

Comparative Economics of Tree Protection

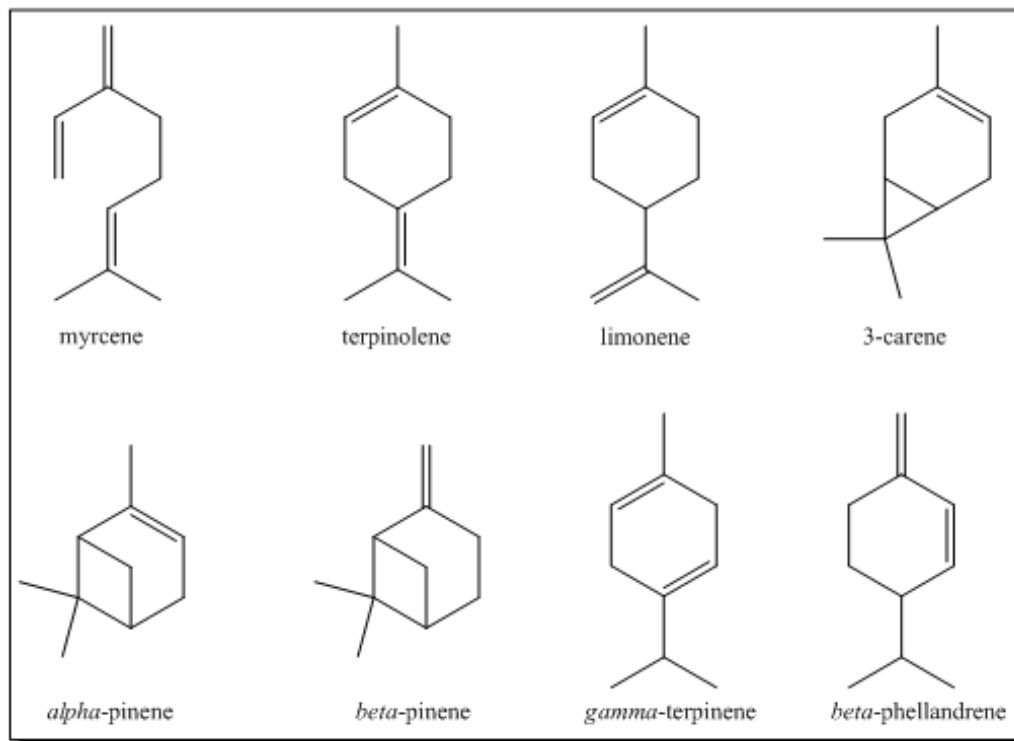
- Treatments using verbenone devices fixed to trees 100 devices/ha = 675 g of AI. Device cost \$825
- Treatments using MCH devices fixed to trees at 100 devices/ha = 40g of AI. Device cost \$175
- Verbenone or MCH treatments using flakes (ARD) are very expensive up to thousands/ha as they suffer from poor release kinetics and delivery to non optimal location (forest floor).
- All treatments should be coupled with infested tree removal for best effect which adds additional costs
- Efficacy of repellent can be increased by using trap out techniques at the same time (source and sink).

The Love/Hate Relationship: A Marriage of Convenience

- Terpenes serve as kairomones, the primary olfactory signal that attracts beetles to their host species,
- Host recognition requires recognizing terpene ratios (α -pinene in oak vs α -pinene in fir)
- Act as xenobiotic compounds and have toxic properties to microbial and higher organisms
- Detoxified via oxidation processes
- Some oxidized terpene products are 'pheromones'; verbenone an oxidation product of α -pinene, MCH an oxidation product of limonene



Common Monoterpenes



Typical Bole Volatiles Over 5%							
Terpene	Douglas-fir	Interior Fir	Englemann	White spruce	Lodgepole	Sugar Pine	
(-)- <i>alpha</i> -pinene	72.7	10.2	39.4	25.6	5.94	18.9	
(+)- <i>alpha</i> -pinene			9.29	49		35.1	
(-)- <i>beta</i> -pinene	7.82	24.16	29.46	15.3	19.15	22	
(-)-sabinene	5.78						
(+) 3-carene		8.55	9.94	10.6	6.98		
(-)- <i>b</i> -phellandrene		34.7	11.9		60.73		
(-)-limonene		6.76			7.19	9	
(-)-camphene	13.62						
myrcene						5.5	

Experimental Methods

- oxidize individual monoterpenes, (~50-80 new compounds per terpene: library 350~500 compounds with 7 substrates)
- Collect MPB, DFB and SPB. Callow adults load into pasture pipettes cap with bark, viable beetles chew their way out
- Run coupled GC-EAD... GC separates the mixture and the insect antennae respond to molecules they recognize
- Use chemical methods to identify the unknowns
- Behavioral bioassay using multiple funnel traps and 'standard' semiochemical lures

Preliminary Results

MPB	TERPENE	GC-EAD HITS	MS UNKNOWNNS
	B-pinene	8	1
	terpinolene	9	2
	3-carene	16	2
	myrcene	11	7
	A-pinene	18	5
	limonene	7	0
	Lodgepole turpentine	4	1
	Crude (+) verbenone	1	1
totals		73	19
DFB	TERPENE	GC-EAD HITS	MS UNKNOWNNS
	B-pinene	9	1
	terpinolene	11	1
	3-carene	13	1
	myrcene	4	2
	A-pinene	13	3
	limonene	15	4
	Lodgepole turpentine	17	15
totals		82	27

What's in store for the future?



Thank you Contributors

- Jorge Macias-Samano, Synergy
- Ken Gibson
- Darren Blackford, USDA FS
- Steve Munson, USDA FS
- Carl Jorgensen, USDA FS
- Phil Mocettini USDA FS
- Evert Wakarchuk, Synergy
- Troy Kimoto, CFIA
- Ria Parker, Synergy

