

Wheat progeny response to preharvest herbicide applications

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Summary

At times it can be advantageous to apply a herbicide to kill or desiccate immature green weeds growing in maturing wheat (*Triticum aestivum*). However, applied too early, the herbicides may reduce wheat yields, affect seed maturation or be translocated into the seed and affect subsequent seedling growth. Four herbicides were applied over-the-top of standing wheat at four stages of seed maturity. Glyphosate, paraquat and sulfosate applied at the late milk stage reduced seed weight, germination and subsequent seedling emergence. When applied at the soft dough stage only seedling emergence was affected. Paraquat applied at the hard dough stage retarded seedling emergence. None of the 2,4-D treatments affected any parameter measured in this study.

Introduction

A number of broadleaf weeds such as kochia (*Kochia scoparia*), sunflower (*Helianthus annuus*) and lambsquarter (*Chenopodium* spp) commonly infest wheat fields. These weeds continue active growth as wheat matures and are still green at harvest. The small leaves, flower parts and seeds from these weeds pass over or through the same screens as the wheat seed and become contaminants in the grain. They are high in moisture and, if not removed or dried, can cause the grain to absorb moisture and spoil. Farmers often swath wheat prior to combining to reduce the moisture in both the wheat and immature weeds. A foliar herbicide application to desiccate the weeds and wheat would eliminate the need to swath prior to combining and would reduce possible harvest losses that occur as wheat is in the swath on the ground. Several researchers (1,2,3,5) have used late season herbicide applications to control perennial weeds or as harvest aids to desiccate crops but most have failed to study the effect of these applications on the crop seed or subsequent seedlings (3, 4).

The objective of this research was to determine how herbicides applied as wheat is maturing affect seed maturation and subsequent seedling growth.

Methods and Materials

'Fremont' wheat was planted on April 17, 1989 and April 4, 1991 at the Brigham Young University Agricultural Research Station near Spanish Fork, Utah on an irrigated Timpanogos loam (fine-loamy, mesic, Calcic Agrixerolls).

Herbicide treatments were ((2,4-dichlorophenoxy)acetic acid) applied at 0.8 and 1.6 kg ha⁻¹, glyphosate (N-(phosphonomethyl)-glycine) applied at 1.1 and 2.2 kg ha⁻¹, paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) applied at 0.5 and 1.1 kg ha⁻¹ and sulfosate, (trimethylsulfoniumcarboxymethylaminomethylphosphonate) applied at 1.1 and 2.2 kg ha⁻¹. All herbicides were applied with a CO₂-pressurized, hand-held sprayer delivering 190 L ha⁻¹ at 210 kPa. Herbicides were applied on July 11, 17, 26 and 31 in 1989 and on July 10, 17, 28 and August 2, 1991. These dates of over-

the-top herbicide applications corresponded to the late milk, soft dough, hard dough and mature grain stages of wheat and to the 11.1, 11.2, 11.3 and 11.4 growth stages on Large's scale (4) and to the 7.7, 8, 8.7 and 9 growth stages on the Zadoks' et. al. scale (6). The average seed moisture measured at the time of herbicide application at each stage was 45, 33, 22 and 13%, respectively.

The experimental design was a split-plot design with main plots being wheat maturity stages and sub-plots being herbicide treatments plus an untreated control. Individual plots were 1.8 by 6.7 m. Each herbicide treatment was applied to an individual plot and was replicated three times.

Wheat was harvested on August 2, 1989 and August 4, 1991 using a small-plot self propelled combine. Seed weight, germination and seedling emergence were determined. Wheat seed was germinated between moistened blotter papers maintained at 25°C in a growth chamber. Seedling emergence was determined by planting wheat seed 2 cm deep in a peat potting mix in the greenhouse. The number of emerged abnormal seedlings also was recorded. A seedling was considered abnormal if it was stunted, deformed or showed a severe lack of green pigmentation.

Results and Discussion

Seed weight. Glyphosate, sulfosate and paraquat applied at the late milk stage of seed maturity reduced seed weight, while 2,4-D had no effect (Table 1). When applied at later stages of maturity, none of the herbicides affected seed weight.

Germination Sulfosate at 2.2 kg ha⁻¹ and paraquat at both 0.5 and 1.1 kg ha⁻¹ applied at the late milk stage, reduced seed germination (Table 1). No other herbicide treatment applied at this maturity stage affected germination. Paraquat applied at 1.1 kg ha⁻¹ at the soft dough stage reduced seed germination by 18% when compared to the control. None of the other herbicide treatments affected germination if they were applied at the soft dough or later stages of maturity. Regardless of application rate or wheat maturity stage when applied, 2,4-D had no effect on germination.

Emergence Seeds from plants treated with herbicides during the later stages of seed maturity were planted, and allowed to germinate and grow for 14 days. Herbicides applied over-the-top of mature wheat had no effect on seedling emergence (data not shown). Likewise, herbicides applied during the hard dough stage had little effect on seed's ability to emerge although paraquat applied at the 1.1 kg ha⁻¹ rate retarded the rate of emergence somewhat (data not shown). Glyphosate and sulfosate applied at the 2.2 kg ha⁻¹ rate and paraquat applied at both the 0.5 and 1.1 kg ha⁻¹ rates during the soft dough stage reduced seedling emergence (Figure 1). Also, these herbicides reduced seedling emergence if they were applied during the late milk stage. Sulfosate applied at the 2.2 kg ha⁻¹ rate reduced seedling emergence more than when applied at the 1.1 kg ha⁻¹ rate. Seedling emergence was not affected by 2,4-D regardless of the rate or wheat maturity stage when it was applied.

Abnormal seedlings Most glyphosate, sulfosate and paraquat treatments applied at the late milk and soft dough stages caused abnormal and deformed seedlings (Table 1). Many of these seedlings were very slow in emerging and in extending the first leaf. Many seedlings were slow to develop normal green pigmentation and some seedlings were extremely short and twisted. Depending on the severity of the abnormality, some seedlings died while others finally produced normal pigmentation and developed into normal seedlings.

Literature Cited

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Table 1. Seed weight, germination, and abnormal seedlings from seed treated at three stages of maturity with four herbicides.

Herbicide	Rate	Wheat Maturity Stages ^δ								
		Seed Weight			Germination			Abnormal Seedlings		
		LM	SD	HD	LM	SD	HD	LM	SD	HD
	kg/ha ⁻¹	---gm/100 seed---			-----%-----					
Glyphosate	1.1	2.3*	3.3	3.4	95	98	98	26*	5	2
	2.2	2.5*	3.1*	3.4	85	92	97	27*	21*	4
Sulfosate	1.1	2.3*	3.1*	3.4	86	96	99	35*	6	1
	2.2	2.3*	3.2*	3.5	81*	91	96	52*	28*	2
2, 4-D	0.8	3.3	3.5	3.3	95	99	96	1	1	1
	1.7	3.1	3.4	3.3	94	99	97	1	2	1
Paraquat	0.5	2.2*	3.3	3.2	45*	95	95	14*	22*	2
	1.1	1.8*	3.2*	3.4	26*	76*	96	57*	25*	4
Control		3.3	3.5	3.5	95	94	98	2	1	2
	LSD 0.5	0.3	0.2	NS	12	8	NS	9	7	NS

^δ Wheat maturity stages at the time of herbicide application: LM = Late Milk State (45% Moisture), D = Soft Dough Stage (33% Moisture), HD = Hard Dough Stage (22% Moisture)*
*Significantly different than control

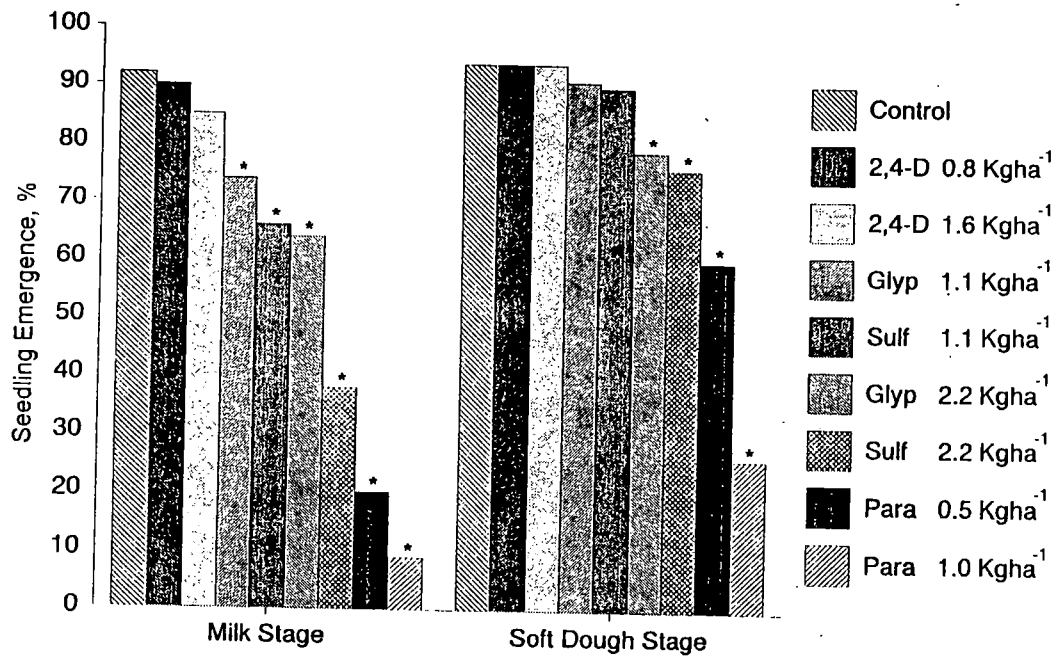


Figure 1. Seedling emergence as affected by eight herbicide treatments applied at the late milk and soft dough (Zadok 7.7 and 8.0) stages of maturity.