

For Weed Control

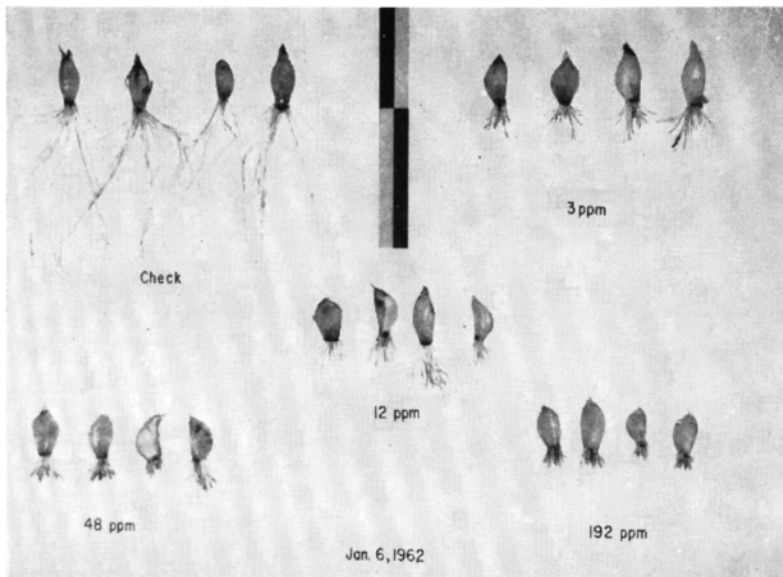
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The herbicide CIPC, applied at 4 lbs per acre as a preemergence treatment for weed control in garlic, can be used safely in major production areas of California—and offers substantial savings over the usual cultivation and hand-weeding costs.

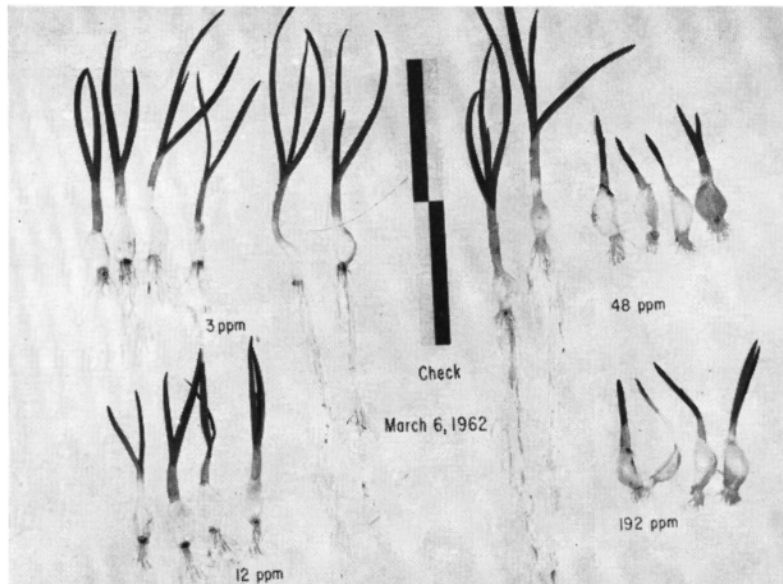
THE CONTROL OF WEEDS in garlic by cultivation and hand weeding is costly, ranging from \$50 to \$150 per acre per season, which adds up to a total weed bill estimated from \$200,000 to \$600,000 per season for the 4,000 acres of garlic grown in California. Research conducted during the past several years indicates substantial savings are possible with chemical weed control methods.

Weeds are particularly serious in garlic, since it is planted during the fall and winter when frequent rains encourage annual winter weeds and make the fields inaccessible for cultivation. The principal annual winter weeds are annual bluegrass, *Poa annua*; shepherds' purse, *Capsella bursa-pastoris*; common chickweed, *Stellaria media*; miner's lettuce, *Montia perfoliata*; common groundsel, *Senecio vulgaris*; small nettle, *Urtica urens*; and cheeseweed, *Malva parviflora*. Since garlic is harvested from June through August, certain warm weather weeds such as rough pigweed, *Amaranthus retroflexus*; lambs'-quarters, *Chenopodium album*; purslane, *Portulaca oleracea*; and barnyard grass, *Echinochloa crusgalli*, occasionally become problems. The small narrow leaves and slow rate of growth of garlic make it a poor competitor with vigorous, rapidly growing weeds.

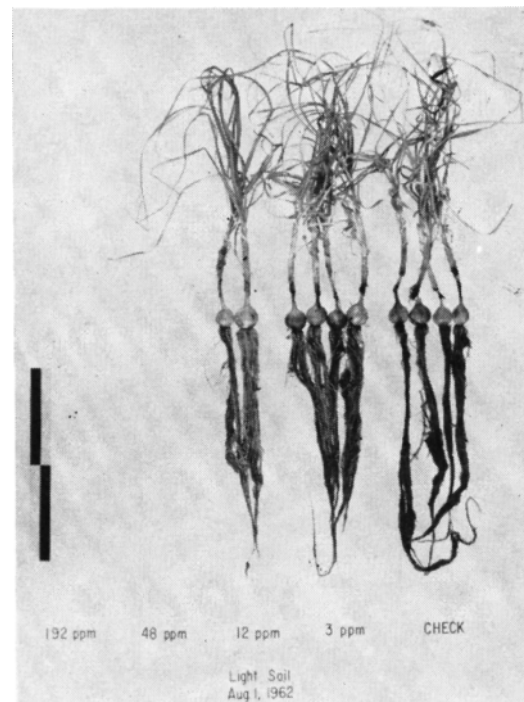
Occasionally abnormal growth occurs in commercial garlic fields. This may be due to mineral excesses or deficiencies, insects, diseases, or any of a number of other environmental factors. When abnormal growth occurs in fields treated



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Photo 1. The effect of CIPC on garlic planted in pots of Yolo fine sandy loam soil containing this herbicide. They were grown in a lathhouse and photographed one month after planting.

Photo 2. The effect of CIPC on garlic planted in pots of Yolo fine sandy loam soil containing this herbicide. They were grown in a lathhouse and photographed three months after planting.

Photo 3. The effect of CIPC on garlic planted in pots of Yolo fine sandy loam soil containing this herbicide. They were grown in a lathhouse and photographed seven months after planting.

PC

in Garlic

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TABLE 1. EFFECT OF CIPC ON FRESH WEIGHT OF BULBS AND ROOTS OF GARLIC GROWN IN POTS IN A LATHHOUSE AND HARVESTED SEVEN MONTHS AFTER PLANTING.

| Treatment | Light soil* | | Heavy soil† | |
|-----------|-------------|-----------------|-------------|-----------------|
| | wt/bulb | wt of roots/pot | wt/bulb | wt of roots/pot |
| Ppm | Grams | | | |
| Control | 4.66 | 15.85 | 3.77 | 3.71 |
| 3 | 4.82 | 16.93 | 3.12 | 1.73 |
| 12 | 2.97 | 3.09 | 3.22 | 0.49 |
| 48 | 0.00 | 0.00 | 0.00 | 0.00 |
| 192 | 0.00 | 0.00 | 0.00 | 0.00 |
| LSD 5% | 1.87 | 6.27 | 2.38 | 0.59 |

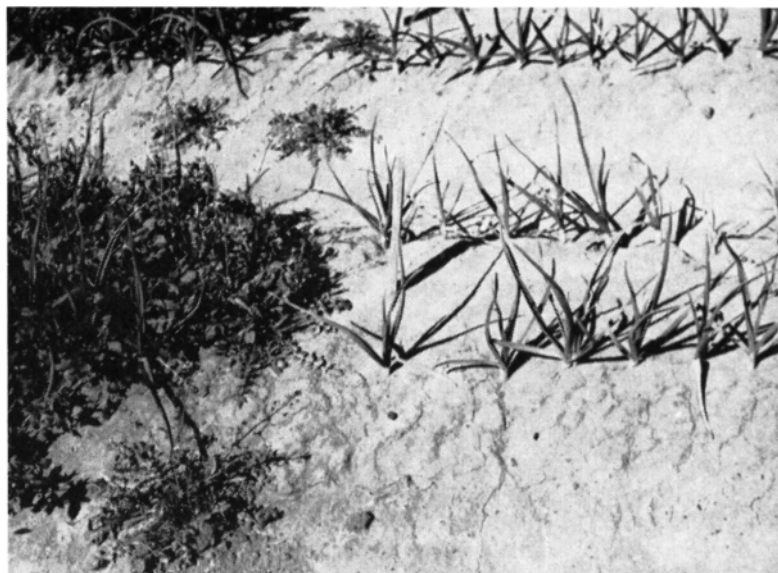
* Yolo fine sandy loam.

† Yolo clay loam.

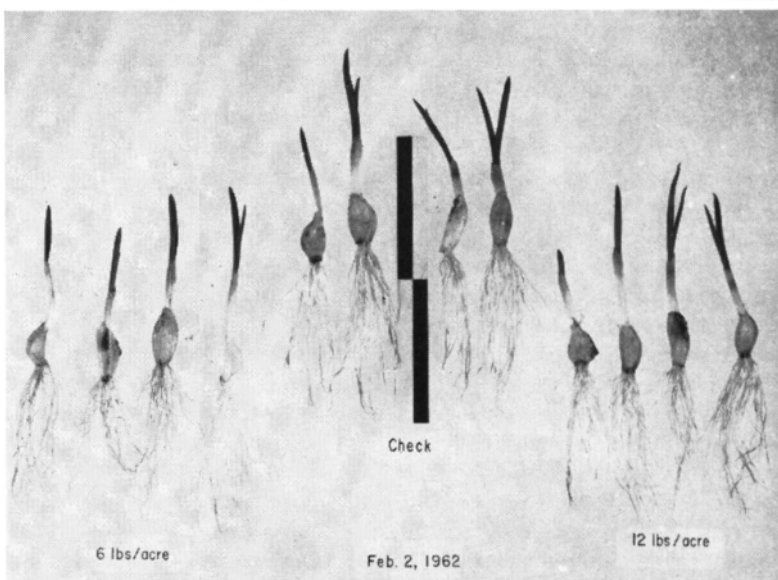
Photo 4. Weed control in garlic treated with CIPC at 6 lb/A applied as a preemergence treatment under field conditions; left, untreated; right, treated.

Photo 5. The effect of CIPC at 6 and 12 lb/A applied as a preemergence treatment under field conditions two months after planting; no injury is noted.

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with a herbicide, the chemical is a prime suspect. This study was undertaken to determine the specific toxicity symptoms (abnormalities) of CIPC, isopropyl N-(3-chlorophenyl) carbamate, on garlic and to determine its effect on yield in several locations.

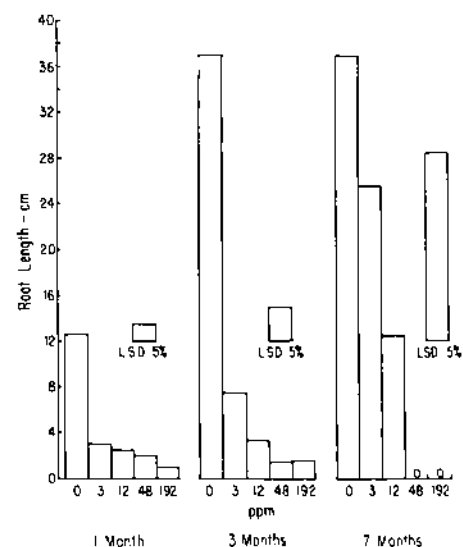
Lathhouse experiments

Since the object of the lathhouse investigation was to cause injury to garlic, the amount of CIPC applied and the means of treatment do not represent typical field applications. Also, since there is no evident damage to garlic tops when CIPC is applied as a postemergence spray, and because CIPC is believed to damage plants by acting on their roots, CIPC was mixed into the soil in pots, and garlic cloves were planted. To incorporate the CIPC in the soil, pots were filled with soil in five successive layers with 100 ml of a CIPC solution added to each

layer. Twenty pots were filled with a light soil, Yolo fine sandy loam, and 20 with a heavy soil, Yolo clay loam. Four pots of each soil type were used for each of four CIPC treatments, 3, 12, 48 and 192 ppm of active ingredient on the basis of soil dry weight. For controls, four pots of each soil type were treated with water instead of the CIPC solutions. Four uniform cloves of "California Late" garlic weighing 2.6 gm each were planted in each pot at a depth of $\frac{1}{2}$ to $\frac{3}{4}$ inch. The pots were placed in a lathhouse and watered as needed. After seven months the plants were harvested, and bulb yield, root length, and amount of rooting were determined.

A time-course experiment was conducted simultaneously to determine the toxicity of CIPC on garlic at intermediate times. Twenty pots of light soil were planted with garlic cloves and treated with CIPC as described. The garlic plants

EFFECT OF CIPC ON ROOT LENGTH OF GARLIC PLANTED IN POTS CONTAINING YOLO FINE SANDY LOAM SOIL AND GROWN IN LATHHOUSE



were removed from the pots at intervals of one, three and seven months after planting, and the roots were washed free of soil, measured and photographed.

All treatments sprouted uniformly during the first month except the 192 ppm CIPC treatment in which sprouting was delayed about one month. After about two and one-half months, the plants from this latter treatment showed an accumulation of anthocyanin in the leaves. This reddish discoloration was more extreme at the tips of the leaves than at the base. Although the plants from the 48 ppm CIPC treatment emerged normally, the amount of growth was subsequently reduced, anthocyanin pigmentation developed, the plants wilted and ultimately died. The fresh weights of bulbs and roots at harvest, seven months after planting, are given in table 1. By this time the plants from the 48 to 192 ppm CIPC treatments had died and disintegrated in both soil types. The bulb weights from the other three treatments showed no significant differences in either soil type.

In the heavy soil, the weight of roots per pot was decreased significantly in all treatments. In the light soil, however, only in treatments greater than 3 ppm were root weights significantly decreased. As measured by weight of roots, the difference in response of the garlic in the two soil types was perhaps due to an increased rate of loss of CIPC by leaching or decomposition in the light soil as compared with the heavy soil. Several workers have previously shown that soil type is an important factor in the effectiveness of CIPC.

The quantitative data from the time-course study are shown in the graph and the photographs. At one month (photo 1) and three months (photo 2) after planting, there was significant stunting of roots at all levels of CIPC treatments. However, at three months, the roots in the 3 ppm CIPC treatments continued to elongate but at a slower rate than the controls. This was also true, to a lesser degree, for the 12 ppm CIPC treatments. Seven months after planting (photo 3) the plants treated with CIPC at 48 and 192 ppm had died and disintegrated. In the 3 ppm CIPC treatments, the roots were growing normally and were approaching the length of the roots from the control plants. The roots in the 12 ppm CIPC treatments were growing but were significantly shorter in length than those of the control plants. These results indicate that levels of 3 and 12 ppm of CIPC in the soil were not lethal to garlic roots, but merely inhibitory, and after the

TABLE 2. EFFECT OF PRE- AND POSTEMERGENCE APPLICATION OF CIPC ON YIELD OF "CALIFORNIA LATE" GARLIC UNDER FIELD CONDITIONS AS HARVESTED SEVEN TO EIGHT MONTHS AFTER PLANTING.

| Treatment lb/acre | Yield of garlic lb/plot | | | | | | | | |
|----------------------|-------------------------------|------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------------------------------|----------------------|-------------------------------|
| | Preemergence | | | | | Postemergence | | | |
| | Yolo | Lassen | Santa Clara* | Santa Clara† | San Benito | Yolo | Lassen | Santa Clara‡ | San Benito |
| 6 | 19.5 | 10.5 | 17.9 | 26.2 | 21.2 | 19.7 | 14.8 | 31.1 | 23.7 |
| 12 | 18.4 | 10.7 | 12.0 | 26.0 | 21.6 | 19.8 | 14.2 | 32.3 | 23.0 |
| Hand-weeded | 19.0 | 11.1 | 19.8 | 26.2 | ... | 16.9 | 11.9 | 32.6 | ... |
| Check | 12.4 | 10.5 | 20.1 | 25.2 | 22.8 | 17.9 | 12.5 | 31.6 | 22.6 |
| LSD 5% | 1.2 | 1.8** | 5.5 | 5.3** | 6.7** | 2.2 | 1.9 | 4.2** | 6.7** |
| Soil type | Yolo fine sandy loam | Standish loam | Yolo fine sandy loam | Yolo fine sandy loam | Yolo silty clay loam | Yolo fine sandy loam | Bunting- ville clay loam | Yolo clay loam | Yolo silty clay loam |

* Planted by hand without PCNB seed clove treatment.

† Planted by machine with PCNB.

‡ Planted with "California Early" garlic (weed-free plots).

** No significant difference.

CIPC had dissipated through leaching and/or decomposition, normal root growth resumed.

The field experiment was conducted in Lassen, Santa Clara, and San Benito counties, as well as at the University of California at Davis, Yolo County. Sixteen beds, each 26 ft long by 40 inches wide, were planted with "California Late" garlic. Each bed had two rows 12 inches apart with four cloves per foot of row. Immediately after planting, four beds were sprayed with CIPC at 6 lbs per acre active ingredient and four beds were sprayed with CIPC at 12 lbs per acre active ingredient. Eight beds not sprayed with CIPC were kept as controls, four of which were hand-weeded and four unweeded.

A second lot of 16 beds was planted and treated as before except that the CIPC was applied at 6 and 12 lbs per acre after the garlic plants were 4 to 5 inches high. The plots were randomized in the field. All plots were harvested seven to eight months after planting, and the bulbs were air-dried and weighed.

The soil types for the preemergence treatments were: Standish loam in Lassen County, Yolo fine sandy loam in Santa Clara County, Yolo silty clay loam in San Benito County, and Yolo fine sandy loam at Davis in Yolo County. The soil types for the postemergence treatments were Buntingville clay loam in Lassen County, Dublin clay loam in Santa Clara County, Yolo silty clay loam in San Benito County and Yolo fine sandy loam at Davis.

A summary of the yield data is presented in table 2. The effects of the herbicide varied somewhat from field to field, depending mainly on such environmental factors as soil type, depth of planting, occurrence of white rot disease (*Sclerotium cepivorum*), precipitation or irrigation and weed population.

There was a slight increase in yield in the postemergence applications at Davis

and Lassen County relative to the hand-weeded control; however, since no increase was observed between the hand-weeded and unweeded controls this increase was not due to weed control. The preemergence and postemergence applications of CIPC at 6 lbs per acre did not cause significant reduction in yield at any of the locations. The application of CIPC at 12 lbs per acre (three times the recommended rate) did not cause a significant yield reduction in any of the postemergence applications at any of the locations but did cause a significant yield reduction in one test as a preemergence treatment. In the other three counties no yield reduction was evident. Apparently this yield reduction in one test was caused by one or both of the following factors: (1) shallow planting in the hand-planted plots (2) increased susceptibility to CIPC injury caused by existence of white rot disease.

These data indicate that the use of CIPC for weed control in garlic at the recommended rate of 4 lbs per acre is a relatively safe practice. Precautions are in order where white rot disease is prevalent, in shallow plantings, and in soils lighter than Yolo fine sandy loam, since lighter soils have not yet been critically evaluated.

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