

Management of charcoal caused by *Macrophomina phaseolina*

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Charcoal Rot caused by *Macrophomina phaseolina*



* Similar to symptoms caused by *Colletotrichum* and *Phytophthora*

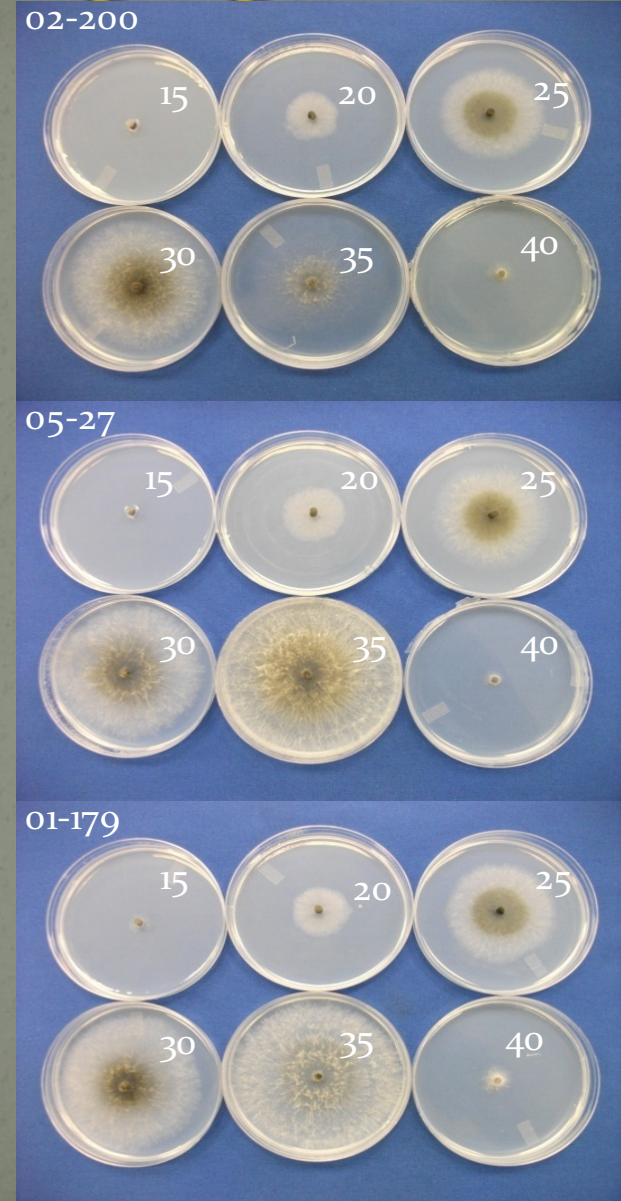
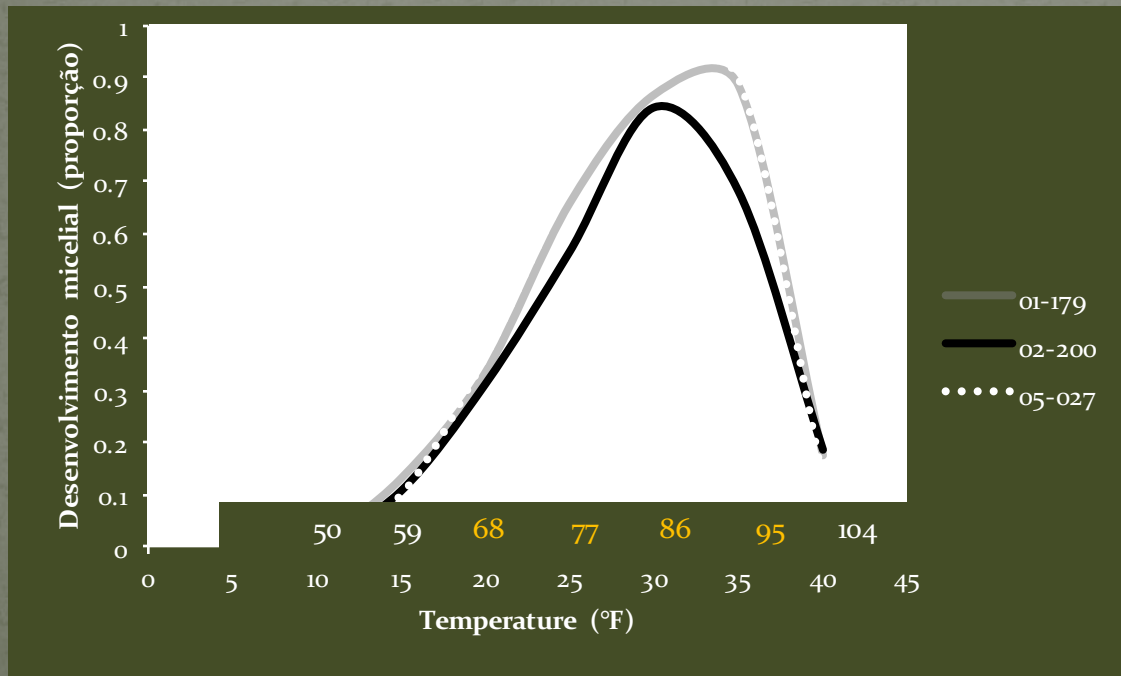
Charcoal rot

- ✓ FL in 2001; in CA in 2005 - coinciding with phase out of MB
- ✓ Patchy areas
- ✓ MB alternatives
- ✓ Usually observed early or late in the season – warmer temp

Season	# samples
2001-02	2
2002-03	3
2003-04	6
2004-05	4
2005-06	1
2006-07	5
2007-08	3
2008-09	1
2009-10	16
2010-11	6
2011-12	27
2012-13	14
2013-14	12
2014-15	14
2015-16	26

Effect of temperature on fungal growth *in vitro*

- Optimum conditions – high temperatures (85 – 95°F), low moisture, and high O₂ concentration in the soil



Average soil temperatures (Dover)

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Sept	84.1	84.8	83.3	83.4	82.6	82.7	84.0
Oct	80.9	79.4	76.2	78.9	78.7	78.7	79.6
Nov	72.0	70.5	71.3	70.2	73.1	68.9	77.0
Dec	66.0	58.0	67.5	67.2	69.8	66.3	73.5
Jan	57.7	61.6	63.3	68.3	62.6	65.0	64.2
Feb	59.0	67.7	69.5	68.0	68.0	63.3	65.9
Mar	63.7	73.2	76.7	67.8	70.1	75.4	73.6
Apr	75.5	80.1	79.7	77.5	76.0	80.0	76.9
Average	69.9	71.9	73.5	72.7	72.6	72.5	74.3

Macrophomina and *Fusarium*

End of season dieback in CA



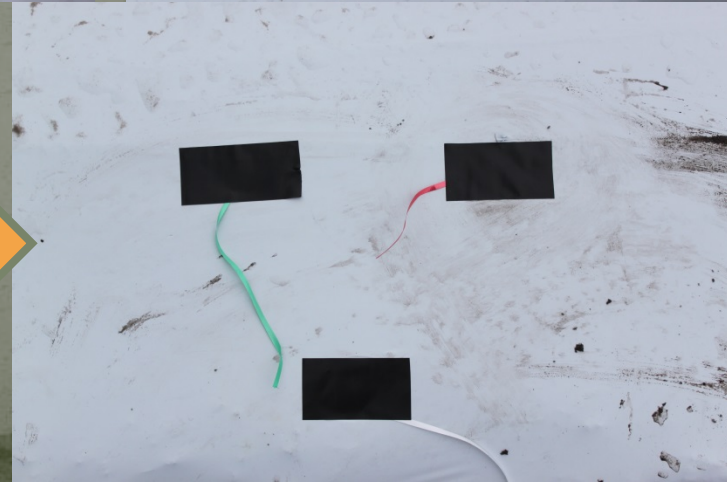
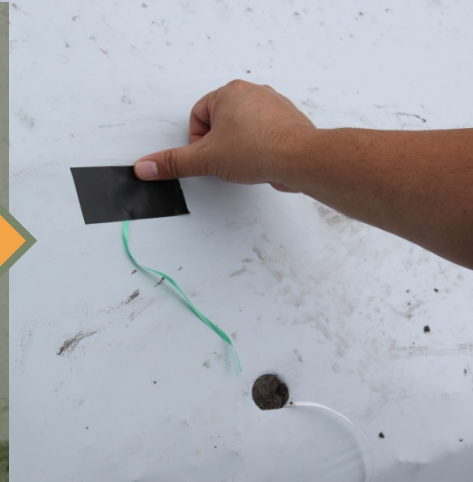
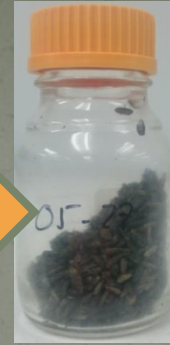
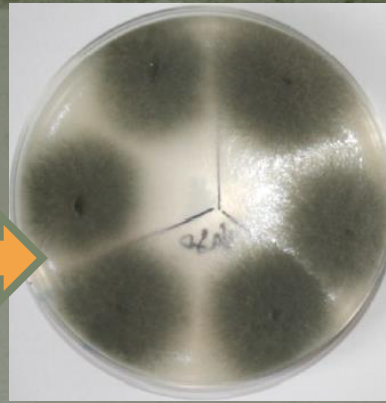
Macrophomina cultivar evaluation

Cultivar	Disease Incidence (%)				
	2011-12	2012-13	2013-14	2014-15	2015-16
FL Radiance	2.5 a	0 a	2.5 a	2.5 a	12.5 ab
Winterstar	2.8 a	2.5 a	5.0 a	5.0 a	5.0 a
FL Sensation	--	2.5 a	2.5 a	5.0 a	7.5 ab
Festival	46.1 b	22.5 b	35.0 b	27.5 b	25.0 b

Charcoal Rot




- ✓ Survives in the soil as microsclerotia – viable for up to 3 years
- ✓ Up until this season, no indication of transplants infected from nursery
- ✓ Research trials in collaboration with Dr. Noling to evaluate MB alternative fumigants for control of *Macrophomina phaseolina*

Methods



Dover fumigation trial 2012-13

Macrophomina evaluation

Treatment (rate)	Plastic/Method	Number of Macrophomina colonies/g (center of bed)
Methyl Bromide + Pic 67/33 (350 lb/ta)	Blockade/Shank	5 a
Methyl Bromide + Pic 50/50 (320 lb/ta)	Blockade/Shank	1 a
Telone C35 (35 gpta)	LDPE/Shank	262 ab 
Telone C35 (30 gpta)	Blockade/Shank	8 a
DMDS + PIC (45 gpta)	Blockade/Shank	4 a
DMDS + PIC (60 gpta)	Blockade/Shank	4 a
DMDS + PIC + Telone II (400 lb)	Blockade/Drip	31 a
DMDS EC + PIC EC + Telone EC (60 gal)	Blockade/Shank	2 a
Pic Clor 60 (300 lb/ta) (Shank)	LDPE/Shank	1037 cd 
Pic Clor 60 (250 lb/ta) (Shank)	Blockade/Shank	696 bc 
KPam (60 gpta)	LDPE/Drip	2 a
Vapam (75 gpta)	LDPE/Drip	2 a
Non-fumigated	LDPE/---	1310 d

Balm fumigation trial 2013

Macrophomina evaluation

Treatment (rate)	Plastic/Method	Number of Macrophomina colonies/3ml kaykob bundle	
		<i>Center of Bed</i>	<i>Side of Bed</i>
Non-fumigated	LDPE/---	7567 a	6067 a
TE ₃ (Telone+DMDS+Chlor) (300 lb/A)	LDPE/Shank	63 bc	2450 b
PicChlor60 (300 lb/A)	LDPE/Shank	847 b	1643 bc
MBr:Pic (50:50) (350 lb/A)	LDPE/Shank	8 c	2 c
MBr:Pic (67:33) (350 lb/A)	LDPE/Shank	2 c	1 c

Dover fumigation trial 2013-14

Macrophomina evaluation

Treatment (rate)	Plastic/Method	Number of Macrophomina colonies/ 3ml kaykob bundle	
		<i>Center of Bed</i>	<i>Side of Bed</i>
Dazitol + Integrate 20	LDPE/drip	3350 a	4879 a
Non-fumigated	LDPE/--	2929 a	2941 b
Pic-Clor 60 (300 lb/ta)	LDPE/shank	977 b	1165 bc
DMDS + PIC (60 gpta)	Blockade/shank	773 b	927 c
TE3 (DMDS+PIC+Telone) (400lb/ta)	Blockade/shank	12 c	4 c
DMDS EC + PIC EC (60 gpta)	Blockade/drip	16 c	6077 a
Kpam (60 gpta)	LDPE/drip	6 c	1334 bc
Telone C35 (35 gpta)	LDPE/shank	4 c	2 c
DMDS EC + Vapam (50 + 75 gpta)	Blockade/drip	6 c	2 c
Vapam (75 gpta)	LDPE/drip	4 c	4 c
MBr+PIC (67/33) (218 lb/ta)	Blockade/shank	5 c	6 c
MBr+PIC (50/50) (320 lb/ta)	Blockade/shank	1 c	15 c

Dover fumigation trial 2013-14

End season evaluation

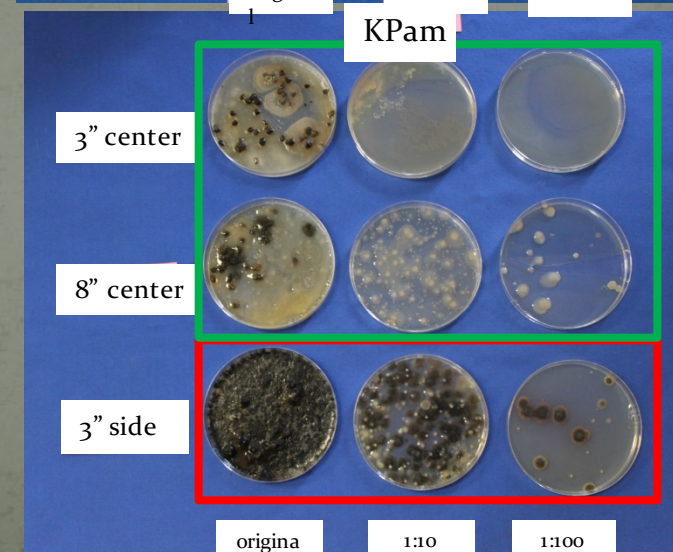
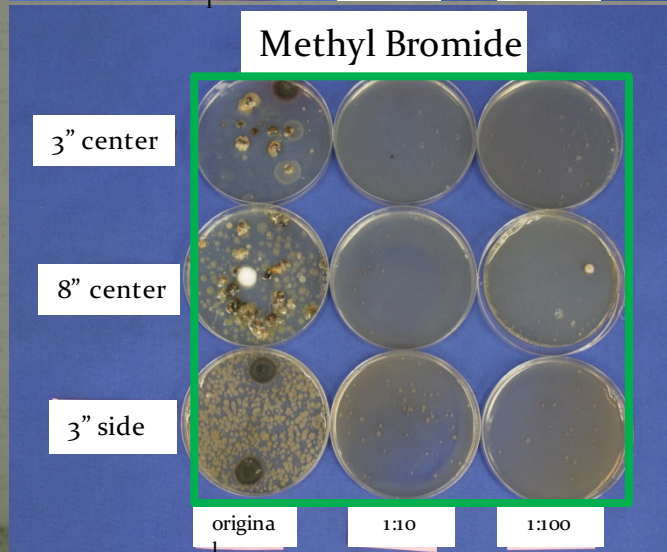
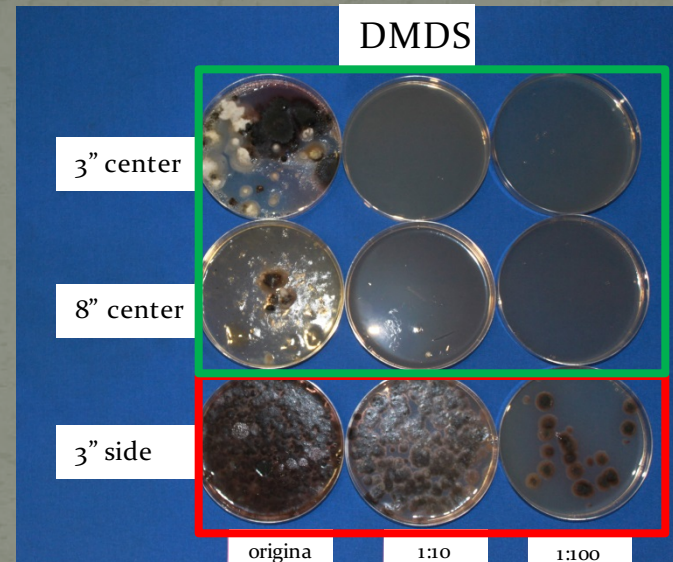
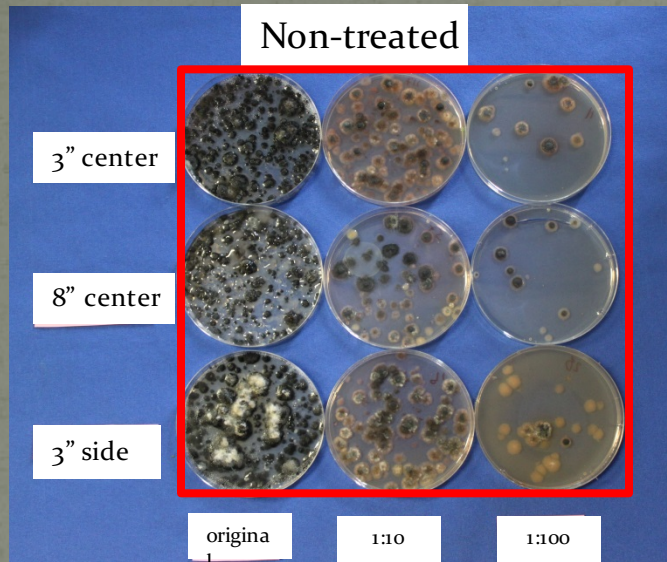
Treatment (rate)	Plastic/Method	% Mortality	Estimated % Macrophomina
Non-fumigated	LDPE/--	25.1 a	15.4 a
Dazitol + Integrate 20	LDPE/drip	21.4 a	11.3 a
Pic-Clor 60 (300 lb/ta)	LDPE/shank	3.2 b	1.0 b
Kpam (60 gpta)	LDPE/drip	2.6 b	1.0 b
Telone C35 (35 gpta)	LDPE/shank	2.3 b	1.0 b
Vapam (75 gpta)	LDPE/drip	2.1 b	0.3 b
MBr+PIC (67/33) (218 lb/ta)	Blockade/shank	2.1 bc	0.9 b
DMDS EC + PIC EC (60 gpta)	Blockade/drip	2.0 bc	0.9 b
DMDS + PIC (60 gpta)	Blockade/shank	1.9 bc	0.4 b
TE3 (DMDS+PIC+Telone) (400lb/ta)	Blockade/shank	1.7 bc	0.3 b
MBr+PIC (50/50) (320 lb/ta)	Blockade/shank	1.3 c	0.2 b
DMDS EC + Vapam (50 + 75 gpta)	Blockade/drip	1.0 c	0.1 b

Dover fumigation trial 2014-15

Macrophomina evaluation

Treatment	Number of Macrophomina colonies/g	
	<i>Center of bed</i>	<i>Side of bed</i>
T35	1.6 b	235.3 cd
MeBr67	2.8 b	6.0 d
Dominus (15.6 gpta) (drip)	3.1 b	3208.5 a
MeBr50	3.3 b	1.0 d
DMDS EC + PIC (40 gpta) (drip)	3.9 b	540.8 bc
Dominus + PIC (203 lb/ta) (drip)	3.9 b	1825.0 b
Kpam (60 gpta) (drip)	5.5 b	1,398.0 b
DMDS+PIC+Telone II (300 lbs/ta)	9.1 b	17.7 d
Piclor60	1,103.5 a	82.3 cd
DMDS+PIC (40 gpta)	1,211.0 a	354.1 cd
Non-fumigated	3,185.0 a	3208.5 a

Importance of fumigation distribution for *Macrophomina* control



Macrophomina trials summary

- ✓ Except for PicClor60 and Dazitol, most fumigants evaluated were able to effectively suppress *Macrophomina* inoculum in the soil *IF uniformly distributed in the beds*
- ✓ Treatments applied by drip usually performed poorly in the bed shoulders

Macrophomina management recommendation

- ✓ Integrated approach:
 - ✓ Crop destruction
 - ✓ Pre-plant fumigation
 - ✓ Cultivar selection

- ✓ FL Radiance, Winterstar and FL-127 are more tolerant to charcoal than Festival

GCREC Strawberry Pathology Team



Thank you!!



Questions?