Control of creeping woodsorrel in ornamentals

Jodie S. Holt

Oxalis, or creeping woodsorrel, is one of the most troublesome weeds of nurseries, greenhouses, and turf in California and many other parts of the country. Some of the characteristics of oxalis that contribute to its noxiousness are its perennial growth habit, brittleness, prolific seed production, and explosive seed dispersal from elongated pods. An understanding of the biology of this weed, *Oxalis corniculata*, particularly seed production, dispersal, and germination, is essential in order to develop effective control techniques.

A study of the biology, ecology, physiology, and control of oxalis in ornamentals was undertaken at UC Riverside. Experiments were conducted to characterize phenology (life history), seed dispersal, growth, germination, and possible control measures in the greenhouse environment.

Phenological observations and measurements were made for two years on oxalis seeded into 15-gallon pots and placed in three different environmental regimes. Greenhouse-grown plants were more vigorous and productive than plants grown outdoors either in the shade or in full sun. Plants in a greenhouse with moderate light intensity and warm night temperatures did not respond to seasons as did plants growing outdoors; rather, they completed one life cycle in a shorter time span (approximately five weeks from seed to seed), and produced many generations of seedlings in a single year. Measurements of seed dispersal demonstrated that a single mature oxalis plant can disperse over 800 seeds in 24 hours to a distance of nearly 5 meters. The number and total weight of seeds dispersed per pod were very constant and averaged 48 seeds and 9 mg, respectively.

Germination trials

Experiments to determine the temperature limits for germination of freshly produced seeds were conducted for two years. Maximum and minimum temperatures for germination varied with the season of seed production and ranged from 29.5°C to 8.7°C, respectively. Seeds produced in the winter had the narrowest temperature range of germination (15° to 25°C); seeds produced in summer had the widest temperature range of germination (10° to 30°C). Germination was shown to require light, although only a very low level was needed. Viability of stored, aged seeds was tested monthly for 18 months. Fresh seeds had nearly 100 percent viability, regardless of season of production. Seeds stored for as long as 15 months had 50 percent germination relative to fresh seeds.

Wetted seeds were pretreated with moist heat for varying periods of time before germination to determine the effect of soil sterilization on oxalis. Ten-minute heat pretreatments resulted in 100 percent germination of oxalis seeds, perhaps because of a stimulatory mechanism. Treatment at 40°C or more for a longer time, however, resulted in varying degrees of inhibition of subsequent germination, probably because of thermal injury. Thus, sterilization, in which soil is usually heated to around 82°C (180°F) for 30 minutes, should be effective in destroying oxalis seeds.

In experiments to ascertain the growth habits and productivity of oxalis, greenhouse-grown plants germinated and grew rapidly, and flowering began by 37 days. Within 58 days, each plant had an average of 200 leaves with a total leaf area of 362 square centimeters, 7 stolons, 120 reproductive structures (buds, flowers, or pods), and had dispersed approximately 683 seeds. Studies performed in growth chambers in two temperature regimes showed greatly enhanced growth and earlier reproduction at day/night temperatures of 27°/16°C (80°/60°F) when compared with either a 21°/10°C (70°/50°F) regime or greenhouse conditions. As was the case with germination, vigor and productivity of oxalis were regulated by temperature (possibly night temperature).

With both the ethyl ester and sodium salt formulations of the growth regulator naphthaleneacetic acid (NAA), a rate of 2.5 pounds per acre was sufficient to control oxalis up to 49 days of age. Carrier volume did not affect degree of control; rather, the rate of material applied was the critical factor. Control of mature plants (older than 70 days) was poor with these materials. With technical grade NAA, 16-, 49-, 98-, and 193-day-old plants were treated in foliar and soil applications. As indicated by fresh weight, phytotoxicity rating, and plant regrowth following treatment, oxalis plants over 49 days old were not susceptible to foliar applications of NAA, while those younger than 49 days were controlled by a rate of 0.6 pound per acre. Soil applications of NAA at rates greater than 0.5 percent solution provided good control of all plants. No regrowth occurred from soil-treated plants.

NAA did not significantly reduce the germination percentage of dry seeds; however, root length of seedlings from seeds treated when dry, and of seedlings that were directly treated with NAA, was significantly reduced relative to untreated controls. Furthermore, these seedlings showed no growth beyond that achieved before treatment with NAA.

Deceptively attractive, creeping woodsorrel, or oxalis, has become a noxious pest in nurseries, greenhouses, and turf. It can overwhelm plants such as coleus (right). Control is a continual challenge because of the plant's explosive reproduction; a single plant can disperse over 800 seeds in a single day to a distance of over 15 feet.

A number of ornamental species were treated with two formulations and several rates of NAA, applied as overhead spray. Several species were very tolerant of the growth regulator, while some were susceptible to wilt and browning. The tested species appeared safe with applications of 10 pounds per acre of both the ethyl ester and salt formulations. The rate of carrier applied did not appear to increase the safety of NAA on ornamentals.

Herbicides registered for use in ornamentals were studied for oxalis control, including atrazine, bromoxynil, chlorpropham, dicamba, diuron, oxyfluorfen, fusilade, and 2,4-D amine. Based on vigor of oxalis following postemergence treatment with these chemicals, it was concluded that atrazine, diuron, and oxyfluorfen were the most effective. Chloramben also completely prevented seed germination when applied preemergence.

Control

Completed phenology and growth studies have provided useful information on the timing of life cycle events and productivity of oxalis, both outdoors and in greenhouses. These results have demonstrated that oxalis needs to be removed within five weeks of germination to prevent further seed dispersal in the greenhouse. Furthermore, control of this species indoors is a year-round problem. Germination experiments demonstrated that present soil sterilization methods may kill all oxalis seeds, but sterilized soil must be covered so that no further dispersal of seeds occurs into it. Light is important in controlling oxalis germination, and manipulations of the potting medium, such as with mulches, may deter or create unfavorable conditions for germination. Studies of chemical control have yielded information about the possible utility of growth regulators for their herbicidal effects on oxalis, with minimal injury to a number of ornamental species. Several herbicides were also found to be effective against this weed.

Since few herbicides are presently registered for use inside the greenhouse, and the possibility for registration of new materials for use indoors is minimal, it is essential that information on the biology, ecology, and physiology of oxalis be combined with other forms of weed control to make the best possible management recommendations.

Jodie S. Holt is Assistant Professor of Plant Physiology and Assistant Plant Physiologist, Department of Botany and Plant Sciences, University of California, Riverside.