up the full bins in the field and load them on trucks for transport to the packing house.

During the 1962–63 harvest, about 4% of the crop was harvested mechanically on an experimental basis. This was followed by commercial harvesting of 10% of the crop during 1963–64, and 30% during 1964–65, with equipment especially designed or modified for this purpose. It is estimated that 65% of the 1965–66 crop will be harvested mechanically.

From time studies of harvest operations and evaluation of harvest records, it has been found that labor requirements of mechanical harvesting systems now in use are 20 to 50% of conventional hand picking requirements per 1,000 lbs of fruit havested. Since the equipment is expensive, and requires many acres to justify its use, some smaller growers who want to harvest their own fruit have developed systems of mechanical harvesting which still employ the ladder. In these systems the picker uses a ladder to enter the palm. Once he is in the palm he cuts the bunch and lowers it by rope to a shaker trailer where the fruits are removed from the bunch. This saves about 50% in labor and total harvesting costs.

The total harvest costs, including machines and necessary labor, have been reduced to about half the conventional costs. Exact labor requirements depend upon the harvest system being used, conditions in the date garden, type of labor, and amount of acreage covered with harvest systems capable of high capacities. Since the harvest season has been shortened (by delaying the start of harvest and then harvesting by bunches), a given acreage must now be harvested in a shorter period and peak labor requirements for the industry may be slightly higher than previously mentioned figures suggest.

Improvements will no doubt be made as more acreage is adjusted to the equipment, but the mechanical harvesting of dates is now a commercial reality. One of three areas in which gains may be made is in the improvement of existing equipment. This will be the smallest gain, however, since most of the mechanical advantages have already been realized. The second area of improvement involves the conversion of more acreage to mechanical harvesting with necessary changes in cultural practices, such as irrigation, tillage, and row length. Third, an increase in the annual use of each machine can be made so that a maximum acreage is harvested—either on a contract basis or by combining the small acreage holdings of a group of growers—to justify the purchase of the most efficient mechanical harvesting equipment.

Remaining problems in date production include the mechanization of the pollination operation so that commercially acceptable yields can be obtained without the accompanying high labor requirements. All palms must now be hand pollinated and the timing is most critical. Research is now underway to develop new pollination methods.

R. M. Perkins is Assistant Specialist, Department of Agricultural Engineering, University of California; and G. K. Brown is Agricultural Engineer, Agricultural Engineering Research Division, U.S. Department of Agriculture, Riverside, California.

PICLORAM

. . . a promising new herbicide for control of woody plants

J. R. GOODIN · L. R. GREEN · V. W. BROWN

In more than 20 years of research on the chemical control of plant growth, many hundreds of compounds with herbicidal activity have been tested on woody plants and then fallen into obscurity. The standard of comparison for all new chemicals has been and remains 2,4-dichlorophenoxyacetic acid and related chemicals. Their physiological activity, although less than desired, is superior to any other compounds screened.

The latest, and among the most promising herbicides to challenge 2,4-D and 2,4,5-T in control of woody plants is Picloram (4-amino-3,5,6-trichloropicolinic acid). Picloram is a systemic herbicide readily absorbed by both leaves and roots that injures or kills most woody species, as well as herbaceous broadleaved plants. Established grasses are generally tolerant, and growth responses following applications of Picloram resemble responses following treatments with the phenoxy herbicides.

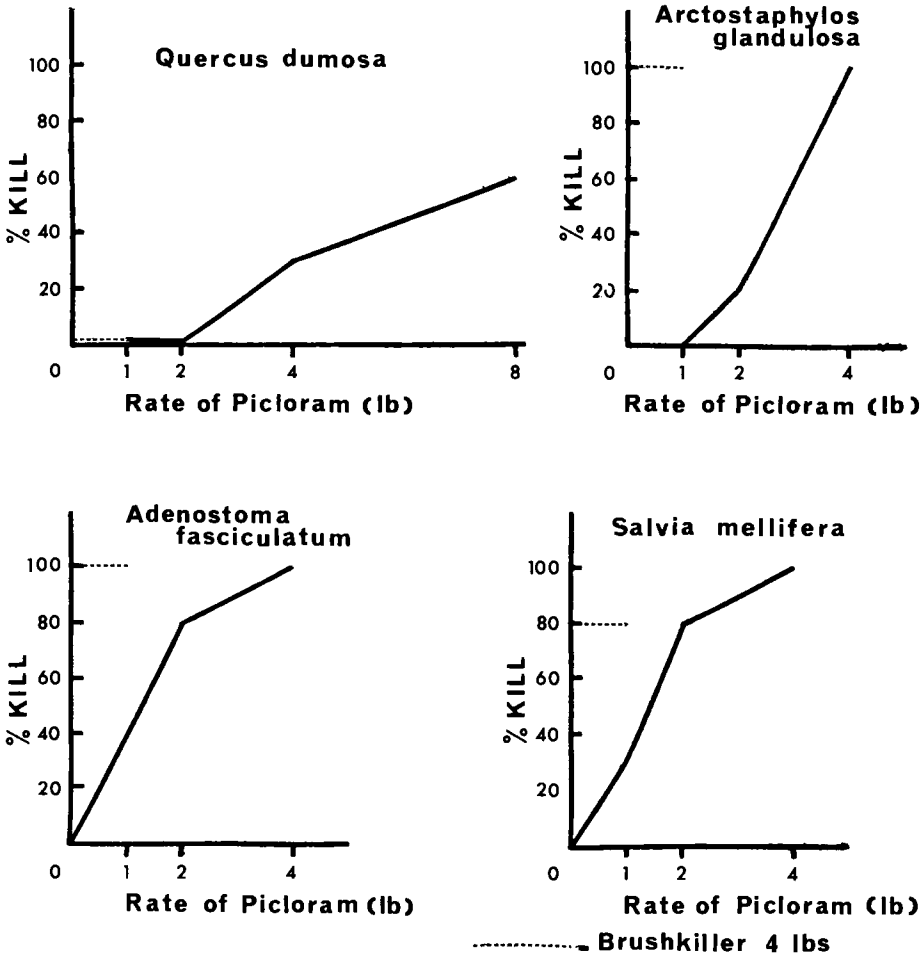
This article is a progress report of experimental use of Picloram as a rangeland herbicide. This material has not yet been registered for rangeland use and is not recommended at this time by the University of California.

Four groups of experiments have been conducted under various site and climatic conditions in southern California to test the relative merits of Picloram in the control of chaparral. Foliar sprays were applied to representative sprouting shrubs on the 1962 Glendora Ridge burn above Glendora in the Angeles National Forest; on the hand-cleared Oak Grove fuel-break and other locations in San Diego County; and on a hand-cleared site on the North Mountain experimental area adjoining the San Bernardino National Forest near Banning. Dry pellets were applied to old, established brush on two San Diego County locations.

Glendora Ridge

The Morris fire of 1962 had removed mature brush from Glendora Ridge. Sprouting was rapid, and by spring, 1963, regrowth was 1 to 2 ft high. Picloram was applied at rates of ½, 1, and 2 lbs per 100 gal of emulsion; and

PERCENTAGE KILL BY PICLORAM AS COMPARED WITH BRUSHKILLER APPLICATIONS ON FOUR REPRESENTATIVE CHAPARRAL SPECIES



"brushkiller" (equal parts of 2,4-D and 2,4,5-T) at 4 lbs per 100 gal. All treatments were applied in aqueous solution sufficient to wet the foliage.

Picloram at all rates completely killed chamise (*Adenostoma fasciculatum*), and controlled laurel sumac (*Rhus laurina*) and Eastwood manzanita (*Arctostaphylos glandulosa*) more effectively than did the brushkiller. At the higher rates, more than half the manzanita and sumac plants were killed but the rest sprouted, usually from the crowns.

Scrub oak (*Quercus dumosa*) was resistant to Picloram just as it had been to all other chemicals in previous tests. At all rates there was considerable leaf kill, generally followed by vigorous stem or crown sprouting.

Oak Grove fuel-break

This fuel-break was originally dominated by chamise with some red shank (*Adenostoma sparsifolium*). It was hand-cleared over a period of years beginning in 1958. Broadcast spraying with brushkiller satisfactorily controlled regrowth of chamise, but not of red shank. In September, 1963, red shank was sprayed with Picloram at rates of ½, 1, and 2 lbs per 100 gal of spray solution. For comparison, 2,4-D and 2,4,5-T, each at 4 lbs per 100 gal, were also tested. At the 2-lb rate of Picloram, all plants of red shank were killed, whereas 2,4-D killed approximately 33% of the plants, and 2,4,5-T killed 50% of the plants. The remaining plants crown-sprouted in these two test areas.

North Mountain experimental area

Brush sprouts on a previously cleared fuel break were removed by hand cutting in March 1964. Ten resprouting shrubs of several species were sprayed July 8, 1964, with Picloram at varying concentrations, and with brushkiller. Results for four of the most important species—*Quercus dumosa, Adenostoma fasciculatum, Arctostaphylos glandulosa,* and *Salvia mellifera* are presented in the graph. Picloram at rates up to 2 lbs had little more effect on scrub oak than the recommended 4-lb rate of brushkiller, but at the 8-lb-per-100-gal rate, Picloram gave promise of good scrub oak control. Sixty per cent of the plants given the higher treatment rate were killed, whereas the brushkiller resulted only in top kill, and allowed subsequent sprouting from the crown area.

Eastwood manzanita was fully controlled at the 4-lb, but not at the 2-lb rate of Picloram. In this test, brushkiller also killed the manzanita sprouts. Fair control was achieved with chamise at the 2-lb rate, but 4 lbs were necessary for complete kill. Brushkiller killed all chamise. Black sage had approximately the same susceptibility to Picloram as did chamise, but was more resistant to brushkiller. Picloram was also tested on California buckwheat (*Eriogonum fasciculatum*) and woolly blue-curls (*Trichostema lanatum*). A maximum of 60% kill was achieved for the buckwheat, and 50% kill for woolly blue-curls.

Santa Ysabel

Picloram was applied at the rate of 1, 2, and 3 lbs per 100 gal of water to mature stands of chamise on May 14, 1963. In the two years following treatment, an almost total kill has been effected. Isolated branches are still alive on a few plants. In comparable plots treated with 2,4-D, many plants have resprouted both along branches and from the crown area.

Dry applications

Pelleted Picloram (10% active ingredient) has been applied in limited tests at Oak Grove, Santa Ysabel, and Lakeside, all in San Diego County. *Adenostoma sparsifolium* was readily controlled by 2 and 4 ounces of pellets applied at the base of each plant. Plants similarly treated with high rates of Fenuron (3-phenyl-1, 1-dimethyl urea) or sprayed with "brushkiller" suffered considerable leaf kill, but many plants have stem- or crown-sprouted.

At Santa Ysabel, dense stands of chamise were treated with 50 to 150 lbs per acre of 10% Picloram pellets. All rates of application have given complete kill and native grasses are rapidly invading the site. No resprouting has been observed. Similar stands of chamise treated with 2,4-D spray have resprouted.

At Lakeside, plots of a mixed chaparral vegetation (*Adenostoma fasciculatum, Eriogonum fasciculatum, Salvia clevelandii, Xylococcus bicolor, Artemisia californica,* and *Rhus laurina*) were treated in exactly the same manner as those at Santa Ysabel. All rates have

given complete control, and invasion by native grasses has been rapid.

Conclusions

These experiments, comparing Picloram control data from several environmental conditions and vegetation types in southern California, lead to the conclusion that Picloram has certain advantages over standard brushkillers: (1) Careful observation of plant condition following foliar application indicates that leaf kill occurs more slowly than with brushkillers. This delay may account for greater translocation of Picloram. Foliar applications require total coverage while translocation may not be sufficient to kill the entire plant if one or two branches escape contact. On the other hand, soil applications appear to be absorbed readily and distributed throughout the plant. Greatest consistency in total plant kill has been obtained with soil applications. (2) Experience of other workers and observations from these studies indicate that Picloram has a relatively long residual life in the soil which may prove a distinct advantage in brush control, since retreatment to control sprouting has been an expensive and time-consuming maintenance problem. (3) The relative tolerance of grasses to Picloram allows the invasion of native grasses or the seeding of introduced grasses to be accomplished. A reasonable stand can probably be achieved during the season following treatment.

J. R. Goodin is Assistant Agronomist, Department of Agronomy, University of California, Riverside; L. R. Green is Fuel-Break Project Leader, Pacific Southwest Forest and Range Experiment Station, U. S. Forest Service, Riverside; and V. W. Brown is Farm Advisor, San Diego County.

ENCORE and

. . . two new mandarin hybrids with unusually late seasons of use

Encore and Pixie are two new citrus hybrids, suitable for eating out of hand in late spring to summer. Both were originated at the University's Citrus Research Center in Riverside and evaluated primarily in the Riverside area.

MANDARIN VARIETIES with main seasons of use extending from as late as June to August are rare in all citrus areas of the United States. 'King,' which is perhaps a tangor, is one of the latest maturing such varieties. 'Murcott,' a variety of uncertain parentage, is unusually late in season in both Florida and California. Where the spring months are cool, the 'Kara' mandarin is sometimes good in flavor until July. Very late mandarin types have the disadvantage that their fruit must remain on the tree through the winter and spring. This fruit also meets severe competition from summer-ripening fruits of many other species. Nevertheless, the very scarcity of such citrus types makes them of interest both in the market and for breeding.

Citrus Research Center

The two new hybrids, 'Encore' and 'Pixie,' originated at the University of California Citrus Research Center from seed obtained by Howard B. Frost. Both have unusually late seasons of use. They have been evaluated at Riverside, and the descriptions apply to this climatic area, but some information on 'Pixie' has been obtained from other locations. Neither hybrid has all the characters which make for an ideal variety, but each has an unusual combination of qualities. Both are of good flavor and suitable for eating out of hand. 'Pixie' is almost completely seedless in all locations tested.

'Encore' is a cross of 'King' by 'Willow Leaf' mandarin. A budline was maintained at Riverside for some years, after which detailed studies of the hybrid were begun about 1954. The fruit ripens at Riverside from May to June, and usually is good until August or September. Fruit shape is oblate, with little-to-no neck. The rind is thin and smooth, except for a slight pebbling at the base. A small navel opening is usually present. Overall rind color is a yellow-orange that is deeper at the blossom end than at the stem end. The fruit peels easily, with very little albedo adhering to the flesh.

Encore mandarin is oblate, easy to peel, rich flavored and good until August at Riverside.