Fire Stimulated Germination

effect of burning on germination of brush seed investigated in physiological study of chamise

Edward C. Stone and Gustaf Juhren

The successful use of fire to convert brush areas to agricultural uses is often dependent upon the prevention of subsequent establishment of brush from seed.

If subsequent establishment is to be prevented an understanding of the germination behavior of the seed is necessary. This article reports on the germination behavior of chamise seed—one of the important brush species in the State.

Since the viable seed stored in the duff —leaves and other decomposing vegetative matter covering the ground beneath the plant—is the seed that produces the seedling crop, first consideration was given to its behavior. This seed was collected by running large samples of duff through a clipper-type seed separator using various speed and screen combinations.

The total number of seeds per square foot stored in the duff was found to be extremely variable, even under what was apparently uniformly dense stands of chamise; within the same area some samples contained only 500 seeds per square foot, while others contained as many as 30,000 per square foot. The proportion of this stored seed that was filled—seed containing embryo and endosperm—was very low, ranging from 0% to 4%.

When samples of the duff-stored seed were planted in flats and allowed to germinate without any additional treatment, some germination took place. However, if a 1" layer of excelsior was burned over the planted seed, or if the seed was previously heated in an oven for five minutes at 212°F an eight-fold increase in germination occurred. This indicated that there were two physiologically distinct types of seed in the duff. One type germinated readily without any preliminary heat treatment; while the other type germinated only after it had received such a treatment.

Per Cent of Viable Seed Germinating under Various Treatments

Series No.	Seed gathered from the duff in an old stand			Seed gathered from the plant			
	No treatment (control)	1" layer of excelsior burned over seed after planting in sand	5 min. exposure in 212°F oven before planting	No treatment (control)	5 min. exposure in 212°F oven before planting	Seed pre-germinated 60 days and then replanted	Seed pre-germinated 60 days and then exposed for 5 min. in 212°F oven before replanting
1	12	88	74	78	63	5	22
2	7	93	80	82	71	11	18
3	11	89	90	70	68	7	30
4	20	80	88	87	80	4	13
5	5	95	85	70	68	7	30
Average	11	89	83	77	70	7	23

When seed was collected directly from the plant, only the first type of seed appeared to be present; germination took place readily without any apparent stimulus from a preliminary heat treatment. This presented the problem of explaining the origin of the high proportion of seed in the duff which required a preliminary heat treatment for germination. Two possibilities suggested themselves.

The first to be examined was that a germination inhibitor, destroyed by heat, occurred in the duff and that it was accumulated by the seed when stored in the duff. However, extensive experimentation failed to demonstrate the presence of such an inhibitor.

The second possibility to be considered was that the largest proportion of the viable seed on the plant was readily germinable without a preliminary heat treatment and that this obscured the presence of a smaller amount of seed which required heat stimulation.

This hypothesis was experimentally tested by using seed which had been previously placed under germination conditions for 60 days, thus removing most of the readily germinable seed. When samples of this seed were planted some germination did occur. However, if this seed was first held in a 212°F oven for five minutes and then planted, a three-fold increase in germination was obtained.

On the strength of these data it would appear that the duff serves as a concentrating as well as a storing medium for that seed which requires a preliminary heat treatment. True, at any one time it also contains some seed which does not require the preliminary heat treatment. However, these seeds are continually being removed by germination whenever moisture and temperature are not limiting; while those requiring the heat stimulus do not germinate and are thus not removed until a fire occurs or until they lose their viability.

The difference between the two types of seed appears to be located in the seed coat. The preliminary evidence pointing to a seed coat difference is the fact that there is no apparent difference in the germination of the two types of seed when either the seed coat is cracked or removed; in both instances, the seed germinates readily without any preliminary heat treatment.

On the basis of the physiological re-

Concluded on next page

drilled and covered with a ring-roller, cultipacker, or even a chain, cable, tree limb, or board. Satisfactory stands have been obtained by broadcasting seed from the ground or by airplane with absolutely no seedbed preparation, but thinner stands must be expected from this method of seeding.

All clover seed should be inoculated before seeding—a low cost investment to help assure good stands.

A mixture of 30% Rose clover, 40% Crimson clover, 15% Mt. Barker Subterranean clover, and 15% Tallarook Subterranean clover may be seeded at one to 10 pounds per acre. The rate of seeding is determined by the expense and the time the individual stockman will wait for a thick stand. Heavy seeding may result in thick stands in one or two years. Light seedings, with proper grazing management, may become solid stands in three to five years.

These annual legume seedings have lengthened the green feed period for from 2-4 weeks.

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The Clover Root Nematode

new pest discovered in Camarillo district is apparently destructive to clover and may become important pest

D. J. Raski and W. H. Hart

A potentially serious pest, in the production of clover—as well as other crops in this state—has been found in the Camarillo district of Ventura County.

So far this pest, the clover root nematode—a cyst forming species of *Heterodera*—is known in California in this one locality only and has not been collected in any commercial plantings of clover. However, it appears to be very destructive on clover and on the basis of its host range it may become an important pest.

A sample of soil and roots of white clover was taken from a circular area approximately 10′ in diameter in the lawn of a private residence in Camarillo where the clover showed yellowing and poor growth in August 1951. The sample was found to be heavily infested with a cyst-forming species of *Heterodera*. Subsequent examination of surrounding properties showed infestations in two other lawns in the near vicinity—an area which had been planted to barley for many years and subdivided in 1948—the soil was too poor to grow good barley. Subsequent growth was volunteer barley, wild oats and Russian thistle.

As homes were built in the subdivision many owners scraped off top soil and imported other soil. Much of the imported soil came from Camarillo Heights, a high ridge nearby where considerable native vegetation — lupine, vetch, and others — occurs. It has not been possible as yet to investigate that area for native infections of this nematode.

Apparently the clover root nematode was not introduced into the area in clover seed because a portion of the original seed used in planting one of the infested lawns was available for examination—and no nematodes were found in the seed. The original lot of seed at the nursery was traced to plantings in other areas which were checked and no infestations were found.

There is no conclusive evidence as to the origin of the infestations of this nematode found in California.

A quantity of soil from the infected lawn was used to test the host range of the clover root nematode. In the first tests — started February 6, 1952 — the test plants were seeded directly into the infested soil in pots in the greenhouse and allowed to grow approximately 70 days. Then the roots were washed clean and examined for females and cysts. Very heavy populations of females were found in the white clover, in carnations and in Golden Wax bush beans where three cysts were found also; one female nematode and five cysts were found on *Sesbania macrocarpa;* two females were on garden peas but no infestation was found on sugar beets.

The soil from each pot was washed and examined for larvae and males but none was present or detectable on any of the host plants.

On May 18, 1952 the test was repeated for sugar-beets in sterilized greenhouse soil infested with the washings and roots of the Golden Wax bush bean, white clover and carnation. In addition, 10 females and one cyst from Golden Wax bush bean were used in another pot of sterilized soil. The sugar beets were allowed to grow for approximately 70 days and then examined. No females or cysts were found on the roots and no males in the soil washings.

On June 16, 1952 host tests discovered a heavy population of females on *Sesbania macrocarpa* grown for 107 days in soil infested with five cysts taken from roots of *Sesbania;* curly dock, planted in infested soil, had a very heavy population of females after 67 days but table beets, also planted in infested soil, had no females after 51 days of growth. The results on table beets may possibly be considered inconclusive because of the shorter period of growth.

On August 20, 1952, another series of hosts were planted to infested soil and grown for 126 days. Ladino clover was found to have a heavy population of females and some cysts; red clover had six females and strawberry clover had one but neither females nor cysts were found on alsike, subterranean, burr, YB sweet clovers nor on alfalfa and birdsfoot trefoil.

The results of these tests agree in general with observations of other research workers with *Sesbania* and carnation the only new host records.

It was noted in these tests that there was a distinctive yellow phase in the color of the female as it turned from white to brown.

Measurements on larvae of this species of nematode showed an average total length of 0.517 mm—millimeter—with a spear length of .026 mm to .029 mm. The larvae of the clover root nematode are distinctly longer than those of the sugar-beet nematode — *H. schachtii* — which average 0.469 mm in length.

In view of the greater length of the larvae, the yellow color phase found in the female and differences in host range, the clover root nematode undoubtedly represents a species distinct from the sugar-beet nematode. Further studies are expected to disclose other morphological as well as biological differences.

No males were available for study and there seems to be no explanation for the failure of males to develop in these tests.

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GERMINATION

Continued from preceding page

sponse of the seed, discussed above, certain aspects of field behavior should be predictable. For example, the age of the stand—years since the last burn—should be an important factor in determining the total amount of germination as well as the degree of fire response. An old stand of chamise should contain a larger number of viable seed in the duff than a young stand; furthermore, the percentage of seed requiring fire to germinate should be higher in the old stand. Therefore, total germination should be higher in an old stand than in a young stand if fire is the method of clearing. If an old stand were cleared by burning more germination should occur than if it were cleared by mechanical means, while little or no difference should be expected in a young stand.

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