Paraquat—Effects of Growing Season Applications[1]

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Highlight

Paraquat applied at 0.8 lb./acre to the same stand of crested wheatgrass in three consecutive years did not significantly reduce the grass yield in the fourth year. Floral primordia mortality from paraquat application on May 20 ranged from 50 to 87 percent. Further research in application technique and timing in relation to chemical coverage and meteorological conditions are believed needed to assure a consistently high floral primordia mortality, a perequisite of successful two-crop management.

The residual or accumulative effect from any management treatment on perennial grasses is of vital concern. Two consecutive years of curing range grasses when in anthesis with paraquat[2] (1,1′ dimethl-4,4′-bipyridinium ion) caused no significant reduction in herbage yield (Sneva, 1967). This note gives additional information on the effect of paraquat on crested wheatgrass (*Agropyron desertorum* (Fisch.) Schult.) yield after 1, 2, and 3 years of growing season treatments.

Management of crested wheatgrass stands for a two-crop system, as proposed by Hyder (1961), requires the removal of apical dominance with sufficient soil moisture remaining to assure a second crop of vegetative stems. He suggested, for this area, that grazing begin about May 1 and terminate about May 20; the stocking rate so adjusted to allow the floral primordia to be elevated and removed. Successful achievement of floral primordia removal requires intimate knowledge of grass growth rate, forage intake by animals, and flexibility in the ranch operation. Seldom is 100% control of the floral primordia achieved. I desired to use paraquat in place of the grazing animal to remove apical dominance in crested wheatgrass. If successful, this could simplify the management for a two-crop system but the herbage produced up to the time of treatment is essentially lost to the grazing animal. Thus, floral primordia control by the earliest spring treatment for obtaining a second crop composed of vegetative stems is discussed.

Method and Materials

A previous paper (Sneva, 1967) describes the experimental area and equipment used to apply spray treatments. Treatments consisted of: (1) 0.8 lb. of paraquat cation in 10 gallons of water plus X-77 added at 0.5% total volume per acre applied once on May 20, June 10, June 20, or June 30 in each of the years 1964, 1965, and 1966, (2) clipping at ground level on May 20 for positive removal of all elevated floral primordia, and (3) control.

The randomized complete block design contained four replications with date-of-spray, clipping, and control treatments assigned to whole plots (12 × 108 ft). Subplots (12 × 36 ft) received year treatments of: treated only in 1964, treated in 1964 and 1965, or treated in 1964, 1965, and 1966.

Standing vegetation on all plots was mowed in the fall of each year with a rotary mower. The herbage yield harvested on June 6, 1967 from a 4 × 12 ft area in each subplot measured the accumulative effect of treatments upon production. Treatment means were tested with Duncan's multiple range test at the 0.05 level of significance.

Effectiveness of May 20 treatments in controlling floral primordia was estimated from the number of reproductive stems present in August, 1965, and 1966 in two, 1 ft² samples randomly located in each subplot. Reproductive stems could not be counted in August 1964 because cattle broke into the experimental area in late July and ate all herbage on the treated plots. Visual estimates of growing point control recorded July 13, 1964 will be used in lieu of enumerated data.

Table 1. Yields (lb./acre) of crested wheatgrass on June 6, 1967 after 1, 2, and 3 years of application of paraquat during the growing season and clipping on May 20.

Treatment year	Control	Clipped May 20	Paraquat applied				Mean
			May 20	June 10	June 20	June 30	
1964	922	776	1088	1118	784	1080	961
1964, '65	934	964	1084	1112	1150	1044	1048
1964, '65, '66	1026	796	978	910	964	864	923
Mean	960	845	1050	1047	966	996	

Results

Table 1 shows the mean yields in 1967 for treatments imposed in the three previous years. Mean yield of crested wheatgrass was not reduced significantly by any treatment. No significant interactions were found.

Table 2. Control of floral primordia in each of the three years by clipping or by applying paraquat on May 20 in each year expressed as a percent of the control.

Year	Treatment	
	Clip	Paraquat
1964[1]	75	50
1965[2]	97	87
1966[2]	99	64

[1] Visual estimate on July 13, 1964.
[2] Based on two, 1 ft² samples/plot in August.

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[2] As of this date, paraquat has not been registered by the U.S. Department of Agriculture for this use.

Table 2 shows the percent control of elevated growing points in each year by clipping at ground level or by treating with paraquat, both being imposed on May 20 of each year. In two of the three years, nearly all floral primordia were sufficiently elevated above the soil surface to be removed by clipping on May 20. Control of floral primordia with paraquat was poorer than clipping in every year, ranging from 50 to 87%.

Discussion

Paraquat treatments in June, which provide a cured herbage for late season grazing, did not cause a yield depression after three successive years of treatment. This agrees with Hyder (1961) who found clipping treatments during June to have little or no effect upon the following year's yield of crested wheatgrass. Thus, it is inferred that paraquat can be applied up to at least three years in succession for curing the first crop of stems without fear of diminished production in subsequent years.

Successful control of the growing point whether by grazing, clipping, or contact chemicals requires that the floral primordia be elevated to a susceptable height for removal or for contact in the case of a chemical. In 1964, cool April temperature and dry soils delayed plant growth and retarded floral primordia elevation. Only 75% of the reproductive stems produced in 1964 were removed by the clipping treatment on May 20. Increases in floral primordia control in that year could have been realized by delaying both the clipping and the chemical treatments.

Poorer control of floral primordia in all years resulted from paraquat treatments than from clipping. Yet, in 1965, paraquat applied on May 20 controlled 87% of the emerged growing points. This suggests that a relatively high degree of control may be possible if those factors influencing paraquat activity are known. Recent studies evaluating temperature, oxygen, humidity, and light combinations (Merkle et al., 1965; Brian, 1966; Putman and Ries, 1968) on the activity of paraquat offer possible solutions for increasing success of field applications.

Herbage removal by clipping during April and May has been shown to depress crested wheatgrass yield significantly in the year following treatment (Hyder, 1961). Lowest residual yields in this study, though not significantly different from the others, resulted from clipping on May 20 in three consecutive years. A similar depression of yield did not occur from the comparable chemical treatment probably because of the poorer control of the floral primordia.

Floral primordia control with early spring treatments of paraquat appears possible; further research is needed to define guide lines for optimum effectiveness. Consistently high floral primordia control in May may cause subsequent yield reductions; thus, rotation of pastures used for two-stem cropping is suggested for counteracting a yield decline, if such occurs.

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