Use of fungicides in LMICs*

*Based on recommendations recorded in the Plantwise Online Management System

The Role of Plant Agricultural Practices on Development of Antimicrobial Resistant Fungi Affecting Human Health

National Academy of Sciences

Data analysis Rob Reeder and Phil Taylor

Presenter:Phil Taylor, 22nd June 2022

KNOWLEDGE FOR LIFE

CABI

what is CABI?

CABI is a not-for-profit science-based development and information organization

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The Netherlands


Trinidad & Tobago


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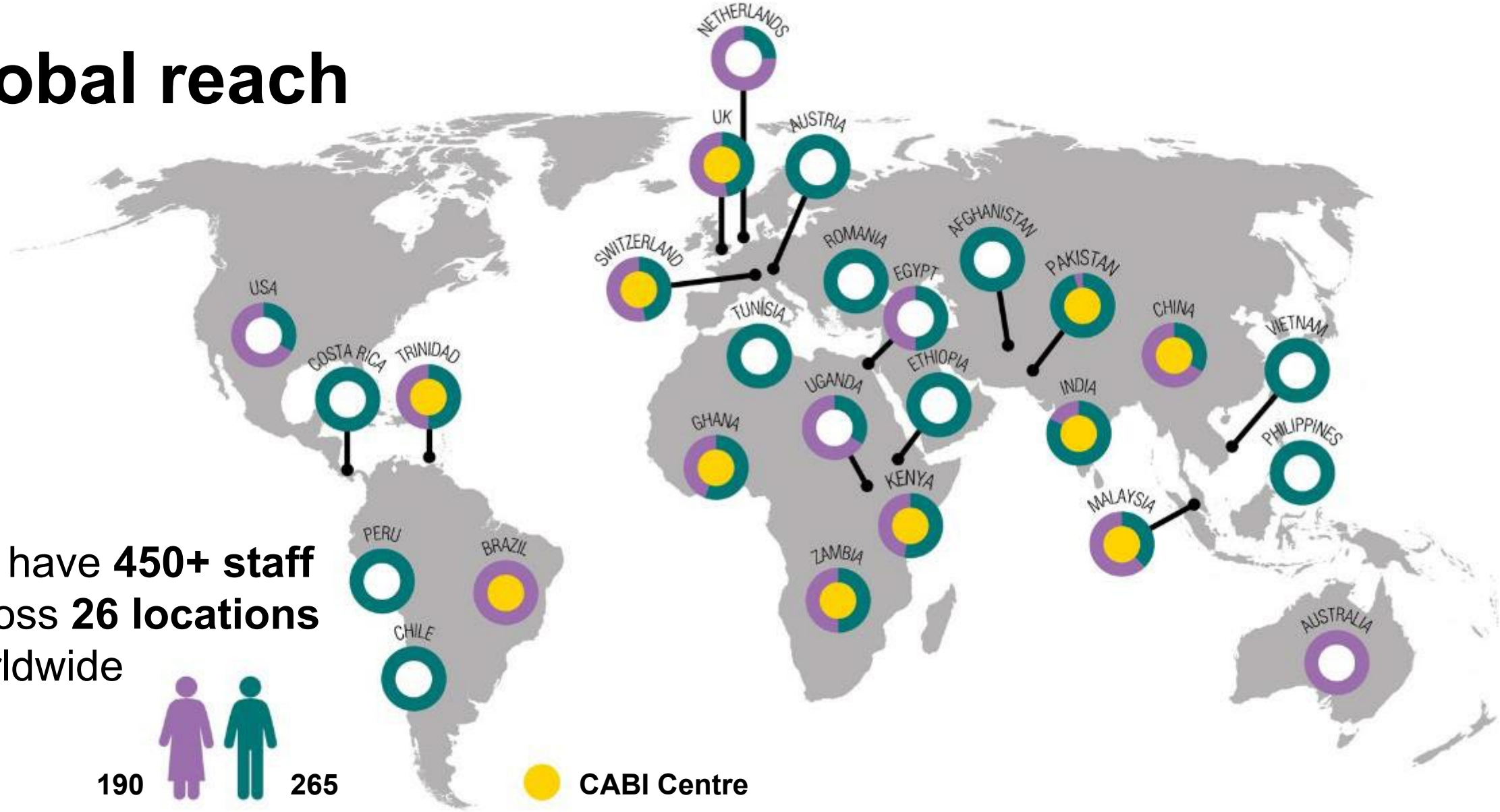
Global reach



We have **450+ staff** across **26 locations** worldwide

190 265

CABI Centre

What is Plantwise?

Plantwise is a global programme, led by **CABI**,
to increase food security and improve rural livelihoods by reducing crop losses

Plantwise;

To improve food security farmers need locally available advice appropriate to their situation.

Plant clinics pioneered by CABI have bolstered extension in many countries around the globe.

Plant clinics are very simple and affordable and can be rolled out on a large scale.

SET UP; in local meeting places

e.g. at markets, village squares and near human health clinics

PROVIDE; diagnosis and treatment advice;

to halt the immediate problem and to prevent it from reoccurring

Strapline “any crop and any problem”

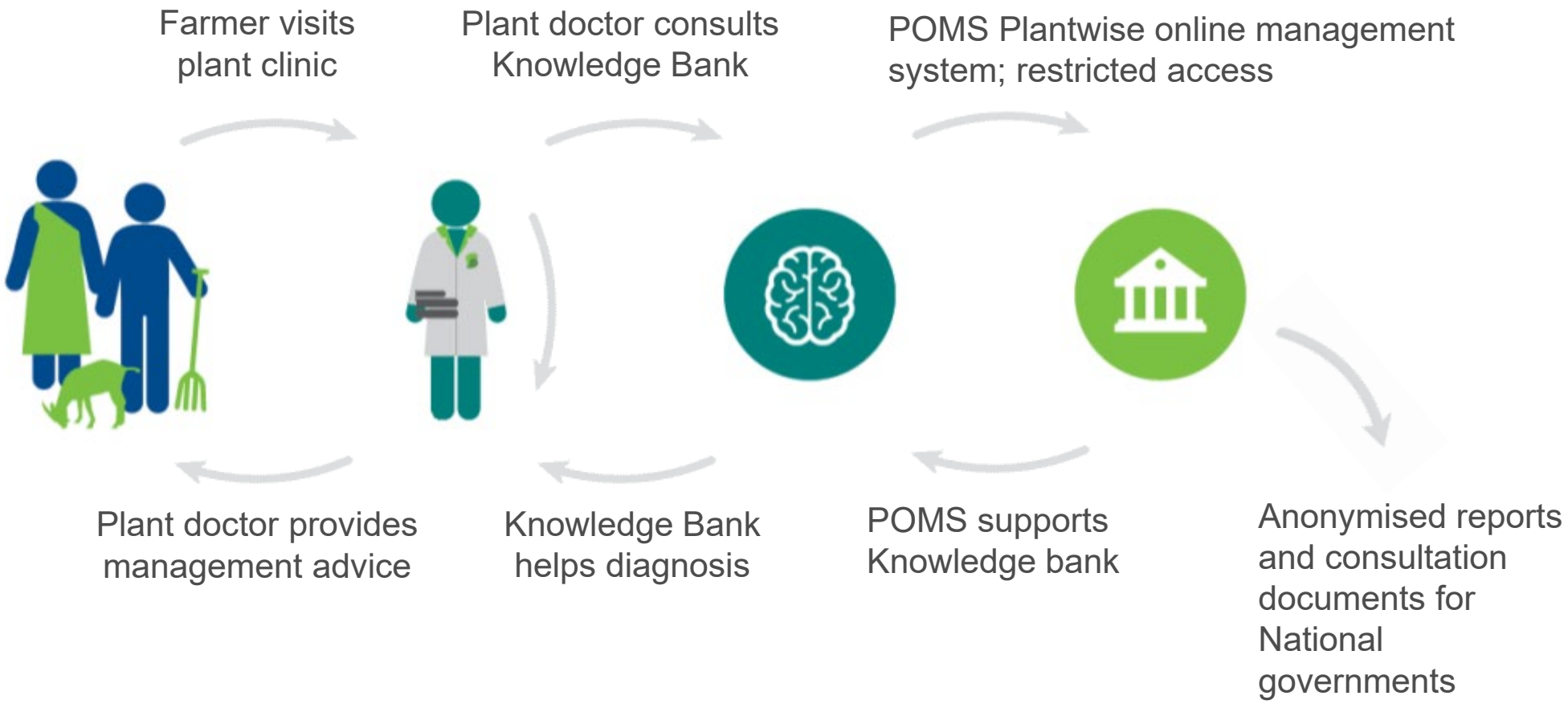
COLLECT; data about farmers and crops

e.g. crop area, symptoms, diagnosis and treatment

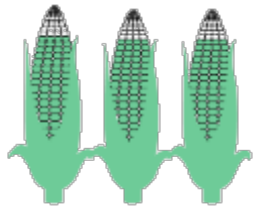
Plantwise clinics:


Send SMS to farmer
plantwise
Summary
To send an SMS of the recommendation to the farmer, select the language you want the SMS to be sent in and check this in the preview
If a phone number was recorded earlier in the form, this will appear here. This number can be edited.
Touch Send SMS
Send SMS
Save as draft
Save and submit
RECOMMENDATIONS FOR MANAGEMENT
Monitor problem
Cultural
Biological
Host resistance
Fungicides
Insecticides
Acaricides
Nematicides
Herbicides
TYPE OF ORGANISM: BIOTIC
Fungi
Bacteria
Insect/Mite
DIAGNOSIS (start a new sheet fo
Pest/disease/weed
FOLLOW UP ACTIVITIES:
Sample sent to lab
Factsheet given
Field visit arranged
Yes
No

Process;


Farmer visits plant clinic
Plant doctor consults Knowledge Bank
POMS Plantwise online management system; restricted access
Plant doctor provides management advice
Knowledge Bank helps diagnosis
POMS supports Knowledge bank
Anonymised reports and consultation documents for National governments

Plantwise; Impact



79% of farmers reported yield increases after visiting a plant clinic

70% of farmers reported their income increased after visiting a plant clinic

Over half of plant clinic prescriptions recommend non-chemical inputs

25% of Plantwise plant doctors worldwide are female

Government partners; all Plantwise countries contribute funds and/or staff time towards activities

Plantwise has linked with **70 private sector organisations**

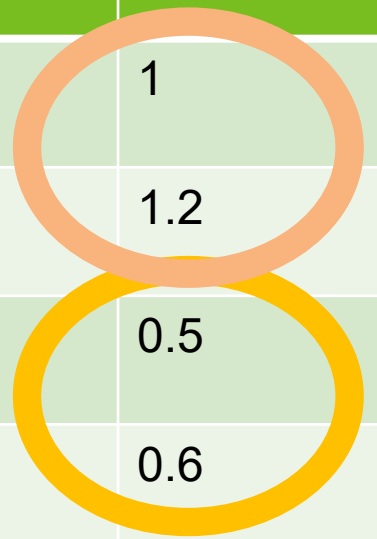
Acribat	Companic	Dithriamon	Dithani M 45
Acrobat	Conti Zeb	Dithtenium	Dithanium
Acrobat MZ	Contizeb	Ditin M	Dithante
Afrizeb	Coraza	Dittane	Dithate
Afrizeb supe	Corum	Dizane	Dithau
Agrithane	Cosavet	Dizcozeb	Dithchem
Agro Laxe	Cotzeb	Dm45	Dithex M4
Agrobat	Covaset	Dolomite	Dithean
Agrobate	Cozeb	Downlight	Dithein
Agrolaxyl	Crinoxil G	Dthane	Ditheme
Agromax	Curamyl	Dthiran	Dithen
Agrozeb	Curaseb	Duthane	Dithen M45
Agrozebe	Curatane	Dy Thine	Dithene
Althane	Curathan	Dythane	Dithenere
Amimax	Curathane	Dythen	Dithenium
Ascozeb	Curthane	Dythen M	Dithering
Ashothane	Curtine	Dythene	Dithian
Autracol	Curzat M	Dythin	Dithiane
Autrocel	Curzate M	Ebony	Dithienm
Belthane	Curzatem	Emithane	Dithine M37
Biothane	Dadamast	Emthane	Dithion
Bonus	Dai Theen	Emthane M4	Dithithan
Brothane	Daiphane	Emthanem45	Dithon
Cadilac	Denyomil	Eureka	Focozeb
Callipso	Derazeb	Fantic	Fokozeb
Calypso	Determin	Farm Cozeb	Fortazeb
Carathane	Dethan	Farmcozeb	Fortress
Carathene	Dethane	Farmer Zeb	Galven
Carothem	Dhidomil	Farmerzeb	Glory
Carpenderze	Dhitanne	Farmezeb	Gold Mz
Carzate	Dhithane	Flyee	Greenzeb

Notes on the analysis.

- This study was limited to commercially available fungicides
- No attempt was made to distinguish between blends and alternatives "Use fungicide A **and** B or use fungicide A **or** B"
- What was meant was not always clear based on what was written
- Automation of the process was not possible due to problems with tradenames and misspelling
- The Plantwise data may not be a true reflection of the problems in country nor of the treatments applied and can only be used as a proxy

Extent of fungicide use:

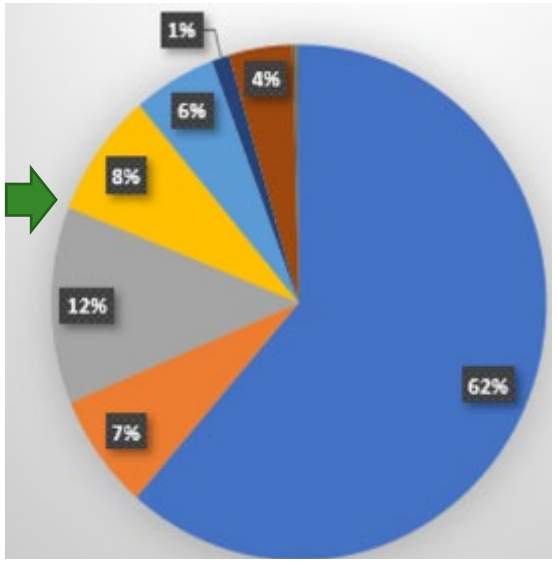
Region	Total number of records	Total number of records containing a fungicide	Percentage of microbial pathogen* diagnoses	Percentage of all records containing a fungicide	Approx ratio of microbial diagnoses to fungicide containing records
LAC	12498	3028	24	24	1
SA	77807	12160	13	16	1.2
SEA	13222	1755	27	13	0.5
SSA	62671	10496	30	17	0.6



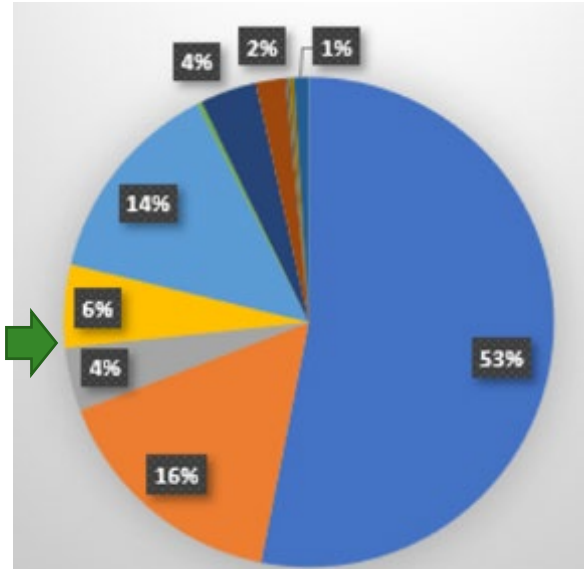
* Microbial pathogens included fungi, watermoulds (oomycetes) and bacteria

Of the fungicide-containing data; what was the diagnosis?

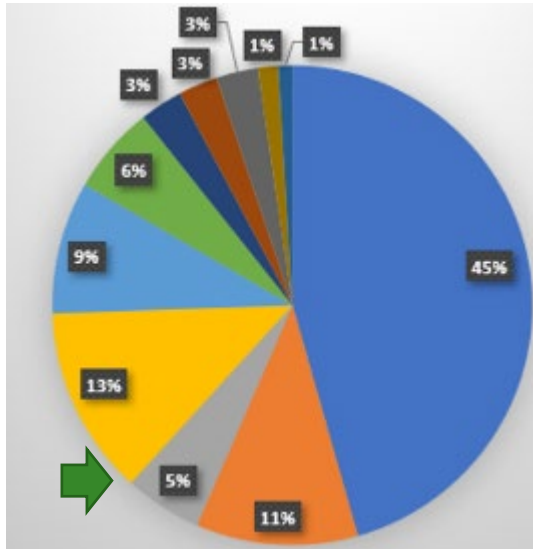
SEA



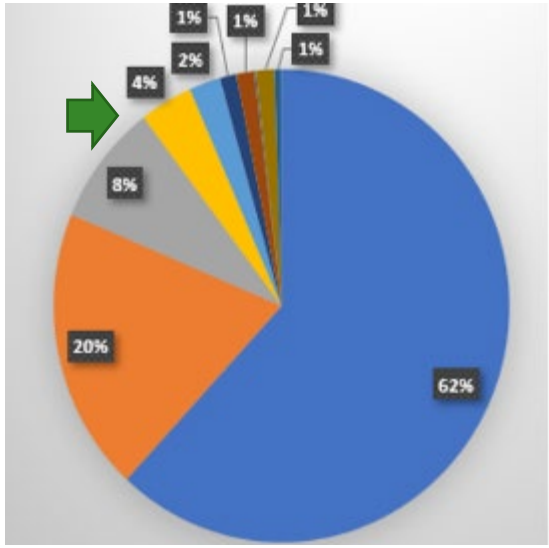
LAC



SA



SSA



- Fungus
- Water mould
- Bacteria
- Arthropod
- Blank or unknown
- Advice ahead of the problem
- Symptom
- "Disease" or "Diseases"
- Environmental
- Virus
- Deficiency

List of active ingredients found in FRAC 3 listings with those in red found in the POMS data.

Azaconazole Bitertanol Bromuconazole Cyproconazole Difenoconazole Diniconazole Epoxiconazole Etaconazole Fenbuconazole Fluquinconazole Flusilazole Flutriafol Hexaconazole Imibenconazole Ipconazole Mefentrifluconazole Metconazole Myclobutanil Penconazole Propiconazole Prothioconazole Simeconazole Tebuconazole Tetraconazole Triadimefon Triadimenol Triticonazole

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Other chemicals ending in “azole”:

Thiabendazole (Frac1); Etridiazole (Frac14);Tricyclazole (Frac 16.1)

Albendazole and Clotrimazole (veterinary products both used on rice in SEA)

Which active ingredients were found within the data set? Single site AI

FRAC CODE	Number of active ingredients identified in the data	Number of fungicide active ingredients making up FRAC code	Colloquial name for group of fungicides or chemical grouping as appropriate.	Common member of the FRAC code
FRAC 1	4	5	MBC - fungicides (Methyl Benzimidazole Carbamates)	Carbendazim
FRAC 11	7	20	QoI Quinone outside inhibitor	Azoxystrobin
FRAC 12	1	2	PP-fungicides (PhenylPyrroles)	Fludioxonil
FRAC 14	3	7	AH-fungicides (Aromatic Hydrocarbons) (Chlorophenyls, Nitroanilines)	Tolclofos Methyl
FRAC 16.1	2	3	MBI-R (Melanin Biosynthesis Inhibitors Reductase)	Pyroquilon
FRAC 2	1	5	Dicarboximides	Iprodione
FRAC 20	1	1	Phenylureas	Pencycuron
FRAC 21	1	3	QiI - fungicides (Quinone inside Inhibitors)	Cyazofamid
FRAC 22	1	2	Benzamides	Zoxamide
FRAC 27	1	1	Cyanoacetamide- oxime	Cymoxanil
FRAC 28	1	3	Carbamate	Propamocarb
FRAC 29	2	4	(Uncouplers of oxidative phosphorylation)	Dinocap
FRAC 3	17	37	DMI-fungicides (DeMethylation Inhibitors) SBI: Class I)	Difenoconazole
FRAC 30	1	3	Organo tin compounds	Triphenyltin

30 Frac groups in total

FRAC CODE	Number of active ingredients identified in the data	Number of fungicide active ingredients making up FRAC code	Colloquial name for group of fungicides or chemical grouping as appropriate.	Common member of the FRAC code
FRAC (33) P07	2	2	Phosphonates	Fosetyl aluminium
FRAC 36	1	2	Benzene-sulfonamides	Flusulfamide
FRAC 4	3	5	PA – fungicides (PhenylAmides)	Metalaxyl
FRAC 40	2	7	CAA-fungicides (Carboxylic Acid Amides)	Dimethomorph
FRAC 5	3	7	Amines (“morpholines”) (SBI: Class II)	Tridemorph
FRAC 6	3	4	Dithiolanes	Isoprothiolane
FRAC 7	5	23	SDHI (Succinate dehydrogenase inhibitors)	Boscalid, Carboxin
FRAC 8	2	3	Hydroxy-(2-amino-) pyrimidines	Bupirimate
FRAC 9	2	3	AP fungicides (Anilino-pyrimidines)	Cyprodinil
FRAC 17	1	2	KRI fungicides (KetoReductase Inhibitors) SBI: Class III	Fenhexamid

Which active ingredients were found within the data set? Multi site

FRAC CODE	Number of active ingredients identified in the data	Number of fungicide active ingredients making up FRAC code	Colloquial name for group of fungicides or chemical grouping as appropriate.	Common member of the FRAC code
FRAC M 01	1	1	Inorganic (electrophiles)	Copper Salts
FRAC M 02	1	1	Inorganic (electrophiles)	Elemental Sulphur
FRAC M 03	7	9	Dithiocarbamates and relatives	Mancozeb
FRAC M04	2	3	Phthalimides	Folpet
FRAC M05	1	1	Chloronitriles (phthalonitriles)	Chlorothalonil
FRAC M09	1	1	Quinones (anthraquinones)	Dithianon
Unclassified	3		No FRAC code available	Fluopicolide, Peroxyacetic Acid, Lime Sulphur
Vetinary products	2		No FRAC code available	Albenedazole Clotrimazole

30 Frac groups and 87 active ingredients in total.

To simplify the data; if an active ingredient did not feature in more than 1% of the fungicide-containing records from *a* region it was excluded from the analysis of that region.

Imposing the 1% rule reduced the data considerably:

Region	Total number of active ingredients represented in regional data	Total number of active ingredients represented in more than 1% of the fungicide containing regional data
LAC	59	23
SA	58	17
SEA	38	20
SSA	66	15

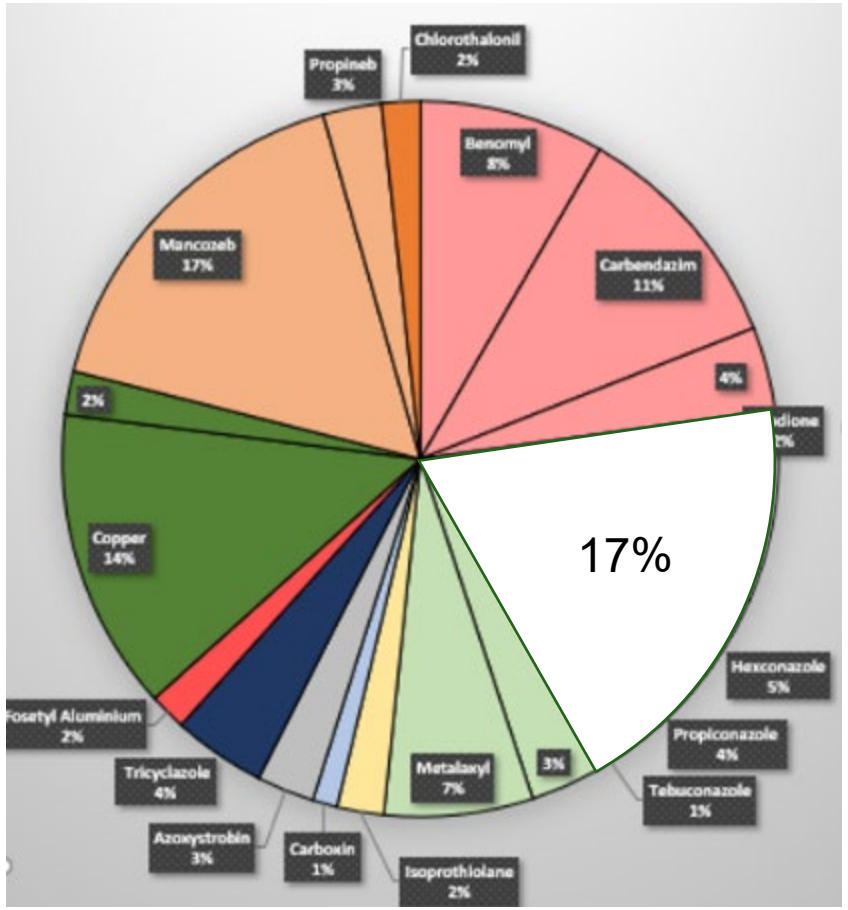
When applied to the azoles only those in blue cleared the 1% rule

Azaconazole Bitertanol Bromuconazole Cyproconazole Difenoconazole Diniconazole Epoxiconazole Etaconazole Fenbuconazole Fluquinconazole Flusilazole Flutriafol Hexaconazole Imibenconazole Ipconazole Mefentrifluconazole Metconazole Myclobutanil Penconazole Propiconazole Prothioconazole Simeconazole Tebuconazole Tetraconazole Triadimefon Triadimenol Triticonazole

Benomyl	Azoxystrobin
Carbendazim	Famoxadone
Thiophanate Methyl	Pyraclostrobin
Iprodione	Tricyclazole
Cyproconazole	Cymoxanil
Difenoconazole	Propamocarb
Hexconazole	Fosetyl Aluminium
Metconazole	Dimethomorph
Propiconazole	Copper
Tebuconazole	Sulphur
Triadimenol	Mancozeb
Triadimefon	Metiram
(Metalaxyl M)	Propineb
Metalaxyl	Thiram
Isoprothiolane	Captan
Boscalid	Folpet
Carboxin	Chlorothalonil

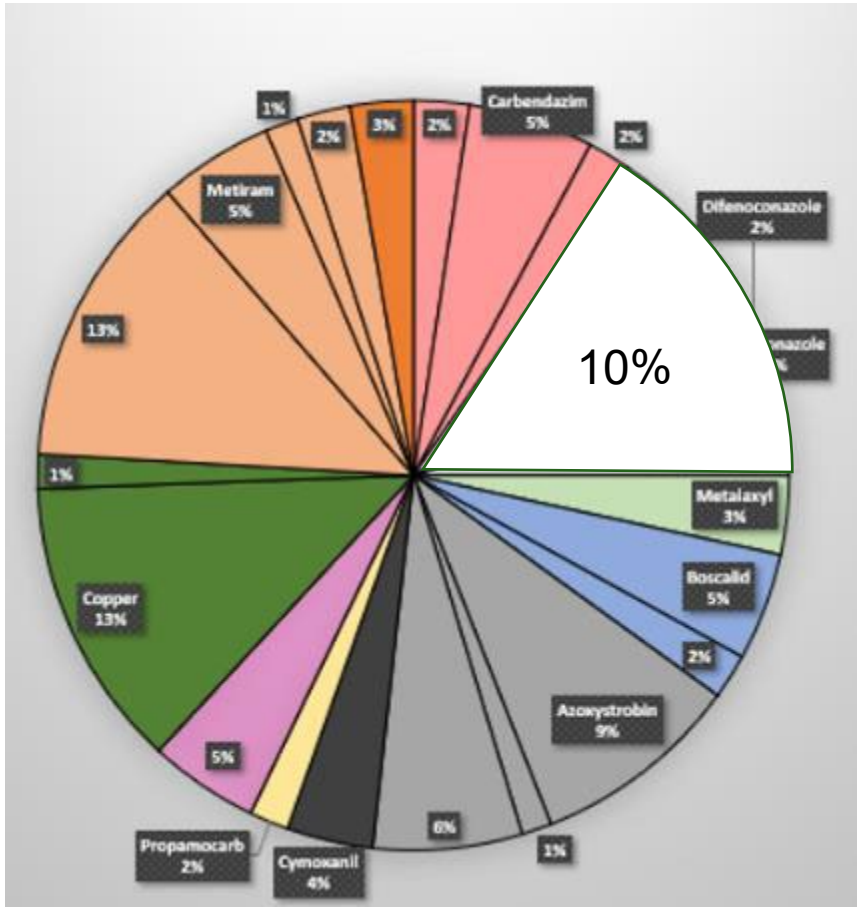
Regional breakdown of fungicide use:

SEA



12 Frac groups

LAC

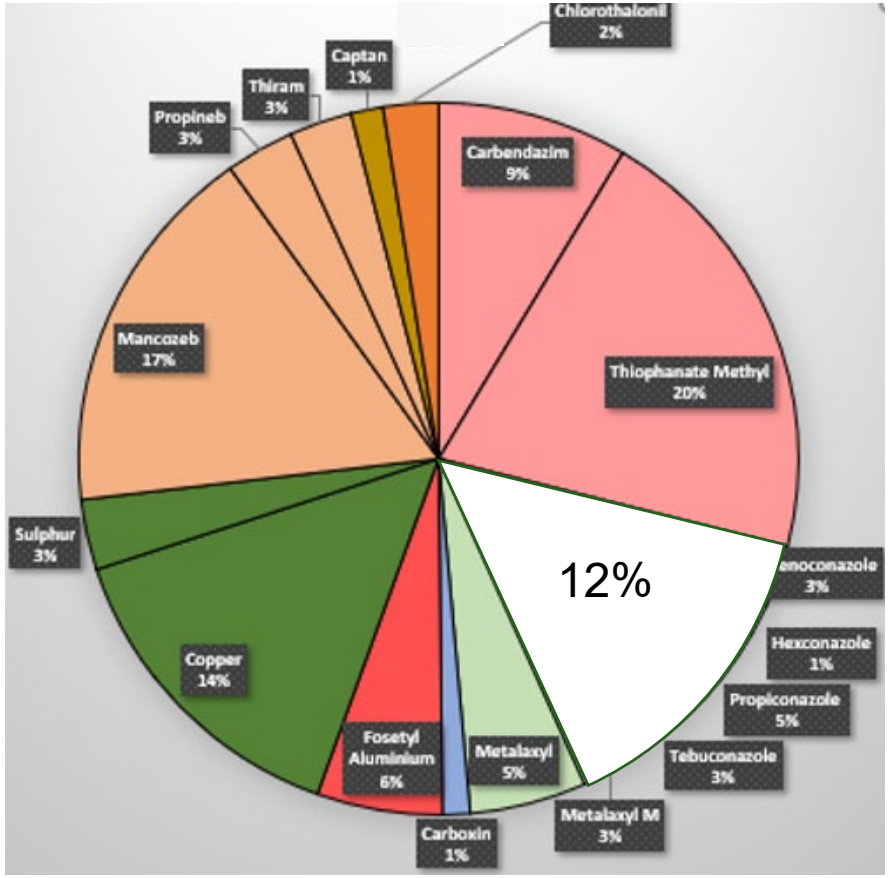


11 Frac groups

Benomyl	Azoxystrobin
Carbendazim	Famoxadone
Thiophanate Methyl	Pyraclostrobin
Iprodione	Tricyclazole
Cyproconazole	Cymoxanil
Difenoconazole	Propamocarb
Hexconazole	Fosetyl Aluminium
Metconazole	Dimethomorph
Propiconazole	Copper
Tebuconazole	Sulphur
Triadimenol	Mancozeb
Triadimefon	Metiram
(Metalaxyl M)	Propineb
Metalaxyl	Thiram
Isoprothiolane	Captan
Boscalid	Folpet
Carboxin	Chlorothalonil

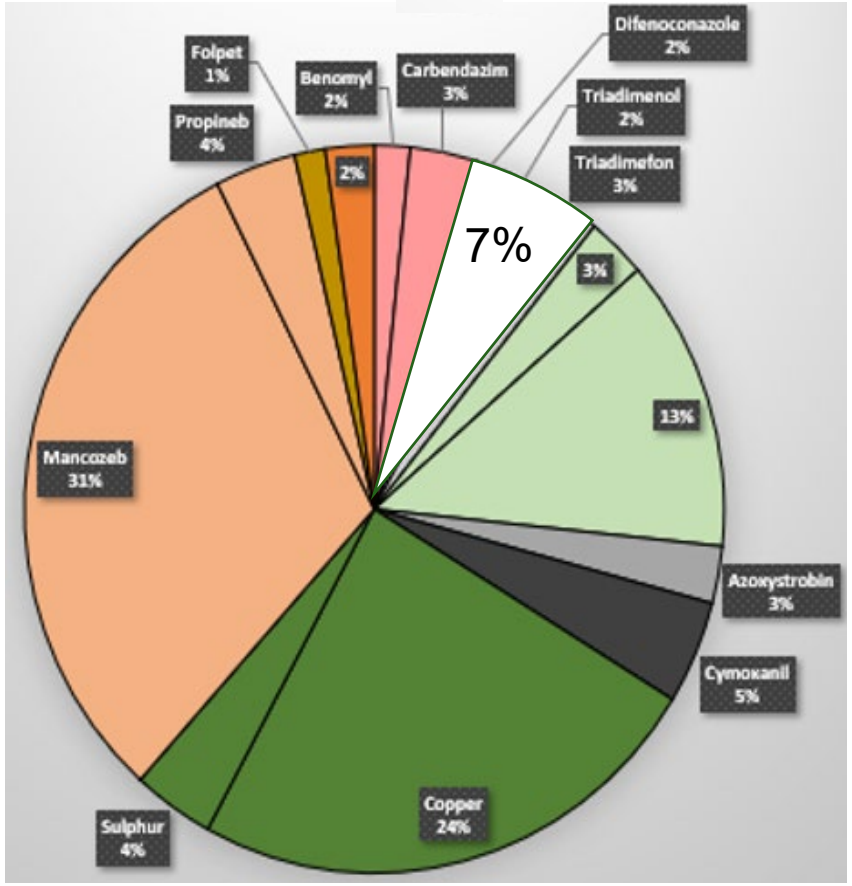
Regional breakdown of fungicide use:

SA



12 Frac groups

SSA



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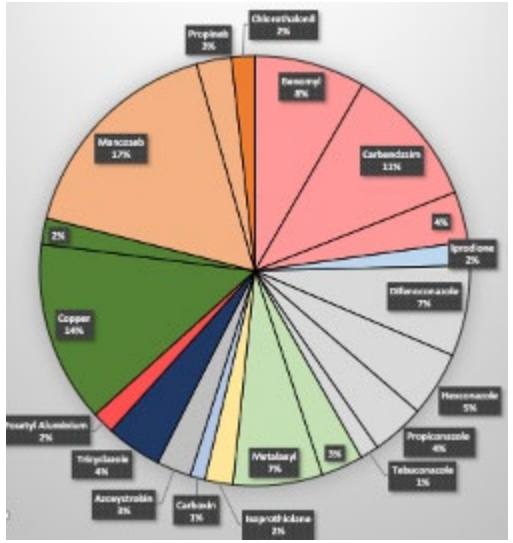
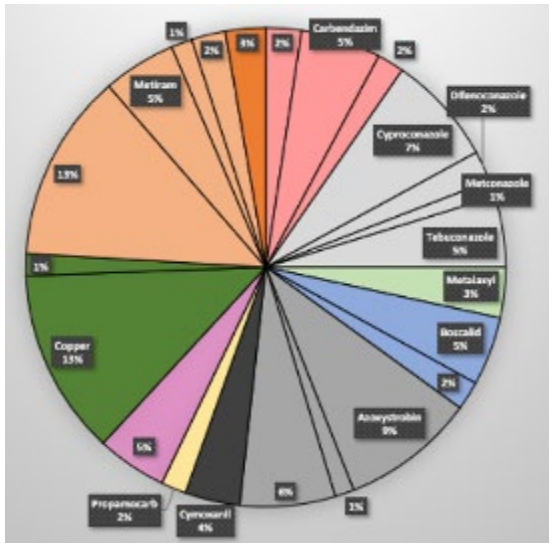
(Metalaxyl M)	Propineb
Metalaxyl	Thiram
Isoprothiolane	Captan
Boscalid	Folpet
Carboxin	Chlorothalonil

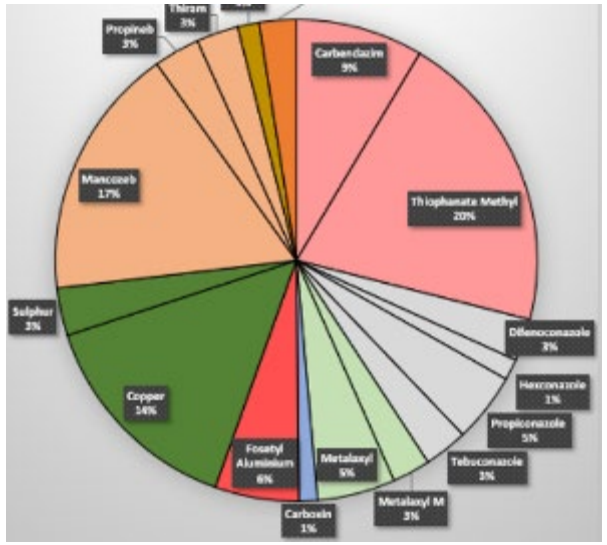
Frac group comparisons of the 4 regions: with the main active ingredients of each group highlighted.



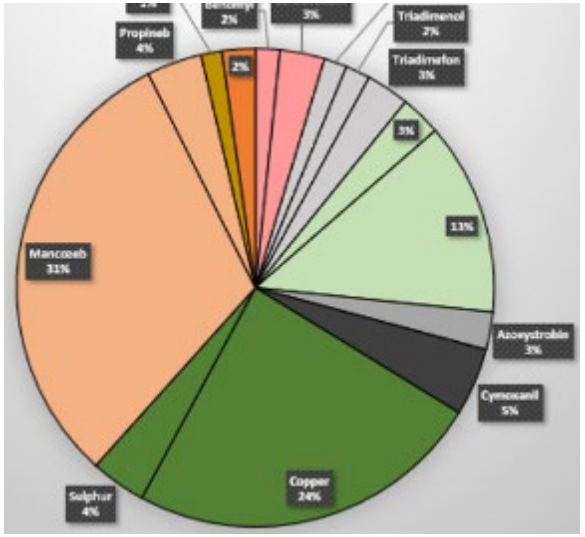
SEA



LAC



SA



SSA

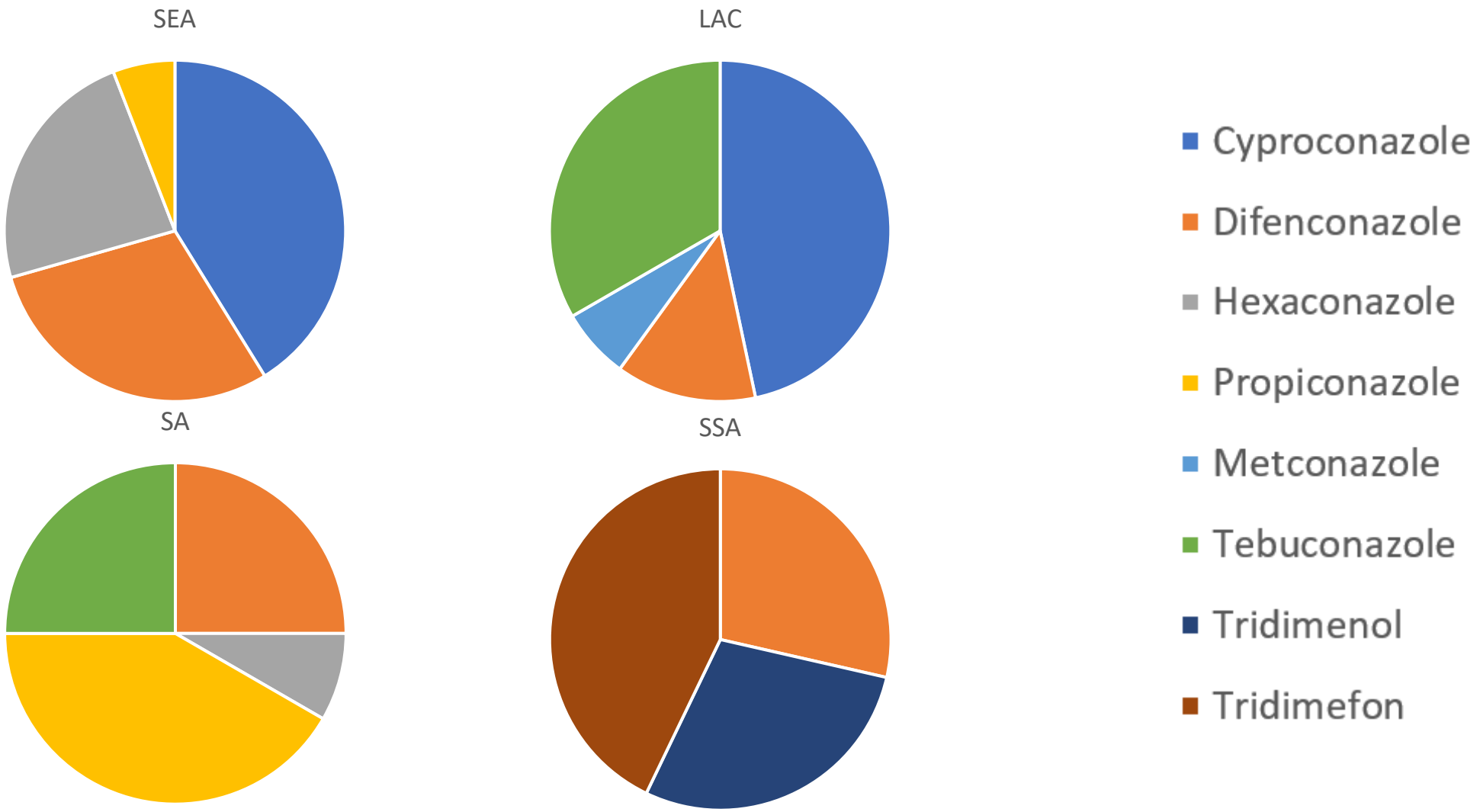
	Frac1; Carbendazim Thioph'te methyl
	Frac 2; Iprodione
	Frac 3; Cyproco'zole Difenoco'zole
	Frac 4; Metalaxyl Metalaxyl M
	Frac 6; Isoprothiolane

	Frac11; Azoxys'bin Pyraclos'bin
	Frac 16.1; Tricyclazole
	Frac 27; Cymoxanil
	Frac 28; Propamocarb
	Frac 33; Fosetyl aluminium

	Frac MO1; Copper, sulphur
	Frac MO 3; Man'zeb Propineb
	Frac MO 4 ; Captan Folpet
	Frac MO 5; Chlorothalonil

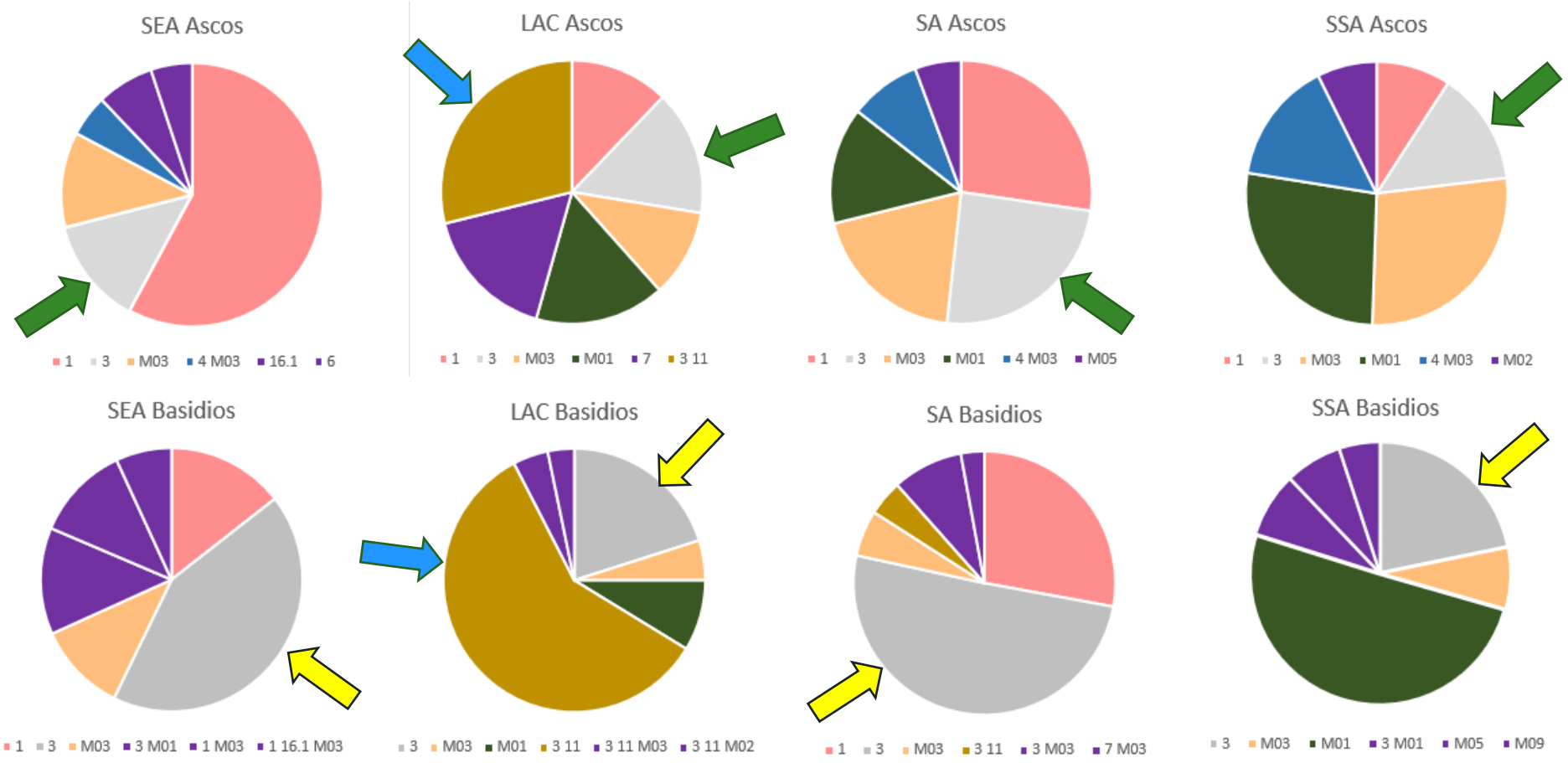
Fungicide recommendations are dominated by the same five FRAC codes (FRAC 1, 3, 4, M01 and M03) these make up more than 84% of the fungicide records in three regions SEA, SA and SSA and 61% of those in LAC

Which azole fungicides are being used in the regions?



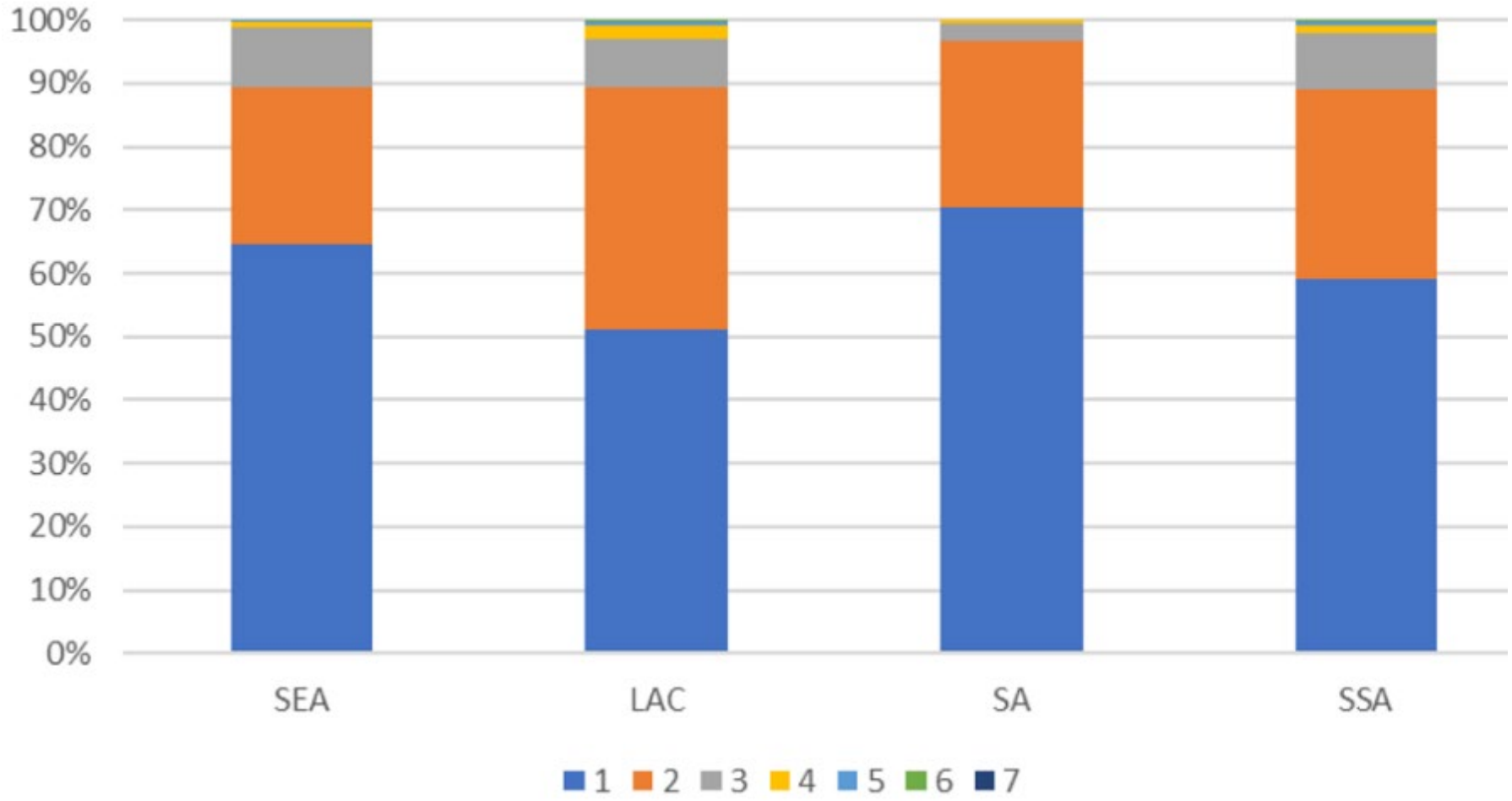
Differences in recommendation with regard fungal group

(considerable reduction in data)

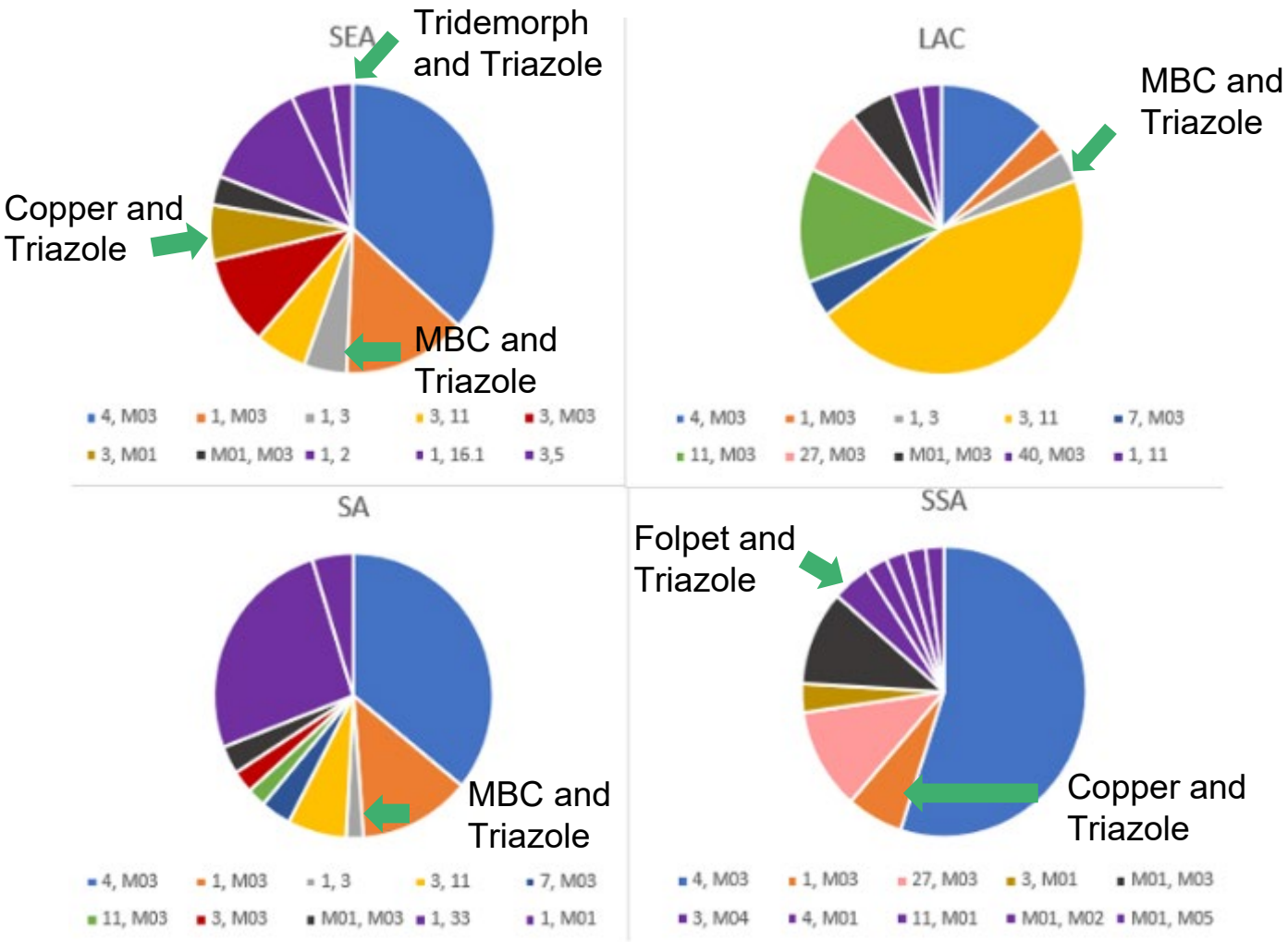


	Frac 1 Carbendazim etc
	Frac 3 Triazoles
	Frac MO3 Mancozeb
	Frac MO1 Copper
	Frac 3 + 11 Triazoles and Strobilurins
	Frac 4 + MO3 Mancozeb and Metalaxyl
	Other Frac code

Number of active ingredients per recommendation by region.



What are the most popular blends ?



- Frac 3 / Frac MO3 Triazoles and Mancozeb
- Frac 3 / Frac 11 Triazoles and Strobilurins
- Frac 4 / Frac MO3 Metalaxyl and Mancozeb
- Frac 1 / Frac MO3 Carbendazim and Mancozeb
- Frac 11 / Frac MO3 Strobilurins and Mancozeb
- Frac 27 / Frac MO3 Cymoxanil and Mancozeb
- Frac MO1 / Frac MO3 Copper and Mancozeb

What other actives are azoles are in commercial blends?

Name of azole	Blended active ingredients (FRAC group in brackets)		
Cyproconazole	Trifloxystrobin (11)	Azoxystrobin (11)	
Difenoconazole	Propicon*azole* (3)		
Epoxiconazole	Pyraclostrobin (11)		
Fluquinconazole			
Flusilazole			
Flutriafol			
Hexaconazole	Bupirimate (8)		
Metconazole	Pyraclostrobin (11)		
Myclobutanil			
Penconazole			
Propiconazole	Difenocon*azole* (3)	Prothiocon*azole* (3)	
Prothioconazole	Propicon*azole* (3)		
Tebuconazole	Spiroxamine (5)	Azoxystrobin (11)	Chloropyriphos (NA)
Tetraconazole			
Triadimefon			
Triadimenol	Folpet (M04)	Triflumuron (NA)	

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Australian Government Australian Centre for International Agricultural Research

Agriculture and Agri-Food Canada

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