

T0P-AGRI-Network – COST Action CA21134

Country synthesis on crop protection status and actions: MOROCCO

Final report of the Virtual Mobility Grant, September 2026

Prepared from the national virtual meeting (open webinar) of 14 September 2026 and from the associated stakeholder survey, complemented by Moroccan institutional and scientific documentation.

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Context and summary

This report provides the Moroccan contribution to the T0P-AGRI-Network country synthesis on crop protection. The approach is based primarily on i) literature, ii) information collected from participants in the webinar “Country synthesis on crop protection status and actions: MOROCCO” and iii) from the associated stakeholder survey. This participatory approach aimed to bring together complementary viewpoints from scientific research, advisory, agricultural extension, producer organisations, cooperatives, farmers and other relevant actors. The crop-protection system in Morocco merges a formal phytosanitary and pesticide-regulatory framework with research, advisory and producer-support activities. Chemical treatments remain the dominant component of crop protection, especially in intensive and export-oriented systems, while integrated pest management using biological control, preventive intervention, resistant cultivars, cultivation practices, monitoring and improved advisory services present pathways to decrease unneeded pesticide use. However, adoption is restricted by limited access to technical knowledge, inconsistent advisory coverage, availability of alternatives and cost, market requirements, farmland fragmentation, limited record-keeping and monitoring at farm level and the need for stronger coordination between research, regulation, extension and producers. In this report, we identified the main levers and barriers, reviewed relevant national programmes and initiatives, and consequently we propose priorities for strengthening agroecological and preventive crop protection in Morocco. Quantitative findings from the stakeholder survey are reported throughout this document. Given the small number of respondents ($n = 12$), they are used as indicative evidence that illustrates and qualifies the overall picture, not as a statistically representative national sample. Three results structure this synthesis. First, the decision to treat is taken on the farm itself (83.3% of respondents) and rests on field scouting (91.7%): the decision-making culture that integrated pest management requires already exists. Second, the main advisory channel remains the input distributor (41.7%), who is also the source respondents trust least — an advisory market failure rather than a knowledge deficit. Third, the obstacles ranked highest are economic rather than technical: the absence of a selling price that rewards lower-pesticide production is rated an important or major barrier by 10 of the 12 respondents, whereas the local availability of biocontrol products is cited by only 4.

1. Objectives and scope

The Virtual Mobility Grant was designed to coordinate and consolidate the Moroccan contribution to the T0P-AGRI-Network country synthesis on crop-protection status and actions. More particularly, it sought to:

- Review the current status of crop protection and pesticide use in Morocco;
- Identify existing agricultural practices related to integrated, biological, preventive and agroecological crop protection;
- Highlight advisory, techno-economic, organizational, knowledge and market-related barriers;
- Gather stakeholder perspectives from different producing regions and production systems;
- Report the main national projects, programmes and initiatives relevant to Moroccan crop protection;
- State transferable lessons and applicable priorities for the wider T0P-AGRI-Network.

The report focuses on Moroccan crop protection in the wide sense: diagnosis, prevention, monitoring, cultivation practices, biological control, pesticide application, integrated pest management, extension, farmer organization, governance, research and innovation.

2. Methodological approach

This report was established in four complementary stages; the limitations of the approach are stated at the end of this section.

- Preparation and desk review. Scientific publications, official Moroccan institutional reports, information and programme materials were analyzed, with emphasis on ONSSA (Office national de sécurité sanitaire des produits alimentaires), INRA (Institut National de la Recherche Agronomique) and ONCA (Office National du Conseil Agricole) documents and Moroccan research outputs on integrated pest management and alternative control approaches.
- Stakeholder discussion. A national webinar was organized with participants representing research and higher education, public institutions, agricultural advisory services, producer organizations, cooperatives, farmers and biological-control actors. In the framework of the participatory approach, participants discussed many aspects of crop-protection in Morocco such as agricultural practices, actions, constraints, adoption of preventive and agroecological approaches, and the roles of institutional and market actors. The national online meeting was held on 14 September 2026 as an open webinar, “Crop protection in Morocco: state of the art and perspectives”, which combined a case study on the role of cultural practices and intercropping systems derived from the PRIMA VALMEDALM project (Sara Najjari, Université Sultan Moulay Slimane) with a round table between researchers from INRA, ONSSA and ONCA and experienced producers from several value chains.
- Stakeholder survey. A standardized survey was used to collect complementary information on production systems, main pests and diseases, pesticide application, use of monitoring and thresholds, access to biological-control products, consultative assistance, farmer training and organization, constraints and priority actions. The questionnaire was administered online in French, comprised eight sections and about 45 items, and remained open throughout September 2026. Twelve stakeholders responded: mainly farmers and farm technical managers, secondarily, cooperatives, professional organizations and technical or

research staff, from six regions of Morocco: Souss-Massa (41.7%), Fès-Meknès (25%), and one respondent each from Casablanca-Settat, Béni Mellal-Khénifra, Tanger-Tétouan-Al Hoceïma and Oriental.

- Synthesis and validation. The data collected was structured topically, compared across stakeholder points of view and synthesized to prepare the Moroccan contribution.
- Limitations. With twelve respondents, the survey is a purposive and not a probabilistic sample. It over-represents certified and export-oriented holdings (41.7% certified under GLOBALG.A.P., 66.7% drip irrigation) and under-represents rainfed smallholders, who form the majority of Moroccan farms. Results are therefore expressed as counts out of twelve and read as directions of evidence rather than national estimates.

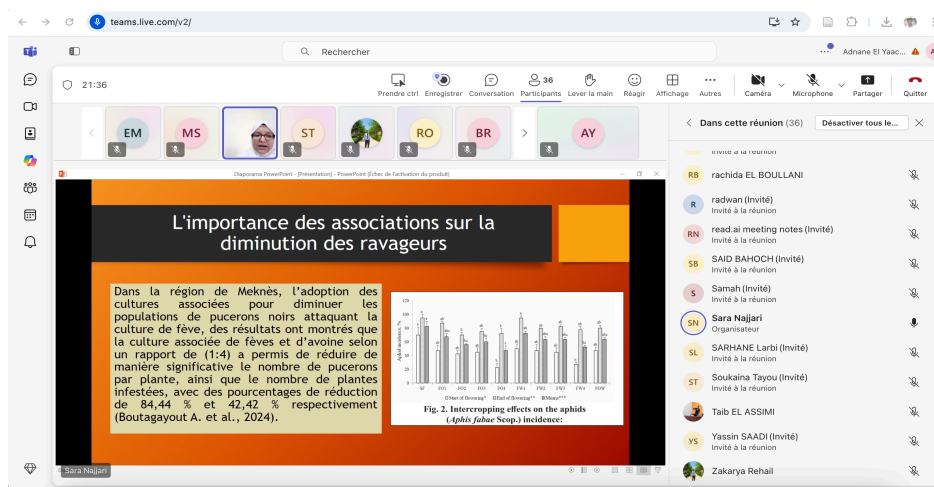


Figure 1: The national webinar on crop protection in Morocco, state-of-art and perspectives, organized on 14 September 2026.

3. Moroccan crop protection and pesticide use

Morocco has a wide variety of agricultural systems, ranging from rainfed cereal and legume cultivation by smallholders to irrigated orchards, vegetable production, protected horticulture, plantations, and intensive export-oriented systems. Consequently, phytosanitary protection needs vary considerably depending on the crop, agroecological zone, farm size, irrigation regime, market destination, and pest pressure. Key crop protection challenges identified in Moroccan literature and frequently highlighted by stakeholders include fungal and bacterial diseases, insect and mite pests, weeds, soil-borne pathogens (e.g., *Fusarium*, *Verticillium*, *Phytophthora*) and plant-parasitic nematodes (notably *Meloidogyne* spp.), storage pests, and emerging or re-emerging organisms linked to climate variability, trade, and changes in production systems. Drought, heat, irregular rainfall, and water stress can increase plant susceptibility and affect pest and disease dynamics and patterns, making preventive and surveillance-based approaches increasingly important. Registered chemical pesticides continue to be widely applied because they deliver responses that are relatively fast and familiar, can be obtained via established distribution networks, and are frequently regarded as essential for safeguarding yield and market quality. Nevertheless, risks arise when treatments follow fixed calendars, rely on insufficient diagnosis, involve poor calibration, repeat the same mode of action, use incorrect doses, occur at the wrong time, or give little thought to beneficial organisms and environmental conditions. The Moroccan regulatory system allows for the authorization and oversight of agricultural pesticides. According to ONSSA, pesticide products intended for agricultural use must be homologated or otherwise authorized, and the assessment takes into account efficacy, selectivity, safety for humans and animals, environmental impacts and residues. ONSSA additionally keeps a phytosanitary index of products approved for agricultural use and carries out controls relating to quality, labelling, storage, distribution and the removal of unauthorized, falsified or expired products. Since 2021, Law 34-18 on plant protection products has replaced Law 42-95: it maintains the rule that no product may be imported, manufactured, held for sale or distributed without a marketing authorization, and it opens a mechanism by which professional agricultural organizations may request the extension of an existing authorization to a minor use - a provision of direct relevance to the crops and uses for which Moroccan producers report having no authorized alternative. Within this framework, 63 active substances have been withdrawn from the Moroccan market since 2018 and the use of 13 others has been restricted. Crop protection in Morocco is thus defined by the coexistence of: i) conventional chemical protection, ii) integrated protection that combines monitoring, thresholds and selective interventions, iii) biological and biotechnical methods, iv) cultural and preventive measures and v) emerging agroecological approaches founded on biodiversity, soil health, crop diversification and less dependence on external inputs.

3.1. Evidence from the stakeholder survey

Two readings of Table 1 deserve emphasis. The first is encouraging: the decision architecture already resembles what integrated pest management requires. Treatment decisions are taken on the farm, field scouting is almost universal (91.7%), treatment registers are kept by 83.3% of respondents and sprayers have been checked or calibrated by two thirds of them. What is missing is not the habit of observing, but the reference framework that turns an observation into a decision — validated action thresholds, which only 25% of respondents use, and laboratory confirmation, used by 16.7%.

The second reading is a warning: the reported problem profile is heavily biased towards what is visible above ground. Insect pests are cited by 91.7% of respondents and soil nematodes by only 16.7%, whereas surveys in the same production basin found root-knot nematodes (*Meloidogyne javanica*, *M. incognita*) in more than 80% of greenhouse samples (91 of 110) in the Souss (Janati et al., 2018). Soil-borne constraints are not absent; they are under-diagnosed, because they require root examination and laboratory confirmation rather than visual scouting, and because their symptoms — patchy vigour, poor water and nutrient uptake — are readily attributed to irrigation or fertilization.

This is consistent with the very limited use of laboratory analysis as a basis for decisions and with the fact that access to diagnostics and laboratory analyses is the lever most often rated "determinant" by respondents (5 of 12). It also has a direct bearing on pesticide-use figures, since soil disinfection and nematicide applications are likely to represent a substantial share of the active ingredients applied in protected horticulture.

The regulatory environment is moving faster than the technical alternatives. Respondents rank the withdrawal of active substances among the three main risks of the coming five years (33.3%) and, invited to name a problem for which they have no satisfactory alternative to chemical control, they cite rusts, powdery mildews, *Botrytis* grey mould and midges on their crops, and weed control in direct-seeding (no-till) systems following the restrictions on glyphosate. The withdrawal of an active substance without a validated replacement is currently the point at which regulation and field practice diverge; it is also the point at which the minor-use extension mechanism of Law 34-18 could be used.

Table 1. Profile and reported practices of the twelve respondents to the national survey (September 2026).

Item	What the respondents report
Profile and regions	Farmers and farm technical managers (about three quarters of the sample); cooperatives, professional organizations, technical and research staff (remainder). Souss-Massa 41.7%, Fès-Meknès 25%, and one respondent each from Casablanca-Settat, Béni Mellal-Khénifra, Tanger-Tétouan-Al Hoceïma and Oriental.
Systems and markets	Greenhouse vegetables 41.7%; open-field vegetables, olive, cereals and pulses 33.3% each; date palm and aromatic-medicinal plants 16.7% each; soft fruits, blueberry, citrus, vine, cactus and fodder crops also represented. Drip irrigation 66.7%; export-oriented production about half of the sample. Global G.A.P. 41.7%, buyer-specific standards 25% (SMETA, GRASP, LEAF), organic 16.7%, no certification 41.7%.
Main phytosanitary problems	Insect pests 91.7%; aerial fungal diseases 58.3%; mites 50%; weeds 33.3%; soil nematodes 16.7%; soil-borne diseases, viruses and their vectors, and rodents 8.3% each; bacterioses 0%.
Treatment decision and application	Decision taken on the farm itself 83.3%. Bases: field scouting 91.7%; fixed calendar 33.3%; experience and habit 33.3%; defined action threshold 25%; trapping 16.7%; laboratory analysis 16.7%; warning bulletins 8.3%. Treatment register kept systematically 83.3%; sprayer checked or calibrated within two years 66.7%; protective equipment always 41.7%, often 33.3%, rarely or never 25%.
Preventive practices	Mechanical or thermal weeding 66.7%; resistant or tolerant varieties 58.3%; rotation and mass trapping 50% each; resistant rootstocks and adjusted planting dates 41.7% each; insect-proof netting, mating disruption, crop-residue management and organic-matter inputs 33.3% each; solarization or biofumigation 8.3%; hedges and flower strips 8.3%.
Biological control	Used regularly 41.7%, occasionally or on trial 41.7%, known but not used 16.7%. Methods (n = 10): micro-organisms and pheromones 50% each; natural enemies and introduced pollinators 40% each; botanical extracts and essential oils 30%; entomopathogenic nematodes 0%. Assessment positive or very positive for 90.9% of users (n = 11); leading difficulty: cost (58.3%).
Advice, training and support	Main advisory source: input distributor 41.7%, export-company or cooperative technician 33.3%. No training on integrated protection or pesticide uses in five years: 75%; formats requested: field demonstrations 66.7%, practical on-farm training 58.3%. No public programme or subsidy received in five years: 91.7%. No collective action in the area: 58.3%, with no area-wide coordinated control and no collective collection of empty containers reported.
Risks expected over five years	Development of resistance 83.3%; withdrawal of active substances, rising input costs, labor shortage and climate-change effects 33.3% each; new pests and restrictions on irrigation water 25% each.

4. Approaches for agroecological and preventive crop protection

4.1. Improved monitoring, diagnosis and early warning systems

Systematic field scouting, dependable diagnosis, pest surveillance, weather-driven risk assessment, pheromone and other traps, remote sensing and digital advisory tools can all help improve the timing of interventions and cut down on needless treatments. Monitoring needs to be tied to practical action thresholds and recommendations suited to local conditions. In Moroccan conditions the weakest link of the monitoring chain lies below ground: soil and root diagnosis — nematode extraction and counting, identification of soil-borne pathogens, resistance testing — is rarely part of routine scouting, although it determines decisions on rotation, rootstock choice and soil disinfection that are taken months before planting.

4.2. Integrated pest management and preventive agronomy

Rotating crops, sanitation, balanced fertilization, managing irrigation, resistant or tolerant varieties, crop association, suitable planting dates, pruning, removal of infected material, protected-cropping hygiene and habitat management can all lower pest pressure before chemical intervention is needed.

4.3. Biological and biotechnical control

Moroccan research has documented the promise of natural enemies, microbial agents, bio-insecticides, mass trapping, mating disruption and sterile-insect methods. Such solutions call for quality assurance, farmer training, dependable supply chains, clear recommendations and economic assessment under real farm conditions.

4.4. Extension, demonstration and farmer-to-farmer learning

Having a trusted adviser available, along with visible demonstration plots, is a major lever for adoption. Advisory services ought to frame crop protection as a comprehensive decision-making process, not merely a catalogue of products. Farmer field schools, cooperatives and producer organizations are able to support learning in groups.

4.5. Collective action, digital tools and artificial intelligence

Cooperatives and producer groups can enhance access to scouting, equipment calibration, biological-control products, shared storage and advisory services. Digital platforms can help with alerts, pest identification, treatment records and traceability, as long as they are affordable and suited to local languages and connectivity. Digital tools and artificial intelligence can support this transition in three ways that are realistic in the Moroccan context. First, image-based identification of pests and diseases on a smartphone lowers the diagnostic barrier for advisers, lead farmers and cooperative technicians, provided the models are trained on Moroccan

hosts, symptoms and cultivars and are calibrated against expert and laboratory identification. Second, risk modelling and spray-window forecasting, built on local weather series, connected traps and crop phenology, convert calendar spraying into threshold-based intervention — precisely the step not yet taken by the third of respondents who still treat by calendar and by the three quarters who do not use action thresholds. Third, automatic recording of treatments and residue traceability, already required by export standards, can be re-used to produce the national indicators of pesticide-use intensity that Morocco currently lacks. These uses are consistent with the objective of *Génération Green 2020–2030* of connecting at least two million farmers to digital service platforms. Three conditions determine whether this potential is realized. Artificial intelligence displaces the diagnostic bottleneck but does not remove it: a model is only as reliable as the reference collections, curated occurrence data and expert identifications behind it, and Morocco has no shared, open reference dataset of pest, disease and soil-organism occurrences. Below-ground organisms, which require extraction and molecular or morphological identification, will not be covered by image recognition and still call for a laboratory network. Finally, digital advice must not reproduce the failure of the current advisory market: if the tool is supplied and interpreted by the input seller, the recommendation it generates carries the same conflict of interest as the advice it replaces. An open, publicly governed data infrastructure — pest observations, trap counts, weather series, laboratory identifications and anonymized treatment records — is the prerequisite, not the by-product, of useful artificial intelligence in Moroccan crop protection.

4.6. Soil health and the management of soil-borne organisms

A significant and largely invisible share of the pesticide load in intensive horticulture and in orchards is applied to the soil, in the form of fumigants, nematicides and soil-applied fungicides. Managing it requires a different toolbox from foliar protection, and Morocco already holds most of that toolbox. Rotation, organic-matter inputs, crop-residue management, solarization and biofumigation, resistant rootstocks and the maintenance of suppressive soil biological activity act on inoculum and on population build-up rather than on a visible outbreak. The survey showed a revealing contrast: resistant rootstocks are used by 41.7% of respondents and organic-matter inputs by 33.3%, whereas solarization or biofumigation is used by only 8.3% — the widest gap in the whole questionnaire between an agronomically available technique and its actual use. Rootstock resistance is also fragile: the *Mi-1.2* gene deployed against root-knot nematodes in tomato loses efficacy above about 28 °C soil temperature, a level common in Moroccan greenhouses, and can be overcome by virulent populations under repeated cropping (Ornat and Sorribas, 2008), so it must be managed as part of a rotation, not as a permanent solution. Locally validated biological options exist — indigenous strains of entomopathogenic nematodes (*Steinernema feltiae*, *Heterorhabditis bacteriophora*) isolated in Morocco reduced both egg-mass formation and galling index by about 80% on tomato under greenhouse conditions (El Aïmani et al., 2022), and Moroccan strains have also been evaluated against the cactus cochineal *Dactylopius opuntiae* (El Aalaoui et al., 2022) — yet no respondent reported using entomopathogenic nematodes in practice. The gap between what Moroccan research has validated and what reaches the farm is nowhere wider than for soil biology, and it is where the transition towards lower pesticide use has the most ground to gain.

5. Main barriers and risks

Multiple obstacles stand in the way of adopting suitable approaches to crop protection in Morocco. Qualified crop-protection guidance is still limited or unevenly distributed, especially for smallholders and farmers located in remote regions. Farmers frequently lack adequate knowledge about identifying pests, economic thresholds, pesticide resistance, protective equipment and environmental hazards. Locally validated agroecological packages, aggregated farm-level data on active substances and doses, and effective feedback between research, regulators, extension services, suppliers and farmers are all in short supply, while pesticide resistance, harm to beneficial organisms and occupational exposure add to the pressure. Lastly, climate change, water scarcity and emerging pest pressures heighten uncertainty, making fixed-calendar crop-protection strategies progressively harder to apply effectively.

5.1. How the stakeholders themselves rank barriers and levers

Table 2 inverts the assumption that usually underlies transition programmes. Supply-side constraints — availability of biocontrol products (4/12), cost of alternatives (5/12), lack of independent technical advice (3/12) — rank below demand-side ones. The top barrier and the top lever are the same variable seen from two sides: the price signal. Ten of the twelve respondents consider that the absence of a selling price rewarding lower-pesticide production is an important or major obstacle, and the same number consider that such a price would have an important or determinant effect. Alongside it, the residue requirements of export markets are rated as powerful a lever as the price itself, which suggests that in Morocco the export standard, rather than national regulation, is currently the main driver of practice change. The corollary is that farms supplying the domestic market are exposed to neither driver, and that is where public action is most needed.

Table 2. Barriers rated "important" or "major" and levers rated "important" or "determinant" by the respondents.

Barrier to preventive and agroecological methods	n/12	Lever favoring their adoption	n/12
No selling price that rewards the practice	10	Residue requirements of export markets	10
Shortage of qualified labor	8	A selling price that rewards the production	10
Risk of yield loss	8	Training of farmers and technicians	10
Higher pest pressure linked to the climate	8	Access to diagnostics and laboratory analyses	9
Slow and complex product registration	7	Local demonstrations and reference farms	8
Access to finance and working capital	7	Equipment subsidies (netting, traps, machinery)	8
Contradictory requirements of buyers	6	Collective action at territory level	8
No technical references adapted to Morocco	5	Faster registration of biocontrol products	7
Cost of the alternatives	5	Reinforced, independent local advice	7
Local availability of biocontrol products	4	Stricter regulation of pesticides	7

The survey also documents an advisory paradox that no technical programme can correct on its own. The input distributor is the main source of phytosanitary advice for 41.7% of respondents — but not a single respondent rated that source as highly trustworthy, nine respondents rating it only "moderate". Conversely, the sources that receive the highest trust ratings are other farmers, research bodies such as INRA and universities, and export-company or cooperative technicians, none of which reaches a comparable share of farms. The dominant channel is therefore the one whose recommendation is structurally tied to selling a product, while the trusted channels remain marginal. Three quarters of respondents had received no training on integrated protection or pesticide use in the last five years, and the support formats they ask for are field demonstrations (66.7%) and practical on-farm training (58.3%) rather than documentation. This is consistent with national evidence that a large majority of Moroccan farm workers cannot name the products they apply (Scientific Reports, 2026) and that most have had no formal training in pesticide application (Ben Khadda et al., 2021). Two further gaps emerge, both structural. Collective action is nearly absent: 58.3% of respondents report no collective initiative in their area, and no respondent reported either area-wide coordinated control or collective collection of empty containers, which are still stored, burned, buried or discarded with ordinary waste. Mobile pests, resistance management and the safe disposal of packaging are landscape-scale and value-chain-scale problems currently addressed at plot scale. Public support is equally thin: 91.7% of respondents have received no public programme or subsidy related to crop protection in the last five years, at the same time as they identify equipment subsidies as one of the strongest levers. The instruments exist; they are not reaching the farms that would use them.

6. Nationally funded programmes, institutions and actions

The Moroccan crop-protection landscape is backed by a number of national institutions and agricultural-development frameworks. Their roles complement one another rather than being interchangeable. The Ministry of Agriculture, Maritime Fisheries, Rural Development and Water and Forests (MAPMDREF) provides the overall policy framework through strategies such as *Génération Green 2020–2030*, which promotes agricultural competitiveness, resilience, innovation and improved support to farmers. Its implementation is supported by specialized public institutions, including ONSSA, ONCA, INRA and the Agricultural Development Agency (ADA).

6.1. ONSSA: phytosanitary regulation and control

ONSSA is tasked with key regulatory and operational duties, including plant-health surveillance, phytosanitary control, guidance on pests and good agricultural practices, promotion of control methods, authorization and oversight of agricultural inputs, pesticide supervision, and risk management. Its phytosanitary index serves as a national reference for authorized products and their approved uses.

6.2. INRA: research, innovation and technology transfer

INRA conducts research on crop protection, pest and disease diagnosis, resistance, biological control, integrated pest management, crop diversification and sustainable production. Moroccan INRA documentation includes work on integrated protection in cereals, legumes and orchards, directed control based on monitoring and thresholds, alternative methods against crop pests, beneficial organisms and bio-insecticides. INRA regional centers also provide opportunities for demonstration and interaction with professional organizations.

6.3. ONCA and agricultural advisory services

ONCA and regional advisory structures support farmers through technical advice, training, awareness activities, organization of producers and links with administration and development programmes. Crop protection should be integrated more systematically into advisory packages addressing irrigation, fertilization, climate adaptation, farm economics and market access. The survey suggests that this function is currently under-supplied: three quarters of respondents had received no training on integrated protection or on pesticide use over the past five years, and the formats they ask for — field demonstrations and practical on-farm training — are precisely those that require adviser time on the ground rather than the production of written material.

6.4. Agricultural strategies and development frameworks

The *Plan Maroc Vert (2008–2020)* and the *Génération Green 2020–2030* framework provide the broader context for agricultural modernization, resilience, human capital, professional organization, innovation and value-chain development. Within these frameworks, crop protection can be strengthened through sustainable intensification, improved quality and traceability, digital agriculture, farmer organization and support to young people and women in agricultural entrepreneurship.

6.5. Research and development priorities

Nationally supported research should prioritize: locally adapted integrated pest management packages, pest forecasting, biological-control production and quality standards, resistance management, safe application technologies, residue and environmental monitoring, agroecological infrastructure, farmer decision-support tools, and participatory evaluation of technologies under commercial conditions.

6.6. Universities, laboratories and international projects

Beyond INRA, the Moroccan universities and the specialized schools — Ibn Zohr University in Agadir, the Hassan II Institute of Agronomy and Veterinary Medicine (IAV Hassan II, Rabat, with its Horticultural Complex in Agadir), the National School of Agriculture of Meknès (ENA), and the newer research universities — host most of the country's diagnostic capacity in nematology, phytopathology, entomology and phytochemistry, together with the doctoral training that supplies the sector's future advisers. They are also the main Moroccan entry point for European and Mediterranean programmes (PRIMA, Erasmus, Horizon Europe, COST Actions), through which several of the practices discussed in this report have been tested under local conditions. The survey gives an unexpected indication of that interface: 41.7% of respondents have already taken part in a research or development project on crop protection, and they cite by name work on the management of *Drosophila suzukii*, *Scirtothrips* thrips and aphids on blueberry, control of white grubs, and the PRIMA VALMEDALM project on agroecological practices in almond. The relationship between research and farms therefore exists, but it is project-based and discontinuous: it ends when the funding ends, and it has no national mechanism for consolidating results into recommendations that survive the project.

7. Initiatives involving farmers, cooperatives, extension services and policymakers

The consultation highlighted the importance of moving from isolated technical demonstrations to coordinated territorial and value-chain initiatives. Relevant forms of action include:

- Farmer field schools and demonstration plots on scouting, thresholds, biological control and safe pesticide use;
- Cooperative-based collective monitoring and purchase of traps, protective equipment, calibration services and biological inputs;
- Participatory trials comparing calendar-based protection with monitoring-based integrated pest management;
- Training of advisers and lead farmers as local crop-protection resource persons;
- Joint activities between INRA, universities, ONCA, ONSSA, private operators and producer organizations;
- Value-chain agreements linking producers, packhouses, retailers and exporters to responsible pesticide-use plans;
- Policy dialogues on registration, quality control, availability and affordability of biological-control products;
- Support for women's and youth cooperatives in scouting services, production of bio-inputs, nursery sanitation, composting and other preventive services;
- Integration of crop protection into climate-smart agriculture, water management and soil-health programmes;
- A network of accessible diagnostic laboratories for soil-borne organisms, nematodes and resistance testing, with published turnaround times and a standard fee schedule, and laboratory diagnosis made an eligible expense under support programmes;
- Collective collection and disposal of empty containers organized at value-chain or cooperative level, an initiative that no respondent reported as existing in their area;
- Use, by professional organizations, of the minor-use extension mechanism of Law 34-18 to close the specific gaps for which producers report no authorized alternative;
- Reference farms in each production basin publishing not only technical protocols but also gross margins, since the economic comparison, not the technical demonstration, is what respondents say they lack;
- An open national repository of pest, disease and soil-organism observations, combining farmer reports, trap networks and laboratory identifications, as the shared data infrastructure for warning systems and decision-support or artificial-intelligence tools.

8. Priority recommendations

The following recommendations are proposed to strengthen sustainable, integrated and efficient crop protection in Morocco:

- Establish a Moroccan stakeholder platform or working group on sustainable crop protection linking research, ONSSA, ONCA, producers, cooperatives, biological-control operators and policymakers;
- Develop crop- and region-specific integrated pest management packages with clear monitoring protocols, thresholds, decision rules and economic comparisons;
- Strengthen national and regional surveillance of pests, diseases, pesticide resistance and environmental residues, with accessible farmer-oriented alerts;
- Improve training on diagnosis, pesticide stewardship, application equipment, personal protection, resistance management and protection of beneficial organisms;
- Support the local production, registration, quality control and distribution of effective biological and biotechnical solutions;
- Use cooperatives and producer organizations as delivery channels for collective scouting, demonstration, traceability and access to inputs and services;
- Promote participatory research and multi-season validation before scaling new agroecological practices;
- Develop indicators for tracking progress: pesticide-use intensity, treatment frequency, active-substance diversity, biological-control adoption, monitoring coverage, farmer training, residue compliance and farm profitability;
- Ensure that climate adaptation, soil health, water management and biodiversity are treated as integral components of crop protection;
- Make the price signal explicit: pilot a contractual premium or differentiated payment for produce grown under validated low-pesticide protocols, since the absence of valorization is at once the first barrier and the first lever identified by stakeholders, and extend residue-based requirements to domestic-market channels, which are currently exposed to no driver at all;
- Separate advice from sales: fund independent advisory capacity within public services, cooperatives and producer organizations, and require a transparent declaration of commercial interest in any phytosanitary recommendation;
- Establish a national diagnostic and resistance-monitoring service covering soil-borne organisms, and make laboratory diagnosis an eligible cost in support schemes, so that decisions rest on identification rather than on symptoms;
- Use the minor-use extension provided by Law 34-18, on an agreed timetable, to close the gaps in authorized low-risk solutions reported by producers, and align the withdrawal of active substances with the availability of validated alternatives.

9. Outcomes of the national webinar

- The importance of cultural practices in crop protection — case of the role of intercropping systems, derived from the PRIMA VALMEDALM project (Sara Najjari, Université Sultan Moulay Slimane), in the reduction of weeds and insect pests, using leguminous crops in almond orchards;
- Positions expressed by researchers from INRA, ONSSA and ONCA on the issue of registration of low-risk products, the coverage of advisory services and the organization of surveillance, the mismatch between intensive and extensive crop-protection systems across regions, and the weight of farmers' habits and practices;
- Statements by producers, by value chain (early vegetables, citrus, soft fruits, olive, cereals, date palm) highlighting: the difficulty of maintaining a fixed treatment calendar under climate change; the market challenge for organic produce, still poorly valorized relative to the burden of organic specifications; compliance costs for export-oriented production; the emergence of viruses, pathogens and insect pests and the development of resistance; and the importance of integrated pest management and biopesticides, with successful experiences reported in blueberry and raspberry;
- Points of convergence and points of disagreement between stakeholder categories: stakeholders generally agree on the need to reduce excessive pesticide use, strengthen integrated pest management, improve farmer training, and promote monitoring and biological alternatives. However, they differ mainly regarding the economic feasibility of the transition: producers are

concerned about additional costs, uncertain profitability, and potential yield or quality losses, whereas researchers and extension actors emphasize the long-term benefits of sustainable practices.

- Commitments and actions that participants are willing to carry forward: producers and farmers expressed their willingness to strengthen field monitoring, improve pest and disease identification, adopt preventive and integrated crop-protection practices, and use pesticides more responsibly. They also showed interest in participating in demonstration trials, farmer-training activities, collective scouting through cooperatives, and the testing of biological and biotechnical alternatives. Their engagement would be facilitated by accessible technical advice, reliable input availability, financial support, locally validated recommendations and evidence demonstrating the economic benefits of the transition.

10. Conclusion

Morocco possesses important institutional, scientific and professional foundations for a transition towards more integrated, preventive and agroecological crop protection. The regulatory role of ONSSA, the research capacity of INRA and universities, the advisory function of ONCA, and the practical knowledge of farmers, cooperatives and private operators provide a strong basis for coordinated action. The central challenge is not simply to replace chemical pesticides, but to improve the quality of crop-protection decisions. This requires better diagnosis, monitoring, thresholds, prevention, biological and biotechnical options, safer application, reliable advisory support and stronger cooperation across the value chain. The Moroccan contribution to T0P-AGRI-Network could provide a useful Southern Mediterranean case study, while also identifying lessons relevant to other countries facing water scarcity, climate pressure, fragmented farming systems and increasing market requirements. Beyond technical substitution, the survey points to three structural priorities: making the price signal reward low-pesticide production, separating phytosanitary advice from input sales, and bringing soil and root diagnosis into routine crop-protection decisions.

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