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CLIPPING AFFECTS FLOWERING
of California-poppy at two growth stages

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The effects of clipping California-poppy (*Eschscholzia californica* Cham.) at various growth stages on plant survival, flowering, herbage yield, and root production were studied at the San Joaquin Experimental Range, in central California. Plants were clipped once to a 2-cm stubble at one of six stages. Through the early reproductive stage, a single clipping had little effect, but clipping at either the start or peak of vernal flowering reduced the display of spring flowers. Other factors studied were not significantly affected.

Oxford: 168.2:451.1:176.1 Eschscholzia californica Retrieval Terms: Eschscholzia californica; browse damage.

Much of the land still available for growing the California-poppy (*Eschscholzia californica* Cham)—the State flower—is devoted to livestock production. Whether livestock consider the plant palatable seems to be in dispute. Some authorities[1] maintain that cattle relish the plant; others[2] report that the opposite is more nearly true. The difference may reflect changes in palatability related to different growth stages.

A growing concern for the future of the California-poppy has triggered widespread calls for a "California Poppy Preserve," in which the species would be protected.[3] Research has suggested, however, that protection may be the wrong cultural approach.[4] Grazing or other kinds of disturbance may actually help perpetuate poppies. Site disturbance that produces a harsh microclimate or reduces competition or both may favor California-poppy.[5]

Specifically, how does grazing affect California-poppy? As a step to finding out, we did a study at the San Joaquin Experimental Range, in central California, in which clipping was used to simulate grazing. The effects of clipping at various growth or phenological stages on plant survival, flowering, herbage yield, and root production were studied. We found that clipping did not affect poppy survival. Clipping at the start and at the peak of vernal flowering reduced the display of spring flowers, but did not significantly affect other factors. To take full advantage of these findings, however, will require more information than is now available about the seasonal selection of California-poppy.

METHODS

Experimental Design

Six treatments based upon phenological stages (*table 1*) were arranged in a 6 by 6 Latin Square

design in a fenced area. By "clip" we mean the removal of herbage to a 2-cm stubble height. By "harvest" we mean the removal of herbage to soil level.

The six treatments and dates of treatment were:

1. Clip at early to mid-vegetative stage (Feb. 12, 1974), harvest with control.
2. Clip at mid- to late-vegetative stage (March 4, 1974), harvest with control.
3. Clip at early reproductive stage (March 20, 1974), harvest with control.
4. Clip at start of vernal flowering stage (April 2, 1974), harvest with control.
5. Clip at peak of vernal flowering stage (April 24, 1974), harvest with control.
6. Control—harvest at the start of the summer-autumnal flowering stage (May 9, 1974).

Preparation and Care

A 23-foot (7-m) square area was spaded, worked smooth, and rolled. Cylinders (furnace pipe) 30 inches (76.2 cm) long and 8 inches (20.3 cm) in diameter were set into the soil to a depth of 27.5 inches (70 cm). They were placed on 3.3-foot (1-m) centers on a 6 by 6 grid.

Each cylinder was partly filled with screened soil that had come from an area adjacent to the square. Water was added in volume, permitted to percolate, and soil added again until it was about 2 cm from the top. Our objective was to pack the soil as naturally and uniformly as possible. Extra soil was placed around the exposed outer portions of the cylinders to maintain normal soil temperatures there.

Table 1—*Phenological stages at which California-poppy was clipped, harvested, or both, San Joaquin Experimental Range, California, 1974*

Phenological stage	Plant characteristics
Early to mid-vegetative	Leaf length about 8 cm, 10 true leaves present, cotyledons no longer evident
Mid- to late-vegetative	Leaf length about 15 cm, no flower buds evident
Early reproductive	First flower buds evident in center of leaf cluster
Start of vernal flowering	First flowers open and large with petals bright orange from the base to apex, few well developed and several less well developed buds evident
Peak of vernal flowering	Flowers large with petals bright orange from the base to apex, earliest seed capsules well developed with the sutures starting to turn brown, many buds still developing
Start of summer-autumnal flowering	Latest flowers to open smaller than vernal ones, petals grading from orange at the base to yellow at the apex, maturity of older seed capsules well advanced and a few have fallen

Commercial seed of an annual variety of California-poppy was planted to a depth of one-fourth inch (0.6 cm) in the cylinders on November 9, 1973. After germinating, poppy seedlings were thinned to a 1-inch (2.5-cm) spacing. On January 17, 1974, when the plants were about 2 inches (5 cm) tall, they were thinned to leave three healthy plants per cylinder.

The cylinders were weeded as needed to remove seedlings of other species, eliminate interspecific competition, and keep the cylinders free of roots other than those of the three poppy plants. Late germinating poppies were also removed. In addition, a band 4 inches (10 cm) wide around each cylinder was kept free of vegetation.

All cylinders were covered with wire cages in late November to protect the seedlings. Birds or mice or both had nipped some seedlings, and protection was continued until the end of the study.

Except for one artificial watering during a dry spell in March, moisture was provided by natural precipitation. Natural precipitation from February to harvest in May totaled 7.8 inches (19.8 cm).

Data Collection

Before the plants in a given cylinder were clipped or harvested or both, we tallied the numbers of opened flowers and visible buds. Herbage was oven-dried at 60°C for 24 hours and weighed to one-tenth gram.

For treatments one through five herbage weights at harvest (May 9) were added to the weights at clipping to obtain the total weights of herbage produced. Similarly, the numbers of opened flowers present at clipping and harvest were summed. The total number of visible buds was added to the total number of opened flowers to give the potential flowering at the time of harvest.

Each cylinder was carefully lifted, placed on a one-fourth-inch (0.6-cm) mesh screen, and opened to expose the soil and roots. Soil was gently washed from the roots using a fine spray of water. The root material was carefully gathered off the screen, bagged, and air dried for 1 week. Afterwards, the root material was put in a crucible, weighed, ashed at 600°C for 4 hours, and reweighed to determine the "ashed root weights."

Table 2–*Herbage yield, root weight, flower production, and potential flower production of California-poppy plants clipped at six phenological stages, San Joaquin Experimental Range, California, 1974*

Phenological stage	Total herbage yield	Ashed root weight	Flower production	Potential flower production
	Grams/plant			*Number/plant*
Early to mid-vegetative	11.65	2.38	26.8 ab[1]	42.1
Mid- to late-vegetative	13.02	2.08	26.4 ab	40.6
Early reproductive	11.11	1.97	23.2 ab	39.9
Start of vernal flowering	10.07	2.22	14.1 b	49.6
Peak of vernal flowering	14.46	1.99	13.7 b	52.4
Start of summer flowering	17.08	2.45	36.9 a	53.2

[1] Values followed by one or more like letters do not differ significantly at the 5 percent level of probability by Tukey's test (D = 19.9). The F-ratios were: for treatment effects–3.84. F.95 (5,20) = 2.71; for herbage yield–1.03, for root weight–2.71, and for potential flower production–0.67.

Statistical

While all of the soil was screened, we could not be certain of duplicating soil texture and fertility in each cylinder. We used the Latin Square experimental design, therefore, to remove the effects of possible soil heterogeneity.

Because three poppy plants were left to grow in each cylinder, results were converted to values per plant for analysis. Conversion to a per plant basis allows the results to be presented in a more standard format.

Using analysis of variance for Latin Square, we tested the null hypothesis for herbage yield, ashed root weight, flower production, and potential flower production. Where the F-ratios from analyses of variance were significant, Tukey's Test[6] was used to find differences between treatment means.

RESULTS AND DISCUSSION

The only significant differences we found were the numbers of flowers produced (*table 2*). Clipping at either the start or the peak of vernal flowering reduced the display of spring flowers. If poppy plants are clipped at the start of flowering, the developing buds are removed. Flowering must await regrowth and the development of new buds. Clipping the plants at the peak of flowering removes both the flowers then present and all remaining vernal flower buds.

Either time of clipping will reduce the number of flowers, but clipping or grazing poppies at the peak of vernal flowering seems to be most damaging. While the plants can make good regrowth and new buds will develop, too little of the spring growing season is left to allow flower maturation. Therefore, the entire spring seed crop is eliminated. Clipping or grazing at the start of vernal flowering permits a spring seed crop to develop.

Clipping had no effect on survival of the poppy plants. One plant died, but its death was not caused by clipping.

Although we could find no differences between root weights by using Tukey's Test, the analysis of variance produced a barely significant F-ratio for treatment effects. Clipping or grazing poppies at the peak of vernal flowering may reduce the root biomass. Even if this is so, it is probably of minor concern because the poppy roots all appeared healthy. Roots extended the length of the cylinders in all cases.

Root penetration to the 30-inch (76-cm) depth of the cylinders was not expected. Annual varieties of California-poppy produce an unthickened root that can reach a depth of about 8 inches (20.3 cm).[7] The deep, friable soil in the cylinders and the prevention of lateral root spread may explain the unusual rooting depth.

Some effects of clipping California-poppy plants during the early to mid- to late-vegetative and the early reproductive stages were not statistically significant; they still should be considered. These effects suggest that early clipping or grazing will not significantly reduce either total herbage production or the numbers of vernal and potential flowers. Poppy plants can regrow quickly after clipping, and by the time they reach the peak of vernal flowering appear normal. Also, clipping California-poppies before the flush of spring growth did not stimulate greater flower production.

The effects of multiple clipping of the same plant

at different times were not studied. But we suspect that, as long as poppies are not clipped or grazed too frequently and treatment is stopped by the start of vernal flowering, California-poppies will produce enough vernal flowers and seed to perpetuate the species and beautify the landscape.

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NOTES

[1] Clements, Edith S. 1928. *Flowers of coast and Sierra.* p. 16-17. H. W. Wilson Co., New York.

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[4] Ratliff, Raymond D., and Stanley E. Westfall. *Protection may be· wrong for California-poppy.* (Manuscript in preparation.)

[5] Ratliff, Raymond D., Stanley E. Westfall, and Richard W. Robarts. 1972. *More California-poppy in stubble field than in old field.* USDA Forest Serv. Res. Note PSW-271, 4 p., illus. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif.

[6] Snedecor, George W. 1956. *Statistical methods.* p. 251-253. Iowa State Univ. Press, Ames, Iowa.

[7] Cook, S. A. 1962. *Genetic system, variation, and adaptation in Eschscholzia californica.* Evolution 16(3):278-299.

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