FOREST RESEARCH NOTES

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
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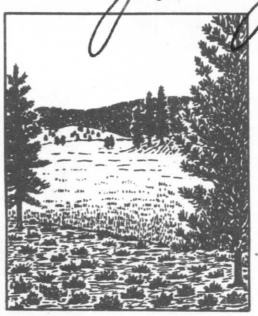

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OBSERVATIONS ON GROWTH AND CONTROL OF TARWEED

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Tarweed (Hemizonia virgata), a summer growing annual abundant on California foothill ranges, is sticky, ill-scented, and nearly worthless as a forage plant. It grows tallest and rankest on the best soils, using moisture that might well produce better forage plants. In the summer tarweed towers over the dry annual grasses and makes grazing use difficult (fig. 1). Stockmen would like to be rid of this objectionable plant. Studies at the San Joaquin Experimental Range have shown that mowing in the early full flowering stage will kill tarweed and greatly reduce the seedling stand in succeeding years. Tarweed is also killed by broadcast chemical spraying aimed at control of brush seedlings and sprouts.

GROWTH HABITS

Tarweed seed germinates in the fall after about an inch of rain has fallen. Winter growth is slow. When most annual-plant vegetation is mature in the spring, tarweed plants may be as little as an inch or as much as a foot tall, but tarweed continues to grow during the summer. Flowering starts during the latter part of July, is well underway by mid-August, and continues until after rains have started the next crop of plants in the fall.

Summer growth of tarweed is possible because it sends roots to depths where soil moisture is above the wilting coefficient through all or most of the summer. In one early study at the San Joaquin Range during a year of abnormally high total and late spring rainfall, 1,694 tarweed and 36 Spanish clover (Lotus americanus) plants were pulled from a 16-foot-square plot. An adjoining paired plot with a similar number of tarweed plants was undisturbed. On June 22, all depths of the deep swale soil on both plots contained available water. After July 6 the surface 6 inches of soil on both plots was below the wilting coefficient, but below this depth the amount of available soil water was related to the presence or absence of tarweed (table 1). At a depth of 3 to 4 feet, moisture was available throughout the summer, but the quantity was much greater where the tarweed had been removed.

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Figure 1.--A thick stand of tarweed on productive soil.

Tarweed responds to good soil and moisture conditions. It reaches greater height and lateral growth but not always greater numbers of plants per square foot on swale soil which is deeper and finer textured than the slope soils above (fig. 2). On ridges or slopes with coarse-textured or shallow soil, it makes little or no growth in most years. On slopes and ridgetops having fine-textured soil it usually grows well. Years of above normal total or late spring rainfall have produced more numerous and taller plants than drier years (table 2). During 7 years the highest total rainfall produced by far the greatest number of tarweed plants and the driest year the fewest.

No attempt was made to determine the effect of density of other annuals on survival, but any grazing or cultural treatment which conserved soil moisture without at the same time destroying tarweed favored its heavy production. Close grazing before the middle of the growing season reduced other annuals more than the slower developing tarweed. Close grazing later in the growing season destroyed or set back many tarweed plants and greatly reduced their production.

In a field of Stipa, tarweed plants were much smaller between the grass plants and for about a foot on each side of the rows than outside a few feet away. Also, hardinggrass (Phalaris tuberosa stenoptera) plants growing not more than 2 feet apart

greatly reduced the stand of tarweed. These two grass species are perennials which root deeper than most annuals, grow later in the spring, and thus compete more with tarweed. Where habitat and management make possible good stands of perennials, tarweed is much less of a problem.

GRAZING VALUE

As a forage plant, tarweed has little value. While herbage is young and succulent cattle eat tarweed along with other species. After it gets several inches high, it is grazed less and less and then little or none as maturity approaches. During late summer or fall it may be nibbled slightly when other feed is scarce but most tarweed plants stand untouched even after other herbaceous plants are gone.

Range pasture observations have indicated that the heaviest use of tarweed occurs where plants are few or where heavy stocking is allowed. Even then tallies of mature plants have showed that not more than one-third were grazed. From one-third to half as much grazing of tarweed was observed in a natural area and an unstocked pasture as occurred in five pastures stocked for light, moderate, and close utilization. This use in unstocked pasture

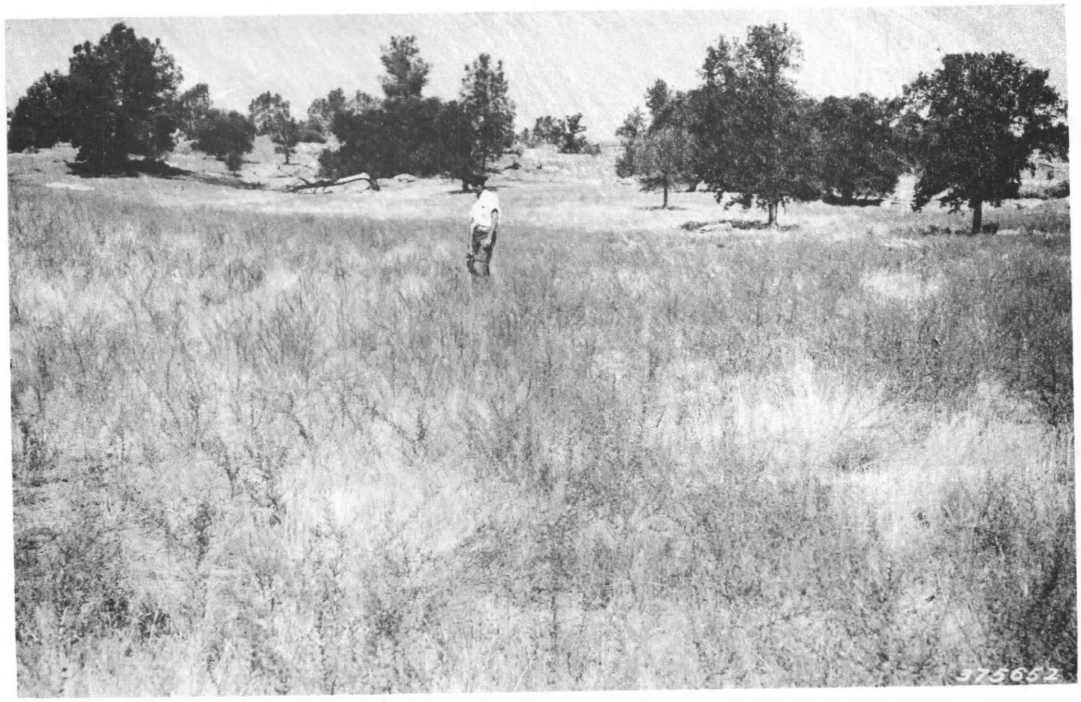

Figure 2.--Tarweed grows vigorously where soil is deep and of medium to fine texture, during years of late rainfall, or where earlier growing annuals have been grazed off sufficiently early that soil moisture is not depleted.

Table 1.--Average percent soil moisture above or below wilting coefficient on plots with and without tarweed 1/

Soil depth, inches	Plot treatment	Date of observation						
		June 22	July 6	July 20	Aug. 17	Aug. 31	Sept. 14	Sept. 28
4-6	Tarweed removed	1.03	-0.27	-0.77	-0.92	-1.02	-0.87	0.08
	Tarweed present	1.48	-0.77	-0.87	-0.07	-0.97	-0.82	-0.57
10-12	Tarweed removed	1.00	0.25	0.75	1.05	0.15	0.20	-0.05
	Tarweed present	1.70	-0.05	-0.40	0.20	-0.40	-0.53	-0.15
22-24	Tarweed removed	2.10	1.35	1.80	1.90	1.10	2.00	1.25
	Tarweed present	1.75	0.40	0.40	-0.15	0.20	0.10	0.45
34-36	Tarweed removed	2.60	2.30	2.25	3.20	1.80	2.55	1.80
	Tarweed present	1.65	0.65	0.65	0.55	0.50	0.50	0.70
46-48	Tarweed removed	2.70	2.55	2.25	3.70	2.20	3.85	2.60
	Tarweed present	2.10	1.05	0.60	0.35	- .20	0.40	0.75

1/ Data from two paired plots each 16 feet square. Wilting coefficients were determined by growing sunflowers in pots, sealing them, and measuring the moisture remaining after permanent wilting.

Table 2.--Numbers and size of tarweed plants in September on permanent plots located in three pastures

Year	Rainfall	Plants per plot[1]	Average height of plants	Average spread of plants
	Inches	Number	Inches	Inches
1936	22.65	4.6	9.8	5.2
1937	22.96	36.4	11.9	5.8
1938	32.09	207.8	12.6	3.3
1939	12.25	3.8	3.6	[2]0.1
1940	21.22	52.0	14.7	8.0
1941	28.33	34.8	11.6	5.3
1942	21.54	6.0	12.1	8.1

1/ Each plot contained 50 square feet.

2/ Mostly single stemmed plants.

must have been by rodents. Small animals such as ground squirrels, also may be responsible for part of the tarweed grazing in stocked areas.

MOWING FOR CONTROL

Since tarweed is an annual and seeding can be prevented by mowing, a small study was started in 1948 to determine the feasibility of clearing mowable areas of this weedy pest. A rectangular plot of land containing about 1-1/3 acres of gentle north-facing swale and slope was selected. It had a heavy stand of tarweed interspersed with and understoried by annual grasses, some annual broadleaved species and occasional purple stipa (Stipa pulchra) and hardinggrass plants. Tarweed growth was most rank along the swale side of the study area. Height and average size, but not numbers of plants, decreased up the slope.

The area was divided into 12 strips, each 40 feet wide and about 120 feet long. Each strip started along the swale edge and extended up the slope.

Three dates for first-year mowing were selected (table 3). Plots were mowed in May, in May and July, in May and August, and in August without a previous mowing.

At the first mowing, tarweed was in the leaf stage, growing actively, and varied in height from a few inches to a foot or more. By the July mowing date scattered flowers were visible. By mid-August the plants were in full flower and seed was beginning to form.

In 3 succeeding years, 4 plots including 1 of each of the first year treatments were left unmowed. The other 8 plots were mowed only during the flowering period.

Table 3.--Mowing schedule for tarweed plots

Plot number	Date of mowing			
	1948	1949	1950	1951
1	May 21 July 6	-- --	-- --	-- --
2	May 21	Sept. 21	Aug. 24	Aug. 20
3	Aug. 17	Sept. 21	Aug. 24	Aug. 20
4	May 21 Aug. 17	-- --	-- --	-- --
5	May 21 July 6	Sept. 21 --	Aug. 24 --	Aug. 20 --
6	May 21	Sept. 21	Aug. 24	Aug. 20
7	Aug. 17	--	--	--
8	May 21 Aug. 17	Sept. 21 --	Aug. 24 --	Aug. 20 --
9	May 21 July 6	Sept. 21 --	Aug. 24 --	Aug. 20 --
10	May 21	--	--	--
11	Aug. 17	Sept. 21	Aug. 25	Aug. 20
12	May 21 Aug. 17	-- Sept. 21	-- Aug. 25	-- Aug. 20

RESULTS FROM MOWING

Mowing only in May did not effectively reduce the tarweed. Only about one-fifth of the plants were killed. The 80 percent which survived stooled out too near the ground for later mowing to prevent seed production. The density resulting from the vigorous regrowth was probably greater than it would have been without mowing. July mowing killed about 90 percent of the tarweed plants, but the scattered stand of remaining plants branched profusely from near the base and produced much seed.

Tarweed was killed by mowing in August. The only plants to survive August mowing were those few lying flat on the ground. There was no branching from the base and production of seed was prevented.

At the end of June the following year, counts were made to determine abundance of tarweed seedlings for each of the four 1948 mowing dates. Results of the counts were as follows:

	May 21	May 21 July 6	May 21 August 17	August 17
No. per average sq. ft.	21.9	14.1	16.3	2.8
Average height (inches)	10	8	9	8
Percent of ground surface covered by tarweed	20	12	7	3

Number of seedlings declined steadily with later mowing up to the time of full flowering. Also, number of seedlings was directly related to proportion of the ground covered by tarweed because size of plant varied little between plots. The plots mowed only on August 17 had a sparse tarweed stand but good grass, filaree, and clover production--better than on plots mowed earlier. There appeared to be little or no difference in growth of grasses and forbs other than tarweed among the other three mowing dates.

Because mowing at flowering time but before seed maturity gave such complete kill of tarweed, 8 of the plots, including 2 of each 1948 mowing treatment were mowed at flowering in 1949, 1950, and 1951. Four other plots including one of each of the 1948 treatments were not mowed. In 1949 mowing was not done until September, and some of the earliest blooming plants may have matured seed. During 1950 and 1951 mowing in August allowed no seed to mature. Seed may have blown or been carried onto the plots from surrounding areas, however, and occasional plants lying on the ground were not completely eliminated by the mower. But even so, the stand was greatly reduced:

	1950 mowed	1950 not mowed	1951 mowed	1951 not mowed	1952 mowed	1952 not mowed
Average number per square foot	3.1	6.7	0.4	3.0	0.3	3.2
Average height (inches)	14	13	19	21	16	18

In August 1950, it was estimated that tarweed on the unmowed strips made up an average of 31 percent of the herbage produced; on the mowed strips, 11 percent. In 1951 the estimates were 24 percent on the non-mowed strips and 5 percent on the mowed. In 1952 no mowing was done, but the proportion of tarweed in the total herbage remained about the same. Five years later, in 1957, there were still only half as many tarweed plants per square foot on an average mowed strip as on the non-mowed strips.

EFFECT OF CHEMICAL SPRAY

An 18-acre area, located at 2,500 feet elevation in the Sierra foothills, was broadcast sprayed in June 1954 to control brush seedlings and sprouts a year after a controlled burn. The spray solution at 10 gallons per acre contained about 3 pounds per acre of a 50-50 mixture of low-volatile esters of 2,4-D and 2,4,5-T. All sprouting brush on some other areas totaling 33 acres was hand sprayed but little solution touched other plants. Two unsprayed check strips each 132 feet wide, went through the areas to aid in evaluating effectiveness of the spray. Later in the summer almost all tarweed plants were eliminated from the broadcast sprayed area, but a thick stand grew in the check strips and on land where sprouting plants were hand sprayed. The reduction in tarweed was still apparent during the summer of 1957.

The spray treatment was applied after other desirable annuals, except Spanish clover (Lotus americanus), had matured; consequently they were not damaged. Tarweed kill was so definite in this test that additional tests of chemical spraying are justified.