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Legume Response Unrelated to Fuel Moisture at Time of Burning

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Highlight: *The response of sensitive partridgepea and other legumes was unrelated to moisture content of fuels at the time a slash pine stand was burned.*

Controlled burning in the Southeast causes certain herbaceous species to increase in number. Some of these "fire followers," particularly legumes, are beneficial to wildlife, and periodic burning is commonly used to perpetuate them.

It has been suggested that moisture and heat generated during a fire are scarifying forces capable of increasing the germination of wild sensitive partridgepea (*Cassia nictitans* L.) (Stoddard, 1931; Martin and Cushwa, 1966), and possibly other important legumes. Under laboratory conditions, Martin and Cushwa (1966) demonstrated that moist heat increased the germination of sensitive partridgepea by softening the mucilaginous layer on the seed coat. They speculated that since water is one of the main products of thermal degradation and combustion and because burning is normally done in pine stands when the lower litter layer is quite damp, moist heat from either of these sources would be available to soften the coats of seeds which were incorporated within the litter and upper soil layer.

If the fuel moisture content of the litter at time of burning is an important factor in the regeneration of legumes, this factor might explain some of the variability associated with the occurrence of mature plants following field burning. This study sought to find whether the moisture content of the fuel at time of burning would affect the subsequent density of legumes in a stand of pine.

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Study Area and Methods

The study was conducted in a 50-year-old stand of slash pine (*Pinus elliottii* Engelm) at International Paper Company's Southlands Experimental Forest in south Georgia. Tree spacing was relatively wide; basal area averaged 50 ft^2 per acre. A 2-year-old accumulation of litter and vegetative fuels ranged in weight from 4.1 to 5.1 tons per acre (Fig. 1).

A randomized split-plot design with three replications was used to test the effects of three fuel moisture conditions: "wet"–dry surface fuels and wet subfuels; "dry"–dry surface and dry subfuels; and "intermediate"–dry surface fuels and moist subfuels. Treatment plots were 100 X 200 ft; each contained two 50 X 50 foot subplots, 50 ft apart, centrally located along the long axis of the main plot. All plots were protected by disced firelines.

Prior to burning, legume seeds and litter were sampled on all plots. Estimates of pretreatment seeds were made according to procedures described by Ripley and Perkins (1965). Analysis indicated that there was no significant difference in numbers of pretreatment seed among blocks or treatment plots. One randomly selected subplot in each treatment plot was then broadcast seeded to sensitive partridgepea at the rate of 4.4 pounds of unscarified seed per acre. Litter samples collected from ten 1-ft^2 quadrats per plot were weighed, ovendried for 24 hours at 90° C, reweighed, and the fuel

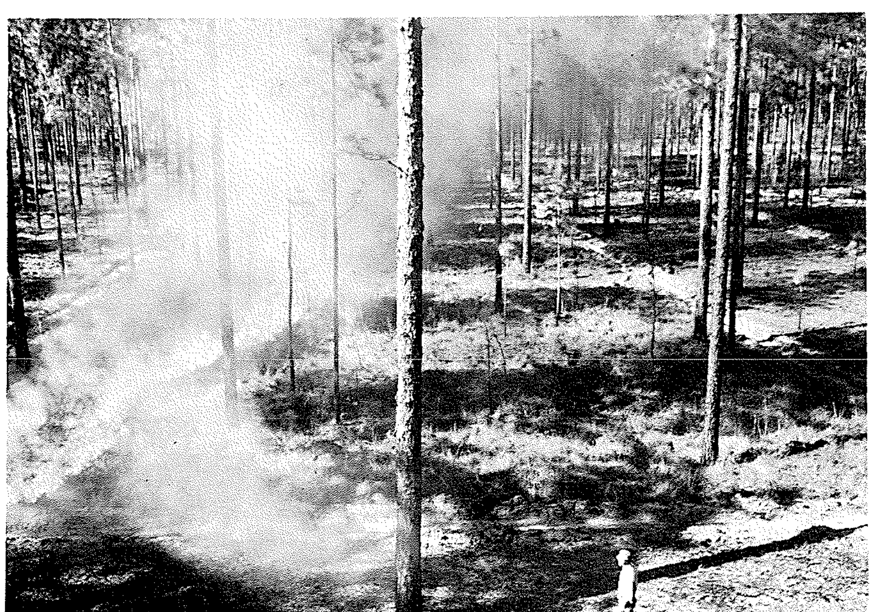

Fig. 1. *Intermediate burn in south Georgia pinelands.*

Table 1. Rate of fire spread and temperatures generated at the soil surface under three burning conditions.

Burns	Burning conditions: Fuel moisture (%)	Ambient temp. (°F)	Wind speed (MPH)	Relative humidity (%)	National fire danger rating: Spread	Buildup	Rate of fire spread (ft/sec.)	Temperature generated at the soil surface (°F)
Wet	31.9	70	13-18	73	17	25	0.7	200-300
Intermediate	15.8	60	8-12	41	19	30	0.9	275-375
Dry	7.2	73	8-12	25	19	35	1.1	350-450

moisture computed. Rate of fire spread was estimated by placing firecrackers 10 ft apart in the direction of anticipated fire movement and timing the interval between explosions. Soil temperatures during burning were recorded with a complete range of temperature-indicating pyrometric material (Tempil) placed on the soil surface in the center of each quarter of each treatment plot. Ambient temperature and relative humidity were measured as each plot was ignited.

Initial burns, under "wet" conditions, were conducted 8 hours after the passage of a cold front which deposited 0.16 inch of rain. Fuel moisture conditions for the "intermediate" and "dry" burns occurred 2 days later, in the morning and afternoon, respectively. Headfires were used, and all plots receiving the same treatment were ignited simultaneously.

Legumes were counted the following summer on 10 randomly located 9.6-ft^2 samples on each subplot. Data were subjected to analysis of variance and significance tests at the 90% probability level.

Results and Discussion

Rate of fire spread was directly related to wind speed and inversely related to fuel moisture content. Temperatures generated at the soil surface by fires were also inversely related to fuel moisture content and relative humidity (Table 1). Fuel consumption was greatest when the moisture content of the fuels was less than 16%. When fuel moisture contents exceeded 30%, coarse fuels such as pine cones and branches were only scorched and pine straw beneath these fuels was left unburned.

Although distinctly different burns were obtained, legume responses were not correspondingly different. The number of sensitive partridgepea plants and other leguminous species did not differ significantly between treatments (Table 2). Plant numbers were not increased by the broadcast seeding of unscarified partridgepea seed.

Table 2. Average number of leguminous plants (per 9.6 ft^2) after burning with three different conditions of fuel moisture.

Species	Burns: Wet	Intermediate	Dry
Cassia nictitans L.	2.4	1.6	2.6
Lespedeza spp.	2.5	1.5	2.0
Desmodium spp.	1.1	0.5	0.5
Shrankia uncinata Willd.	0.4	0.3	0.1
Rhynchosia spp.	0.8	0.6	0.7
Other	0.2	1.0	0.0
Total	7.4	5.5	5.9

Fuel moisture contents under a range of field burning conditions directly influenced the time-temperature exposure of seed at the soil surface. Calculations indicate that field burning produced conditions which were similar to those which increased the germination of partridgepea seed in previous laboratory work. While we did not measure germination, our treatments did not affect the number of mature legumes 6 months after treatment.

The lack of plant response, even when partridgepea seeds were sown in conjunction with our treatment, suggests some limiting factor within the environment or some competitive interaction among or between plants which limits overall population size. The study did not define the nature of this factor or interaction, but it did show the need for more detailed observations following fire to isolate those components which determine the population size of mature legumes.

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