D3.1: summarized outcome of interviews and questionnaires

WP3 – Benchmarking methodologies and technologies

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Executive summary

The SmartProtect Project focus on the benchmark of innovative, smart technologies and techniques in the IPM-topics in the frame of their technical, socio-economic, and regulatory context based on the data collected by the project partners as well as on the data from the stakeholder and experts' surveys, to identify bottlenecks hindering widespread use of the best technologies. The stakeholders and experts surveys were designed by the SmartProtect members as online surveys via the easyfeedback survey tool. Multiple choice questions (Closed Format Questions), where respondents are restricted to choose among any of the given multiple choice answers were used, offered in 12 different languages, and comprised of four main questions: professional, knowledge, behavioural, and technical questions. These surveys, which ran from 4 March – 14 June 2021, were extensively promoted by SmartProtect members, their partners, and a variety of European development networks. All the data we collect is managed under the requirements of the General Data Protection Regulations (GDPR).

1,028 participants from 17 countries visited the surveys website, of which 438 responded to the surveys although some of those did not complete all of the questions to the end. From the responders, 322 participants completed the surveys until the end, while 116 participants cancelled the surveys at different stages. The highest participation in the SmartProtection surveys was recorded in Spain with 28.3% followed by participation in the United Kingdom with 23.2% and Slovenia with 21.7%.

The categories of the respondents' jobs, age group, as well as their experience in the agriculture sector, their vegetable production systems, crops which they grow most, and how they manage pests and diseases were identified. Interestingly, 75% of the survey's respondents did not use any of the surveyed smart IPM techniques. However, of the survey's respondents, who used the surveyed smart IPM techniques in plant protection, 59.5% did not face any problems.

Barriers hindering the spread use of the smart IPM techniques were also identified. It is interesting to know that 68% and 62% of the survey's respondents feel not or only little informed about using smart IPM technologies and methodologies in plant protection. There is furthermore a gap between experts and stakeholders with regard to the time they discuss smart IPM-techniques. Whilst 50% of experts stated to discuss the topic often or very often, 80% of the stakeholders discuss about smart-IPM never or only sometimes. Nevertheless, both groups find the use of smart-IPM techniques important or very important in plant protection (stakeholders: 84%, experts: 94%). Furthermore, 53% and 56%, respectively, of the stakeholder- and experts survey's respondents found that the local markets for smart technologies in plant protection are not available or not easily accessible, and almost 60% of both survey's respondents agreed that obtaining information or technical support regarding the use of smart technologies in plant protection is difficult. Moreover, 56% of both survey's respondents seeing that using smart technologies in plant protection is expensive. On the other hand, 95% of the respondents in the expert survey agreed/strongly agreed that the farmer needs training before applying the smart technologies and methodologies in plant protection.

More barriers were also identified by the survey's respondents as 48% of the respondents in the experts' survey found that the governmental support to the farmer to use the smart technologies and methodologies in plant protection is low, as well as, 35% of the respondents in the experts' survey saw that the willingness of the farmer to use the smart technologies in plant protection is low. More factors hindering the use of smart IPM technologies and methodologies in plant protection were also identified by the survey's respondents such as low efficacy, low profitability, and low availability with 70%, 55%, and 42%, respectively.

1 Introduction

1.1 Background

Integrated Pest Management (IPM) is a strategy that encourages the reduction of pesticide use by employing a variety of nonchemical pest control methods to contain or manage pests below their economic injury levels. The EU-wide concern for environmental sustainability and economic competitiveness for agriculture requires the entire agriculture sector to grow under IPM conditions. In national and European research over recent years, much effort has been invested to generate new knowledge and to develop innovative approaches and tools for IPM. Nevertheless, this kind of research has been fragmented and addressed via specialized research disciplines.

The integration and adaptation of available knowledge into the holistic approach of IPM are still insufficient or lacking. To fill this innovation gap, the role of extension and demonstration farms is of paramount importance as an “interface”. Filling this knowledge gap concerning innovation in IPM-methodology in different crops in open fields and greenhouses is the objective of the EU-project SmartProtect, which is a thematic network focusing on cross-regional knowledge sharing of SMART IPM solutions for farmers and advisors.

The SmartProtect project stimulates knowledge flow in the regional Agricultural Knowledge and Innovation Systems (AKISs) across the EU, focusing on the innovative potential of advanced methodologies for IPM, integrating precision farming technologies and data analytics in vegetable production.

SmartProtect focuses on the introduction of innovative, smart technologies and techniques in the IPM-topics of monitoring and detection of beneficial, pests and pathogens; application techniques of beneficial and pesticides; decision Support Systems. We benchmark these smart IPM methodologies and technologies in the frame of their technical, socio-economic, and regulatory context based on the data collected by the project partners (SmartProtect WP2 Database) as well as on the stakeholder and experts’ surveys to identify bottlenecks hindering widespread use of the best technologies.

The summarised outcome from the surveys and benchmarking is discussed within a Strategic Innovation Board (regional and local authorities, advisors, universities and growers’ organizations) to identify the most promising technologies and map their applicability in various farming systems. We identify gaps where education, information flow, and training are needed. Solutions such as making techniques more efficient by using Decision Support Systems, adapting computer models so they are comprehensible for farmers, amendment of national legislation, or adapting spraying technology will be proposed.

1.2 Objectives

The objective of the SmartProtect stakeholder and expert interviews and questionnaires is to identify the current European socio-economic, regulatory, and technical bottlenecks hindering the widespread use of smart IPM methodologies and technologies. SmartProtect surveys create multi-stakeholder, expert-centred, cross-sectoral platforms that will bring together stakeholders and experts representing relevant constituencies of smart IPM.

1.3 Goals

The goals of the surveys are:

1- To analyse stakeholders' and experts' familiarity with the smart IPM methodologies and technologies.
2- To assess the stakeholders' and experts' knowledge and needs in agriculture regarding using smart technology in plant protection in Europe.
3- To identify in which area of plant protection, in which crops and production systems are the smart IPM methodologies and technologies highly needed.
4- To identify examples of potential smart IPM methodologies and technologies already taking place.
5- To identify potential benefits of using the smart IPM methodologies and technologies as perceived by stakeholders/experts, and to identify the barriers which prevent them from receiving these benefits.
6- To determine where we might be able to support or improve the currently used plant protection approaches as well as the currently used smart technologies and technologies.

******Revision Nov 2021**: It is furthermore planned to exploite the survey results for writing a publication and / or use them for practical abstracts. As we think it is very important to explore the results of the survey more intensively, as it shows exactly what the baseline regarding the knowledge on those IPM smart solutions is, we prefer to publish about it. To that extent we have exported the data so we are able to analyze them further. Currently we prepare an extendet abstract for the special issue "Responsible Innovation in Smart Farming: Novel approaches and empirical experiences" in the journal "Agricultural Systems". If the abstract will be accepted, results of the survey will be further processed for publication within this special issue.*

2 Methods

2.1 Approach

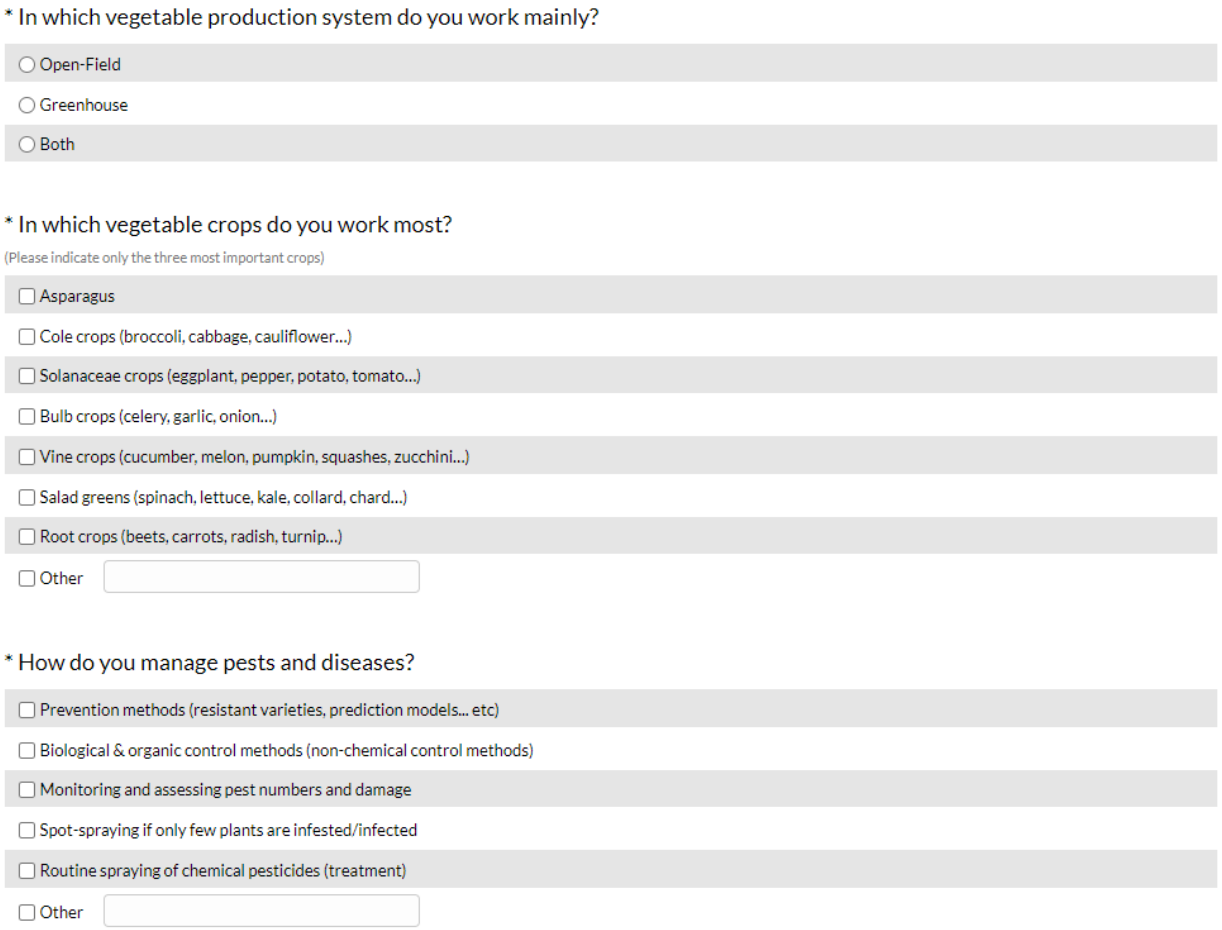
The stakeholders and experts surveys were designed by the SmartProtect members as online surveys via the easyfeedback survey tool (https://easy-feedback.com/). The easyfeedback servers are located in Germany in the Strato AG data centre (ISO27001 certified).

Multiple choice questions (Closed Format Questions), where respondents are restricted to choose among any of the given multiple choice answers were used and offered in 12 different languages (English, Dutch, German, French, Portuguese, Spanish, Latvian, Greek, Czech, Hungarian, Estonian and Slovenian).

The surveys were comprised of four main questions:

1- Professional Questions

Professional questions were asked to help paint the picture of the respondent allows us to check and see if our survey respondents are similar to, and therefore representative of, the wider population. These questions such:


* In which vegetable production system do you work mainly?

- ○ Open-Field
- ○ Greenhouse
- ○ Both

* In which vegetable crops do you work most?

(Please indicate only the three most important crops)

- ☐ Asparagus
- ☐ Cole crops (broccoli, cabbage, cauliflower...)
- ☐ Solanaceae crops (eggplant, pepper, potato, tomato...)
- ☐ Bulb crops (celery, garlic, onion...)
- ☐ Vine crops (cucumber, melon, pumpkin, squashes, zucchini...)
- ☐ Salad greens (spinach, lettuce, kale, collard, chard...)
- ☐ Root crops (beets, carrots, radish, turnip...)
- ☐ Other

* How do you manage pests and diseases?

- ☐ Prevention methods (resistant varieties, prediction models... etc)
- ☐ Biological & organic control methods (non-chemical control methods)
- ☐ Monitoring and assessing pest numbers and damage
- ☐ Spot-spraying if only few plants are infested/infected
- ☐ Routine spraying of chemical pesticides (treatment)
- ☐ Other

Figure 1: Examples of the professional questions in the SmartProtect surveys

2- Knowledge Questions

This section consists of a series of questions like:

* How often do you discuss using smart technology in plant protection in your business?

- ○ Never
- ○ Sometimes
- ○ Often
- ○ Very often

* According to your opinion: how important is using smart technology in plant protection?

- ○ Very unimportant
- ○ Unimportant
- ○ Important
- ○ Very important

* Do you agree that, ...

	Strongly disagree	Disagree	Agree	Strongly agree
Local markets for smart technology in plant protection are available/easily accessible	○	○	○	○
Obtaining information/technical support regarding the use of smart technology in plant protection is difficult	○	○	○	○
Using smart technology in plant protection reduces chemical pesticide inputs to the crop/environment	○	○	○	○
Using smart technology in plant protection is expensive	○	○	○	○
The farmer needs a training before applying the smart technology in plant protection	○	○	○	○

Figure 2: Examples of the knowledge questions in the SmartProtect surveys

These questions provided a more robust and reliable measure to assess the stakeholders' and experts' knowledge and needs in agriculture regarding using smart technology in plant protection in Europe.

3- Behavioural Questions

These behavioural questions provided us with information that is crucial to the success of the initiative. Without knowing exactly what the extent of the problem is in the stakeholders' and experts' communities, improving it would be quite a challenge!

Therefore, these questions were designed to ask about respondents' factual circumstances such as:

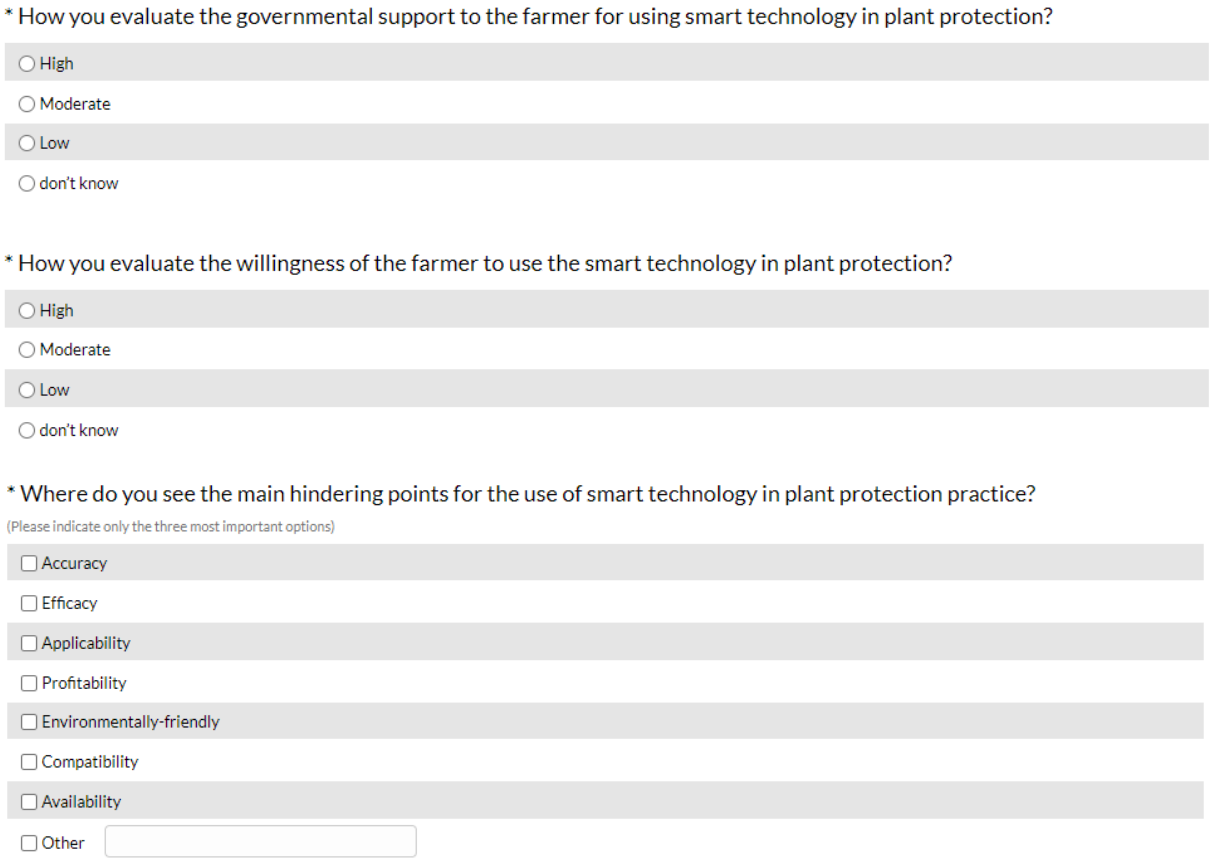


Figure 3: Examples of the behavioural questions in the SmartProtect surveys

4- Technical Questions

The technical questions were designed to gauge the level of the stakeholders and the experts of the use of smart IPM technologies and their perceived benefit with regard to the use or non-use of technology.

These questions had also identified the barriers which prevent the stakeholders and the experts from receiving these benefits. Furthermore, the results from the technical questions will play an important role in the benchmarking of the smart IPM methodologies and technologies which will be conducted in the next step to identify the socio-economic, regulatory, and technical bottlenecks hindering widespread use of these smart practices.

These questions such:

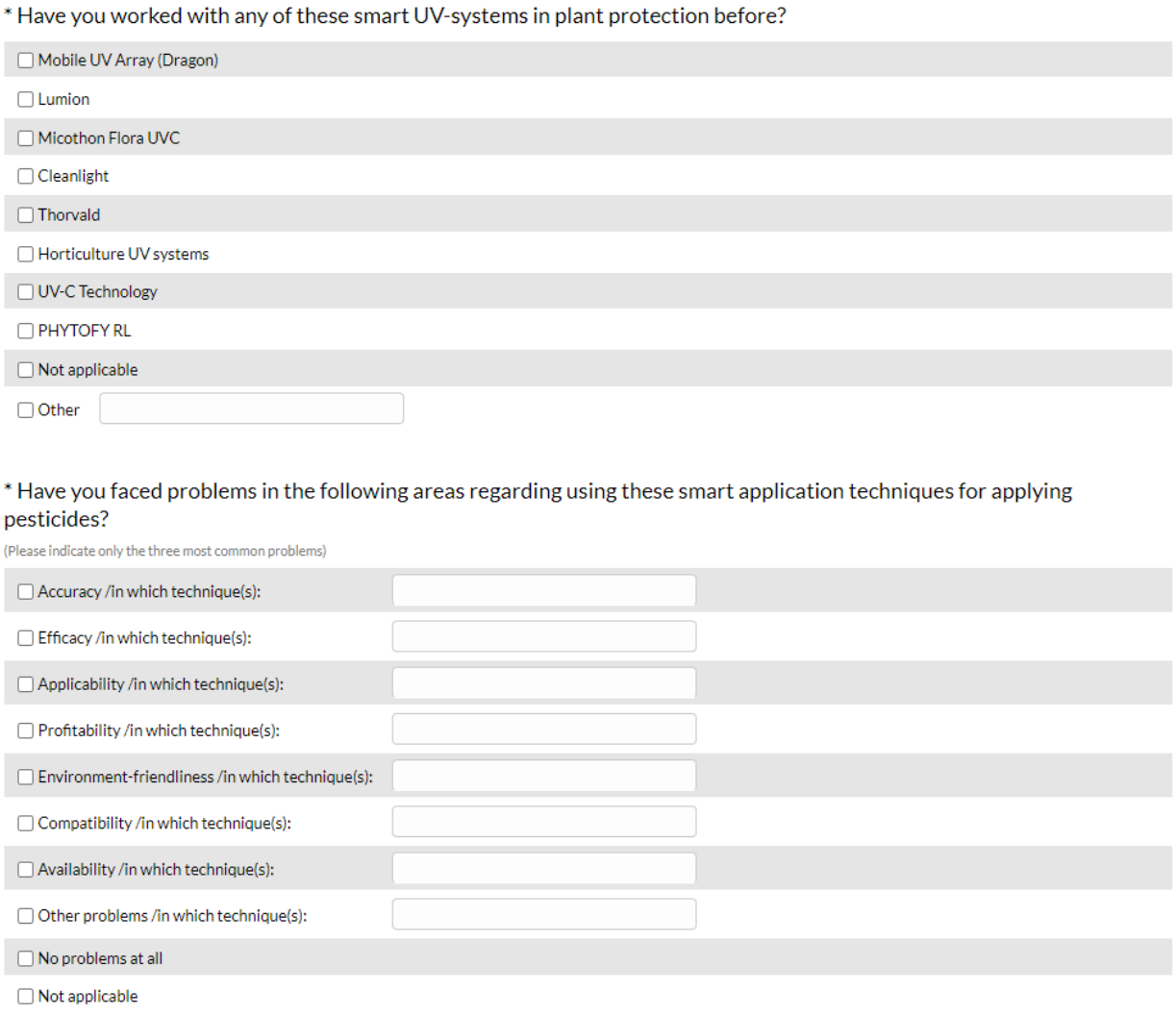


Figure 4: Examples of the technical questions in the SmartProtect surveys

A draft of the Stakeholders' and experts' surveys was subjected to a pretest, resulting in modifications to the questionnaire both in terms of question wording and length. These surveys, which ran from 4 March – 14 June 2021, were extensively promoted by SmartProtect members, their partners, and a variety of European development networks.

The minimum number of in-person survey interviews which supposed to be achieved per partner were 20 interviews (10 virtual interviews for stakeholder survey and 10 virtual interviews for expert survey). These in-person virtual interviews were filled out by the partners online directly on the survey webpage. A table of the achieved in-person virtual interviews was provided by each partner after filling them out online.

2.2 Promotion within and by the Consortium

******Revision Nov 2021*** *It was very challenging to get sufficient numbers of interviews due to the limited direct contact to stakeholders and experts because of Covid. Therefore, besides the promotion of the interview via social media like LinkedIn, Facebook, Twitter, the project platform and within the personal network of the partners, other approaches where regularly discussed in the Executive Board Meetings and shared with the entire consortium. First measure was to define a minimum number of interviews that partners should do directly with experts and stakeholders. Depending on the pandemic regulations in each country, these interviews could be done in person or by phone call. After discussing the experiences with these approaches, a best case example was given by the Belgian partners, stating that they got most response if the interviewee was provided with the printed survey, but interview was carried out by phone. That way, interviewees had all techniques visible on first sight, and if no technique was used by the interviewee, following questions could be skipped fast in order to limit the interview time. This approach was adopted by several partners and proved successful.*

2.3 Data management

Statistics and charts were provided from the easyfeedback survey tool. All the data we collect is managed under the requirements of the General Data Protection Regulations (GDPR). The data were kept secure, not given to another organization, used only for the purposes that were created for. All answers were pseudonymized. The participant had the opportunity, at any time, to withdraw the participation, including the withdrawal of any information they have provided. To start the survey, the participant had to open the link to the GDPR, agreed to participate in this research, and agreed to the publication of the overall results of this research with the understanding that pseudonymity will be taken into account.

3 Results

3.1 Survey's participants

1,028 participants (Figure 5) from 17 countries (Figure 6) visited the surveys website, of which 438 responded to the surveys although some of those did not complete all of the questions to the end.

From the respondents, 322 participants completed the surveys until the end, while 116 participants cancelled the surveys at different stages and could not complete them until the end (Figure 5).

A

Visitors	Responses	Completed	Canceled
557	183 32.85%	139 75.96%	44 24.04%
557	**183** 32.85%	**139** 75.96%	**44** 24.04%

B

Visitors	Responses	Completed	Canceled
471	255 54.14%	183 71.76%	72 28.24%
471	**255** 54.14%	**183** 71.76%	**72** 28.24%

B

Figure 5: Number of participants to the SmartProtect surveys (A: stakeholder survey; B: expert survey)

The highest participation in the SmartProtection surveys, summarizing percentages from stakeholder- and expert survey, was recorded in Spain with 28.3% followed by participation in the United Kingdom with 23.2% and Slovenia with 21.7% (Figure 6).

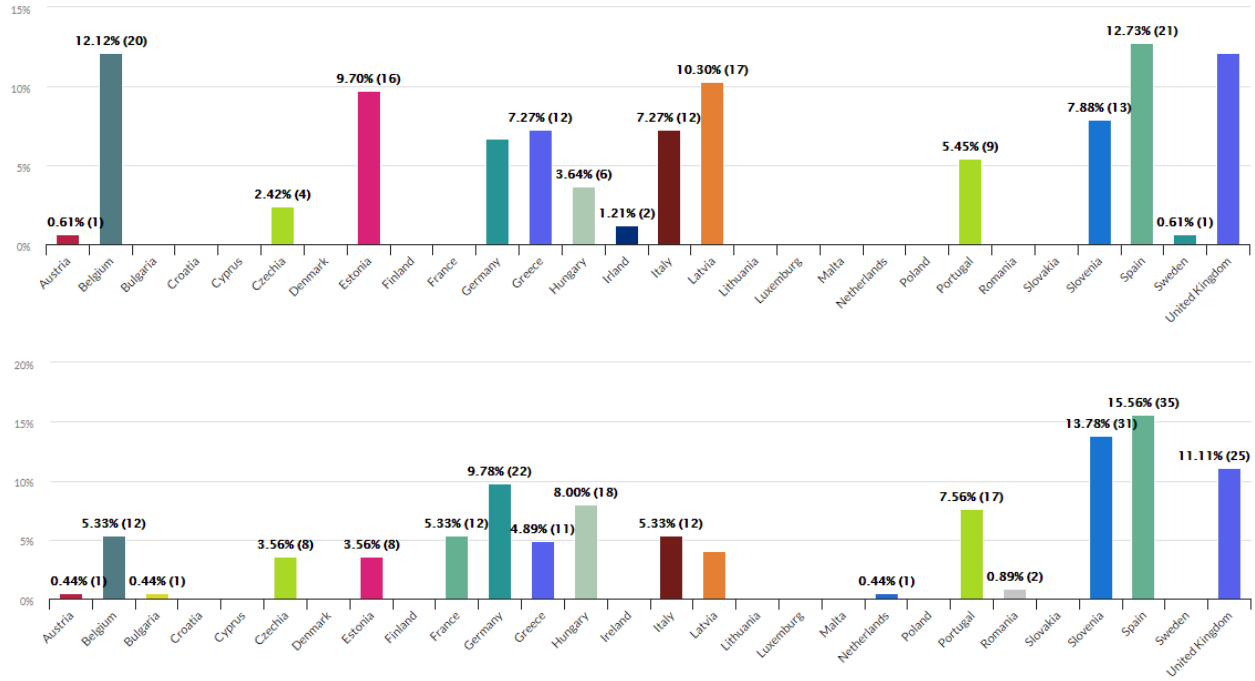


Figure 6: Number of participants from different countries to the SmartProtect surveys (A: stakeholder survey; B: expert survey)

3.2 Profile of Respondents

Respondents to the survey were asked to identify the categories of their job, age-group, as well as their experience in the agriculture sector, their vegetable production systems, crops which they grow most, and how they manage pests and diseases (Figures 7, 8, 9, 10, 11, and 12 respectively).

In the stakeholder survey, 31.5% of the respondents were growers following by 20 % Agronomist as well as 16% other jobs, and 15% landowners, respectively. The Respondents which are from other jobs were handlers, investigators, and students (Figure 7A).

In the expert survey, were the most respondents farm advisors with 36.4 % followed by other jobs with 25% and the researchers from research stations with 24%. The other jobs were represented by consultors, technicians, and managers (Figure 7B).

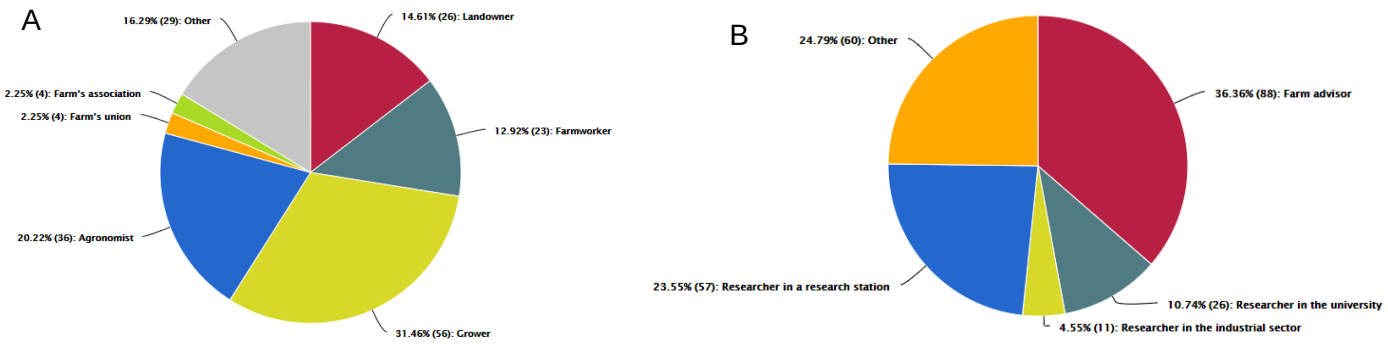


Figure 7: The job profile of the respondents in the SmartProtect surveys (A: stakeholder survey; B: expert survey)

Interestingly, the age-group profiles of the respondents in stakeholder and expert surveys are almost similar (Figure 8). 31% of the respondents in both surveys belong to the age group 41-50 years old followed by the age group of 51-60 years with 25-29% and the age group of 31-40 years with 18-25%, respectively.

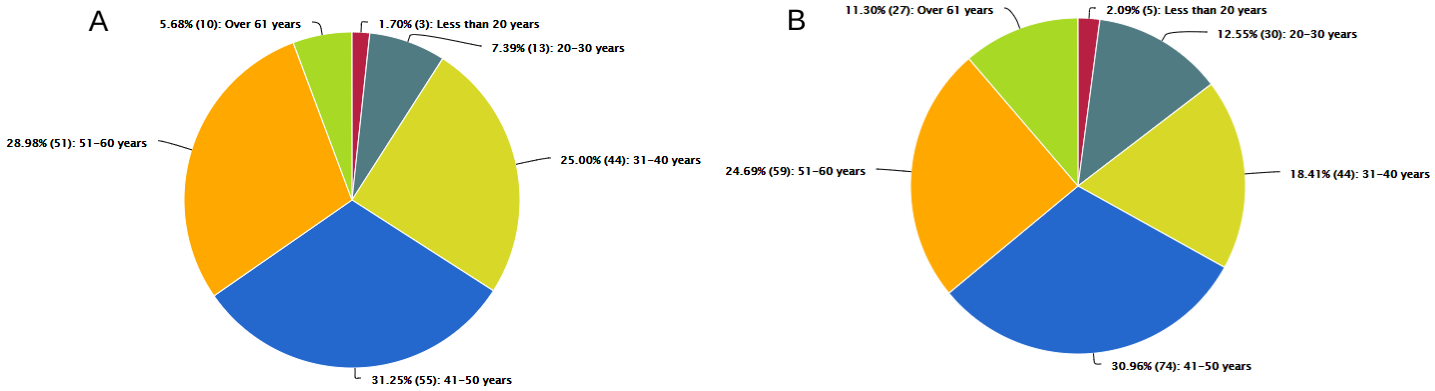


Figure 8: The age-group profile of the respondents in the SmartProtect surveys (A: stakeholder survey; B: expert survey).

The experience profile of the respondents in the agriculture sector in both surveys was also interestingly almost similar (Figure 9). 27-30% of the respondents have 21-30 years of experience working in the agriculture sector followed by 24% of the respondents who have 11-20 years of experience working in the agriculture sector and 16-18% of the respondents who have 5-10 years of experience working in the agriculture sector, respectively.

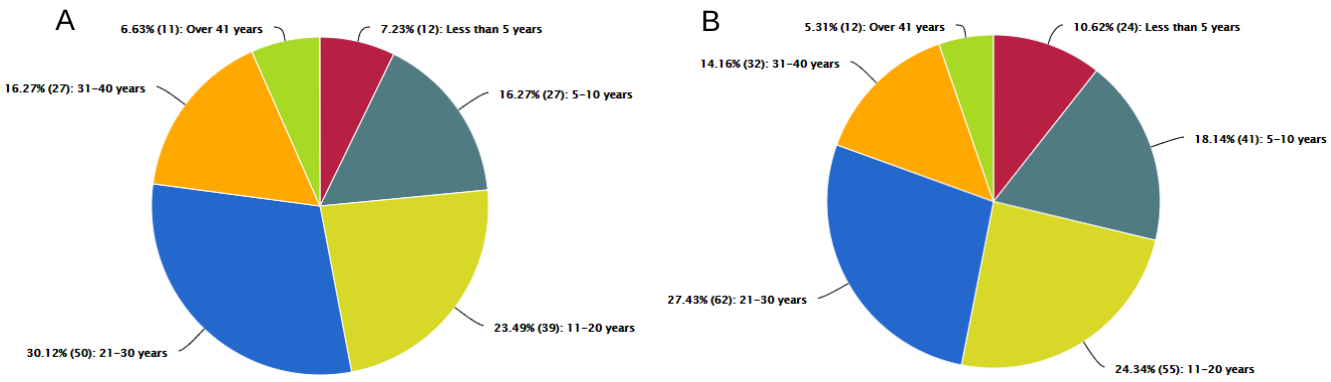


Figure 9: The experience profile of the SmartProtect survey's respondents in the agriculture sector (A: stakeholder survey; B: expert survey)

Almost half of the stakeholder and expert survey's respondents are mainly working in open-field vegetables production systems followed by respondents who are working on both open-field and greenhouse production systems with 30-36% (Figure 10). The SmartProtect survey's respondents who are working only in greenhouse production systems are 15%.

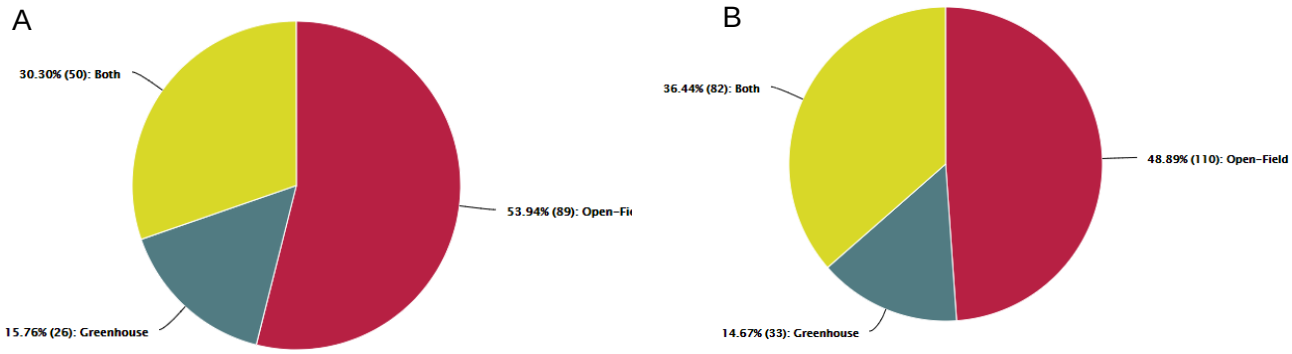


Figure 10: The Production systems of the SmartProtect survey's respondents (A: stakeholder survey; B: expert survey)

In the stakeholder and expert surveys, 41-48% of the respondents are mostly working in Solanaceae crops such as eggplant, pepper, potato, and tomato followed by Cole crops such as broccoli, cabbage, and cauliflower with 35-38%. 30% of the responders in the stakeholder survey work in Cucurbit crops such as cucumber, melon, pumpkin, squashes, and zucchini in the third place, while the responders in the expert survey work in the salad greens such as spinach, lettuce, kale, collard, and chard in the third place with 29%.

A

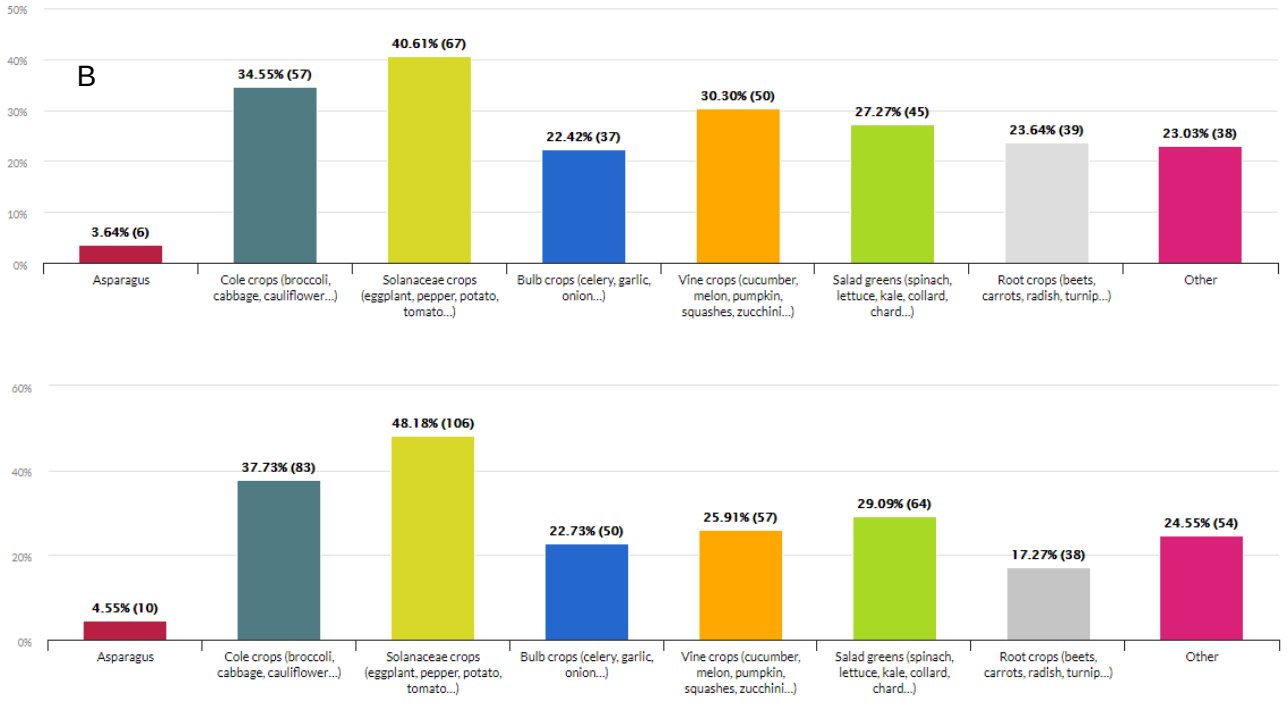


Figure 11: The crops that the SmartProtect survey's respondents are mostly working in (A: stakeholder survey; B: expert survey)

Prevention methods such as resistant varieties and prediction models came in the first place when asked for the preferable pest and pathogen management methods in the stakeholder survey's with 60%, while the monitoring and assessing pest numbers and damage methods were prefered from the experts and came in the first place in the expert survey with 73% of the respondents (Figure 12). After the prevention methods and the monitoring methods, the biological and organic control methods came in third place with 50-59%.

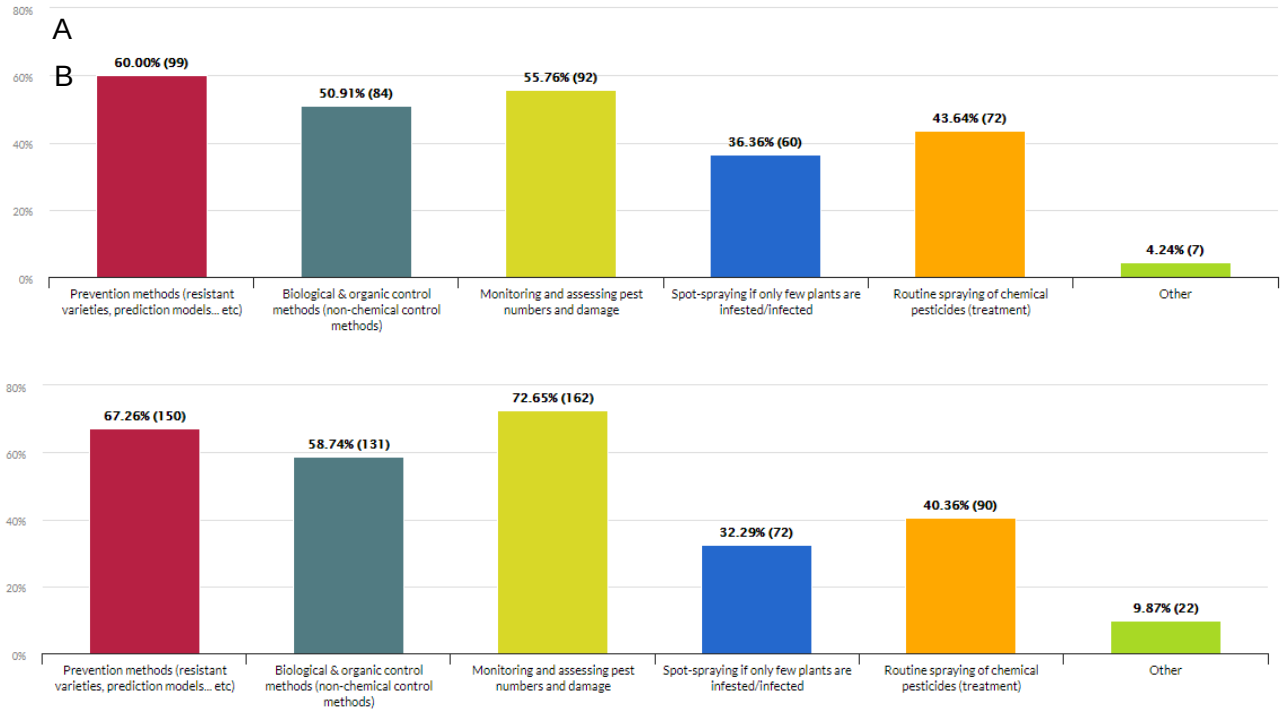


Figure 12: Pest and pathogen management profile of the SmartProtect survey's respondents (A: stakeholder survey; B: expert survey)

3.3 Familiarity with the smart IPM methodologies and technologies

Of the survey's respondents, 44-55% considered themselves only little informed about using smart IPM technologies and methodologies in plant protection followed by 26% of the survey's respondents who considered themselves as well- or deeply informed about using the smart IPM technologies and methodologies in plant protection (Figure 13). Interestingly, about 13-18% of the survey's respondents are not at all informed about using smart IPM technologies and methodologies in plant protection.

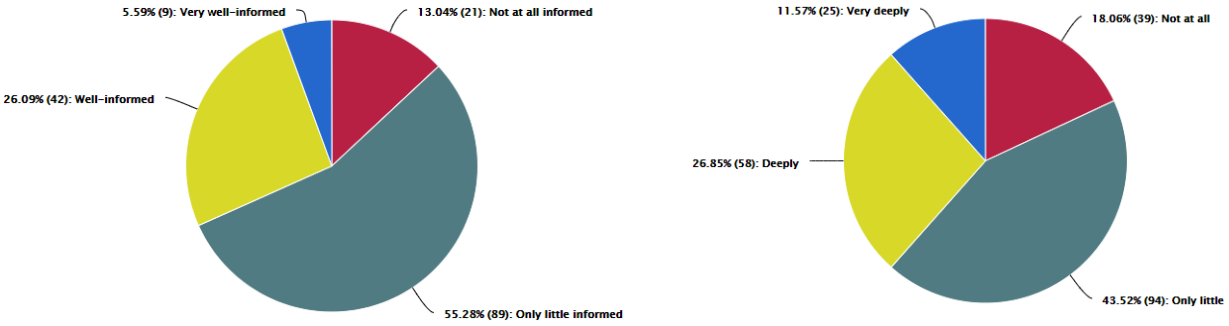


Figure 13: How informed the SmartProtect survey's respondents about using the smart IPM technologies and methodologies in plant protection (A: stakeholder survey; B: expert survey)

Of the survey's respondents, 43-55% are sometimes discussing using smart IPM technologies and methodologies in plant protection in their work (Figure 14). 37.5% of the respondents in the expert survey discussing very often the use of smart IPM technologies and methodologies in plant protection in their work, while 25.5% of the respondents in the stakeholders survey never discussed in their work the use of smart IPM technologies and methodologies in plant protection.

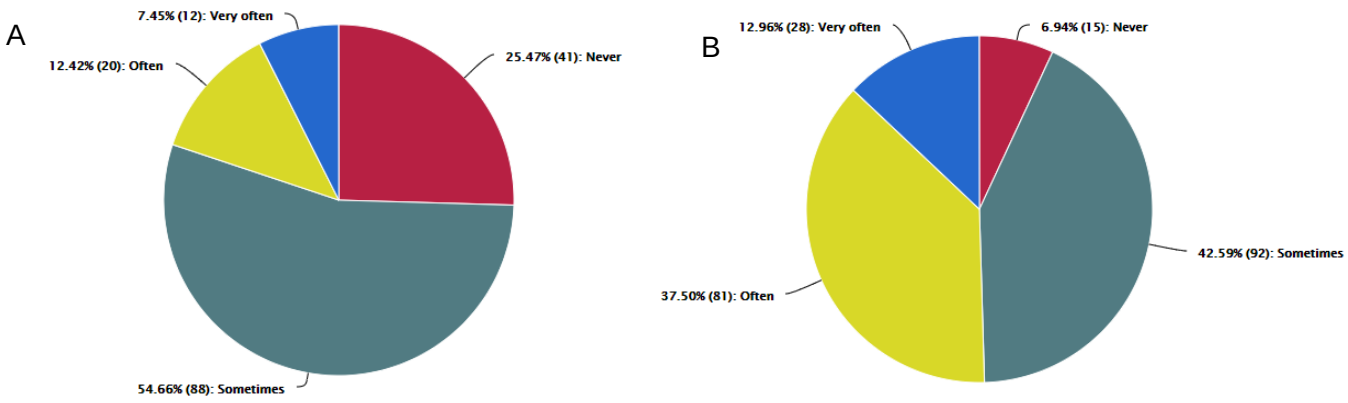


Figure 14: How oft discuss the SmartProtect survey's respondents about using the smart IPM technologies and methodologies in plant protection in their work (A: stakeholder survey; B: expert survey)

Of the survey's respondents, about 60% in both surveys considered that the use of smart IPM technologies and methodologies in plant protection is important, and 25-35% of the survey's respondents found the use of the smart IPM technologies and methodologies in plant protection is very important (Figure 15). Only 6-16% of the survey's respondents see the use of the smart IPM technologies and methodologies in plant protection as very unimportant or unimportant, respectively.

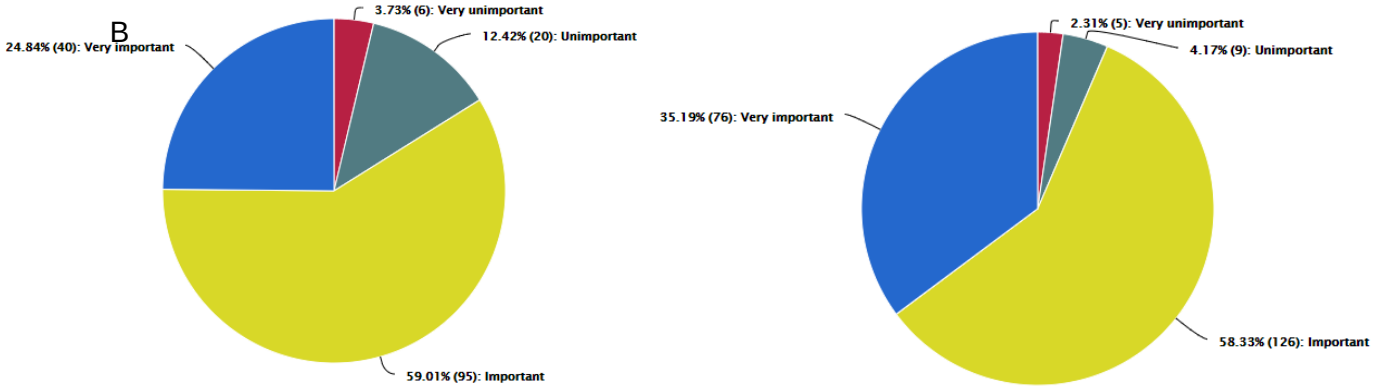


Figure 15: How important is using the smart IPM technologies and methodologies in plant protection for the SmartProtect survey's respondents (A: stakeholder survey; B: expert survey)

3.4 Barriers hindering the spread use of the smart IPM techniques

Of the survey's respondents, 53-56% found that the local markets for smart technologies in plant protection are not available or not easily accessible, and almost 60% of the survey's respondents agreed that obtaining information or technical support regarding the use of smart technologies in plant protection is difficult (Figure 16). Furthermore, 56% of the survey's respondents seeing that using smart technologies in plant protection is expensive.

On the other hand, 95% of the respondents in the expert survey agreed/strongly agreed that the farmer needs training before applying the smart technologies and methodologies in plant protection. Positively found, 92-98% of the respondents in both surveys agreed/strongly agreed that using smart technologies and methodologies in plant protection reduces chemical pesticides inputs to the crop and environment.

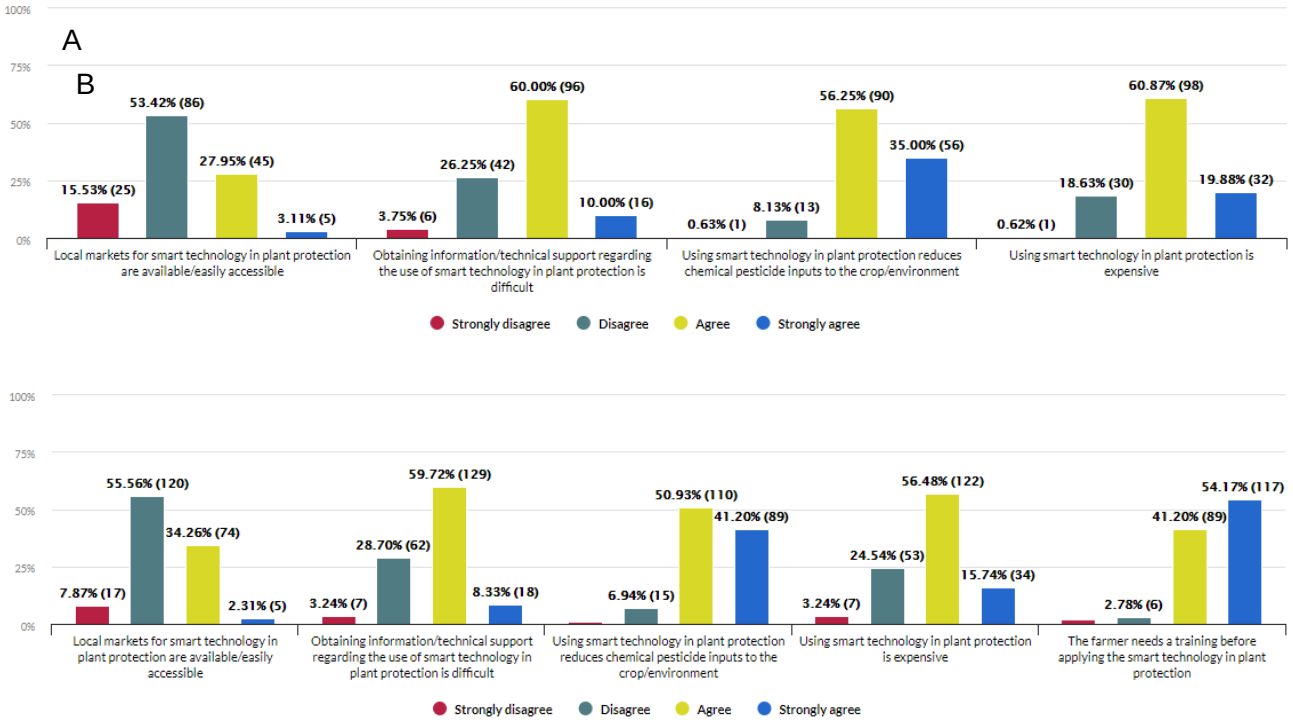


Figure 16: Difficulties facing the use of smart IPM technologies and methodologies in plant protection (A: stakeholder survey; B: expert survey)

Of the respondents in the experts' survey, 48% found that the governmental support to the farmer to use the smart technologies and methodologies in plant protection is low, followed by 32% moderate (Figure 17A). However, 52% of the respondents in the experts' survey saw that the willingness of the farmer to use the smart technologies in plant protection is moderate, while 35% found the willingness of the farmer is low (Figure 17B).

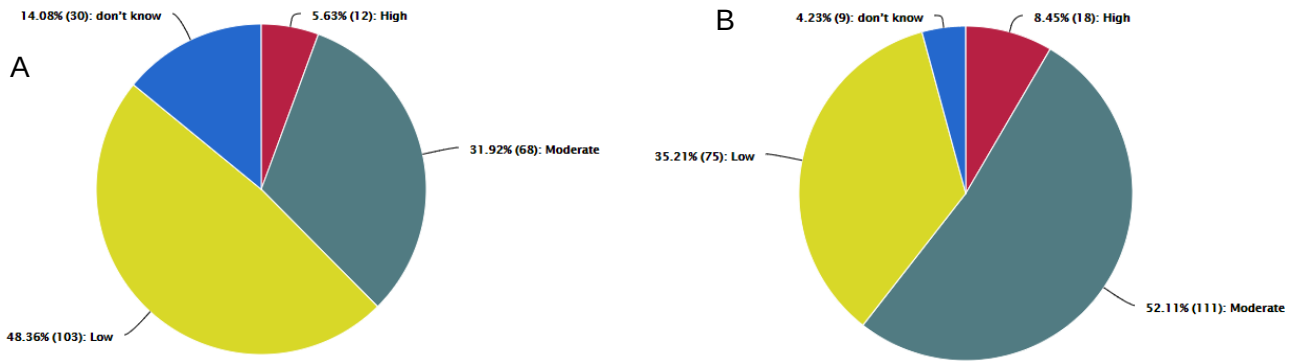


Figure 17: A: Governmental support to the farmer to use the smart technology; B: Willingness of the farmer to use the smart technology in plant protection

The survey's respondents were asked to identify the factors hindering the use of smart IPM technologies and methodologies in plant protection. Low efficacy came in the first place in the stakeholder survey with 70% followed by the low profitability with 42% (Figure 18). The respondents in the expert survey found that the low availability should come in the first place with 55% followed by low applicability and low profitability with 50 and 48%, respectively.

Some other factors besides the low accuracy and compatibility were mentioned by the survey's respondents as factors hindering the use of smart IPM technologies and methodologies in plant protection such as the low experience of the farmer and the regulatory bottlenecks.

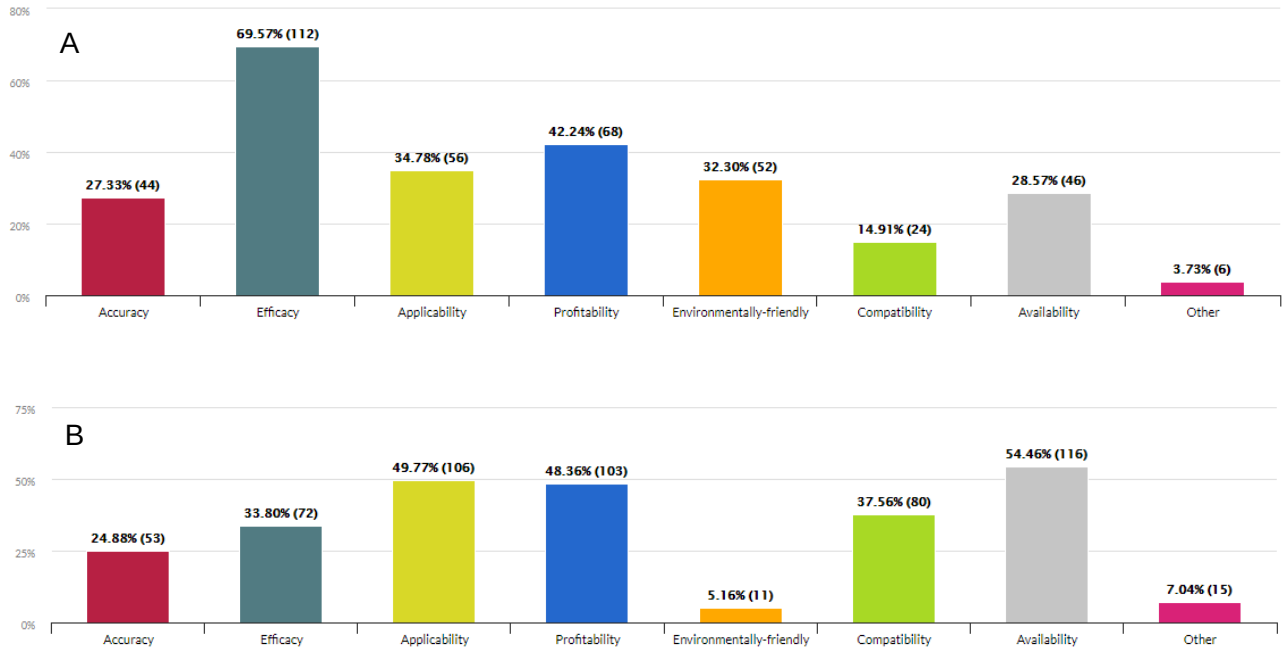


Figure 18: Factors hindering the use of smart IPM technologies and methodologies in plant protection (A: stakeholder survey; B: expert survey)

3.5 Smart IPM techniques in use

3.5.1 Application techniques

Survey respondents were asked to choose between 24 smart pesticides application techniques, seven smart beneficial application techniques, and eight smart UV systems which may they have used before in plant protection in their business.

Around 75% of the survey's respondents did not use any of the surveyed smart pesticides application techniques while 83% did not use any of the surveyed smart beneficial application techniques. It was also interesting to know that around 90% of the survey's respondents did not use any of the surveyed smart UV systems in their business.

Smart pesticides application techniques such as Dropleg Lechler, Dropleg Hardi, Wingsprayer, ESS Electrostatic greenhouse sprayer, and DJI Drone Agras T16 were mostly used by the survey's respondents with 16%. While the most used smart beneficial application techniques by the survey's respondents were Koppert Airobug, Trichoderma dropper, and Biosprayer with 14.82% (Figure 19). Moreover, smart UV systems such as Clean light, horticulture UV system, and UV-C technology were the most used techniques by the survey's respondents with 5%.

20.6% of the survey's respondents used other smart techniques to apply pesticides such as DJI Mavic 2 Pro, and other smart techniques to apply beneficial such as Biobest's new Nutri-App as well as UV Robots in plant protection.

Interestingly, 49.2% of the survey's respondents who did used the surveyed smart application techniques did not face any problems using these techniques. 9.19% and 7.8% of the survey's respondents faced problems with the applicability and efficacy of the smart application techniques, respectively. On the other hand, problems concerning the accuracy, profitability, and compatibility did not exceed 5% as mentioned by the survey's respondents. Other problems such as the regulatory challenges and the practicability were also mentioned as additional problems by the survey's respondents.

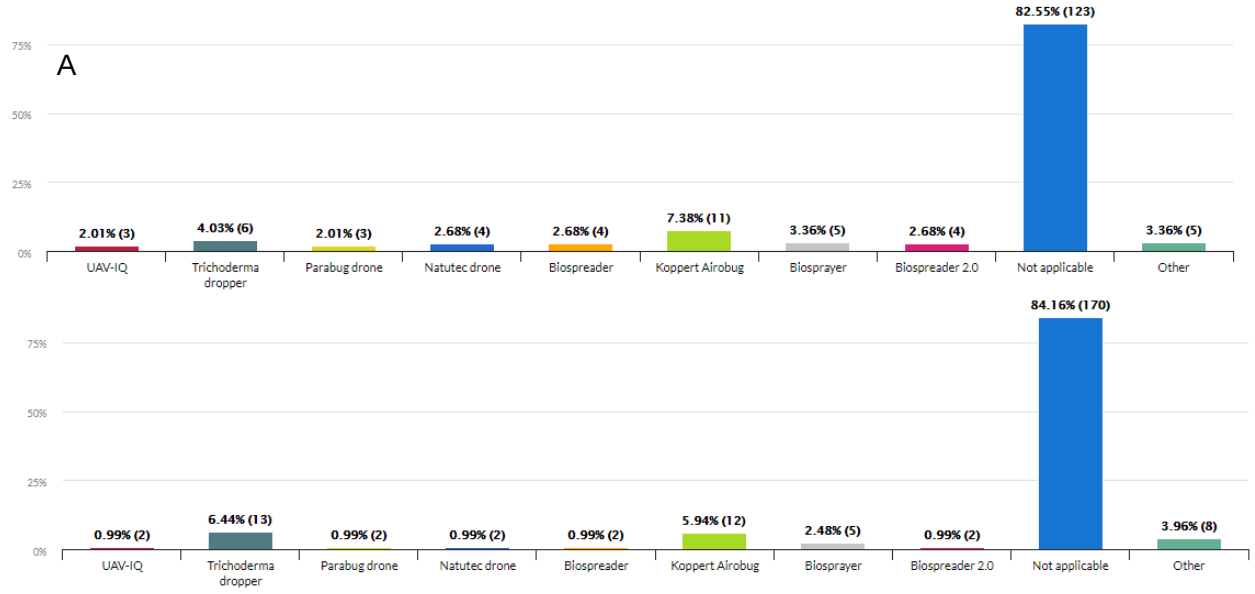


Figure 19: Smart beneficial application techniques used by the survey respondents in plant protection (A: stakeholder survey; B: expert survey)

3.5.2 Diagnostics and detection techniques

Survey respondents were also asked to choose between 18 smart ELISA, RNA, DNA diagnostics/detection techniques, and mobile APPs which may they have used before in plant protection in their business. 84% of the survey's respondents did not use any of the surveyed smart diagnostics/detection ELISA, RNA, DNA techniques while 86% did not use any of the surveyed smart diagnostics/detection mobile APPs.

The most used smart ELISA, RNA, DNA diagnostics/detection techniques by the survey's respondents were pocket diagnostics, optiGene Genie II, Flashkits, and creative diagnostics with 10%. As well, smart diagnostics/detection mobile APPs such as crop-scanner app, Cropanalyser, and Plantix were the most used techniques by the survey's respondents with 10% (Figure 20).

However, 13% of the survey's respondents used other smart ELISA, RNA, DNA diagnostics/detection techniques such as InmunoStrips® test and loewe®fast Kits as well as other smart diagnostics/detection mobile APPs such as Wisecrop app and Epicollect app in plant protection.

Of the survey's respondents, who used the surveyed smart diagnostics/detection ELISA, RNA, DNA techniques, and mobile APPs in plant protection, 63% did not face any problems. 9.25% and 6.7% of the survey's respondents faced problems with the accuracy and availability of the smart ELISA, RNA, DNA diagnostics/detection techniques, and mobile APPs, respectively.

On the other hand, problems concerning the applicability and compatibility did not exceed 10% as mentioned by the survey's respondents. Other problems such as no connection with the nets/internet, the long waiting time until getting the results, the newly introduced pests/pathogens, and the long loading time of the mobile APPs were also mentioned as additional problems by the survey's respondents.

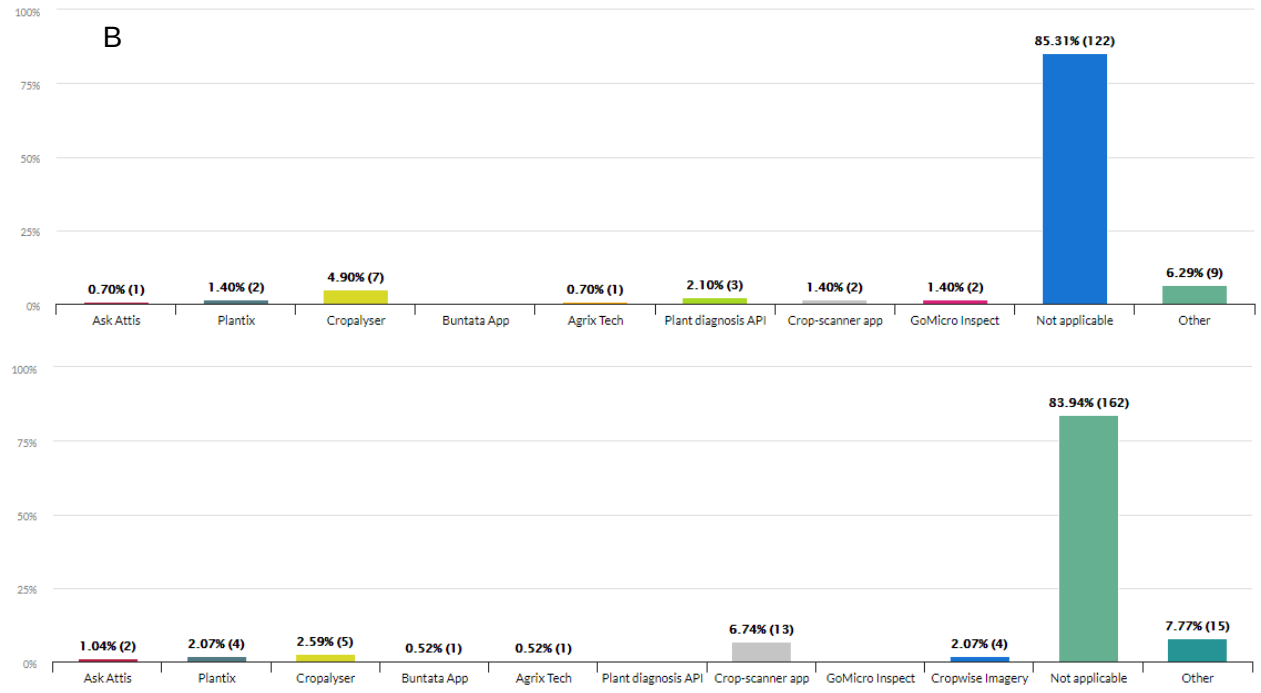


Figure 20: Smart mobile APPs used by the survey respondents in plant protection (A: stakeholder survey; B: expert survey)

3.5.3 Monitoring techniques

Survey respondents were also asked to choose between 24 smart plant and insect monitoring techniques that they have used before in plant protection in their business. It was interesting to notice that 86% of the survey's respondents did not use any of the surveyed smart plant monitoring techniques while 76% did not use any of the surveyed smart insect monitoring techniques.

Smart plant monitoring techniques such as P4 Multispectral Drone and EOS satellite crop monitoring were the most used techniques by the survey's respondents with 8.2% while the most used smart insect monitoring techniques were Trapview, Iscout, Croptrap, and Agronet with 21.6%.

On the other hand, 11.5% of the survey's respondents used other smart plant monitoring techniques such as Natutec Scout and Fieldview as well as other smart insect monitoring techniques such as Ceratrap and Raspberry Pi Camera in plant protection (Figure 21).

Interestingly, 55.75% of the survey's respondents, who used the surveyed smart plant and insect monitoring techniques in plant protection, did not face any problems, while 11.75% and 9.5% of the survey's respondents faced problems with the accuracy and applicability of the plant and insect monitoring techniques, respectively. Problems with the availability, profitability, and efficacy were also recorded by around 10% of the survey's respondents.

Other problems such as lack of pheromones, lack of publication, specification, and communication networks for data transmission in rural areas of the interior were also mentioned as additional problems by the survey's respondents while using the surveyed smart plant and insect monitoring techniques.

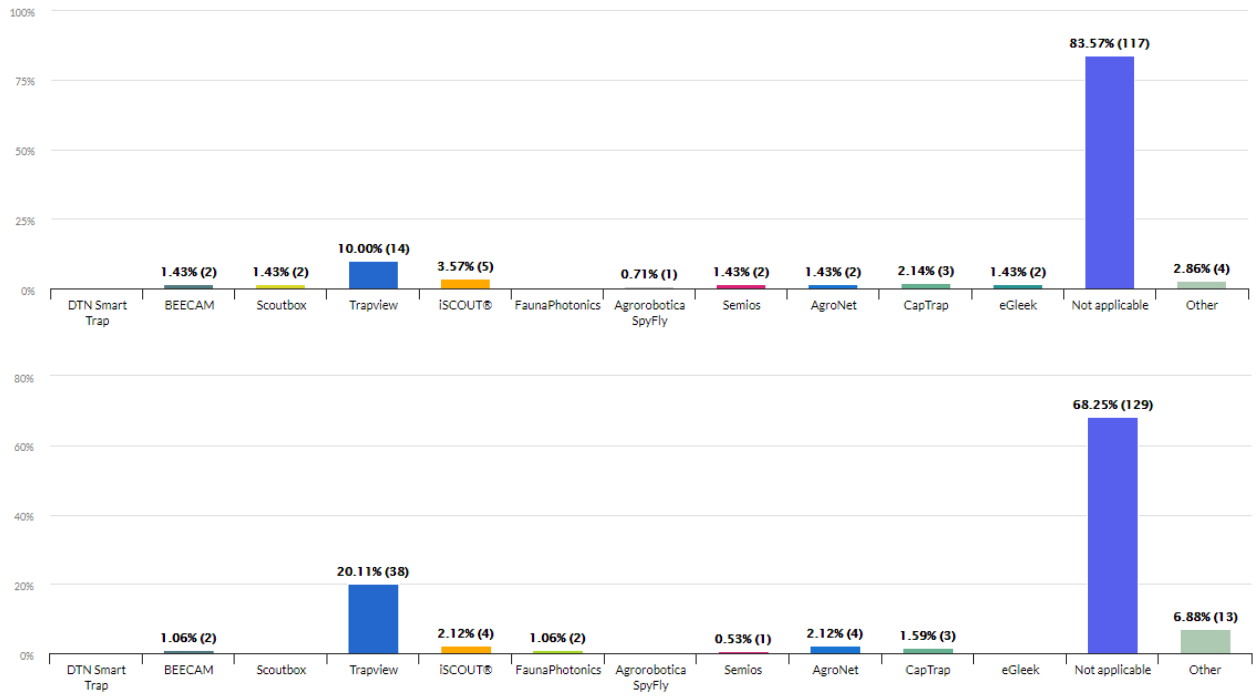


Figure 21: Smart insect monitoring techniques used by the survey respondents in plant protection (A: stakeholder survey; B: expert survey)

3.5.4 Decision support techniques

Survey respondents were asked to choose between 22 smart decision support techniques which may they have used before in plant protection in their business. Around 78.8% of the survey's respondents did not use any of the surveyed decision support techniques in their business.

The most used smart decision support techniques by the survey's respondents were Xarvio, Cropscanner app, Bioline app, and crop diagnosis with 13.42% (Figure 22).

Interestingly, 7.43% of the survey's respondents used other smart decision support techniques such as Dacom, GeoInsecta, Agrovir, and RIMpro in plant protection.

B

However, 70% of the survey's respondents did not face any problems using the surveyed smart decision support techniques while 27.5 % of the survey's respondents faced problems with the accuracy, efficacy, and applicability of the smart decision support techniques. Other problems such as lack of platform support and weak internet connection were also mentioned as additional problems by the survey's respondents.

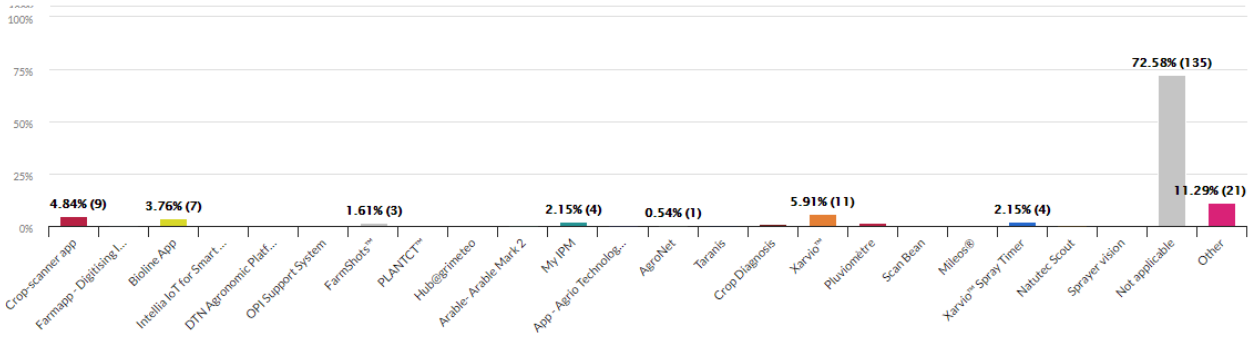


Figure 22: Smart decision support techniques used by the survey respondents in plant protection (A: stakeholder survey; B: expert survey)

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