Evaluation and Management of Grasses for Dual Livestock and Game Bird Use

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Abstract

Kleingrass 75 and Verde kleingrass *(Panicum coloratum* L.), PI 217229 and PMT 4022 plains bristlegrass (*Setaria macrostachya* H.B.K.) Nees), and commercial green sprangletop (*Leptochloa dubia* (H.B.K.), were studied for forage and seed production. Acceptability of seed was studied using caged bobwhite quail *(Colinus virginianus)*. Defoliation management practices had relatively little influence on forage yield. Forage digestibility declined rapidly when defoliation was delayed, and the species responded differently in the rate and pattern of decline. Seed yields were as high or higher with 30-day interval harvesting as with deferred harvesting except that spring deferment increased kleingrass and summer deferment increased green sprangletop seed yields. Green sprangletop also produced more seed by leaving a 20-cm stubble than a 10-cm stubble. These indeterminate species apparently mature seed in approximately 30 days, indicating that a management system that leaves some tillers intact for 30 days or longer will result in some seed formation. Seed production decreases to nil in 2 to 3 months following first maturity in an undefoliated stand.

Bobwhite quail readily consumed kleingrass seed as a significant portion of their diet even in the presence of a high quality game bird diet. They subsisted for short periods on an all grass seed diet, but consumed little plains bristlegrass or green sprangletop when game bird diet, pearl millet, or kleingrass were present. Thus, kleingrass has the most potential of the species studied for dual use.

The value of grasses for tame pasture has been based almost exclusively on forage production, adaptation, and soil protection. Similarly, selection of grasses for rangeland revegetation has been based largely on the ability to become established, persist, and produce an acceptable amount of forage. In Texas, game birds are an important or potentially important source of income from hunting leases and a recreation resource for both rural and urban populations. While grass seed plays a significant role in bird nutrition (Davidson 1949), bobwhite quail *(Colinus virginianus)* require seed of more than one vegetation type to meet their nutrient requirements (Stoddard 1931, Casey 1965). Thus, grasses and management practices are needed that produce good quality forage for livestock and seed for bird use.

Wernecke (1977) identified grasses with seed production patterns and seed characteristics that apparently make them acceptable for game birds. The genera included Panicum, Paspalum, and Setaria. Growth and forage quality in response to defoliation have been reported for some species (Pitman and Holt 1983). This study was undertaken to evaluate selected management practices for forage and seed production and to determine the acceptability of selected grass seeds to bobwhite quail.

Materials and Methods

Kleingrass 75 and Verde kleingrass (*Panicum coloratum* L.), PI 217229 and PMT 4022 plains bristlegrass (*Setaria macrostachya* H.B.K.), and commercial green sprangletop (*Leptochloa dubia* (H.B.K.) Nees) were used in these studies. All 3 have an indeterminate flowering habit. Kleingrass 75 was the only kleingrass in use in Texas prior to 1982. Verde kleingrass, which has larger seed and better seedling vigor, was released in 1982 (Holt et al. 1983). PMT 4022 plains bristlegrass is a Soil Conservation Service accession supplied by the SCS Plant Materials Center at Knox City, Texas. The management of grasses for forage and seed production was conducted in 3 studies and a fourth study involved caged bobwhite

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Table 1. The influence of harvest treatments on forage and seed yields of two grasses in 1977.

Grass	Harvest treatments				
	(1) Monthly at 10 cm height	(2) Monthly at 20 cm height	Not harvested in:[1] (3) Spring	(4) Summer	(5) Fall
			Kg DM/ha		
Kleingrass 75	5480$^{a}_{x}$	4760$^{b}_{x}$	5700$^{a}_{x}$	5770$^{a}_{x}$	—
Plains bristlegrass PI 217229	1280$^{a}_{y}$	980$^{b}_{y}$	1290$^{a}_{y}$	1070$^{ab}_{y}$	—
			Kg seed/ha		
Kleingrass 75	4$^{b}_{y}$	8$^{b}_{y}$	44$^{a}_{y}$	8$^{b}_{x}$	
Plains bristlegrass PI 217229	41$^{b}_{x}$	62$^{a}_{x}$	77$^{a}_{x}$	14$^{c}_{x}$	
			IVDDM, % of dry matter		
Kleingrass 75	57±2.6[2]	56±2.1	55±5.0	58±2.8	58±0.8
Plains bristlegrass PI 21729	55±3.2	52±5.2	53±3.9	53±4.2	52±5.9

[1]Harvested monthly at 10 cm height except in periods noted.
[2]Means ± standard deviation
a,b,c Significant ($P<.05$) differences within a row.
x,y Significant ($P<.05$) differences within a column for a parameter.

quail feeding.

Study 1

Kleingrass 75 and PI 217229 plains bristlegrass established in 1975 on Norwood clay loam (fine, loamy, mixed, thermic udifluvents) near College Station, Texas, were used in the first study. The grasses were in main plots with 5 harvest treatments superimposed in subplots on each grass as follows: (1) monthly clipping to 10-cm stubble height, (2) monthly clipping to 20-cm stubble height, and monthly clipping to 10-cm stubble height except during deferment in (3) spring, (4) summer, or (5) fall. Deferment indicates periods with no clipping and was chosen as a management tool to permit seed to mature at various times of the year. The deferment periods were: spring, 15 March to 15 June; summer, 15 June to 31 August; and fall, 1 September to 30 November. The harvest treatment subplots consisted of 4 rows spaced 1 m apart, 4.75 m in length. The test was replicated 3 times.

Seeds were harvested as they matured in deferred plots and on clipping dates in monthly clipping treatments if mature seed were present. Forage yields were determined monthly or at the end of specified deferment periods by harvesting 2 center rows using a flail mower. Seed yields are reported as screened seed material, free of leaves and stems.

Study 2

The second study was conducted on plots of Verde kleingrass,

Table 2. The response of grasses to harvest treatments in 1978.

Grass	Harvest treatments				
	(1) Monthly at 10 cm stubble height	(2) Monthly at 20 cm stubble height	Not harvested in:[1] (3) Late spring early summer	(4) Late summer early fall	(5) Late fall
			Kg DM/ha		
Verde kleingrass	9990$^{a}_{x}$	9400$^{ab}_{x}$	7760$^{b}_{x}$	10970$^{a}_{x}$	10660$^{a}_{x}$
PMT 4022 Plains bristlegrass	3650$^{a}_{z}$	3520$^{a}_{z}$	3750$^{a}_{z}$	3960$^{a}_{z}$	4125$^{a}_{y}$
Green sprangletop	6030$^{a}_{y}$	5780$^{b}_{y}$	6560$^{ab}_{y}$	7930$^{a}_{y}$	5310$^{b}_{y}$
			Kg seed/ha[2]		
Verde kleingrass	92	94	214	78	60
PMT 4022 Plains bristlegrass	420	522	124	184	168
Green sprangletop	86	251	114	279	89
			IVDDM, % of dry matter[2]		
Verde kleingrass	60±2.9[3]	59±3.5	53±2.6	48±2.5	53±2.4
PMT 4022 Plains bristlegrass	56±3.7	55±3.9	50±1.9	42±2.0	40±2.1
Green sprangletop	60±3.7	60±3.6	51±2.1	40±1.9	36±1.8

a,b,c significant ($P<.05$) differences within a row.
x,y,z significant ($P<.05$) differences within a column for a parameter.
[1]Harvested monthly at 10 cm height except in periods noted.
[2]Seed and IVDDM values for deferred defoliation treatments (3,4,5) represent peak seed yields of weekly samples and IVDDM of final biweekly sample during defoliation deferment period.
[3]Mean ± standard deviation.

PMT 4022 plains bristlegrass and green sprangletop established in early April 1978. Plants were transplanted as 45-day old seedlings on 30-cm centers in rows 30 cm apart. A split plot design was employed with grass species as main plots and harvest treatments as subplots. The 5 harvest treatments described in Study 1 were superimposed on each grass in subplots consisting of 4 rows 3.66 m in length. The test was replicated 4 times.

Forage measurements in the above tests consisted of dry matter (DM) yield and in vitro digestible dry matter (IVDDM). Yield and IVDDM were determined from 3 plants harvested at prescribed monthly intervals and at biweekly intervals during clipping deferment periods. Seed yields were determined at monthly harvest periods and weekly during clipping deferment periods by collecting seed from 3 different plants each week. IVDDM was determined by the Tilley and Terry (1963) procedure as modified by Goering and Van Soest (1970).

Study 3

Seed production patterns were determined in undefoliated plots of Verde kleingrass and PMT 4022 plains bristlegrass in 1978. The grasses were established in 1977 by transplanting 45-day old seedlings in 50-cm rows on 30-cm centers, in plots 8 m long, with 4 replications. No cultural treatments were applied in 1978. Two plants were hand harvested for seed at approximately weekly intervals beginning with first seed maturation and continuing as long as mature seed was present. Approximately 6 to 8 weeks after first seed maturity, one-half of each plot was cut to a stubble height of 10 cm. Seed harvesting in the cut area began when the first seed matured and continued until early October.

Study 4

In the bird feeding study, 10 bobwhite quail in each of 3 replications were offered ad libitum 2 feed containers: 1 contained a standard game bird diet (20% protein, primarily corn and soybean meal growers feed), and 1 contained 1 of the following seed or feed sources—green sprangletop, Kleingrass 75, PMT 4022 plains bristlegrass, commercial pearl millet, or game bird standard diet (control). Pearl millet is a commonly used game bird feed and served as a second control. Feed consumption from each source was measured daily. Birds were weighed at the beginning and weekly in a 3-week feeding period.

In a second feeding study, using the same number of birds and replications as in the first, 3 seed containers per cage were offered ad libitum choices as follows: (1) Kleingrass-green sprangletop--pearl millet; (2) Kleingrass-plains bristlegrass-pearl millet; (3) plains bristlegrass-green sprangletop-pearl millet; and (4) Kleingrass-plains bristlegrass-green sprangletop. Seed consumption and bird weights during the 3-week study were measured as before. Birds on all grass seed diet (4) were placed on the game bird diet during a fourth week and reweighed at the end of the fourth week.

Results

Study 1

The harvest management treatments employed in this study did not appear to have a major or consistent effect on forage and seed yield (Table 1). Two defoliation stubble heights were used on the rationale that some seed would develop below the 20-cm height. The 20-cm height decreased harvested forage yields, while seed yield of plains bristlegrass (PI 217229) increased. Delaying the initial harvest until mid-June increased the seed yield of both Kleingrass 75 and plains bristlegrass compared to monthly harvest at 10-cm stubble height. However, deferring harvest in the summer did not increase seed yields. Regrowth after 15 August was too limited to harvest, thus there were no fall yield data, but hand samples were collected for IVDDM analyses. Harvest treatments had no significant effects on forage digestibility though plains bristlegrass tended to have lower IVDDM at the end of the non-harvest periods than with monthly harvest.

Study 2

Verde kleingrass yields were reduced by spring deferment in 1978 (Table 2). It seems likely that Verde tillering either decreased or ceased with seed maturation in June in the absence of defoliation whereas regrowth with more frequent defoliation involved new tillers. A similar pattern is noted with late fall deferment of green sprangletop in 1978. Both Verde and Kleingrass 75 produced significantly more forage than the other species with all defoliation practices (Table 1 and 2).

Both Kleingrass 75 and plains bristlegrass seed yields were minimal in 1977 with the most favorable yields occurring with spring clipping deferment. Verde kleingrass followed the same pattern in 1978 (Table 2), but total seed yields were higher. Kleingrass (Verde and Kleingrass 75) produces its major seed crop in June. The absence of defoliation during shoot elongation in late spring improved total seed yields. The deferment of summer clipping seemed to be more favorable than either spring or fall deferment for seed production of both PMT 4022 plains bristlegrass and green sprangletop. However, both of these species produce as much or more seed with monthly cutting than with any seasonal deferment. Green sprangletop seed yields were favored by the 20-cm stubble height because its growth form is erect. It also has fewer tillers than kleingrass and is taller than plains bristlegrass. It seems likely that the 20-cm cutting height permitted more rapid recovery and therefore maturation within a 30-day period, but it did not result in more total growth.

Deferment reduced IVDDM since the forage was 2 to 3 months old at the end of the deferred period. Plains bristlegrass and green sprangletop IVDDM with late summer and fall deferment was affected more than the IVDDM of Verde kleingrass (Table 2). Verde kleingrass and grass sprangletop did not differ appreciably in IVDDM with frequent harvests but differed as much as 8 to 17 digestibility units with late summer and fall deferment.

The influence of advancing maturity on forage digestibility is shown in Figure 1. The 3 species responded similarly in the initial weeks of the first 2 deferment periods although Verde kleingrass tended to recover slightly at the end. Fall IVDDM of Verde was markedly different from the other species and did not decline as rapidly with age.

Table 3. Feed intake and gain by captive bobwhite quail offered free-choice of two feed sources.

Alternate feed source	Average daily feed intake (g/bird/day)			Percent alternate source	Average gain/bird/day, g
	Standard diet	Alternate source	Total consumption		
Green spangletop	15.9±.46[1]	.2±.04	16.1	1.2	.82a[2]
Plains bristlegrass	17.1±.45	.2±.09	17.3	1.1	1.04a
Kleingrass	13.0±.57	5.2±.33	18.2	28.6	1.00a
Pearl millet	3.4±.22	10.5±.27	13.9	75.5	1.25a
Standard diet[3]	8.2±.45	9.2±.40	17.4		1.25a

[1]Mean±standard deviation.
[2]Average gains followed by same letter are not significantly ($P<.05$) different.
[3]A 20% protein corn—soy grower feed in both containers.

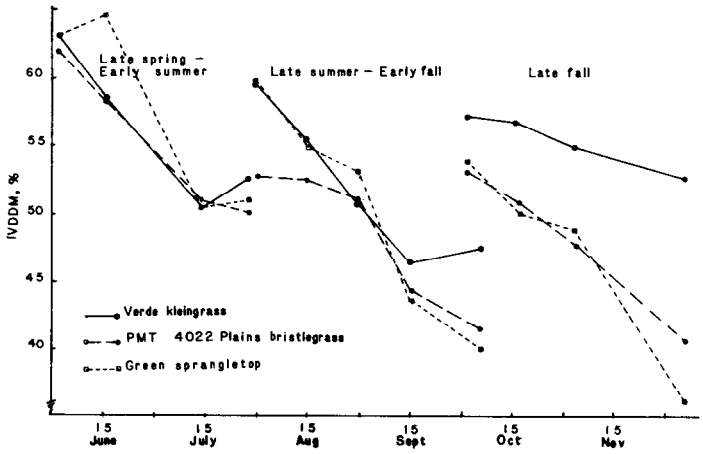

Fig. 1. *Forage digestibility (% IVDDM) patterns as influenced by season and advancing age.*

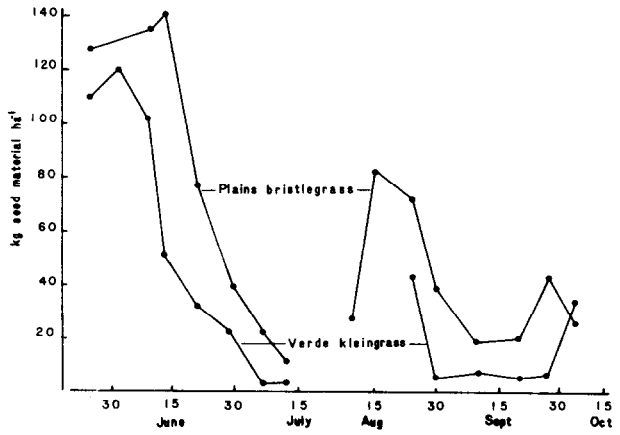

Fig. 2. Amounts of mature seed on plants at intervals following initial maturity.

Study 3

The pattern of seed maturation on non-defoliated stands of 2 grasses is shown in Figure 2. These data, taken from a second-year stand, show that undisturbed plants of both species essentially cease producing new inflorescences after 2 or 3 months. Since seed shattering occurs in both species, no seed are present on the plants after an extended period without defoliation. The late summer and fall pattern on plants defoliated in late July is approximately the same except that some new tillers were produced in late September. The patterns indicate that if grasses are grown primarily for seed for game birds, defoliation by some means is required for continuous seed production.

Study 4

Kleingrass 75 constituted 28% of the diet of caged bobwhite quail where the birds had a high quality alternative seed source (Table 3). However, only negligible amounts of green sprangletop and plains bristlegrass seed were consumed when birds had the high quality alternative. Body weights gains did not differ significantly, but tended to be less when a grass seed was one of the choices.

In a second cafeteria feeding study (Table 4), use of Kleingrass 75 seed exceeded that of either plains bristlegrass or green sprangletop. More pearl millet was consumed than grass seed in all combinations involving pearl millet. The percentage of grass seed in the diet increased over time, indicating that the birds were learning to eat it. Kleingrass seed made up 36% of the diet by the third week when pearl millet was available as a free choice. When only the 3 grasses were available, Kleingrass constituted 86 to 96% of the diet. Body weight increases did not differ among diets that included pearl millet, and the rate of increase was lower than in the first phase because the birds were approaching mature body weight. Birds lost weight when only grass seed was offered, even though total feed intake appeared to be higher in the second and third weeks. There was 30% mortality among birds on the grass seed diet. The diet did not meet the nutrient requirements of the birds as indicated by the weight loss. Apparently some birds could not survive the rate of weight loss. There was no mortality in other treatments. The surviving birds on the all grass seed diet were placed on the standard diet in the fourth week. They showed compensatory gain, with body weights approximately equalling those of birds from the other diets at the end of the week.

Discussion and Conclusions

The defoliation deferment practices used in these studies generally resulted in omitting 1 monthly harvest within each season. The harvest treatments designed primarily to influence seed yields, had relatively little influence on forage yields. The higher seed yield of both Kleingrass 75 and Verde with spring deferment is related to timing of defoliation. The spring seed crop, which is the major crop, usually starts maturing during the first 15 days in June or slightly later in the establishment year. A defoliation during flowering removes many tillers before they mature; thus, a delayed defoliation results in increased seed yield. Subsequent tillers will

Table 4. Feed intake and gain by captive bobwhite quail offered free choice of three feed sources.

	Feed consumption ratio (%)			Average daily feed intake (g/bird)			Gain/bird/day (g)
	wk 1	wk 2	wk 3	wk 1	wk 2	wk 3	
Kleingrass	26	34	36				
Green sprangletop	5	8	13	15.1	17.3	15.7	0.33a[1]
Pearl millet	69	58	51				
Kleingrass	16	29	34				
Plains bristlegrass	5	5	16	15.4	16.4	16.4	0.48a
Pearl millet	79	66	50				
Plains bristlegrass	3	15	22				
Green sprangletop	2	2	2	14.7	16.1	17.2	0.57a
Pearl millet	95	83	76				
Kleingrass	96	90	86				
Green sprangletop	2	4	8	14.7	19.7	21.0	-1.24b
Plains bristlegrass	2	6	6				

[1]Average gains followed by same letter are not significantly different ($P<.05$).

mature in about 30 days. Green sprangletop seed yields tend to be higher with summer deferment, which may indicate that flowering is greater in the summer and that a higher percentage of summer tillers require more than 30 days to mature. The rate of flowering may be reduced also, resulting in a longer time requirement for high seed yields. The study indicates, with these 2 exceptions, that tillers of these indeterminate grasses that are undisturbed for 30 days or longer will mature seed. Thus, grazing intensities or utilization practices that result in defoliation less frequently than 30 days or that result in individual tillers with an intact shoot apex for 30 days or larger will provide some seed for birds. Conversely, undefoliated plants will cease floral development in 2 to 3 months and require defoliation or disturbance to initiate new tillers and inflorescences.

These studies were conducted on a relatively fertile soil which becomes nitrogen deficient rapidly in the absence of fertilization. Also, summer rainfall is a major factor in warm-season grass growth and reproduction, and the study site receives intermittent summer rainfall. Thus, forage and seed yields are likely to be less in lower rainfall areas or on low fertility soils but the general patterns and responses should not change.

If defoliation deferment is required to provide adequate seed production for birds, disposition of the forage with low IVDDM (36 to 42%) at the end of the deferment period may be a problem with plains bristlegrass and green sprangletop. However, the potential problem would appear to be greatest with fall deferment which offered no advantage in seed production in either year. Summer IVDDM of green sprangletop, which declines almost as rapidly as fall IVDDM, may be a problem if summer deferment is required for seed production.

The birds used in the feeding trials were debeaked (tip of beak removed), and this may have influenced their ability to remove the caryopsis from the seed coverings in plains bristlegrass and green sprangletop. Kleingrass has a slick seed. Preferences might be altered to some extent under natural conditions. These studies indicate that Kleingrass seed are readily consumed by bobwhite quail, but when grass seed constitutes the entire diet it may not meet all nutrient requirements of the birds. Birds in nature choose a mixed diet where available to meet their nutrient requirements (Kiel 1976). Performance on all grass seed diets indicates that bird populations may subsist for short periods of time on these grass seeds, primarily kleingrass, and the individual birds recover body weight rapidly when a more balanced diet becomes available.

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