Integrated Pest Management Reduces Greenhouse Gas Emissions: The Case of Pennsylvania Mushroom Farms

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Introduction

Home to sixty-seven mushroom cultivation facilities, Pennsylvania is the U.S. leader in edible mushroom production, accounting for 60% of domestic consumption. Pesticides have become the first line of defense against fly pests of mushroom agriculture. Integrated Pest Management has been documented to decrease pesticide use[5]. This is critical, since pesticides may contribute to the anthropogenic impact on the planet's climate. In this poster, we calculate the estimated carbon dioxide equivalent (CO2e) emissions associated with pesticide use from the commercial mushroom industry in Pennsylvania and forecast potential reduction given Integrated Pest Management implementation.

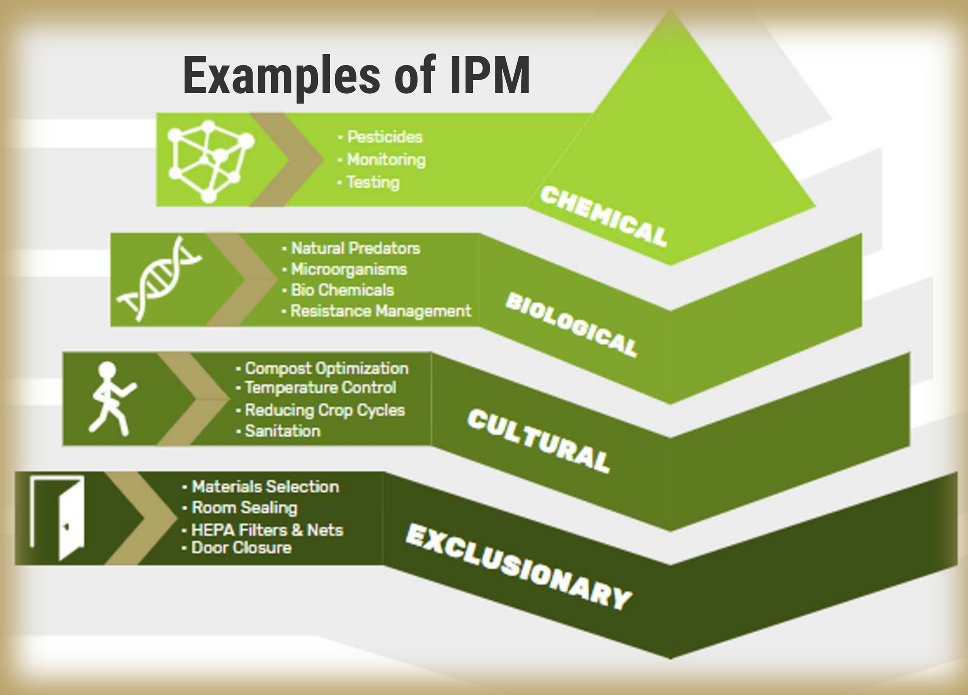

Figure 1: Adapted from the Mushroom IPM Handbook [1]

Figure 2. Megasellia halterata, also known as the phorid fly, is a common pest to mushroom crops

Mushroom Pests

Mushroom flies feed on the mycelium and other parts of the crop as larvae, and spread diseases as adults[1]. Common species of pests include;

- ***Lycoriella mali*, Sciarid Fly**
- ***Megaselia haltera*, Phorid Fly**
- ***Mycophila speyeri*, Cecid Fly**

Integrated Pest Management

Integrated Pest Management (IPM) is employed via exclusionary, behavioral, and biological methods of pest control, leaving chemical pesticide use as a last resort for eradication of pests[1]. Examples of IPM techniques recommended for use on mushroom farms are demonstrated in Figure 1 above.

Methods

Data displayed in Figure 3 (right) was extracted from pesticide labels for eleven pesticides approved for use on mushrooms by the EPA.

Pesticide Name	Active Ingredient	Dilution (grams/gallon)	Application Rate (oz /acre)	Kg ai / oz
Apex	S-Methoprene	1133.980	239.580	0.0088592
Arctic 3.2 EC	Permethrin	1451.500	17.424	0.0113398
Armor IGR	Cyromazine	190.509	1873.080	0.0014883
Debug Turbo	Azadirachtin & Oils Margosa	2310.000	1.250	0.0180468
Ecozin Plus	Azadirachtin	45.400	54.450	0.0003546
Malathion 5	Malathion	2267.960	21.780	0.0177184
Neemix 4.5	Azadirachtin	175.000	174.240	0.0013671
Permastar	Permethrin	1451.500	87.120	0.0113398
Permethrin 3.2 EC	Permethrin	1451.500	87.120	0.0113398
Phor-Ex	Etofenprox & Piperonyl butoxide	3175.150	87.120	0.0248058
Pounce 25 WP	Permethrin	0.550	31.944	4.2969E-0
TOTAL				0.0096968

Figure 3. Pesticide Data

The total kilogram of active ingredient per ounce of applied pesticide (kg AI/oz) was used in an equation that considers; the total acreage of mushroom production for Pennsylvania in 2018[7], Average CO2e emissions from the manufacture of pesticides[2,3,4], and pesticide application rates for mushrooms in California in 2016[8].

$$\underset{\text{(acres)}}{397.90} \times \underset{\text{(CO2e / kg ai)}}{20.45} \times \underset{\text{(oz/acre)}}{79.84} \times \underset{\text{kg ai / oz applied}}{.00969}$$

The result of this equation was reduced by Pretty and Bharucha's estimate of 30.7%[5] to calculate possible reduction over the next twenty years.

Results

CO2e emissions from pesticides used by the mushroom industry is estimated to be 6, 292.065 Mg (6.3 metric tons). That is the equivalent of emissions from 1 and 1/3 cars that average 22 miles per gallon driving for 11,000 miles[6].

This number can be reduced by 1,931.66 Mg (1.9 metric tons) over twenty years through IPM implementation, putting the industry at 4,360.40 Mg (4.3 metric tons).

Conclusion

IPM implementation will lead to pesticide use reduction, therefore reducing CO2e emissions from the mushroom industry in Pennsylvania.

References