A STUDY OF 41 STRAINS OF ANNUAL LESPEDEZA WITH SPECIAL REFERENCE TO HAY AND SEED YIELDS.

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INTRODUCTION

The farmers of Oklahoma have long felt the need for a legume crop that will grow on soils of low fertility. This gap in the agricultural program of this state is rapidly being bridged by two species of annual lespedeza, Korean, Lespedeza stipulacea Maxim and common, Lespedeza striata (Thumb) H & A.

The most important lespedezas are annuals. When properly handled in their area of adaptation, they will reseed themselves each year. In so doing these annuals act much like a perennial crop from which several years growth can be obtained from one seedbed preparation and one planting. The annual lespedezas are not competitors of alfalfa or other hay and pasture legumes, but are a valuable supplement to them. They will grow on soils that will not produce alfalfa and many of the clovers, or where, for reasons not connected with soil productivity, these other legumes are not well adapted (6). On such soils the lespedezas are helping to fulfill the farmers' needs for a legume crop that will aid in erosion control, build up the soil, and at the same time yield some income in the form of hay, pasture and seed.

The value of the annual lespedezas has been recognized in the Southern States for a number of years. A rapid increase in acreage and production has occurred since the introduction of Korean into this country in 1919. This increased popularity of both Korean and common lespedeza is due primarily to their value as a hay and pasture crop, their low cost of seeding, their relative drought resistance, their tolerance of acid soils of low fertility, and their relative

freedom from diseases and insect pests. The development of larger growing varieties of common and of early and late maturing varieties of Korean has increased the use of this crop where it was already grown and has extended its range of adaptation into other states both north and west (4).

With the increase in the range of production of lespedeza, new problems have arisen. As the crop has been moved westward, moisture has become a limiting factor. As it has been moved to the north, the need for varieties that will produce and mature seed in the shorter growing season has become paramount. Kobe and Tennessee 76 are late maturing varieties of common that are adapted only in the southern areas. Some early varieties of Korean are adapted and will produce seed to the northern border of Illinois, and in some instances to the northernmost limits of the United States.

Oklahoma lies in the transitional zone between areas where the early and late varieties of lespedeza are adapted. Because of the lack of moisture, only the eastern half, and to a limited extent the central part of the state, are suited to the growth of lespedeza (8). The southern part of this section of the state in which lespedeza can be grown is climatically adapted to the late varieties. The northern section is suited, for the most part, to the growth of the earlier varieties. Either the early or late varieties may be grown, with a reasonable assurance of success, in the central part of the state.

Throughout the lespedeza growing area there is a need for better adapted and more productive varieties. In the search for improved

varieties, numerous selections differing in growth habits, maturity dates, forage and seed yields, and disease resistance have been made.

The primary objectives of these investigations have been to study the performance of 24 selections of L. stipulacea and 17 selections of L. striata under Oklahoma conditions, and to determine, in so far as possible, which of the various strains will best fulfill the needs of Oklahoma farmers.

REVIEW OF LITERATURE

There is little published information dealing directly with strain tests of lespedeza. Several articles have been reviewed which give a basic knowledge of the problem.

An average hay yield for the annual lespedezas is about 1 ton per acre, according to McKee (4). He reports that in the South, on good lands, Tennessee 76 and Kobe varieties have outyielded Korean, but that farther north Korean has yielded the most hay. The usual range of seed yields of the common, Kobe, and Tennessee 76 varieties is from 100 to 250 pounds per acre, whereas Korean yields slightly more, averaging about 300 pounds.

In tests and plantings throughout the South, Kobe has been considered superior to Tennessee 76 and common lespedeza for general use under cultivation as reported by McKee (3). He further states that, although Kobe lespedeza shatters readily when ripe resulting in smaller seed yields, it makes a more luxuriant growth than Korean and gives maximum hay yields.

Experiments were conducted in Virginia in 1932-33 by Grizzard and Hutcheson (2) to study the adaptability of Korean, Kobe, Tennessee 76, and common lespedeza to the soil and climatic conditions of that state. They report that the Korean variety is adapted to all sections of the state, but that the other varieties are not well adapted to elevations above 1500 feet. They also observed that all the varieties responded favorably to lime applications, but that there was a decidedly greater response in the case of L. stipulacea than for any of the species of L. striata.

Although under some conditions Tennessee 76, Kobe and common lespedeza may be preferable, Korean appears to be the most desirable of the annual lespedeza varieties for Illinois according to Peiper, Sears, and Bauer (5). They also report that in the north part of the state Harbin is the only commercial variety that may be expected to produce sufficient seed for reseeding.

In unpublished data from the Oklahoma Agricultural Experiment Station[1] Staten and Elder state that some of the new strains of lespedeza being tested may prove to be superior to the varieties already grown in the state. They report that one of the new strains, Climax, which was developed at the Experiment Station at Beltsville, Maryland, has been tested at many locations in the United States and has been found satisfactory in the southern sections. These data show that in 1945 at Stillwater, Oklahoma, the late Korean strains, led by Climax with 5313 pounds of air-dry hay per acre, averaged slightly over 4000 pounds while the Kobe strains averaged about 3600 pounds. In 1945 the Kobe strains at Stillwater produced more seed than the Korean selections in practically all cases.

Korean strains P.C. 31856 and 31249 yielded, respectively, 3248 and 3156 pounds of hay per acre in strain tests conducted at Experiment, Georgia in 1945[2]. The Korean check yielded 944 pounds of hay. In the same test the leading Kobe selections were P.C. 31827, 31824,

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[1] Courtesy of H. W. Staten, Professor of Agronomy and W. C. Elder, Assistant Agronomist, Oklahoma A. & M. College, Stillwater, Oklahoma.

[2] Correspondence with Julius M. Elrod, Associate Agronomist, Georgia Agricultural Experiment Station, Experiment, Georgia.

and 31840 with hay yields of 1740, 1504, and 1468 pounds, respectively. The Kobe check yielded 908 pounds of hay.

In strain tests conducted in 1947 at Columbia, Missouri[13], the hay yield of Standard Korean, which was used as a check, was evaluated at 100%. Strains F.C. 90553, 31757, 31249, and 31492 yielded 125, 119, 118, and 118%, respectively. Strain F.C. 30667-9EF, with a hay yield of 126%, was the leading selection at Columbia in 1947.

Some observations and data from various experiment stations concerning the variety tests of annual lespedezas in 1944 were obtained through correspondence with Roland McKee, Senior Agronomist, Division of Forage Crops and Disease, Beltsville, Maryland[14]. Comparative yields in pounds of green forage at Natchez, Mississippi were as follows: Climax - 8400; commercial Korean - 6000. At Lexington, Kentucky the comparative hay yields in pounds were as follows: Kobe (22896) - 7540; Climax - 5968; Late Korean (19601) - 3723; and commercial Korean (22895) - 2712. In tests at Thorsby, Alabama the comparative yields of commercial Kobe and Climax were 6460 and 6340 pounds of forage, respectively. Striking differences in the appearance of the Korean selections and commercial Korean were noted at Williamsburg, Virginia. Climax was attractive in appearance and taller in growth than the commercial strain. Climax was 2 weeks later in maturing than commercial Korean at Beltsville, Maryland, but not as late as Kobe. At Beltsville, Climax was slow in developing early

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[13] Correspondence with Joe D. Baldridge, Agronomist, Missouri Agricultural Experiment Station, Columbia, Missouri.

[14] Correspondence to H. W. Staten, Professor of Agronomy, Oklahoma A. & M. College, Stillwater, Oklahoma, dated Dec. 13, 1944.

in the season, but surpassed the commercial Korean later, indicating its value for the more southern areas and for late pasturage.

The results of several lespedeza strain tests throughout the South have indicated that several of the improved selections of annual lespedeza are superior to the commercial varieties now available. Climax, a late Korean selection, has consistently given high hay yields and in many instances has been the leading selection. Apparently it will compete with Kobe in the southern part of the region where lespedeza is grown.

MATERIALS AND METHODS

This study was conducted in 1947 on the Oklahoma Agricultural Experiment Station Agronomy Farm at Stillwater, Oklahoma in cooperation with the United States Department of Agriculture, Bureau of Plant Industry, Division of Forage Crops and Diseases. Seed of 24 strains of L. stipulacea and 17 strains of L. striata were furnished by Mr. Roland McKee, Senior Agronomist, Division of Forage Crops and Diseases, Beltsville, Maryland.

Prior to planting, the 41 strains of lespedeza listed in Table 1 were classified into early, medium, and late maturity groups. All of the strains were planted April 4, 1947 on a comparatively uniform soil that is transitional between typical Kirkland silt loam and typical Renfro very fine sandy loam. The design used for the experiment was a randomized block with 3 replications (Figure 1). The strains were randomized within the maturity groups and the maturity groups were randomized within the replications. Plantings were made in 2-row plots, 20 feet long with the rows 24 inches apart. The Kobe strains were planted at the rate of 25 pounds of seed per acre and the Korean strains at 20. The seed was planted with a Columbia drill that had the seed box replaced with a funnel. One man pushed the planter while another dropped the seed through the funnel as uniformly as possible. The seed had been weighed out in 1-row lots and inoculated prior to planting. A border row was planted adjacent to the strains at each end of the experimental plot.

During the spring months a thick crust formed on the surface of the soil as a result of frequent and heavy rains. This crust was

Figure 1.--The 1947 lespedeza strain test plots.

kept pulverized with a garden plow which also aided in the control of weeds. When it was necessary a hoe was used to keep the plots free of weeds and grass during the entire growing season.

Observations were made at intervals throughout the summer months. On August 5, and again on October 15, disease readings were taken. Each strain was rated on August 5 in regards to type of growth and plant height.

Dry weather caused all strains to begin shedding leaves about the first week in August. At that time forage yields were taken from all 41 strains. Sixteen feet from the middle of the first row of each plot were hand harvested and weighed leaving 2 feet at each end for border effect. A sample of 400 grams of the green forage from each plot was oven-dried and the percent dry matter determined. Then the yields of 20% moisture hay, in pounds per acre, were calculated.

The seed was harvested as the individual strains matured. The earliest strains were harvested on October 18 and the latest were harvested on November 12, a few days after the first killing frost. Eight feet from the middle of the second row of each plot were cut and threshed by hand. The seed was cleaned and air dried at room temperatures until December 8 when weights were taken and yields in pounds per acre were calculated.

A lespedeza strain test has been conducted for 3 years at the Oklahoma Agricultural Experiment Station at Stillwater, Oklahoma. Thirty-three strains were grown in 1945, 1946 and 1947.[15] The data for

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[15] The data for the years 1945 and 1946 were made available by H. W. Staten, Professor of Agronomy, Oklahoma A. & M. College, Stillwater, Oklahoma.

1945 and 1946 gave only the average yields obtained for those years for each strain.

Analyses of variance have been calculated for the data obtained in this experiment and also for the results obtained over the 3-year period. Statistical procedures, as outlined by Snedecor (7), were followed.

EXPERIMENTAL RESULTS AND DISCUSSION

The yield data for the 41 strains of lespedeza tested in 1947 are tabulated in Table 1. Each strain was classified according to maturity as early, medium, or late. Analyses of variance have been calculated for hay and seed yields of strains within each maturity group, for hay and seed yields of maturity groups, and for hay and seed yields of the 41 strains considered collectively.

The analyses of variance of the hay and seed yields of the 17 strains in the early maturing group are presented in Table 2. There is a highly significant difference between strains within this classification for hay and for seed yields. The mean yields were 3677 pounds of hay and 601 pounds of seed per acre. At the 1% level strain F.C. 31757 was significantly higher in hay production than the mean of the early group. Other high hay producing strains, in order of their rank, are F.C. 31480, 31850, 31854, and 31475. Strains F.C. 31850, 31002, 31493, 31818 and 31492 ranked high in seed yields in the order listed. Strain F.C. 31850, which ranked third in hay yield and first in seed yields, was the only strain to place in the top 5 strains for both phases of production.

The analyses of variance of the hay and seed yields of the 15 strains classed in the medium maturity group, are presented in Table 3. There is also significance at the 1% level between strains within this classification. The mean yields were 3713 pounds of hay and 401 pounds of seed per acre. The hay yields of strains F.C. 31856 and 31855 were significantly higher at the 1 and 5% levels, respectively, than the mean of the group (Figure 2).

Table 1.--Hay and seed yields of 41 strains of lespedeza tested at Stillwater, Oklahoma in 1947.

Early Maturity Group[1]

F.C. Number	Species	Yields in Pounds Per Acre: Hay - 20% moisture Replication I	II	III	Av.	Seed Replication I	II	III	Av.
31475	L. stipulacea	4,298	4,275	3,600	4,058	555	554	533	547
31480	"	4,223	4,145*	4,350	4,239	673	455	757	628
31492	"	3,045	2,891	2,376	2,771	974	639	558	724
31493	"	3,889	3,576	3,945	3,803	710	790	748	749
31757	"	4,725	4,433	4,230	4,463	599	533	687	606
31818	"	4,061	3,053	4,314	3,809	686	901	614	734
31819	"	3,893	3,435	3,067	3,465	803	626	526	652
31851	"	3,570	3,120	2,715	3,135	642	526	635	601
90553	"	4,388	3,953	3,488	3,943	756	272	382	470
30935	L. striata	4,268	3,503	3,536	3,769	139	202	254	198
31854	L. stipulacea	4,421	4,234	3,690	4,115	454	470	290	405
19604	"	3,518	3,446	3,019	3,328	669	528	528	575
31850	"	4,399	4,141*	4,166	4,235	737	782	857	792
31002	"	3,143	3,113	3,255	3,170	914	754*	616	761
31476	"	3,386	2,828	2,798	3,004	581	584	334	500
31478	"	4,151	3,855	3,551	3,852	625	560	568	584
31485	"	2,910	3,278	3,855	3,348	898	663	533	698
Totals for early group		66,288	61,279	59,955	3,677**	11,415	9,839	9,420	601**

Table 1.--(Continued)

Medium Maturity Group[12]

F.C. Number	Species	Yields in Pounds Per Acre							
		Hay - 20% moisture Replication				Seed Replication			
		I	II	III	Av.	I	II	III	Av.
31824	L. striata	3,446	3,158	3,544	3,383	140	191	299	210
31825	"	3,428	3,803	3,600	3,610	251	274	219	248
31834	"	3,278	3,323	3,664	3,422	239	251	275	255
31836	"	3,379	3,499	3,698	3,525	175	207	215	199
31837	"	3,840	3,705	3,480	3,675	173	269	225	222
31840	"	3,443	4,285	4,286	4,005	233	290	286	270
31845	"	3,473	3,649	3,244	3,455	186	317	212	238
31846	"	4,013	3,240	3,551	3,601	217	262	224	234
31852	"	3,570	3,533	4,343	3,815	234	436	509	393
19601	L. stipulacea	3,255	3,803	3,608	3,555	739	840	578	719
31855	"	4,320	4,313	4,538	4,390	584	695	338	539
31856	"	4,755	4,815	3,923	4,498	736	659	694	696
31481	"	2,693	2,905	3,585	3,061	388	478	274	380
31817	"	3,731	3,743	3,626	3,700	737	575	929	747
31820	"	3,428	4,020	4,545	3,998	671	544	769	661
Totals for medium group		55,794	57,235	54,052	3,713**	5,703	6,288	6,046	401**

Table 1.--(Continued).

		Late Maturity Group/3							
		Yields in Pounds Per Acre							
		Hay - 20% moisture Replication				Seed Replication			
F.C. Number	Species	I	II	III	Av.	I	II	III	Av.
31827	L. striata	3,994	3,975	3,814	3,928	244	206	227	226
31832	"	3,600	3,896	3,641	3,712	269	193	131	198
31833	"	3,735	3,660	3,806	3,734	245	243	234	241
31835	"	4,223	4,106	3,589	3,973	299	192	205	232
31858	"	3,911	3,735	3,589	3,745	260	272	277	270
31249	L. stipulacea	5,123	4,530	4,575	4,743	511	340	543	465
31853	"	4,643	4,395	3,960	4,333	439	532	614	528
30935	L. striata	3,270	3,765	3,960	3,665	235	236	283	251
31057-5	"	4,275	3,971	3,994	4,080	290	316	320	309
Totals for late group		36,774	36,033	34,928	3,990**	2,792	2,530	2,834	303**
Totals for all 41 strains/4		157,114	153,106	152,118	3,759**	19,910	18,657	18,300	462**

*Missing Plot Data Calculated according to Snedecor (7).

**Mean Yields.

/1 Significant Differences for Early Maturity Group: At 5% level-544 pounds of hay and 202 pounds of seed; at 1% level-732 pounds of hay and 272 pounds of seed.

/2 Significant differences for Medium Maturity Group: At 5% level-552 pounds of hay and 166 pounds of seed; at 1% level-744 pounds of hay and 224 pounds of seed.

/3 Significant Differences for Late Group: At 5% level-419 pounds of hay and 99 pounds of seed; at 1% level-577 pounds of hay and 137 pounds of seed.

/4 Significant Differences for the 41 strains in all Maturity Groups: At 5% level-542 pounds of hay and 173 pounds of seed; at 1% level 719 pounds of hay and 230 pounds of seed.

Table 2.--Analyses of variance of hay and seed yields of 17 early maturing lespedeza strains grown at Stillwater, Oklahoma in 1947.

Source	D.F.	Sum of Squares	Mean Squares	F value
		Hay		
Total	48	15,977,731	332,869	
Reps	2	1,312,744	656,372	6.18**
Strains	16	11,477,083	717,318	6.75**
Error	30	3,187,904	106,263	
		Seed		
Total	49	1,670,793	34,098	
Reps	2	130,184	65,092	4.43*
Strains	16	1,084,611	67,788	4.61*
Error	31	455,998	14,710	

* Significance at 5% level.

** Significance at 1% level.

Table 3.--Analyses of variance of hay and seed yields of 15 medium maturing lespedeza strains grown at Stillwater, Oklahoma in 1947.

Source	D.F.	Sum of Squares	Mean Square	F value
		Hay		
Total	44	9,449,916	214,771	
Reps	2	338,723	169,362	1.56
Strains	14	6,063,752	433,125	3.98**
Error	28	3,047,441	108,837	
		Seed		
Total	44	2,150,527	48,876	
Reps	2	11,521	5,761	0.58
Strains	14	1,862,407	133,029	13.47**
Error	28	276,599	9,879	

**Significance at 1% level.

Strains F.C. 31817, 19601, 31856, and 31820, listed in the order of their rank in seed production, exceeded the mean seed yield of the group at the 1% level. Strain F.C. 31856 was outstanding in this group for both hay and seed yields.

The analyses of variance of the hay and seed yields for the 9 strains in the late maturing group are given in Table 4 (Figure 3). There was a significant difference at the 1% level between strains within this group. Climax (F.C. 31249), with a yield of 4743 pounds per acre, was the leading strain in hay production, followed by strain F.C. 31853 which yielded 4333 pounds. The same 2 strains, in reverse order, ranked first and second in seed yields. The mean yields for the group were 3990 pounds of hay and 303 pounds of seed. The mean hay yield, plus or minus the least significant difference at either the 5 or 1% levels, provides a range that includes all of the strains except Climax. The seed yield of 2 strains, F.C. 31853 and Climax, exceeded the mean of the group at the 1% level.

The 3 maturity groups, as classified in Table 1, were analyzed as units to provide a general comparison of early strains with the medium and with the late strains. These analyses of variance are presented in Table 5. There was no significant difference between groups for hay yields, but there was a highly significant difference for seed yields. The mean hay yield was highest for the late group and lowest for the early group. The mean seed yield was highest for the early group and lowest for the late group.

The hay and seed yield data for the 41 strains included in this experiment have been analyzed as a unit to determine which individual strains are best adapted to this locality. In drawing conclusions

Figure 2.--Some of the medium maturing strains with F.C. 31855 in the center foreground.

Table 4.--Analyses of variance of hay and seed yields of 9 late maturing lespedeza strains grown at Stillwater, Oklahoma in 1947.

Source	D.F.	Sum of Squares	Mean Square	F value
		Hay		
Total	26	4,142,722	159,335	
Reps	2	192,771	95,886	1.64
Strains	8	3,014,006	376,751	6.43**
Error	16	936,945	58,559	
		Seed		
Total	26	378,666	14,564	
Reps	2	6,031	3,016	0.92
Strains	8	320,155	40,019	12.2 **
Error	16	52,480	3,280	

*Significance at 5% level.

**Significance at 1% level.

Figure 3.--Some of the late maturing strains.

Table 5.--Analyses of variance of hay and seed yields of 3 maturity groups of lespedeza grown at Stillwater, Oklahoma in 1947.

Source	D.F.	Sum of Squares	Mean Squares	F value
		Hay		
Total	8	3,725,626		
Reps	2	341,466	183,233	0.49
Maturity Groups	2	1,882,387	941,194	2.51
Error	4	1,501,773	375,443	
		Seed		
Total	8	1,998,479		
Reps	2	34,874	17,437	0.62
Maturity Groups	2	1,850,743	925,372	32.8**
Error	4	112,862	28,216	

**Significance at 1% level.

from these analyses the limitations of the experimental design should be recognized. Even though the individual strains were randomized within their respective maturity groups and the maturity groups were randomized in the replications, the individual strains are confounded with their maturity groups. It is felt, however, that such an analysis is justified, especially since there was no significant difference between maturity groups for hay yields.

The analyses of variance of the hay and seed yields of the 41 strains are shown in Table 6. The F value for the hay yields indicates a significant difference at the 1% level between strains. Climax, which was the leading strain in hay production, yielded 1972 pounds per acre more than the lowest yielding strain (Figure 4). The mean hay yield was 3759 pounds per acre. The hay yield of 2 strains, Climax and P.C. 31856, exceeded the mean at the 1% level. The hay yields of 3 other strains, P.C. 31757, 31855, and 31853, listed in order of their rank, were significantly higher at the 5% level than the mean.

The analysis of variance of the seed yields for the 41 strains reveals a significant difference at the 1% level (Table 6). In general the Korean selections produced more seed than the Kobe selections. The mean seed yield for the experiment was 462 pounds per acre, which was 69 pounds more than the leading Kobe strain produced. Nine Korean selections produced significantly more seed at the 1% level than the mean of the experiment. Rated on the basis of seed production, the 5 leading strains in descending order are P.C. 31850, 31002, 31493, 31817, and 31818.

Table 6.--Analyses of variance of hay and seed yields of 41 strains of lespedeza grown at Stillwater, Oklahoma in 1947.

Source	D.F.	Sums of Squares	Mean Squares	F value
		Hay		
Total	120	31,452,757	262,106	
Reps	2	341,466	170,733	1.54
Strains	40	22,437,229	560,931	5.04**
Error	78	8,674,062	111,206	
		Seed		
Total	121	6,050,729		
Reps	2	34,874	17,437	1.53
Strains	40	512,227	127,806	11.17**
Error	79	903,628	11,438	

*Significance at 5% level.

**Significance at 1% level.

Figure 4.--Climax (F.C. 31249), a consistent high hay yielding selection at Stillwater, Oklahoma.

The average hay and seed yields for the 33 strains tested for 3 years (1945-1947) are tabulated in Table 7. Climax produced the most hay in 2 of the 3 years and ranked first for the period. Strain F.C. 90553 yielded the most hay in 1946 and ranked second for the period. The other 31 strains are listed in the table in descending order with respect to their 3-year average hay yields. The mean hay yield for the 3 years was 3420 pounds per acre. The average hay yield of Climax was significantly higher at the 1% level than the mean. The hay yields of 2 other strains, F.C. 90553 and 31855, were significantly higher at the 5% level than the mean. Only 1 Kobe selection, F.C. 31852, with an average hay yield of 3521 pounds per acre, was better than the mean of the 33 strains. These data indicate that the L. stipulacea selections are better adapted to this locality than the strains of L. striata.

The 5 leading strains, listed in descending order on the basis of their 3-year average seed yields, are F.C. 31820, 31817, 31818, 31835 and 31853 (Table 7). Strain F.C. 90553 was lowest in seed yield with an average of 361 pounds per acre. The mean yield of the 33 strains tested over the 3-year period was 563 pounds. With respect to seed yield, there was no significant difference between strains for the 3-year period. In 1947, when the seasonal conditions were not favorable for the late strains, the earlier selections produced the most seed. In 1945 the seasonal conditions were such that the late strains outyielded the earlier selections. Even though the data in Table 6 shows high significance between strains for seed yields in 1947, the results of 3 years of testing (Table 7) indicate that no individual strain is significantly better than the other 32 in the

Table 7.—Average hay* and seed yields in pounds per acre of 33 strains of annual lespedeza grown at Stillwater, Oklahoma years 1945, 1946 and 1947.

Strain No.	1945		1946		1947		3 year av.	
	Hay	Seed	Hay	Seed	Hay	Seed	Hay	Seed
31249	5,313	856	2,632	385	4,743	465	4,229	569
90553	5,005	436	3,168	176	3,943	470	4,039	361
31855	5,007	695	2,642	288	4,390	539	4,013	507
31757	4,528	933	2,730	232	4,463	606	3,907	590
31856	4,751	609	2,394	115	4,498	696	3,881	473
31493	4,826	734	2,718	305	3,803	749	3,782	596
31480	4,478	743	2,556	305	4,239	628	3,758	559
31853	4,304	1,125	2,582	358	4,333	528	3,740	670
31475	4,525	469	2,376	185	4,058	547	3,653	400
31817	4,757	1,001	2,134	275	3,700	747	3,530	674
31852	4,292	944	2,456	270	3,815	393	3,521	536
31827	3,979	1,141	2,646	411	3,928	226	3,518	593
19601	4,337	747	2,478	170	3,555	719	3,457	545
31818	4,011	1,008	2,472	270	3,809	734	3,431	671
31840	3,903	1,174	2,334	545	4,005	270	3,414	663
31832	3,849	979	2,616	426	3,712	198	3,392	534
31820	3,701	974	2,394	425	3,998	661	3,364	687
31854	3,644	858	2,328	185	4,115	405	3,362	483
31492	4,511	955	2,736	228	2,771	724	3,339	636
31851	4,267	882	2,496	373	3,135	601	3,299	619
31819	4,029	903	2,358	208	3,465	652	3,284	588
31835	3,540	1,221	2,268	561	3,973	232	3,260	671
30935	3,589	875	2,358	392	3,769	251	3,239	506
31858	3,798	936	2,100	300	3,745	270	3,214	502
31834	3,851	1,013	2,256	458	3,422	255	3,176	575
31846	3,621	826	2,190	373	3,601	268	3,137	489
31825	3,279	964	2,514	428	3,610	248	3,134	547
31837	3,010	1,069	2,386	480	3,675	222	3,024	590
31833	3,073	1,166	2,250	540	3,734	241	3,019	649
31481	4,109	633	1,842	247	3,061	380	3,004	420
31824	3,550	1,029	2,004	458	3,383	210	2,979	566
31836	3,126	926	2,154	401	3,525	199	2,935	509
31845	2,975	1,044	2,172	476	3,455	238	2,867	586
Means	4,047	884	2,416	341	3,801	442	3,420	563

*The hay yields are based on 20% moisture hay.

Significant Differences: Hay - 591 pounds at 5% level and 785 pounds at 1% level; Seed - none.

production of seed. It is felt that further tests are necessary before definite conclusions can be made. If future investigations support the results obtained in the past 3 years, it may be possible to make recommendations on the basis of hay yields alone.

Lespedeza in Oklahoma has been considered to be practically free of disease, however, some of the strains tested in 1947 were severely damaged by bacterial wilt. In the spring months dark water-soaked spots were observed on the leaflets, but very little total damage occurred at that time. During the mid-summer drought the amount of damage became much greater and the symptoms corresponded very closely with those described for bacterial wilt (1). At this time small areas of plants turned brown and died. Diseased plant specimen were collected in the fall and sent to the Division of Forage Crops and Diseases at Beltsville, Maryland. Three different organisms were reported to be present. The bacterial wilt organism was found on the green plants; the charcoal rot organism was found on the dead plants; and what appeared to be Rhizoctonia mycelium was found on both the green and the dead plants[16]. It is beleived that most of the damage to the 1947 plantings of lespedeza in this experiment was caused by bacterial wilt[17]. Since no previous report of bacterial wilt on lespedeza in Oklahoma could be found in the literature, this is perhaps the first time it has been observed in the state.

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16 Correspondence with Dr. C. L. Lefebure, Pathologist, U.S.D.A., Division of Forage Crops and Diseases, Beltsville, Maryland.

17 Field plantings were examined by Dr. Harvey McLaughlin, Assistant Pathologist, Oklahoma A. & M. College, Stillwater, Oklahoma.

Observations that were made during the season in regards to disease damage, height of plants, type of growth, and maturity dates are recorded in Table 8. Disease readings were taken on August 5 and on October 15 and a relative index for each strain on each date was determined. Each plot of each replication was evaluated separately, based on the relative amount of damage from all disease. The ratings were as follows: 0 indicated no visible damage, 1 slight damage, 2 moderate damage, and 3 heavy damage. The numerical ratings for all 3 replications were then combined to give a disease index for each strain. These indexes are an estimate of the relative amount of damage in evidence on each strain at the time the observations were made, taking into consideration the visible damage from all diseases that were present. The Kobe strains F.C. 31834, 31827 and 31833 each had an index of 0 on both dates, whereas, no Korean selection had an index of 0 on either date. Strain F.C. 31853, with an index of 1 for both observations, showed less damage than any other Korean selection. The strains that were most severly damaged were F.C. 31476, 31817, 31820, and 19604. In this experiment the Korean strains were more severely affected than the Kobe strains. On August 5 the mean index was 4.79 for the 24 Korean strains and 1.0 for the 17 Kobe strains. On October 15 the mean index was 5.29 for the Korean selections and 1.53 for the Kobe selections. Bacterial wilt is seed borne (1) and since it is not known whether or not the seed of all the strains was equally infested, no conclusions in regard to the resistance of strains or of the 2 species can be made.

Each strain was rated on August 5, at the time of forage harvest, in regard to type of growth and plant height. The growth habit of

Table 8.--Observations on disease damage, plant height, growth habit, and maturity dates of 41 strains of lespedeza grown at Stillwater, Oklahoma in 1947.

F.C. Number	Source of Selection	Disease Index* Aug. 5	Disease Index* Oct.15	Average Hgt. in in. Aug.5	Growth Habit**	Maturity Date***
31475	Korean	6	7	5	4	Oct. 18
31480	Korean	4	5	6	3	Oct. 18
31492	Korean	6	6	5	4	Oct. 23
31493	Korean	4	7	6	3	Oct. 18
31757	Korean	4	4	8	2	Oct. 23
31818	Korean	5	5	8	2	Oct. 23
31819	Korean	4	6	7	3	Oct. 23
31851	Korean	4	3	6	4	Oct. 23
90553	Korean	5	5	6	4	Oct. 18
30935	Kobe	2	3	7	2	Nov. 12
31854	Korean	4	1	8	2	Nov. 12
19604	Korean	7	7	7	3	Oct. 18
31850	Korean	4	3	6	4	Oct. 23
31002	Korean	3	7	5	4	Oct. 18
31476	Korean	8	9	5	4	Oct. 18
31478	Korean	6	8	5	4	Oct. 18
31485	Korean	5	6	6	3	Oct. 23
31824	Kobe	1	4	9	1	Nov. 12
31825	Kobe	2	3	9	1	Nov. 12
31834	Kobe	0	0	9	1	Nov. 12
31836	Kobe	1	0	8	1	Nov. 12
31837	Kobe	1	0	9	1	Nov. 12

Table 8.--(Continued).

F.C. Number	Source of Selection	Disease Aug. 5	Index* Oct.15	Average Hgt. in in. Aug.5	Growth Habit**	Maturity Date***
31840	Kobe	0	1	9	1	Nov. 12
31845	Kobe	1	1	8	2	Nov. 12
31846	Kobe	1	0	8	1	Nov. 12
31852	Kobe	2	4	7	2	Oct. 31
19601	Korean	5	7	5	4	Oct. 24
31855	Korean	3	3	9	2	Oct. 31
31856	Korean	3	3	10	2	Oct. 31
31481	Korean	5	5	5	4	Nov. 12
31817	Korean	8	7	6	3	Oct. 24
31820	Korean	8	8	7	3	Oct. 24
31827	Kobe	0	0	10	1	Nov. 12
31832	Kobe	0	1	10	1	Nov. 12
31833	Kobe	0	0	10	1	Nov. 12
31835	Kobe	2	1	8	1	Nov. 12
31858	Kobe	2	3	8	2	Nov. 12
31249	Korean	3	4	9	2	Oct. 31
31853	Korean	1	1	11	2	Nov. 12
30935	Kobe	1	2	6	3	Nov. 12
31057-5	Kobe	1	3	9	1	Oct. 31

*Relative rating 0-9 inclusive, the higher the number the greater the damage.

**Growth habit: 1 - erect, 2 - Medium erect, 3 - Medium decumbent, 4 - Decumbent.

***Based on date seed were ready to harvest.

each strain was evaluated numerically on the following basis: 1 erect, 2 medium erect, 3 medium decumbent, and 4 decumbent. The plant height, which was taken as an average of the actual measurements of each strain in each replication, is expressed in inches.

There was considerable variability among the 41 strains in regard to plant height and type of growth (Table 8). Both are somewhat related and are more or less dependent upon the thickness of the plantings. If the plants are sparse they tend to spread and fill in the space with a more prostrate type growth. If the plants are thick, the tendency is towards a taller and more erect growth. Strain F.C. 90553 made a heavy decumbent growth even where the plants were thick. In general the late strains tested grew more erect than did the earlier strains. The 5 highest hay yielding strains in the test (Table 1) were either erect or medium erect in growth habit. There was no definite correlation between plant height and hay yields, as strains F.C. 31757 and 31853, with average heights of 8 and 11 inches, respectively, yielded 4463 and 4333 pounds of hay, respectively.

SUMMARY

This experiment was conducted in 1947 on the Oklahoma Agricultural Experiment Station Agronomy Farm at Stillwater, Oklahoma, in order to compare the hay and seed yields of 41 strains of annual lespedeza.

The data presented in this paper includes the results of the 1947 strain test in detail and the average yields of 33 strains for the years 1945-47 inclusive. Only limited conclusions, which may be altered by future results can be made. The data show the following:

1. There were significant differences at the 1% level for strains within the early, medium, and late maturity groups for both hay and seed yields in 1947.

2. In 1947, there was no significant difference between maturity groups for hay yields, but there was a significant difference at the 1% level for seed yields.

3. When the 41 strains were considered collectively there were significant differences at the 1% level for both hay and seed yields in 1947.

4. There was a significant difference at the 1% level between hay yields of the 33 strains tested over the 3-year period, but there was no significant difference between seed yields.

5. Climax, strain F.C. 31249, yielded the most hay in 1945, 1947, and also over the 3-year period.

6. From the standpoint of hay yields, the 8 leading strains in 1947 and the 10 leading strains over the 3-year period, were selections from the Korean variety.

7. Over the 3-year period, strain F.C. 31852 led the Kobe strains in hay yields. Strain F.C. 31057-5, which has been tested but 1 year, led the 17 Kobe selections in hay production in 1947.

8. All strains produced more than enough seed required to reseed themselves in every case.

9. Since the data for the 3 years show no significant difference between strains for seed yields, the possibility of making recommendations for this locality on the basis of hay yields alone is presented.

10. The Kobe selections in this test suffered less damage from disease than did the Korean selections.

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