Using biological control as part of IPM

Curriculum

Day 1		**Natural enemies and biological control**	(timing day 1 might change depending on field transfer time)
	10h00		**Welcome and introduction**
1)	10h15		**Pre course exam**
2)		Presentation	**General introduction natural enemies** Short summary IPM (with focus on control strategy: cultural - biological - chemical control); motivate participants to contribute! Overview biological control (conservation, augmentation, brief outline classical control)) Introduce natural enemy groups (predators / parasitoids / pathogens - bacteria, fungi, viruses, protozoa / nematodes); - short descriptions of groups and examples (described later in more detail) - overall biology at group level - typical life cycle per group
	10h45		DURING SHORT COFFEE BREAK
		Handouts	Introduction for handouts 'natural enemies' and 'pollinators' (pocket guides 1.3); handout 1.3b to follow presentations about natural enemy groups
	11h00		Transfer to the field
3)	12h00	Field exercises	**'Insect zoo' exercises** Collection of insects in the field 1 introduction (general issues about collecting insects / where to look for insects / how to collect / how to keep them alive/…) 2 participants collect samples (various life stages from egg to adult / life as well as dead insects) collected insects are kept in separate containers (petri dishes, vials, plastic bottles,…) 3 short plenary exchange: overview about what was collected 4 participants working in groups of 4-5: - sorting collected samples (similar looking, known - unknown, pest - natural enemy - not sure) - sort out what is known, label on collection container - if not known: set up insect with plant material in container and observe (to find out if pest or natural enemy) 5 participants looking at other groups labelled containers 6 short group presentations and discussion, labeling of all known insects / groups 7 setting up and observing pest - predator combinations (dep. on samples collected; aphid and predators easiest to observe…) Handouts: copies pocket guide natural enemy groups / pocket guide important pollinator groups (separate material list for practical work with insects)
	14h15		LUNCH BREAK

	15h15	Discussion	**'Insect zoo' exercises** Summary / discussion /wrap up - collected insect samples
4)	15h30	Presentation & discussion	**Important natural enemy groups** More detailed information about important natural enemy groups (2-3 slides per group)

Predators:	*Parasitoids:*	*Pathogens:*	*Nematodes:*
Spiders	Short introduction	Fungi	Outline two major groups
Mites	Hymenoptera groups	Bacteria	
Beetles	Diptera	Viruses	
Lacewings		Microsporidia	
Bugs	Example: diamondback	…with examples (Beauveria, Metarhizium, GV, NPV, Nosema,…)	
Flies	moth parasitoids	Overview microbial pesticides	
Wasps and ants			
Other predatory groups			

for each group, information on: how do they look like? What do they feed on? Summary biology / ecology; life cycle, especially for pathogens and nematodes; interesting facts…

	16h15		COFFEE BREAK
6)	16h45	Group exercise	**Recognise natural enemy groups** Grouping pictures: pests - predators - parasitoids - pathogens - nematodes Mixed collection of picture / cards (two versions available: 36 or 64 cards) Work in 5 groups, discuss in group to allocate cards / plenary discussion
	17h45		END DAY 1

Day 2		**Side effects of pesticides / Conservation of natural enemies**	
1)	8h30	Presentation	**Overview topic and link to IPM** IPM pyramid, chemical pesticide application as last resort Link of pyramid to earlier IPM concept as presented in plant doctor training Problems associated with the use of chemical pesticides - resistance - cost - health problems - environmental impact

2)	8h50	Exercise	**Possible unwanted effects of pesticide use** Handout: list and describe possible side effects of applying pesticides (individual, then exchange with neighbours) Short presentations, listing key topics on flip chart Discuss list in plenary session (topics as mentioned below, to be updated after following presentations)
3)	9h10	Presentation	**Impact of pesticide use in agriculture** *Human health and ecosystem* Direct impact on humans (brief summary) Impact through food commodities (brief summary) Surface water contamination Ground water contamination Soil contamination Effect on soil fertility (beneficial soil microorganisms) Contamination of air, soil, and non-target vegetation
4)	9h45	Movies	**Natural enemies at work** (depending on availability: natural enemy (biocontrol) movies / internet short movies, e.g. via links in doc 'Day 2 - 4
5)	10h30	Presentation	**Impact of pesticide use in agriculture** *Non target organisms* Bees and other pollinators Beneficial orrganisms Soil microorganisms Fish and wildlife
	10h00		COFFEE BREAK
6)	10h30	Presentation	**Conservation of natural enemies** Introduction and link to the IPM pyramid: preventive measures to avoid crop damage Increase populations of natural enemies & pollinators by: - improving resources alternative hosts food (energy) sources: flowers - providing appropriate microclimates refuge habitat , diapause or dormancy habitats field edges / no bare soil (mulch, cover crops; crop residues) - using attractants - avoiding negative factors on natural enemies agronomic practices, appropriate use and careful application of pesticides

7)	11h30	Field exercise	**How to improve situation for natural enemies and pollinators in the field?** In groups (4-5) field visit, assessment of current situation regarding natural enemies and pollinators (habitat, crop situation, agronomic practices, etc.) - how does the field look like in terms of suitability for natural enemies and pollinators? (consider actual situation in field, surrounding areas, agronomic practices, landscape etc.) ***make a list that describes the situation*** - How could the situation be improved? What would need to be changed, what would be the ideal situation? What should be considered in terms of agronomic practices and pesticide use? ***make a drawing of the field in the landscape, add to the drawing some elements that should ideally be included, describe practices (bullet points)*** - Discuss your proposed drawing: from the drawing (ideal situation), what would be realistic / feasible currently and could easily be implemented? / what are the anticipated barriers for some of the proposed measures? ***discuss and summarise important findings on flipchart*** Group presentations, feedback and plenary discussion
	13h00		LUNCH BREAK
8)	14h00		**Biocontrol products**
		Introd. discussion	Exchange participants: experiences with biocontrol products (availability / application / effect / cost /...); most important questions concerning use of biocontrol (capture on flipchart)
		Presentation	Introduction, short repetition about biocontrol (augmentation, inundation, conservation); overview available macrobials / microbials in the country where the training is implemented - groups of agents and some examples --> presentation to be adjusted to country context… (2 examples India included in training materials, Day 2.8)
		Group exercise	Samples of products that are commercially available in country x (to be organised), displayed with additional information, distributed in the room (alternatively, product information, pictures of packages) Trainees gather in groups at product locations in the training room, read available information, exchange and discuss After 5 minutes, groups change to next product
		Presentation & discussion	One person per group is giving an overview about the last product the group discussed Pleanary discussion, including questions from introduction / inputs for discussion if required, e.g. barriers for biocontro implementation and how to overcome difficulties
	optional depending on timing		
		Handout, disc.	Additional information about combination of bio-products with chemical pesticides
		Exercise	Combinations biocontrol agent - chemical pesticide
	15h30		COFFEE BREAK
9)	16H00		**Koppert side effects app**
		Live Demo	How to use the Koppert side effects database

		Introduction slides & Handout	How to use the product specific information of the application for assessing effects on natural enemy groups (handout same content as presentation)
		Exercise	Using the Koppert database - getting familiar with the application (participants using the app) - specific exercises (e.g. products x, y and z are available for aphid control; which one do you recommend)
		Wrap up	Discussion as required to clarify issues on biocontrol products
	17H00		END DAY 2

Day 3			**Recommendations of plant doctors concerning chemical product side effects**
1)	09H00		**Information and tools to improve pesticide recommendations regarding hazards and side-effects of pesticides**
		Short present. Handouts (extracts)	Introduction of information resources More general information sources - WHO classification - Plantwise red list (conventions and WHO Ia & b) - Green and Yellow lists (PMDGs, some examples fitting local context)
		Short exercise(s)	4-5 chemicals given; using above information, rank from most to least recommended product (small groups, direct feedback and plenary discussion)
		Handouts (extracts)	Specific information on non - target organisms - IOBC - CABI Pesticide side effects on beneficial organisms - Koppert side effects database (basis for Koppert side effects app' - 'EIS - Environmental Impact Sheet' (developed to assess pesticide compatibility with IPM / biocontrol)
		Short exercise(s)	4-5 chemicals given; using above information, rank from most to least recommended product eg when applying parasitoids (small groups, direct feedbackand plenary discussion)
	10H15		COFFEE BREAK
2)	10H45	Exercise	Introduce list of the most often recommended pesticides by extension workers (pre-course analysis needed! See example India in course materials, Day 3.2) In Plantwise countries, PMDGs and / or POMS data about recommendations Update the proposed list with inputs from participating extension specialists (plant doctors in PW countries) --> 'what do you usually recommend?'

In groups: With the list, compile available information (non-target effects, using handouts) in a format that is useful for you when giving advice to farmers about what pesticides to use…
Exchange on developed lists between groups, updates as required

3) 12H00 **Post course exam**

4) 12H15 Wrap up **Training summary:**
Feedback questionnaire
Extract key messages from the training that should influence recommendations for farmers

13H00 END DAY 3

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