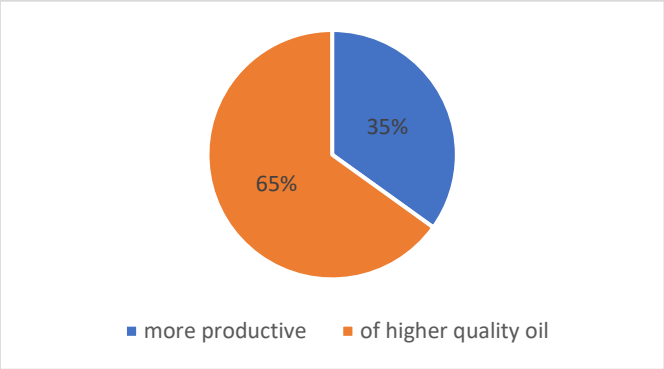
C. What would you improve on the current olive oil varieties for their implementation in a high-density system?



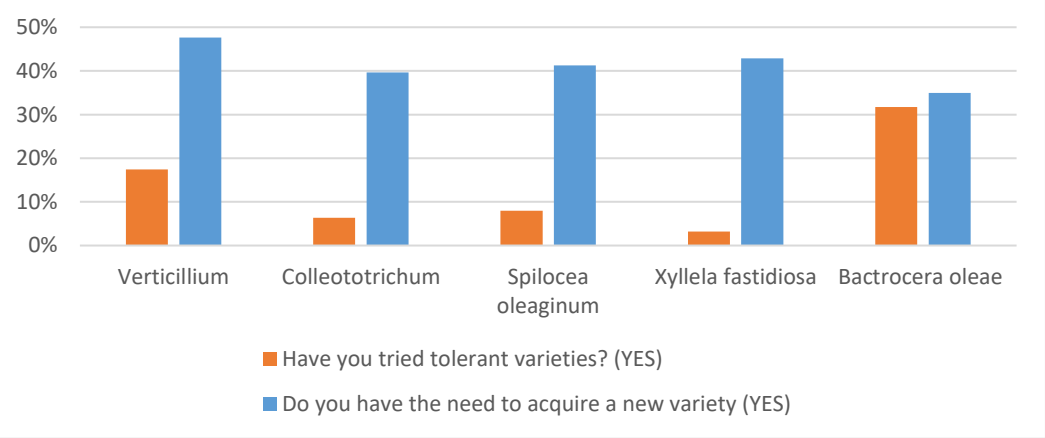
D. Which level of importance would you give to plant improvement activities focused on obtaining varieties resistant to Xyllela fastidiosa?

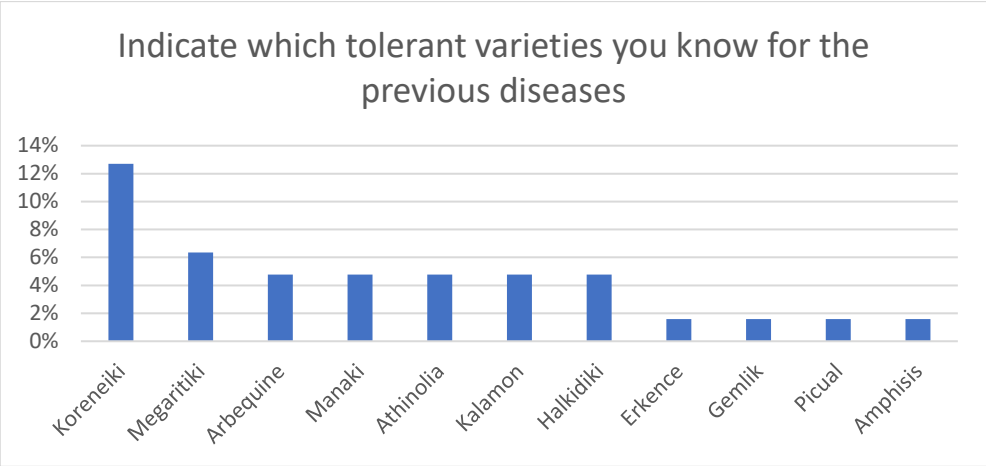


E. Do you consider that the future orientation of the olive grove will follow guidelines for varieties



F. For the following diseases:





G. What do you think of the future of the table olive? What activity would you consider essential to improve it?

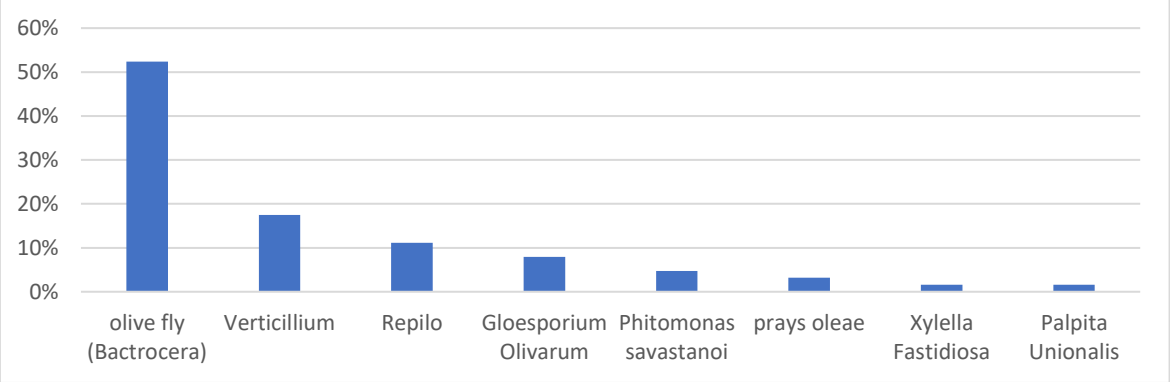
The answers provided by the respondents were:[3]

Increase its durability without the use of additives and preservatives.
More promotion should be done to promote the consumption of black olives in Europe.
Activities to reduce taste differences.
Collaborate with locals to improve the quality of production in rural areas.
An export-oriented study and a serious training study should be carried out on which markets demand what type of olive and how to produce a suitable product for these markets. First, the actors of the sector must be trained. Unfortunately, it is a fact that the production is carried out with false, incomplete, primitive information, far from food technology and with too many rumors in the sector at the moment of the commercialization of the product.
Natural fermented.
Local varieties should be grown where they belong.
Table olives cannot go one step further if there is no precocity. The early darkening characteristic should be developed.
Table olives love harsh weather, it is necessary to develop such regions.
When our olive oil production reaches the level it deserves, when our national sales and exports increase too much, I believe that marketing studies should be carried out abroad to develop the market for table olives.
It's better to decrease table olive production and increase olive oil instead. For health aspects.

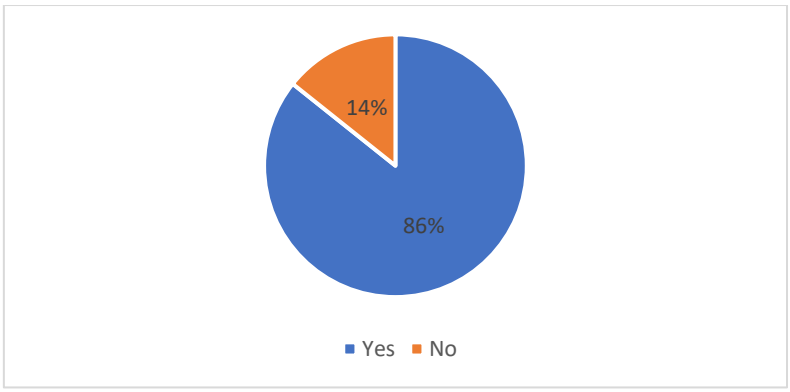
[3] Some answers were slightly modified for their understanding.

Promote the development of olive groves and their economic benefits.
To reduce the level of salt in its procedures and conservation.
Increase in amount of consumption.
I think table olive would be more vulnerable and less usage.
Pest and toxin control.
Developing high density plantations.
Improvement in production and consumption.
Mechanical harvest.
Fruit size.
Good enough. You need the right professionals.
High density plantations.
Table olives are priceless, especially in 2020, edible olives were turned into oil.
Improvement needed against harmful insects.
Treatment of diseases like dakos.
Appropriate cultivation area according to the variety.
It has a future. Harvest cost reduction.
Adaptation to mechanical harvest.
I think the demand won't increase much more than how it is now.
Standardization and marketing without intermediaries.
Improve harvest and processing.
Improve standardization and marketing.
Ease of harvesting an excellent product.

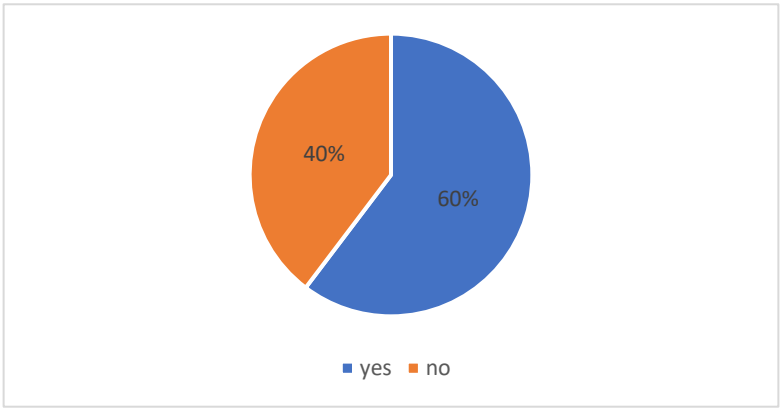
H. What are the pests and diseases that most concern you when planting or managing the olive?



I. Would you like to acquire a new resistant variety to face a specific problem?



J. Would you consider a high quality olive oil variety for your farm, even if they were less highly productive?



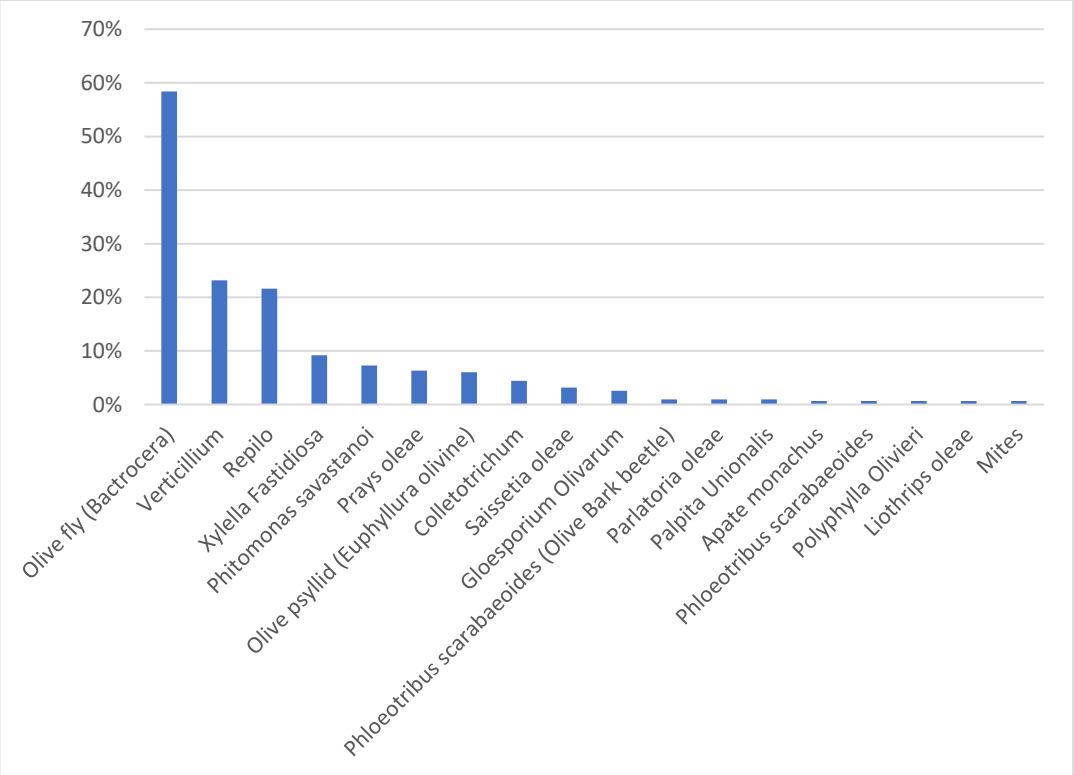
2.4.2. Global Results of survey

A. Please, rank the following criteria to focus plant improvement activities in order of importance from 1 to 4, where 1 is most important to you and 4 is least important to you.

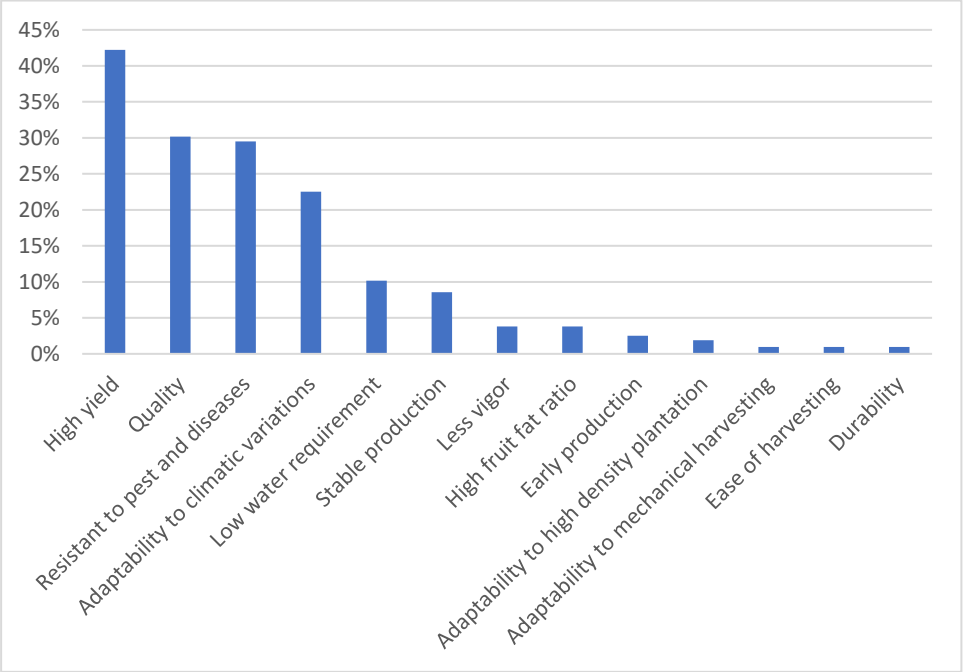
Below are the criteria ordered from highest to lowest importance, according to the respondents:

1. Climate change resistant varieties
2. Pest and disease resistant varieties
3. Highly productive and quality varieties
4. Varieties adapted to high density plantations

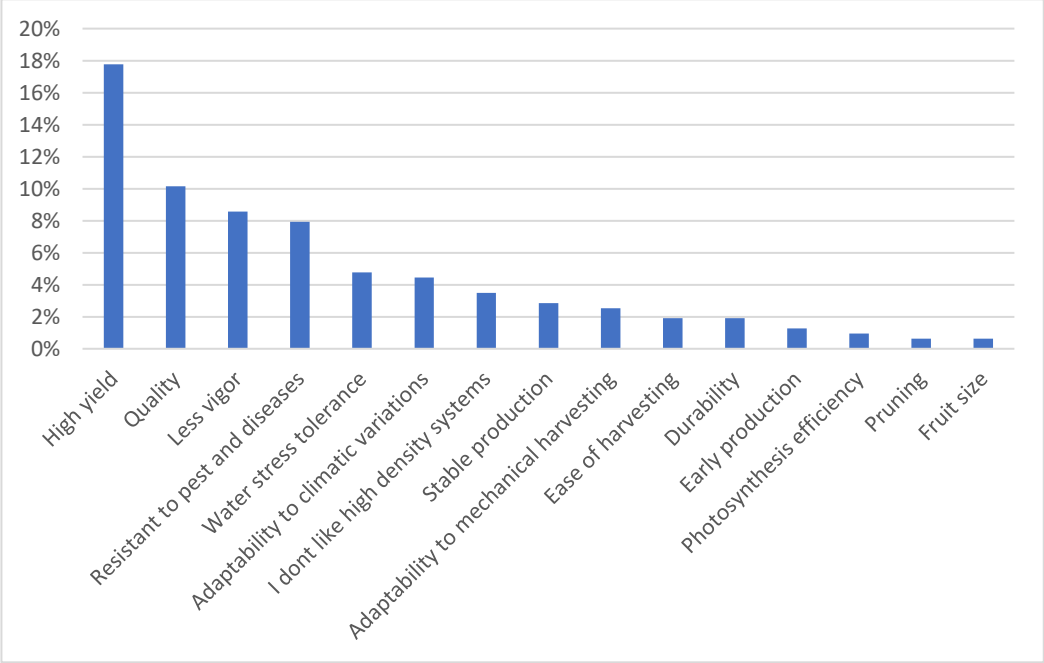
B. What are the pests and diseases that most concern you when planting or managing the olive?



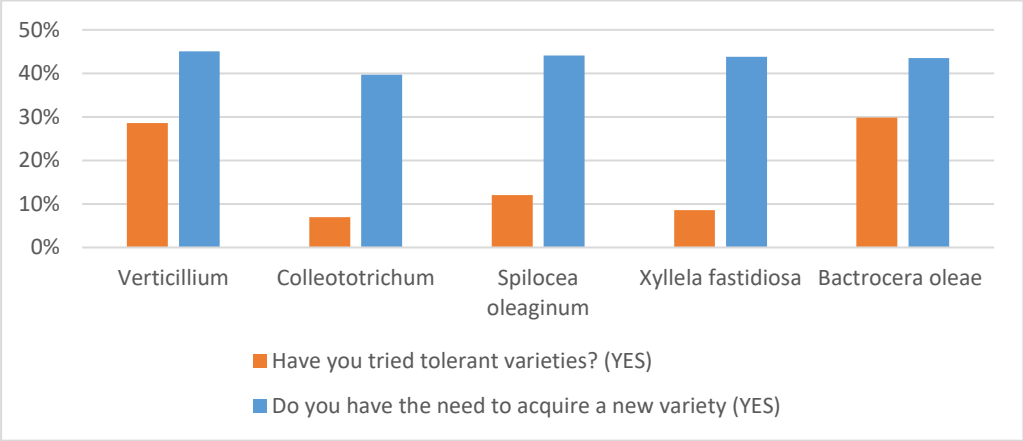
C. What would you value the most in a new olive variety obtained by a breeding program to obtain the "ideal variety"? (of most important to least important)

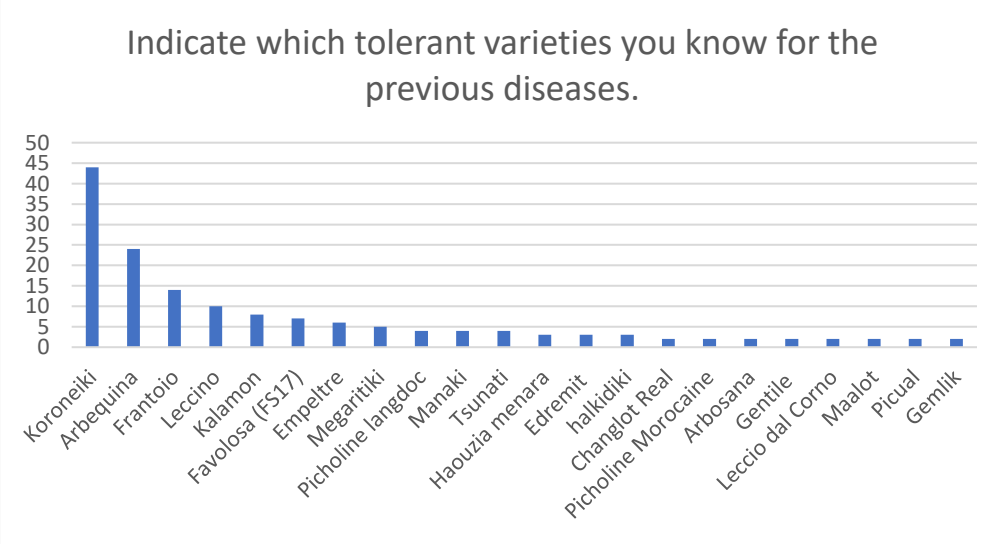


D. What would you improve on the current olive oil varieties for their implementation in a high-density system?

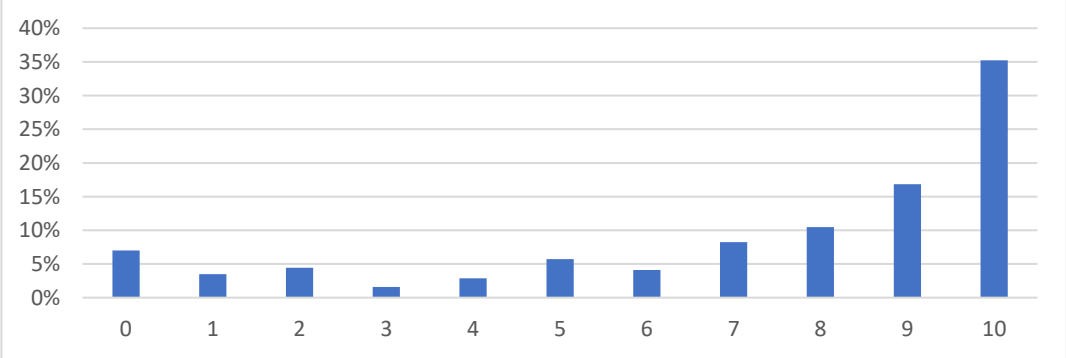


E. For the following diseases:





F. Which level of importance would you give to plant improvement activities focused on obtaining varieties resistant to Xyllela fastidiosa?



G. Which quality would you appreciate most in a variety to suit your geographic area? (from 1 to 4, of most important to least important)

Spain (19 votes)

1. Chilling hour reduction
2. Cold resistance
3. High temperature resistance
4. Drought tolerance

Morocco (22 votes)

1. Drought tolerance
2. High temperature resistance
3. Cold resistance
4. Chilling hour reduction

Greece (61 votes)

1. Drought tolerance
2. High temperature resistance
3. Chilling hour reduction
4. Cold resistance

Italy (17 votes)

1. Drought resistance
2. Cold resistance
3. High temperature resistance
4. Chilling hour reduction

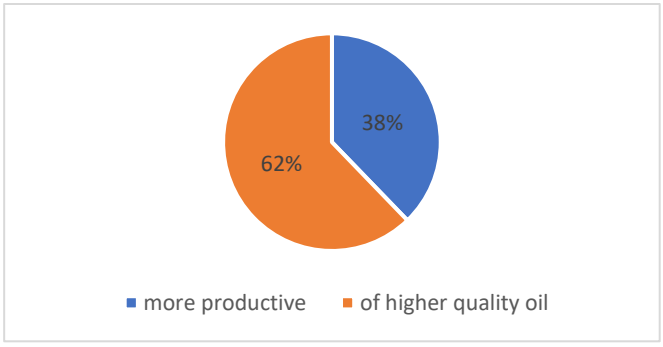
Turkey (44 votes)

1. Drought resistance
2. High temperature resistance
3. Chilling hour reduction
4. Cold resistance

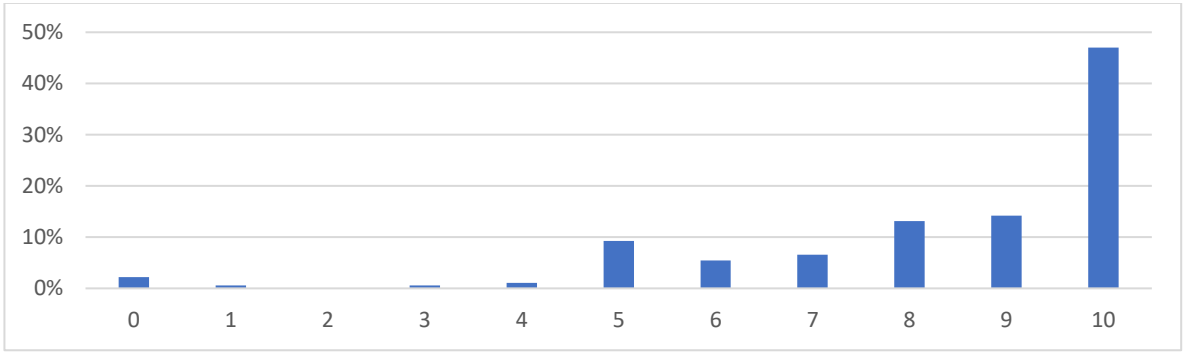
Iran (54 votes)

1. High temperature resistance
2. Chilling hour reduction
3. Drought tolerance
4. Cold resistance

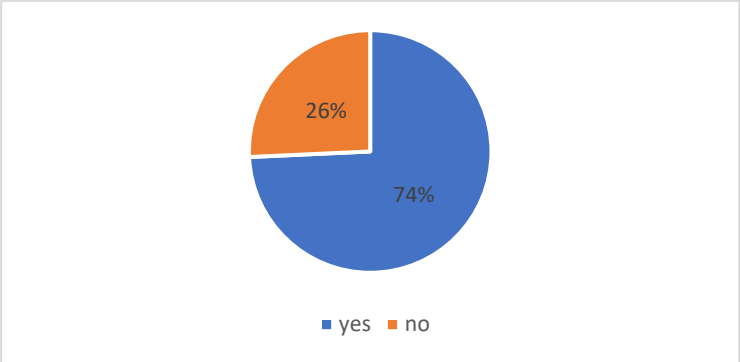
H. Do you consider that the future orientation of the olive grove will follow guidelines for varieties



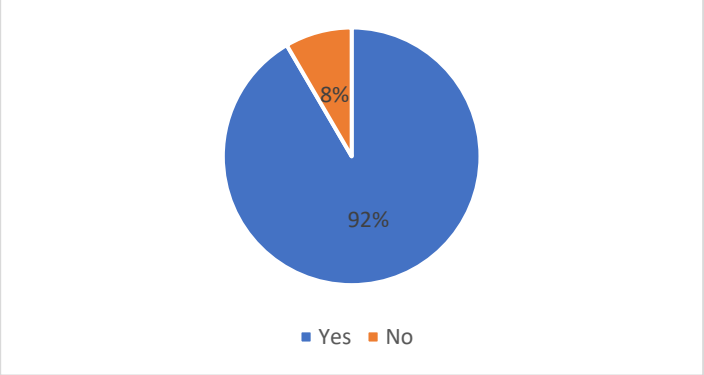
I. Do you value a breeding program for the improvement of the polyphenol content of an oil as important?



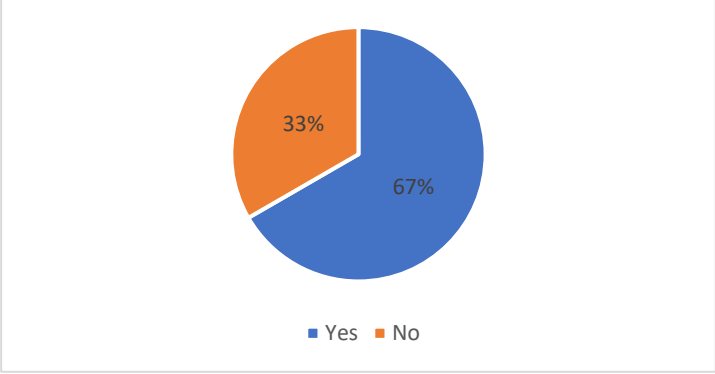
J. **Would you consider a high quality olive oil variety for your farm, even if they were less highly productive?**



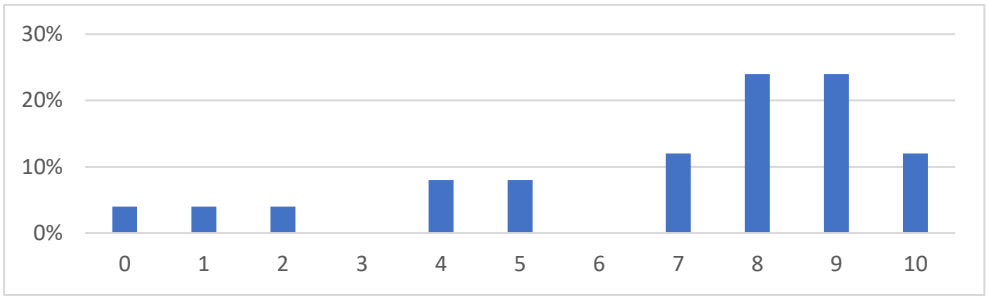
K. **Would you like to acquire a new resistant variety to face a specific problem?**



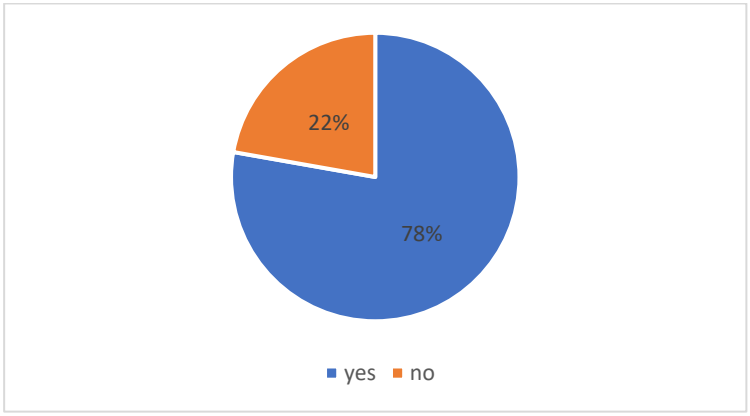
L. **Do you consider that table olive breeding activities should focus on varieties that are adapted to high-density systems?**



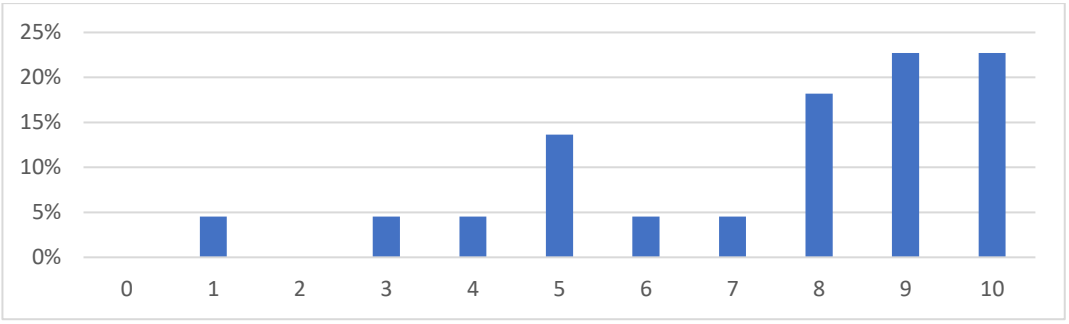
How important do you think an improvement breeding program of table olives adapted to high-density systems is?



M. Do you think that juvenile phase, from the time of propagation to the time of production, should be reduced?



If your answer to the above question is YES, how important do you think an improvement breeding program of the juvenile phase is?



3. CONCLUSIONS

- In general, based on the end-user needs, the plant improvement activities should focus on the following aspects, in that order:
    - Resistance to climate change
    - Resistance to pest and diseases
    - Production and quality
    - Adaptability to high density plantations

- In addition, when asked about what they would value the most in an olive variety in order to consider it the ideal variety, more than 42% agreed on obtaining high yield varieties, more than 30% quality and the resistance to pest and diseases important. And more than 23% valued the adaptability to climatic variations. At last, only 2% proposed varieties adapted to high density plantations.

- More than 50% of the surveyed end users are concerned about the Olive Fly as an olive tree pest. Likewise, approximately 22% are concerned about *Verticilium* and *Repilo* diseases. Only 9% have concerns about *Xyllela fastidiosa*. Regarding this last one, when asked about the level of importance that they give to plant breeding activities focused on obtaining a variety resistant to this disease, 75% of the end users gave a punctuation more than 5 to that level of importance, being 10 the highest value of importance.

- In order to implement a high-density system, end users considered that the existing varieties should be improved in terms of the olive oil yield, quality and that the trees should have less vigor and be more resistant to pest and diseases.

- In general, end users have tried more tolerant varieties for the *Bactrocera oleae* pest and *Verticillium* disease, rather than for *Colletotrichum, Spilocea oleaginum* and *Xyllela Fastidiosa*. More than 40% of the surveyed present the need to acquire varieties that are tolerant to those pests and diseases. In addition, the most known tolerant varieties are *Koroneiki, Arbequina, Frantoio* and *Leccino*.

- In Spain, the aspect that was considered most important for a new variety, regarding the geographic location, was the chilling hour reduction. In Morocco, Greece, Italy and Turkey it was the drought tolerance, and in Iran the high temperature resistance.

- All end users agreed that the future orientation of olive oil will follow guidelines for varieties of higher quality oil, rather than more productive varieties. In addition to this, when asked to farmers, more than 85% valued a breeding program for the improvement of the polyphenol content of the oil as important (i.e., punctuation more than 5). Also, when asked to farmers and people related to the industry, 74% of them would consider having a high-quality olive oil for their farm, even if that meant less production.

- Regarding the table olives, most of the end user agreed that there will be an increase in the consumption of this product, consequently the production will escalate. They also agreed that improvement activities should focus on increasing the fruit size, making it easier to detach the seed from the fruit, improve the adaption to mechanized harvesting and the resilience to pest and diseases.

- Finally, more than 90% of the surveyed are interested in acquiring a new olive variety to face a specific problem.

GEN4OLIVE

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