ALLELOPATHIC POTENTIAL OF *EUPATORIUM ODORATUM* IN ABANDONED SHIFTING CULTIVATION FIELDS IN TROPICAL ASIA

N. Nakamura[1] and M. Nemoto[2]
[1] Department of Biology, Ibaraki University, Mito, Ibaraki 310, Japan
[2] Division of Plant Ecology, National Institute of Agro-Environmental Sciences, Tsukuba, Ibaraki 305, Japan

Summary. The perennial weed *Eupatorium odoratum* invades rapidly into and dominates in abandoned shifting cultivation fields in tropical Asia. The effects of leaf and stem exudates of *E. odoratum* on the germination and growth of the common weeds such as *Crassocephalum crepidioides, Ageratum conyzoides, Cynodon dactylon, Oxalis corniculata* and *E. odoratum* were studied. Aqueous leaf extracts delayed germination of all the weeds in petri dishes. Exudates from powdered leaf and stem inhibited seedling growth of all the weeds in pot culture in the greenhouse. The growth of *C. crepidioides*, the first dominant in such fields, was inhibited more than that of the other three species. Combining effects of allelopathy and shading gave greater inhibition than either factor alone on all the weeds except for *C. dactylon*, which was unaffected by the leaf exudates.

INTRODUCTION

Eupatorium odoratum is a perennial weed in crop field and pasture of southern Asia and western Africa (4). In abandoned shifting cultivation fields in northeast Thailand, *Crassocephalum crepidioides* is the first dominant species and is followed by *Ageratum conyzoides* in the early stage of the first year. After that, the most dominant species changes to *E. odoratum* in the later stage of the same year, and its dominance increases in the next year. *E. odoratum* is able to grow quickly and forms a tangled bush of 3 to 7 m in height (6, 7, 8).

It is reported that the *E. odoratum* seedling population experienced very heavy mortality with only 1.4% survivors left at the end of one year after germination (9). The occurrence of seedlings of the other species at the neighbourhood where *E. odoratum* is growing is also a few. These phenomena may be due to the allelopathic substances produced by *E. odoratum* plants, as well as the competition with *E. odoratum* plants for water, nutrient, light etc. (7).

As the bush of *E. odoratum* develops, the sunlight rarely reaches to the ground surface of its community. The percentage to full sunlight at the ground surface of its community is only about 10%. For that reason, there are a possibility of combining effects of allelopathy and shading on the growth of weeds in the field conditions.

The objective of this study is to determine the allelopathic effect of *E. odoratum* on seed germination and seedling growth and to evaluatethe combined effects of allelopathy and shading on seedling growth of weeds.

MATERIALS AND METHODS

To study the allelopathic potential of *E. odoratum*, five common weeds in the abandoned shifting cultivation field in northeast Thailand, i.e., *Crassocephalum crepidioides, Ageratum conyzoides, Cynodon dactylon, Oxalis corniculata* and *E. odoratum* were selected as the receptor species.

Germination test. Aqueous extract was made from fresh leaf of *E. odoratum*. The fresh leaf was cut into 2 cm fragments and soaked in 500 mL distilled water at 4°C. After 3 days, the aqueous extract was filtered, and the filtrate was diluted below 1 mS/cm in electroconductivity (2). The germination test was carried out in 9 cm glass petri dish on two layers of filter paper wetted with 4 mL of the extract. Twenty-five seeds were evenly dispersed in each dish. The control was treated with distilled water instead of the aqueous extract. The dishes were incubated at 25°C by day and 20°C at night. The germination percentage was observed every day during ten days. This test was replicated twice.

Pot experiment. The washed quartz sand was put into unglazed pots (12 cm diameter), and three seedlings of receptor species were transplanted in each pot. This experiment was conducted in three pots for each species. After one week, powdered dead leaf, fresh leaf and stem of the *E. odoratum* plants were placed on the quartz sand. Each pot was watered daily and plant height was measured every five days. After three weeks, all plants were harvested, and root length, leaf area, and dry weight were measured. As control, powdered humus made from the common forest plants, which has no allelopathic effect, was used instead of the plant powder of *E. odoratum*. The amounts of dead leaf, fresh leaf and stem used in the experiment were 8.9 g, 9.1 g and 6 g, respectively, and that of humus for the control was 6 g (these contain the equal amount of nitrogen). Prior to transplanting, the seedlings of each species were germinated and grown for one month in soil and vermiculite mixture in the greenhouse.

Combined effects of allelopathy and shading. The same pot experiment as mentioned above was conducted under shading condition in a shadow box. Fresh leaf powder was used in the test pot, and humus powder was used in the control pot. Full sunlight and two shading conditions (the percentages to full sunlight were 30% and 10%) were set. The test and control pots were put under these conditions just after the two kinds powder were placed on the quartz sand. Each pot was watered daily and the plant height was measured every five days. After three weeks, all plants were harvested and the root length, leaf area and dry weight were measured.

RESULTS AND DISCUSSION

The germination of all the weeds in petri dishes were delayed from two to four days by the aqueous leaf extract of *E. odoratum*. The germination of weeds on the 10th day after the treatment was about 80% of the control (Fig. 1). In the pot experiment, the seedling growth of all receptor plants was reduced when the powdered dead leaf, fresh leaf and stem were placed on the sand surface. The powdered dead leaf exhibited remarkable growth inhibition. By the treatment of dead leaf, dry weight of all the weeds were reduced by 14 to 44% of the control (Fig. 2). The growth of *C. crepidioides* was inhibited more than that of the other species, on the other hand *A. conyzoides* and *C. dactylon* were less affected. These results demonstrated that *E. odoratum*, especially its dead leaf, had allelopathic potential and its effects were different between the receptor species. The fact that *C. crepidioides*, the first dominant species in abandoned shifting cultivation fields, was most inhibited by *E. odoratum* indicates that *E. odoratum* will become the most dominant species in the common Thailand forests, even if *C. crepidioides* is the first dominant species. It was reported that the essential oil of *E. odoratum* had an anti-bacterial activity, and its components were identified (5). However, allelopathic substances of *E. odoratum* are not yet determined.

The inhibitory effect of exudate from powdered leaf on the receptor species was enhanced by shading, and the inhibition got greater with higher shading level (Figs. 3 and 4). *C. dactylon*

looked unaffected by the leaf exudate under shaded condition. This indicates that *C. dactylon* was so sensitive to shade that the effects of exudates appeared ineligible. Incidentally, the relative light intensity at the ground surface in *E. odoratum* community was about 10%; seedlings in this experiment were placed in the similar dark conditions.

In the field, the combined effects of allelopathy and shading may inhibit seedling growth; moreover if competitive and environmental stresses are added, ultimately these seedlings may exhibit low survivorship. It was reported that the effects and amount of allelopathic substances released by plants were different among environmental conditions (1, 3). Therefore it is very important to consider the combining effects of allelopathy and environmental stresses under field conditions.

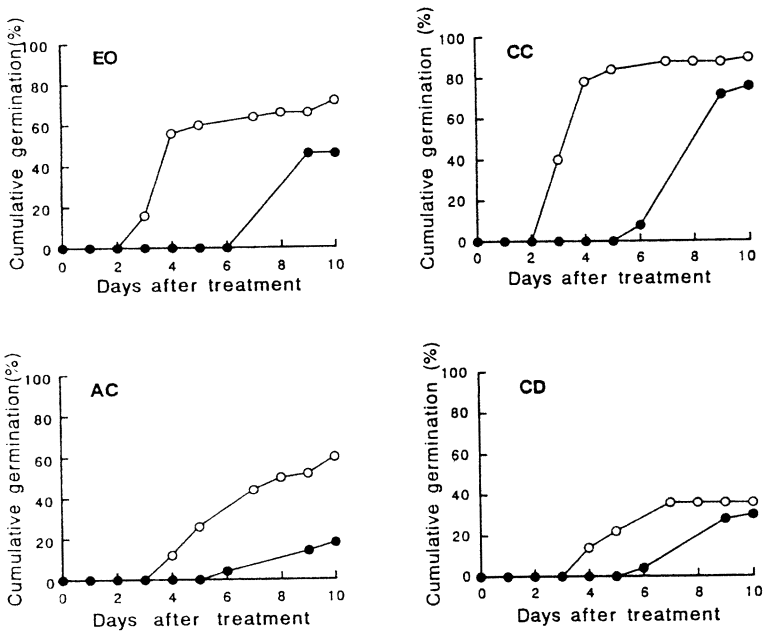

Figure 1. Effect of aqueous leaf extract of *E. odoratum* on the receptor plants on the seed germination. EO: *E. odoratum* , CC: *C. crepidioides* , AC: *A. conyzoides* and CD: *C. dactylon* . ○ : control (distilled water), ●: leaf extract.

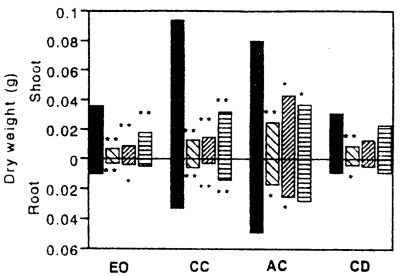

Figure 2. Dry weight of the receptor plants grown in the pots at different treatments. EO: *E. odoratum* , CC: *C. crepidioides* , AC: *A. conyzoides* and CD: *C. dactylon* . ■: control ▨: dead leaf ▨: fresh leaf ▤: stem. * : significant at 5% level and ** : 1% level (Man-Whitney's U-test).

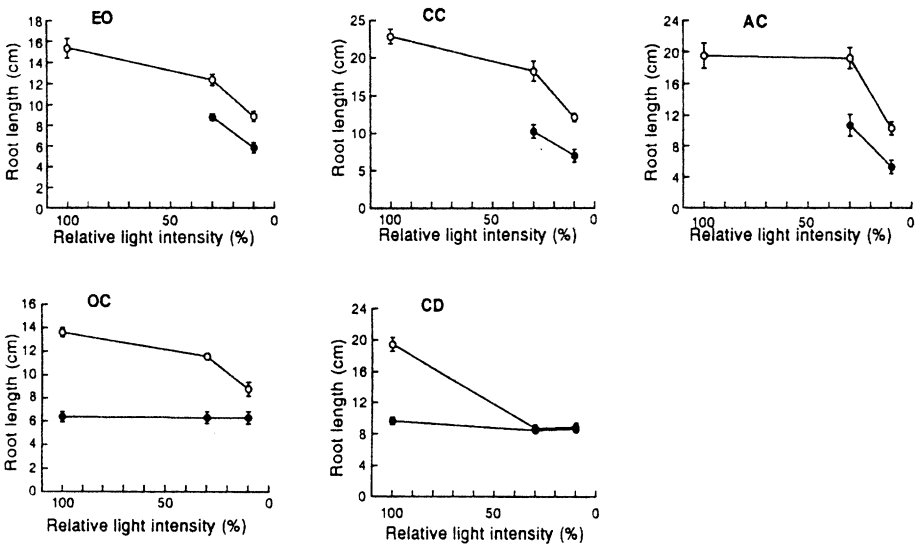

Figure 3. Combining effects of powdered fresh leaf and shading on the receptor plants of the root length. EO: *E. odoratum* , CC: *C. crepidioides* , AC: *A. conyzoides,* OC: *O. corniculata* and CD: *C. dactylon* . ○ : control (humus powder), ●: fresh leaf powder. Bar indicates s.e. of the mean.

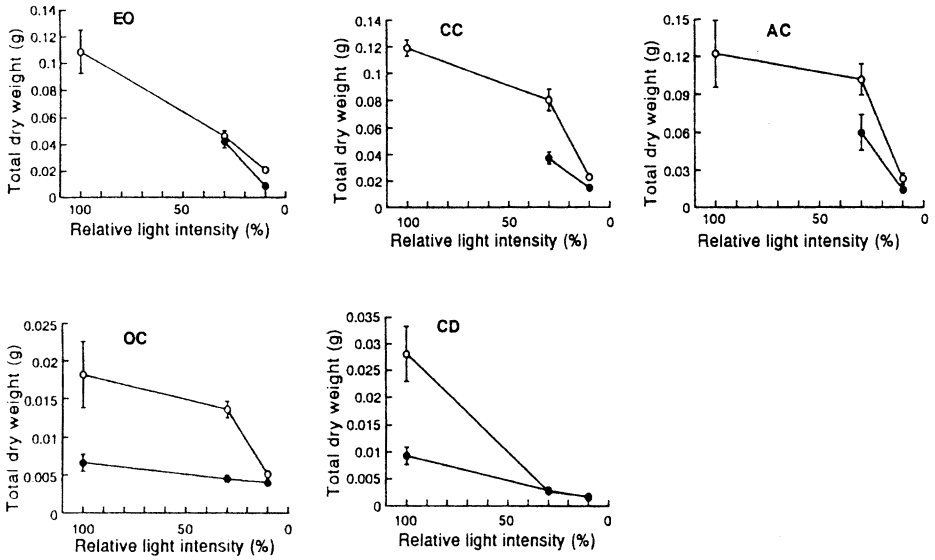

Figure 4. Combining effects of powdered fresh leaf and shading on the receptor plants of the dry wight. See Fig. 3 for symbols.

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