in pots which restricted root depth.

Under summer field conditions both the deep penetrating root system and the high temperature tolerance would aid in the persistence and growth of the three-awn. It would be of interest to measure transpirational losses in this species under stress of heat and dryness.

**Summary**

The growth behavior of prairie three-awn, an annual bunch grass possessing unusual ability to grow during the hot dry summers on California ranges, was studied in comparison with soft chess and nodding stipa.

The root system of prairie three-awn consists of a few vertical and sparsely branched rapidly elongating roots in the field in the absence of summer rainfall. This is in contrast to the much-branched fibrous root system common among winter annual grasses.

Rapid regrowth follows clipping in the summer. The water for such growth is obtained at depth. If normal root penetration is prevented by growing the three-awn in pots, it has the same ability to endure soil dryness as soft chess.

Prairie three-awn possesses high heat tolerance as measured by survival of stresses in controlled chambers. The plant has tolerance much greater than soft chess and similar to nodding stipa.

**EFFECTS OF AQUEOUS EXTRACTS OF HALOGETON TISSUE ON GERMINATION OF SEEDS AND GROWTH OF SEEDLINGS**

**DIXIE SMITH AND FRANK RAUCHFUSS**

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The occurrence of growth and germination inhibitors in desert plants is not uncommon. White brittlebrush (Encelia farinosa) contains 3 acetyl-6-methoxybenzaldehyde which, when leached from the leaves, retards the establishment of other species in the immediate area (Bonner, 1950). Bennett and Bonner (1953) indicated that toxic extracts might be obtained from mojave deserttrue (Thamnosa montana), black greasewood (Sarcobatus vermiculatus), mesquite (Prosopis juliflora), and goldeneye (Viguiera reticulata). Toxic substances leached from guayule (Parthenium argentatum) may inhibit the establishment and growth of seedlings of the same species as well as other plants (Bonner and Galston, 1944; Bonner, 1946).

Halogeton (Halogeton glomeratus) is an annual weed, which in the past twenty years has invaded more than five million acres of desert and semi-desert rangelands in the western states. Field observations in the Big Horn Basin of Wyoming indicate that revegetation following halogeton control is a slow process.

In November 1957, preliminary studies were initiated to determine the effects of soluble halogeton residues on the germination and growth of other plant species.

In the first of a series of greenhouse experiments, a 3 x 3 latin square design was established to determine the effects of halogeton residues on germination of yellow sweetclover (Melilotus officinalis) seed. One hundred seeds were placed on white filter paper in plastic trays for germination. The treatment solutions were placed on the filter papers in the germination trays until the paper was saturated, then covered and placed in a greenhouse to germinate at 70 degrees Fahrenheit.

The treatment solutions, outlined in Table 1, were made by taking the designated amount of halogeton, placing it in distilled water, and agitating it for 15

<table>
<thead>
<tr>
<th>pH of solution</th>
<th>Soluble salts F.C. x 10⁻³</th>
<th>Percentage germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distilled water</td>
<td>6.0</td>
<td>0</td>
</tr>
<tr>
<td>1 gram residue/100 ml. water</td>
<td>8.8</td>
<td>10</td>
</tr>
<tr>
<td>10 grams residue/100 ml. water</td>
<td>8.9</td>
<td>36</td>
</tr>
</tbody>
</table>

LSD of percentage germination at 0.05 confidence level = 20.81
0.01 confidence level = 48.06
minutes in a Waring blender and then filtering the resulting solutions.

Halogeton residues at concentrations of one and ten grams per 100 ml. of water completely inhibited the germination of yellow sweetclover seed. Statistical analysis indicated that the degree of inhibition was significant unless a one-in-twenty chance occurred.

In order to obtain more conclusive data, a 4 x 4 latin square design was established using the same experimental materials and techniques. The results of this study are summarized in Table 2.

Filtrates obtained from one gram of plant material per 100 ml. of water again completely inhibited germination of yellow sweetclover seed. The difference in inhibitory effects between 0.1 and 0.2 grams was no greater than would be expected through chance alone, but both treatments significantly lowered the germination percentage.

Once it had been determined that halogeton residues limited germination, it became desirable to determine if the halogeton residues added to the soil would limit or reduce the germination and growth of other plants. A 3 x 3 latin square design was established in which ground-up halogeton plants were incorporated into the surface inch of soil within plastic trays containing 50 seeds of the Hiland strain of cultivated barley (Hordeum vulgare). Water was added until the soil was at field capacity. Germination was determined at the end of 10 days, and all plants were clipped and weighed at the end of 30 days. The results of this experiment are summarized in Table 3.

The incorporation of halogeton residues into the surface inch of soil at the rate of 38.4 pounds per 100 square feet resulted in a significant reduction in germination amounting to about eight percent (Fig. 1). The reduction in average dry weight of individual plants approached significance at the 0.05 confidence level. Incorporation of halogeton at the rate of 3.84 pounds per 100 square feet of soil surface produced no significant reduction in percentage germination or in dry weight of barley plants.

**Summary**

Aqueous extracts of halogeton plants inhibited the germination of yellow sweetclover seeds. Extracts obtained from as little as 0.1 gram of plant material per 100 ml. water resulted in a significant reduction in germination amounting to about eight percent.

Incorporation of plant material into the surface inch of soil at the rate of 38.4 pounds per 100 square feet resulted in a significant reduction in the germination of barley seeds amounting to approximately 69 percent. The

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**Table 2. Percentage germination of yellow sweetclover seed ten days after treatment with halogeton residues**

<table>
<thead>
<tr>
<th>Grams of residue per 100 ml. tap water</th>
<th>pH of solution</th>
<th>Soluble salts E.C. x 10^-3</th>
<th>Percentage germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>7.3</td>
<td>0.2</td>
<td>59.50</td>
</tr>
<tr>
<td>0.1</td>
<td>8.3</td>
<td>1.8</td>
<td>51.75</td>
</tr>
<tr>
<td>0.2</td>
<td>8.5</td>
<td>2.8</td>
<td>48.50</td>
</tr>
<tr>
<td>1.0</td>
<td>8.7</td>
<td>5.1</td>
<td>0.00</td>
</tr>
</tbody>
</table>

LSD of percentage germination at 0.05 confidence level = 4.91

LSD of percentage germination at 0.01 confidence level = 7.41

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**Table 3. Percentage germination and weight of barley plants growing in soil containing halogeton residues**

<table>
<thead>
<tr>
<th>Pounds of halogeton per 100 square feet of soil surface</th>
<th>Percentage germination</th>
<th>Average dry weight per plant in grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>73.33</td>
<td>0.124</td>
</tr>
<tr>
<td>3.84</td>
<td>31.33</td>
<td>0.124</td>
</tr>
<tr>
<td>38.40</td>
<td>4.67</td>
<td>0.064</td>
</tr>
</tbody>
</table>

LSD of percentage germination at 0.05 confidence level = 43.03

LSD of average dry weight at 0.05 confidence level = 0.066
reduction in dry weight of the surviving plants approached significance at the 0.05 confidence level.

LITERATURE CITED

BOOK REVIEWS
Edited by Lowell K. Halls, Forest Service, U. S. Department of Agriculture, New Orleans, Louisiana


When man's tenure on Earth is evaluated in the light of its total length, his success in modifying the landscape is no less than astounding. This Johnny-come-lately has, within a few millennia, emerged as the ecologically dominant species and has altered both the physical and biotic worlds more than any of his competitors. He has changed forests into grasslands, grasslands into deserts, and in many areas so modified the landscape that the pristine vegetation can only be clumsily postulated.

This volume had its origins in a symposium sponsored by the Wennergren Foundation for Anthropological Research in 1955. The symposium, under the chairmanship of Professor Carl O. Sauer, drew together seventy scholars from widely scattered parts of the world. Fifty-three of these scholars were asked to prepare formal papers for the symposium so that a permanent record of our present state of knowledge of the topics considered would be available to (and perhaps serve as a stimulant for) future generations. The resulting volume is many things: it is history, anthropology, botany, geography, economics, sociology, political philosophy, and other subjects which deal with the multifarious nature of the earth-man relationship. Above all else, however, it is a printed compendium of scholarly thought.

Due to the enormity and diversity of subject matter, my comments are confined to a few aspects of particular concern to those interested in range management.

In the lead-off paper, Professor Sauer speaks of man's deformation of the prehuman landscape and sketches the development of man as an ecological force from Paleolithic Time to the present. Speech, tools and fire are considered to be the triad upon which man built his cultures. Of these, fire has been the most important because the hearth early became the center of the home and workshop and the focal point for social life and idea exchange. He discusses fire as a prehistoric tool of landscape management and critically evaluates some overconfident conclusions with regard to past climatic changes. The role of man, rather than climate, in creating grasslands by fire and deserts by overgrazing is stressed. Dr. Omer C. Stewart writes of Fire as the First Great Force Employed by Man and agrees with Sauer that both tropical and temperate grasslands have been formed and maintained by the activities of man.

Dr. James C. Malin offers an interesting appraisal of the grasslands of North America. He suggests, and offers evidence to support his suggestions, that the Plains Indians were not, as is often assumed, living in a state of ecological harmony before the intrusion of the white man. He argues that severe wind and water erosion are characteristic of the geographical formations underlying the Great Plains and that severe erosion has occurred since antiquity. He views these forces as almost entirely geological phenomena. Malin suggests that, paradoxically, the low annual rainfall characteristic of the Great Plains is, in reality, a major asset to the occupying human culture because a heavier precipitation would cause even more destructive erosion.

The more recent influences of man upon the landscape are treated by a group writing on the processes by which man has altered his environment. Dr. J. T. Curtis discusses the Modification of Mid-latitude Grasslands and Forests by Man and describes man as a simplifier of plant communities. The most advanced, complex and conservative communities (i.e., climax communities) are those most capable of energy capture. Under the influence of man, however, these communities have been largely superseded by less complex, less conservative communities able to tolerate greater fluctuations and disturbances but less efficient in the capture and retention of solar energy. Man is characterized as a species dependent upon pioneer communities which "... are composed of a small number of extremely vigorous, highly specialized weeds of cosmopolitan distribution, whose origins and distributions are in themselves man-induced phenomena. The subfinal stages are a mixture of those weeds and the most aggressive elements of the native flora. The relative proportion of indigenous and exotic elements varies with the climate, ..." Dr. Edgar Anderson discusses the genetic mechanisms which have been operative in man's creation of new plants and new plant communities. He describes how man (mostly by accident and unknown to himself) has brought new plants into being by the creation of numerous habitats which offer a place for survival to new genetic combinations,