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Growth responses of Three Annual Clovers to treatments with 2,4-D—Part I

Annual clovers are seeded following brush removal in many range improvement programs in California. In the growing season following brush removal, brush seeds germinate, and old brush roots and crowns sprout. These seedlings and sprouts can be destroyed readily by 2,4-dichlorophenoxyacetic acid—2,4-D—sprays if they are applied soon after emergence. Such applications are most effective in the spring when growth is rapid. Unfortunately, at that time the seeded clovers are also susceptible to injury by 2,4-D.

In addition to stockmen, seed producers are also interested in the tolerance of annual clovers to 2,4-D used for control of the broad-leaved weeds in seed production fields. Also, annual clovers are often seeded on abandoned grainland, or with a grain crop. They furnish valuable forage in the grain stubble after harvest and in ensuing years. Here again, their tolerance to 2,4-D is of interest to the producer who desires weed control on his grainlands.

Three annual clovers are widely used, often in mixture, for seeding rangeland in California: rose clover—*Trifolium hirtum* All.; subterranean clover—*T. subterraneum* L.; and crimson clover—*T. incarnatum* L. A series of experiments has been carried out to study the tolerance of these species to 2,4-D formulations. Main considerations were the comparative effects of rate of 2,4-D, volume of spray material, and time of application in relation to growth stage of the three clovers.

Range Conditions

The studies were begun in 1957 with an experiment established on an Auburn type soil in El Dorado County, at 1,800′ elevation. This site is typical of improved range in the foothills of the Sierra Nevada. In 1952 the area had been mechanically cleared, and the piled woody plant material had been burned. A mixture of the three clovers was then seeded, and a mixed stand of rose clover, subclover, crimson clover, volunteer grasses, and forbs resulted.

The experimental design consisted of nine replications of a randomized complete block type, each plot measuring 10′ by 20′. The herbicide treatments consisted of two rates of a 2,4-D ester formulation—Esteron-10-10, a low volatile propylene glycol butyl ether ester; 0.3 and 3.0 pounds per acre, applied at three different times corresponding to three growth stages of the clovers. The 0.3 pound per acre rate was intended to correspond to a broadleaf weed spray, and the 3.0 pounds per acre to a brush-killing spray. Total spray volume was 100 gallons per acre, including one gallon per acre Diesel oil. A hand-pump type sprayer with a pressure gauge and a single Teejet No. 8002 nozzle was used. The pressure was kept as close as possible to 30 pounds during the spraying process, and the contents of the spray tank were agitated frequently to maintain a uniform spray mixture.

Plots were sprayed during the spring of 1957 on March 30, when all species were in a vegetative stage; on April 29, when rose clover was in a late bud to early bloom stage and crimson clover and subclover were in full bloom; and on May 23 when rose clover was in full bloom and crimson clover and subclover were in late bloom. At the last date some subclover plants were still blooming, but most seed heads were formed and were rapidly approaching maturity.

Clovers were harvested during early July after they had reached the mature ripe stage. Harvests were made in the early morning hours to avoid seed shatter. Four one-third-square-yard quadrats uniformly spaced down the plot center were cut from each plot. Three of the quadrats were separated according to each of the three clovers at time of clipping, with special consideration given to accurate separation of seed heads. The separate clover samples were put through a small hammer mill running at moderate speed, and the resultant threshed material was cleaned in a clipper cleaner. The fourth quadrat was clipped at ground level, dried and weighed, and taken as a measure of total dry matter production on the plots. Visual observations were made on each plot at that time, and the relative proportions of three clovers, grasses, and forbs were estimated.

After the harvests, the remaining forage was grazed off. In order to evaluate the effect of the treatments on the following year's stand, step-point observations of botanical composition were made on March 18, 1958. Seventy-five points were recorded for each plot.

The germinability—viability—of the seed was determined by using 100-seed lots on moistened filter paper in small glass dishes. Rose clover was germinated at 59°F and crimson clover and subclover were germinated at 68°F. Quantitative data were obtained for all species on the effect of the treatments on the proportions of normal seedlings and 2,4-D-injured seedlings.

Since crimson clover was present in rather small amounts, and showed similar results to rose clover in all factors considered, only data for rose clover and subclover are reported.

Cultivated Conditions

This experiment was initiated in the fall of 1957 at Davis—50′ elevation. The experimental design was a split-block with clover species as one series of main plot treatments, and 2,4-D treatments as the other. There were five replications, each consisting of four clover species main plots, crossed by 10 treatment main plots. Each replication had a border row on each side which was of the same species as the outermost utilized row.

The following species were seeded November 9, 1957, in 16′ rows, 3′ apart: rose clover, subclover—variety Mt. Barker—crimson clover—variety Dixie—and mixed rose clover and subclover.

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Addition of Minerals to a beef cattle ration

Thirteen mineral elements are essential to animals, and must be present in their diet: calcium, chlorine, cobalt, copper, iodine, iron, magnesium, manganese, phosphorus, potassium, sodium, sulfur, and zinc. Under certain conditions or in certain limited areas, livestock production has been greatly improved by addition of one or more of these essential elements to the animals' diet. This finding has led to the extensive use of mineral supplements in livestock feeding even in areas where specific deficiencies have never been shown to exist. It is important that livestockmen know definitely the conditions and areas under which one or more minerals is likely to be lacking so that expenditures for unnecessary feed supplements for specific situations can be avoided.

Approximately one-third of all California's feedlot cattle are in the irrigated desert valleys of Imperial and Riverside counties. These animals are fed widely varying rations. Generally, however, the major components of the rations are produced in the desert areas. A trial was conducted to determine if additional minerals would be beneficial to Hereford steers on a fattening ration the components of which were produced in the Imperial Valley.

Two groups of steers were fed, for 152 days, a basal ration of 40% alfalfa hay, 45% barley, and 15% molasses dried beet pulp—ration analyzed 14.6% protein, 3.6% lignin. One group received, in addition, a complex mineral supplement mixed with the basal ration at the rate of two pounds of supplement to 98 pounds of ration. The supplement was composed of 1.5 grams of cobalt sulfate and the following percentages of minerals: dicalcium phosphate, 45.5; iodized salt, 30.4; magnesium sulfate, 21.2; ferric citrate, 1.8; manganese sulfate, 0.4; zinc sulfate, 0.4; copper sulfate, 0.3.

No significant differences were found in average daily gains or carcass yields. The control animals had significantly fatter carcasses than did those fed extra minerals although all animals were sufficiently well finished to be graded choice. Analysis of the feed intake data indicated a very significant decrease in consumption of the mineral-fortified ration. It could not be determined from the data whether this indicates a decrease in ration palatability due to the mineral supplement or is simply a result of animal variation.

The results of the trial indicate that rations made up of feedstuffs produced in the Imperial Valley, which are adequate in content of other nutrients, will also supply sufficient minerals to permit maximum utilization of the feed by beef cattle.

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Gains, Feed Consumption, and Carcass Data of Control and Mineral-Supplemented Steers

Treatment	Steers per lot	Initial weight lbs.	Total gain lbs.	Daily gain lbs.	Daily feed* lbs.	Feed/ lbs. gain	Carcass yield† %	Body fat‡ %
Control	9	596	375	2.46	20	8.1	59.5	26.3
Minerals	8	591	365	2.40	19	7.9	60.6	24.6

* Dry basis.
† Warm carcass weight divided by final experimental weight.
‡ Live weight basis.

CLOVERS

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Ten pounds per acre of pure viable subclover seed were used as the standard rate with the seeding rate for the other species adjusted accordingly on a per viable seed basis.

Herbicide treatments consisted of 0.3 and 3.0 pounds per acre of 2,4-D ester—Esteron 10-10. Two volumes of spray material were tested at both 2,4-D rates—10 and 100 gallons per acre—including one gallon per acre of Diesel oil at both spray volumes.

Spray treatments were made with a hand-pump type sprayer equipped with a three-nozzle hand boom. For the 10-gallon per acre volume, Monarch No. 20—.0020-inch diameter—tips with 100-mesh screens were used. For the 100-gallon per acre volume, No. 59—.0059-inch diameter—tips with 40-mesh screens were used. Pressure was maintained as nearly as possible at 30 pounds as indicated by a pressure gauge at the pump valve.

Spray treatments were made on April 17, 1958, and May 22, 1958. At the first date the subclover was in a very early bloom stage, the crimson clover was in the immediate pre-bud stage, and the rose clover was still in a vegetative condition. At the second date the subclover was still flowering. The crimson clover was about 90% to 95% past full bloom, with most seed heads browned. The rose clover was about 50% past full bloom with 50% of the heads at full bloom. The plot area was sprinkler irrigated once on May 9, 1958, to alleviate the harmful effects of a prolonged dry spell. To eliminate possible effect of weed populations resulting from treatments, weeds were removed several times by hand hoeing.

Harvests were made during the first week of July, in the early morning hours. Eight feet of row were harvested from the center of each plot. In the case of the mixed rose and subclover rows, the two species were separated at time of harvest. The plant material was air-dried for several days and then weighed. The seed was threshed, cleaned, and germinated as in the previous experiment.

The second part of this article will be published in August.

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