



REDUCING THE NUMBER OF FUNGICIDE TREATMENTS TO CONTROL DOWNY AND POWDERY MILDEW

Ana M. Díez-Navajas, PhD
adiez@neiker.eus

July 2017 – Oregon State University – Corvallis, Oregon USA



FITOVID

Implementation of demonstrative and innovative strategies to reduce the use of phytosanitary products in viticulture



Universidad del País Vasco
Euskal Herriko Unibertsitatea





DIRECTIVE 2009/128/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.



**National plan for agriculture
(in each European country)**



In Spain it is regulated by
Real Decreto 1311/2012



por el que se establece el marco de actuación para conseguir un uso sostenible de los productos fitosanitarios.



To demonstrate the reduction of the environment impact in the production of grape, juice and wine

by means of:

- Evaluating new management strategies to control DM and PM by reducing the number of treatments.
- Analyzing the residues of the used fungicides in each applied strategy present in grape, juice and wine, and in flow waters and soils; to analyze possible effects in human health and environment.
- Evaluating the socioeconomical impacts from grape production.
- Educating and training farmers about the importance of an adequate adjustment of spray application equipment and spraying process, and its effect on efficacy and efficiency of the pesticide application.
- Developing of a system able to automatically detect DM in the early stages of the Infection, allowing an earlier treatment application.



Downy mildew *Plasmopara viticola*



Conditions:
18-22 °C - 64-72 °F
Constant HR



Powdery mildew *Erysiphe necator*



Conditions:
24-30 °C - 75-86 °F
No water





Number of treatments



DM

7 -10 Italy, Switzerland
19 Galicia - Spain (2012)
12 Txakoli
6 Rioja

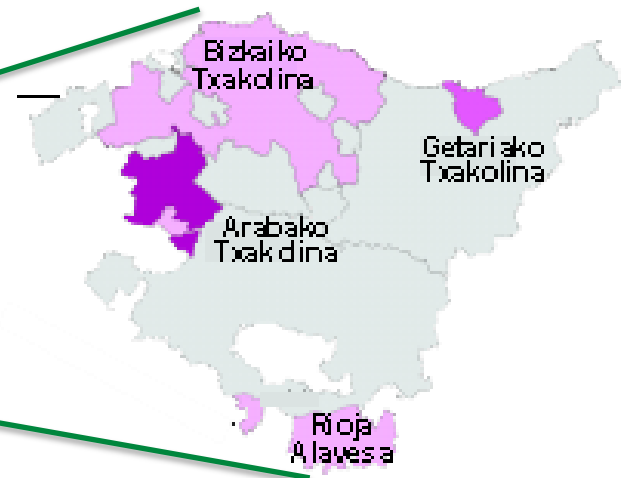
PM

7-15 Canada
6-9 Rioja

Is reduction possible?



MAPA DE LAS DENOMINACIONES DE ORIGEN PROTEGIDAS DE VINOS DE ESPAÑA alimentación.es

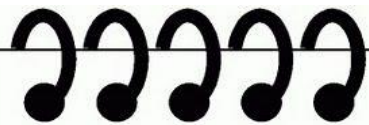




DOWNY MILDEW



POWDERY MILDEW

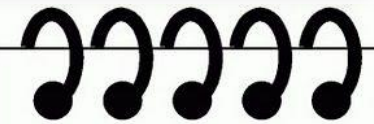


Aia (Gipuzkoa)

Surface: 1 ha

Var.: Hondarrabi zuri

Training: double guyot



Laguardia (Alava)

Surface: 1 ha

Var.: Tempranillo

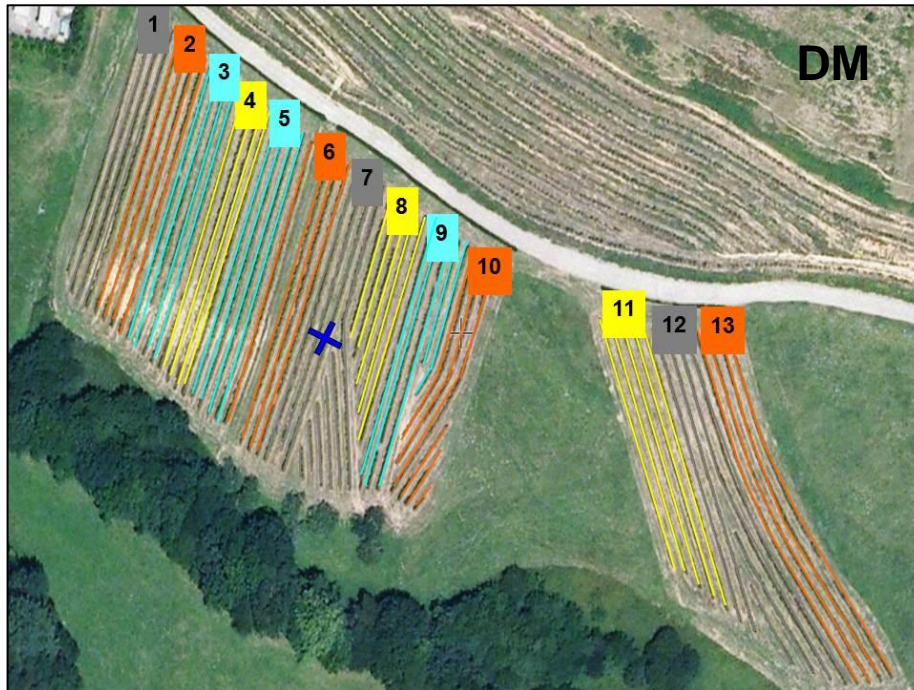
Training: free vase





- Treatments as grower's criterion, conventional chemicals
- Treatments with products for organic production
- Treatments when risk emission by weather station, conventional chemicals
- 1st treatment: 200 degree-day accumulation and next as phenology, conv. chem.
- Control (no treatment)

✕ weather station



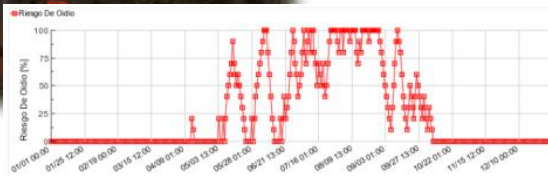


Weather stations

Grapevine growth stage keys

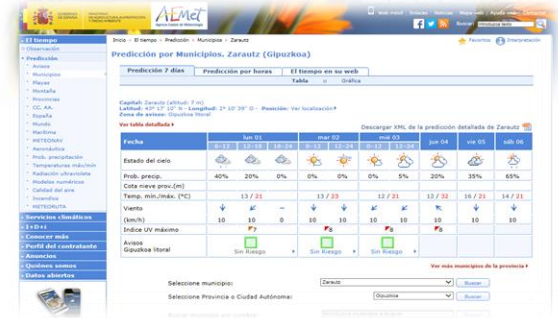
Estados fenológicos de la vid

(púlsate en la imagen para ampliar)



Disease risks

Weather forecast



DM: buried oospores



PHYTOSANITARY PRODUCTS: DOWNY MILDEW



mancozeb, folpet, copper oxychloride, cymoxanil, dimethomorph, fosetil Al, metalaxyl, benalaxyl, cyazofamide, iprovalicarb.

Trade name	Composition	Trademark	Action way
CODIMUR	Folpet 30%+copper oxychloride 16%	SARABIA	systemic + contact
TAIREL C	Benalaxyl 4%+ copper oxychloride 33%	BELCHIM	systemic
MILDICUT	Cyazofamide 2.5%	BELCHIM	penetrating/fix epic wax
FORUM F	Dimetomorph 11,3% + folpet 60% [WG] P/P	BASF	penetrating/fix epic wax
PEARZE TRIPLE	Fosetil-Al 50%+Cymoxanil 4%+Folpet 25%	KENOGARD	systemic
EKYP COMBI	Folpet 40% + Metalaxyl 10%	SAPEC AGRO	systemic
MIKAL PREMIUM F	Folpet 25% + fosetil-al 50% + iprovalicarb 4%	BAYER	systemic

**Conventional
Chemicals
(fungicides)**

Trade name	Composition	Trademark	Action way
LITHOVIT	75% cuprocal sulfate+ 4% Mg carbonate+ 0.5% iron+5% silica+ 0.1% K ₂ O+ 0.015% Na+0.015% P> 0.01% Mn	CLC Bio Innovation	
CUPRIN	copper 5%+Gluconic+Galacturonic	Ecoproyectos	contact
MANICA	cuprocal sulfate 12,4%	MANICA	contact
MIMOSAN	veg. extracts: Mimosa tenuiflora+Quercus robur	Ecoproyectos	

**Products for
organic production
(Bio-fertilisers and
Plant Strengtheners)**

PHYTOSANITARY PRODUCTS: DOWNY MILDEW



sulphur, penconazol, tebuconazol, triadimenol, pyraclostrobin, metiram, metraphenone, boscalid, quinoxyfen, methyldynocap

Trade name	Composition	Trademark	Action way
GRANO DE ORO	Sulphur 98.5%	SAPEC AGRO	Contact
DORADO	Penconazol 10%	SYNGENTA	Penetrating
DARCOS	Tebuconazol 25%	KENOGARD	Penetrating
BAYFIDAN	Triadimenol 31.2%	BAYER	Penetrating
CABRIO TOP	Metiram 5%+pyraclostrobin 5%	BASF	Penetrating
VIVANDO	Metraphenone 50%	BASF	Penetrating
COLLIS	Boscalid 20 % + kresoxym-methyl 10 %	BASF	Penetrating
ARIUS	Quinoxyfen 25 %	DOW AGROSCIENCE	Penetrating
KARATHANE STAR	Mepthyldynocap 35%	DOW AGROSCIENCE	Contact

**Conventional
Chemicals
(fungicides)**

Trade name	Composition	Trademark	Action way
AQ10	$> = 5 \times 10^9$ ufc	Agrichem	Contact
HELIOSUFRE	Sulphur 72%	Agrichem	Contact
JOBASAN	veg. extratcs	Ecoproyectos	
GRANO DE ORO	Sulphur 98.5%	SAPEC AGRO	Contact

**Products for
organic production
(Bio-fertilisers and
Plant Strengtheners)**

TREATMENT APPLICATION 2015: DM

PM



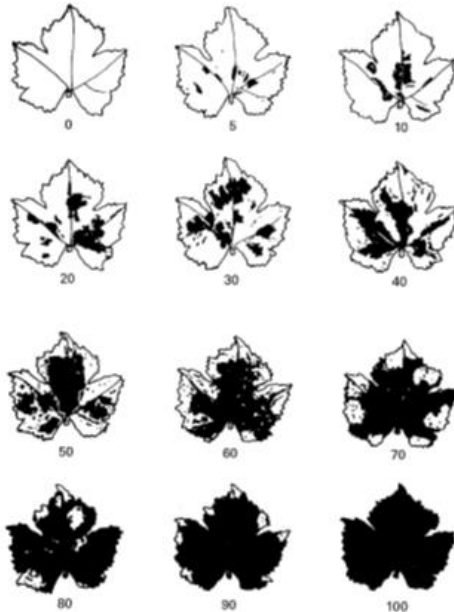
FECHA	EF	PARCELAS	PRODUCTO	MATERIA ACTIVA
21/04/2015	F-G	4,8,11	EKYP COMBI	FOLPET 40% + METALAXIL 10%
24/04/2015	F-G	3,5 y 9	LITHOVIT	75% carbonato cálcico+ 4% carbonato magnésico+ 0.5% hierro+5% sílice+ 0.1% óxido potásico+ 0.015% sodio+0.015% fósforo> 0.01% manganeso
29/04/2015	G	4,8 y 11	PEARZE	Fosetil-Al 50%+Cimoxanilo 4%+Folpet 25%
29/04/2015	H	2,6,10,13	MIKAL PLUS	4% cimoxanilo + 25% folpet + 50% fosetil-Al.
			MICRORAM	oxiclورو de cobre 70%
			VIVANDO	Metrafenona 50%
30/04/2015	H	3,5 y 9	MIMOSAN	Ext. Mimosa tenuiflora+Quercus robur
06/05/2015	H	3,5 y 9	MANICA	Sulfato Cuprocálcico 12,4%
06/05/2015	H	4,8 y 9	TAIREL C	Benalaxil 4%+ oxiclورو de cobre 33%
12/05/2015	H	2,6,10,13	MIKAL PLUS	4% cimoxanilo + 25% folpet + 50% fosetil-Al.
			POLTIGLIA	Sulfato Cuprocálcico 20%
			CERCOBIN	Metil Tiofanato 45%
18/05/2015	H	3,5 y 9	LITHOVIT	75% carbonato cálcico+ 4% carbonato magnésico+ 0.5% hierro+5% sílice+ 0.1% óxido potásico+ 0.015% sodio+0.015% fósforo> 0.01% manganeso
			CUPRI	cobre 5%+ác. Glucónico+ac.galacturónico
18/05/2015	H	4, 8 y 11	MIKAL PREMIUN	folpet 25% + fosetil-al 50% + iprovalicarb 4%
			CODIMUR	Folpet 30%+oxiclورو de cobre 16%
18/05/2015	H	2,6,10,13	EKYP COMBI	FOLPET 40% + METALAXIL 10%
			SONG	tebuconazol 25%
28/05/2015	H	3,5,9	MIMOSAN	Ext. Mimosa tenuiflora+Quercus robur
02/06/2015	I1-I2	3,5,9	LITHOVIT	75% carbonato cálcico+ 4% carbonato magnésico+ 0.5% hierro+5% sílice+ 0.1% óxido potásico+ 0.015% sodio+0.015% fósforo> 0.01% manganeso
03/06/2015	I1-I2	4,8,11	FORUM	DIMETOMORF 15%
04/06/2015	I1-I2	2,6,10,13	EKYP COMBI	FOLPET 40% + METALAXIL 10%
			VIVANDO	matrafenona 50%
22/06/2015	K	3,5,9	MANICA	Sulfato Cuprocálcico 12,4%
22/06/2015	K	2,6,10,13	ACROBAT MZ	Dimetomorf7.5%+mancozeb 66,7%
			CERCOBIN	Metil tiofanato 45%
23/06/2015	K	4,8,11	TAIREL C	Benalaxil 4%+ oxiclورو de cobre 33%
06/07/2015	L	2,6,10,13	MIKAL PREMIUN F	folpet 25% + fosetil-al 50% + iprovalicarb 4%
			STROBY	Kresoxim-metil 50%
07/07/2015	L	4,8,11	PEARZE	Fosetil-Al 50%+Cimoxanilo 4%+Folpet 25%
07/07/2015	L	3,5,9	CUPRI	cobre 5%+ác. Glucónico+ac.galacturónico
10/07/2015	L	TODO	MIKAL PREMIUN F	folpet 25% + fosetil-al 50% + iprovalicarb 4%
			MICRORAM 50%	oxiclورو de cobre 70%
			COLLIS	Boscalida 20% + Kresoxim-metil 10%
17/07/2015	L	TODO	EKYP COMBI	FOLPET 40% + METALAXIL 10%
24/07/2015	L	TODO	TAIREL C	Benalaxil 4%+ oxiclورو de cobre 33%
06/08/2015	M1	TODO	MILDICUT	Ciazofamida 2,5%
			COLLIS	Boscalida 20% + Kresoxim-metil 10%
20/08/2015	M2	TODO	FORUM	DIMETOMORF 15%
07/09/2015	N	TODO	CHORUS	Ciprodinil 50%

FECHA	EF	PARCELAS	PRODUCTO	MATERIA ACTIVA
20/04/2015	D	3,9,12	KARATHANE STAR	metildinocap 35%
25/04/2015	D	2,6,13	grano de oro	azufre 98,5%
06/05/2015	F-G	5,10,14	grano de oro	azufre 98,5%
06/05/2015	F-G	4,8,15	grano de oro	azufre 98,5%
21/05/2015	H	4,8,15	latino	Miclobutanil 12,5%
21/05/2015	H	3,9,12	cabrio top	Metiram 55% + Piraclostrobin 5%
21/05/2015	H	2,6,13	heliosufre	Azufre 72%
25/05/2015	H	5,10,14	grano de oro	azufre 98,5%
03/06/2015	H	4,8,15	collis	kresoxim-metil 10%
04/06/2015	H	3,9,12	dorado	penconazol 10 %
04/06/2015	H	2,6,13	jobasan	ext. Veg.
04/06/2015	H	1,7,11	fobeci	Benalaxil 6% +Cimoxanilo 3,2%+ Folpet 35%
04/06/2015	H	5,10,14	fobeci	Benalaxil 6% +Cimoxanilo 3,2%+ Folpet 35%
22/06/2015	K	4,8,15	domark	Tetraconazol 12,5% p/v
22/06/2015	K	2,6,13	jobasan	ext. Veg.
22/06/2015	K	3,9,12	grano de oro	azufre 98,5%
23/06/2015	K	5,10,14	grano de oro	azufre 98,5%
09/07/2015	L	3,9,12	vivando	Metrafenona 50%
09/07/2015	L	2,6,13	helisufre	Azufre 72%
09/07/2015	L	9	heliosufre	Azufre 72%
09/07/2015	L	4,8,15	cabrio top	Metiram 55% + Piraclostrobin 5%
24/07/2015	L-M1	4,8,15	collis	kresoxim-metil 10%
24/07/2015	L-M1	3,9,12	arius	quinoxifen 25 %
25/07/2015	L-M1	2,6,13	jobasan	ext. Veg.
25/07/2015	L-M1	5,10,14	grano de oro	azufre 98,5%
12/08/2015	N	4,8,15	bayfidan,caldo bordes	31,2% triadimenol, (CuSO4.5H2O + CaOH)
16/08/2015	N	1,7,11	aq10	aq10
16/08/2015	N	2,6,13	aq10	aq10
26/08/2015	N	1,7,11	aq10	aq10
26/08/2015	N	2,6,13	aq10	aq10
29/10/2015	O2	todas	KARATHANE STAR	metildinocap 35%



OEPP/EPPO. 2001. Efficacy evaluation of fungicides: *Plasmopara viticola*. Bulletin OEPP/EPPO, 31: 313-317.
OEPP/EPPO. 2002. Efficacy evaluation of fungicides: *Uncinula necator*. Bulletin OEPP/EPPO, 32: 315-318.

% LEAF AFFECTION



1 = NO symptom
2 = < 5%;
3 = 5–10%;
4 = 10–25%;
5 = 25–50%;
6 = 50–75%;
7 = > 75%.

DATA:

% affected leaves/plant: INCIDENCE
% leaf affection: SEVERITY
% bunch affection

Townsend-Heuberger (1943):

$$\%A = \left(\frac{\sum(n*v)}{z*N} \right) * 100$$

n= n units in each class

v= value of class

z= highest value in class

N= total number of units

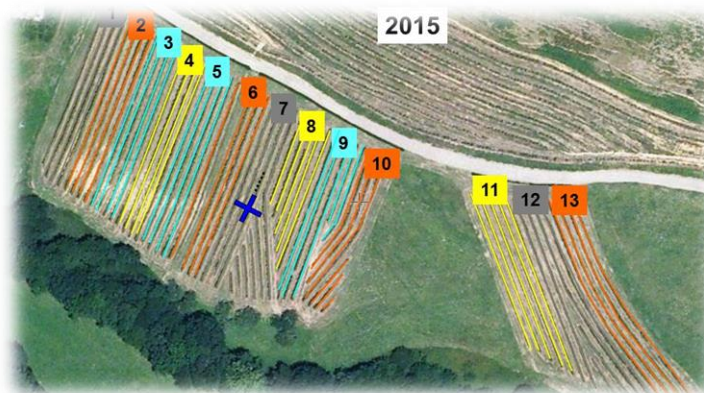
% BUNCH AFFECTION

1 = NO symptom
2 = 1–5%;
3 = 5–25%;
4 = 25–50%;
5 = > 50%.



DOWNY MILDEW

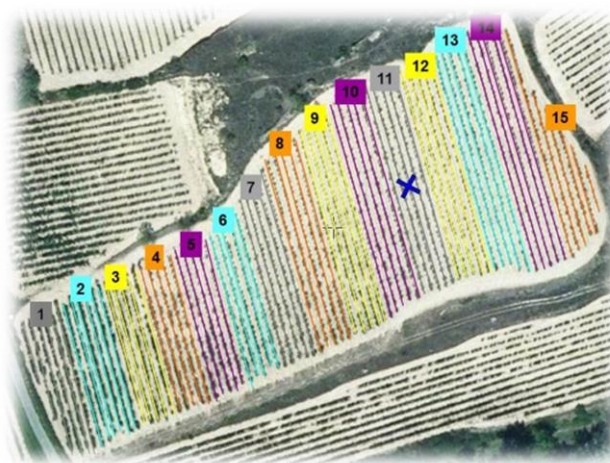
PLOTS	TREATMENTS		DISEASE			PRODUCTION		
	NUMBER OF APPLIED TREATMENTS	% REDUCTION	INCIDENCE	SEVERITY	BUNCH AFFECTION	BUNCH PRODUCTION /PLANT (Kg)	BUNCH NUMBER/ PLANT	BUNCH WEIGHT/ PLANT (g)
Control	0	-	49,64	43,75	53,79	0,1	6	23
Organic products	9	35,71	46,16	40,85	56,32	0,5	17	29
Disease risk	8	42,85	27,86	27,85	32,31	1,4	27	47
Grower's criterion	14	0	25,69	25,55	25,94	2,3	32	68





POWDERY MILDEW

PLOT	TREATMENTS		DISEASE EVALUATION			PRODUCTION		
	NUMBER OF APPLIED TREATMENTS	% REDUCTION	INCIDENCE	SEVERITY	BUNCH INCIDENCE	BUNCH PRODUCTION/ PLANT (Kg)	BUNCH NUMBER/ PLANT	BUNCH WEIGHT/ PLANT (g)
Control	0	-	26,64	27,20	30,26	12,3	3,3	264
Organic products	7	0	13,17	14,73	21,43	11,1	3,1	273
Disease risk	6	14,28	11,18	11,20	15,33	11,3	3,3	290
200 dd + phenology	5	28,57	6,05	6,92	6,80	10,9	3,5	313
Grower's criterion	7	0	6,36	6,63	6,73	12,2	3,6	293





- In both cases, the number of treatments to control both diseases was reduced respect to that applied by growers.
- For Downy Mildew, the best results for efficacy were obtained for the plot based in disease risk by weather station (42,85 % reduction).
- For Powdery Mildew, the best results for efficacy were obtained for the plot based in temperature accumulation for the 1st treatment and next ones according to phenological stages, with only 4 sulphur applications (28,5 % reduction).
- More assays based in products for organic production (increasing use) are required to optimize their results.



Thank you

