RESPONSE OF PARTRIDGEPEA TO SOIL FACTORS

By E. S. NIXON

Biology Department, Stephen F. Austin State University, Nacogdoches, Texas

and

L. K. HALLS

Wildlife Habitat and Silviculture Laboratory, Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture, Nacogdoches, Texas [1]

Showy partridgepea (*Cassia fasciculata* Michx.) and sensitive partridgepea (*Cassia nictitans* L.) are annual legumes widely distributed in the central and southeastern United States. They are important sources of food for wildlife in the South, particularly bobwhite quail and wild turkey. Showy partridgepea has recently been emphasized as a soil stabilizer and a possible forage or hay crop because it grows rapidly on a wide variety of soil types, many of which are nutritionally deficient (Foote and Jackobs, 1966a, 1966b and 1966c).

Both species occur mainly on sandy soils. They appear to be excluded from the more calcareous soils, especially those of the Texas Blackland Prairie which extend in a north-south direction contiguous with the sandy soils of east Texas (Reeves and Bain, 1947; Shinners, 1958; Turner, 1959).

This study was conducted with soil-filled pots in a greenhouse at the Stephen F. Austin Experimental Forest near Nacogdoches, Texas.

Its purpose was to measure plant growth response on acid and calcareous soils in order to find if soil factors influence the distribution and yield of these legumes.

There are several varieties of each species but in this study we used the typical variety of both species and the robust variety of showy partridgepea (*C. f.* var. *robusta* (Poll.) Macbride).

The selected soil types were:

Houston clay loam: This Blackland Prairie soil, collected near Dallas, Texas is calcareous, basic, and has good structure. Native vegetation consisted of sideoats grama (*Bouteloua curtipendula* (Michx.) Torr.), buffalo grass (*Buchloe dactyloides* (Nutt.) Engelm.), threeawns (*Aristida* spp.) and interspersed forbs and other grasses.

Kalmia fine sandy loam: This soil, collected near Nacogdoches, Texas, is deep, moderately well-drained, and medium to strongly acid. It occurs on terraces along streams in the southern Coastal Plain. The natural vegetation was mainly pines—longleaf (*Pinus palustris* Mill.), shortleaf (*P. echinata* Mill.), and loblolly (*P. taeda* L.), with a few oaks (*Quercus* spp.), sweetgum (*Liquidambar styraciflua* L.), and blackgum (*Nyssa sylvatica* Marsh.).

Two collections were made of Kalmia soil, one from an old abandoned field and the other from beneath a natural stand of pine-hardwood trees.

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1 The laboratory is maintained at Nacogdoches, Texas, by the Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture, in cooperation with Stephen F. Austin State University.

TABLE 1.—Analyses of Houston, Kalmia, Rains and Tifton Soils

Soil type	pH	Organic matter	Ca	P	K	Soluble salts	Mg
		Percent			kg/ha		
Houston clay loam	7.7	1.1	5,606+	17	357	1,192	45
Kalmia fine sandy loam							
Forest	5.2	1.6	2,601	12	156	1,695	359
Old field	6.3	0.6	2,152	5	145	1,789	291
Rains fine sandy loam	4.8	1.7	382	36	145	1,663	11
Tifton fine sandy loam	4.8	2.7	852	12	111	1,130	168

TABLE 2.—Germination of partridgepea seeds

Treatment	Sensitive partridgepea	Showy partridgepea
	Percent	Percent
Unscarified seeds		
Filter paper	23.0	2.5
Houston clay loam	9.0	3.0
Kalmia fine sandy loam	4.5	3.5
Scarified seeds		
Filter paper	99.5	61.0
Houston clay loam	94.5	39.0
Kalmia fine sandy loam	81.0	21.0

Rains fine sandy loam: This soil, collected near Bay Minette, Alabama, is deep, poorly drained, and strongly acid. It occurs in the Coastal Plain in seep areas at the base of slopes and in slight depressions along drainages. Natural vegetation consisted of pitcher plants (*Sarracenia* spp.), sedges (*Carex* spp.), grasses, cypress (*Taxodium* spp.), blackgum, slash pine (*Pinus elliottii* Engelm.), and pond pine (*P. serotina* Michx.).

Tifton fine sandy loam: This soil, also collected near Bay Minette, is a deep, well-drained, strongly acid, upland soil that is now largely in cultivation and pastures. Natural vegetation was longleaf and shortleaf pines, flowering dogwood (*Cornus florida* L.) and several oaks.

PROCEDURES

Showy partridgepea and sensitive partridgepea seeds were collected from south Georgia [2] and seeds from the robust variety of partridgepea at Stephen F. Austin Experimental Forest near Nacogdoches, Texas in the fall of 1966. They were stored in dry containers at room temperature. Seeds from each collection were planted in mid-February 1967 in 8-inch pots lined with plastic bags and containing soil from the uppermost 8 inches of each soil type. Plants were grown, one to a pot, for each soil type and treatment. For the Houston clay loam soil this included pots with a normal soil, with iron (Fe), and with iron plus phosphorus (P) added. For Kalmia, both old field and forest soils were included. There were 8 replicates of treatments for showy and sensitive partridgepea and six for the robust variety of showy partridgepea.

Plants were watered as needed with distilled water. Data obtained included height of plants and number of branches and flowers.

Soils were analyzed for acidity (pH), calcium (Ca), organic matter, phosphorus (P), potassium (K), soluble salts, and magnesium (Mg) by the Stephen F. Austin State University soil testing laboratory.

Seed germination was tested in February 1967 on filter paper, and on the Houston and Kalmia (forest) soils with scarified (mechanical nicking of seedcoat) and non-scarified samples of 200 seeds each. Germination counts were made periodically to 30 days after seeds were placed on germinating mediums. Germination percentages were calculated from this data.

Data were subjected to an analysis of variance with treatment comparisons tested by the method of Scheffé at the .05 level of significance.

RESULTS AND DISCUSSION

Soil Analyses

The soils exhibited wide differences in the various attributes tested (Table 1). Among the more obvious were the very high Ca and high pH and K levels of the Houston clay loam, the relatively high Ca and Mg levels of both forest and old field Kalmia soils, and the low pH and low to medium levels of Ca and Mg of the Rains and Tifton soils.

Seed Germination

Scarified seeds of sensitive partridgepea germinated very quickly on filter paper. Seventeen seeds had germinated within 17 hours after initiation of the germination experiment. Forty hours after initiation 193 of 200 seeds had germinated. Showy partridgepea seeds followed this same pattern but germination percentages were much lower. For both species the scarified seeds germinated from 2 to 3 days quicker than unscarified seeds. Germination percentages for sensitive partridgepea seeds were significantly higher than for showy partridgepea, however, germination of unscarified seeds in soil was very low for both species (Table 2).

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[2] Carroll Perkins, International Paper Co., Bainbridge, Georgia furnished seed for these species.

Even though the 23 percent germination for unscarified seeds of sensitive partridgepea on filter paper indicates a fairly good inherent germination, the very low percentages on soil indicates that its chances are poor for ready germination in the field.

The results of this study suggest that if the seeds are collected in the fall and dry stored over winter they would need scarifying by some means if good stands are to be artificially established quickly as a source of food for game birds. The needs for seed scarification of both species has likewise been demonstrated by Cushwa, *et al.* (1968).

Growth Response

As evidenced by a greater height and number of branches and flowers, plant growth was generally best on the Kalmia soils (Table 3). A possible explanation for this better growth is the combination of a high Ca and Mg content on both the old field and forest collections of Kalmia soils.

Plants of the robust variety of showy partridgepea were significantly smaller and had fewer flowers on the Rains and Tifton soils than on the Kalmia soils. The same general relation held true for the other species although the differences were not always significant. The less favorable growing conditions were possibly a reflection of the medium to low Ca, Mg, and low pH of these soils.

Plant height was significantly less on the Houston soil in comparison to the Kalmia soils. A stunted growth was noted fairly early in the ontogeny of plants grown on this calcareous soil. Young leaves were chlorotic, particularly those of sensitive partridgepea, indicating the possibility of a mineral deficiency. The chlorosis, however, was not relieved by addition of Fe and Fe + P. A similar lack of response to Fe and P additions on blackland soils has been noted for *Lupinus subcarnosus* L. by Nixon (1964).

Reasons why plants grew poorly on the Houston soil are merely speculative but the obvious factors that distinguish it from other soils is the high pH and wide Ca to Mg ratio. It seems likely that the exclusion of these species from the Texas Blackland Prairie soil is due to an inherent characteristic of the soil rather than to its geographic location.

Our findings generally support other literature (Fernald, 1950) that showy partridgepea grows best on sandy textured soils but they differ with Foote and Jackobs (1966c) who state that its greatest occurrence is on silty clay loam soils. However, they worked with a northern strain which may have responded differently to edaphic factors.

All plants were precocious in their flowering. Most of them started flowering in April and May, well ahead of their normal flowering dates of late summer. It is thought that greenhouse conditions likely influenced the number of flowers, flowering dates, and fruit formation. Although no scheduled checks were maintained on the outside it was generally observed that plants growing under natural conditions were more productive of flowers and fruits than those in the greenhouse.

The flowering of sensitive partridgepea appeared to be particularly abnormal thus no comparison is made between it and showy partridgepea. In comparing the typical with the robust variety of showy partridgepea the latter made a significantly greater height growth and produced more flowers on all soils. Since the flowers are indicative of potential seed yields it is inferred that the robust variety would be more practical than the typical variety for wildlife food seedings on soils represented in this study.

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TABLE 3. Growth response of partridgepea

SOIL TYPE	Sensitive partridgepea (typical variety)			Showy partridgepa (typical variety)			Showy partridgepa (robust variety)		
	Plant Height	Branches	Flowers	Plant Height	Branches	Flowers	Plant Height	Branches	Flowers
	Cm	Number	Number	Cm	Number	Number	Cm	Number	Number
Kalmia fine sandy loam									
Forest	39.6a	5.1a	2.3*	47.4a	3.8ab	5.9b	73.5a	0.8*	52.8a
Old field	33.1a	7.8a	2.1	43.6a	7.7a	22.7a	67.5a	2.8	64.3a
Rains fine sandy loam	21.3ab	0.0b	1.3	35.0ab	1.3b	4.6b	56.2b	0.0	39.2b
Tifton fine sandy loam	23.9ab	3.9ab	3.3	33.5ab	5.8ab	2.7b	44.2b	0.0	30.4b
Houston clay loam									
Normal	13.0b	1.5b	1.4	25.5b	0.1b	3.6b	36.8b	0.0	8.8c
Fe added	16.2b	0.5b	0.6	25.8b	0.3b	2.5b			
Fe + P added	18.9b	1.4b	2.9	24.7b	1.0b	4.3b			

Treatments followed by a common letter are not different at the .05 level of significance.
* No significant difference among these.