

Tecnología de Boquillas



Condiciones ambientales

- Velocidad del viento:

- El RD 1311/2012 establece que se evitara todo tipo de tratamientos con vientos > 3 m/s

- Temperatura:

- T moderadas [10-25°C]
- Si la T es muy elevada \rightarrow efectos térmicos tienden a levantar las gotas más finas

- Humedad:

- HR $> 50\%$
- Si la HR es muy baja el agua de las gotas tiende a evaporarse \rightarrow incremento de gotas más finas



Funciones de la boquilla



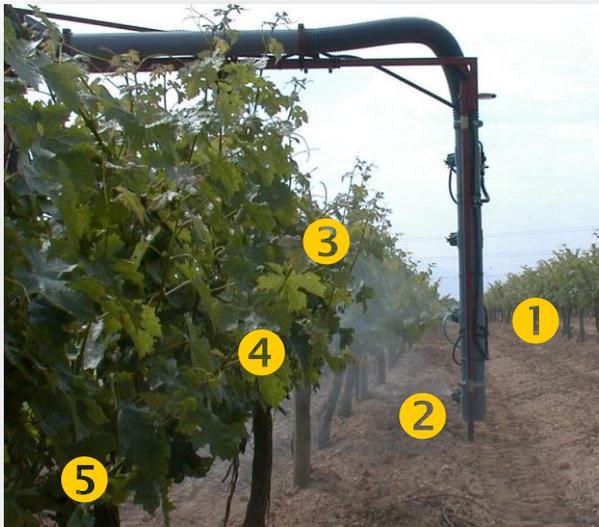
1. Control del caudal de líquido

2. Formación de las gotas

3. Distribución sobre el objetivo

4. Recubrimiento

5. Penetración

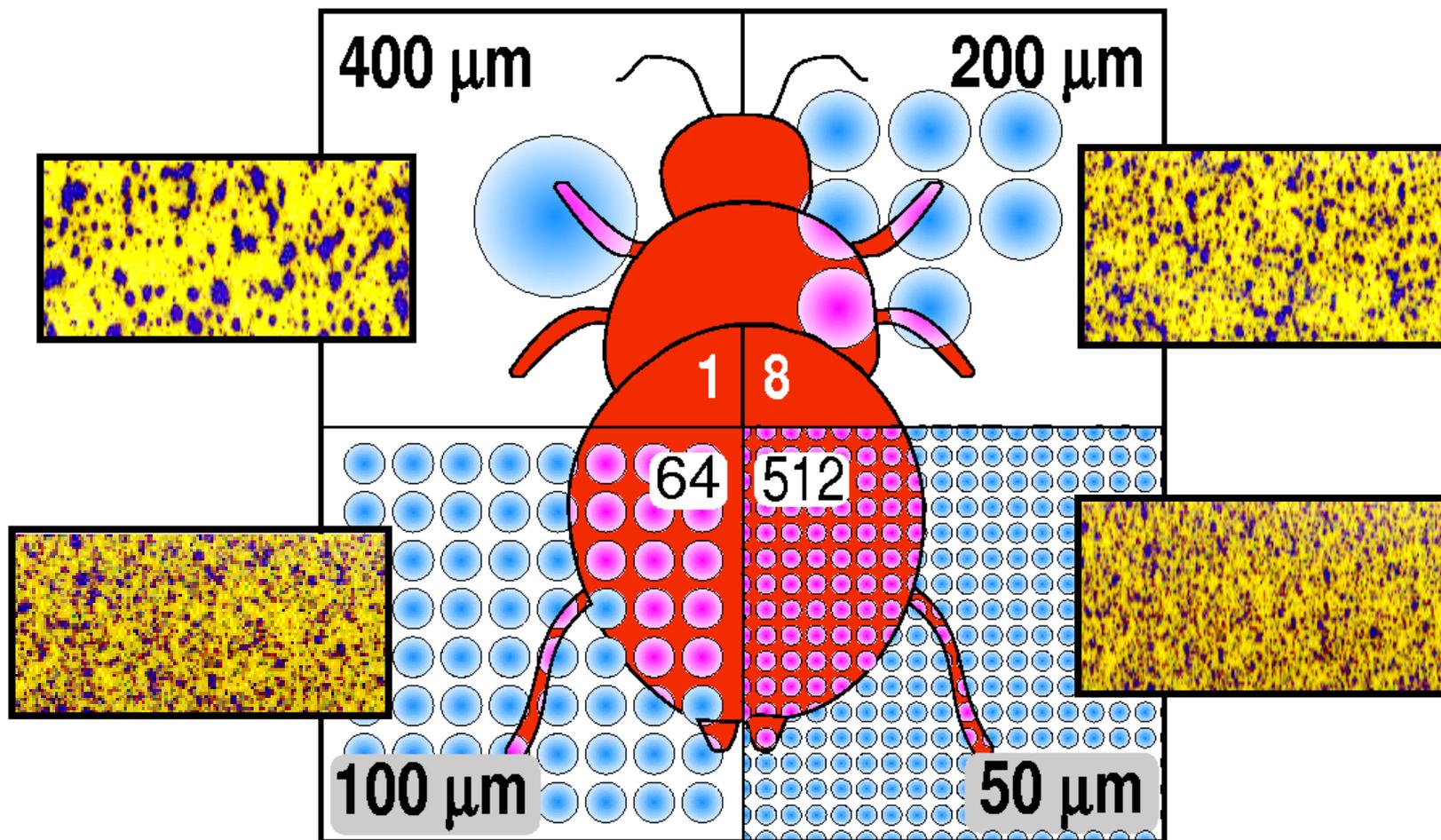


La eficacia y el riesgo de deriva de un tratamiento dependen de:

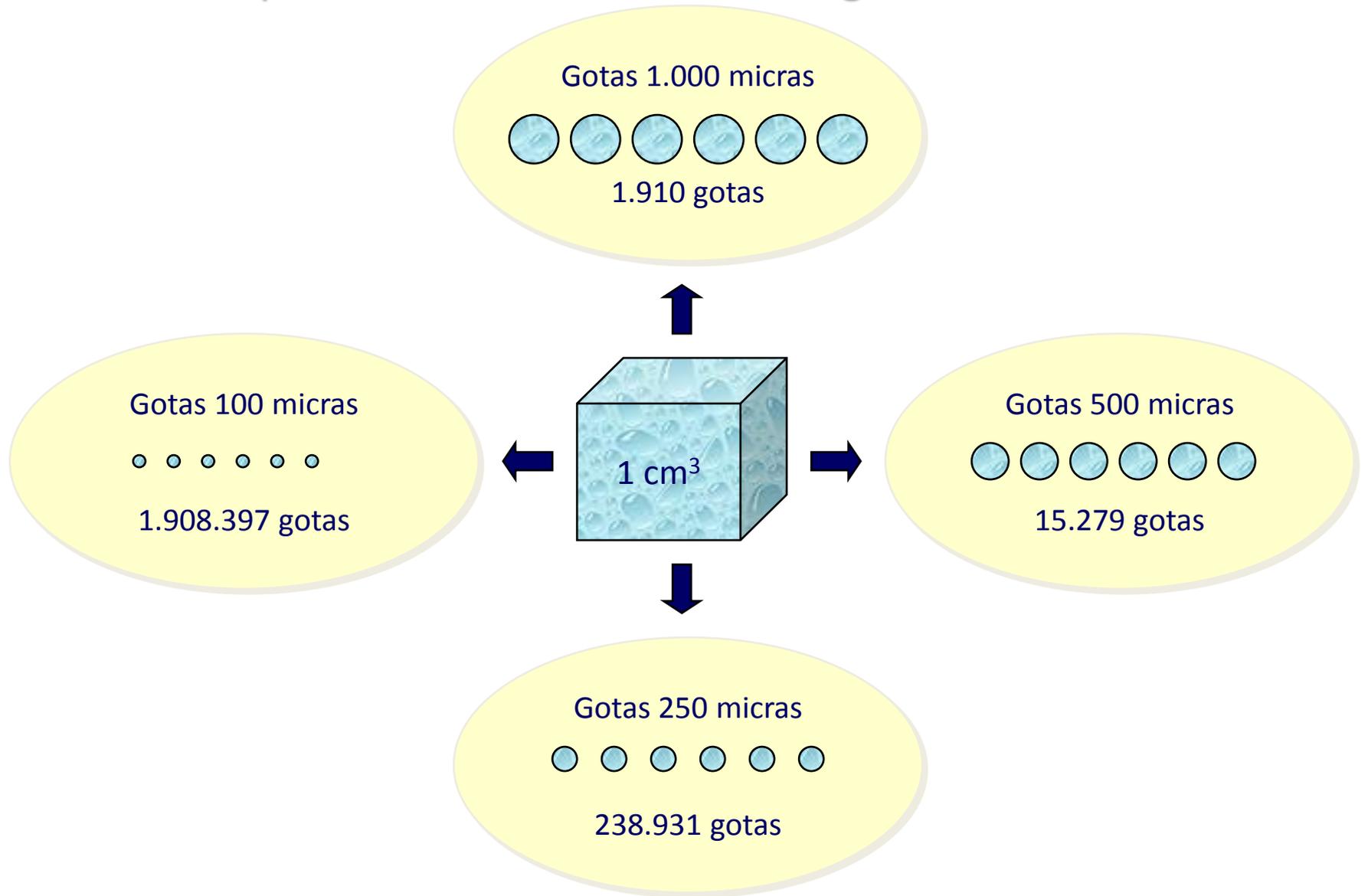


- El tamaño de gotas
Diámetro mediano en volumen (VMD)
- El espectro de gotas formado
Rango (% gotas gruesas-% gotas finas)

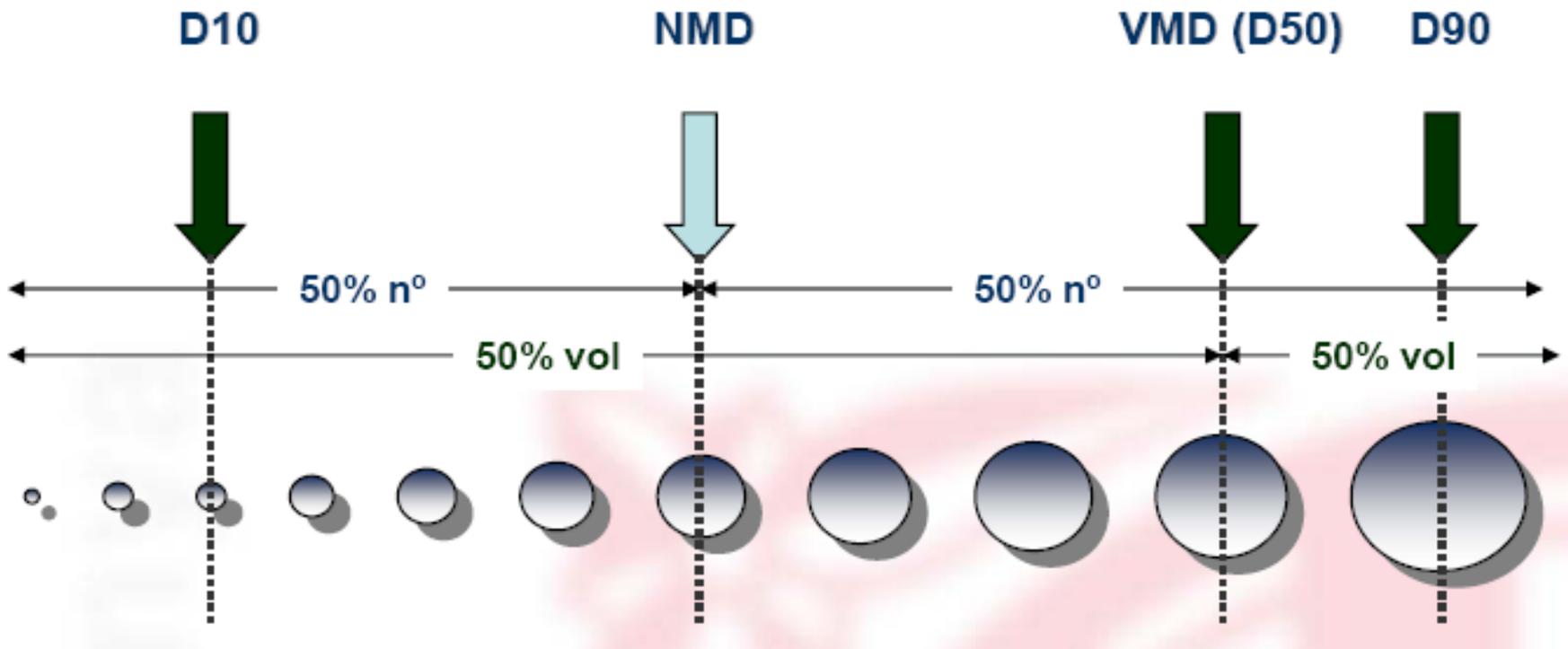




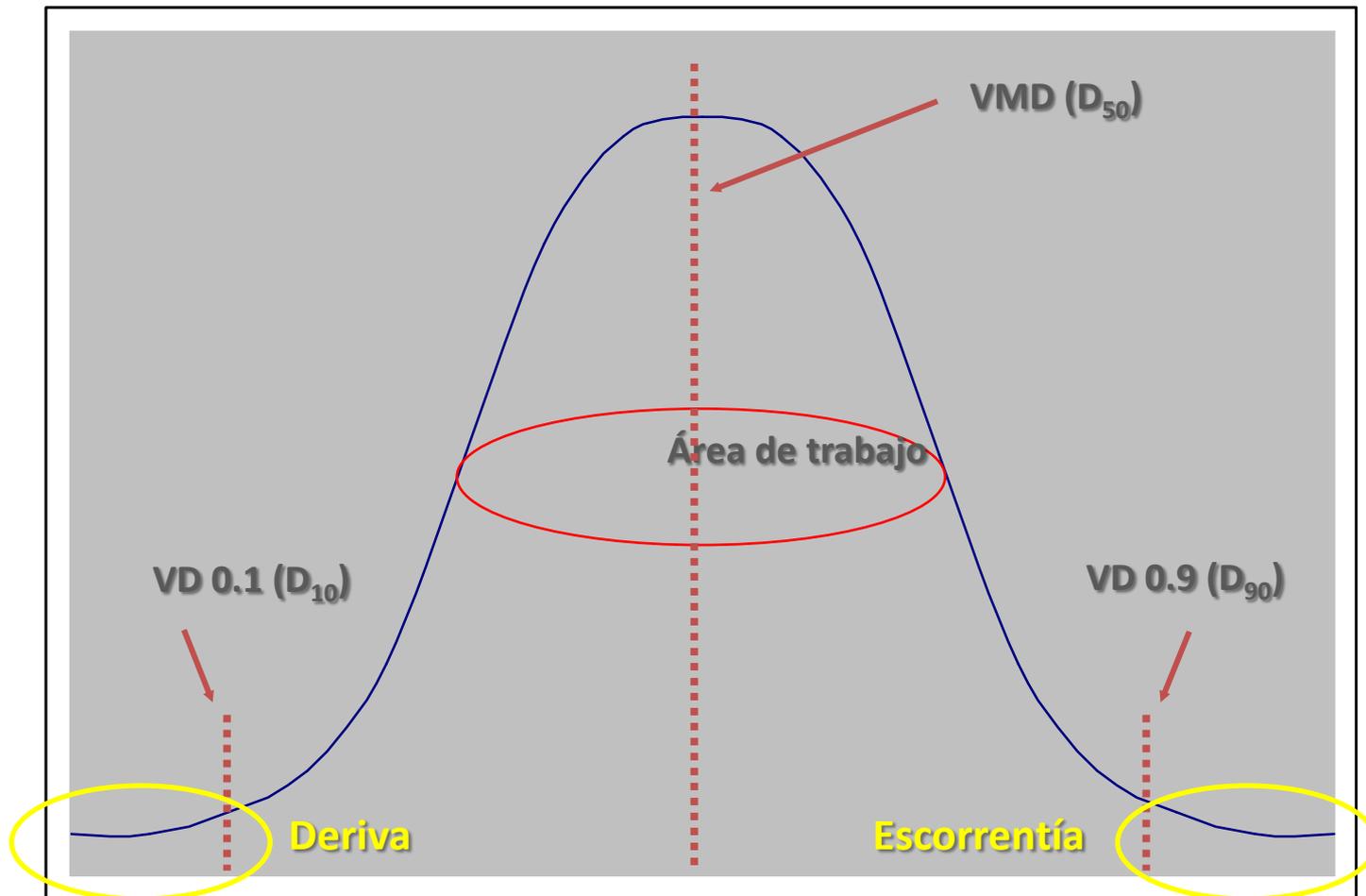
Elección de la pulverización: tamaño de las gotas



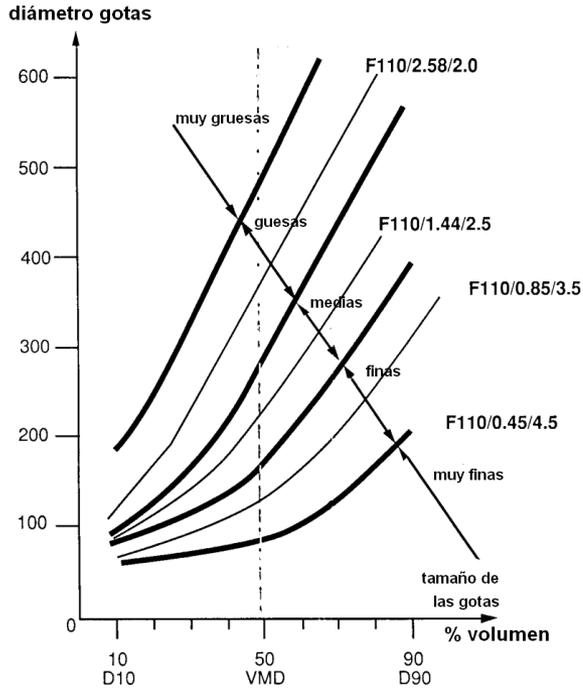
Población de gotas



Importancia del espectro de gotas



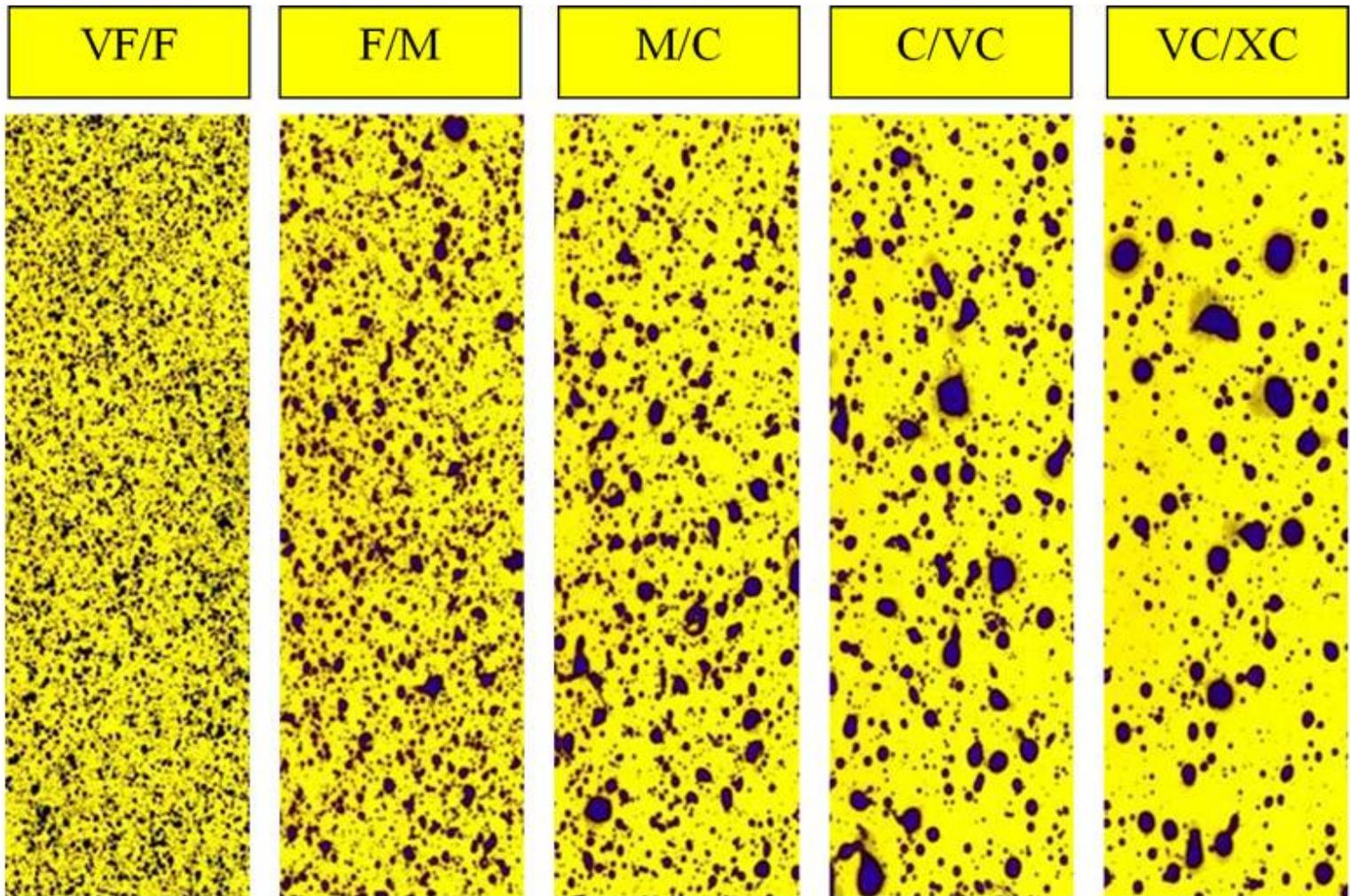
Clasificación del tamaño de gotas



Category	BCPC	ASABE S572
Muy fina (VF)	$< 90 \mu\text{m}$	$< 100 \mu\text{m}$
Fina (F)	$90 - 200 \mu\text{m}$	$100 - 175 \mu\text{m}$
Media (M)	$200 - 300 \mu\text{m}$	$175 - 250 \mu\text{m}$
Gruesa (C)	$300 - 450 \mu\text{m}$	$250 - 375 \mu\text{m}$
Muy gruesa (VC)	$> 450 \mu\text{m}$	$375 - 450 \mu\text{m}$
Extra gruesa (XC)		$> 450 \mu\text{m}$



Droplet category droplet sizes



<http://www.wilger.net/Drop%20cat%20drop%20sizes.jpg>

Image courtesy of Tom Wolf, Agriculture and Agri-Food Canada, Research Centre





 	 bar	DROP SIZE		CAPACITY ONE NOZZLE IN l/min
		80°	110°	

XR8001 XR11001 (100)	1.0	M	F	0.23
	1.5	F	F	0.28
	2.0	F	F	0.32
	2.5	F	F	0.36
	3.0	F	F	0.39
	4.0	F	VF	0.45

XR80015 XR110015 (100)	1.0	M	F	0.34
	1.5	M	F	0.42
	2.0	F	F	0.48
	2.5	F	F	0.54
	3.0	F	F	0.59
	4.0	F	F	0.68

XR8002 XR11002 (50)	1.0	M	M	0.46
	1.5	M	F	0.56
	2.0	M	F	0.65
	2.5	M	F	0.72
	3.0	F	F	0.79
	4.0	F	F	0.91

XR110025 (50)	1.0		M	0.57
	1.5		M	0.70
	2.0		F	0.81
	2.5		F	0.90
	3.0		F	0.99
	4.0		F	1.14

XR8003 XR11003 (50)	1.0	M	M	0.68
	1.5	M	M	0.83
	2.0	M	F	0.96
	2.5	M	F	1.08
	3.0	M	F	1.18
	4.0	M	F	1.36

XR8004 XR11004 (50)	1.0	C	M	0.91
	1.5	M	M	1.12
	2.0	M	M	1.29
	2.5	M	M	1.44
	3.0	M	M	1.58
	4.0	M	F	1.82



 	 bar	DROP SIZE	CAPACITY ONE NOZZLE IN l/min
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TTJ60-11002 (100)	1.5	C	0.56
	2.0	C	0.65
	3.0	C	0.79
	4.0	M	0.91
	5.0	M	1.02
	6.0	M	1.12

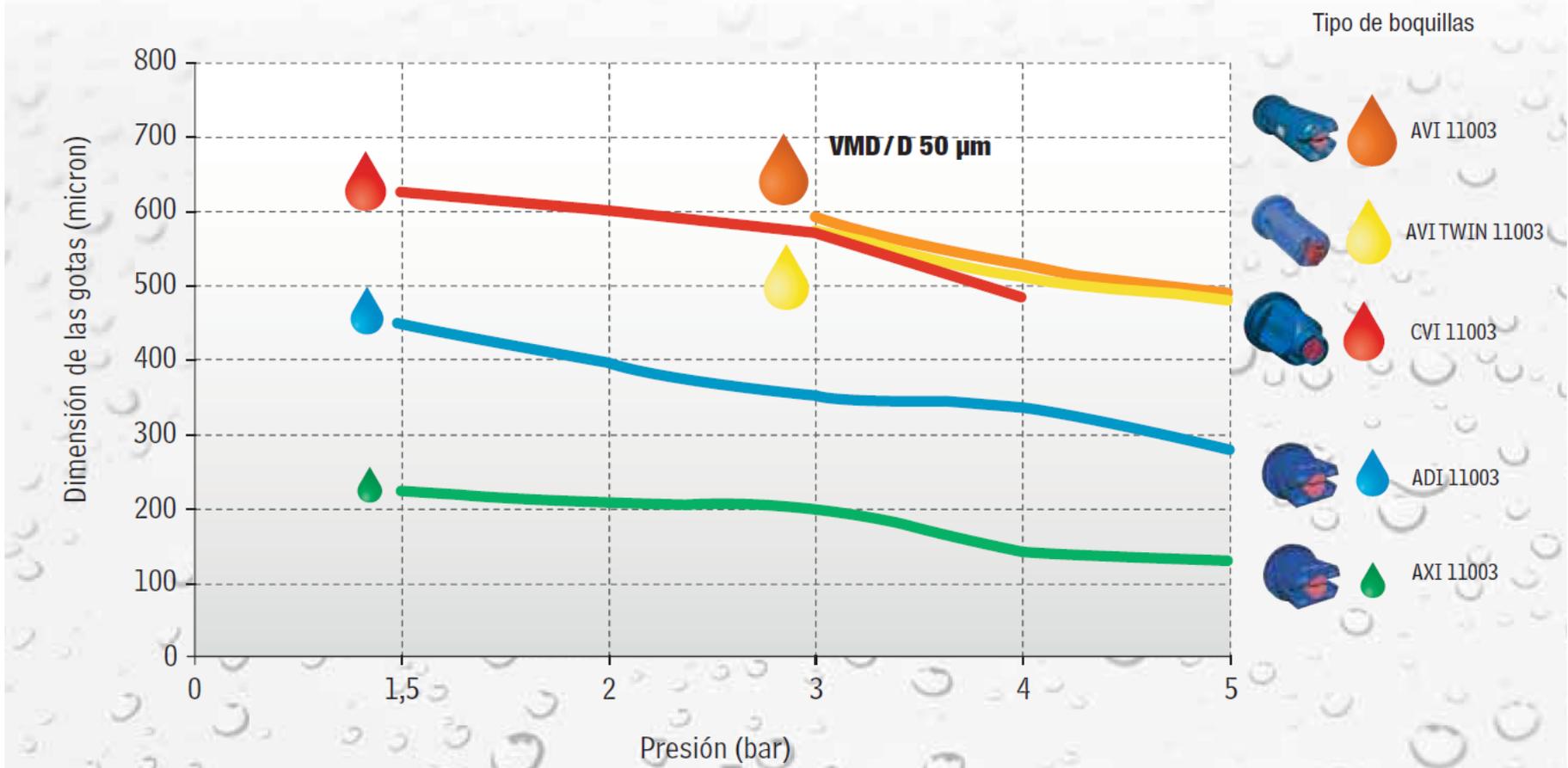
TTJ60-110025 (100)	1.5	VC	0.70
	2.0	C	0.81
	3.0	C	0.99
	4.0	C	1.14
	5.0	M	1.28
	6.0	M	1.40

TTJ60-11003 (100)	1.5	VC	0.83
	2.0	C	0.96
	3.0	C	1.18
	4.0	C	1.36
	5.0	C	1.52
	6.0	M	1.67

TTJ60-11004 (50)	1.5	VC	1.12
	2.0	C	1.29
	3.0	C	1.58
	4.0	C	1.82
	5.0	C	2.04
	6.0	M	2.23



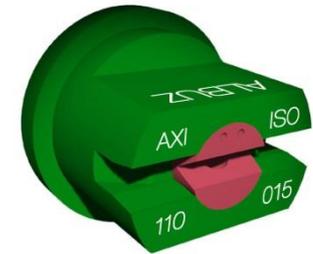
COMPARATIVA DEL TAMAÑO DE GOTAS: BOQUILLAS MODELO 03



Fuente: Catalogo Albuz 2013

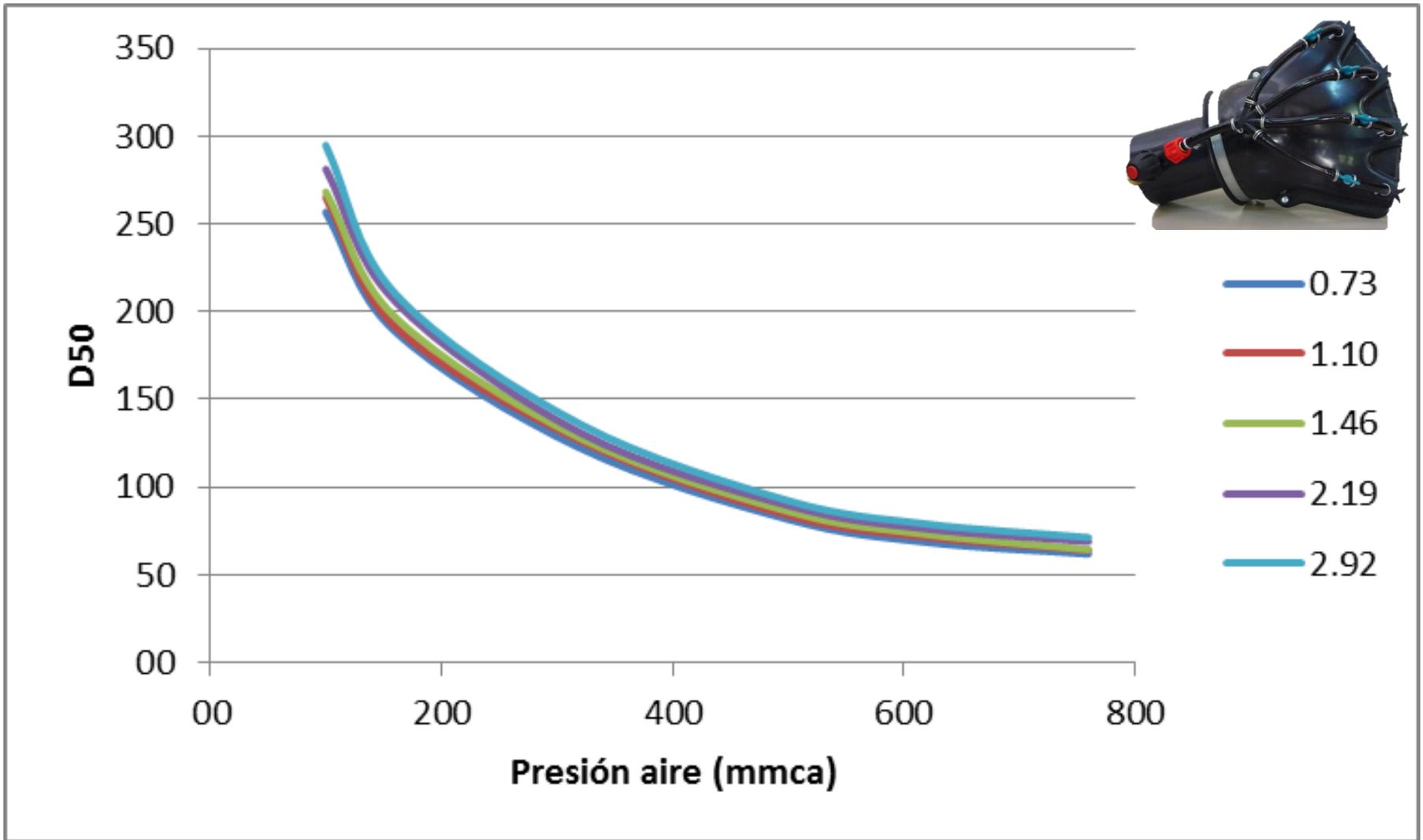


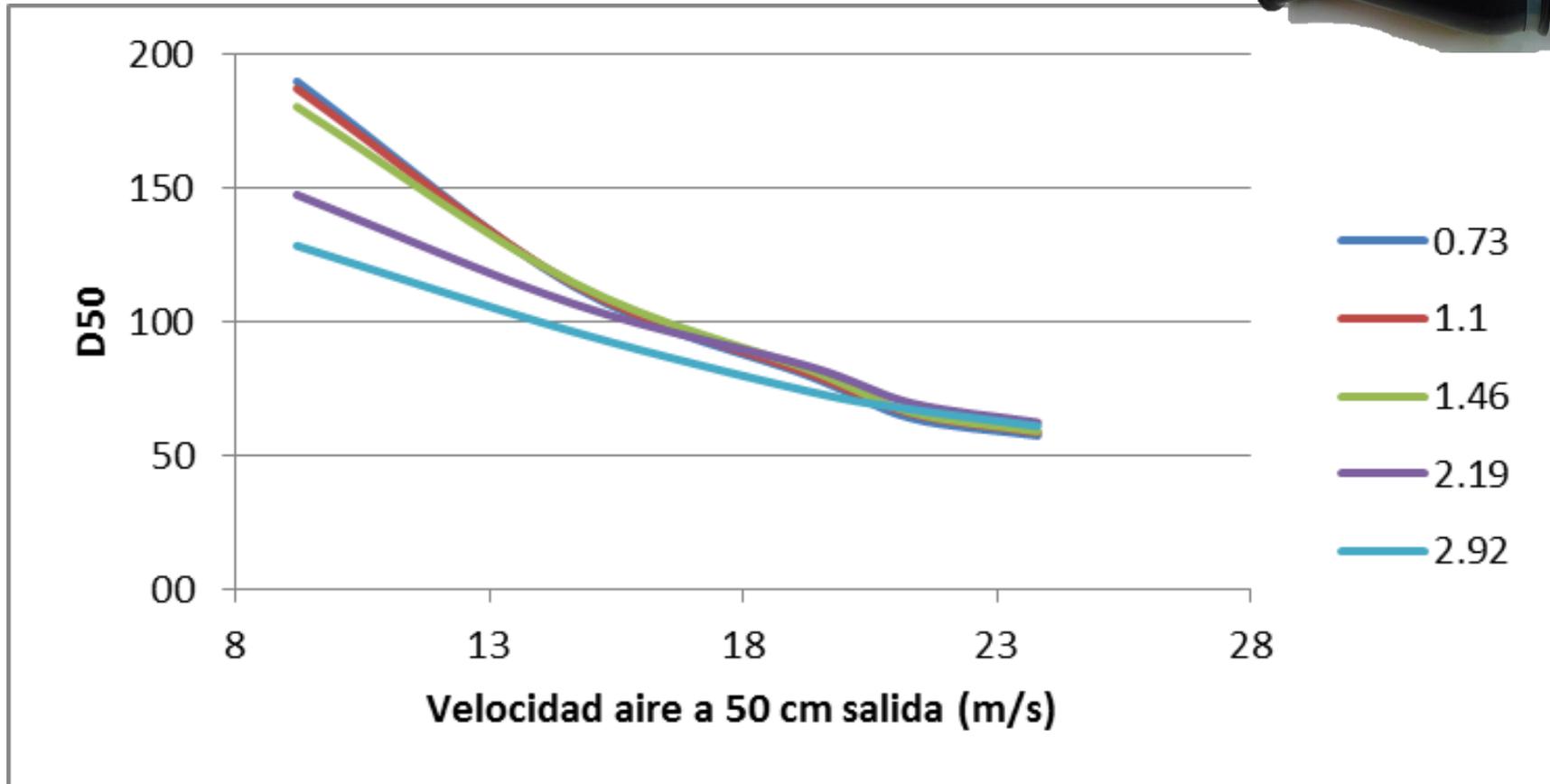
bar	AXI 110°						
	VERDE 110015	AMARILLA 11002	LILA 110025	AZUL 11003	ROJA 11004	MARRON 11005	GRIS 11006
1,5	F	F	M	M	M	M	C
2	F	F	F	M	M	M	M
3	F	F	F	M	M	M	M
4	VF	F	F	F	M	M	M



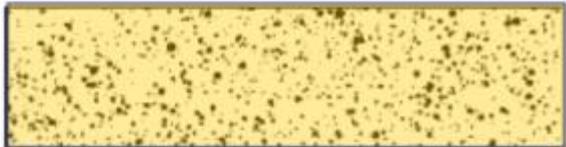
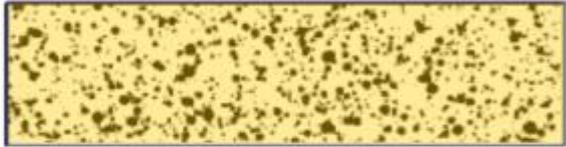
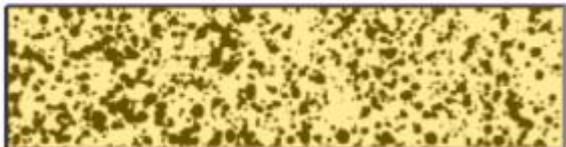
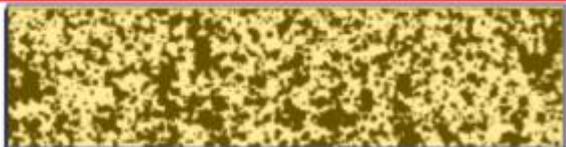
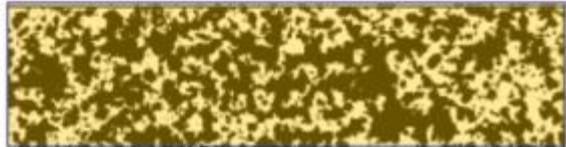
	bar						
	1	1.5	2	2.5	3	3.5	4
XR11001	F	F	F	F	F	VF	VF
XR110015	F	F	F	F	F	F	F
XR11002	M	F	F	F	F	F	F
XR110025	M	M	F	F	F	F	F
XR11003	M	M	F	F	F	F	F
XR11004	M	M	M	M	M	F	F
XR11005	C	M	M	M	M	M	M
XR11006	C	C	M	M	M	M	M
XR11008	C	C	C	C	M	M	M
XRC11010	VC	C	C	C	C	C	M
XRC11015	XC	VC	VC	VC	C	C	C
XRC11020	XC	XC	XC	VC	VC	VC	VC







Tamaño de las gotas

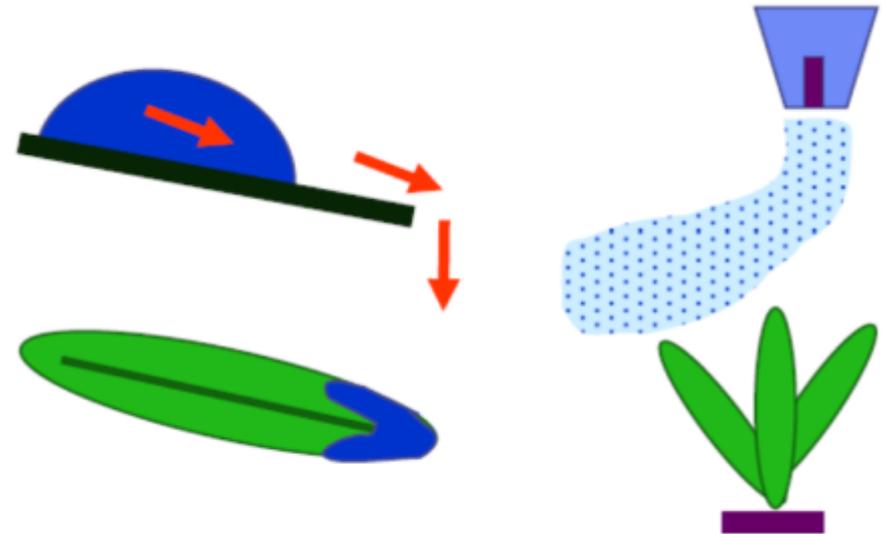
Gotas/cm ²	Porcentaje de cobertura	Tamaño de las gotas (VMD) μm	STP Referencias
85	10 %	250	
70	20 %	275	
60	30 %	300	
55	40 %	312	
40	50 %	325	

Recubrimientos del 20-30% son suficientes en la mayor parte de los tratamientos



Tamaño de las gotas

GOTAS PEQUEÑAS	GOTAS GRANDES
Buen recubrimiento	Espacios desprovistos de producto
Buena fijación	Peligro de escorrentía hacia el suelo
	Acumulación de materia activa en el borde de las hojas
Peligro de evaporación y deriva	Escaso peligro de evaporación y deriva



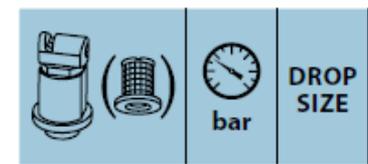
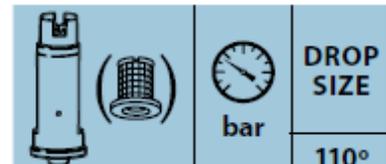
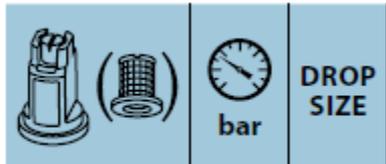
Equipment for crop protection — Sprayer nozzles — Colour coding for identification

ISO/FDIS 10625

Matériel de protection des cultures — Buses de pulvérisation — Code de couleur pour l'identification

Caudal @ 3 bar / 40 psi		Color	Código	Tipo
l/min	GPM			
0.4	0.1	Naranja	01	F, LD
0.6	0.15	Verde	015	F, LD, AI
0.8	0.2	Amarillo	02	F, LD, AI
1.0	0.25	Rosa	025	AI
1.2	0.3	Azul	03	F, LD, AI
1.6	0.4	Rojo	04	F, LD, AI
2.0	0.5	Marrón	05	F
2.4	0.6	Gris	06	F
3.2	0.8	Blanco	08	F





	bar	DROP SIZE	
		80°	110°
DG80015† DG110015 (100)	2.0	M	M
	2.5	M	F
	3.0	M	F
	4.0	M	F
	5.0	F	F
DG8002† DG11002 (50)	2.0	C	M
	2.5	M	M
	3.0	M	M
	4.0	M	M
	5.0	M	M
DG8003† DG11003 (50)	2.0	C	C
	2.5	M	M
	3.0	M	M
	4.0	M	M
	5.0	M	M
DG8004† DG11004 (50)	2.0	C	C
	2.5	C	C
	3.0	M	M
	4.0	M	M
	5.0	M	M

	bar	DROP SIZE
AIXR110015 (100)	1.0	XC
	2.0	VC
	3.0	C
	4.0	C
	5.0	M
	6.0	M
	AIXR11002 (50)	1.0
2.0		VC
3.0		C
4.0		C
5.0		C
6.0		M
AIXR110025 (50)		1.0
	2.0	XC
	3.0	VC
	4.0	C
	5.0	C
	6.0	C
	AIXR11003 (50)	1.0
2.0		XC
3.0		VC
4.0		C
5.0		C
6.0		C
AIXR11004 (50)		1.0
	2.0	XC
	3.0	VC
	4.0	VC
	5.0	C
	6.0	C

	bar	DROP SIZE	
AI80015 AI110015 (100)	2.0	UC	
	3.0	XC	
	4.0	XC	
	5.0	VC	
	6.0	VC	
	7.0	C	
	8.0	C	
	AI8002 AI11002 (50)	2.0	UC
		3.0	XC
4.0		XC	
5.0		VC	
6.0		VC	
7.0		C	
8.0		C	
AI80025 AI110025 (50)		2.0	UC
		3.0	XC
	4.0	XC	
	5.0	VC	
	6.0	VC	
	7.0	C	
	8.0	C	
	AI8003 AI11003 (50)	2.0	UC
		3.0	XC
4.0		XC	
5.0		VC	
6.0		VC	
7.0		C	
8.0		C	
AI8004 AI11004 (50)		2.0	UC
		3.0	XC
	4.0	XC	
	5.0	VC	
	6.0	VC	
	7.0	C	
	8.0	C	

	bar	DROP SIZE
TTI110015 (100)	1.0	UC
	2.0	UC
	3.0	UC
	4.0	XC
	5.0	XC
	6.0	XC
	7.0	XC
TTI11002 (50)	1.0	UC
	2.0	UC
	3.0	UC
	4.0	UC
	5.0	XC
	6.0	XC
	7.0	XC
TTI110025 (50)	1.0	UC
	2.0	UC
	3.0	UC
	4.0	UC
	5.0	XC
	6.0	XC
	7.0	XC
TTI11003 (50)	1.0	UC
	2.0	UC
	3.0	UC
	4.0	UC
	5.0	XC
	6.0	XC
	7.0	XC
TTI11004 (50)	1.0	UC
	2.0	UC
	3.0	UC
	4.0	UC
	5.0	XC
	6.0	XC
	7.0	XC



DROPSZ bar	DROPSZ	CAPACITY ONE NOZZLE IN l/min	
AIXR110015 (100)	1.0	XC	0.34
	2.0	VC	0.48
	3.0	C	0.59
	4.0	C	0.68
	5.0	M	0.76
	6.0	M	0.83
AIXR11002 (50)	1.0	XC	0.46
	2.0	VC	0.65
	3.0	C	0.79
	4.0	C	0.91
	5.0	C	1.02
	6.0	M	1.12
AIXR110025 (50)	1.0	XC	0.57
	2.0	XC	0.81
	3.0	VC	0.99
	4.0	C	1.14
	5.0	C	1.28
	6.0	C	1.40
AIXR11003 (50)	1.0	XC	0.68
	2.0	XC	0.96
	3.0	VC	1.18
	4.0	C	1.36
	5.0	C	1.52
	6.0	C	1.67
AIXR11004 (50)	1.0	UC	0.91
	2.0	XC	1.29
	3.0	VC	1.58
	4.0	VC	1.82
	5.0	C	2.04
	6.0	C	2.23



DROPSZ bar	DROPSZ	CAPACITY ONE NOZZLE IN l/min	
AI80015 AI110015 (100)	2.0	UC	0.48
	3.0	XC	0.59
	4.0	XC	0.68
	5.0	VC	0.76
	6.0	VC	0.83
	7.0	C	0.90
	8.0	C	0.96
	AI8002 AI11002 (50)	2.0	UC
3.0		XC	0.79
4.0		XC	0.91
5.0		VC	1.02
6.0		VC	1.12
7.0		C	1.21
8.0		C	1.29
AI80025 AI110025 (50)		2.0	UC
	3.0	XC	0.99
	4.0	XC	1.14
	5.0	VC	1.28
	6.0	VC	1.40
	7.0	C	1.51
	8.0	C	1.62
	AI8003 AI11003 (50)	2.0	UC
3.0		XC	1.18
4.0		XC	1.36
5.0		VC	1.52
6.0		VC	1.67
7.0		C	1.80
8.0		C	1.93
AI8004 AI11004 (50)		2.0	UC
	3.0	XC	1.58
	4.0	XC	1.82
	5.0	VC	2.04
	6.0	VC	2.23
	7.0	C	2.41
	8.0	C	2.58



DROPSZ bar	DROPSZ	DROPSZ		CAPACITY ONE NOZZLE IN l/min
		80°	110°	
XR8001 XR11001 (100)	1.0	M	F	0.23
	1.5	F	F	0.28
	2.0	F	F	0.32
	2.5	F	F	0.36
	3.0	F	F	0.39
	4.0	F	VF	0.45
XR80015 XR110015 (100)	1.0	M	F	0.34
	1.5	M	F	0.42
	2.0	F	F	0.48
	2.5	F	F	0.54
	3.0	F	F	0.59
	4.0	F	F	0.68
XR8002 XR11002 (50)	1.0	M	M	0.46
	1.5	M	F	0.56
	2.0	M	F	0.65
	2.5	M	F	0.72
	3.0	F	F	0.79
	4.0	F	F	0.91
XR110025 (50)	1.0		M	0.57
	1.5		M	0.70
	2.0		F	0.81
	2.5		F	0.90
	3.0		F	0.99
	4.0		F	1.14
XR8003 XR11003 (50)	1.0	M	M	0.68
	1.5	M	M	0.83
	2.0	M	F	0.96
	2.5	M	F	1.08
	3.0	M	F	1.18
	4.0	M	F	1.36
XR8004 XR11004 (50)	1.0	C	M	0.91
	1.5	M	M	1.12
	2.0	M	M	1.29
	2.5	M	M	1.44
	3.0	M	M	1.58
	4.0	M	F	1.82



bar	l/mn							
	MORADA 80-0050	ROSA 80-0075	NARANJA 80-01	VERDE 80-015	AMARILLA 80-02	LILA 80-025	AZUL 80-03	ROJA 80-04
5	-	0,39	0,52	0,77	1,03	1,29	1,55	2,07
6	-	0,42	0,57	0,85	1,13	1,41	1,70	2,26
7	0,31	0,46	0,61	0,92	1,22	1,53	1,83	2,44

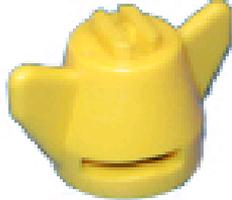


SPECIFICAS

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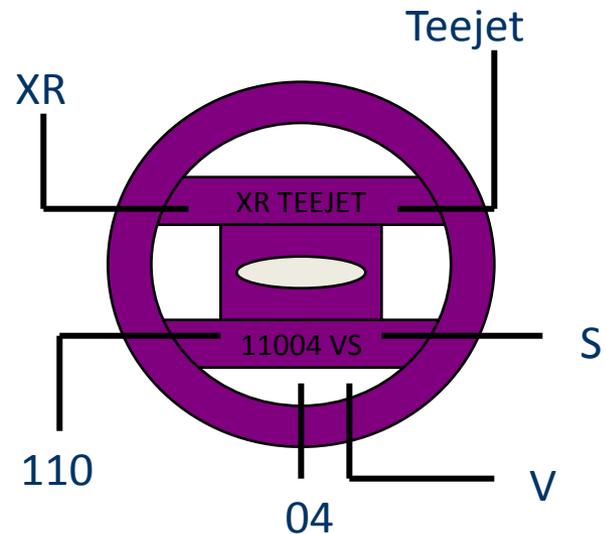
Nomenclatura ISO

S ISO F-02-110 CT Yellow



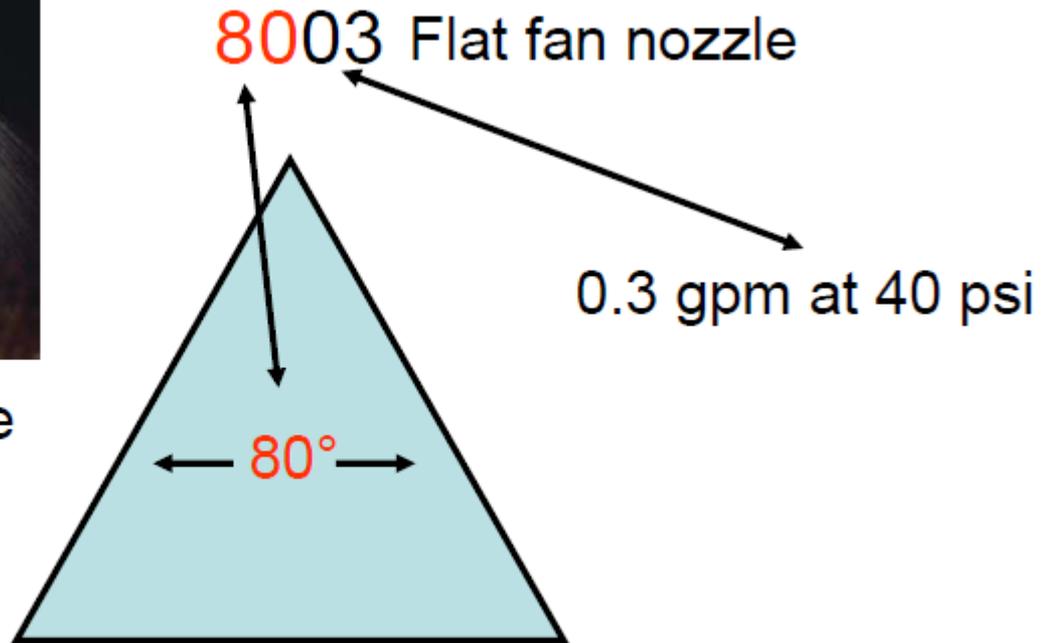
S: Sintético
ISO: Boquilla normativa ISO
F: Abanico
02: Caudal nominal (gal/min) a 3 bar
110: Ángulo de pulverización

Teejet: Fabricante
XR: Tipo de boquilla
110: Ángulo de pulverización
04: Caudal nominal (gal/min) a 3 bar
V: Codificación de colores "VisFlo"
S: Tipo de material (acero inox.)





Flat fan nozzle pattern



Numbering system for Teejet nozzles

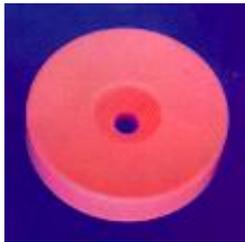


Nozzle flow rate and color code ISO according ISO 10625

Pressure bar	Flow rate l/min at nozzle size ISO												
	-01	-015	-02	-025	-03	-04	-05	-06	-08	-10	-12	-16	-20
1.0	0.23	0.35	0.46	0.58	0.69	0.92	1.15	1.39	1.85	2.31	2.77	3.70	4.62
1.5	0.28	0.42	0.57	0.71	0.85	1.13	1.41	1.70	2.26	2.83	3.39	4.53	5.66
2.0	0.33	0.49	0.65	0.82	0.98	1.31	1.63	1.96	2.61	3.27	3.92	5.23	6.53
2.5	0.37	0.55	0.73	0.91	1.10	1.46	1.83	2.19	2.92	3.65	4.38	5.84	7.30
3.0	0.40	0.60	0.80	1.00	1.20	1.60	2.00	2.40	3.20	4.00	4.80	6.40	8.00
4.0	0.46	0.69	0.92	1.15	1.39	1.85	2.31	2.77	3.70	4.62	5.54	7.39	9.24
5.0	0.52	0.77	1.03	1.29	1.55	2.07	2.58	3.10	4.13	5.16	6.20	8.26	10.33
6.0	0.57	0.85	1.13	1.41	1.70	2.26	2.83	3.39	4.53	5.66	6.79	9.05	11.31
7.0	0.61	0.92	1.22	1.53	1.83	2.44	3.06	3.67	4.89	6.11	7.33	9.78	12.22
8.0	0.65	0.98	1.31	1.63	1.96	2.61	3.27	3.92	5.23	6.53	7.84	10.45	13.06
9.0	0.69	1.04	1.39	1.73	2.08	2.77	3.47	4.16	5.54	6.93	8.31	11.09	13.86
10.0	0.73	1.10	1.46	1.83	2.19	2.92	3.65	4.38	5.84	7.30	8.76	11.68	14.61
12.0	0.80	1.20	1.60	2.00	2.40	3.20	4.00	4.80	6.40	8.00	9.60	12.80	16.00
14.0	0.86	1.29	1.73	2.16	2.59	3.46	4.32	5.19	6.91	8.64	10.37	13.83	17.28
16.0	0.92	1.39	1.85	2.31	2.77	3.70	4.62	5.54	7.39	9.24	11.09	14.78	18.48
18.0	0.98	1.47	1.96	2.45	2.94	3.92	4.90	5.88	7.84	9.80	11.76	15.68	19.60
20.0	1.03	1.55	2.07	2.58	3.10	4.13	5.16	6.20	8.26	10.33	12.39	16.52	20.66
25.0	1.15	1.73	2.31	2.89	3.47	4.62	5.77	6.93	9.24	11.55	13.86	18.48	23.09



Baja deriva?



Angulo?



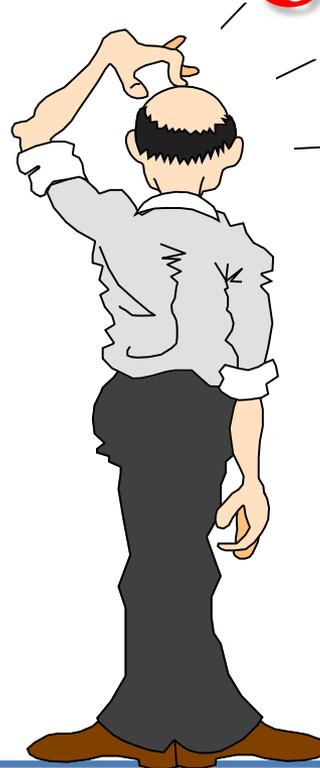
Abanico?



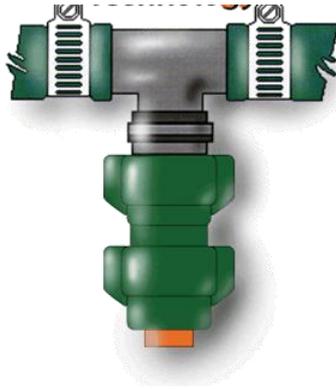
Conicas?



? * + !



La elección de la boquilla depende de ...



1. El caudal necesario
2. La presión de trabajo
3. La distribución
4. El ángulo de pulverización
5. El líquido a pulverizar
6. La calidad de la atomización
7. El material de la boquilla



Tipo de boquillas

Abanico o chorro plano



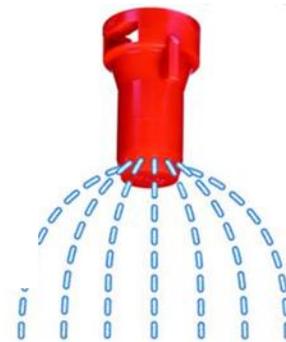
Turbulencia o cónicas



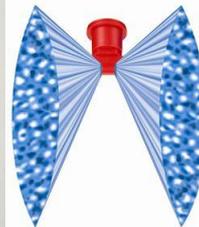
Deflectoras o de espejo



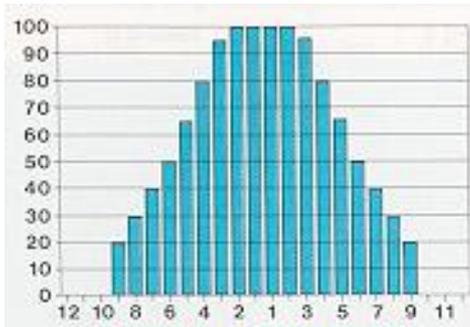
De chorros múltiples



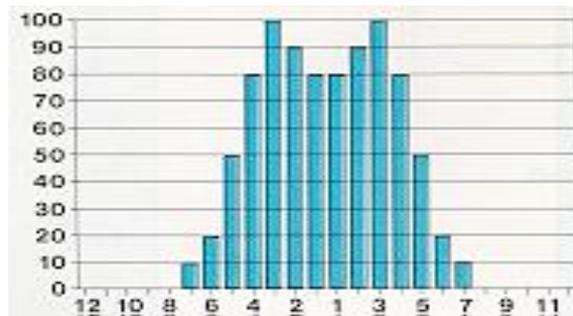
Especiales



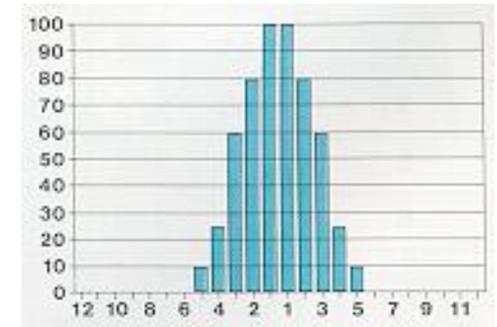
Abanico



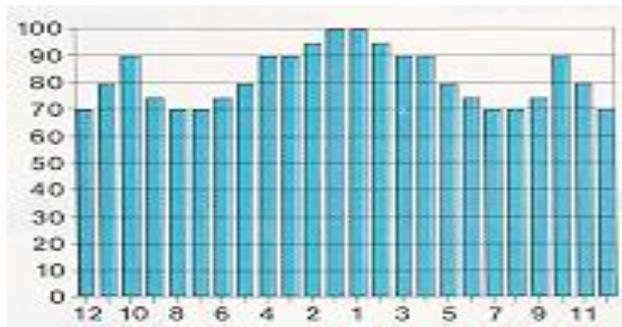
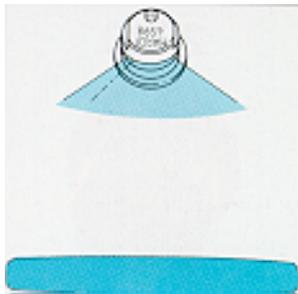
Cónica



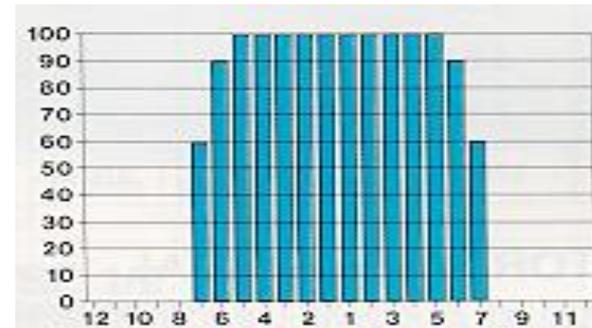
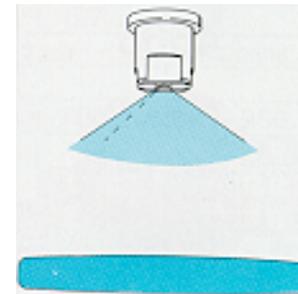
Cono Lleno

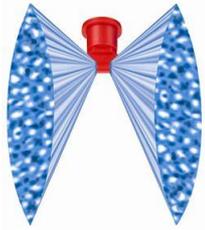


Espejo



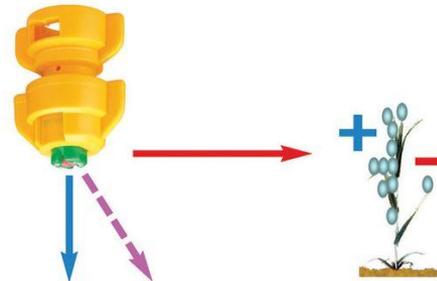
Abanico uniforme



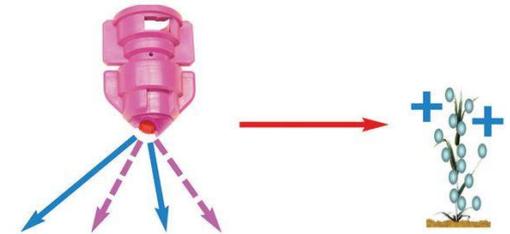


TurboDrop® HiSpeed Standard

Asymmetric high pressure double flat fan venturi nozzle made from ceramic (coated with POM)



TurboDrop® TD

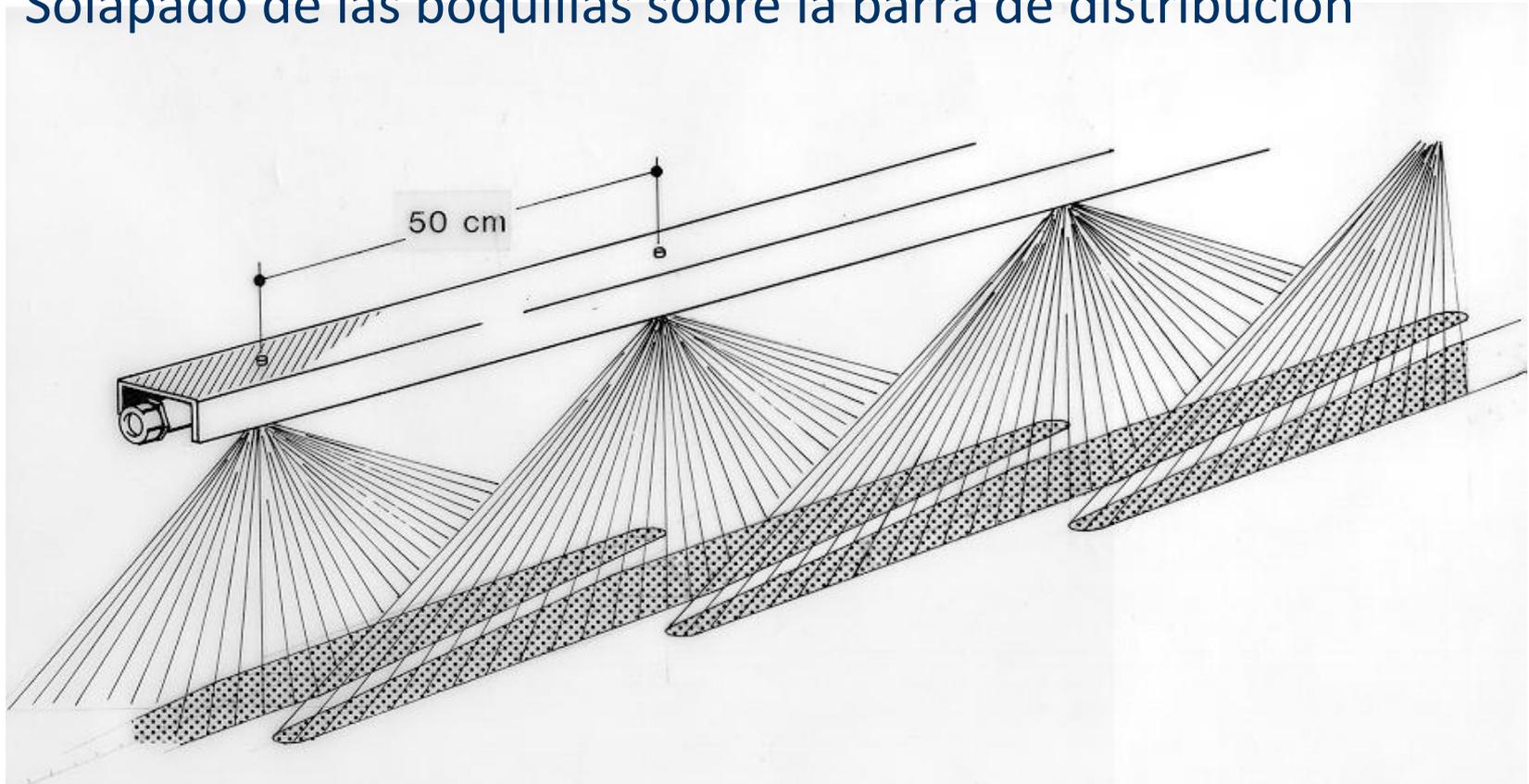


TurboDrop® HighSpeed

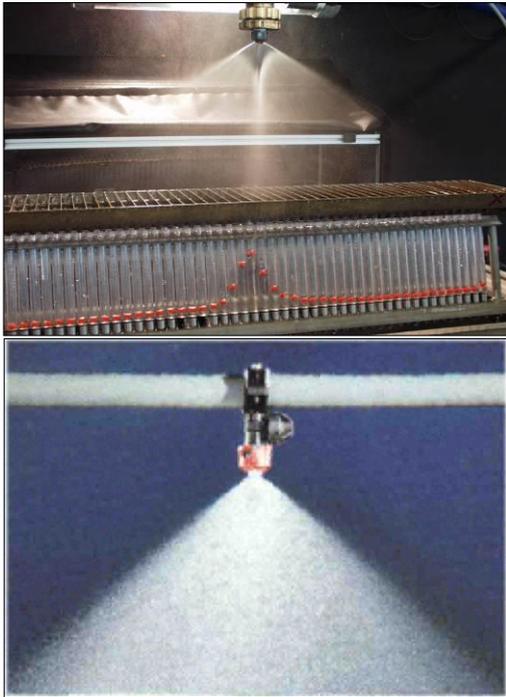


Características Boquillas de Abanico

Solapado de las boquillas sobre la barra de distribución



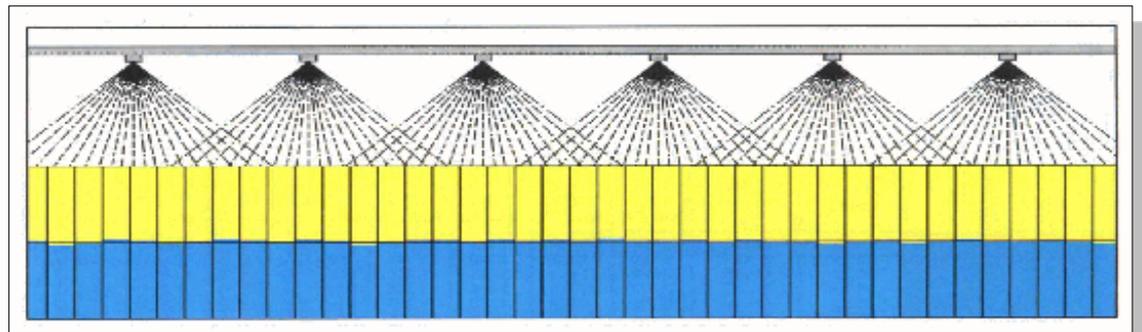
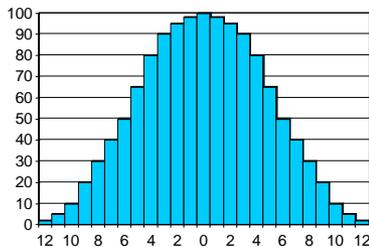
Uniformidad de distribución – factor clave



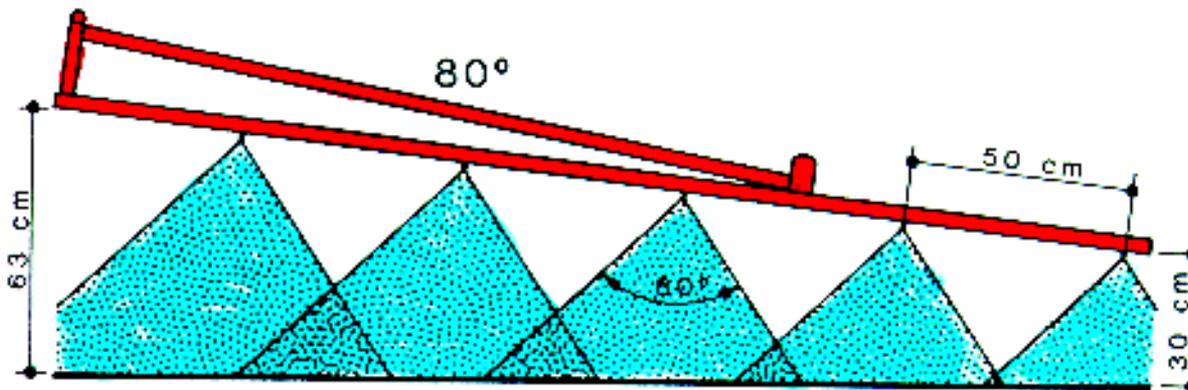
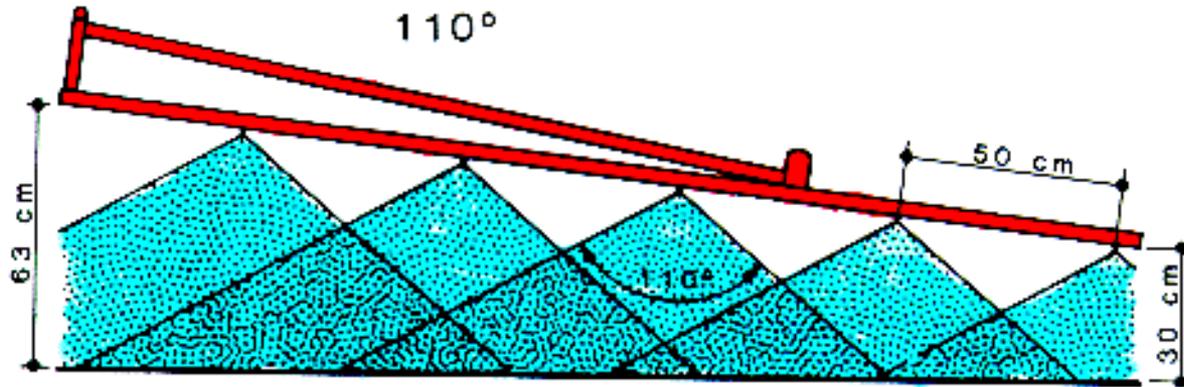
Las boquillas de abanico presentan una distribución triangular de dimensiones variables en función del ángulo de pulverización

La altura de la barra es un factor clave para la consecución de una distribución uniforme en toda la superficie a tratar

Los sistemas de estabilidad de la barra permiten amortiguar errores de distribución debidos al mal estado de las parcelas



Las boquillas de 110° permiten mayores movimientos de la barra sin afectar gravemente a la distribución horizontal.



J.H. Cambellack Keith Turnbull Research Institute Victoria Australia





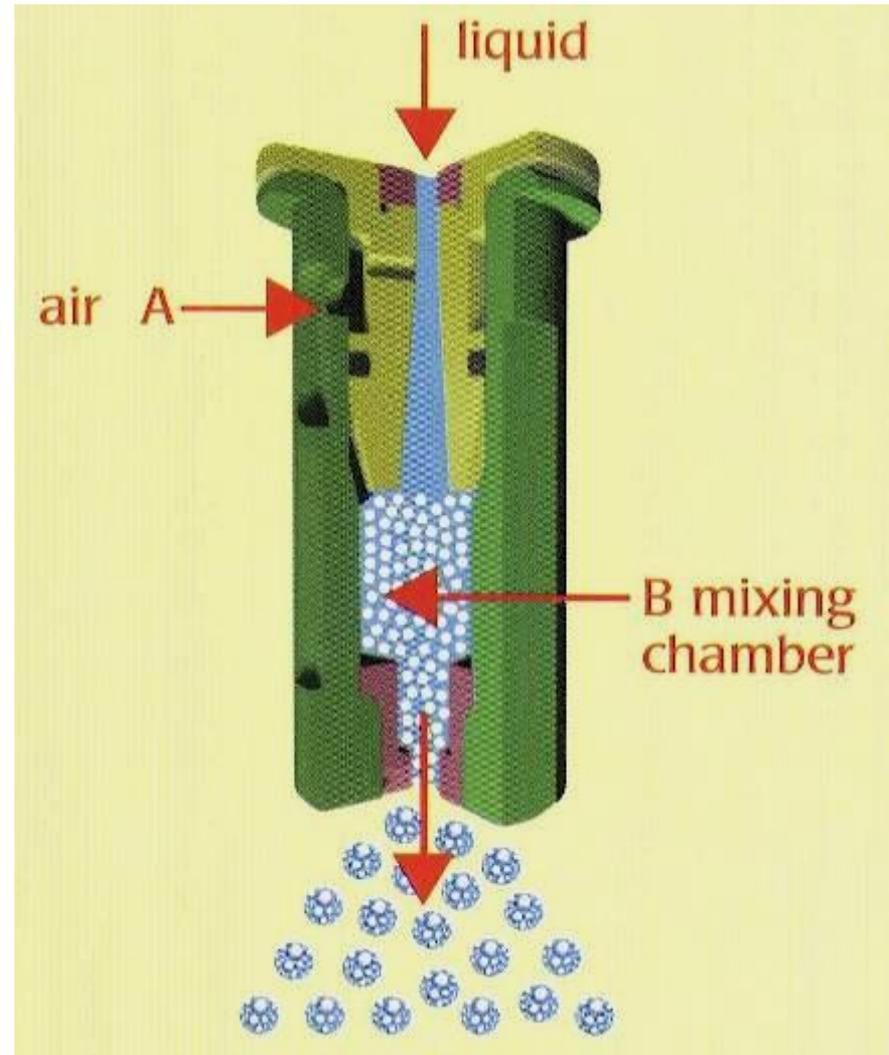
Striping caused by boom being too low or having insufficient pressure to develop spray pattern

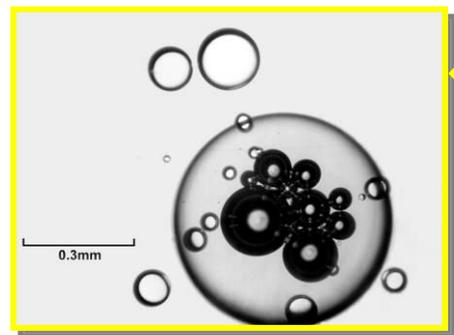
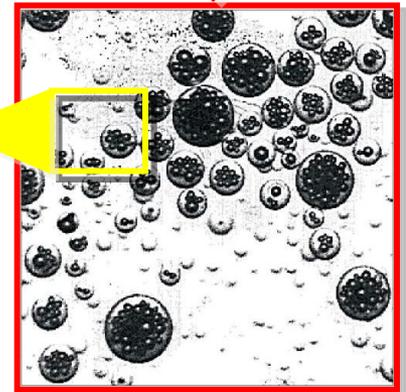
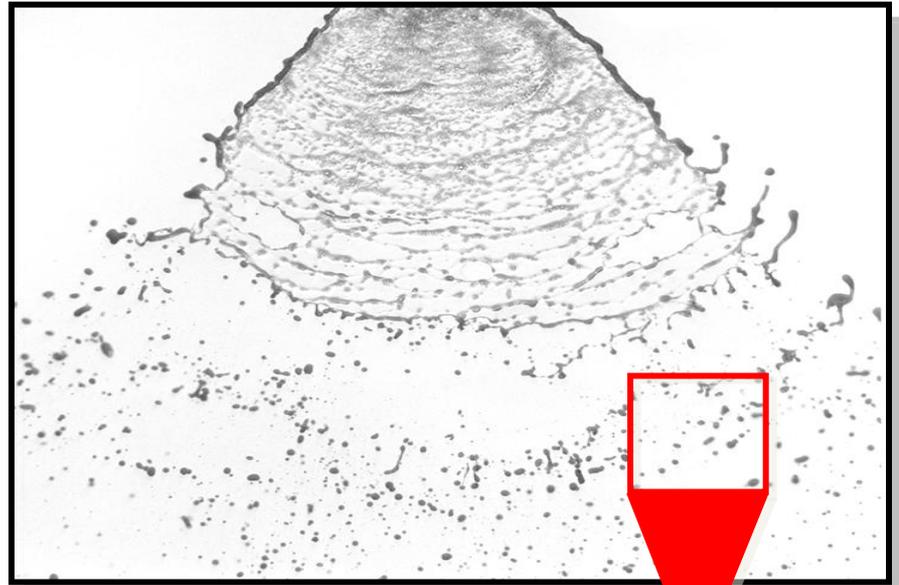


Boquillas antideriva

Existen 2 tipologías:

- Inyección de aire
- Con precámara

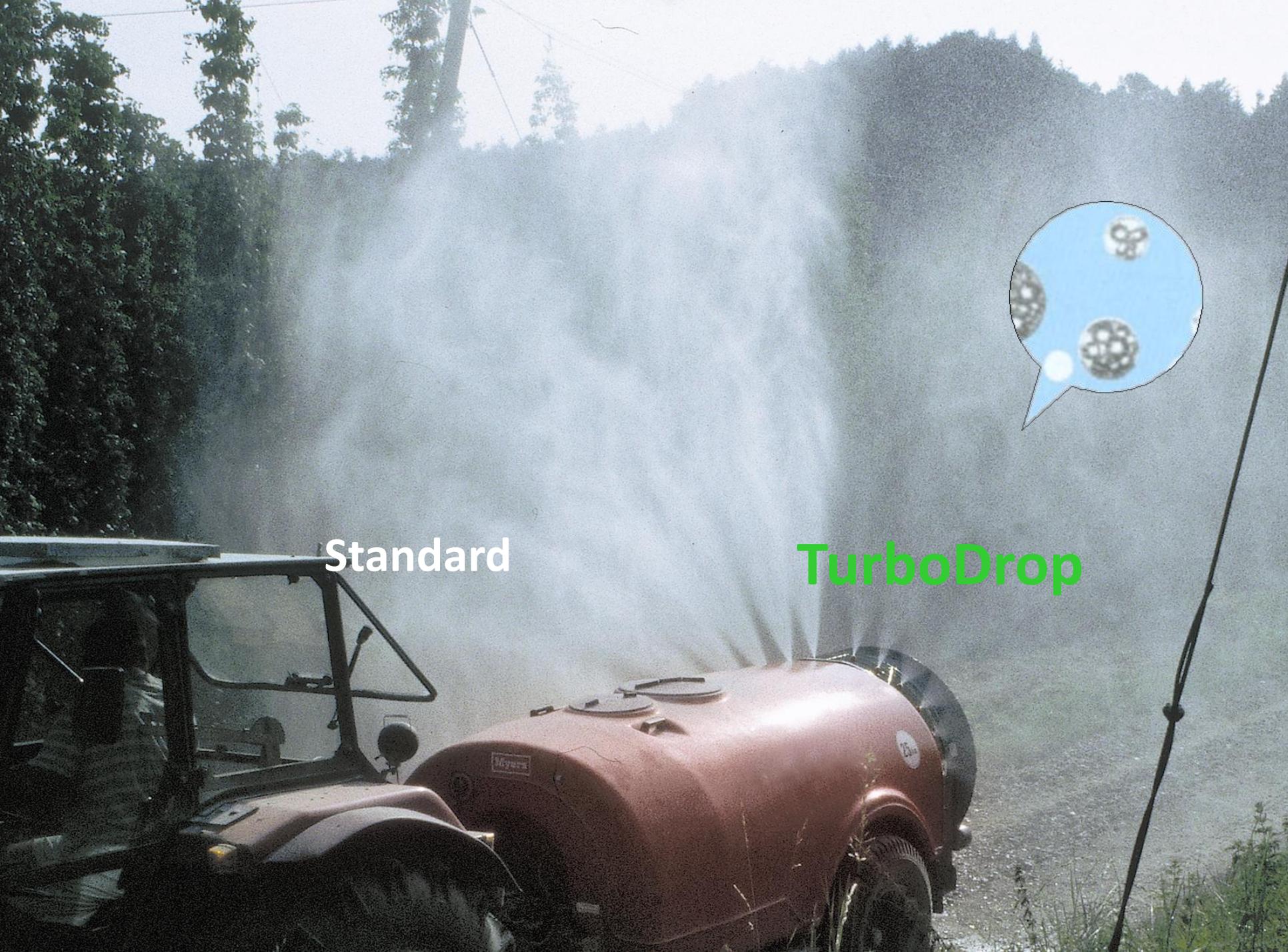






TurboDrop

Standard



Standard

TurboDrop

