Deliverable D 3.1

Quantification of the actual deployment of practices and systems and the potential acreage of implementation.

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Table of Contents

1 Executive Summary

Integrated Pest Management (IPM) refers to an approach to plant protection that combines a range of cultural biological, physical, and, when necessary, chemical methods to minimize the use of agrochemical inputs, and to reduce risks to human health and the environment. Thus, it encompasses broader strategies to sustainably manage pests. According to the EU Sustainable Use of Pesticides Directive, IPM is defined as "*the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of populations of armful organism and keep plant protection products and other form of interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms*."

Deliverable D 3.1 aimed to quantify the actual deployment of IPM practices and systems across the European Union Member States of this Consortium and to estimate the potential acreage for their implementation.
The study employed a multi-step approach, combining:

- Collection of available data on IPM-based practices and their current adoption levels across the Member States.
- Estimation of potential acreage for given IPM practices, using expert assessments and national agricultural databases.
- Comparative analysis of both regional and national IPM guidelines to identify common principles and discrepancies.
- Integration of all findings into a harmonized dataset to facilitate cross-country comparisons.

The Key Findings and Results obtained are:

- Data Collection and Analysis: Available IPM guidelines were systematically gathered for both arable and perennial crops across all the partner countries of the Agrowise project (Italy, France, Germany, Poland, Ireland, Sweden, Romania, and Croatia). National and regional disparities were identified, particularly concerning legislative mandates and specific agronomic practices.
- Current Deployment: The study revealed significant variations in the practical interpretation of IPM by each country in terms of the available guidelines.
- Potential Acreage Estimation: Using available databases and expert assessments, the study estimated the acreage where IPM specifications were implemented, given that the implementation of IPM general principles is compulsory by the Sustainable Use of Pesticides Directive. The lack of detailed acreage data for specific IPM practices required complementary information from grower associations and national authorities. Furthermore, even when data were available on acreage, the data were aggregated making it very difficult to discriminate between the single practices adopted. Nevertheless, it was not possible to discriminate whether the growers were implementing the entire IPM strategy, according to the national guidelines, or just one or a few single practices present within the IPM guidelines.
- Comparison with the Taxonomy Framework: The findings aligned with the taxonomy developed in WP 2, reinforcing the applicability of a standardized framework for IPM

implementation.

Limitations and Challenges

- Not all guidelines were precise or detailed in a similar manner.
- The availability and accessibility of IPM data (e.g.: acreage per crop, use of a single IPM tool in a guideline, pesticide usage and the reduction of pesticide use in relation to the adoption of the different IPM tools) varied among Member States, impacting on the completeness of comparative analyses.
- Most of the MS countries lacked detailed documentation on specific IPM practices (e.g., acreage estimation and pesticide usage) and required either further estimations or the implementation of practices.
- Differences in national legislative frameworks created challenges in harmonizing IPM guidelines across Europe. There is a requirement of a baseline of minimal applications/guidelines needed to foster IPM effectiveness strategies, since specific climatic conditions in the different countries play a role in the types of strategies adopted.

This deliverable provides insights into the current and potential implementation of IPM strategies with a particular focus on the practices promoted by national guidelines and the limited availability of monitoring data regarding their actual implementation. By addressing these aspects, the deliverable contributes to the overall objectives of the AGROWISE project in promoting sustainable agricultural practices whilst mitigating pesticide impacts. The findings may serve as a basis for further research and policy development to achieve the European Green Deal goals.

2 Background

The present document constitutes the Deliverable D 3.1 “Quantification of the actual deployment of practices and systems and the potential acreage of implementation” in the framework of the **Agrowise Project – GA 101148740**.

3 Objective/Aim

The aim of the deliverable was to identify and collect available data on the implementation of IPM-based practices and systems. The current deployment of practices and the quantity of potential acreage for their implementation were analysed.
Hence, AGROWISE Task 3.1 provided a detailed overview of the current state of implementation of IPM-based practices and systems across the AGROWISE Member States (Italy, France, Germany, Poland, Ireland, Sweden, Romania, and Croatia), with particular attention to both major arable crops and perennial trees. These eight Member States represent key agricultural production zones, encompassing Mediterranean, Scandinavian, Eastern European, respectively.

Task 3.1 objectives were:

- Identification of available data on the implementation of IPM-based practices and systems
- Quantification on the extent and the potential area for IPM implementation
- Analysis of the contextual factors influencing IPM effectiveness, considering both mandatory and optional practices across Member States

Documenting the implementation of these practices is essential. The data collected from the available databases in each partner country substantiated the analysis on the level of adoption of IPM-based practices classified in WP 2 (namely, Layer 2 of the Taxonomy of IPM practices, described in the deliverable 2.1). The aim was to estimate the acreage of IPM implementation and to define the shared practices across MS. This was undertaken by searching for information in national databases (e.g.: National State Repository or websites recognized by national authorities for the IPM guidelines).

4 IPM Practices at European Level

4.1 Actual deployment of practices and systems and the potential acreage of implementation

The information necessary for the development of the IPM guidelines was collected on a national level by all WP 3 partners (Italy, France, Germany, Poland, Ireland, Croatia, Sweden, and Romania). Each above-mentioned partner contributed data and insights based on their respective national contexts, ensuring that the guidelines reflected a broad and representative understanding of IPM practices across the participating countries. The sources from which these partners elaborated the resulting information are comprehensively presented in **Erreur ! Source du renvoi introuvable.** of the following text (4.3 paragraph).
Furthermore, the methodology adopted by each partner in gathering and analysing the data, as well as the challenges they encountered during this process, were then subsequently documented. These methodological details and reported difficulties are outlined in paragraph 4.4 and summarized visually in **Erreur ! Source du renvoi introuvable.**. This approach ensured transparency in the data collection process and highlighted the diversity of experiences among the partners.
Finally, the data and subsequent analysis contained in this document were derived from the information provided by the Agrowise partners from the different MS.

4.1.1 Collection of IPM Guidelines in Italy

To establish a comprehensive overview of IPM in Italy, the specific guidelines (referring to IPM from the Italian standpoint) for both arable and perennial tree crops were systematically collected from all Italian regions. Since each region operates under its own legislation, official documents were retrieved from the national website: www.rete.rurale.it. On this platform, all IPM documentation is present on a regional level. Hence, the specific regional guidelines of IPM, were then merged and consolidated into a unified dataset for this Project. A final document was then produced regarding the principles shared across all Italian regions. This process allowed for the identification of shared principles as well as region-specific variations. A comparative analysis of these regional guidelines was then performed to highlight both commonalities and differences, thereby forming the basis for a standardised national framework (screenshots of the documents available as ANNEX 1 A: Integrated Production Regulations 2024 - Technical growing standards for Apple/Plum trees in Italy. This harmonized framework ensures consistency in IPM implementation across Italy, facilitating its applicability on a national scale. Two illustrative examples of these regulations, focusing on *Apple/Plum tree* and *Autumn/Winter Cereals*, are presented in ANNEX 1 A: Integrated Production Regulations 2024 - Technical growing standards for Apple/Plum trees in Italy.

4.1.2 Integration with Other Member States

After establishing the national framework for Italy, a broader European perspective was incorporated by collecting and comparing the IPM guidelines, which were requested and collected from the other partner countries (Germany, Poland, Croatia, Romania, Ireland, France, Sweden). As expected, the guidelines were different among all countries. Although the main principles of

IPM are shared among the Project Member States (Italy, France, Germany, Poland, Ireland, Croatia, Sweden, and Romania), the Italian guidelines were found to be more specific and complete (further explained in *paragraph 4.1.3*). In order to allow comparison between the agricultural practices covered by the guidelines of all MS, the international contributions were analysed and merged to generate a single document.

4.1.3 Reformatting for Accessibility

To enhance, clarity and facilitate cross-country comparisons, the compiled guidelines were structured into a standardised table format on the national level for each Consortium partner (ANNEX 2: IPM guidelines for arable crops and fruit trees on a national level for all the Agrowise partner countries). This table categorised the guidelines under key agronomic topics, ensuring a coherent and user-friendly presentation.

The final dataset included the following key thematic areas, based on the IPM guidelines developed from the Italian national guidelines:

- Preserving the Natural Agro-ecosystem
- Choice of cultivars and planting materials
- Soil preparation before transplanting or seeding
- Crop rotation *(only for arable crops)*
- Sowing, transplanting, and planting
- Soil management and agronomic practices
- Other production methods and issues
- Fertilization and fertiliser application
- Irrigation
- Weed and pest management
- Harvest

After the taxonomical development, these thematic areas were matched with the taxonomy layers (see *paragraph 4.1.5*). This structured approach ensured that the collected guidelines served as a comprehensive reference for stakeholders involved in IPM-based agricultural systems across the different European regions (Consortium countries) (**ANNEX 2**: IPM guidelines for arable crops and fruit trees on a national level for all the Agrowise partner countries).

4.2 Estimation of the Acreage

One of the main challenges encountered during the development of AGROWISE project was the limited availability and inconsistency of data regarding the IPM production areas across the eight MS. While certain countries provide detailed and accessible datasets, in many other cases the information is either unavailable, or only available in aggregated forms that do not allow for consistent or comparative analysis across countries. This lack of harmonized and disaggregated data has significantly constrained the possibility of conducting a comprehensive and uniform assessment. Considering these limitations, it was decided to focus in greater detail on the case study of Italy, where more complete and granular data were accessible.

4.2.1 Italian case study

In order to achieve the information regarding the production surface areas on an Italian level, the first step involved collecting data from the www.rete.rurale.it and ISTAT.it website.

Figure 1 provides an overview of the number of Italian farms and their respective agricultural surfaces, categorized by crop/fruit trees type and management practices. The data show the extent of adoption of IPM and other sustainable farming schemes (e.g., organic and voluntary IPM, namely SQNPI, across the country. The total agricultural area in Italy amounts to 12,364,740 hectares, with arable crops representing the largest share at 7,185,011 hectares, distributed across 721,605 farms. Within arable crops, cereals account for nearly half (3,134,768 ha). Indeed, permanent crops (e.g., vineyards, olive, citrus, and other fruit trees) cover 2,164,034 hectares, spread among 800,586 farms, whilst the organic farming practices are adopted by 94,441 farms, covering 2,456,020 hectares.

In addition, the actual number of farms practicing voluntary IPM is likely lower, reinforcing the previously stated concern about limited adoption. The National Quality System for Integrated Production (SQNPI) is an official certification framework established by the Italian Ministry of Agriculture to promote environmentally responsible agricultural practices based on integrated production principles. The certification is granted to agricultural producers and supply chain operators who rigorously comply with regional technical guidelines, undergo systematic audits conducted by accredited certification bodies, and guarantee full product traceability. Through strict adherence to these standards, the SQNPI label assures conformity with sustainability criteria, environmental protection objectives, and consumer health safeguards. In fact, the voluntary uptake of the SQNPI certification appears limited: only 1,210 farms comply with environmental standards, covering 550,447 ha. Only 668 farms are exclusively certified under the SQNPI scheme, covering 34,570 hectares, while a more comprehensive integration is observed in 1,044 farms certified under both schemes, spanning 113,047 hectares. However, the total voluntarily certified area amounts to merely 698,064 hectares, approximately 5.7% of the national IPM surface, highlighting the limited voluntary uptake of certification beyond regulatory compliance.

	Categories	Number of farms	Surfaces (ha)
Total area	Arable crops	721,605	7,185,011
	Cereals (overall)	325,305	3,134,768
	Other arable crops	45,289	108,255
	Woody agricultural trees	800,586	2,164,034
	Citrus trees	49,087	112,033
	Vineyards	255,514	629,517
	Olive trees	619,375	985,481
	Fruit crops (overall)	154,101	386,631
	Other woody agricultural trees	10,191	17,323
Organic area	Organic agriculture	94441	2456020
IPM	IPM area	1.133.023	9908720
SNQPI	Agro-climatic and environmental compliance	1210	550446.6451
	SQNPI label	668	34570.019
	SQNPI label and agro-climatic and environmental compliance	1044	113047.2871
	Total voluntary area	2922	698063.9512

Total agricultural area (ha) : 12364740

Figure 1. Hectares (ha) and number of farms following the IPM-practices, the organic agricultural system and grant the SQNPI label. Source: www.rete.rurale.it and ISTAT.it websites.

4.2.2 Current available Consortium data

Afterwards,

Country	Surface supporting the IPM (Ha)	Explanation of the entered value
Italy	9908720	Value obtaied with the sum of Regional surfaces present in the retruale.it website
France	1211152	Field crops under the HVE label
France	109481	Fruit trees under the HVE label
Croatia	756281,6	Sum of all fruit crop areas under integrated production
Croatia	34222,52	Sum of all arable crop areas under integrated production
Croatia	790504,12	Total sum (rable plus fruit tree)
Sweden	2475774	Based on percentages of how implemented practices are in the JBV report, we scaled this to the entire cropped area in Sweden. For example, the total area arable land that the report covers is 2526300 ha. 98% of farms implement the IPM recommendations, hence the guideline is implemented on 2475774 ha of arable land in Sweden

Figure 2 was developed with the aim of extending the analysis of surface area estimations to include all Consortium partners. Overall, the adoption and reporting of IPM varied widely across the respective countries. The data were gathered by Agrowise-members of each Member States sourced from national and official websites. However, only four out of the eight Country-members of the Consortium were able to retrieve this data (Italy, France, Croatia, and Sweden) on national databases (included in column N of ANNEX 3, and ANNEX 3). This highlighted a potential issue within the project consortium's member states and, more broadly, within the EU context: the availability of data relating to agricultural surface areas.

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Figure 2. Summary of surface areas supporting voluntary IPM (ha) of the project partners, and the explanation pertaining to the entered value, for each of the Project State Members (where the surface area data under IPM were possible to retrieve, as stated previously). Refer to ANNEX 3 for specific information.

4.3 Guidelines linked to taxonomy (WP 2.1) for each partner

Once the information regarding the existing and adopted IPM guidelines were collected and summarised for the States of each Project Partner (Italy, France, Germany, Poland, Ireland, Croatia, Sweden, and Romania), a unique document linked with taxonomy in accordance with WP 2 leaders (SLU and INRAE) was created (ANNEX 3: National IPM guidelines from the Agrowise partner countries : specific sources, production surfaces, and links to the WP 2.1 taxonomy of IPM practices). In particular, the list of official and national sources and the relative IPM practices for each Project MS, was then linked to taxonomy layers. Furthermore, the Agrowise Project partners (Italy, France, Germany, Poland, Ireland, Croatia, Sweden, and Romania) were asked to indicate whether the IPM guidelines were either mandatory or optional. A request was also made to

indicate the relative cultivated acreage adhering to IPM-based practices (ANNEX 3).

In the Table (**ANNEX 3**), the columns under "*Source of the guideline*", entitled as "*source of the guidelines", "binding/optional", "Link to the source"* and *"Citation source*" (columns A to E, **Erreur ! Source du renvoi introuvable.**), were created to obtain a framework of the actual available IPM-based documents for the European partners. In the orange columns named "*Guidelines*" (**Erreur ! Source du renvoi introuvable.**, columns F to I), all the information relating to the available guidelines for each country was added. In particular, the measurement methods accounting for the implementation of the promoted practice(s) and whether a particular guideline was either binding or optional in the reported sources were requested from the partners. In the blue section (**Erreur ! Source du renvoi introuvable.**, columns J to K) "Link to practices", the information described above was subjected to a more in-depth analysis. To do this, it was important to understand which crop practices might be applied ("*crop using"*, J column) and then to link the respective practices to the taxonomy layers (Layer 3 and 4 in the "*Tax_Layers_ids*" sheet, **Erreur ! Source du renvoi introuvable.**) targeted by the guideline ("*IPM practices from Taxonomy Tax_Layers_ids* sheet", K column, **Erreur ! Source du renvoi introuvable.**), developed from WP 2 activities. Finally, surface area information was gathered in the green section named "*Surfaces*" (**Erreur ! Source du renvoi introuvable.**, columns L to Q). As mentioned above, it was only possible to retrieve this information for four out of the eight MS (Italy, France, Sweden and Croatia), although these data are not precise or complete. In the column "*Surface supporting the Guideline*" (column L), surface areas (ha) were requested from the partners supporting the practices. In the "*Source of the surface*" column (column N), the corresponding links were reported.

This structured approach ensured that the guidelines were categorised appropriately and aligned with the overall objectives of WP 2. This method facilitated cross-country comparisons, making it easier to analyse trends and regulatory frameworks across different regions. The Realisation verification Method reported the Organisation in charge to control/verify the realisation of an IPM practice. Indeed, the "Measurement Method" defines the specific procedures used to obtain quantitative data, specifically, to account for the realisation of the promoted practice(s). Lastly, the binding or optional character of each guideline, as part of the broader document, was registered.

The outcomes and outlined verification methods suggested a variety of guidelines for agricultural practices, with a focus on the presence or absence of specific actions that are either binding or optional. Many of these practices within the entire set of IPM strategies (shared across the Project State Members) were verified through the inspection of certified organizations, for example:

- 1. Certifications, quality labels and guidelines,
- 2. Inspections and audits by retailers,
- 3. Farm records and documentation,
- 4. Government and regulatory inspections.

This included checking whether specific practices had been followed, with official reports created to verify compliance following the surveillances. For most guidelines, a checklist is used to assess whether the single practices, within the entire IPM strategy, are being implemented. The presence or absence of these practices is then recorded. Some guidelines are mandatory and require the farmer to comply with specific practices. However, many of the guidelines, are merely optional,

such as for Germany and France (**Erreur ! Source du renvoi introuvable.**, row C13 to C23, and row C63 to C129). The measurement methods for verifying practices are generally based on either the presence or absence (i.e., whether the practice is applied or not). This approach simplifies verification, but also reflects whether specific criteria have been achieved (e.g., the percentage of the farm area treated with biological control, or the presence of diverse plant species). The role of independent inspection bodies can also be useful for the specific quality label (e.g., SQNPI, HVE). The latter could ensure compliance with both binding and optional guidelines. These bodies are typically approved of by relevant authorities (e.g., Ministry of Agriculture) and perform various services. The services include audits, including on-farm visits and documentation reviews, as well as the presence of Farmers consortiums or Farmers and Agricultural associations (e.g., for Italy: category association and Unions). Additionally, certain recommendations in the guidelines are 'non-enforceable', meaning there are no specific controls or verification methods attached. For example, the use of risk models or forecasting systems. These may provide useful suggestions for improving the efficacy of IPM practices, but lack mandatory compliance checks.

A major structural issue has emerged regarding the availability, quality, and traceability of data on agricultural areas effectively managed under Integrated Pest Management (IPM) criteria. In the European countries represented and studied by AGROWISE project, it is particularly difficult to ensure access to updated, geographically detailed, and methodologically consistent data that clearly document the actual implementation of IPM practices. Thus, it relies on whether these repositories are present or not in the Project Member States. This lack of both transparency and consistency severely limits the ability to assess how widely IPM strategies are currently being adopted. Moreover, it makes it harder to identify those areas with the highest potential for further adoption. Such information is crucial for planning targeted interventions.

Several systemic and organizational factors have contributed to this fragmentation. Firstly, in many cases, there is no centralized or digitalized system for collecting and storing IPM implementation data. This lack of structured documentation, in turn, may limit the further adoption of IPM on the farm or crop level. Secondly, there is considerable variability among EU Project Member States on how IPM practices are classified and monitored. The methodologies, indicators, and tools that are employed vary significantly across the Member States, making comparison and data aggregation on the European level particularly challenging. This issue is particularly critical in relation to the absence of harmonised and quantitative data on pesticide use. The consequence is that comprehensive assessments and policy development on the EU level are severely hampered. Thirdly, another barrier exists in the limited interoperability and coordination among the various entities involved in data production and management. These entities include agriculture ministries, research institutes, regional agencies, and regulatory bodies. The lack of synergy between these institutions has led to information gaps and disrupted data flow in the following areas: IPM principles adopted by the MS, monitoring of IPM principles, and in obtaining qualitative/quantitative information.

Moreover, many IPM practices are adopted through voluntary schemes rather than mandatory national policies, which may vary between the MS. For example, Italy and Romania classify some IPM practices as mandatory (e.g., crop rotation, fertilization, mating disruption), whilst in other countries some IPM practices are optional (e.g., monoculture or plant mixture during crop rotation, cover crops). Instead, in Germany (data provided by JKI and ZALF), all practices are

optional. This means that although farmers should still apply IPM, they are able to select practices adopted that are tailored to the specificities of their respective farms.
This fragmented landscape makes it extremely challenging to gather consolidated, verifiable data on both national and EU levels. As a result, the development of coordinated strategies to promote and monitor IPM is significantly hindered. The absence of an integrated and mandatory European data collection system for IPM constitutes a critical systemic gap.

As showed in the ANNEX 3, there are some differences in how IPM is implemented across the AGROWISE consortium countries. These differences could be attributed to a range of factors, including local agricultural practices, climate conditions, pest species, prevalence and pressure or explained by the wide margin of leeway given to the MS to promote IPM who then opted for different levels of regulatory stringency. While IPM principles are recognised throughout the EU, specific methods, tools, and approaches can vary significantly, reflecting the diverse needs of the agricultural landscape of each country. For example, some countries may focus more on biological control methods, while others emphasise chemical alternatives or cultural practices.

Starting with the information presented in **Erreur ! Source du renvoi introuvable.**, a summary of the main Taxonomy layers (present in each MS), containing the primary differences for the presence or absence of different practices, was created (**These *aspects*** will contribute to the implementation of IPM throughout the European Union.

Figure 3 **and ANNEX 4**: Presence or absence of the main IPM practices in the national guidelines of the Agrowise partners' countries, according to the WP2.1 IPM taxonomy layer 2). The letter V was then assigned when a national guideline was linked to one of the taxonomy items. The letter **X** was assigned when it was absent, as based on the Taxonomy Layer 2. This provided a comparative overview of the implementation of IPM measures across the eight EU Member States.
Generally, the figure highlighted a sound ability to link the key agronomic practices incorporated in the IPM guidelines, such as cultivar diversity, site-specific adaptation, and crop management. Some countries showed a lower level of adoption, particularly for soil management and planting materials.

Pest prevention practices, such as equipment cleaning and landscape-level resource management are inconsistently transcribed in the guidelines, suggesting varied biosecurity awareness. Similarly, monitoring, forecasting, and predictive systems are also well-integrated in some contexts but absent in others, reflecting disparities in access to data-driven tools. Broadly speaking, given that this was shown to be an outcome of the eight Project Member States, it could also be expected in the whole EU context, when considering all 27 member States.
Finally, evaluation and reporting systems, which are crucial for sustainability, are not yet uniformly implemented.

These findings underscored the need for further harmonization across the EU States, particularly in monitoring, evaluation, and knowledge exchange. These aspects will contribute to the implementation of IPM throughout the European Union.

MAIN PRACTICE	TAXONOMY LAYER 1	TAXONOMY LAYER 2	IRELAND	ROMANIA	CROATIA	ITALY	FRANCE	GERMANY	SWEDEN	POLAND
1. Prevention And Suppression	1.1 Crop Selection	1.1.1 Cultivar And Rootstock Diversity	V	V	V	V	V	V	V	V
		1.1.2 Crop Species Diversity	V	V	V	V	V	V	V	V
		1.1.3 Adaptation To Site Conditions	V	V	V	V	V	V	V	V
		1.1.4 Seed/Planting Materials	V	V	V	V	V	V	V	V
	1.2 Crop Establishment	1.2.1 Sowing	V	V	X	X	V	V	V	V
		1.2.2 Planting (Cuttings/Seedlings)	X	V	V	V	V	V	V	X
	1.3 Cultivation Techniques	1.3.1 Soil Cultivation	V	X	X	X	V	V	X	V
		1.3.2 Crop management	V	X	X	X	V	V	X	V
		1.3.3 Harvest Management	V	V	X	V	X	V	X	V
	1.4 Amendments	1.4.1.Suppressive Amendments	X	V	X	X	V	V	V	X
		1.4.2. Balanced fertilisation	V	V	X	X	V	V	V	V
		1.4.3 Ph Management	V	X	X	X	X	V	V	V
		1.4.4 Water Management	X	X	X	V	V	V	V	X
	1.5 Increase of natural regulation	1.5.1 Management Of Ecological Infrastructure	V	V	X	X	V	V	V	V
		1.5.2 Management Of Resources To The Pest (landscape)	X	V	X	X	V	V	X	X
	1.6 Hygiene measures and biosecurity	1.6.1 Cleaning Of Machinery And Equipment	V	X	X	V	V	V	V	V
		1.6.2 Management Of Resources To The Pest (materials in field)	X	X	X	V	V	V	V	X
		1.6.3 Soil Disinfection	X	X	X	X	V	V	X	X
2.Monitoring	2.1 Monitoring	2.1.1 Monitoring	V	X	V	V	V	V	V	V
		2.1.2 Assessment	V	X	X	V	V	V	V	V
		2.1.3 Prognosis and forecast	V	X	X	V	X	V	V	V
3. Decision making	3.1 Decision Support Systems & Thresholds	3.1.1 Prediction And Warning (Seasonal)	X	X	X	V	V	V	X	X
		3.1.2 Predictive Farm Systems (Long Term/Systemic)	X	X	X	V	X	V	X	X
		3.1.3 Thresholds	V	X	X	V	V	V	V	V
4. Biological, physical and other non chemical methods	4.1. Biological Control	4.1.1 Supplemental Release Of Live Beneficials	X	V	V	V	V	V	V	X
	4.2 Biotechnical Control	4.2.1 Attractants And Repellents (natural)	X	X	X	V	V	V	X	X
		4.2.2 Attractants and repellents (other)	X	X	X	V	V	V	X	X
		4.2.3 Stimulation And Interference	V	X	X	X	V	V	X	V
		4.2.4 Engeneering of biocontrol agents	X	X	X	V	X	V	X	X
	4.3 Physical Control and mechanical	4.3.1 Barriers	X	X	V	V	V	V	V	X
		4.3.2 Thermal Control (Excluding Thermal Seed Treatment)	X	X	V	V	V	V	V	X
		4.3.3 Mechanical removal of pests	V	X	V	V	V	V	V	V
		4.3.4 Visual Attractant	X	X	X	X	V	V	X	X
	4.4 Natural Substances	4.4.1 Natural Substances	V	V	X	X	V	V	V	V
5. Pesticide Selection	5.1 Pesticide Selection	5.1.1 Pesticide Selection	X	V	X	V	V	V	V	X
6. Reduced Pesticide Use	6.1 Reduced Pesticide Use	6.1.1 Adapting Spraying Technology	X	X	V	X	V	V	X	X
		6.1.2 Spray Application	X	X	V	X	V	V	V	X
7. Anti-resistance strategies	7.1 Pesticide Selection	7.1.1 Choice Of Active Substance And Control Agent	X	X	X	X	V	V	V	X
8. Evaluation	8.1.Documentation And Reporting	8.1.1 Record Keeping	X	X	X	V	X	V	V	X
		8.1.2 Reporting Systems	X	X	X	V	X	V	X	X
	8.2 Impact Assessment	8.2.1 Efficacy Evaluation	V	X	X	X	X		V	V
		8.2.2 Environmental Assessment	X	X	X	X	V	V	V	X
		8.2.3 Societal Assessment	X	V	X	X	X	V	X	X
		8.2.4 Economic Assessment	V	V	V	V	X	V	X	V

Figure 3. Presence or absence of the main IPM practices for the AGROWISE partners according to the Taxonomy layers. The document reports the differences among the Country Partners for each IPM practice considered (ANNEX 4). The table includes both compulsory and optional measures included in national guidelines. Thus, the inclusion in a guideline does not strictly indicate that a single practice is adopted. Data collection for IPM guidelines: Accessibility, Implementation, and Policy Integration

4.1 Data collection for IPM guidelines: Accessibility, Implementation, and Policy Integration

The sources of guidelines, the difficulties involved in finding these guidelines, as well as the broader context of to whom they are intended to be directed (farmers, policymakers, etc.) are all presented in ANNEX 5: Summary of the characteristics of the national IPM guidelines in the Agrowise partner countries. Specifically, this comparative analysis of approaches used in the different countries revealed distinctive strategies in terms of accessibility, usability, stakeholder engagement and policy integration, respectively.

In fact, countries adopted diverse strategies in structuring their IPM frameworks. In some cases (countries such as Croatia and France), guidelines are embedded within broader environmental certification schemes (e.g., practices that are both part of IPM and other agricultural designations, such as organic or biodynamic systems) that promote sustainability and compliance with EU directives (Directive 2009/128/EC) on pesticide reduction. In some other cases (e.g., Italy), IPM guidelines are initially developed at the regional level, and subsequently integrated into national frameworks, ensuring alignment with the requirements of the Common Agricultural Policy (CAP). These differences reflect contrasting degrees of centralisation and policy-driven coordination. Some systems emphasise voluntary adoption through certification, whilst others focus on cohesive technical harmonisation on the national level. Direct data collection from farmers' practices is very limited. Where this exists, the focus is largely on the use of pesticides (e.g., Eurostat).

Furthermore, the accessibility of IPM guidelines is another issue where national strategies diverge. Some MS offer centralised digital public repositories (e.g., France, Italy) that facilitate easy navigation and document retrieval for end-users. Other MS frameworks (e.g., Ireland) are lacking or fragmented with technical materials dispersed across multiple institutional websites.

In addition, a key factor that could promote the adoption of IPM on the farm level is the availability of implementation tools, such as drones, climatics maps, ripening maps, country reports, prediction models, decision support systems (indicated in the taxonomy layers 1.1.3.2.1, 2.1.1.1, 2.1.1.3, 2.1.2.1, 2.1.2.2, 2.1.2.3, 2.1.3.1, 2.1.3.2, 3.1.1.1, 3.1.2.1 and all layer 8). The latter ones are often lacking in the surveyed MS. Tools may either rely on statistical knowledge-based documents or support real-time farm management decisions, including forecasting models for pests and diseases (e.g., Emilia Romagna Phytosanitary Service[1]).

While some national systems integrate inspection and certification into their IPM frameworks, others (such as Romania, France, Croatia, see **Figure 3**) do not clearly articulate the mechanisms for oversight or compliance verification. This lack of transparency may undermine the trust and reliability of the IPM approach, particularly when guidelines are voluntary.

1 Website : https://agricoltura.regione.emilia-romagna.it/fitosanitario/difesa-sostenibile/previsione

5 Conclusion

The work of Deliverable D3.1 sought to improve the understanding and assessment of IPM implementation and provide insights into its optimization. The methodology involved data collection from different sources, including national guidelines, and expert consultations.
The gathered guidelines were then systematically analysed to compare IPM strategies across countries and assess their integration into agricultural systems. The findings confirmed that differences exist between countries both in IPM management approaches and information access. The findings also highlighted challenges, such as varying data accessibility and differences in regulatory frameworks. These differences impact on the harmonization of IPM practices on the European level.

IPM guidelines in the EU show notable variations due to factors, such as local practices, climate, pest species, and national regulations, respectively. Whilst core principles are widely present and adopted by the Project MS (e.g., first main layer of taxonomy such as irrigation, crop rotation, cultivar choice, pesticide selection, and soil preparation, see ANNEX 3, strategies were shown to differ among countries. Some countries focus more on biological control, whilst others are more focussed on the optimization of chemical treatments or cultural practices. For example, IPM guidelines for perennial crop cultivation (from the majority of surveys) include cultivar selection and use of biocontrol agents/beneficial organisms. In some countries, such as France, Germany and Italy, these guidelines also include cultural methods, pesticide selection and the reduction of pesticide usage (**Figure 3** and ANNEX 4).

These variations underscored the importance of adopting a more unified approach to IPM throughout Europe. Establishing a standardized framework would promote consistency in pest control measures, encouraging better cross-border collaboration to enhance IPM effectiveness. Indeed, IPM principles, such as pest population monitoring (2.1), management of ecological infrastructure (1.5.1), landscape management (1.5.2), and the release of live beneficials (4.1.1) need to be performed not only on a local or regional scale, but also on a cross-border level unless geographical barriers are present. Furthermore, documentation and reporting (8.1), and impact assessment (8.2) should all be systematically organized among MS to provide comparable data and assessment of potential EU-wide outcomes and impacts, respectively. Harmonising basic IPM methods and regulations would permit a more cohesive, sustainable pest management system, benefiting both agricultural output (e.g., pesticide usage, food safety and quality, and food availability) and environmental health (ecosystem preservation, biodiversity conservation and soil fertility). This type of harmonization needs to take into account the regional conditions, crop type and cultivar, local biodiversity and ecosystem services, as well as pest and disease spread and pressure. Therefore, the same principles (e.g., crop selection, cultural management, biological control) should be included in the guidelines of all MS, to be tailored to local conditions. As a non-exhaustive example, crop selection should be a widely adopted principle that can result in the establishment of different cultivars according to local conditions and characteristics (e.g., cultivars with resistance to local pests and pathogens with the greatest impacts). On the other hand, principles related to documentation and reporting (8.1) and impact assessment should be applied in fully comparable manner. Such alignments would serve to enhance the resilience of the agricultural sector, enabling it to better meet the challenges posed by both pests and climate change.

To support the broader adoption of IPM, the following recommendations were proposed:

1. The improvement of the practicality (feasible application) of technical guidelines. This is important since for crop selection, independent data on crop susceptibility are often lacking. Similarly, data are also missing for inter-cropping cultivation and cultivar compatibility;
2. Open access to retrieve information (Layer 8 of Taxonomy, namely "*Evaluation*") permitting the access of data subdivided into headings of crop, region, acreage, pesticide application etc, respectively, the data must be presented in English and exist in a statistically usable form;
3. The introduction or improvement of both inspection systems and certification systems. This can be obtained through the implementation of protocols for inspection and the creation of digital open access platforms that record either the adoption or alternatively, the non-adoption of IPM principles;
4. To encourage the use of cross-country benchmarking to evaluate the effectiveness of national IPM systems and to foster knowledge exchange within the EU.

An important aspect would be the collection of data on the real application of farming practices, beyond pesticide application.

In the present context and with presently available technologies, some of these recommendations cannot be achieved without increasing the administrative burdens for farmers.
Finally, the continuation of academic and applied research is crucial to refine IPM frameworks and identify additional factors that influence their effectiveness. Addressing gaps in data availability, ensuring real-time updates, and expanding stakeholder engagements will all be essential towards improving the robustness of IPM strategies. Future efforts should also assess the long-term impacts of IPM adoption across different agricultural sectors.

6 Annexes

6.1 ANNEX 1 A: Integrated Production Regulations 2024 - Technical growing standards for Apple/Plum trees in Italy

https://eng-agrowise.hub.inrae.fr/content/download/260/2639?version=1

6.2 ANNEX 1 B: Integrated Production Regulations 2024 - Technical growing standards for herbaceous crops (Autumn/Winter cereals) in Italy

https://eng-agrowise.hub.inrae.fr/content/download/259/2636?version=1

6.3 ANNEX 2: IPM guidelines for arable crops and fruit trees on a national level for all the Agrowise partner countries

https://eng-agrowise.hub.inrae.fr/content/download/258/2633?version=1

6.4 ANNEX 3: National IPM guidelines from the Agrowise partner countries : specific sources, production surfaces, and links to the WP 2.1 taxonomy of IPM practices

https://eng-agrowise.hub.inrae.fr/content/download/262/2645?version=1

6.5 ANNEX 4: Presence or absence of the main IPM practices in the national guidelines of the Agrowise partners' countries, according to the WP2.1 IPM taxonomy layer 2

https://eng-agrowise.hub.inrae.fr/content/download/263/2648?version=3

6.6 ANNEX 5: Summary of the characteristics of the national IPM guidelines in the Agrowise partner countries

https://eng-agrowise.hub.inrae.fr/content/download/257/2630?version=1