Management tips for integrating preemergence herbicides and cover crop surface mulch

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Soil-applied, **pre-emergent (PRE) herbicides** are an important component of weed management programs in no-till production systems. Consider integrating PRE herbicides and cover crop surface mulch to limit weed competition, reduce weed seedbanks, and prevent evolution of herbicide resistant weed species to POST herbicide products. To optimize performance of PRE herbicides in systems that utilize cover crops, it is important to understand how cover crop management tactics, herbicide application strategies, and herbicide properties influence the availability of PRE herbicides in soil.

- **If less than 1 tn/ac (< 2,000 lbs) of rye biomass**, management strategies result in similar levels of PRE herbicide activation in soil due to high levels of spray deposition.
- **Between 1.5 to 2.5 tn/ac (3,000 – 5,000 lbs)**, roll-crimping significantly increases interception of herbicide spray. Consider applying herbicide program prior to roll-crimping and planting when planting green but minimize in-row disturbance by row cleaners.
- **Above 2.5 tn/ac (>5,000)**, consider delaying application of PRE residual herbicides to EPOST timing because washoff potential in high biomass levels is significantly greater in dead residues.
- Use of **grass-legume mixtures** increase spray interception and more dependent on washoff dynamics.

Herbicide reaching soil surface relative to no cover (%) at application (left column) and after incorporating rainfall (right column)

Cereal rye biomass (lbs/ac) at application	Applied at termination ("Planting green"; 0 DAT)				Applied after termination (EPOST; 21 DAT)			
	standing cereal rye		roll-crimped cereal rye		standing cereal rye		roll-crimped cereal rye	
1,000	85	85	80	85	70	75	70	75
2,000	80	80	70	75	65	75	60	70
3,000	70	70	55	60	60	70	50	65
4,000	65	65	40	50	55	70	40	55
5,000	55	55	25	40	50	65	25	50
6,000	45	45	10	25	45	65	5	45
7,000	40	40	<1	15	40	60	5	40

Cover crop mix biomass (lbs/ac) at application	Applied at termination ("Planting green"; 0 DAT)				Applied after termination (EPOST; 21 DAT)			
	roll-crimped rye-vetch		roll-crimped rye-crimson		roll-crimped rye-vetch		roll-crimped rye-crimson	
1,000	45	60	80	90	45	60	50	60
2,000	40	55	70	75	40	55	40	55
3,000	30	45	50	65	30	50	35	50
4,000	20	40	40	50	20	50	30	50
5,000	15	35	20	35	15	45	20	45
6,000	5	25	5	20	10	40	15	40
7,000	<1	20	<1	10	<1	40	5	35

Spray deposition at application (%)

Total herbicide in soil after incorporating rainfall (%)
Pyroxasulfone used as test herbicide. Washoff potential will differ based on herbicide properties.

Understanding the effect of herbicide properties on washoff potential from residues. In a planting green scenario, residual herbicides may be absorbed into living cover crop plants. The potential for these herbicides to be incorporated into soil via washoff from precipitation will depend on **herbicide polarity (K_{ow})**, which influences its permeation rate through cell walls, and the time to a rainfall event. Herbicide washoff potential from dead cover crop surface residues is influenced by **herbicide solubility** and **mobility (K_{oc})** properties, as well as cover crop residue properties (% lignin), and amount and time to rainfall. Our research suggests that:

- Lipophilic herbicides with low solubility and mobility (i.e., pendimethalin) should be avoided when higher levels of cover crop biomass (> 2,000 lb/ac) are produced.
- Herbicides with intermediate polarity and low solubility have the greatest potential to be washed off living and dead cover crop residues if adequate rainfall occurs.
- Herbicides with intermediate polarity and moderate to high solubility can be washed off cover crop residues. But in planting green scenarios, these herbicides may result in greater absorption and less washoff.

Solubility (mg/L)	Mobility (K_{oc})	Polarity (K_{ow})	Example herbicides	Washoff potential from living and dead cover crop residues
Low (0-50)	Low (> 500) Moderate (75-500)	Lipophilic	pendimethalin	**Low**: Entrapped in cell walls when applied to living cover; tightly sorbed to dead residues after drying, preventing washoff
		Intermediate	flumioxazin pyroxasulfone atrazine isoxaflutole	**Moderate to High**: Greater availability on surface of living plants and dead residues for washoff after rainfall events (> 0.5")
Moderate (50-500) High (>500)	Moderate (75-500) High (15-75)	Intermediate	acetochlor S-metolachlor dimethenamid metribuzin sulfentrazone	**Moderate:** Absorption and uptake in living plants may results in smaller proportion available for washoff. Washoff from dead residues will depend on water content of residues (i.e., dry at time application) and time to incorporating rainfall event.
		Hydrophilic	mesotrione clopyralid prosulfuron	

Application strategies for improving deposition of herbicide spray. Changing herbicide application strategies may improve the deposition of herbicide spray into the soil profile. However, it is important to balance management objectives when completing burndown and weed control objectives and application of PRE residual herbicides in a single pass. Potential strategies for improving deposition of herbicide spray through cover residues include:

- Decrease application speed to less than 10 mph
- Increase carrier volume (>15 gpa) to increase the number of droplets produced
- Utilize narrow nozzle spacing (15 in) and narrow fan angles to increase droplet speed
- Minimize boom height while ensuring double overlap

Summary. *Cover crop surface mulch is an important IWM tactic. Understanding how to adjust cover crop management, herbicide selection, and application strategy to optimize use of PRE herbicides in cover crop systems is important for realizing the benefits of both weed management tools.*