Deliverable D 2.1
Harmonised Taxonomy

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Description harmonisation of the taxonomy

In the following document we lay out how to harmonise the IPM taxonomy. As a starting point, we used the current entries in the JRC “Farmer’s Toolbox for Integrated Pest Management” (https://datam.jrc.ec.europa.eu/datam/mashup/IPM/index.html). All proposed changes to the structure of presenting a harmonised taxonomy and integrating these changes in the JRC toolbox have been discussed in meetings with the JRC. It was agreed that all suggested changes are technically possible to implement and we will continue the dialogue with JRC on the technical implementation of the upgraded toolbox.

Starting from the eight IPM principles we classify IPM practices by describing them in 4 hierarchical layers. This systematic mapping of practices leads to a harmonisation of nomenclature within the taxonomy, and beyond, will ensure a similar level of resolution in each practice layer across the different practices. The established hierarchical taxonomy will facilitate the mapping of future practices, and the monitoring of implementation and efficiency of practices within and across taxonomic levels. The classification of practices in the below mentioned levels, will facilitate the usage of this taxonomy as a tool to farmers and advisors as well as linking it to policies.

- **Layer 1** describes the **target of adapted management**. This serves as a general descriptor of families of practices that fall under the same target of adapted management, highlighting the practical aspect of IPM. An example can be the *selection of crops*, or *physical control* measures that are taken.
    - Introducing this layer into the taxonomy offers growers, advisors and policy makers practical guidance on which part of the production is to be targeted by the practices.

- **Layer 2** describes the **IPM practices strategy** in suppressing pests. The concept of IPM is broad and it is important to define the strategic goals when using IPM. Especially when using this taxonomy to support policymaking, the practices under different strategic goals have varying importance to sustainable agriculture. Strategically increasing the efficiency of pesticide use will fail to contribute substantially a sustainable agriculture, as continued use of pesticides has systemic impacts on the environment, biodiversity and human health (Zhou et al. 2025). To minimise such risks, priority should be given to strategic actions focus on a systemic, non chemical approach to crop protection, and to avoiding pest and weed infestations to a minimum. For instance, enhancing and relying on natural processes that break pest life cycles and enhance beneficial organisms that quell pests in the cropping system, so called ecological intensification (Bommarco et al. 2013), contributes to sustainable agriculture by replacing the use of harmful agrochemicals by harnessing biodiversity generated ecosystem services to sustain yields and control pests. Hence, this

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layer refines the description of the management target, describing how the practices are used instead of, or to reduce pesticides. An example would be to *establish barriers* to hinder pests from populating the crop (under Layer 1 physical control), or harnessing *crop species diversity* to suppress pests (under Layer 1 crop selection).

    - Introducing this layer to the taxonomy offers a direct link to the strategic ways of improving plant protection.

- **Layer 3** describes the **IPM practices *per se***. This layer is, however, kept at a coarse level of describing IPM practices. For example, the establishment of barriers (Layer2) is further refined into use of *barriers made of natural materials* and barriers that fall under *other types of barriers*. Also crop species diversity (Layer2) can be further defined into the use of *crop rotations* (in time) and *intercropping* (in space).

    - This layer is intended to be specific, yet adaptable to the context in different member states, and specific conditions at different locations.

- **Layer 4** describes the **differences in options** within the layer 3 practices. This layer will add specifics to practices and refine the differentiation between different modes of actions of the practices. For example, "barriers made of natural materials" in (Layer 3) can be the *use of straws, chalk, or salt in Layer 4* both occurring under Layer 2 "establish physical barriers". For other physical barriers (Layer 3) the options can be the *use of nets, or electric fences*. Similarly, crop rotations (Layer 3) can be done in several ways such as *crop sequences, or service cropping*. Intercropping (Layer 3) can be *crop species mixtures* such as strip cropping, but also *service cropping* where only one crop is harvested.

    - Introducing this layer specifies adaptations of practices to several contexts and specifics that work in these contexts.

You will notice that some principles are replicated until the practice layer. We did so intentionally as we found that some of the current 8 IPM principles are descriptors of practices rather than principles.
In the following, we will outline the differences between categories in each layer. The resulting table 1 is based on expert comments and discussion on which differentiations between groups of practices and practices itself were needed. Hence, the options listed (Layer 4 in table 2) are drawn from the IPM toolbox of Agrowise partner countries and expert knowledge among consortium members. Based on the discussions we arrived at consensus for the harmonised nomenclature of practices and their description in the afore-defined layers. Please note that this is a living document, which will be edited and enriched over the duration of the Agrowise project. Table 1 shows the number of entries for each

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principle in each layer indicating differences in richness of targets, strategies, practices and options. The richness of options for, in particular, principle 1 and 4 is based on a multitude and increasing number of alternatives in the previous layers.

Table 1. Number of entries by IPM-principle and layer from the

IPM principle	Layer 1 Target	Layer 2 Strategy	Layer 3 Practice	Layer 4 Options
1	6	18	37	99
2	1	3	11	22
3	1	3	5	6
4	4	10	19	37
5	1	1	2	3
6	1	2	7	15
7	1	1	4	7
8	2	6	22	27

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Table 2 Entries (bold) and definitions (italic) in the harmonised IPM taxonomy. The table shows the eight IPM principles and nested in those Layers 1 to 4 of the proposed taxonomy.

IPM-Principle	Layer 1	Layer 2	Layer 3	Layer 4
1 Prevention And Suppression	**1.1Crop Selection** *Practices that include the process of choosing crops and crop varieties for reducing the need for chemical interventions*	**1.1.1 Cultivar And Rootstock Diversity** *Strategic selection of individual cultivars and/or rootstock to enhance resistance to pest, diseases and environmental stress.*	**1.1.1.1 Use Resistant And/or Tolerant Cultivars** *The practice of selecting and planting crop varieties that are genetically resistant or tolerant to specific pests, diseases, or environmental stresses.*	**Cultivar mixtures** *Growing multiple cultivars (genetically distinct varieties) of the same crop species within the same field. These mixtures are designed to combine the strengths of different cultivars, such as resistance to specific pests or diseases, differing maturation rates, or environmental adaptability, to create a more resilient crop system*
				Cultivar monoculture *Cultivar monoculture refers to the practice of growing a single cultivar (genetically uniform variety) of a crop species over a large area. This approach focuses on maximising yield potential by selecting a high-performing cultivar suited to the local growing conditions*

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		1.1.2 Crop Species Diversity *Strategic selection of several crop species within a production area or crop cycle to reduce pest pressure, improve soil health and to break pest and disease cycles.*	**1.1.2.1 Crop Rotation** *The practice of alternating different crop species in the same field across seasons or years (time)*	**Crop sequences** *Sequential growing of different crop types in a planned order over several growing seasons. Crop sequences are designed to interrupt pest and disease cycles, enhance soil health, and reduce the risk of pest build-up by varying host availability*
				Relay cropping *Crop rotation where a second crop is planted before the first crop is harvested, creating overlapping growth periods. This practice strategically disrupts pest life cycles by introducing non-host plants and maintaining continuous vegetation cover, which can reduce pest pressure.*
				Service/cover crop (sequential) *Crop rotation where crops grown primarily to improve soil health, provide habitat for beneficial organisms, and suppress pests. Service or cover crops are not harvested for profit but act as a living mulch, reducing pest populations by disrupting their habitat and creating unfavourable condition*

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				Fallow (pest suppression through fallow) *Crop rotation where fields are left unplanted for a/several seasons to reduce pest populations by depriving them of host plants. Fallow can interrupt pest life cycles and reduce pest pressure in subsequent crops, while allowing soils to recover.*
			1.1.2.2 Intercropping *The practice of growing two or more crop species together in the same field (space)*	**Crop species mixtures** *This layer describes crop species mixtures in intercropping where both crops are harvested such as strip cropping*
				Service/cover crop (spatial) *Describes growing several species in the same area but only harvest one crop whereas the other is used as soil cover during winter and or ploughed under as green manure*

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		1.1.3 Adaptation To Site Conditions	**1.1.3.1 Crop selection based on Soil Conditions**	**Agrochemical** *Planting crops while considering soil nutrient levels and chemical properties, such as pH, salinity, and the presence of residual chemicals (e.g., pesticides, herbicides).*
		Strategic choosing of crops and varieties that are best suited to local climate, soil, and environmental conditions, as well as adapted to infested areas. This strategic selection reduces the need for inputs like water and fertilisers and increases the crop's resilience to pests and diseases.	*The practice of selecting crops based soil attributes such as texture, structure, fertility, and moisture to optimise crop health and reduce pest risks*	*Matching crops to these agrochemical conditions ensures that plants can thrive and resist pests, while minimising the risk of chemical imbalances that might affect crop health and pest susceptibility.*
				Soil texture *Planting crops considering the proportion of sand, silt, and clay particles in the soil, which affects water retention, drainage, and root penetration. Strategically choosing crops suited to the specific soil texture helps optimise growth conditions and reduces plant stress, making crops less vulnerable to pests and diseases.*
				Soil structure *Planting crops considering the arrangement of soil particles into aggregates, influencing aeration, water infiltration, and root development. Good soil structure supports healthy crop growth, while poor structure can lead to compaction, root restriction, and increased susceptibility to pests. Adapting crop choices to soil structure ensures that plants have the necessary conditions to thrive and resist pest pressure.*

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				Microbiology *Planting crops considering the biological activity and diversity of microorganisms in the soil, which influence nutrient cycling, disease suppression, and overall soil health. Selecting crops that promote beneficial soil microbes or adapt well to the existing microbiological profile enhances plant health and natural pest resistance, contributing to a more balanced and resilient agro-ecosystem.*

			1.1.3.2 Crop selection based on Climatic Region, Conditions Or Factors *The practice of selecting crops based climatic region, conditions or factors*	**Climatic maps/tools/instruments** *Adapting crop or varietal choices to specific climatic regions or factors to ensure better crop performance and sustainability. This can be done by using climatic maps which help farmers to determine which crops will be best suited for their specific location, as well as tools and instruments including weather stations and other tools that offer microclimatic variability farm specific data.*
				Winter hardiness/early versus late cultivar *Selection of crop varieties based on their ability to withstand climatic extremes such as cold winters or the length of the growing season. Early cultivars are chosen for short seasons or frost-prone areas, while late cultivars can be more suitable for extended growing periods. This selection reduces crop stress, enhances resilience to climatic factors, and minimises pest-related issues linked to unsuitable environmental conditions.*

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			1.1.3.3 Crop selection based on Infested Area *The practice of selecting crops based on infested areas*	**Phytosanitary risk** *Selection of crops based on the risk of pest and disease outbreaks/pressure in a given area. This involves assessing the presence of quarantined pests, localised disease pressures, and historical pest outbreaks.*
		1.1.4 Seed/Planting Materials	**1.1.4.1 Use Of Certified Seed**	**Use of certified standard**
		Strategic use of highquality, certified seeds or planting materials that are disease-free and adapted to farm conditions. Strategic selection of seeds ensures better crop establishment, growth, and resistance to pests, reducing the need for chemical interventions. *Strategic determination of optimal sowing time, seed densities, row spacing and seeding depth to maximise crop*	*The practice of using seeds that have been officially tested and certified for quality, purity, and disease-free status*	*Use of seeds that meet official certification standards, ensuring genetic purity, varietal authenticity, and consistent quality. Certified seeds undergo rigorous testing to guarantee uniformity in growth and yield potential, reducing the likelihood of pest and disease issues associated with poor-quality or non-certified seeds.*
				Physiological value (quick emergence) *Selection of seeds with high physiological quality, characterised by quick and uniform emergence after planting. Fast-growing, vigorous seedlings are more resilient to early-season pests and diseases, and they contribute to a more successful crop establishment, reducing the need for later interventions.*

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		health and minimise pest infestations. Practices that help crops establish quickly and competitively against weeds and other pests.		**Phytosanitary quality (absence of pathogens and weed seeds)** *The use of seeds that are free from harmful pathogens, pests, and weed seeds. Certified seeds are inspected and treated to ensure they do not introduce or spread diseases and weeds into the field, significantly lowering phytosanitary risks and helping to maintain a healthy growing environment.*
			1.1.4.2 Use Of Certified Planting Material *The practice of using planting materials such as seedlings or tubers that have been certified for quality and health.*	**Use of certified standard** *Use of planting materials that meet official certification standards, ensuring genetic purity, varietal authenticity, and consistent quality.*

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			1.1.4.3 Seed Treatment *The practice of applying biological, chemical, or physical treatments to seeds before planting to protect them from pests, diseases, or soil-borne pathogens.*	**Microbial inoculants** *Treatment of seeds with beneficial microorganisms to promote early growth and enhance natural resistance to pests and diseases. Microbial inoculants help establish beneficial microbial colonies on plant roots, improving nutrient uptake and reducing vulnerability to soil-borne pathogens.*
				Steeping *Soaking seeds to promote early growth*
				Thermic *The use of controlled heat treatment to eliminate pathogens and pests from seeds without damaging their viability. Thermic treatments are particularly effective against seed-borne diseases and pests, providing a chemical-free method of reducing phytosanitary risks.*
				Botanicals

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				The application of plant-based substances to seeds to protect them from pests, diseases, or environmental stress. Botanical seed treatments use natural compounds, such as plant extracts or essential oils, which offer a sustainable and eco-friendly alternative to synthetic chemicals in protecting seeds during germination and early growth stages.
				Seed clusters *The grouping of multiple seeds into a single planting unit, which can increase the likelihood of successful establishment, particularly in challenging soil or environmental conditions. Seed clustering can also offer a buffer against early pest damage by providing a denser or more resilient plant population in the initial growth stages.*
				Electron treatment *A high-tech method that uses electron beams to disinfect seeds by inactivating pathogens without the use of chemicals. Electron treatment is a precise and environmentally friendly way to manage seed-borne pests and diseases, ensuring healthier crops while maintaining seed viability*
	1.2 Crop	**1.2.1 Sowing**	**1.2.1 Sowing Time**	**Early/late sowing/delayed sowing**

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	Establishment *Practices that involve preparing and planting of crops to ensure healthy crops.*	*Strategic adaptations in sowing operations*	*The practice of timing seed sowing to match optimal conditions for germination and growth while avoiding peak pest or disease periods to enhance crop establishment*	*Timing of planting seeds based on optimal climatic conditions and pest management goals. Early sowing takes advantage of longer growing seasons, while late or delayed sowing can help avoid peak pest periods or adverse weather conditions. Adjusting sowing times can improve crop establishment, reduce pest risks, and align with environmental factors for better overall crop performance.*
			1.2.2 Seeding Depth *The practice of planting seeds at the correct depth to ensure successful germination and seedling establishment.*	**Shallow or deep sowing** Placement of seeds at varying depths in the soil to optimise germination and seedling establishment. Shallow sowing promotes quicker emergence and can be advantageous in warmer, well-drained soils, whereas deep sowing may help seeds access moisture and protect them from surface pests, especially in dry or compacted soils.
			1.2.3 Seed Density *The practice of sowing the appropriate number of seeds per unit area. Proper seed density ensures optimal crop growth, reduces*	**Low density (disease prevention)** *The practice of planting seeds at lower densities to reduce the likelihood of disease spread and promote better air circulation between plants. Low seed density can help minimise the risk of disease outbreaks, reduce competition for resources, and improve overall plant health and yield.*

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				High density (weed prevention) *The practice of planting seeds at higher densities to create a competitive environment that suppresses weed growth. High seed density allows crops to quickly cover the soil surface, reducing light availability for weeds and improving resource use efficiency, which helps in managing weed populations and enhancing crop yields.*
			1.2.4 Sown plant spatial arrangement *The practice of arranging seeds within a field to optimise light, space, and nutrient use*	**Sowing in raised beds** *Densify the sowing over a width of 1m to 1.5 metres and leave spaces between these zones*
				Sowing three densified rows *Sowing 3 densified rows to then leave a wider between-row space*
				Sowing positioned on the row and perpendicularity *Sowing positioned on the row and perpendicularly (which allows weeding in the direction of the rows and perpendicularly)*
		1.2.2 Planting (Cuttings/Seedlings) *StrategicStrategical planning of plant*	**1.2.2.1 Plant Spatial Arrangement** *The practice of arranging*	**Row spacing** *Distance between rows of plants, designed to optimise light penetration, air circulation, and access to nutrients and water. Proper row spacing enhances crop growth, reduces competition between plants, and can also facilitate pest and disease management by allowing easier access for monitoring and treatment.*

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		(cuttings or seedlings)	*crops (e.g. seedlings)*	**Plant density**
				Number of plants per unit area, which influences competition for resources such as light, water, and nutrients. Adjusting plant density helps to balance growth, maximise yield potential, and manage pest and disease pressures. Higher densities can improve weed suppression, while lower densities may reduce disease risk.
		spatial arrangement to ensure optimal growth conditions and lower crop competition. This specifically deals with seedlings and cuttings as opposed to sowing.	*within a field to optimise light, space, and nutrient use*	**Precision seeding/(patch cropping)** *Use of advanced technologies and methods to place seeds with high accuracy in specific areas of the field. Precision seeding involves using GPS or other tools to ensure optimal seed placement and spacing, which enhances crop uniformity, improves resource use efficiency, and helps manage spatial variations in pest and disease pressure.*

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	1.3 Cultivation Techniques *Practices that involve the preparation of planting sites, such as soil preparation, harvest and crop management*	**1.3.1 Soil Cultivation** *Strategic practices that modify soil structure and composition to promote healthy root development, improve water infiltration, and suppress pests. Methods like inversion tillage, no-till, or reduced tillage are selected based on their ability to reduce soil compaction, enhance organic matter, and disrupt pest life cycles while minimising soil erosion and degradation.*	**1.3.1.1 Reduced Tillage (Non-Inversion)** *The practice that involves minimal disturbance of only the top soil. Noninversion tillage helps preserve soil structure, reduce erosion, and maintain soil health while managing pests and diseases*	**Cultivator** *A cultivator can be used for reduced tillage when equipped with shallow tines designed to break up soil crusts and control weeds without turning the entire soil profile. Effective for secondary tillage and weed control between rows after planting, maintaining soil integrity and moisture.*
				Shallow Cultivator *A shallow cultivator is designed to work the top layer of soil lightly, controlling weeds and preparing the seedbed while maintaining soil structure. Useful in reduced tillage systems to suppress weed growth without significant disturbance to the soil profile.*
			1.1.3.2 Direct Seed/ Direct Sowing *The practice of sowing seeds directly into the field without prior seedbed preparation. This method can reduce*	***Drill Planters*** *Equipment that combines seeding with fertilisation, often used in direct sowing systems to apply both seeds and fertilisers simultaneously while minimising soil disturbance.*

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			soil disturbance and pest exposure while conserving soil moisture.	***Seed Drills*** *Machines designed to place seeds into the soil at a consistent depth and spacing. They can be equipped with various types of seed metering systems to handle different seed sizes and types.*
				No-Till Seeders *Specialised equipment that allows planting directly into undisturbed soil or crop residues. These seeders are designed to create a narrow furrow or slot in the soil for seed placement, minimising soil disturbance and preserving soil structure.*

				Air Seeders *High-capacity machines that use air pressure to distribute and plant seeds over large areas efficiently. Air seeders can handle various seed types and are suitable for large-scale direct sowing operations.*

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			1.1.3.3 Plough (Inversion) *The practice of turning the soil over using a plough to bury weeds, pests, or crop residues. Inversion tillage can help manage soil-borne pests and diseases but should be used judiciously to avoid soil degradation.*	***Moldboard Plough*** *Mouldboard plough uses curved blades (moldboards) to cut into the soil and turn it over, inverting the topsoil and burying plant residues and weeds.* *Ideal for primary tillage in heavy or compacted soils, leaving a clean and inverted soil profile ready for planting.*
				Chisel Plough A chisel plough has a series of shanks or tines that penetrate the soil, breaking it up without turning it over. It is considered a form of conservation tillage as it minimally disturbs the soil layers. Used for breaking up compacted soils to allow water infiltration while maintaining soil structure and organic matter on the surface.
			1.1.3.4 Stale Seed Bed *The practice of preparing*	**Power Harrow** A power harrow uses rotating tines to finely cultivate the top layer of soil, creating a level and even seedbed while encouraging weed seeds to germinate

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				Cultivator (Tine or S-Tine Cultivator) *A cultivator with adjustable tines is used to loosen and prepare the topsoil. Tine cultivators are effective for breaking up the soil and encouraging weed seed germination without turning the soil deeply.*
		1.3.2 Crop management *strategic practices that increase crop health by managing their growth*	**1.3.2.1 Pruning** *Practice of pruning of fruit trees to manage plant health, optimise yields, and reduce pest pressure*	**Appropriate time and weather condition** *The selection of the most suitable period for pruning, based on the crop's growth stage and local climate conditions, to promote healthy plant development and minimise the risk of disease. Pruning is typically done during dormant seasons (e.g., winter for deciduous trees) or post-harvest when the plant can recover. The weather conditions are equally critical—pruning during dry periods reduces the risk of disease transmission, while avoiding wet or frosty conditions ensures that open wounds from pruning heal faster and are less prone to infection.*
			1.3.2.2 Crop topping *Practice of cutting weeds that emerge within the*	**Mechanical Topping** *Using tractor-mounted or hand-pushed mowers to cut the top portion of weeds*

			crop to reduce weed flowering and weeding capacity	**Topping with Flail Mowers or Mulchers** *Flail mowers or mulchers use rotating blades to shred weeds rather than simply cutting them. This helps break down weed biomass, which decomposes and adds organic matter to the soil.*

		1.3.3 Harvest Management *Strategic decisions around the timing, technique, and conditions of harvest to minimise pest damage, disease spread, and crop loss. Harvesting at optimal maturity, avoiding mechanical damage, and reducing moisture content all help to maintain crop quality and prevent post-harvest infestations or spoilage.*	**1.3.3.1 Advanced Harvest Technology** *Practice of using modern machinery and techniques for harvesting crops to maximise efficiency and minimise damage to both crops and soil. This includes selecting appropriate equipment and technologies that reduce pest and disease spread, improve crop quality, and optimise yield.*	**Seed destruction** *The practice of managing or destroying seeds from harvested crops to prevent them from germinating and causing future weed problems or pest issues. Seed destruction can involve various methods, such as incorporating residues into the soil, using mechanical seed destructors, or applying chemical treatments. This practice helps to reduce the seed bank in the soil and minimise the risk of persistent weed infestations or pest outbreaks in subsequent growing seasons.*
				Low impact harvest *Harvesting methods designed to minimise damage to the soil, remaining crops, and the surrounding environment. Low impact harvest techniques aim to reduce soil erosion, preserve soil structure, and avoid unnecessary disturbance. Examples include using equipment with minimal ground contact, employing controlled traffic patterns, and harvesting during dry conditions to prevent soil compaction. The goal is to maintain or enhance soil health and ecological balance while efficiently collecting the crop.*

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			1.3.3.2 Optimal Harvest Timing *Practice of scheduling harvest to optimise crop quality, yield, and resistance to pests and diseases. Proper timing can reduce losses due to overripe or under ripe crops and minimise the risk of pest infestations*	**Early/late harvest** *Decision to harvest crops either earlier or later than the standard maturation period based on market demand, crop quality, and environmental factors.* ***Early Harvest**: Involves harvesting crops before they reach full maturity to meet specific market demands (e.g., higher prices for early produce) or to avoid risks like pests, diseases, or adverse weather conditions (such as frost). Early harvesting may result in slightly lower yields or reduced flavour, but it helps secure the crop and maintain profitability.*

			or disease outbreaks.	***Late Harvest**: Involves allowing crops to mature fully or even slightly overripen for improved flavour, higher yields, or specific processing needs (e.g., wine grapes). However, delayed harvesting carries the risk of increased exposure to pests, diseases, or weather damage, so it requires careful timing.*
	1.4 Amendments *Practices that include bringing in externalities to the field*	**1.4.1.Suppressive Amendments** *Strategic additions of organic or inorganic materials to the soil that actively suppress pests, diseases, and weeds*	**1.4.1.1 Mulching** *The practice of applying organic or inorganic materials to the soil surface around plants to conserve moisture, suppress weeds, and improve soil health. Strategic mulching can also help to regulate soil temperature and reduce*	**Organic Mulch (e.g., straw, compost, wood chips)** *Organic mulch consists of plant-based materials such as straw, compost, or wood chips applied to the soil surface. Organic mulch helps improve soil structure as it decomposes, adds nutrients, and enhances moisture retention. It also suppresses weed growth and helps maintain soil temperature.* *Used in areas where enhancing soil fertility and organic matter content is desired, particularly in perennial crops or agroforestry systems.*

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	supporting directly or indirectly plant growth and fitness to reduce vulnerability to pests		*pest and disease pressure.*	**Inorganic Mulch (e.g., plastic film, gravel)** *Inorganic mulch involves non-decomposable materials like plastic films, geotextiles, or gravel applied to the soil. These materials provide excellent weed suppression and moisture retention but do not contribute to soil fertility.*
				Living Mulch (e.g., cover crops or ground cover) *Living mulch refers to cover crops or ground cover plants that grow alongside the primary crop to provide weed suppression, soil protection, and habitat for beneficial organisms. Unlike organic or inorganic mulches, living mulches remain active and can contribute to nutrient cycling.*
				Temperature Regulation Mulch
				Mulch can be used strategically to regulate soil temperature by either insulating the soil to keep it cool during hot weather or warming it up during early spring. Organic mulch provides insulation, while black plastic mulch warms the soil for faster crop establishment. *Useful in regions with extreme temperatures, where maintaining a consistent soil temperature can improve crop growth and reduce stress.*

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		1.4.2 Balanced Fertilisation *The careful and strategic application of nutrients to crops in proportions that meet their specific needs without overloading the soil or plants. Ensuring a balance between nitrogen, phosphorus, potassium, and micronutrients helps to promote healthy growth, increase resilience to pests and diseases, and reduce environmental harm such as nutrient runoff.*	**1.4.2.1 Organic Fertilisation** *The practice of applying natural, organic materials, such as compost, manure, or plant-based fertilisers, to enrich the soil and enhance plant growth. Organic fertilisation improves soil structure, promotes beneficial microbial activity, and reduces reliance on synthetic chemicals.*	**Compost (animal)** *Composted manure involves animal waste that has undergone controlled decomposition to stabilise nutrients and reduce pathogens. The composting process transforms raw manure into a safer, nutrient-rich amendment that improves soil fertility, structure, and microbial activity.*
				Compost (plant) *Compost derived from plant materials, such as crop residues, grass clippings, or food waste, rich in organic matter and nutrients. It undergoes decomposition, resulting in a stabilised product that can be applied to the soil as a natural fertiliser.*
				***G*reen manure (cover crops)** *Green manure refers to cover crops grown primarily to be incorporated into the soil to increase organic matter, improve nutrient content, and enhance soil structure.*
				These crops are typically legumes, grasses, or crucifers that fix nitrogen or provide biomass for decomposition.

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				Vermicompost *Vermicompost is produced through the breakdown of organic material by earthworms. This type of compost is highly nutrient-dense and contains beneficial microbes that enhance soil fertility and plant health. Vermicompost introduces beneficial microbes and enzymes that can suppress harmful pathogens in the soil, promoting a natural form of pest resistance. The high nutrient availability in vermicompost strengthens plants, making them less susceptible to pests and reducing the need for chemical inputs.*
				Animal Manure (Raw) es.*Raw manure is animal waste that has not undergone composting. It is typically used as a nutrient source in organic farming but requires careful management due to the potential presence of pathogens and weed seeds.* *While raw manure provides nutrients, improper use can introduce harmful pathogens or create conditions conducive to pest outbreaks. Managing the timing and application of raw manure is critical to prevent excessive nutrient build-up, which can attract pests or cause imbalances that weaken plant defence*

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			Mineral Fertilisation	**Optimised Nutrient Dosing** *Applying the correct amount of fertiliser based on soil nutrient levels and crop requirements, avoiding both over- and under-fertilisation.*
				Use of Slow-Release Fertilisers *Applying fertilisers that release nutrients gradually over time to match the crop's nutrient uptake rate.*
				Split Applications *Dividing the total amount of fertiliser required into multiple applications throughout the growing season rather than applying it all at once.*
		1.4.3 Ph Management *The strategic adjustment of soil pH levels to optimise nutrient availability and enhance plant health. Amendments like lime or sulphur are added to raise or lower the pH, respectively, ensuring that the soil environment supports strong root development and reduces the likelihood of pest infestations or*	**1.4.3.1 Liming** *The practice of applying lime or sulfur to adjust soil pH to optimal levels for crop growth. Liming raises soil pH, while sulfur lowers it, ensuring that nutrient availability and plant health are maximised while managing pest and disease risks.*	**Type of Lime (Calcium Carbonate vs. Dolomitic Lime)** *There are different types of lime used for pH management, including calcium carbonate (calcitic lime) and dolomitic lime (which contains both calcium and magnesium).*
				Application Timing *Liming should be applied at specific times of the year, ideally several months before planting, to allow for full soil pH adjustment. Timing lime application well before planting allows it to react with the soil and adjust pH levels over time. Applying lime too close to planting may not allow sufficient time for pH correction, leaving plants exposed to suboptimal pH conditions that can stress them and increase their vulnerability to pests and diseases. Early application also helps improve the activity of beneficial soil organisms that contribute to natural pest suppression*

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				Lime Particle Size (Fineness) *The fineness of lime particles determines how quickly they dissolve and neutralise soil acidity. Finer lime particles react more quickly with the soil, providing faster pH adjustment. However, coarse lime takes longer to react but has a longer-lasting effect. Choosing the right particle size ensures timely pH correction without over-application, which supports healthy root development and reduces the likelihood of pest infestation. Proper pH also enhances the availability of essential nutrients, which strengthens plant defences against pests and diseases.*
				Lime Incorporation (Depth of Application) *Lime should be incorporated into the soil to the depth where plant roots are actively growing, typically through tillage or other soil cultivation methods.*
		nutrient deficiencies.		**Interaction with Fertiliser Application** *Liming can interact with certain fertilisers, such as ammonium-based nitrogen fertilisers, affecting their availability and the overall nutrient balance.* *Liming can reduce the effectiveness of certain nitrogen fertilisers if applied simultaneously, as it can cause the volatilisation of ammonia. This interaction may lead to nutrient imbalances that weaken plant health and increase vulnerability to pests. Timing liming and fertiliser applications appropriately ensures that both pH and nutrient levels are optimal for plant growth, supporting natural pest resistance.*

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		1.4.4 Water Management *Strategic control of water inputs and drainage, such as irrigation timing and quantity, to ensure optimal soil moisture levels for crop growth. Effective water management prevents conditions that encourage pests and diseases (like excessive soil moisture) and improves plant resilience to stress, reducing the need for chemical treatments.*	**1.4.4.1 Irrigation** *Practice of applying water to crops to ensure optimal growth and yield. Effective irrigation practices, including timing, quantity, and method, help to maintain soil moisture levels, reduce stress on plants, and manage pest and disease pressures.*	**Drip irrigation** *Irrigation method that delivers water directly to the plant roots through a network of tubing and emitters. Drip irrigation ensures precise water application, reduces water wastage, and minimises weed growth and soil erosion, making it an efficient choice for managing water resources and improving crop health.*
				Automated Irrigation Systems *Use of automated technologies to manage irrigation schedules and water application. These systems can be programmed or controlled remotely to adjust watering based on crop needs, weather conditions, and soil moisture levels, enhancing water use efficiency and reducing manual labour.*
				Sensor-Based Irrigation Management *The use of sensors to monitor soil moisture, weather conditions, and crop water requirements. Sensor-based irrigation management enables precise and data-driven irrigation decisions, optimising water use, improving crop growth, and reducing the risk of over- or under-watering.*

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			1.4.4.2 Drainage *Practice of managing excess water in agricultural fields through systems like ditches, tiles, or pumps to prevent waterlogging*	

			and soil erosion. Proper drainage improves soil aeration, reduces disease risk, and creates a more favourable environment for crop growth, helping to minimise pest and disease problems.	
	1.5 Increase of natural regulation	**1.5.1 Management Of Ecological Infrastructure** *Strategic planning and maintenance of habitats and landscape features (e.g., hedgerows, flower*	**1.5.1.1 Creation Or Restauration Of Habitat For Beneficial Organisms Outside The Production Area** *Practice of establishing*	**Hedges** *Planting of dense, woody shrubs or trees along field boundaries or between fields. Hedges provide shelter and food for beneficial organisms, such as pollinators and natural predators, and can act as windbreaks and erosion controls, enhancing biodiversity*

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	Practices that encourage or introduce beneficial organisms that naturally control pest populations, and the removal of cop pest habitats, creating a balanced ecosystem in the crop environment.	*strips, buffer zones) that support beneficial organisms, such as predators, pollinators, and parasitoids. By enhancing biodiversity and creating refuges for these species, farmers can naturally regulate pest populations and reduce the need for chemical control measures. This also strengthens the farm's resilience to pest outbreaks and promotes ecosystem*	*or enhancing natural habitats, such as hedgerows, or wildflower meadows, adjacent to or surrounding agricultural fields. These habitats support beneficial organisms like pollinators, predators, and parasitoids, which help in natural pest regulation and contribute to overall ecosystem health.*	**Beetle banks** *Establishment of raised, grassy areas within or around fields to provide habitat for predatory beetles and other beneficial insects. Beetle banks offer refuge and breeding sites, supporting natural pest control and improving overall farm biodiversity.*
				Field margins *Management or creation of buffer zones along the edges of fields. Field margins can be planted with wildflowers, grasses, or other vegetation to attract and support beneficial insects, provide habitat for wildlife, and reduce the impact of agricultural practices on surrounding ecosystems.*
				Semi natural habitat (SNH) *Preservation or restoration of natural landscapes or habitats within or near agricultural areas. SNH includes areas such as woodlands, wetlands, or meadows that support diverse flora and fauna, offering critical resources and habitat for beneficial organisms and contributing to overall ecological balance.*

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				Buffer zones *Establishment of vegetated areas between fields and natural or semi-natural habitats, water bodies, or other sensitive areas. Buffer zones help to filter runoff, reduce chemical drift, and provide habitat for beneficial organisms, enhancing environmental protection and biodiversity.*
				Introduction of man made structures *(e.g. bird poles, stone mounds, polinator shelter)* *Placement of artificial structures to support beneficial organisms. Examples include bird poles for nesting, stone mounds for insect habitats, and pollinator shelters. These structures provide additional resources and habitat, enhancing the ecological function of agricultural landscapes.*
			1.5.1.2 Creation Or Restoration Of Habitat For Beneficial Organisms Inside The Production Area *Practice of incorporating*	**Flower strips** *Planting of strips of flowering plants within crop fields. Flower strips provide food and habitat for pollinators and other beneficial insects, enhance biodiversity, and can improve crop yields by promoting effective pollination and supporting natural pest control.*
			habitat features within the production area, such	

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			as flowering plants, beetle banks, or bird boxes, to attract and sustain beneficial organisms. This practice enhances biological pest control, improves biodiversity, and supports sustainable crop production within the farm.	**Preserving grass clover between rows** *Maintaining grass or clover cover between crop rows. This technique provides habitat for beneficial organisms, enhances soil structure and fertility, and reduces weed growth. It also supports natural pest control by creating a more hospitable environment for predatory insects and pollinators.*
				Provision of nesting sites (permanent herbaceous spots…) *Creation or maintenance of permanent areas within fields that provide nesting sites for beneficial organisms. This can include planting herbaceous plants or creating designated spots for nesting birds or insects. Providing such sites supports the reproduction and habitat needs of beneficial species, contributing to long-term pest management and ecosystem health.*
				Introduction of man made structures *(e.g. bird poles, stone mounds, pollinator shelter)* *Installation of artificial structures within crop fields to support beneficial organisms. These structures can include bird poles for nesting, stone mounds for insects, and pollinator shelters. They offer additional habitat and resources, enhancing the ecological value of production areas and supporting integrated pest management strategies.*

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		1.5.2 Management Of Resources To The Pest *Strategic manipulation of resources like food, water, or shelter to disrupt pest life cycles or reduce their impact on crops. This involves removing or reducing plants that serve as alternative hosts for pests, eliminating standing water that supports pest breeding, or altering crop residues to make the environment less suitable for pest survival. By managing these resources, farmers can reduce pest pressure without relying on pesticides, fostering a sustainable and integrated approach to pest control.* *Please note that this is mainly done on a landscape scale whereas more targeted*	**1.5.2.1 Removal of noncrop hosts around the parcel** *Practice of eliminating plants or plant residues that serve as alternative hosts for pests or diseases in the wider context of the arable field*	

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		measures can be found below under hygiene measures and biosecurity-management of resources to pests.		
	1.6 Hygiene measures and biosecurity *Practices that implement sanitation and preventative measures to limit the spread of pests and diseases within or between agricultural sites.*	**1.6.1 Cleaning Of Machinery And Equipment** *Strategic cleaning and disinfection of farm machinery, tools, and equipment to prevent the spread of pests, diseases, and weed seeds between fields or farms. Regular maintenance and thorough cleaning ensure that contaminated soil, plant debris, or pathogens do not transfer to new areas, helping to safeguard crop health and reducing the need for reactive pest control measures.*	**1.6.1.1 Cleaning Of Machinery And Equipment** *Practice of thoroughly cleaning and disinfecting farm machinery, tools, and equipment to prevent the spread of pests, diseases, and weed seeds between fields. Regular cleaning reduces the risk of contamination, helps maintain equipment performance, and supports overall farm biosecurity.*	**Frequency of Cleaning** *The regularity with which machinery and equipment are cleaned after use. : Regular cleaning is essential to prevent the build-up and spread of pest organisms, weed seeds, and soil pathogens. Cleaning after each use, especially when moving between fields or farms, helps stop the transfer of infestations from one area to another. The more frequently machinery is cleaned, the lower the risk of introducing new pest populations, making this a critical component of biosecurity in IPM.*
				Cleaning Techniques *The methods used to clean machinery, such as pressure washing with water or air blasting to remove soil and debris.*
				Water and Detergent Use *The use of water, disinfectants, or detergents during cleaning to remove contaminants more effectively.*
				Legal and Biosecurity Requirements

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				Regulations or biosecurity protocols that mandate certain cleaning practices for machinery, especially when moving between different areas or regions.
		1.6.2 Management Of Resources To The Pest *Strategic removal or reduction of pest and disease inoculum sources, such as infected plant material, crop residues, or alternate host plants, to prevent the spread of pests and diseases. This includes practices like crop residue management, prompt removal of diseased plants, and the destruction of pest breeding sites, which lower the risk of infestations by eliminating potential reservoirs that pests*	**1.6.2.1 Water/Soil Sanitation** *Practice of treatment and management of water and soil to eliminate or reduce pathogens, pests, and contaminants. This may include practices such as filtering irrigation water, using biocides, or implementing soil sterilisation techniques to create a healthier growing environment and minimise pest and disease risks.*	

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		rely on.	**1.6.2.2 Removal Of Inoculum Sources** *Practice of eliminating sources of pests and diseases, such as infected*	**Removal of plant debris** *Elimination of leftover plant material from previous crops, including stems, leaves, and roots. Removing plant debris helps to prevent the buildup of pathogens and pests that can overwinter or persist in residual material, reducing the risk of new*
			plant debris, crop residues, or volunteer plants, that could serve as reservoirs for future infestations (within fields). Removing these sources helps to reduce the likelihood of pest and disease outbreaks and supports overall crop health	*infections or infestations in subsequent crops.*
				Removal of infested plant parts *targeted removal and disposal of specific plant parts that are visibly infected or infested with pests or diseases. This practice prevents the spread of pathogens and pests to healthy parts of the crop or other plants, reducing the potential for widespread outbreaks and contributing to overall plant health.*
				Plant debris management *management of plant residues through methods such as composting, incorporating into the soil, or removal. Effective plant debris management helps to break down or remove sources of pathogens and pests, improving soil health and reducing the risk of disease and pest issues in future crops.*

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				Mulching/cutting of debris *practice of using mulch or cutting plant debris to manage and decompose residual material. Mulching can help suppress weed growth and promote the breakdown of plant material, while cutting debris into smaller pieces accelerates decomposition and reduces the risk of pest and disease harbouring. This approach also enhances soil moisture and nutrient availability.*

			1.6.2.3 Suppression Of Pest And Disease Reservoirs	**Weed Hosts** *Implement rigorous weed management practices, including regular removal and control, to prevent these plants from becoming reservoirs for pests and diseases. This helps limit the spread of harmful organisms into the main crop.*
				Crop Residue Management *Properly manage crop residues by removing, composting, or shredding them to eliminate potential pest and pathogen reservoirs. This reduces the risk of these organisms surviving and infecting future crops.*

				Alternate Hosts (Non-Crop Plants) *Regularly inspect and manage non-crop plants in and around the production area to prevent them from becoming reservoirs for pests and pathogens. This includes removing or treating these plants to disrupt pest life cycles.*
				Soil Reservoirs *Employ soil sanitation techniques, such as soil disinfection or solarisation, to reduce the presence of soil-borne pests and pathogens. This prevents the soil from becoming a reservoir for harmful organisms.*
				Water Sources *Ensure that water sources are kept clean and free from contaminants by using appropriate treatment methods (e.g., filtration, UV sterilisation) to prevent the spread of pests and diseases via irrigation*

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		1.6.3 Soil Disinfection *The strategic use of soil treatments (e.g., solarisation, steam, or biological control agents) to reduce or eliminate harmful pathogens and pests in the soil. Soil disinfection is employed when pest pressure is high or when transitioning between crops, ensuring a healthier growing environment. This method supports long-term pest suppression while minimising reliance on chemical fumigants.*	**1.6.3.1 Removal Of Nematodes, Soil Pathogens** *Practice of reducing or eliminate harmful nematodes and soil-borne pathogens that affect crop health.*	**Sowing plant species with Soil disinfection/ disinfection effect** *Planting biofumigant plants, release natural compounds (e.g., glucosinolates) into the soil during their growth or decomposition, which can reduce pathogen levels, disrupt pest life cycles, and improve soil health*
			1.6.3.2 Soil fumigation *Practice of applying fumigants to soil to eradicate pests, pathogens, and weed seeds before planting. Soil fumigation is used to create a pest-free environment for crops, promoting healthy plant growth and reducing the need for chemical treatments later.*	

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2.Monitoring	**2.1 Monitoring**	**2.1.1 Monitoring** *Strategic, ongoing observation and data collection on pest populations/presence, environmental conditions, and crop health. This involves regular field visits, and employing sensor technologies to detect early signs of pests or diseases. Effective monitoring provides the data needed to make timely and informed decisions on pest control measures, minimising the need for broad-spectrum interventions.*	**2.1.1.1 Drone-Based Crop And Pest Monitoring** *Practice of using drones equipped with cameras and sensors to capture real-time data on crop health, pest populations, and field conditions. Drone-based monitoring provides detailed, aerial views that help in early detection of issues, enabling timely and precise management actions.*	**Drone Type and Specifications** *The specific model and technical features of the drone used for monitoring, such as camera resolution, sensor types (e.g., multispectral, thermal), and flight duration.* *Choosing a drone with high-resolution cameras and suitable sensors is crucial for capturing detailed images and data, which improves the accuracy of pest and crop health assessments. Advanced drones can provide more precise information on pest distribution and crop condition.*
				Flight Planning and Scheduling *The planning of drone flight paths, including timing, frequency, and altitude of flights to optimise data collection.* *Effective flight planning ensures that drones cover the entire crop area at the right times, such as during peak pest activity or critical growth stages. Proper scheduling can enhance the detection of pest outbreaks and crop issues.*

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				Integration with Other Monitoring Systems *The use of drone-collected data in conjunction with other monitoring systems, such as ground-based sensors, weather stations, or remote sensing technologies. Integrating drone data with other monitoring tools provides a comprehensive view of pest and crop conditions, allowing for more effective and coordinated IPM strategies.*
				Calibration and Maintenance *Regular calibration and maintenance of drones and their sensors to ensure they function correctly and provide accurate data* *Regular calibration and maintenance help maintain the accuracy and reliability of the drone's data collection. This prevents issues that could lead to incorrect pest and crop assessments.*
			2.1.1.2 Field Observations *Practice of regularly inspecting fields to assess crop health, pest*	**Visual inspection of plants** *Examination of crops by visually assessing plant health, growth, and symptoms of pests or diseases. Regular visual inspections help in early detection of issues, allowing for timely interventions and management practices to mitigate potential damage and improve crop yields*

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			presence/pressure?, and environmental conditions. Field observations provide critical, hands-on information that informs pest management decisions and helps in detecting problems early.	
				Soil survey *Systematic collection and analysis of soil samples to assess soil health, structure, and nutrient content. A soil survey provides critical information for making informed decisions on soil management practices, identifying potential pest and disease risks, and optimising crop growth conditions.*
				Visual inspection of plant debris *observation of plant residues left in the field to identify signs of pest infestations or disease presence. Inspecting plant debris helps in managing and removing sources of inoculum, thereby reducing the risk of pest and disease transmission to current or future crops.*
			2.1.1.3 Remote Sensing *Practice of using satellite or aerial imagery and sensors to monitor large areas of farmland for crop health, pest activity, and environmental factors. Remote sensing enables efficient, large-*	**Remote Sensing Technology and Sensors** *The types of sensors and technology used in remote sensing, such as multispectral, hyperspectral, thermal, or radar sensors, and their specifications. Selecting the appropriate sensor technology is crucial for capturing the necessary data. Multispectral sensors, for example, are effective for detecting plant health and stress, while thermal sensors can help identify areas of temperature variation that might indicate pest infestations.*

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				Resolution and Scale *The spatial, spectral, and temporal resolution of remote sensing data, which affects the detail and accuracy of the information captured. High-resolution data provides detailed imagery of the crop and pest conditions, allowing for more precise monitoring and analysis. Proper scale ensures that data can be effectively used to assess specific areas of interest within the field.*
			2.1.1.4 Monitoring With Traps *Practice of placing and using traps to monitor pest populations and activity levels. Traps provide valuable data for assessing pest pressure, timing control measures, and evaluating the effectiveness of pest management strategies.*	**Visual attractants** *Objects or colours used in traps to attract pests through visual cues. These can include brightly coloured surfaces, patterns, or shapes that mimic natural stimuli or create contrast to draw pests to the trap.*
				Olfactory attractants (pheromones and feeding attractants) *Substances or compounds used in traps to attract pests through scent. These can be pheromones, food scents, or other chemical attractants that mimic natural smells that pests are drawn to.*

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				Smart traps *Advanced traps equipped with technology such as sensors, cameras, or data collection systems that can provide real-time monitoring and data analysis. Smart traps often connect to networks or databases to track and report pest activity automatically.*

		2.1.2 Assessment *The strategic evaluation of the data collected during monitoring to determine the severity and potential impact of pest populations on crops.*	**2.1.2.1 Monitoring Reports**	**Country level reports**
			2.1.2.2 Advisory Service *Practice involving expert guidance and recommendations on pest management practices, crop protection, and sustainable farming*	**Expertise and specialisation** *The level of knowledge and expertise provided by advisory services, including the specialisation of advisors in areas such as pest identification, crop management, and IPM strategies. Access to expert advice ensures that pest management decisions are based on the latest research and best practices. Specialised knowledge helps in addressing specific pest issues and tailoring IPM strategies to meet individual farm needs.*

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			techniques. Advisory services typically include consultations, technical support, and tailored solutions to help farmers implement effective IPM strategies.	**Customisation and recommendations** *The extent to which advisory services provide tailored recommendations based on the unique conditions and requirements of the farm or crop in question* *Customised recommendations ensure that advice is relevant and applicable to the specific pest and crop conditions. This personalised approach enhances the effectiveness of IPM strategies and improves pest management outcomes.*
				Follow up and support *The provision of ongoing support and follow-up services after initial advice has been given, including monitoring the effectiveness of implemented strategies and providing additional guidance as needed.* *Follow-up and support help in assessing the success of pest management strategies and making necessary adjustments. Continuous support ensures that farmers receive the assistance they need throughout the pest management process.*

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			2.1.2.2 Molecular detection tools *Practice of using advanced techniques, such as PCR (Polymerase Chain Reaction) or DNA sequencing, to detect and identify pests, pathogens, or genetic traits at a molecular level. These tools provide precise, early detection of pests and diseases, enabling targeted and effective management actions.*	**DNA based analysis** *Techniques that utilise DNA sequences to identify and characterise pests, pathogens, or other organisms. This can include methods such as Polymerase Chain Reaction (PCR), quantitative PCR (qPCR), and DNA sequencing.*
				Enzyme based analysis *Methods that involve detecting specific enzymatic activities associated with pests or pathogens. This can include enzyme-linked immunosorbent assays (ELISA) and other enzyme-based assays that identify pest or pathogen presence through enzymatic reactions.*
			2.1.2.3 Geomorphometric analysis for pest management	

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			Practice of applying statistical methods to analyse the shape and size of biological organisms, including pests and beneficial insects. Geometric morphometry helps in understanding pest morphology and behaviour, which can inform targeted control measures and improve pest management strategies.	
			2.1.2.4 Identification of pest and diseases	**Pest identification keys**
		2.1.3 Prognosis and forecast	**2.1.3.1 Disease and forecast models**	**Weather conditions**
			2.1.3.2 Disease prediction models	

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3. Decision making	**3.1 Decision Support Systems & Thresholds** *Practices such as tools or software that provide datadriven recommendations to guide pest management decision based on predicted and observed pest pressures, including thresholds for interventions (inherently linked to monitoring)*	**3.1.1 Prediction And Warning (Seasonal)** *Strategic use of predictive models that integrate monitoring data, historical trends, weather patterns, and pest biology to forecast potential pest outbreaks or disease pressure. Modelling allows farmers to anticipate and prepare for pest issues before they escalate, ensuring that preventive measures or targeted interventions are applied in a timely manner, reducing crop losses and reliance on chemical controls.*	**3.1.1.1 Use Of Pest And Disease Prediction Models** *Practice of applying models that forecast and predict pest and disease outbreaks based on historical data, environmental conditions, and pest biology. These models help in anticipating future pest pressures and planning timely interventions to mitigate potential impacts.*	**Thresholds** *Thresholds refer to the specific levels of pest or disease indicators (such as population density or infection rates) that trigger a predefined response or intervention. These thresholds are established based on predictive model outputs and historical data to determine when management actions should be implemented.* *Please see also thresholds under 3.1.3*
				Warning and Alert Systems *Warning and alert systems are mechanisms integrated with pest and disease prediction models that provide timely notifications to farmers and pest managers when predicted pest or disease conditions reach critical levels or exceed predefined thresholds. These systems use real-time data, model outputs, and historical information to generate alerts that prompt immediate action or further monitoring.*
			3.1.1.2 Use Phenological Prediction Models *Practice of using models that predict the timing of pest and crop development stages*	**Growth stages prediction according to local climatic conditions** *Growth stages prediction involves using phenological prediction models to estimate the development phases of crops or pests based on local climatic conditions. This process integrates real-time weather data, historical climatic patterns, and model algorithms to forecast specific growth stages, such as flowering, fruiting, or pest life*

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			based on environmental conditions and historical patterns. Phenological models assist in aligning management practices with critical growth stages and pest activity periods.	*cycle stages, tailored to the local environment.*
			3.1.1.3 Use Water Monitoring And Prediction Modelling *Practice of using monitoring and modelling of water resources to predict their impact on pest and disease dynamics. This includes assessing soil moisture, irrigation patterns, and water availability to manage related pest risks and optimise water use in crop production*	**Real time monitoring of field water capacity** *Real-time monitoring of field water capacity involves continuously measuring and analysing the amount of water available in the soil at any given moment. This is achieved using various sensors and technologies that provide immediate data on soil moisture levels, water holding capacity, and field conditions.*
		3.1.2 Predictive Farm Systems (Long Term/Systemic)	**3.1.2.1 Modelling And Risk Assessment (Long Term)**	***Risk Factor Analysis***

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			Use of long-term models to assess and predict risks related to pests, diseases, and environmental factors over extended periods. This approach supports long-term planning and risk management, helping to anticipate future challenges and implement sustainable solutions.	
		3.1.3 Thresholds	**3.1.3.1 Thresholds** *Practice of establishing pest population levels or damage thresholds at which control measures should be implemented. Thresholds help to avoid*	**Thresholds for biological intervention** *Threshold for biological intervention refers to the point at which natural enemies (e.g., predators, parasitoids, or beneficial microorganisms) or biological control agents are introduced or supplemented to control pest populations. This threshold is determined by monitoring pest densities and evaluating whether natural regulation alone is sufficient to maintain pest levels below economic thresholds.*

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			unnecessary treatments and ensure that pest management actions are taken only when necessary, based on economic and practical considerations.	**Thresholds for chemical intervention** *Pest population level or damage extent at which the use of chemical pesticides becomes necessary to prevent economic loss. This threshold is typically based on pest monitoring and prediction models and aims to apply pesticides only when the potential damage exceeds acceptable leve***ls.**
			Please see also under	

4. Biological, physical and other non chemical methods	**4.1 Biological Control** *Practices that introduce beneficial organisms, such as predators, parasites, or pathogens, as well as other plants/crops with naturally repellent effects to manage pest populations* *Please see also*	**4.1.1 Supplemental Release Of Live Beneficials** *Practice of introducing beneficial organisms, such as predators or parasitoids, into the crop environment to enhance natural pest control. Supplemental releases are timed and targeted to augment existing populations and improve overall pest management effectiveness*	**Release of Macrofauna (e.g. above ground arthropod predators)** *Macrofauna refers to larger beneficial organisms released into the environment to manage pests. These include predators such as ladybirds, lacewings, and spiders, which are visible to the naked eye and play a significant role in controlling pest populations*	**Carabid predators**

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	increase of natural regulation for encouragement of beneficials and biotechnical control for technologically harnessing biological mechanisms			
			Release of Microflora and Fauna (bacteria, fungi, nematoda) *Microflora refers to beneficial microorganisms such as bacteria and fungi, while microfauna includes tiny soil-dwelling organisms like nematodes and protozoa. These organisms can be released to enhance soil health and biological control.*	**Entomopathogenic nematodes**
	4.2 Bioltechnical Control	**4.2.1 Attractants And Repellents (natural)** *The strategic planting*	**4.2.1.1 Planting Of Repelling/Disturbing Plants**	**Strips** *Strip planting involves establishing a continuous row or band of repellent plants within or around the crop field. These strips can act as a barrier or deterrent to*

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	Practices that use biological or behavioural mechanisms, like pheromone traps or mating disruption, to interfere with pest reproduction or behaviour without relying on toxic chemicals.	*of attracting and repelling plants to attract beneficial organisms or repel pests.*	*Practice of planting certain crops or plants that deter or disrupt pest activity through natural repellent properties or physical barriers. This practice helps to reduce pest pressure and protect main crops from damage.*	*pests, reducing their access to the main crop.*
				Spots *Spot planting refers to planting repellent plants at specific locations within the crop field, rather than in continuous strips. These locations are strategically chosen based on pest activity or known problem areas to maximise the repellent effect.*
				Push-pull strategies *The "push" component involves using repellent plants or other methods to push pests away from the main crop, while the "pull" component uses attractive plants or traps to draw pests away from the main crop and concentrate them in specific areas where they can be more easily managed or controlled.*

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		4.2.2Attractants And Repellents(other) *The strategic use of substances, such as pheromones, plant extracts, or essential oils, to attract beneficial organisms or repel pests. Attractants are*	**4.2.2.1 Use Of Pheromone Traps** *Practice of deploying traps that use synthetic pheromones to attract and capture specific pest species. Pheromone traps are used for monitoring pest populations,*	**Mass trapping** *Mass trapping involves using pheromone traps to capture large numbers of target pests over a wide area. The traps are designed to attract and hold pests using synthetic pheromones that mimic the mating signals of the pests*

				Mating disruption *Mating disruption involves using pheromone traps to interfere with the mating behaviour of pests. By releasing synthetic pheromones in the environment, the traps create confusion among pests, making it difficult for them to locate mates and reproduce effectively.*

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			4.2.2.2 Other (Olfactory) Attractants/Repellents	**Ultrasound** *Repelling Pests: Ultrasound can be used to repel a range of pests, including rodents, insects, and birds. The sound waves can interfere with the sensory and communication systems of pests, making areas less attractive or habitable to them.* *Behavioural Disruption: For some pests, ultrasound can disrupt key behaviours such as mating, foraging, or navigation. This disruption can reduce pest activity and population growth, contributing to overall pest management goals.* *Preventing Infestations: By creating an environment that is unpleasant or inhospitable for pests, ultrasound can prevent infestations before they occur. This preemptive approach can help in maintaining pest-free conditions and reducing the need for more intensive control measures*
		4.2.3 Stimulation And Interference *The strategic activation of beneficial organisms*	**4.2.3.1 Plant Resistance Activatio***n* *Practice of stimulating a plant's inherent defence*	**Induced resistance** *induced resistance refers to the activation of a plant's defence mechanisms in response to specific stimuli, such as exposure to certain pathogens, pests, or environmental conditions.*

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				Use of Elicitors *Elicitors are substances that trigger the plant's defence responses. They can be natural or synthetic compounds that stimulate the plant's immune system to activate resistance mechanisms.*
			4.2.3.2 Ozone treatment (abiotic interference)	**Exposure levels**
			4.2.3.3 UV light (abiotic interference)	**Exposure levels**
		4.2.4 Engineering of biocontrol agents	**4.2.4.1 Release of sterilised insect pests or organisms**	**Mating interference**
	4.3 Physical Control *Practices that*	**4.3.1 Barriers** *Strategic use of physical structures, such as nets, fences, or row covers,*	**4.3.1.1 Barriers: Natural Materials** *Practice of using natural materials, such as plant*	**Straw barrier** *Straw barriers involve laying down straw bales or mats in a specific area or wrapping straw around tree trunks to create a physical obstruction. These barriers are used to prevent or limit the movement of pests, such as rodents or insects*

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				Chalk barrier *Chalk barriers involve the application of powdered chalk or similar substances around a plant or area to create a physical or visual deterrent for pests. Chalk can act as a repellent by affecting the pests' movement or interaction with the treated area.*
				Salt barrier *Salt barriers involve using salt or saline solutions to create a barrier around plants or fields. Salt can deter pests such as slugs, snails, and certain insects by creating an inhospitable environment.*
			4.3.1.2 Barriers: Other Physical *Practice of using nonnatural physical barriers, such as nets, screens, or fences, to protect crops from pests. These barriers physically prevent pests from accessing the plants, reducing the need for chemical controls and*	**Electric fences** *Electric fences use electrically charged wires or barriers to create a physical and electrical deterrent for pests. These fences are designed to deliver a mild shock to deter animals such as deer, rabbits, and other wildlife from entering protected areas.*
				Nets *Nets are physical barriers made from various materials (e.g., mesh, fabric) that are placed over plants or around areas to prevent pests from reaching the crops. Nets can be used to protect against insects, birds, and other small animals.*

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			supporting integrated pest management.	Insect capture channels around fields
		4.3.2 Thermal Control (Excluding Thermal Seed Treatment) *The strategic use of heat or cold to control pest populations by directly killing or inhibiting the development of pests. Techniques include solarisation (heating soil using plastic covers), flame weeding, or cold storage to manage pests in specific areas. Thermal control is a non-chemical method that reduces pest presence by*	**4.3.2.1 Heat Killing Of Pests And Diseases** *Practice of using high temperatures to eliminate pests and pathogens. This can include methods such as steam treatments or heat chambers to manage pest populations and reduce pathogen loads in soil, plant materials, or equipment.*	**Thermal weed control** *Application of heat to control weed populations. This can be achieved through methods such as flame weeding or hot water treatments, which target weeds by overheating their tissues. Thermal weed control effectively reduces weed competition without the use of chemicals, promoting healthier crop growth.* **Soil sterilisation: steam** *use of steam to disinfect soil by killing pathogens, pests, and weed seeds through high-temperature treatment. Soil sterilisation with steam improves soil health and reduces the risk of soil-borne diseases, creating a more favourable environment for crop growth.*

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		targeting their vulnerabilities to temperature extremes.		**Decontamination of amendments (of soil, planting materials, compost etc)** *application of heat to disinfect and decontaminate soil, planting materials, or* *compost. This process involves using heat treatments to kill harmful pathogens, pests, or weed seeds present in these materials, ensuring that they do not negatively impact crop health or soil quality when used in the field.*

			4.3.2.2 Temperature Management *Practice of regulating environmental temperatures to optimise crop growth and minimise pest and disease risks. This includes practices such as using climate control systems in greenhouses or adjusting field operations to mitigate temperature-related pest problems.*	**Temperature control/ plasticulture** *Temperature control in plasticulture refers to the use of plastic materials and structures, such as plastic tunnels, greenhouses, or row covers, to regulate the temperature around plants. These structures help to create a controlled microclimate that can enhance plant growth, extend the growing season, and protect plants from extreme temperatures.*
				Cold storage temperatures to kill pests in fruit storage *The use of low temperatures, typically achieved through refrigeration or freezing, to manage and kill pests in stored fruit. This method involves maintaining fruit at temperatures that are below the threshold required to control or eradicate pest populations, such as insects or larvae, that may infest the fruit during storage.*

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		4.3.3 Mechanical removal of pests *The strategic use of mechanical approaches to physically remove, kill, or inhibit pests. This includes practices like handpicking, mowing, or using machinery to disrupt pest habitats or remove weeds. Mechanical control provides direct intervention with*	**4.3.3.1 Mechanical Weeding** *Practice of using physical methods, such as hoes, tillers, or weed pullers, to remove weeds from the crop area. Mechanical weeding helps to reduce weed competition, manage weed-borne pests and diseases, and minimise reliance on chemical herbicides.*	**Hand or machine** *Removal of weeds using either manual methods (hand weeding) or mechanical equipment (machine weeding). Hand weeding involves manually pulling out weeds, while machine weeding uses tools such as cultivators or weeders to efficiently remove weeds from larger areas. Both methods aim to reduce weed competition and improve crop growth.*
				Physical removal, electrical, burning *Physical Removal: The direct extraction or cutting of weeds from the soil, either by hand or with mechanical devices. This method helps to physically disrupt and remove weeds without altering the soil structure significantly.*

		minimal environmental impact. *The strategic use of brightly coloured traps or reflective surfaces, and light to lure pests, particularly insects, into traps or away from crops. These attractants exploit the pests' natural responses to visual cues, allowing for effective monitoring or direct pest control.*		*Electrical: The use of electrical currents to target and kill weeds. Electrical weeding systems apply a controlled electric charge to the weeds, effectively destroying their tissues and roots without significant impact on the surrounding soil or crops.* *Burning: The application of heat through controlled burning to destroy weeds. This method uses flames or hot air to incinerate weeds and their seeds, reducing weed populations and preventing them from spreading.*
				Weeding between rows

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			4.3.3.2 Robotic removal of pests and weeds *Practice of deploying robotic systems designed to detect and remove pests and weeds from crops. These robots use sensors and automated mechanisms to identify and target pests, providing precise and efficient pest management with minimal environmental impact.*	
		4.3.4 Visual Attractants	**4.3.4.1 Mass Trapping** *Practice of using large numbers of traps to capture and reduce pest populations. Mass trapping is employed to decrease pest numbers, monitor pest activity, and prevent pests from reaching economically*	**Coloured traps** *Traps designed with specific colours to attract and capture target pests. The use of colours can exploit the visual preferences of certain insect species, increasing the effectiveness of the traps in capturing pests and monitoring pest populations.*
				Coloured sticky traps

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			damaging levels.	**Pan traps** *Traps that consist of shallow, open containers filled with attractants or water. Pan traps capture insects that are lured by the attractants or fall into the container inadvertently. They are commonly used for monitoring and managing various pest species.*
				Light traps *Traps that use light sources, such as ultraviolet (UV) or incandescent bulbs, to attract nocturnal or flying insects. Insects are drawn to the light and are then captured or killed by the trap. Light traps are effective for monitoring and controlling a range of pest species, particularly those active at night.*
				Sticky traps *Traps coated with a sticky adhesive that captures insects when they come into contact with the surface. Sticky traps are used to monitor and control pest populations by capturing flying or crawling insects, and they can help in early detection of pest issues.*

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	4.4 Natural Substances *Practices that use of nonchemical alternatives (e.g., plantbased oils, natural extracts, or mechanical devices) to replace conventional pesticides in managing pests*	**4.4.1 Natural Substances** *The strategic use of natural substances such as biopesticides and biofertiliser to manage pests in sustainable and environmentally friendly manner.*	**4.4.1.1 Essential Oils And Plant Extracts** *Practice of using of natural oils and extracts derived from plants with known pest-repellent or insecticidal properties. These substances can be used as alternatives to synthetic chemicals to manage pests while supporting sustainable and environmentally friendly pest management practices.*	**Seed treatments** *The application of essential oils or plant extracts to seeds before planting, aimed at protecting the seeds from pathogens, pests, and enhancing seedling vigour. This method involves coating or soaking seeds in these natural substances to prevent disease and improve germination rates.*
				Foliar/plant protection *The use of essential oils or plant extracts applied to the leaves of plants to protect them from pests, diseases, and environmental stress. This involves spraying or misting these natural substances onto the foliage to create a protective barrier or induce plant resistance.*
			4.4.1.2 Bio-Pesticides/Botanical Pesticides *Practice of using of natural oils and extracts derived from plants with known pest-repellent or insecticidal properties. These substances can be used as alternatives to synthetic chemicals to manage pests while supporting sustainable and environmentally*	

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			friendly pest management practices.	
			4.4.1.3 Bio-Fertiliser/ Bio Products *Practice of using of natural oils and extracts derived from plants with known pest-repellent or insecticidal properties. These substances can be used as alternatives to synthetic chemicals to manage pests while supporting sustainable and environmentally friendly pest management practices.*	
5. Pesticide Selection	**5.1 Pesticide Selection**	**5.1.1 Pesticide Selection** *The strategic process of choosing the most appropriate pesticide based on its efficacy, and mode of action while considering its impact on the environment, non-target organisms, and human health.*	**5.1.1.1 Mixing Substances** *Practice of combining different pest management substances or products to enhance efficacy, or address multiple pest issues. This approach involves careful formulation and application to ensure compatibility and*	

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		Strategic selection aims to optimise pest management outcomes, minimise ecological disruption, and prolong the effectiveness of pest control measures.	*maximise effectiveness.*	
			5.1.1.2 Single-Substance Choice *Practice of selecting and using a single pest management substance or product to address specific pest issues. This approach simplifies pest control practices and reduces complexity, focusing on a targeted solution for particular pest problems.*	**Choosing least harmful pesticide** *The practice of selecting a pesticide that poses the lowest risk to humans, animals, beneficial organisms, and the environment, while still being effective against the target pest. This involves evaluating the relative toxicity, persistence, and ecological impact of different pesticides to make an informed decision that aligns with integrated pest management (IPM) principles.*
				Choosing most specific pesticide The practice of selecting a pesticide selecting a pesticide that targets a particular pest or disease with minimal impact on non-target organisms. This approach prioritises precision, ensuring that the chosen pesticide has a narrow spectrum of action, focusing on the specific pest issue rather than broadly affecting other species.

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6. Reduced pesticide use	**6.1 Reduced Pesticide Use**	**6.1.1 Adapting Spraying Technology** *The strategic modification of spraying equipment and technologies, such as using precision nozzles, or employing advanced application methods, to maximise pesticide efficiency and minimise waste.* *By optimising the delivery of pesticides, these adaptations reduce the amount needed, lower environmental impact, and improve target pest control while minimising exposure to non-target species and reducing the risk of resistance development.*	**6.1.1.1 Equipment/pesticide application techniques/machineries** *Practice of selecting and using equipment and machinery for the application of pesticides and other treatments. This includes choosing appropriate sprayers, applicators, and delivery systems that optimise coverage, minimise drift, and ensure effective pest control.*	**Nozzle Selection and Calibration** *Choosing and adjusting spray nozzles to deliver the appropriate droplet size, pressure, and volume for different pesticides and crops. Proper nozzle selection and calibration ensure that pesticides are applied uniformly and accurately, reducing waste, off-target drift, and environmental contamination while enhancing pest control efficacy*
				Spray Drift Control Technologies *Utilising drift-reducing technologies like air-induction nozzles, low-drift nozzles, or shielded sprayers to minimise pesticide drift to non-target areas. Reduces the potential for pesticide exposure to surrounding ecosystems, protects beneficial organisms, and complies with environmental regulations*
				Automatic Section Control (ASC) *Equipment that automatically shuts off sections of the sprayer when overlapping areas are detected (e.g., at the end of rows). Prevents over-application of pesticides, particularly at field boundaries, reducing both costs and environmental harm*
			6.1.1.2 Mode Of Application *Practices to apply pesticides or other*	**Seed treatment/spraying** *Applying pesticides (such as fungicides, insecticides) directly to the seed before sowing. This practice aims to protect the seed and emerging seedling from earlystage pests, diseases, and soil-borne pathogens.*

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			treatments, such as spraying, drenching, or injection. The choice of mode of application impacts the efficiency, effectiveness, and safety of the treatment, influencing pest control outcomes and minimising environmental impact.	
				Foliage application *Foliar application refers to the direct spraying of pesticides onto the leaves, stems, and other above-ground parts of the plant. This method is commonly used to control pests, diseases, or nutrient deficiencies that directly affect the plant canopy.*
			6.1.1.3 Precision Application *Practice of applying pesticides or other treatments in a targeted manner to specific areas or plants based on precise requirements. Precision application technologies, such as GPS-guided systems, reduce waste, improve efficacy, and minimise non-target effects.*	**Band application** *A targeted pesticide application method that applies chemicals in narrow strips or bands along rows of crops or areas with specific pest problems. This approach reduces pesticide use by treating only the areas where pests are present, minimising exposure to non-target areas and reducing environmental impact.*
				Overall application *A comprehensive pesticide application method that covers the entire field or crop area. This method ensures uniform coverage but may result in higher pesticide use compared to band application. It is often used when pest problems are widespread or when precise targeting is not feasible.*
				Variable rate *method that adjusts the rate of pesticide application based on real-time data and varying field conditions. Variable rate application uses technology such as GPS and sensors to apply different amounts of pesticides according to factors like pest density or crop needs, optimising resource use, reducing waste, and improving pest*

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				management efficiency.
				Spot spraying- green on brown selection of weeds *A targeted pesticide application technique where chemicals are applied selectively to areas with visible weed infestations (green) while avoiding areas with healthy crops or bare soil (brown). This method focuses on treating specific problem spots, reducing overall pesticide use and minimizing impact on non-target plants and the environment.*
		6.1.2 Spray Application *The strategic adjustment of pesticide application practices, including dosage, timing, frequency, and placement, to optimise effectiveness and minimise unnecessary use. This involves applying pesticides at the most opportune times for pest control (e.g., during pest life*	**6.1.2.1 Pesticide Dosage** *Practice of determining the amount of pesticide to apply based on factors such as pest population, crop type, and environmental conditions. Proper dosage ensures effective pest control while minimising the risk of resistance development and environmental harm*	***Amount of spray liquid adapted to the crop*** *the amount of spray liquid adapted to the crop refers to the precise quantity of pesticide solution applied to a crop, tailored to the specific requirements of the crop type, growth stage, and density.*

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		stages most susceptible	**6.1.2.2 Pesticide Timing**	**Weather conditions**
		to treatment), using targeted application techniques (e.g., spot treatment), and reducing the frequency of applications based on pest monitoring data. By tailoring these practices, farmers can reduce pesticide use, decrease environmental impact, and enhance the overall efficiency of pest management strategies.	*Practice of scheduling pesticide applications to coincide with key pest life stages or environmental conditions. Timely applications improve effectiveness, reduce the need for multiple treatments, and lower the risk of pest resistance*	*Scheduling of pesticide applications based on current and forecasted weather conditions. This involves considering factors such as wind speed, temperature, humidity, and rainfall to optimise the effectiveness of the pesticide while minimizing drift, runoff, and potential harm to non-target organisms. Proper timing according to weather conditions ensures better pesticide performance and reduces environmental impact.*
				spraying in the beginning of pest population development r according to threshold *Beginning of Pest Population Development: The practice of applying pesticides at the early stages of pest infestation, before populations reach damaging levels. Timing applications at this stage helps to control pests effectively and prevent them from reaching thresholds that could cause significant crop damage.* *According to Threshold: The application of pesticides based on established economic or action thresholds, which are predetermined levels of pest populations that warrant treatment. Monitoring pest populations and applying pesticides when they reach these thresholds ensures that interventions are both timely and necessary, balancing pest control with cost and environmental considerations.*

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			6.1.2.3 Pesticide Frequency *Practice of adjusting frequency based on pest pressure, crop growth stages, and resistance management helps optimise control while minimising environmental and economic impacts.*	**Pest Population Dynamics** *Adjusting pesticide application frequency based on the population levels and lifecycle of the target pest. This involves monitoring pest numbers and determining the optimal timing for pesticide applications to manage pest populations effectively.*
				Crop Growth Stage *Modifying the frequency of pesticide applications based on the growth stage of the crop. Different growth stages may require varying levels of pest protection and thus different application frequencies.*
				Environmental Conditions *Adjusting pesticide application frequency based on environmental factors such as weather conditions, temperature, and humidity. These conditions can influence the effectiveness and persistence of the pesticide*

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			6.1.2.4 Pesticide And Adjuvants Placement *Practice of proper placement to ensure optimal coverage and penetration, improving pest control while reducing waste and potential harm to nontarget organisms.*	**Pesticide only sprayed on the outside of orchard** *Properly placing adjuvants with the pesticide to enhance absorption, adhesion, or spreadability on the target plant or pest.*

7. Antiresistance strategies	**7.1 Pesticide Selection** *Choice of pesticides to prevent pest and weed resistance to pesticides. Other practices with secondary effects on resistance, can be found under*	**7.1.1 Choice Of Active Substance And Control Agent** *Strategic choice of pesticides with different modes of action to prevent or delay the development of pest resistance. This involves rotating or mixing pesticides to reduce the likelihood that pests will adapt and become resistant, ensuring longterm effectiveness*	**7.1.1.1 Pesticide dosages (substance choice)** *Practice of calculating and adjusting the amount of pesticide applied to ensure effective pest management. Proper dosages are critical for controlling pests while avoiding overuse, resistance, and environmental damage.*	**Appropriate dosages to kill sufficient level of pest and pathogens to avoid resistance** *Ensuring Sufficient Killing to Avoid Resistance refers to the practice of adjusting the amount of pesticide applied to ensure it is effective enough to kill the majority of the pest population. This strategy prevents a sub-lethal dose that could allow pests to survive, reproduce, and develop resistance.*

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	crop rotations where the main aim is to prevent and suppress pests.	*of pest control measures*	**7.1.1.2 Timing of pesticide application** ***Practice of scheduling pesticide applications to maximise*** *effectiveness and minimise risks. This involves considering pest life cycles, environmental conditions, and crop growth stages to optimise pest control and reduce potential adverse effects.*	**Targeting Early Pest Stages:** *Applying pesticides at the most vulnerable stage of the pest's life cycle, typically when the population is young and more susceptible to control. Early intervention helps reduce the overall pest population before it becomes harder to manage, and can prevent resistant individuals from surviving and reproducing*
				Timing Based on Pest Thresholds *Using economic thresholds or pest population monitoring to determine the optimal time for pesticide application. Applying pesticides only when necessary (above threshold levels) reduces the frequency of applications and the selective pressure for resistance development*
				Avoiding Late Application *Preventing applications when the pest population is already well-established or at the peak of its lifecycle. Late-stage pests are often more resilient, and treatment at this time can lead to survival of resistant individuals, driving resistance development.*

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			7.1.1.3 Pesticide *Replacement/Rotation* ***Practice of alternating*** *or replacing different pesticides or modes of action to manage resistance and enhance efficacy. Rotation reduces the likelihood of pests developing resistance and helps maintain effective pest control over time.*	**rotating different mode of actions in active ingredients** *alternating between pesticides with different mechanisms by which they affect pests (referred to as Modes of Action, or MoA). This approach helps to delay the development of resistance in pest populations by reducing the selective pressure that would favour the survival of pests resistant to a single MoA.*
			7.1.1.4 Pesticide Mixtures (Mixtures Of Moa) *Practice of combining pesticides with different modes of action to enhance efficacy and manage resistance. Mixtures help to address a broader spectrum of*	**Compatibility of Active Ingredients** *ensuring that the active ingredients in a pesticide mixture do not interact negatively with each other, leading to reduced efficacy or phytotoxicity (plant damage). Incompatible mixtures can reduce pest control efficiency or harm crops, so it is critical to verify that all components work synergistically or at least do not interfere with one another.*

				Dosage adjustment *When mixing pesticides, dosage rates may need to be adjusted to ensure that the combined effect does not lead to overdosing or underdosing of either active ingredient*

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8. Evaluation	**8.1 Documentation And Reporting** *Strategic choice of pesticides with different modes of action to prevent or delay the development of pest resistance. This involves rotating or mixing pesticides to reduce the likelihood that pests will adapt and become resistant, ensuring longterm effectiveness of pest control measures*	**8.1.1 Record Keeping** *Practice of maintaining detailed and accurate records of pest management activities, including pesticide applications, timings, dosages, and environmental conditions. Record keeping supports effective monitoring, compliance, and future decisionmaking.*	**8.1.1.1 Maintaining detailed activity logs** *Maintaining comprehensive logs of all pest control activities, including pesticide application, biological control releases, and monitoring data. Provides a clear history of interventions, helping to assess the effectiveness of various strategies and comply with legal standards.*	**Pesticide application documentation** *Keeping detailed records of pesticide types, quantities, application dates, and target areas.*
				Fertiliser application documentation
				Fungicide application documentation
				IPM measure implementation documentation
			8.1.1.2 Maintaining Pest Monitoring Records	**On farm monitoring records**

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			Documenting pest populations and thresholds observed over time. Enables trend analysis, allowing timely and informed decisions to prevent outbreaks while avoiding unnecessary pesticide use.	
		8.1.2 Reporting Systems *Practice of using systems and processes for documenting and communicating pest management activities, outcomes, and observations. Reporting systems facilitate information sharing, compliance with regulations, and continuous*	**8.1.2.1 Use standardised reporting format** *Using a uniform template or system for reporting IPM activities and outcomes. Ensures clarity, consistency, and easy interpretation of data for all stakeholders, enabling more informed decisions*	**Standardised reporting across regions/countries**

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		improvement in pest management practices.	**8.1.2.2 Use Digital reporting systems** *Utilising digital platforms, mobile apps, or software to input and track pest management data in real-time. Streamlines data collection and*	**Farm internal use of data**
			sharing, allowing for realtime adjustments and improving responsiveness to pest pressures	
			8.1.2.3 Risk assessment reports *Summarising the risks identified through monitoring, such as potential pest outbreaks or pesticide resistance. Allows stakeholders to understand current and future risks, aiding in the development of proactive management plans.*	**Pest and disease reports**

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			8.1.2.4 Data Sharing Platforms *Practice of using digital platforms and tools for sharing pest management data among stakeholders, including farmers, researchers, and advisory services. Data sharing enhances collaboration, improves decision-making, and supports broader pest management efforts*	
	8.2 Impact Assessment *The strategic evaluation of the outcomes and effectiveness of pest management practices on crop health, pest populations, societal and environmental conditions. This involves analysing*	**8.2.1 Efficacy Evaluation** *Practice of assessing the effectiveness of pest management practices and treatments. Efficacy evaluation involves analysing outcomes, comparing results with objectives, and making adjustments to improve future pest control strategies.*	**8.2.1.1 Performance measurement** *Efficacy evaluation helps determine whether the selected pest management approach is performing as expected. It ensures that the strategy is effectively reducing pest populations and protecting crops.*	**Fungicide efficacy**
				Herbicide efficacy

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	the efficacy of pest control measures, measuring changes in pest incidence, assessing economic returns, and evaluating environmental or societal impacts. Impact assessment helps to determine the success of implemented	***8.2.2 Environmental Assessment*** *Practice of evaluating the environmental impacts of pest management practices. This includes assessing effects on non-target organisms, soil health, water quality, and overall ecosystem balance to ensure sustainable and responsible pest management.*	**8.2.2.1 Assess Long-Term Environmental Sustainability** *The overall sustainability of pest management practices in terms of their long-term impact on the environment. Evaluating practices for their ability to maintain environmental health and resilience over time is crucial*	
			8.2.2.2 Assess Impact on Biodiversity *The effects of pest management practices on the diversity and abundance of plant and animal species in the environment. Assessments should consider whether practices help conserve or negatively affect biodiversity, including non-target species and beneficial organisms.*	

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			8.2.2.3 Assess Soil Health and Structure *The impact of pest management practices on soil properties, including soil health, structure, and fertility. Practices that affect soil erosion, nutrient content, or microbial communities need to be evaluated for their long-term effects on soil quality.*	

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			8.2.2.4 Assess Ecosystem Services *The effects of pest management practices on ecosystem services such as pollination, natural pest control, and nutrient cycling. Practices should be evaluated for their impact on these essential services that support agricultural productivity and environmental health*	

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			8.2.2.5 Assess Water Quality *The potential effects of pest management practices on water resources, including surface water and groundwater. This includes assessing risks of pesticide runoff, contamination, and impacts on aquatic ecosystems.*	

		8.2.3 Societal Assessment *Practice of evaluating the social implications of pest management practices, including impacts on human health, community well-being, and public perception. Societal assessment helps ensure that pest management strategies align with*	**8.2.3.1 Equity and Access** *The accessibility and affordability of pest management practices for different segments of society, including smallholder and resource-limited farmers. Ensuring equitable access and addressing disparities can impact societal acceptance and implementation.*	

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		social and ethical considerations.	**8.2.3.2 Cultural and Social Values** *The alignment of pest management practices with cultural and social values or practices. Respecting and incorporating local knowledge, traditions, and practices can improve societal acceptance and effectiveness.*	
			8.2.3.3 Education and Awareness (e.g. farmers round tables) *The availability of*	

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			education and training for farmers and communities about IPM practices and their benefits. Increasing awareness and knowledge can lead to better adoption and more positive societal outcomes.	
		8.2.4 Economic Assessment *Practice of evaluating the economic outcomes of pest management practices, including cost-effectiveness, return on investment, and financial impacts on farming operations. Economic assessment helps optimise resource use and support financially*	**8.2.4.1 Assess Labour Costs and Expertise** *The cost and availability of skilled labour to implement and manage IPM practices can impact economic assessments. More sophisticated IPM methods may require specialised knowledge and training*	
			8.2.4.2 Availability of Subsidies and Support	

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			Financial support, grants, or subsidies for implementing certain IPM practices can affect the economic feasibility. Availability of such support can make otherwise costly practices more viable.	
		sustainable pest management strategies.	**8.2.4.3 Environmental Impact and Regulation** *Environmental regulations and potential costs related to compliance (e.g., for reduced pesticide use or sustainability certifications) can affect the economic assessment. Practices that reduce environmental impact may also offer financial incentives or subsidies.*	

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			8.2.4.4 Assess Long-Term vs. Short-Term Costs *Some IPM practices may have higher upfront costs but provide long-term benefits, such as reduced pesticide use or improved*	**On farm IPM implementation cost assessment**

			soil health. Evaluating both short-term and long-term costs and benefits is essential for a comprehensive economic assessment.	
			8.2.4.5 Market Prices and Economic Conditions *Fluctuations in market prices for crops and changes in economic conditions can impact the profitability of pest management practices. Assessments need to account for current and projected market conditions to evaluate the economic feasibility of different strategies.*	

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			8.2.5.6 Crop Value and Yield *The economic value of the crop being protected and the potential yield loss due to pests are critical factors. Higher-value crops or those with higher yield potential may warrant more investment in pest management to protect economic returns.*	**Market evaluation of crop and crop quality**
			8.2.4.7 Cost of Control Measures *The cost of various pest control methods, including pesticides, biological controls, and cultural practices, affects the overall economic assessment. This includes direct costs (e.g., purchase of chemicals, labour) and indirect costs (e.g., potential disruption to other farm operations).*	**On farm IPM implementation cost**

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References:

Bommarco, R., Kleijn, D. & Potts, S.G. (2013). Ecological intensification: harnessing ecosystem services for food security. *Trends in Ecology & Evolution*, 28 (4), 230–238. https://doi.org/10.1016/j.tree.2012.10.012

Zhou, W., Li, M. & Achal, V. (2025). A comprehensive review on environmental and human health impacts of chemical pesticide usage. *Emerging Contaminants*, 11 (1), 100410. https://doi.org/10.1016/j.emcon.2024.100410

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