Warm Season Supplemental Forages for White-tailed Deer in the Pineywoods of East Texas

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Abstract: Supplemental forage plantings for white-tailed deer (*Odocoileus virginianus*) have been aimed primarily at the winter stress period with little or no consideration to supplementing the summer diet. Consequently, there is little information concerning the efficacy of summer plantings. A total of 14 summer cultivated forages was evaluated using 4 criteria: 1) productivity, 2) availability during stress periods, 3) utilization and acceptance by deer, and 4) nutritional quality. Warm-season forages performing best were alyceclover, iron and clay cowpea, catjang cowpea, American jointvetch, and centennial soybean. Bottomland sites were more productive than upland sites. Combination plantings, particularly comprised of alyceclover and cowpea in the upland and alyceclover, cowpea, and jointvetch in the bottomland, are recommended over single variety plantings.

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Supplemental plantings providing winter forage for white-tailed deer have been used widely throughout eastern Texas and much of the Southeast. Recently, use of warm-season forages has increased as landowners and deer managers attempt to provide deer with high quality forage during the summer stress months, when native vegetation quality generally is poor (Kroll 1991). In light of the economic potential (Haney 1983, Kroll 1987) and growing popularity of intensive white-tailed deer management (Kroll 1991), planting programs have become more cost-effective. Since detailed information on forage performance, nutritional value, and utilization rates by white-tailed deer generally are lacking, the objectives of this study were to evaluate white-tailed deer acceptance, utilization, and quality of 14 warm-season forages, and evaluate adaptability and yield potential of forages on upland and bottomland sites.

Methods

Our study was conducted on the Eason Lake Hunting Club (Angelina Co., Texas) belonging to Temple-Inland, Inc., located in the Pineywoods Ecological Region (Gould et al. 1960). Deer populations were high (i.e., 1 deer/3 ha).

Forage evaluations were conducted on upland and bottomland sites, located approximately 8 km apart, and selected on the basis of being representative of east Texas deer habitat. No domestic livestock were present; however, a substantial feral hog population was on the area.

Fourteen warm-season forages were examined for 2 years (1987 and 1988); 3 others were tested in 1987 only: whippoorwill cowpea, Illinois bundleflower, and bicolor lespedeza. Four other varieties were used in 1988 only: mungbean, Crawford soybean, centennial soybean, and bobwhite reseeding soybean. Planting rates were: non-reseeding soybeans (67.2 kg/ha), cowpeas (56.0 kg/ha), lespedezas and Japanese millet (33.6 kg/ha), reseeding soybean (28.0 kg/ha), alyceclover (22.4 kg/ha), mungbean (13.4 kg/ha), American jointvetch (11.2 kg/ha), and Illinois bundleflower (5.6 kg/ha). Planting depth and inoculation was according to agricultural standards.

Each site was soil tested annually; fertility and pH were amended accordingly. Fertilization and seeding rates were in accordance with accepted guidelines for each forage. Seeding rate was based on percentage of live seed, determined via germination tests. Seedbed preparation consisted of shredding and disking. Legumes were inoculated and all seed hand-broadcast evenly over each plot and covered to the appropriate depth via raking.

A randomized block design was used to evaluate forages at each site. Each forage was assigned randomly within each of the 3 replicates. Plots were 1.8 x 10.9 m, separated by a buffer strip approximately 0.5 m wide.

Following site preparation and planting, 1 wire exclosure 1 m in diameter and at least 1 m in height was located randomly on each plot and staked in place. Where rabbits (*Sylvilagus* spp.) were deemed a potential depredator, poultry netting (2.54 cm mesh) was placed around exclosures. Exclosures provided an estimate of total standing crop and a comparison for utilization estimates. This was a "free-choice" experiment which allowed deer to select between forage types. Consequently choice of 1 variety could have been influenced by presence of another.

Visual observations and measurements of utilization rates (%) were collected from each plot at 30-day intervals from planting until cessation of growth. Utilization was measured by examining 10 randomly selected stems for recent browsing. Random harvests (clipping all above-ground vegetation) of forage samples from each plot using a 0.6 m ring were made at 30-day intervals beginning 60 days after planting and continuing until the end of each forage's growing season.

An additional forage sample was harvested from within each plot exclosure at the end of each variety's growing season. Differences in yield (dry mass, kg/ha) inside- vs. outside-plot exclosures at final harvest served as a conservative estimate of utilization throughout the growing season. Forage samples were measured for sample dry mass (g), crude protein (Cp, %), and acid detergent fiber (ADF, %; Foley et al. 1973). Precipitation data were obtained from the Lufkin, Texas, weather station located nearby.

In all cases, the null hypothesis tested was no significant difference between parameters for each forage tested. Hypothesis testing was established *a priori*, with an α-level of 0.05. Statistical tests included ANOV, with subsequent testing by Duncan's multiple range test.

Results and Discussion

In order for a particular forage to be efficacious, it must meet each of 4 evaluation criteria. First, it must produce enough forage to justify establishment costs (= forage production). Second, it should be available in sufficient quantities during stress periods (= forage availability). Third, the variety must be readily accepted and utilized by white-tailed deer (= Florida utilization). Last, it should be of nutritional value to white-tailed deer (= forage quality). We evaluated each forage with these 4 criteria.

Forage Production

Standing crop estimates varied greatly between forages throughout the study. In general, forages producing total standing crops less than 2,240 kg/ha were considered to be low in productivity and cost-prohibitive.

Standing crop estimates for alyceclover were acceptable (2,353.5 to 2,381.8 kg/ha, respectively) on bottomland and upland sites in 1987 (Tables 1–2), but only on the bottomland site in 1988 (7,599.9 vs. 294.3 kg/ha). Drought conditions in May–June 1988 (Fig. 1) led to reduced yields of alyceclover and on the upland site (Table 2).

Cowpea varieties generally produced high yields on both sites in 1987 trials with iron and clay cowpea, catjang cowpea, and red ripper cowpea producing higher yields during 1988 trials (Tables 1–2). Although not strictly comparable due to site and climatic differences, Thro et al. (1987) produced 7,056 kg/ha of iron and clay cowpea in Louisiana, while Lunceford (1986), Jones and Wellborn (1987), and Davis (1988) produced only 572, 972, and 1,373 kg/ha, respectively, in Mississippi. Higher soil moisture inherent to bottomland sites appeared to increase cowpea yields during the 1988 drought.

American jointvetch produced moderate yields (2,212.0 to 2,991.1 kg/ha) in 1987 trials (Tables 1,2). In 1988 the bottomland site produced extremely high yields (8,300.2 kg/ha) of American jointvetch, while the upland site produced minimal standing crops. Since American jointvetch thrives in mesic, well-drained sites (Joost and Chaney 1990), the bottomland was the only site capable of meeting this forage's growth requirements in 1988. Previous studies on different sites and much different climatic conditions reported yields ranging 439–6,720 kg/ha (Lunceford 1986, Jones and Wellborn 1987, Thro et al. 1987, and Davis 1988).

Table 1. Mean standing crop estimates (kg/ha) of warm-season forages in a Pineywoods bottomland site on the Eason Lake Hunting Club, Angelina Co., Texas, 1987 and 1988.[a]

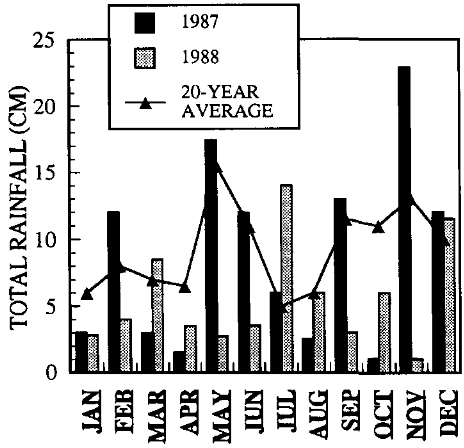
	Days since planting									
	60		90		120		150		Cage	
Variety	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	390.1 A	184.8 A	295.5 A	213.4 B	152.9 AB	261.2 B		152.9 AB	2353.5 A	7599.9 DE
Iron and clay cowpea	3810.1 B	2.2 A	2108.2 C	5.7 A	976.5 C	0.0 A		41.1 A	4304.2 A	9608.7 E
Whippoorwill cowpea	3855.8 B		737.0 AB		1121.3 C				3157.6 A	
Mungbean		0.0 A		10.3 A						1758.0 AB
Red ripper cowpea	3754.2 B	4.6 A	1570.9 BC	3.5 A	451.7 ABC				773.5	2830.2 ABCD
Catjang cowpea	3452.0 B	27.3 A	962.9 AB	11.4 A	811.1 BC	31.9 A			3972.2 A	6657.5 CDE
American jointvetch	70.7 A	121.1 A	147.2 A	201.9 B	181.3 AB	220.2 A		236.1 B	2991.1 A	8300.2 E
Kobe lespedeza	201.9 A	66.2 A	270.4 AB	67.3 A	494.5 ABC	76.4 A		84.4 A,B	3090.3 A	130.0 A
Bicolor lespedeza	92.4 A		0.0 A		0.0 A				47.9 A	
Japanese millet	1024.5 A	3116.6 B								5446.0 BCDE
Illinois bundleflower	75.3 A		51.3 A		17.1 A				15.5 A	
Crawford soybean		6.8 A		0.0 A		0.0 A				2647.7 ABC
Centennial soybean		0.0 A		13.7 A		0.0 A		0.0 A		6740.8 CDE
Reseeding soybean		2.2 A		0.0 A		0.0 A				962.9 AB

[a] Values in columns followed by the same letter are not significantly different from each other at the $P \leq 0.05$ level, Duncan's Multiple Range Test.

Table 2. Mean standing crop estimates (kg/ha) of warm-season forages in a Pineywoods upland site on the Eason Lake Hunting Club, Angelina Co., Texas, 1987 and 1988.[a]

	Days since planting									
	60		90		120		150		Cage	
Variety	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	290.9 A	252.1 A	1040.4 BC	211.0 E	568.1 AB	195.1 E		171.1 B	2381.8 A	294.3 A
Iron and clay cowpea	4222.0C	9.1 A	2631.8 D	10.3 A,B	2054.5 D	78.7 AB		87.8 AB	5583.0 B	5351.4 BC
Whippoorwill cowpea	3215.9 B,C		2011.2 D		968.5 AB				4799.8 B	
Mungbean		70.8 A		0.0 A						1512.0 A
Red ripper cowpea	2976.3 B,C	55.9 A	1704.3 CD	1.1 A	1395.2 BCD				2494.9 A	2073.9 AB
Catjang cowpea	2544.0 B	8.0 A	2433.3 D	20.5 AB	1601.6 CD	36.5 AB			5523.6 B	5875.0 C
American jointvetch	114.1 A	52.5 A	419.8 A,B	77.6 C	488.2 AB	154.0 AB		189.4 B	2212.0 A	1279.9 A
Kobe lespedeza	59.4 A	29.7 A	211.0 AB	58.1 BC	181.3 A	85.6 AB		62.7 AB	435.8 A	104.9 A
Bicolor lespedeza	14.8 A		0.0 A		14.8 A				246.4 A	
Japanese millet	711.9 A	2172.0 B								5278.3 BC
Illinois bundleflower	14.8 A		2.2 A		3.5 A				90.2 A	
Crawford soybean		51.3 A		0.0 A		0.0 A				4907.6 BC
Centennial soybean		13.7 A		0.0 A		0.0 A		0.0 A		6801.3 C
Reseeding soybean		17.1 A		0.0 A		0.0 A				52.5 A

[a] Values in columns followed by the same letter are not significantly different from each other at the $P \leq 0.05$ level, Duncan's Multiple Range Test.



Standing crop estimates for soybean varieties (1988) suggested they may be slightly more tolerant of drought conditions than cowpea varieties (Tables 2, 3), contrasting the findings of Davis (1988) in Mississippi. Soybeans generally are not thought to be more drought tolerant than cowpeas (Hartwig 1953).

Other forages tested (mungbean, bicolor lespedeza, Illinois bundleflower, kobe lespedeza, and reseeding soybean) produced poorly on 1 or both sites (Tables 1, 2), and did not establish satisfactory stands presumably due to competition, particularly from woolly croton (*Croton capitatus*) and pigweed (*Amaranthus retroflexus*).

Forage Availability

All forages were available throughout the warm season stress period (Aug–Sep), except Japanese millet (Jul maturation) and mungbean (Aug maturation). All other forages were more or less available throughout the summer. Forages providing the longest season of availability included alyceclover, American jointvetch, centennial soybean (1988 trials only), and iron and clay cowpeas.

Forage Utilization

That a supplemental forage is both highly productive and available during major stress periods may be meaningless unless the forage is utilized. Utilization of warm season supplemental forage apparently was influenced by native range conditions. In 1987 spring (Mar–May) rainfall patterns (Fig. 1) were near "normal" resulting in low utilization of supplemental forage (Tables 3, 4). However, during periods of lower rainfall (spring and early summer 1988), availability and/or quality of native forage presumably were reduced, with a concomitant shift toward supplemental forage (Tables 3, 4). Additionally, deer acceptance of certain forage varieties may have increased over time.

Many forages were heavily utilized (i.e., 75%–100%) to the point of stand elimination, possibly due to small plot size and heavy grazing pressure. In 1987,

Table 3. Mean utilization rates (%) of warm-season forages established in a Pineywoods upland site on teh Eason Lake Hunting Club, Angelina Co., Texas, 1987 and 1988.[a]

	Days since planting									
	30		60		90		120		150	
Forage	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	0.0 A	0.0 A	70.0 BC	16.7 AB	95.0 C	70.0	100.0 C	20.0 A		55.0 B
Iron and clay cowpea	0.0 A	100.0 B	3.3 A	10.0 AB	100.0 C	0.0 A	100.0 B	0.0 A		70.0 AB
Whippoorwhill cowpea	3.3 A		0.0 A		100.0 C		100.0 C			
Mungbean		98.3 B		7.7 AB		0.0 A				
Red ripper cowpea	3.3 A	100.0 B	26.7 A	6.7 AB	100.0 C	2.5 A	100.0 C			
Catjang cowpea	26.7 B	100.0 B	0.0 A	35.0 C	100.0 C	5.0 A	100.0 C	33.3 A		
American jointvetch	0.0 A	6.7 A	23.3 A	8.3 A,B	98.3 C	50.0 B	100.0 C	13.3 A		86.7 B
Kobe lespedeza	0.0 A	0.0 A	3.3 A	3.3 A	30.0 A	3.3 A	56.7 B	0.0 A		0.0 A
Bicolor lespedeza	0.0 A		16.7 A		10.0 A		5.5 A			
Japanese millet	33.3 B	95.0 B	43.3 B	8.3 AB						
Illinois bundleflower	0.0 A		40.0 AB		38.3 AB		0.0 A			
Crawford soybean		98.3 B		8.3 AB		0.0 A	0.0 A			
Centennial soybean		100.0 B		8.3 AB				0.0 A		
Reseeding soybean		98.3 B		3.3 A		0.0 A				

[a] Values in columns followed by the same letter are not significantly different from each other at the $P \leq 0.05$ level, Duncan's Multiple Range Test.

Table 4 Mean utilization rates (%) of warm-season forages established in a Pineywoods bottomland site on the Eason Lake Hunting Club, Angelina Co., Texas, 1987 and 1988.[a]

	Days since planting									
	30		60		90		120		150	
Forage	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	0.0 A	40.0 B	96.7 C	100.0 C	95.0 B	100.0 B	100.0 B	18.3 AB		91.7 B
Iron and clay cowpea	1.7 A	100.0 C	30.0 A	5.0 A	100.0 B	0.0 A	100.0 B	0.0 A		50.0 AB
Whippoorwill cowpea	0.0 A		15.0 A		100.0 B		100.0 B			
Mungbean		100.0 C		1.7 A		0.0 A				
Red ripper cowpea	0.0 A	100.0 C	15.0 A	5.0 A	100.0 B	50.0 AB	100.0 B			
Catjang cowpea	3.3 A	100.0 C	21.7 A	8.3 A	100.0 B	33.3 A	100.0 B	10.0 AB		
American jointvetch	0.0 A	20.0 AB	91.7 C	98.3 C	98.3 B	96.7 B	100.0 B	20.0 B		98.3 B
Kobe lespedeza	0.0 A	0.0 A	25.0 A	10.0 A	80.0 B	1.7 A	100.0 B	0.0 A		0.0 A
Bicolor lespedeza	0.0 A		10.0 A		0.0 A		0.0 A			
Japanese millet	0.0 A	43.3 B	60.0 B	41.7 B						
Illinois bundleflower	0.0 A		82.5 B		75.0 B		100.0 B			
Crawford soybean		100.0 C		3.3 A						
Centennial soybean		100.0 C		6.7 A		0.0 A				
Reseeding soybean		100.0 C		1.7 A		0.0 A				

toward supplemental forage (Tables 3,4). Additionally, deer acceptance of certain forage varieties may have increased over time.

Many Forages were heavily utilized (i.e., 75%–100%) to the point of stand elimination, possibly due to small plot size and heavy grazing pressure. In 1987, utilization of forages with moderate to high standing crops (>2,240 kg/ha) generally increased through the growing season. Following several weeks with no precipitation, cowpeas virtually were eliminated from plots at both sites during late July to mid-August 1987 (Tables 3, 4). Below normal rainfall in May and June 1988 also led to early and heavy utilization of cowpeas and soybeans at both sites, resulting in stand failures (Tables 3, 4). Heavy utilization at both sites in 1988 soon after germination of cowpeas and soybeans probably was related to poor range conditions due to drought (Johnson 1987), especially for small plots. Large plots are absolutely necessary where deer populations are higher.

Although heavy use of certain plants suggested preference by deer, small plot size magnified utilization effects and resulted in stand failures that may not otherwise have occurred on larger plots. In sites where sufficient stands developed, alyceclover and American jointvetch were better able to endure moderate to heavy use as compared to cowpeas and soybeans.

Comparison of crops inside and outside exclosures served as an additional measure of forage disappearance. Forages producing highest total standing crops were more available, and therefore usually experienced the most disappearance (Tables 1, 2). As a result, disappearance reflected trends based on interactions between production and utilization.

Forage Quality

Samples collected from each plot represented the forage remaining available following deer utilization at the end of each 30-day sampling interval. As a result, nutritive quality was determined for the forage remaining in each plot rather than that actually consumed during the previous 30-day period. This procedure resulted in conservative estimates of forage quality for heavily utilized varieties, since most of the recent and perhaps most nutritious growth probably was removed by white-tailed deer. Nutritive quality as evidenced by high crude protein (CP) and low acid detergent fiber (ADF) generally was best for all forages during active growth, usually the first forage sampling period (Tables 5–8) (Davis 1988).

Exceptions to these trends occurred for forages heavily utilized early in the trials. Quality indices increased as forages developed new growth after heavy utilization. This trend most noticeably occurred for forages such as alyceclover and American jointvetch, which continued to produce high quality forage in spite of heavy utilization. Similar levels of CP content were noted for alyceclover (15%–20%) by Taylor et al. (1986) and for American jointvetch (22.3% to 33.9%, and 14.9% to 20.9%, respectively) by Keegan and Johnson (1987) and Thro et al. (1987). Although quality of cowpeas and soybeans declined over time due to utilization, establishment of larger plots (Johnson 1987, Davis 1988) could have reduced total utilization.

Table 5. Mean crude protein content (%) of warm-season forages established in a Pineywoods upland site on the Easton Lake Hunting Club, Angelina Co., Texas, 1987 and 1988.[a]

	Days since planting							
	60		90		120		150	
Variety	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	13.8 BC	15.6 A	11.5 C	14.6 ABC	11.1 BC	13.4 AB		14.1 A
Iron and clay cowpea	14.1 BC	13.4 A	7.6 AB	12.7 ABC	8.0 ABC	12.7 AB		9.8 A
Whippoorwill cowpea	16.1 C		7.1 A		9.3 ABC			
Mungbean		13.5 A		11.7 AB				
Red ripper cowpea	16.3 C	15.3 A	6.6 A	18.7 C	7.3 A,B			
Catjang cowpea	13.2 BC	14.0 A	7.0 A	11.6 AB	6.1 A	14.5 AB		
American jointvetch	19.6 D	18.1 A	10.4 BC	16.8 BC	9.9 BC	15.8 B		13.1 A
Kobe lespedeza	14.3 BC	12.9 A	9.3 ABC	10.7 A	8.2 ABC	11.6 A		11.9 A
Bicolor lespedeza	12.5 B		9.0 ABC		9.8 ABC			
Japanese millet	11.1 AB	11.9 A						
Illinois bundleflower	9.5 A		7.1 A					
Crawford soybean	—	11.6 A		16.2 ABC				
Centennial soybean	—	12.2 A						
Reseeding soybean	—	9.9 A		10.5 A				

[a] Values in columns follwed by the same letter are not significantly different from each other at the $P \leq 0.05$ level, Duncan's Multiple Range Test.

Table 6. Mean crude protein content (%) of warm-season forages established in a Pineywoods bottomland site on the Eason Lake Hunting Club, Angelina Co., Texas, 1987 and 1988.[a]

	Days since planting							
	60		90		120		150	
Variety	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	12.9 B	14.5 A	15.4 DE	14.3 A	15.5 B	13.0 A		13.5 A
Iron and clay cowpea	17.3 CD	14.8 A	8.5 AB	12.7 A	5.4 A			15.7 A
Whippoorwill cowpea	16.1 C		5.9 A		5.0 A			
Mungbean		18.2 A		7.9 A				
Red ripper cowpea	17.7 CD	12.9 A	7.9 AB	13.2 A	6.1 A			
Catjang cowpea	17.0 CD	17.1 A	7.7 AB	13.1 A	5.5 A	12.2 A		
American jointvetch	20.3 D	17.8 A	18.9 E	16.6 A	18.9 C	15.9 A		11.6 A
Kobe lespedeza	15.0 BC	15.2 A	13.5 CD	17.0 A	16.9 BD	11.0 A		14.9 A
Bicolor lespedeza	10.3 AB		11.1 BCD		3.2 A			
Japanese millet	8.1 A	13.2 A						
Illinois bundleflower	11.0 AB		9.1 ABC		5.8 A			
Crawford soybean		18.7 A						
Centennial soybean		16.2 A		7.5 A				
Reseeding soybean		9.9						

[a] Values in columns followed by the same letter are not significantly different from each other at the $P \leq 0.05$ level, Duncan's Multiple Range Test.

Table 7. Mean acid detergent fiber content (%) of warm-season forages established in a Pineywoods upland site on the Eason Lake Hunting Club, Angelina County, Texas, 1987 and 1988.[a]

	Days since planting							
	60		90		120		150	
Forage	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	31.6 ABC	35.1 BC	36.5 B	33.1 A	46.0 A	36.2 A		33.9 A
Iron and clay cowpea	32.3 ABC	15.0 A	49.2 D		56.2 B	44.0 A		45.8 A
Whippoorwill cowpea	32.8 BC		47.4 D		55.2 D			
Mungbean		24.1 AB		52.5 B				
Red ripper cowpea	33.9 C	30.4 ABC	46.5 D		54.7 B			
Catjang cowpea	33.2 BC		47.2 D	54.0 B	55.6 B	33.6 A		
American jointvetch	26.5 A	27.7 ABC	42.5 CD	34.0 A	58.5 B	37.9 A		46.0 A
Kobe lespedeza	31.5 ABC	35.9 BC	37.8 BC	35.9 A	44.7 A	38.9 A		40.9 A
Bicolor lespedeza	33.0 ABC		30.7 A					
Japanese millet	41.1 D	38.1 BC						
Illinois bundleflower	27.1 AB		33.6 AB					
Crawford soybean		23.7 AB						
Centennial soybean		27.5 ABC						
Reseeding soybean		25.5 ABC						

[a]Values in columns followed by the same letter are not significantly different from each other at the $P \leq 0.05$ level, Duncan's Multiple Range Test.

Table 8. Mean acid detergent fiber content (%) of warm-season forages established in a Pineywoods bottomland site on the Eason Lake Hunting Club, Angelina County, Texas, 1987 and 1988.[a]

	Days since planting							
	60		90		120		150	
Forage	1987	1988	1987	1988	1987	1988	1987	1988
Alyceclover	36.0 BCDEF	48.5 C	34.8 AB	38.8 A	37.9 B	40.2 A		43.0 A
Iron and clay cowpea	40.1 EF		55.5 C		62.2 C			25.3 A
Whippoorwill cowpea	38.8 DEF		51.5 C		61.4 C			
Mungbean		29.3 AB						
Red ripper cowpea	38.1 CDEF		53.6 C		60.2 C			
Catjang cowpea	34.4 BCDE	26.4 A	51.6 C	40.0 A	60.8 C	36.1 A		
American jointvetch	30.1 B	35.6 ABC	31.2 AB	44.0 A	30.3 A	39.7 A		46.4 A
Kobe lespedeza	32.0 BCD	41.7 ABC	34.8 AB	38.5 A	42.6 B	38.5 A		37.9A
Bicolor lespedeza	30.3 BC		37.7 B		38.8			
Japanese millet	42.4 F	45.8 BC						
Illinois bundleflower	21.3 A		25.5 A					
Crawford soybean				42.4 A				
Centennial soybean								
Reseeding soybean								

[a] Values in columns followed by the same letter are not significantly different from each other at the $P \leq 0.05$ level, Duncan's Multiple Range Test.

Conclusions

Based on the previously stated evaluation criteria, no 1 forage was able to improve the nutritional plane of white-tailed deer throughout the year. Warm-season forages generally were more productive in bottomland sites than in upland sites, probably attributable to differing soil moisture levels among sites. This especially was true during periods of low rainfall. Warm-season forages established in May generally provided forage until October.

Based on the 4 evaluation criteria, highest rated forages were alyceclover, iron and clay cowpea, catjang cowpea, American jointvetch, and centennial soybean for the Pineywoods of east Texas.

Although we examined warm-season forages, our previous findings (Higginbotham 1991) on cool-season varieties suggest plantings of both warm- and cool-season plants offer greatest potential for improving the nutrition of white-tailed deer, especially when timed to coincide with winter and late-summer stress periods (Kroll 1991). Combinations of compatible forages within a season might decrease the risk of losing an entire forage stand due to disease, insects, or adverse climatic conditions. Furthermore, combinations can serve to effectively extend the season of forage availability. Areas planted to summer forages should be as large as possible to reduce effects of excessive browsing. We recommend planting in an evenly distributed pattern 2% of the total land area to summer forages (Higginbotham and Kroll 1991).

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