Environmental Factors Related to Medusahead Distribution

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Highlight: *Sites particularly susceptible to medusahead invasion in the more arid portions of Idaho were either those with well-developed soil profiles, particularly those with high clay content either at or near the surface; or those occupying topographic positions that received additional run-off from adjacent sites. In more mesic climates moderately well developed soils appeared as highly susceptible as the well-developed soils. Conversely, soils with little profile development, particularly those which were well drained, remained dominated by cheatgrass in early seral stages regardless of whether they were in the more arid or mesic areas. The nature of the surface geology as it influenced the soil texture derived therefrom was a valuable aid to identifying sites susceptible to medusahead. Maintaining a good stand of perennial vegetation appeared the best barrier to medusahead invasion into susceptible soils.*

The introduction and subsequent rapid spread of medusahead wildrye (*Taeniatherum asperum* Nevski) in Idaho is an increasing cause of concern to all who manage rangelands adapted to this plant. Torrell et al. (1961) regarded this annual grass as the worst range weed in Idaho because of its rapid migration, vigorous competitive nature, and low forage value. It is a serious problem on more than 700,000 acres of rangeland in the 10–20-inch precipitation zone of southwestern Idaho (Hironaka, 1963) where grazing capacity has been reduced as much as 80% in some infested areas (Hironaka, 1961).

McKell et al. (1962) suggest that if the site requirements of medusahead completely overlap those of cheatgrass (*Bromus tectorum* L.), it could spread widely in the Intermountain Region. Cheatgrass is also an exotic annual invader of rangelands, but unlike medusahead, it has distinct value for livestock forage. Although medusahead is reported best adapted to soils that contain considerable clay (Major et al., 1960; Young and Evans, 1970) it was feared that it could replace much of the cheatgrass on rangelands in Idaho.

If site characteristics that favor successful medusahead establishment were known, range improvement efforts could be concentrated on those sites most likely to be invaded. Therefore, the primary objective of this study was to ascertain and describe those site characteristics most favorable to the establishment and growth of medusahead.

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Approved for publication by the Idaho Forest, Wildlife and Range Experiment Station. The study was partially funded by the Bureau of Land Management, U.S. Department of the Interior. The help and guidance of Dr. M. Hironaka throughout the study is gratefully acknowledged.

Manuscript received December 10, 1974.

Description of the Study Area

Major medusahead infestations occur in Gem, Payette, and Washington counties, while less extensive but sizeable areas exist in Ada, Adams, Boise, Idaho, Nez Perce, and Owyhee counties. Spot infestations were found in Canyon, Clearwater, Elmore, and Latah counties (Fig. 1).

The study area has considerable variation in relief, slope, and type of landscape. Squaw Mountain in Washington County, at approximately 5,850 feet elevation, is the highest point within the medusahead-infested region. In the northern portion the Lewiston Basin is only 747 feet above sea level; in

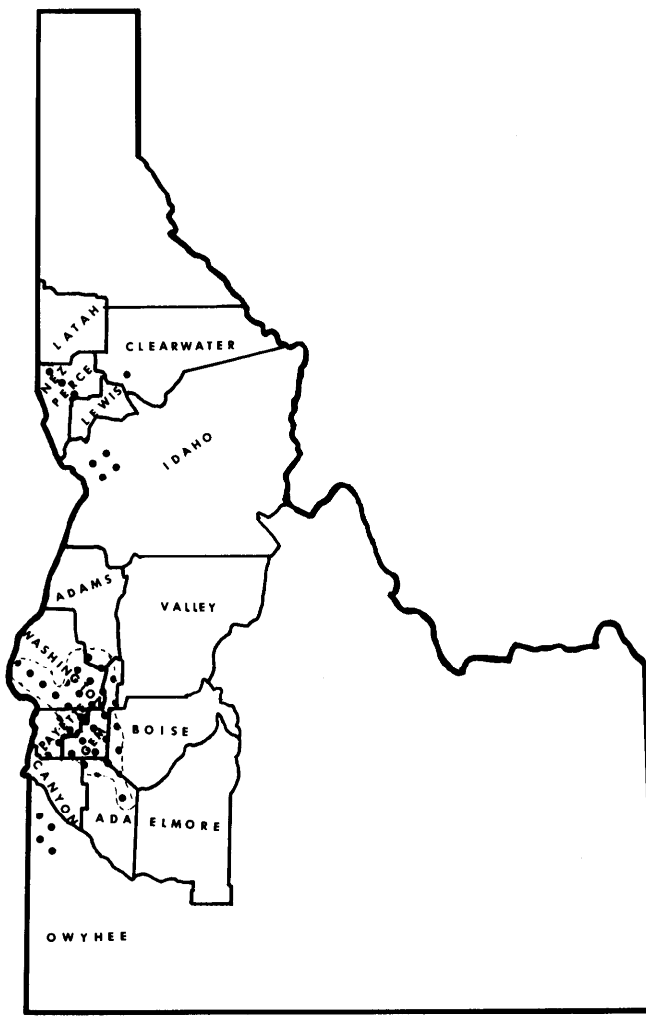

Fig. 1. *Map of medusahead infestation and the study areas in Idaho. Dots indicate extent of infestation in 1964.*

the southern portion the regional low of 2,010 feet occurs on the Snake River north of Payette. Local differences in relief of 900 to 1,200 feet are common throughout the area.

The climate is characterized by a modified maritime type of seasonal precipitation, with over half of the annual total occurring from October through April. The amount of precipitation during July and August is normally very low. Temperatures in the northern portions of the area are relatively mild for the latitude, especially in the lower valleys. Data from representative stations are shown in Table 1.

Native vegetation ranges from Pacific Northwest bunchgrass in the north to sagebrush-grass in the south. Most sites studied were occupied by seral communities composed primarily of annuals. With the exception of two sites in Nez Perce County and one near Orofino in Clearwater County, the study was conducted south of the Clearwater River. In the northern portion two principal vegetation zones, the *Festuca/Agropyron* and *Agropyron/Poa*, can be distinguished. The former is associated with soils of the Chernozem and Prairie Great Soil Groups (Xerolls), and the latter zone with Chestnut soils (Xerolls). Due to cultivation of the more mesic areas, the bulk of the remaining grasslands are in the *Agropyron/Poa* zone (Tisdale et al., 1959).

All sites studied in southern Idaho are in the sagebrush-grass vegetation zone characterized by dominance of a woody species of *Artemisia* and one or more perennial grasses (Tisdale et al., 1969). Much of the perennial vegetation of the area has been replaced by annuals, especially cheatgrass. It is these stands that have been invaded more recently by medusahead. Types of the original sagebrush vegetation involved include several dominated by one of the subspecies of big sagebrush (*Artemisia tridentata*), as well as communities in which dwarf sagebrushes (*A. arbuscula* and *A. rigida*) are dominant. Specifically, medusahead infestations have been found in the *Artemisia tridentata vaseyana/Agropyron spicatum; A. tridentata tridentata/Agropyron spicatum/Poa sandbergii; A. arbuscula/Agropyron spicatum;* and *A. rigida/Poa sandbergii* communities. It is possible that other sagebrush communities have become or will be invaded by this annual grass.

Methods and Procedures

Study sites were chosen throughout the major area of rangeland in Idaho infested by medusahead. Emphasis was placed on areas where sites heavily infested by medusahead occurred closely adjacent to areas similar in degree of depletion (i.e., mostly without perennial species) but occupied by species other than medusahead. On each site at least two macroplots, each 10 feet square, were permanently marked and studied intensively. One plot was placed on that portion of the site occupied by medusahead and another on the area where medusahead was rare or lacking. Occasionally, plots intermediate between these conditions were chosen. Data on elevation, aspect, percent slope, position on slope, vegetation, and soils were obtained at each plot.

The current year's growth of vegetation was clipped at ground level from five square-foot subplots on each macroplot. Density and frequency were also determined for all species. However, only the air-dry weight of medusahead and cheatgrass were used to indicate the degree of dominance of each species on the study sites. Adjacent to each intensively sampled plot a soil pit was excavated and a standard profile description made. Analyses performed on samples taken from each horizon included texture, bulk density, total pore space, organic matter, air space, moisture retention at 1/3 and 15 atmospheres and at 60 cm tension, and a clay mineral index.

The clay mineral index was calculated as 100 less percent air space. Subtraction of the percent air space from 100 was done to eliminate negative values. The method used to obtain percent air space (% total pore space less % total water held at 60 cm tension) often results in negative values if expanding lattice clay minerals are important in the soil. This results because clods used for bulk density determination are in a dry, shrunken state giving high bulk density values. The amount of moisture held by these clay soils at 60 cm tension is very high due to their expansion on wetting, and often exceeds the calculated percent total pore space. Values from this formula give reasonable indexes of the amount of expanding lattice clay minerals in the soil horizon and were used for this purpose.

A topographic position index was also recorded for each site. Bare ridges and steep convex slopes were considered dry positions and given a rating of one, while wet meadows were rated ten. Positions between these extremes were given intermediate ratings.

Table 1. Climatological data for representative stations in medusahead-infested portions of Idaho (through 1972).

Station	Elevation (feet)	Latitude	Mean annual precipitation (inches)	Mean annual temperature (°F) July	Jan.
Southern portion					
Mountain Home	3,180	43°07′	8.78	73.7	28.3
Boise (airport)	2,842	43°34′	11.43	75.2	29.1
Parma Exp. Sta.	2,215	43°48′	9.34	73;6	28.3
Emmett	2,500	43°52′	12.43	73.7	29.5
Weiser	2,120	44°14′	11.31	75.4	27.5
Cambridge	2,650	44°34′	19.71	74.1	22.3
Northern portion					
Grangeville	3,355	45°55′	22.65	67.0	27.7
Lewiston Airport	1,413	46°23′	13.24	73.8	30.7
Orofino	1,027	46°29′	25.93	73.8	31.0

Results and Discussion

To determine site characteristics that were or were not associated with vigorous medusahead stands, the plots were grouped according to degree of dominance of medusahead. Each group is briefly discussed in the following section, with the characteristics of selected sites shown in Table 2.

Areas with Grumusols and Other Related Soils of High Clay Content

Ten of the plots studied were either Grumusols (Table 2, Plot 18) or closely related types (Table 2, Plot 1) having characteristic large vertical cracks when dry, and high clay content. Medusahead grew well on all of these regardless of precipitation zone. Clay content of the most developed horizons in these soils varied from 43 to 64%. Study sites with Grumusol soils ranged from the Camas Prairie near Grangeville with 23 inches of precipitation to the Weiser area with 11 inches of precipitation. To illustrate the apparent importance of this type soil, one plot had a Grumusol type clay overlying a speckled white and yellow sandy textured decomposing rock. Where the clay attained a thickness of 6 inches, medusahead was abundant, but it was almost absent where the clay was only 2 inches thick. Young and Evans (1970) indicated that once medusahead fully occupied Grumusol sites in Nevada they were effectively closed to invasion by naturally or artificially introduced species.

Sites with Mounded Relief

Where medusahead occurred in mounded terrain it was usually confined as a dominant to the intermound areas with cheatgrass remaining dominant on the mounds (Table 2, plots 1 and 27). These mounds were 1 to 3 feet higher than the

Table 2. Site and soil characteristics for selected study sites.

Plot No.	Description	Precipitation	Topographic index	Yield (g/ft^2) Medusahead	Yield (g/ft^2) Cheatgrass	Horizon	Depth (inch)	Texture 1/	Particle size distribution Sand(%)	Silt(%)	Clay(%)	Structure 2/	Clay Mineral index	Wilting Coefficient (%)
18	Grumusol	12	2	62	0	A1	0-1.5	l	47	38	15	lcpl	93	8
						A3-B1	1.5-4	cl				lcpl	131	29
						B21	4-18	c	14	22	64	3msbk	143	35
						B22	18-24	c				2csbk	133	31
						B3ca	24-32	c				2csbk	138	34
						Cmca	32+							
1	Intermound	10	4	47	4	A1(A2)	0-3	sil	23	57	20	2fpl	94	12
						B21	3-9	c	9	32	59	3mpr	147	39
						B22	9-17	c	11	37	52	3cabk	140	38
						B3ca	17-24	sil	31	51	18	2fsbk	137	41
						Cca	24+							
3	Mound	10	3	0	118	A11	0-1	sil	20	55	25	lvfgr	105	16
						A12	1-6	sicl	15	57	28	lfpl	101	14
						B21t	6-16	sicl	19	46	35	lmpr	103	17
						B22	16-23	sil	24	51	25	lmpr	101	16
						B3ca	23+	sil	19	71	10	lmsbk	101	17
27	Intermound	17	3	93	1	A1	0-6	l	45	35	20	lmpl	95	12
						A3	6-10	l	44	36	20	lmgr	87	13
						B1	10-14	l	42	36	22	2msbk	92	13
						B21	14-16	l	43	33	24	3csbk	97	14
						B22b	16-21	cl	42	29	29	3csbk	103	17
						IIB23	21-28	cl	40	28	32	3cpr	104	16
						B3	28-31	scl	52	22	26	3csbk	115	24
28	Mound	17	3	2	64	A11	0-8	l				lcpl	91	22
						A12	8-11	l	35	47	18	lcpl	90	12
						A3	11-16	l	35	45	20	lmsbk	89	12
						B1	16-24	l	36	45	19	lmsbk	95	13
						B2	24-36	l	36	46	18	lmpr	98	11
17	Alluvial fan	12	8	46	13	A11	0-7	sl	53	31	16	lvfgr	90	10
						A12	7-11	l				lcgr	87	7
						B(C1)	11-19	l	49	39	12	lsbk	91	9
						Bca(C2ca)	19-22	l				2sbk	87	10
						Bca(C3ca)	22-32	l				2sbk	90	11
16	Alluvial fan	12	8	1	24	A11	0-2	ls	83	11	6	lfpl	80	5
						A12	2-10	ls	83	11	6	lfgr	73	3
						C	10-13	ls				lfgr	76	4
						Alb	13-16	ls	83	~~10~~	7	lfgr	83	6
						Clb	16-26	ls	83	10	7	lfgr	83	5
25	Clay pan soil	11	5	42	6	A1	0-2.5	sil	52	38	10	lfpl	86	7
						A21	2.5-7	sil	52	38	10	lcpl	84	8
						A22	7-11	sl				lmsbk	88	8
						B21	11-17	c	16	38	46	3cpr	124	32
						B3	17-21	sic				lcpr	120	32
						B3ca	21-25	sic				lfsbk	115	32
26	Adjacent to clay pen (well drained soil)	11	3	1	54	A11	0-4	sil	74	15	11	lvfgr	84	6
						A13	4-19	sil	74	15	11	lmpl	80	5
						C1	19-23	sl				lmsbk	84	6
						C2	23-28	sl	70	17	13	lmsbk	87	9
						C3	28-33	sl				lmsbk	89	9
19	Favorable topography	10	5	59	16	A11	0-4	sil	22	65	13	lfgr	92	14
						A12	4-10	sil	22	65	13	lmpl	88	12
						A3	10-19	sil				lmsbk	93	12
						B2	19-34	sil	15	61	24	lmabk	102	15
20	Unfavorable topography	10	2	0	47	A11	0-4.5	sil	33	63	4	lfpl	79	5
						A2	4.5-13	sil				lfsbk	80	6
						B2	13-15	sil	36	58	6	lfsbk	90	11
						Clm	15-19	sil	36	58	6	?	96	21
						C2mca	19-24						94	15
						C3ca	24-40	l						
23	Favorable climate (intermediate soil)	19	5	49	1	A11	0-9	l	27	49	24	lfpl	98	16
						A+B	9-11	sil				lmsbk	103	13
						B2	11-19	sil	21	54	25	2fpr	99	12
						B31	19-23	sil				2msbk	97	11
						B32	23-30	sil				lmsbk	94	9
24	Favorable climate (well drained soil)	19	3	3	64	A11	0-3	l	42	44	14	lfgr	91	8
						A12	3-6	l				2cpl	88	8
						A+B	6-10	l				lmsbk	91	9
						B	10-14	l	39	46	15	lmsbk	91	9
						R	14+							
9	Perennial dominated site	12	2	6	1	A11	0-2	l	48	39	13	3fpl	86	6
						A12	2-11	l	43	41	16	3mpl	84	6
						B1+A2	11-14	l	44	39	17	lcpr	91	8
						IIB21b	14-23	c	30	23	47	3cpr	116	20
						IIB22b	23-26	cl						
7	No perennial domination	12	5	37	1	A11	0-2	sil	32	50	18	3fpl	94	8
						A12	2-8	l	33	47	20	3cpl	92	10
						A3	8-11	cl	34	36	30	lfsbk	91	11
						B2-A2	11-15	c	32	24	44	3mp4	112	17
						IIB2	15-30	scl	47	19	34	3cpr	110	14
						IICca	30+							

1/ Texture abbreviations: s = sand or sandy; si = silt; c = clay; l = loam.

2/ Structure abbreviations: c = coarse; m = medium; f = fine; vf = very fine; gr = granular; pl = platy; bk = blocky; pr = prisimatic; a = angular; s = subangular.

intermound areas and had little profile development. The soil from all horizons was mixed (Table 2, plots 3 and 28) at least partially from rodent burrowing, as rodent excavations were common. The mounds often had textural but seldom structural B_2 horizons. Conversely, the intermound areas had well-developed profiles with an A_1 or often an A_2 overlying a textural and structural B_2 horizon. Soils of the A horizons were of silt loam to loam texture, with clay loam or clay in the B_2 horizons. Depth to the B_2 horizon seemed critical in the drier portions and less so in areas of greater precipitation. In the Black's Creek area south of Boise with 10–11 inches annual precipitation, medusahead stands were most dense on soils with clay B_2 horizons within 2 to 3 inches of the surface (Plot 1). Where depth to the B_2 reached 11 inches, medusahead was absent. On the other hand, this species grew well on intermound areas with a clay B_2 horizon at 14–16 inches (Plot 27) in the Riley Butte area of Washington County where annual precipitation averages 16–17 inches.

Well-developed Soil Profiles vs Soils with Weak Profile Development

In southwestern Idaho, disturbed sites with well-developed soil profiles were dominated by medusahead, while adjacent areas with weakly developed profiles were generally dominated by cheatgrass (Table 2, plots 25 and 26; Fig. 2). Sites lacking medusahead often had the same soil horizon sequence as those with medusahead, but differed in degree of structural development, clay content of the B_2, or depth to the strongest developed horizon. For example, plots 7 and 8 were similar in texture and profile development, but the strongest developed horizon was at a depth of 11 inches on Plot 7 and 33 inches in Plot 8. Plots 10 and 11 had similar horizon depths, but Plot 10 had greater structural B development and the clay content was several percentage points higher. Plots 25 and 26 were within 150 feet of each other and the first 10 inches of each profile were similar silt loams with 10% clay. However, the soil of Plot 25 changed abruptly at 10 inches to a strongly developed columnar structure with 46% clay content (Fig. 2, left) while Plot 26 had little structural development to 33 inches and its maximum clay content was 13% throughout (Fig. 2, right).

Another example of the effect of soil profile development on susceptibility to invasion by medusahead was observed in the case of sites belonging in *Artemisia arbuscula* communities. Over much of the sagebrush region this species of low sagebrush is confined to soils in which strongly developed B_2 horizons, usually high in clay content, occur within 12 inches of the soil surface (Fosberg and Hironaka, 1964). Big sagebrush (*A. tridentata*) grows in the same general areas, but on deep, well-drained soils of weak to moderate profile development. From data presented earlier, depleted stands of the *A. Arbuscula* type should offer suitable conditions for the invasion of medusahead.

In 1963, personnel of the Owyhee District, Bureau of Land Management reported infestations of medusahead in a portion of Owyhee County where *A. arbuscula/Agropyron spicatum/Poa sandbergii* community was the type concerned. On stands with fair range condition or better, only scattered plants of medusahead were found, but a dense stand of medusahead had developed on a badly depleted stand of this type. The soil profile revealed a 6-inch A_2 horizon of silt loam texture resting on a strongly developed B_2 clay horizon extending from 6 to 19 inches in depth. Approximately 100 feet away, a similarly depleted area was dominated by cheatgrass and Sandberg bluegrass, with remnants of *A. tridentata.* The main difference between the soils of the two sites was depth to the B_2 horizon, which was 13 inches on the big sagebrush site. It would appear that badly depleted sites of the *A. arbuscula* type are among those in the region susceptible to invasion by medusahead. Young and Evans (1970) report similar findings in Nevada.

Medusahead-dominated Sites with Weakly Developed Soil Profiles

While the examples just cited would suggest a clear-cut relationship between degree of profile development and suitability for occupation by medusahead, such was not always the case. Several areas were found where medusahead was abundant on the soils whose profile development, taken alone,

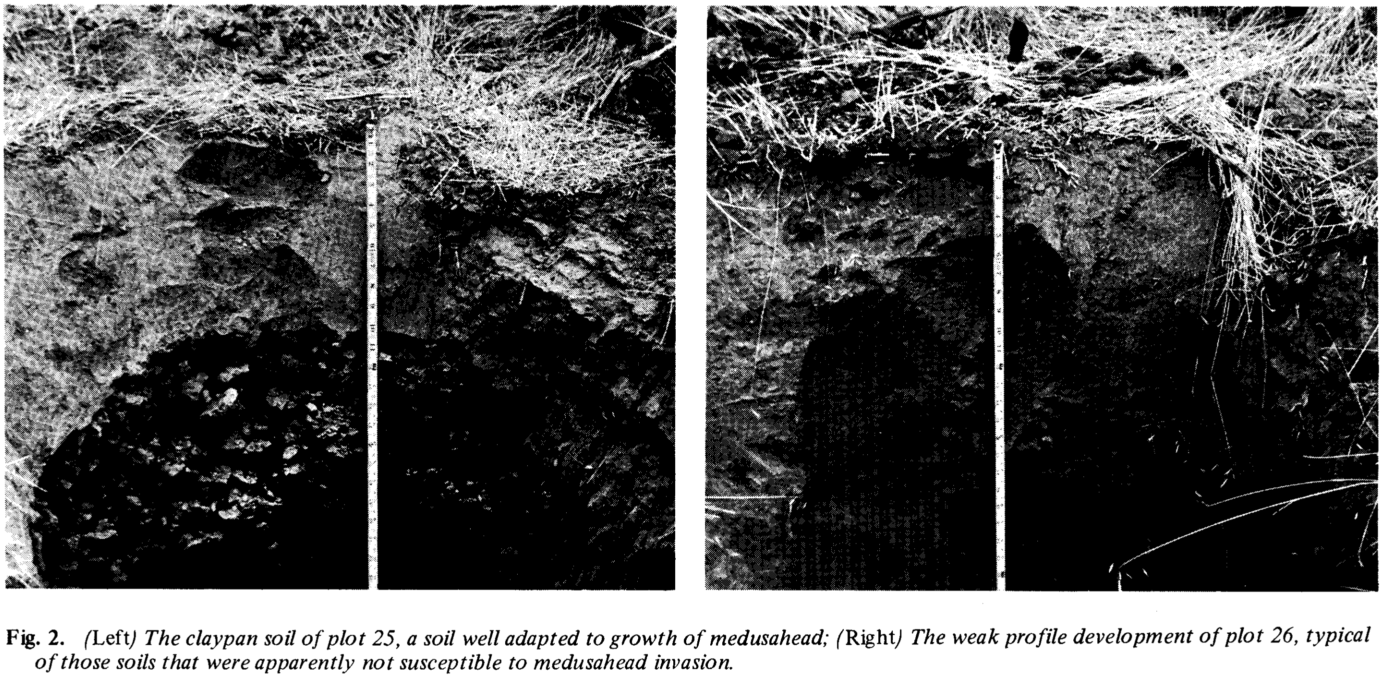

Fig. 2. (Left) *The claypan soil of plot 25, a soil well adapted to growth of medusahead;* (Right) *The weak profile development of plot 26, typical of those soils that were apparently not susceptible to medusahead invasion.*

would have seemed poorly suited for this species. These included four study sites in southwestern Idaho, plus a number of areas in the northern portion of the state for which no formal site descriptions were made.

For the southern sites, favorable topographic position for moisture appeared to compensate in large part for weak development of the B_2 horizon. The soil at one such site had a textural B_2 at 19 inches, but minimal structural development. The site was located in a depression at the head of a drainageway which received extra run-off moisture. An adjacent site with similar soil but located outside the depression was devoid of medusahead (Table 2, plots 19 and 20).

In the northern part of the state, most sites dominated by medusahead were on soils intermediate in profile development (Table 2, plots 23 and 24). More precipitation (14–18 inches annually), plus a relatively mild climate with precipitation mainly in the winter months, produced an environment where medusahead flourished without the strong soil profile development usually required in southern Idaho. Even mounded soils were found to support medusahead in the northern areas.

Alluvial Fans

The degree of profile development and the clay content appeared to be primary determinants of medusahead adaptability on alluvial fans. Plots 16 and 17 were on similar appearing fans, yet on Plot 16 red threeawn (*Aristida longiseta*) and cheatgrass dominated, while medusahead and some squirreltail grass (*Sitanion hystrix*) dominated Plot 17. The soil on Plot 16 showed no profile development, had 83% or more of sand, and was well drained by a gully through the fan. Plot 17 had weak profile development with a maximum of 53% sand, and was less well drained (Table 2). Apparently, the combination of more favorable topographic position, lower sand content, and greater profile development offset the need for the well-developed clay B required for medusahead occupation on many sites. However, medusahead did not dominate this site as completely as at many other sites studied. Plots 21 and 22 were also on an alluvial area. Plot 21 was similar to Plot 16, but Plot 22 had a strongly developed B_2 horizon at 14 inches with 39% clay and was completely dominated by medusahead.

Influence of Perennial Competition

Stands in which medusahead could be rated as anything more than sparse were all seral. In virtually every case, the sites invaded by medusahead had been occupied previously by seral species, mainly annuals, which had in turn replaced climax perennials depleted by overgrazing, fire, or cultivation.

The influence of a remnant perennial stand is shown by a comparison of sites 7 and 9 (Table 2). Site 9 was similar to Site 7 (dominated by medusahead) in soil type, and would also have been expected to be dominated by medusahead if it had not been occupied by the perennial, squirreltail grass. Medusahead had invaded Site 9, but constituted only a small part of the total vegetation, largely replacing other annuals which had grown sparsely in spaces between the perennial grass clumps.

Meadows in the sagebrush-grass, stands of *Artemisia arbuscula* with perennial grasses, and seedings of intermediate wheatgrass on clay soils in Washington County all exhibited this type of perennial control over medusahead and other annuals.

Apparently perennial competition is an effective deterrent to both medusahead and cheatgrass invasion. This does not mean that perennial cover is a total barrier to these annual species. Robocker (1961) has pointed out that some exotic annuals such as cheatgrass have invaded even long-protected native vegetation in semiarid regions and remain as a small part of the total plant cover.

Relations to Soil Taxonomic Units

The normal system of soil classification did not allow for soil groupings according to medusahead susceptibility *per se* at the Great Soil Group level, or the Order level of the 7th Approximation (Soil Conservation Service, 1960). However, we found that Grumusols (Vertisols) in the study area were universally susceptible, and that Azonal (Entisol) soils were nonsusceptible. If one were to construct a soil gradient of susceptibility to invasion of medusahead with these two groups at the extremes, he would find that soils having intermediate characteristics represent almost all stages of susceptibility. As Heerwagen and Aandahl (1961) indicate, probably the most meaningful soil-plant relationships occur at the series and type levels. Except for Gem County, formal soil surveys were not available, and even in that county the data were not sufficiently detailed to designate series for all study sites.

Relation to Geology and Soil Parent Materials

The pattern of infestation by medusahead in the study area showed strong relationships to the nature of the surface geology and soil parent materials. Generally, the finer the soil texture produced by decomposition of the parent rock, the more suitable were the resulting soils for the growth of medusahead.

Soil developed on basalts (Columbia River basalts, Snake River eruptives) or fine-grained sedimentaries from the Payette and Idaho formation supported the more dense and most extensive stands of medusahead. On the other hand sites whose soils were derived from the Idaho Batholith, Tenmile gravels, eolian and fluviatile sediments and the course-textured Caldwell and Nampa sediments were unlikely to be invaded by this species.

A striking example of the influence of fine soil materials on medusahead invasion was provided in the case of soils derived from the Idaho Batholith. This is the oldest geological formation in the area, and covers large portions of Boise, Valley, and Idaho counties. It consists primarily of granodiorite and quartz monzonite with dikes of aplite and pegmatite. These materials weather rapidly to form deep soils of coarse sandy texture and weak profile development. In rare cases, clays are formed as products of late stage decomposition of feldspars and accessory minerals (Peebles, 1962). Depleted areas on patches of these clay soils were consistently found to be dominated by medusahead, which was otherwise lacking on soils derived from the Batholith.

The other extreme of soil suitability for medusahead was shown in the area west of the Idaho Batholith, in Gem, Payette, and Washington counties. Here the major soil forming material is Columbia River basalt, which produces soils high in montomorillonite-type clays. The most extensive and vigorous stands of medusahead in Idaho occur on this parent material.

Conclusions

This study indicated that medusahead plants required from 2 to 3 weeks longer than cheatgrass to mature in the spring, hence they require a source of moisture for a longer period. The apparent requirement of medusahead for a soil with a high clay content is probably a function of the soil's water-holding potential rather than the water content *per se*. Where other combinations of site factors provides the needed wet environment, neither an abnormally high clay content nor a clay pan near the soil surface was required for medusahead domination of sites in seral stages. Sites occupying topographic positions where extra water is received from run-off, sites with soils of high clay content either at or near the surface, or regions with a distinct mediterranean pattern of winter precipitation with moderately well-developed soils may be highly susceptible to medusahead invasion if the perennial vegetation has been lost. Conversely, soils with little profile development, particularly those which are well drained, will probably remain dominated by cheatgrass in the early seral stage, and medusahead invasion should be of little consequence. The nature of the surface geology as it influences the soil texture derived therefrom is a valuable aid to identifying sites susceptible to medusahead. Evidence supporting these conclusions comes from a similar study with *Aristida longiseta* and *Agropyron spicatum* by Evans and Tisdale (1972). They found *Aristida* confined to the well-drained sites and soils of loam texture or coarser, whereas *Agropyron* occurred on a wider range of soil textures and topographic positions. *Aristida* replaced the *Agropyron* following heavy grazing use, except that medusahead dominated those soils with high moisture-holding capacity or areas of restricted drainage. Thus medusahead can apparently spread throughout the sagebrush-grass zone of the Intermountain Region on sites here described as susceptible if a seed source becomes available and perennial vegetation is lost. Maintaining good management on nondeteriorated sites in this region should assume new importance.

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Position Announcement

Manager of Biological Station: The Nature Conservancy is seeking a qualified individual to manage and direct a biological station on a 7,600 acre prairie preserve located in McPherson County, South Dakota, 50 miles northwest of Aberdeen. Must have broad training in grassland ecology, preferably with degree in natural sciences. Experience in and motivation toward the development and establishment of research programs necessary. Will be responsible for all management aspects, including construction, fence repair, and necessary maintenance. Must show ability and willingness to work with minimum of supervision, skill in coordinating volunteers, and responsiveness to local community needs. Salary dependent upon qualifications. Immediate opening. Contact: *Grace M. McDermott, Director of Preserve Management, The Nature Conservancy, 325 W. 15th St., Minneapolis, MN 55403, Phone: (612) 871-6231.*

Have you mailed in your SRM ballot?