يد ال W-1134 DOCUMENT ы 3 0109 00947 6683 **Mechanical** ed Control

with a **Harrow or Rotary Hoe**

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A harrow or rotary hoe can rapidly, economically, and effectively control certain weeds



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Mechanical weed control is one tool in an integrated weed management system. Use of tillage can be the sole weed management tool or, more likely, complement other means such as cultural methods (e.g. crop rotation, proper crop seeding dates and rates) and herbicides. Equipment for mechanical weed control includes harrows, rotary hoes, between-row tillage equipment, undercutters, rod weeders, mowers, combine weed seed savers, etc. Discussion in this publication will be limited to light spring-tooth harrow or rotary hoe use during preemergence to early postemergence crop stages for weed seedling management and control.

A harrow or rotary hoe can rapidly, economically, and effectively control certain weeds. The weeds, crop, environment, equipment, and management techniques (e.g. tillage timing) of the producer are important factors in determining the effectiveness of mechanical weed control.

Research work in North Dakota indicates that the level of weed control and crop seed yield is generally less with use of only a harrow or rotary hoe, but the cost of weed control is generally less compared to extensive use of herbicides. Table 1 shows annual weed control and crop response with a harrow or rotary hoe compared to herbicide checks.

A combination of mechanical weed control and herbicides at reduced rates (if appropriate) may be a viable compromise versus choosing one single method.
 Table 1. Weed and crop response with use of a harrow or rotary hoe in North

 Dakota.

(rep 8		Tillogo	Annual	Crop		
Location	Year(s)	Implement ^a	Control	Injury	Density	Yield
				- % of herbi	cide check	
Field pea:						
Carrington	1996	Harrow	82	14		72
		Rotary hoe	87	11		76
Flax:	·····					
Dickinson	1993-95	Harrow	38		70	88
		Rotary hoe	39		59	89
Lentil:					<u> </u>	
Dickinson	1994	Harrow	50		77	29
		Rotary hoe	14		61	28
Pinto bean:						
Carrington	1991-92	Rotary hoe	77	0	_	86
Ū		(plus two cultivati	ons)			
Wheat:						
Langdon	1988	Harrow	86	42	—	64
Dickinson	1994-95	Harrow	65		83	106
		Rotary hoe	71	—	78	101
Carrington	1995	Harrow	33		76	
		Rotary hoe	35		73	

^a Two passes with tillage implements.

Annual weeds that emerge from shallow soil depths (less than 1 inch) can be controlled by a harrow or rotary hoe. Examples would include common lambsguarters, kochia, nightshade, pigweed, wild mustard, green and vellow foxtail, and barnyardgrass. Weeds that typically emerge from soil depths of greater than 1 inch such as common cocklebur, volunteer grain, volunteer sunflower, and wild oat are difficult to control with shallow tillage. Also, established biennial or perennial weeds are not controlled by shallow tillage due to extensive crown and/or root systems.

Shallow-emerging weeds need to be controlled soon after germination and before the root system is well established. The optimum time to control weeds is the "white sprout" stage. At this stage, weeds have not emerged but are just below the soil surface. Thus, the young plants are white (have not been exposed to sunlight and turned green), tender, and very susceptible to injury by tillage. Check fields for this stage by lightly wiping your hand or a spade across the soil surface. Generally, grassy weeds should not exceed the one-leaf stage and broadleaf weeds the cotyledon-leaf stage of growth in order to expect adequate control with a harrow or rotary hoe.

A general recommendation with mechanical weed control is to till with a harrow or rotary hoe three to five days after crop planting ("blind tillage") followed by a second tillage pass seven to 10 days later. A third tillage pass seven to 10 days later is optional. A compromise may have to be made between optimizing weed control and minimizing crop injury when using a harrow or rotary hoe after crop emergence.

Crop species and stage is an important consideration when timing mechanical weed control operations. Crops generally will tolerate preemergence use of a harrow or rotary hoe until the seedling emergence structure (coleoptile of grasses and epicoty) or hypocotyl of broadleaves) is near the soil surface. However, postemergence tillage generally should not be used on shallowseeded crops such as canola, crambe, tame mustard, and flax as excessive crop injury will likely occur. Table 2 shows various crops and the recommended stages of growth to minimize injury/stand loss while using a harrow or rotary hoe for weed suppression.

Crops can easily be injured. Minimize injury during mechanical weed control operations to maintain uniform crop development, competitiveness with weed escapes or late emerging weeds, and seed yield and quality potential. Loss in crop density is normal and may range from 10 to 25 percent or more depending on the crop, crop stage, environmental conditions, tillage equipment, etc. Table 1 lists crop stand reduction with a harrow or rotary hoe in selected research trials conducted in North Dakota. To compensate for potential stand loss, planting rate should be increased 10-25 percent above normal.

Table 2. General crop stage recommendations for harrow or rotary hoe use¹

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	CROP STAGE				
Crop Species	Preemergence	Postemergence			
Amaranth	Shallow tillage depth 3-5 days after planting	Not recommended			
Barley ²	Before coleoptile near soil surface	1-3 leaf stage (1 time only)			
Buckwheat	3-5 days after planting	Stand reduction will occur			
Canola ³	1-3 days after planting	Not recommended			
Chickpea (Garbanzo bean) ²	Shallow tillage depth 3-5 days after planting	Up to 2-4 inches tall			
Corn ²	Up to and including emergence	Emergence to 6 inches tall			
Crambe ³	1-3 days after planting Shallow tillage depth	Not recommended			
Dry bean	Before crook stage	1-2 trifoliolate stage			
Fababean ²	3-5 days after planting	2-6 inches tall			
Field pea ²	3-5 days after planting	Emergence to 2-4 inches tall			
Flax	Shallow tillage depth 3-5 days after planting	Stand reduction will occur			
Lentil ²	3-5 days after planting	1-4 inches tall Stand reduction will occur			
Lupin	3-5 days after planting	Emergence to 2 inches tall			
Mustard ³	Shallow tillage depth 1-3 days after planting	Not recommended			
Oat ²	Before coleoptile near soil surface	Not recommended			
Proso millet ²	Shallow tillage depth 3-5 days after planting	Stand reduction will occur			
Safflower	3-5 days after planting	Possible stand reduction			
Grain sorghum ²	Before coleoptile near soil surface	surface Emergence to 6 inches ta			
Soybean	Before crook stage	1-2 trifoliolate stage			
Sunflower	3-5 days after planting	2-6 leaf stage			
Wheat ²	Before coleoptile near soil surface	1-3 leaf stage			

¹ Timing of tillage may vary depending on environment and equipment. Chickpea, dry bean, fababean, field pea, lentil, lupin, soybean, and sunflower foliage should be dry before tillage to reduce risk of disease spread.

² Regrowth should occur if aboveground stem severely damaged or removed.

³ Canola, crambe, and mustard should be seeded as deeply as allowable to reduce stand loss from preemergence tillage.

Environmental conditions should be closely monitored to help maximize weed control with a harrow or rotary hoe. Optimum conditions for timing mechanical weed control include a dry and level soil surface, warm air temperatures (75 degrees F or greater), wind and sunshine.

A dry and level soil surface is necessary to allow effective operation of equipment and to minimize reestablishment of displaced weeds from tillage.

Warm, windy, and bright sun conditions, as well as dry weather during and following tillage, will reduce reestablishment of tilled weeds, as the weeds will dry out before they can reroot. Timing the tillage during midday with optimum conditions will allow more time for weed desiccation. Also, these conditions will cause the crop to be less turgid. The crop will be more flexible as tillage implement points or shovels move through the canopy, so less crop injury would be expected. Crops well rooted and anchored will have less injury resulting from mechanical weed control.

Tillage equipment selection, adjustment, and use is important for acceptable mechanical weed control. Numerous types of harrows and rotary hoes are commercially available. Make sure that the implement of choice is suitable for preemergence and postemergence weed control.

For example, light harrows must be used instead of heavy- and/or rigid-tooth types. Harrow teeth should be set back at an angle. If a considerable amount of crop residue is present in the field, make sure the harrow or rotary hoe has adequate clearance to avoid collection of large amounts of residue. Residue bound in an implement will cause excessive crop damage if the operation is continued.

Implement tillage depth (normally 0.5 to 0.75 inches) and speed should be set to dislodge weeds but to minimize crop injury. Recommended harrow speed is 4 to 6 miles per hour. Rotary hoe effectiveness increases with increasing speeds, but so does crop injury potential. Rotary hoes typically are operated at 7 to 14 miles per hour. Closely monitor equipment after the tillage operation is initiated as environmental and plant (crop and weed) changes that can adversely change the expected outcome may occur from one part of the field to another.



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