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## *A Study on the Germination of Medusa-head Seed*

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and  
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# A Study on the Germination of Medusa-head Seed

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## Foreword

WALTER S. BALL, Chief, Bureau of Rodent and Weed Control and Seed Inspection

Medusa-head (*Elymus caput-medusae* L.) is one of the most serious range weeds in California. Due to its unpalatable characteristics and heavy seed production this pest has spread rapidly over thousands of acres of range lands in California. This paper, through the studies on the germination of medusa-head seed will be of real value to those agencies and individuals who are involved in range management and weed control.

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The abundance of Medusa-head (*Elymus caput-medusae* L.) on Northern California rangeland presents a grave problem as far as adequate control is concerned. This weedy grass probably obtained its foothold in California about the turn of the century. It has since spread from the Oregon border approximately 600 miles south, as traces have been reported in Ventura County (2) (5) (7) (10). At its present rate of spread it should easily occupy most range areas of the State, where adaptable, in another 50 years.

## Important as a Pest

As an undesirable range plant this grass ranks close to first place. Pryor (2) in the 1956 annual report on weeds, indicates this plant as one of the most serious range weeds. One reason for its classification as a pest is that it has little or no feed value to livestock at any stage of growth. In some cases stock will utilize the plant where the selection of other feed is limited or of poor quality. This lack of use then leads to an abundance of seed available for the next growing season. Its aggressiveness is also emphasized by high seed production. Scattered plants will generally produce six or more seedheads per plant whereas in a dense stand one head per plant is the rule. This abundant seedhead production of a scattered stand helps to account for the fast buildup to a dense stand. With its aggressive habits most other useful range forage plants are soon crowded out. The plant is

not selective as to site as it will grow on deep fertile soils as well as thin rocky soils. Each seed has a long rough awn which provides an excellent aid for distribution. These awns cling very well to animal fur or wool as well as clothing, thus it is easy to understand why the spread from one area to the next has been so rapid. Movement of this weedy grass can often be traced along sheep and cow trails.

Cultivated areas as well as range are susceptible to invasion by Medusa-head. Fields that have been left idle after cropping are easily infested, even areas in the Sacramento Valley have been noted. If such fields are later used for seed production or feed grain the problem of seed contamination is likely. Although control of this pest on cultivated land is easier than on range it still amounts to an additional cost for cleaning up a field.

## Examination and Identification of Infested Areas

The importance of recognizing Medusa-head at an early stage of invasion cannot be overemphasized. In most cases notice is not taken of this grass until rather dense patches have developed. Usually when dense stands appear the abundance of the weedy grass will be so great that adequate control becomes more difficult. If this grass can be recognized early then the success of control can be enhanced.

Medusa-head differs from most other annual grasses in its later maturity. On Northern California ranges it is classed as an early summer maturing grass. Most of the grasses that make up the "annual type range" normally mature by May whereas Medusa-head will be green usually through June. With this differential maturity date, infestations of this plant can usually be easily distinguished by its greener color on the range.

Germination usually occurs during the first fall rains, as is common with other annual grasses, but very limited growth develops until the soil temperature warms in March and April. Heading commences in



Mature Medusa-head plants. Note the long awns which is typical of this plant.

May and then development is rapid. After the seed has matured it may stay in the head for a month or so if not dislodged by animals.

Botanically Medusa-head belongs to the genus *Elymus*, which include all perennial grasses except this one grass. It grows from 6 to 25 inches tall, depending on site, with very few leaves but with a distinctive seed-head. On the mature dry plant, the awns are often as long as four inches, spread in devious directions as compared to the straight awn when green (11). After the seeds with its long awn have dropped from the head, the remaining bristly spike often is mistaken for the weedy Mediterranean barley (*Hordeum hystrix*). Occasionally squirreltail (*Sitamon hystrix*) with its long awns is mistaken for Medusa-head but the *Sitamon* is a perennial plant and its clump-like basal development, on close inspection, will provide a good distinguishing character (4). Once a few distinct points are known early recognition will be of distinct aid in ultimate control.

#### Physiology Study of Medusa-head

The accumulation of information on the physiology of Medusa-head is quite limited. Sharp and Tisdale (13) and Sharp, Hirakawa, Tisdale (12) reported their findings relative to some ecological and physiological conditions as they existed under Idaho range conditions. Furbush (3) indicated that fire as a method of controlling this introduced annual grass held much promise. Chemicals, such as IPC (Isopropyl-N-phenylcarbamate) and dalapon (sodium salt of 2,2-dichloropropionic acid), have been used on limited infestations but the cost to control any large acreage would be excessive.

#### Experimental Studies at Hopland Field Station

Experimental work with Medusa-head has been carried on by workers in the Agricultural Experiment Station of the University of California since it was recognized as a potentially serious pest on California ranges. Some of this work has been carried on at the university's Hopland Field Station situated in southeastern Mendocino County. This station is devoted to the study of the more important range problems, especially where sheep are the grazing animals. The range is situated in the inner coastal mountains approximately 40 miles inland and about 100 miles north of San Francisco. Topography varies in elevation from 500 to 3,000 feet and rainfall averages between 30 and 40 inches annually. The range vegetation is typical annual grass type with scattering of deciduous and live oaks.

With the establishment of the station in July of 1951, it was found that Medusa-head had secured a foothold in various places on the range. This was not unexpected as Furbush (3) indicated the presence of the plant approximately 20 miles north of the area in 1932. Various phases of control and experimentation have been developed since the initial establishment of the station to try to arrive at a possible method of control for this weedy range grass. The phase reported here involves some of the findings as related to seed germination characteristics under certain environmental conditions, especially burning.

#### Burning Technique

Controlling Medusa-head by burning was reported by Furbush (3) and Murphy (1) in the North Coastal area. This described method was used for controlling most infestations on the Hopland Field Station. Variations in control were from excellent to practically no change. As the burning attempted to destroy the seed crop apparently the variation in control was due to difference in the effect of fire on the seed.

Burning provides a relatively economical method of controlling large infestations when compared to chemical or cultivation treatment. For successful seed destruction by burning, certain burning techniques must be observed. The heat of the fire should be concentrated to burn as many seeds in the head as possible. This can be achieved by having the fire move slowly so as to obtain complete fuel consumption. The fire should then be directed toward burning downslope



Burning a dense stand of Medusa-head. Burning provides a relatively economical method of controlling large infestations.

and against the wind. The opposite of this creates a fast flash fire and many seedheads will be left unburnt. The drier the plant, yet before the seeds shatter, will probably result in the best seed destruction. Fire can be extremely tricky and if used by the inexperienced individual more damage than good can result. In California before any burning of Medusa-head on rangeland is attempted the local State Forest Ranger of the Division of Forestry should be consulted for advice and for the required burning permits.

#### Germination Tests

The efficiency of a burn can best be measured by the amount of seed which the fire destroys. Conducting germination tests on the seed was the measure of the effectiveness of the burn. Some initial testing of seed from burnt areas had been conducted by the State Seed Laboratory in 1951 (1).

During the germination tests it was noted that Medusa-head exhibited a tendency for dormancy. Laude (6) indicated that in some

annual grasses, dormancy of fresh seed persisted from one to five months after seed maturity and dormancy also varied from year to year depending on location. One of his experiments was started to determine the length of dormancy of Medusa-head. Of the seeds collected June 14, 1952, only 4 to 6 percent germination was obtained in June and July but in October 14, 1952, 92 percent of the seed germinated.

With seed collected at Hopland on July 6, 1955, when mature, no germination occurred until 90 days later. In an attempt to break this dormancy the seed was subjected to high and low temperature durations, scarification, and cutting the seed coat. High temperatures were achieved by the use of a drying oven which had a temperature accuracy of about 2 to 4 degrees C. For low temperatures a refrigerator was used which had a temperature accuracy of about 4 to 6 degrees C. In germination, the seed was placed between wet toweling with temperatures between 30 and 38 degrees C. during the day and approximately

19 degrees C. at night. The control seed was collected in 1953 and used to insure that no other conditions except dormancy was involved in preventing germination. All treatments used in this test to break dormancy had no effect on germination.

#### Germinating Seeds From Burned Areas

During the summer burning of 1955 seed collections were made from nine different areas on the Hopland Field Station. All the seed showed some signs of fire damage except one collection. The burns took place during the middle of June and varied in time of burning, fuel density, general maturity of the Medusa-head, and elevation. Nine different locations were selected plus a control sample and 100 seeds were used from each location. All seeds were tested for germination by placing them between wet towels in a germinator. The control sample germinated 98 percent while all other samples showed no germination except one sample. This sample had 5 percent germination and these were the seeds that showed no appearance of burning. Most all other collected seed had the awn burnt off or the seedcoat was scorched. If the awn was burnt off the seed, no germination resulted.

#### Germinating Seeds From Soil Samples

Soil samples were collected from burned areas then later put into flats and watered to determine which plants would develop. Of the burned areas one was a hot burn with good accumulation of fuel while the other was burnt when some of the grass was green and the fuel accumulation was light. In the control sample, Medusa-head represented 24, 17, 42 percent of the vegetation stand in three different samples. The hot burn area showed no germination of Medusa-head. On the light fuel and some greenness the Medusa-head germination was 20, 41, and 4 percent of the vegetation stand. This test would indicate that the depression of seed germination percentage will depend on intensity of the fire or the amount of dry fuel present.

#### Conclusions

(1) Medusa-head represents a serious weed pest on California rangelands and early recognition of this grass will tend to aid control.

(2) Burning of Medusa-head in the dry stage offers an economical method of control. The fire attempts to destroy seed of this annual plant thus diminishing the num-



Typical dense stand of Medusa-head on open rangeland east of Garberville, Humboldt County.

ber of plants forming the next growing season.

(3) Germination tests indicated this grass to have approximately a 90-day period of delayed germination after seed maturity.

(4) Seeds showing signs of scorching or having the awn burnt off, in most cases no germination resulted.

(5) Seeds from soils in burnt area germinated greater where the burn was poor but showed no germination in a good burn.

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