COMMISSION ON PHYTOSANITARY MEASURES

NINETEENTH SESSION

ANTIMICROBIAL RESISTANCE - RESULTS OF THE IPPC OBSERVATORY SURVEYS ON ANTIMICROBIALS USE IN PLANT PROTECTION

AGENDA ITEM 16.1

(*Prepared by the IPPC Secretariat*)

Introduction

[1] The Food and Agriculture Organisation of the United Nations (FAO) considers Antimicrobial Resistance[1] (AMR) as the ability of microorganisms to persist or grow in the presence of drugs designed to inhibit or kill them. These drugs, called antimicrobials, are used to treat infectious diseases caused by microorganisms such as bacteria, fungi, viruses and protozoan parasites.

[2] In fact, when microorganisms become resistant to antimicrobials, standard treatments are often ineffective, and in some cases, no drugs provide effective therapy. Consequently, treatments fail. This increases illness and mortality in humans, animals and plants. For agriculture, this causes production losses, harms livelihoods and jeopardizes food security.

[3] Therefore, considering the need for current data on the extent of AMR in plant health, in 2023, the Commission on Phytosanitary Measures (CPM) requested the International Plant Protection Convention (IPPC) Secretariat to consider how best to undertake a study to better understand the nature and scope of the risks associated with AMR in the phytosanitary context, including resistance to fungicides.

[4] The IPPC Secretariat developed two IPPC Observatory AMR surveys, the first one was to collect data on antibiotics in plant protection in order to determine the products used by the IPPC community, on which crops and against which pests, as well as the estimated quantities and areas of use. The second was to collect data on the use of fungicides in plant protection following a structure of questions.

[5] Considering that data in these IPPC Observatory surveys are only those officially shared by the IPPC official contact points and in view of the complexity of determining the origin of the resistance to antimicrobials, the IPPC Secretariat recommended to limit these studies only to antimicrobials use (AMU).

[6] In April 2024, the IPPC Secretariat presented to CPM-18 the preliminary results of the IPPC surveys on antibiotics and fungicides used in plant protection. Results indicated that the number of countries using antibiotics in plant protection was low compared to those using fungicides. This is explicable since fungicides are among the most widely used chemical classes in plant protection.

[1] FAO webpage on AMR: https://www.fao.org/antimicrobial-resistance/background/what-is-it/en/

[7] To gather more representative data, the CPM requested to extend these surveys[2] as by CPM-18 (2024) only 76 countries had responded to the survey on antibiotics use and 47 countries to the one on fungicides.

Survey on antibiotics used in plant protection

[8] From May to July 2023, the first survey was opened on the use of antibiotic products in plant protection. It had five questions on the use of 11 antibiotic products, their target crops and/or pests as well as the estimated quantities used.

[9] Following the CPM decisions and the CPM Bureau guidelines, the survey was relaunched from 25 November to 10 January 2025, keeping the same questionnaire structure but reducing the crops and pests listed in the survey based on the results of the previous phase of the survey.

[10] In the end, eighty-five (85) countries responded to the IPPC survey on antibiotics use in plant protection. From these final results, only 29 countries (34%) confirmed the use of antibiotics in plant protection. Consequently, 66% of respondents do not use antibiotics for plant protection. The extension of the survey allowed seven (7) new countries to provide responses in addition to the countries that updated their previous responses to this survey.

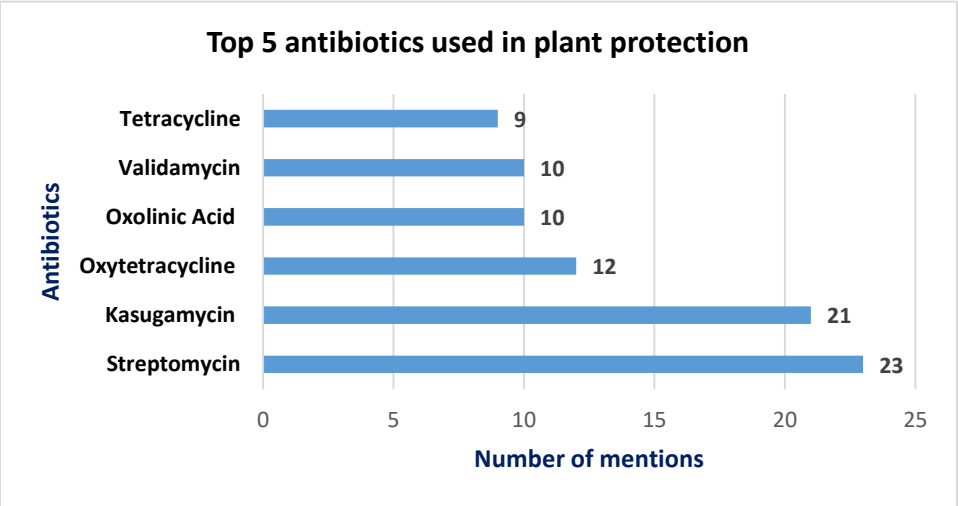

Figure 1. Top 5 antibiotics used in plant protection

[11] Figure 1 shows the five (5) most used antibiotics based on the positive responses received and are Streptomycin (79%), Kasugamycin (72%), Oxytetracycline (41%), Oxolinic Acid (34%), Validamycin (34%) and Tetracycline (31%). These results confirmed the trend observed in 2024 during the preliminary results; that the use of antibiotics in the protection of plants is relatively low.

[12] These survey results are consistent with those presented in the FAO's publication on "Tackling Antimicrobial Resistance in Food and Agriculture", released in January 2024.[3] The study confirmed that in addition to its direct impact on human and animal health, AMR poses certain risks to food and agricultural systems, food safety, food security, livelihoods and economies. It is estimated that more than 70 percent of all antimicrobials sold worldwide are used on animals raised for food (Van Boeckel *et al.*, 2017).

[13] Countries reported the use of antibiotics on a wide range of crops, mainly vegetables and fruits ranked by magnitude: tomato, potato, rice, citrus, apple and pear, pepper and sweet pepper, onion, grapes,

[2] CPM-18 Report : https://assets.ippc.int/static/media/files/publication/en/2024/05/CPM-18_Report_2024-05-15.pdf

[3] Tackling Antimicrobial Resistance in Food and Agriculture: https://www.fao.org/documents/card/en?details=cc9185en

tobacco, and kiwi as detailed in Figure 2. The results confirmed that the above-mentioned antibiotics are most used on tomato, potato, rice and citrus.

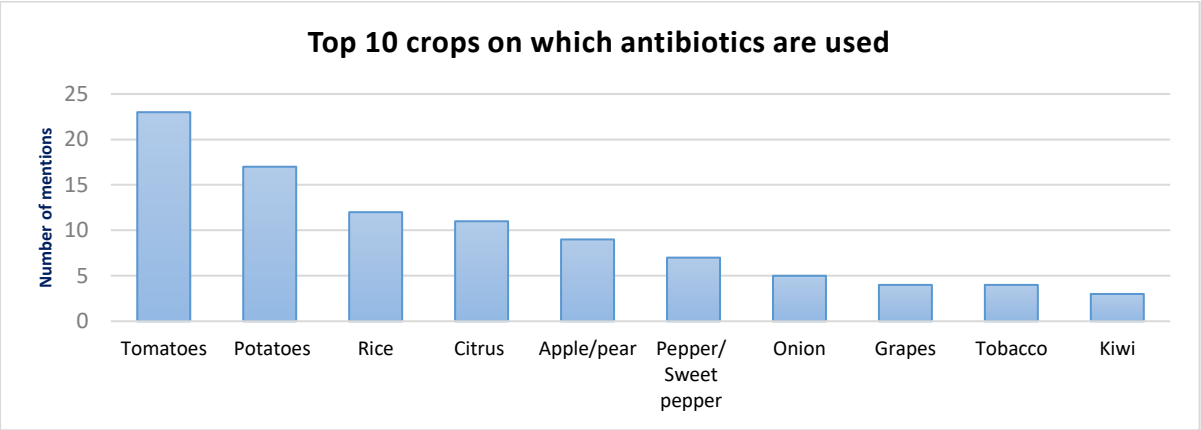

Figure 2. Top 10 crops on which antibiotics are used

[14] Antibiotics used in plant protection primarily target bacterial diseases, such as bacterial soft rot (*Pectobacterium spp*.), fire blight (*Erwinia amylovora*), bacterial canker (*Clavibacter michiganensis*), bacterial spot (*Xanthomonas campestris*), and bacterial fruit blotch (*Acidovorax avenae* subsp. *Citrulli*). While their main application is against these bacterial diseases, these antibiotics have also been used to manage fungal diseases and insects. Figure 3 presents the main pests on which antibiotics are used.

[15] For example, Kasugamycin is used on rice, tomato, potato and Streptomycin is used on sweet pepper, tomato and tobacco.

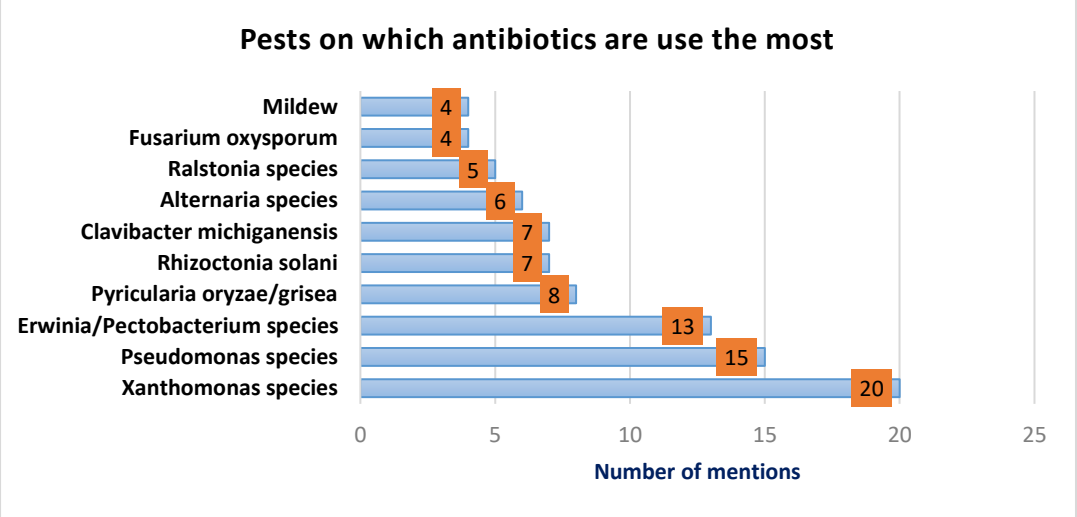

Figure 3. Main pests on which antibiotics are used

[16] These antibiotics can be applied individually to control specific diseases. For example, Kasugamycin is effective against pathogens like *Clavibacter michiganensis, Xanthomonas* spp., *Pseudomonas* spp., and *Erwinia* spp. Moreover, antibiotics can also be used in combination. For instance, Streptomycin and Oxytetracycline are often employed together to tackle *Agrobacterium tumefaciens*, *Pseudomonas spp*., *Xanthomonas spp*., and *Erwinia spp*. Similarly, Gentamicin and Oxytetracycline are used to manage *Clavibacter michiganensis* subsp. *michiganensis*.

[17] It was challenging to compile and interpret data provided on estimated quantities of antibiotics due to the variability of the format of the information shared (units, active ingredient, quantity imported, etc.) and considering that this data must be put into perspective based on the size of the areas cultivated by the respondents.

[18] However, based on the usable data provided, it was possible to estimate that the average quantity of antibiotics used is around 240.7 tonnes/year with a maximum quantity of 2700 tonnes/year and a minimum of 0.3247 tonnes/year.

[19] The survey showed areas of use of these antibiotics as 47% in crop fields, 25% in greenhouses and 16% in gardens (Figure 4)

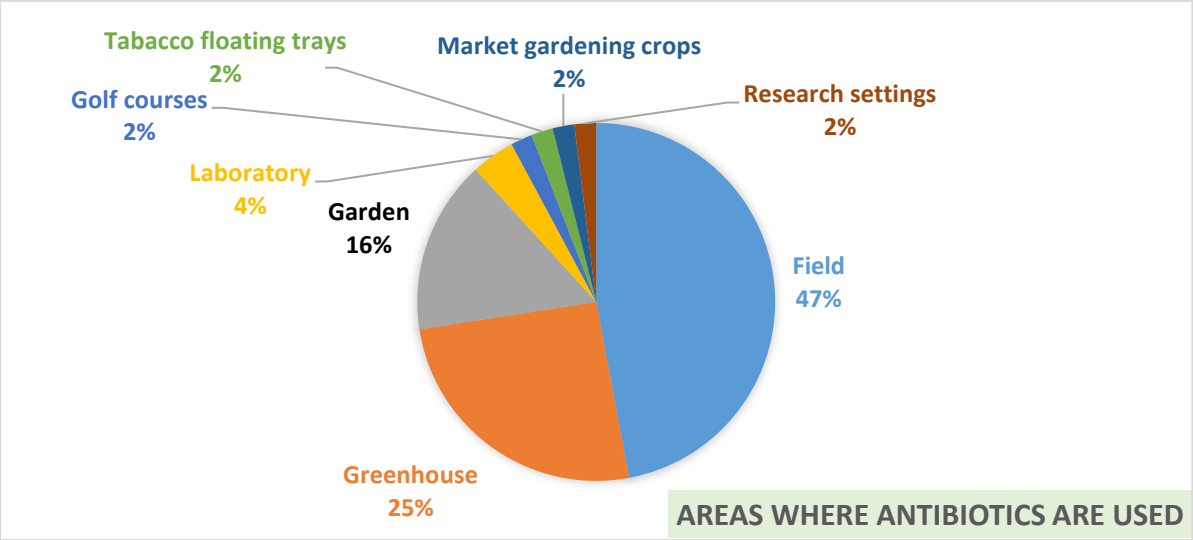

Figure 4. Areas where the antibiotics are used

Survey on fungicides used in plant protection

[20] The first phase of the IPPC Observatory survey on fungicides use was developed to collect data on the use of 74 fungicides. The CPM-18 (2024) agreed to reduce the number of fungicide products included in the IPPC survey to only focus on those related to the One Health concept (i.e. those chemical groups that are used not only for plant health but also for animal or human health).

[21] Following the presentation of the AMR preliminary results to CPM-18 (2024), and considering the guidance of the CPM Bureau in June 2024, the secretariat gathered information to determine the antifungal products used by the three sectors, animal, human, and plant health (One Health). This included working with the FAO's pesticide management and the animal health units.

[22] The IPPC Secretariat also collected information on antifungal products from national human and animal health databases. This data allowed the IPPC Secretariat to compile lists of products used in the human and animal health sectors and to compare the two lists with the initial list of 74 fungicides previously used in the IPPC Observatory survey. The results of the antifungal comparisons of the three lists indicated that none of the 74 fungicide products used in plant protection are used in animal or human health. However, 12 products from the 74 fungicides list were confirmed to be included on both animal and human health lists, including: Amphotericin B, Clotrimazole, Fluconazole, Flucytosine, Griseofulvin, Itraconazole, Ketoconazole, Miconazole, Nystatin, Posaconazole, Terbinafine and Voriconazole.

[23] Nevertheless, literature has provided additional insights relative to the potential use of certain fungicide chemical groups. Woods *et al*. (2023), in "*A One Health approach to overcoming fungal disease and antifungal resistance*[4]" identified four classes of antifungals used to manage and prevent fungal infections in humans and crops: polyenes, azoles, pyrimidine analogs, and echinocandins. Notably, azoles are the primary group of fungicides used in agriculture, and extensively in human treatment (Berger *et al.*, 2017; Geddes-McAlister & Shapiro, 2019). The fungicidal azoles (i.e., difenoconazole,

[4] A One Health approach to overcoming fungal disease and antifungal resistance: https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wsbm.1610

epoxiconazole, propiconazole, and tebuconazole) are structurally similar to medical triazoles (i.e., isavuconazole, itraconazole, posaconazole, and voriconazole) with similar mechanisms of action (Perfect, 2017 and 2022). Pintye *et al*. (2024) in "*Trans-kingdom fungal pathogens infecting both plants and humans, and the problem of azole fungicide resistance*[5]*"* confirmed that among the several types of antifungals, azoles are the most widely used and this is the only group applied both in medicine and in the environment. Around 2 million tons of agricultural azole fungicides were sold in 2020, and more than two-thirds of them were sold in Europe and Asia, occupying about 16% of the global fungicide market volume (Jørgensen and Heick, 2021).

[24] The litterature review has provided the IPPC Secretariat with necessary information to establish a list of 29 fungicides and antifungals used to manage and prevent fungal infection in humans, animals, and crops. Based on this list and the results of the previous phase of the survey on fungicides, the following fungicides were selected for this last phase of the survey: thiophanate-methyl, cyproconazole, propiconazole, myclobutanil, penconazole, triadimenol, boscalid, azoxystrobin, trifloxystrobin, phosphorous acid and salts, copper, chlorothalonily, and other azoles.

[25] Fifty-nine (59) countries responded to the survey on fungicides used in plant protection, including 10 new countries. The 10 most widely used products in terms of number of mentions are azoxystrobin, copper, boscalid, trifloxystrobin, penconazole, propiconazole, chlorothalonil, thiophanate-methyl, myclobutanil and triadimenol. All respondents confirmed the use of fungicides in plant protection.

[26] Figure 5 below presents the main fungicides used in plant protection by the survey respondents

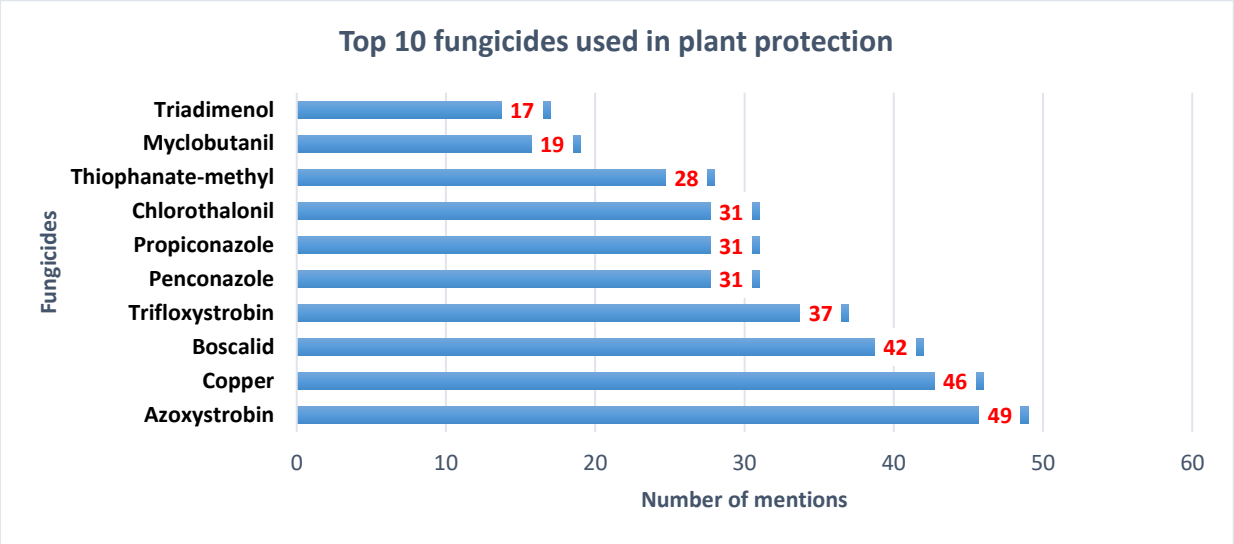

Figure 5. Top 10 fungicides used in plant protection

[27] Fungicides are one of the groups of pesticides most used for plant protection on a very wide range of crops. From the survey results, the main crops on which fungicides are used are tomato, potato, banana/plantain, onion, apple/pear, grapes, wheat, cucumber, beans, cabbage and lettuce.

[5] Trans-kingdom fungal pathogens infecting both plants and humans, and the problem of azole fungicide resistance: https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2024.1354757/full

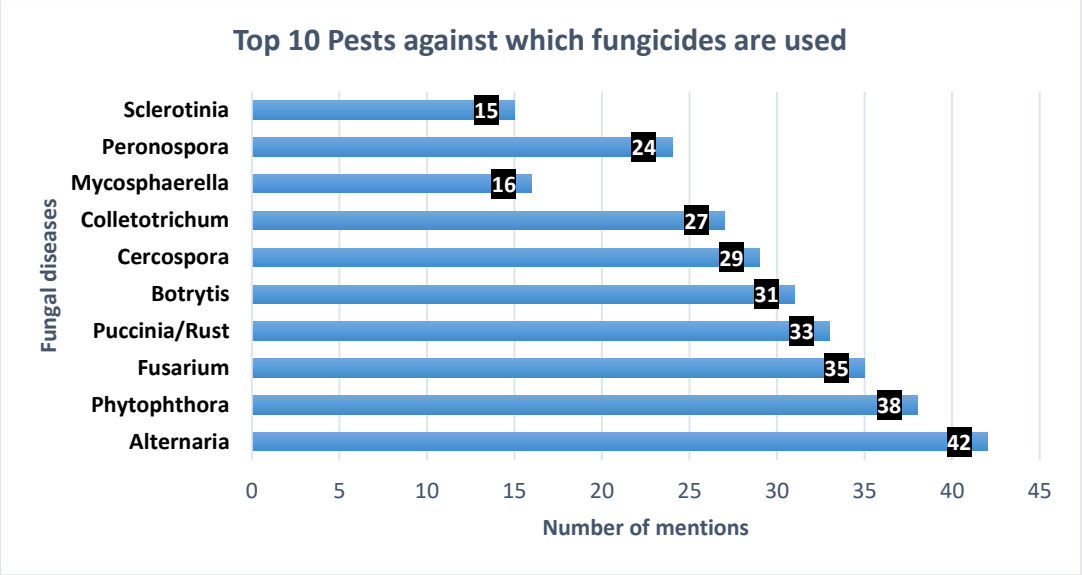

Figure 6. Main fungal diseases on which fungicides are used

[28] The fungicides mentioned are used against a wide spectrum of fungal pests such as *Alternaria sp, Phytophthora sp, Fusarium sp, Puccinia sp, Botrytis sp, Cercospora sp, Colletotrichum sp, Mycosphaerella sp, Peronospora sp* and *Sclerotinia sp*.

[29] Quantities of fungicides used per year vary by even wider proportions than observed for antibiotics. The estimated maximum annual quantity used is 105.400 tonnes, with minimum of 0.5 tonnes and an average of 4.520 tonnes a year. About half of the countries (28/59) did not provide clear numerical data.

Sustainability on AMU data collection and next steps

[30] At this stage, data collected through the IPPC Observatory sureys on AMU in plant protection provides an overview to the IPPC community on antimicrobials use in plant health to take stock of this issue and decide on the next steps. These nexts steps could be to close the two surveys or/and launch an in-depth study on antimicrobials resistance.

[31] If an in-depth One Health study must be carried out on AMR in plant health, fungicides use and resistance are important but should be considered separate to antibiotics use and resistance considering that none of the fungicides listed in the first phase of the fungicides survey are not used in animal health and even less in human health. Such a study should focus on antibiotics used in human, animal and plant health, while considering that the IPPC survey has shown that the number of countries and the quantities used in plant health are relatively low.

[32] However, to ensure the sustainability of data collection and to keep informed about developments in issues relating to the use of antimicrobials in plant protection, the secretariat has investigated options to be considered after the current IPPC surveys on AMR.

[33] Consultations within FAO departments involved in One Health have led to consensus on using a single tool for data collection to avoid redundancies and multiple data requests to countries. The agreement was that the selected option should be part of the Global Integrated System for Surveillance of AMR/AMU of the Quadripartite[6] Surveillance Architecture. Within the framework of this surveillance architecture, the main tool used by FAO is the International FAO Antimicrobial Resistance Monitoring (InFARM)[7]. The InFARM tool consists of an online platform and related FAO activities that assist

[6] The Quadripartite organizations, made up of the Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), World Health Organization (WHO), and the World Organisation for Animal Health (WOAH).

[7] InFARM: https://www.fao.org/antimicrobial-resistance/resources/infarm-system/en/

countries in collecting, collating, analyzing, visualizing, and effectively utilizing their AMR monitoring and surveillance data primarily from livestock, fisheries, and aquaculture, along with their associated food products.

[34] In November 2024, the Implementation and Capacity Development Committee (IC) discussed the next steps of the IPPC surveys on AMR. The IC supported the proposal to integrate data collection on AMR in plant health into FAO's InFARM platform with the IPPC Official Contact Points (OCPs) as the authorized contacts in countries, if applicable. The IC also highlighted the need for the OCPs to coordinate with other agencies within their countries, relevant to the InFARM platform, with the understanding that the coordination would not be more frequent than every three years. This proposal of AMR data collection for plant health though the InFARM platform was also discussed and supported in December 2024 by the CPM Bureau.

[35] A questionnaire is being developed by the NSP Pest and Pesticide Management Team in collaboration with the IPPC Secretariat to redesign the InFARM platform and integrate data collection on AMR in plant health. The OCPs will be able to use the InFARM platform as the authorized contacts in countries to provide information on the use of antimicrobials in plant health in collaboration with the other One Health focal points at national level.

[36] The OCPs would therefore have secure access to InFARM[8] to provide their official information on AMR and data collection campaigns could be relaunched every 2 or 3 years.

Recommendations

[37] The CPM is invited to:

(1) *note* the final results of the IPPC Observatory surveys on antibiotics and fungicides used in plant protection,

(2) *agree* that the data collected by the IPPC Observatory surveys on antibiotics and fungicides are sufficient to understand the use of antimicrobial in plant health and that these two surveys can be closed,

(3) *agree* to integrate data collection on AMR in plant health to the FAO InFARM platform with the IPPC Official Contact Points as the authorized contacts in countries,

(4) *thank* all countries that responded to the IPPC Observatory surveys on antibiotics and on fungicides use for their contributions a better understanding of antimicrobials use in plant health.

[8] InFARM database : https://infarm.fao.org/